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

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3 **Diabetes and associated dietary intake among urban adults in Colombia:**
4 **The Colombian Nutritional Profiles (COPEN) study**
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41 and agree to be accountable for all aspects of the work.
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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

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

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3 about the burden of diabetes in Colombia are not population-based studies, but claim databases
4 like the High-Cost Account (*Cuenta de Alto Costo* - CAC) (15), a registry kept by an association
5 of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema*
6 *Integrado de Información de Protección Social* - Integrated Social Protection Information System)
7 (www.sispro.gov.co/), a database that compiles all health services and procedures provided by the
8 Colombian health system (16). These sources are useful for planning the provision of health
9 services, but cannot provide estimations of diabetes and its associated factors at the population
10 level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June
11 2017, a figure far removed from all worldwide data in similar countries and from IDF projections
12 (1,5,17,18).
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22 Colombia is a geographically, racially and culturally diverse country with marked differences
23 among the five most populated regions: i. Central plateau (administrative and economic center of
24 the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations,
25 iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most
26 of the Afro-Colombian population resides, iv. Northwestern or “paisa” region, where there are
27 many local traditions and there is a larger degree of European and Jewish ancestry and v.
28 Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of
29 indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers,
30 we aimed to estimate the prevalence of diabetes in a sample of adults from the main urban center
31 in each of the five regions described above. The cities were Bogotá (Central plateau), Barranquilla
32 (Caribbean region), Cali (Pacific region), Medellín (Northwest or "paisa" region) and
33 Bucaramanga (Northeast/Andean region). We also assessed the association of diabetes status with
34 demographics, anthropometry and nutrient intake, in the framework of the Colombian Study of
35 Nutritional Profiles (Estudio Colombiano de Perfiles Nutricionales - COPEN).
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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 last 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

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3 <30 Kg/m²) and obesity (BMI ≥ 30 Kg/m²). We defined abdominal obesity as a waist
4 circumference ≥ 90cm for women, and ≥ 94cm for men, according to the proposed cutoffs for
5 Latin American adults (20).
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10 Capillary blood specimens were collected by trained staff following standardized procedures,
11 blood glucose levels were promptly measured and registered using an Accu-Check meter. Since
12 fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one
13 of these three conditions: 1. A capillary blood glucose level ≥ 200 mg/dL, 2. A self-reported prior
14 diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic agent (s).
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20 Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency
21 questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically
22 designed for the Colombian population (21). Portion sizes were established according to the
23 reference unit most frequently consumed for each food. There were 9 possible ingestion
24 frequencies: i. Never, ii. One to three times/month, iii. At least once/week, iv. Two to four
25 times/week, v. Five to six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to
26 five times a day and ix. Six or more times a day. Participants were asked to make their selections
27 based on their usual intake over the last year. FFQs were individually administered by study staff.
28 The nutrient contribution of each food was calculated according to composition tables by the
29 Colombian Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the
30 United States Department of Agriculture and manufacturer's information.
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41 **Data analysis**

42 All prevalence estimations were projected to the target study population using city, sex, age group
43 and SEL-specific expansion factors according to the study multi-stage sampling design. We did
44 not have any missing data points. The univariate associations between nominal predictors and
45 diabetes status were examined using chi-square independence tests. To test for a linear trend in the
46 association between ordinal predictors and diabetes status, we report the p-value associated with a
47 rank-correlation (Spearman) test between predictor and outcome. We also ran multivariable
48 logistical models in which sociodemographic variables were the independent variables and
49 diabetes status was the outcome.
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3 In order to explore dietary intake and the achievement of dietary recommendations, we calculated
4 for patients with diabetes the percent who met the protein ($\geq 15\%$ of daily caloric intake [DCI]),
5 saturated fat (SFA) ($< 7\%$ of DCI), monounsaturated fat (MUFA) ($\geq 12\%$ of DCI) and trans fat
6 ($< 1\text{g/day}$) recommendations set by the by the Latin-American Diabetes Association (22) and the
7 fiber (14 g per each 1,000 Calories) and sodium ($< 2300\text{ mg/day}$) goals set by the American
8 Diabetes Association (23). All analyses were performed in SPSS for Windows, v.21 (Cary, NC,
9 USA).

18 **Ethical aspects**

19 All participants provided written informed consent. All study procedures were performed
20 according to the principles of the Helsinki Declaration, and to local rules and regulations as
21 provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was
22 approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de
23 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 Medellín. 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)

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4 The overall estimated prevalence of diabetes was 10.1%, with no significant difference
5 between sexes (9.6% in women, 10.8% in men, $p=0.43$). The prevalence was highest in Medellín
6 (20.5%), followed by Cali (9.2%), Bogotá (8.1%), Barranquilla (8.0%) and Bucaramanga (7.4%).
7 As expected, the prevalence of diabetes increased monotonically and significantly with age in both
8 men and women (p -trend=0.001). For age groups 18-39 and 40-59, men had a numerically higher
9 prevalence of diabetes than women, while in the 60-75 age group the opposite was true (Figure 1).
10 The association between educational level and diabetes prevalence was dependent on sex. Among
11 men, prevalence went from 7.0% for those with elementary education or lower, to 13.8% for those
12 with a professional or higher degree. On the other hand, diabetes prevalence among women
13 decreased steadily with higher education, going from 12.5% in the elementary or lower education
14 group, to 7.2% in the professional or higher educational level group (Figure 2, panel A).
15 Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest SEL almost
16 doubled that of the lowest SEL (Figure 1, panel B) (p -trend=0.04).
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28 As expected, diabetes was more common as BMI increased, going from 8.0% in the
29 normal/underweight category to 12.4% for obesity. While diabetes was almost equally prevalent
30 among normal weight men and women, it was far more common in the male sex in the overweight
31 and obesity categories (Figure 3, panel A). In males, the largest difference in prevalence was
32 between normal weight and overweight, while for women the largest difference was between
33 overweight and obesity. Abdominal obesity was also strongly associated with diabetes. The
34 relative increase in diabetes prevalence for individuals with abdominal obesity vs. without it was
35 65% in men and 163% (2.63-fold) in women (Figure 3, panel B).
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44 Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower
45 consumption of virtually all the nutrients. The mean reported daily caloric intake was significantly
46 higher for people with diabetes. The same trend was observed for carbohydrates, total lipids,
47 protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and fiber
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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		Difference	p-value
	No	Yes		
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.

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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).

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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.

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3 We were surprised to find a lower self-reported weight-adjusted intake of calories and all
4 macronutrients among patients with diabetes. An optimistic interpretation of this finding would be
5 that it shows good adherence to dietary recommendations. However, such interpretation should be
6 made with caution, as it is known that patients with diabetes and obesity frequently underreport
7 their caloric intake (44). At the same time, the large proportion of participants with diabetes not
8 meeting micronutrient recommendations is worrisome. An adequate intake of MUFA could aid in
9 glycemic control (23), while a high intake of trans fats increases mortality and coronary heart
10 disease risk (45). There is also clinical and mechanistic evidence showing that a high dietary intake
11 of fiber favors glycemic control (23, 46). Lastly, clinical trials in patients with diabetes show that
12 limitation of dietary sodium decreases blood pressure in a clinically significant manner (50).
13 Nutritional education of patients with diabetes in developing countries is an urgent measure with
14 large potential benefits and minimal risks.
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26 Limitations of our study include the entirely urban sample, given the recent increase in
27 obesity rural areas in the region (47) and Colombia (48). It is important, however, that the
28 proportion of total population living in urban centers in Colombia is 77.1% (49), a result of
29 accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic
30 profile of the country (14). Another relevant limitation was the unavailability of oral glucose
31 tolerance test (OGTT) data. OGTT is the most sensitive test for diabetes diagnosis but performing
32 it would have imposed great complexities on the logistics of the study. We acknowledge that the
33 prevalences we report, high as they seem, are most likely an underestimation.
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41 In summary, our results confirm a continued progression of the diabetes epidemic in
42 middle-income countries, and its relationship with demographic and socioeconomic factors. We
43 also found remarkably low rates of achievement of key nutritional goals among patients with
44 diabetes. Further research focused in rural areas is needed in order to build a complete the picture
45 of evolution of the diabetes epidemic in the developing world.
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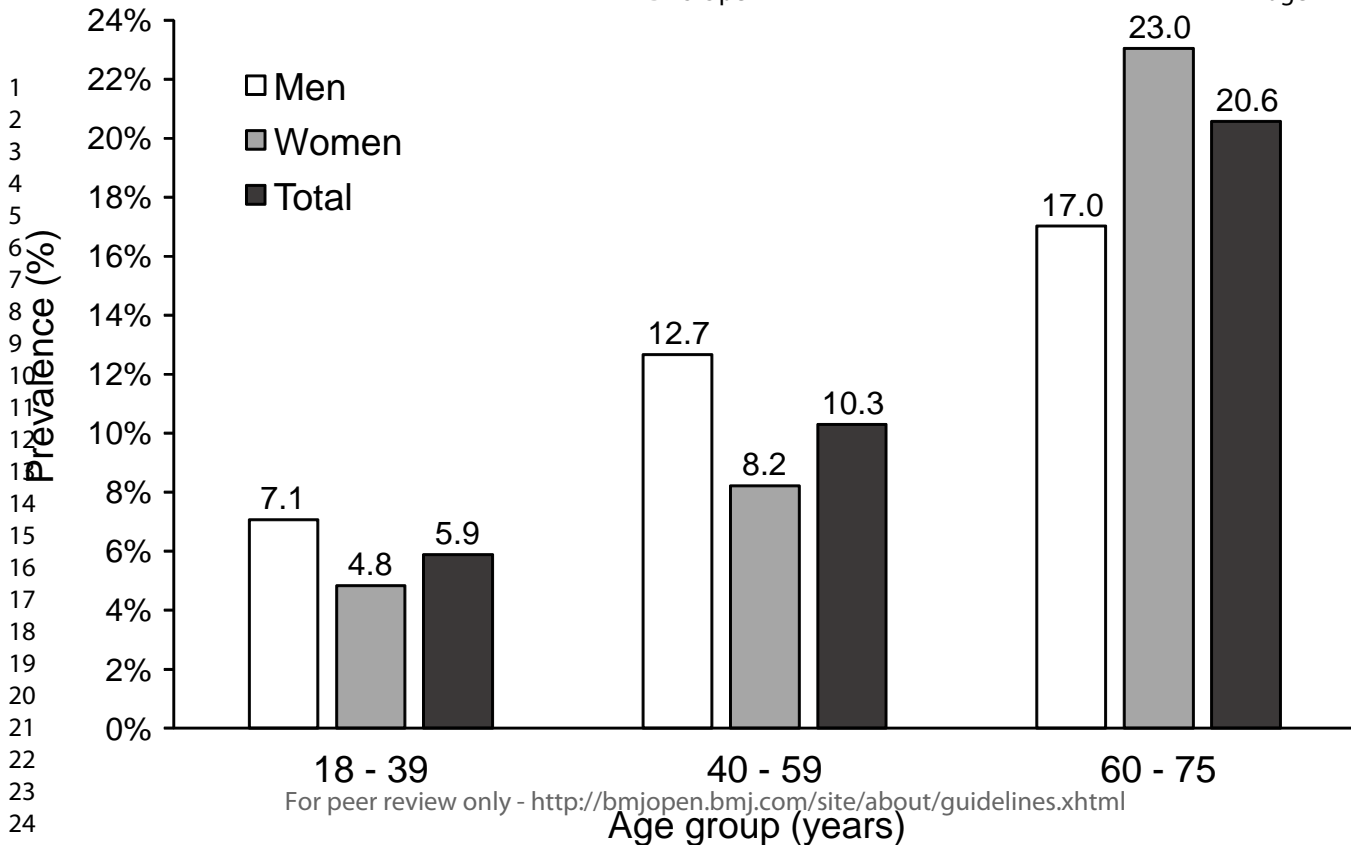
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Figure legends

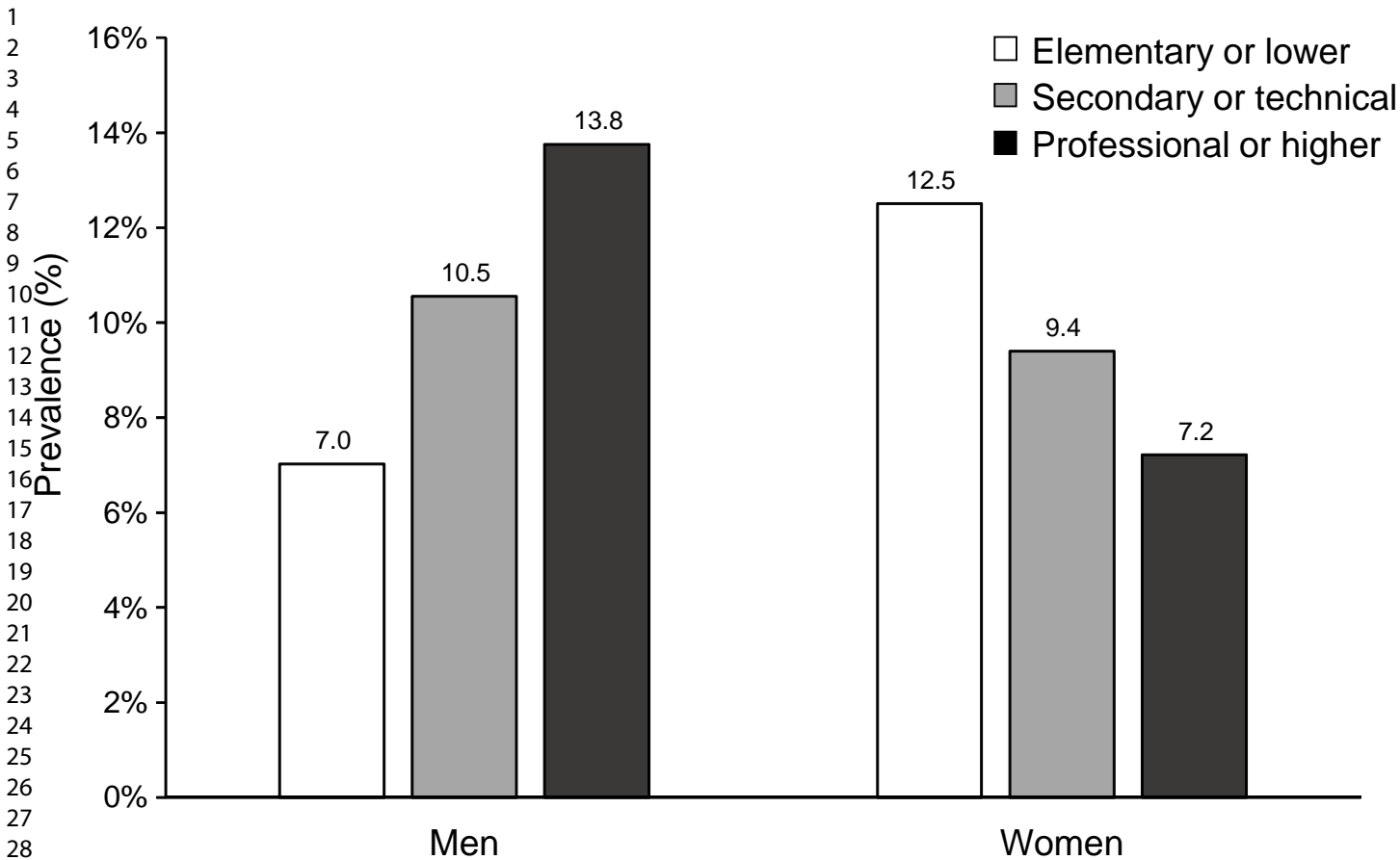
Figure 1. Prevalence of diabetes, by age and sex. Data are expanded group prevalences. P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in diabetes prevalence with increasing age group <0.001.

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.

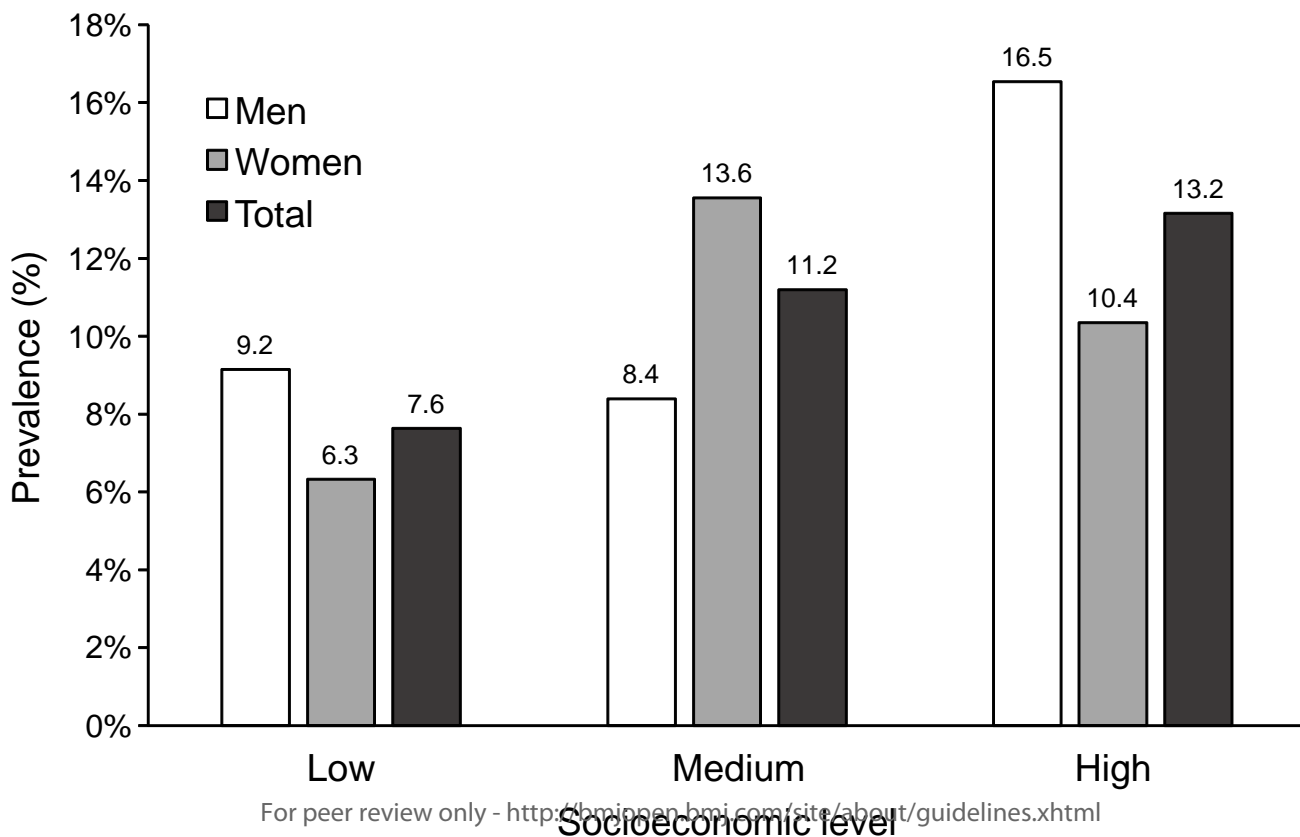
Figure 3. Prevalence of diabetes, by body-mass index (Panel A) and waist circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than 18.5 Kg/m², normal weight as a BMI between 18.5 and less than 25 Kg/m², overweight as a BMI between 25 and less than 30 Kg/m², and obesity 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.



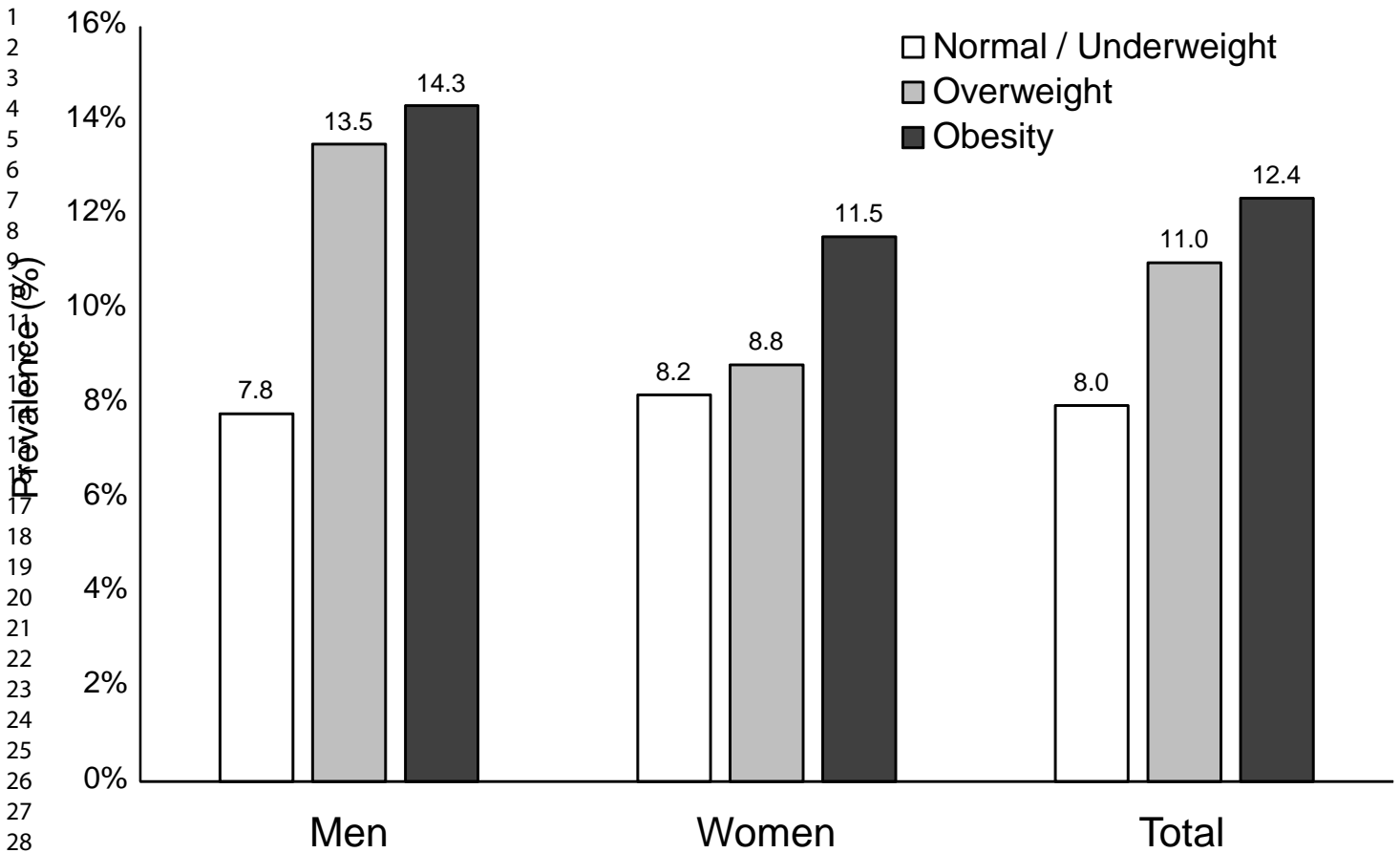
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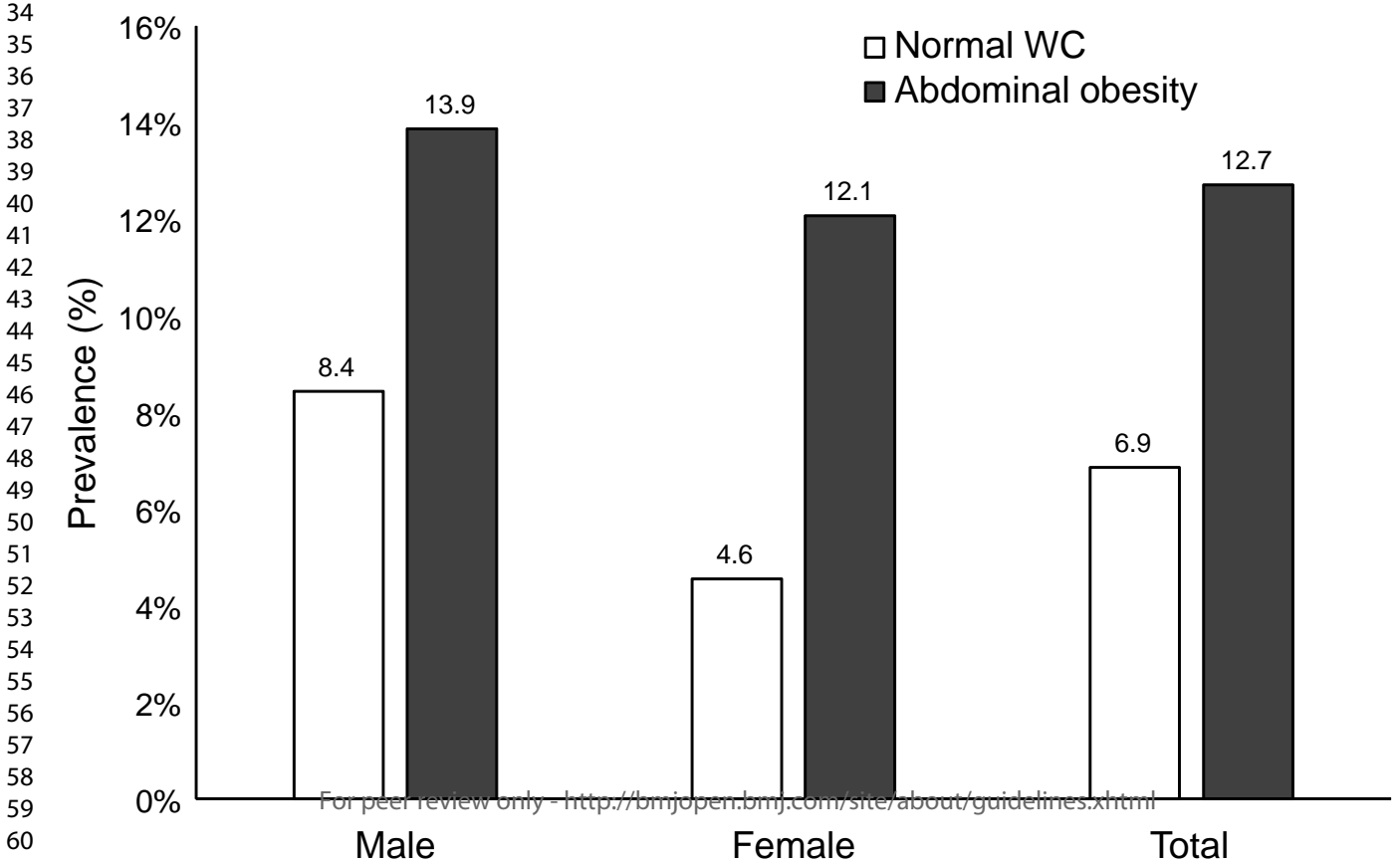
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BMJ Open

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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Running title: Diabetes and diet in Colombian cities

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32 ABSTRACT

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

36
37 **Setting:** The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-
38 sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian
39 cities.

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41 **Participants:** Between June and November 2018, we studied 736 non-pregnant participants aged
42 18 or older. Diabetes was defined as a random plasma glucose ≥ 200 mg/dL, self-reported prior
43 diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also
44 fulfilled a detailed 157-item food frequency questionnaire (FFQ).

45
46 **Primary and secondary outcome measures:** Prevalence of diabetes, dietary intake of key
47 nutrients, achievement of dietary goals among individuals with diabetes.

48
49 **Results:** The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6%
50 in women, 10.8% in men, $p=0.43$). The association between diabetes and education level depended
51 on sex, diabetes was more prevalent among more educated men and less educated women.
52 Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a
53 163% increase in women. Individuals with diabetes reported lower mean consumption of all
54 nutrients, but after multivariate adjustment only their lower sodium consumption remained
55 significant ($p=0.013$). The proportion of non-achievement of dietary intake goals among
56 participants with diabetes was 94.4% for saturated fats, 86.7% for sodium, 84.4% for fiber and
57 80% for trans fats. In multivariate logistical regression models, age was the strongest independent
58 correlate of diabetes.

59 60 Conclusions

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

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3 63 residence, SEL and educational level. The proportion of individuals with diabetes meeting
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5 64 dietary recommendations was alarmingly low.
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For peer review only

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3 65 **Strengths and limitations of this study**
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7 67 - The study explored the prevalence of self-reported diabetes and its associated dietary nutrient
8 68 intake, as well as their relationship to key demographic factors.
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10 69
11
12 70 - The study had a population-based, probabilistic sample from five cities in Colombia.
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14 71
15 72 - Dietary intake was assessed with a food frequency questionnaire adapted to national and
16 73 regional dietary habits, and inquiring about usual behavior, rather than recent intake.
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20 75 - Random plasma glucose and self-reported diabetes may underestimate the real diabetes
21 76 prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.
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23 77
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25 78 - Our study did not include any participants from rural areas, whose diabetes prevalence and
26 79 associated diet may differ significantly from those of urban populations.
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31 81 **Data sharing statement**

32 82 The study dataset and its associated variable definitions file have been publicly deposited in the
33 83 dryad repository, they can be consulted under the following link:

34 84 <https://doi.org/10.5061/dryad.sqv9s4n2n>
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85 INTRODUCTION

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

91
92 In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5%
93 in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated
94 countries in the region, occupy respectively the fifth and sixth position in the ranking of countries
95 with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across
96 Latin American countries. Current data show that Puerto Rico and Mexico are the countries with
97 the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and
98 Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents
99 the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in
100 Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold
101 increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes
102 epidemic in Latin America (10).

103
104 It is expected that, over the coming decades, the largest increase in people with diabetes will occur
105 in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban
106 and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and
107 sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%),
108 lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

109
110 Colombia is a South American country of about 48 million inhabitants, in which no recent
111 population-based studies of diabetes prevalence or associated nutritional factors are available. In
112 Colombia, the urbanization phenomenon has been further complicated by the internal
113 displacement of hundreds of thousands of citizens as a result a protracted internal conflict that only
114 came to an end in the recent years (14). The estimated cost of diabetes in Colombia is the fourth
115 largest in the region below Brazil, Mexico and Venezuela (9). The official sources of information

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3 116 about the burden of diabetes in Colombia are not population-based studies, but claim databases
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5 117 like the High-Cost Account (*Cuenta de Alto Costo - CAC*) (15), a registry kept by an association
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7 118 of Colombian health insurance companies. Another frequently cited source is SISPRO (*Sistema*
8
9 119 *Integrado de Información de Protección Social - Integrated Social Protection Information System*)
10
11 120 (www.sispro.gov.co), a database that compiles all health services and procedures provided by the
12
13 121 Colombian health system (16). These sources are useful for planning the provision of health
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15 122 services, but they cannot provide estimations of diabetes and its associated factors at the population
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17 123 level. For instance, the CAC reported a diabetes prevalence of 2.2% between July 2016 and June
18
19 124 2017, a figure far removed from all worldwide data in similar countries and from IDF projections
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21 125 (2,5,17,18). Similarly, these official sources based on care provision do not register relevant
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23 126 lifestyle variables, so they do not allow the exploration of dietary habits of people with diabetes in
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25 127 the general population. There are, however, some sources of estimates for the population
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27 128 prevalence of diabetes, but they are confined to a specific population group. Thus, the SABE (from
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29 129 the Spanish SALud, Bienestar y Envejecimiento – Health, well-being and ageing) Colombia study
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31 130 found a rate of self-reported diabetes of 18.5% among adults aged over the age of 60 in 2015 (19).
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33 131 A similar prevalence (17.5%) was found in the SABE Bogotá survey of older adults in the
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35 132 country's capital (20).

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39 134 In Colombia, population-based surveys have demonstrated a notorious increase in both child and
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41 135 adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and
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43 136 other Latin-American countries, suggesting that the recent phenomena of mass urbanization,
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45 137 westernization of dietary habits and adoption of sedentary behaviors are translating into a
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47 138 demographic and nutrition transition in the whole region (22). These changes have
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49 139 disproportionately affected more economically vulnerable segments of the population (23).

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53 141 In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained
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55 142 increase in life expectancy that started in the second half of the 20th century, especially among
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57 143 women (24). The combination of these factors greatly favors the development of diabetes and other
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59 144 chronic diseases, hence the exploration of the current of diabetes and its associated dietary
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145 behaviors is of great importance.

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3 147 Dietary behavior is a crucial determinant of the degree of control and the development of chronic
4 148 complications among individuals with diabetes. Dietary habits have a large impact on various
5 149 parameters directly related to the risk of chronic complications, among them blood glucose levels,
6 150 plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the
7 151 dietary habits of this population is of the utmost importance to guide clinical strategies and public
8 152 health policies aimed at persons with diabetes. Despite the multiple combinations of
9 153 macronutrients that may be adjusted to each person's requirements and cultural preferences, most
10 154 guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes
11 155 control, and prevention of chronic complications (26). These goals usually comprise the
12 156 distribution of calories among the different macronutrients, the restriction of dietary trans fats,
13 157 sodium and cholesterol, and the provision of an adequate amount of dietary fiber.
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24 159 Colombia is a geographically, racially and culturally diverse country with marked differences
25 160 among the five most populated regions: i. Central plateau (administrative and economic center of
26 161 the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations,
27 162 iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most
28 163 of the Afro-Colombian population resides, iv. Northwestern or "paisa" region, where there are
29 164 many local traditions and there is a larger degree of European and Jewish ancestry and v.
30 165 Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of
31 166 indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers,
32 167 we undertook a study in five cities, one from each region, in order to answer the following research
33 168 question: What is the prevalence of self-reported diabetes in the main urban centers of Colombia,
34 169 and how does the nutrient intake of these individuals compare to that of people without diabetes?
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36 170 An ancillary goal of the study was to explore to what extent do people with diabetes achieve the
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44 171 internationally recommended dietary goals for individuals with diabetes.
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172 METHODS

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

194
195 Information was captured using a tablet device containing digital forms with proper validation
196 rules, developed for the study. All staff in charge of data collection was extensively trained by the
197 study Principal Investigator. A random 10% of participants were re-contacted by phone in order
198 to double-check the accuracy of the information provided on date of birth, sex, city of residence,
199 marital status, job status, educational level and date of initial contact. All data were collected
200 between June and November 2018.

201

202 Patient and Public Involvement

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

207 **Measurements**

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

224
225 Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata
226 according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being
227 the highest) (28). Residential dwellings are classified according to their physical characteristics
228 and environment. The methodology for this classification creates homogeneous strata taking as
229 input information about land use, public utilities, access routes, topography, land valuation and
230 property characteristics. The stratification unit is the sub-zone, corresponding generally to a block.
231 Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their
232 characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise,
233 they are considered outliers and their stratum is assessed based on their particular characteristics.

234 This information is very well established, updated and freely accessible for all the country. Given
235 that sociodemographic, income and human development indicators are more similar for
236 individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups,
237 corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). We interpreted BMI
238 according to the cut points proposed by the World Health Organization (WHO): Underweight
239 (BMI<18.5 Kg/m²), normal weight (BMI ≥18.5 and <25 Kg/m²), overweight (BMI ≥25 and
240 <30 Kg/m²) and obesity (BMI ≥30 Kg/m²). We defined abdominal obesity as a waist
241 circumference ≥ 90cm for women, and ≥ 94cm for men, according to the proposed cutoffs for
242 Latin American adults (29).

243
244 Capillary blood specimens were collected by trained staff following standardized procedures,
245 blood glucose levels were promptly measured and registered using an Accu-Check meter. Since
246 fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one
247 of these three conditions: 1. A capillary blood glucose level ≥ 200 mg/dL, 2. A self-reported prior
248 diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic medication (s).

249
250 Usual dietary intake was assessed employing a 157-item semi-quantitative food-frequency
251 questionnaire (FFQ). The FFQ was an enhanced and adapted version of an earlier FFQ specifically
252 designed for the Colombian population (30). In a prior validation against four independent 24-hour
253 dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile
254 of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for
255 protein and 0.77 for carbohydrate (31). Portion sizes were established according to the reference
256 unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i.
257 Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to
258 six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix.
259 Six or more times a day. Participants were asked to make their selections based on their usual
260 intake over the last year. FFQs were individually administered by study staff. The nutrient
261 contribution of each food was calculated according to composition tables by the Colombian
262 Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United
263 States Department of Agriculture and manufacturer's information. The COPEN protocol and
264 COPEN field materials (in Spanish) are provided as Supplementary Material 1 and 2, respectively.

265

266 **Data analysis**

267 All prevalence estimations were projected to the target study population using city, sex, age group
268 and SEL-specific expansion factors according to the study multi-stage sampling design. We did
269 not have any missing data points for sociodemographic factors, diabetes status and dietary intake
270 variables. The univariate associations between nominal predictors and diabetes status were
271 examined using chi-square independence tests. To test for a linear trend in the association between
272 ordinal predictors and diabetes status, we report the p-value associated with a rank-correlation
273 (Spearman) test between predictor and outcome. We also ran multivariable logistical models in
274 which sex, age group, SEL and educational level were the independent variables and diabetes
275 status was the outcome. We initially compared mean consumption of macronutrients and
276 micronutrients of interest between individuals with or without diabetes using a one-way ANOVA,
277 with diabetes as fixed factor. Since a higher BMI is associated with diabetes risk and also with a
278 higher dietary nutrient intake, we also performed multivariable linear regression analyses in which
279 age, sex, BMI, SEL and diabetes status were the predictors and the daily consumption of each
280 nutrient was the dependent variable (one model per nutrient). We explored the achievement of
281 dietary recommendations among individuals with diabetes, expressed as the percent of individuals
282 with diabetes who met the protein ($\geq 15\%$ of total caloric intake [TCI]), saturated fat (SFA) ($< 7\%$
283 of TCI), monounsaturated fat (MUFA) ($\geq 12\%$ of TCI) and trans fat ($< 1\text{g/day}$) recommendations
284 set by the by the Latin-American Diabetes Association (32) and the fiber (14 g per each 1,000
285 Calories) and sodium ($< 2300\text{ mg/day}$) goals set by the American Diabetes Association (33). In
286 order to explore factors associated with achievement of dietary goals, we also built a series of
287 nested multivariable logistic models, in which achievement of each dietary goal was the outcome.
288 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model
289 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model
290 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for
291 Windows, v.21 (Cary, NC, USA).

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293 **Ethical aspects**

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

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3 296 provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was
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5 297 approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de
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7 298 Investigaciones), according to minute 1016 of April 27, 2018.
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For peer review only

299 RESULTS

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

309
310 **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)

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

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3 314 strata 1 and 2, medium SEL includes only stratum 3, and high SEL includes strata 4, 5 and 6. Data are n (%) unless
4 315 indicated otherwise .
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8 317 The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%),
9 318 with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men;
10 319 $p=0.43$, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men). The prevalence was highest
11 320 in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/- 5.3%),
12 321 Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the prevalence of
13 322 diabetes increased monotonically with age in both men and women (p for the difference among
14 323 age groups and p -trend both <0.001). For age groups 18-39 and 40-59, men had a numerically
15 324 higher prevalence of diabetes than women, while in the 60-75 age group the opposite was true
16 325 (Figure 1). The association between educational level and diabetes prevalence was dependent on
17 326 sex. Among men, prevalence went from 7.0% for those with elementary education or lower, to
18 327 13.8% for those with a professional or higher degree. On the other hand, diabetes prevalence
19 328 among women decreased steadily with higher education, going from 12.5% in the elementary or
20 329 lower education group, to 7.2% in the professional or higher educational level group (Figure 2,
21 330 panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the highest
22 331 SEL almost doubled that of the lowest SEL (Figure 1, panel B) (P -value for the trend in diabetes
23 332 prevalence with increasing socioeconomic level = 0.04.).
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37 334 Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight
38 335 category to 12.4% for obesity (p -trend <0.001). While diabetes was almost equally prevalent
39 336 among normal weight men and women, it was far more common in the male sex in the overweight
40 337 and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly
41 338 associated with diabetes. The relative increase in diabetes prevalence for individuals with
42 339 abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental
43 340 Figure 2, panel B).
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50 342 In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL
51 343 and educational level as covariates, only age group ($p<0.001$) and city of residence ($p=0.019$) were
52 344 significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI:
53 345 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
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3 346 notorious difference in diabetes prevalence between men and women depending on SEL and
4 347 educational level, the respective interaction terms were not statistically significant ($p=0.074$ for
5 348 the sex*SEL interaction, $p=0.24$ for the sex*educational level interaction term). In this model, the
6 349 adjusted prevalence of diabetes was significantly higher among men than women in the low SEL
7 350 ($p=0.035$).
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11 352 Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower
12 353 consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake
13 354 was significantly lower for people with diabetes. This trend was observed for carbohydrates, total
14 355 lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and
15 356 fiber (Supplemental Table 1). The mean daily consumption of trans fats by individuals with
16 357 diabetes (2.0 ± 1.2 g/day) was significantly lower than in individuals without diabetes (2.4 ± 1.8
17 358 g/day, $p=0.005$), but still much higher than the recommended limit of maximum 1g/day. Similarly,
18 359 persons with diabetes had a significantly lower intake of dietary sodium (3840 ± 1913 mg/day
19 360 *versus* 5330 ± 2767 mg/day, $p<0.001$). People with diabetes showed a trend towards lower
20 361 consumption of fiber, that did not reach statistical significance (33.2 ± 14.1 g/day *versus* $37.9\pm$
21 362 16.9 g/day, $p=0.077$).
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35 364 After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake
36 365 between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7 for
37 366 polyunsaturated fatty acids (Figure 3). After multivariate adjustment, however, only the lower
38 367 consumption of sodium among individuals with diabetes retained statistical significance
39 368 ($p=0.013$).
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46 370 The macronutrient composition of the diet showed only small variations by diabetes status.
47 371 For individuals with and without diabetes, the proportions of TCI from each macronutrient were,
48 372 respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5%
49 373 *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant
50 374 ($p<0.001$) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight
51 375 differences according to diabetes status. The proportions of TCI coming from each type of fat in
52 376 individuals with *versus* without diabetes were, respectively: 11.7% *versus* 11.1% for SFA, 15.9%

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3 377 versus 14.7% for MUFA and 8.1% versus 8.4% for PUFA (Supplemental Figure 3, panel B). The
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5 378 1.8% higher TCI from MUFA in the diabetes group was statistically significant ($p=0.031$).
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9 380 When assessing the compliance of self-reported nutrient intake with current guidelines, the
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11 381 proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%.
12 382 Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats
13 383 (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).
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17 385 The achievement of dietary goals was associated with demographic factors and with the
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19 386 presence of diabetes (Table 2). Men were much less likely to achieve the sodium (5.4% *versus*
20 387 11.4% in women) and fiber (8.5% *versus* 13.1% in women) recommendations. Participants aged
21 388 18 to 39 were less likely to meet the trans fats and sodium recommendations than their older
22 389 counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium intake
23 390 the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of the
24 391 recommended amount of dietary fiber was particularly low in Medellín (4.2%). The proportion of
25 392 people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite the
26 393 observed differences in mean nutrient intake between persons with or without diabetes, the degree
27 394 of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0 in no
28 395 diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).
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398 **Table 2. Proportion of individuals achieving different dietary recommendations, according**
 399 **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%)

400 Data are n (%).

401
 402 In nested logistical models, the variables significantly associated with attainment of dietary
 403 recommendations were different for each goal in the fully adjusted model (Supplemental Table 2).
 404 Male sex showed a negative association with meeting the dietary recommendations for sodium
 405 (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
 406 0.35-0.96). On the other hand, age was positively associated with meeting the recommendations
 407 for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year, 95%CI 1.008-
 408 1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high SEL were more
 409 likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to meet the goal
 410 for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to reach the
 411 dietary protein recommendation (OR 2.02, 95% CI 1.33-3.06). Participants from Cali or

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3 412 Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from
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5 413 Medellin were more less likely to meet the dietary fiber goal. Despite the reported lower intake of
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7 414 most nutrients by participants with diabetes, diabetes status only had a significant independent
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9 415 association with meeting the goal for dietary protein (OR 2.00, 95%CI 1.25-3.20).
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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%

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3 447 in the same city (39). We found a comparable diabetes prevalence for most of the cities except for
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5 448 Medellin, where we found a much larger figure. A population study undertaken in Medellin and
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7 449 its suburbs in 2008-2010 (40) found a prevalence of high plasma glucose (fasting plasma glucose
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9 450 >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by
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11 451 diabetes self-report or random plasma glucose>200 mg/dL, despite the different definition. Further
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13 452 studies are needed in order to identify potential genetic, demographic or cultural reasons for the
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15 453 high prevalence of hyperglycemia in this region of the country.
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17 454
18 455 Worldwide, the prevalence and societal burden of diabetes have been increasing steadily
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20 456 in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted
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22 457 life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (41). The rapid
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24 458 expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely
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26 459 populated Asian countries (China and India) (42), but also by sustained prevalence increases in
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28 460 developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019,
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30 461 diabetes prevalence among adults in the North America and Caribbean region was estimated at
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32 462 13.3%, while in Europe it was 8.9% (34). The most recent estimate of the US Centers for Disease
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34 463 Control places diabetes prevalence in the USA at 13.0% (43). Thus, our estimations worryingly
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36 464 place the prevalence of diabetes among urban adults from Colombia at a level close to that of
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38 465 developed countries. Overall, our study led to an estimate of diabetes prevalence much more
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40 466 plausible and coherent with international projections than data from existing national health
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42 467 surveys.
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44 468
45 469 The most important independent correlate of diabetes in our study was increasing age, as
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47 470 has been described for most populations worldwide (41). Our study found an estimated prevalence
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49 471 of diabetes among older adults remarkably close to that encountered in recent surveys from the
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51 472 SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed
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53 473 in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an
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55 474 accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most
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57 475 part, the relationship between socioeconomic status and diabetes is consistent in high-income
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59 476 countries: a lower position increases risk (44-47). Meanwhile, the magnitude and direction of this
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477 association in middle- and low-income countries is conflicting across studies, perhaps due to

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3 478 imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic
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5 479 and nutritional transitions that affect them in ways different from what takes place in the developed
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7 480 world (48-50). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be
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9 481 explained at least partially by increased access to medical care and diabetes screening with higher
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11 482 income (51).
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13 484 Prior studies had found an interaction between sex and educational level, so that more
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15 485 educated women had a lower prevalence of diabetes. A large multi-national study reported
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17 486 increasing odds of diabetes as education increased among men from middle-income countries. For
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19 487 women, the association was flat or slightly negative (52). Other studies of the associations between
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21 488 socioeconomic variables and diabetes have also found a different pattern according to sex (53,54).
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23 489 Studies from Mexico (55) Argentina (56) and Brazil (57) have also documented higher rates of
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25 490 obesity and diabetes among more educated males and less educated females. Many factors could
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27 491 explain these results, but one that may apply to our context is a larger degree of body dissatisfaction
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29 492 among women, that increases with higher education. A study in Bogotá showed that women with
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31 493 higher education were more likely to identify thinner body silhouettes as their preferred ones (58).
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33 494 Our results complement a body of evidence suggesting that education of women may be a tool in
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35 495 the fight against the diabetes epidemic in developing countries.
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36 497 We were surprised to find a lower self-reported weight-adjusted intake of calories and all
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38 498 macronutrients among persons with diabetes. An optimistic interpretation of this finding would be
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40 499 that it shows good adherence to dietary recommendations. However, such interpretation should be
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42 500 made with caution, as it is known that people with diabetes and obesity frequently underreport
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44 501 their caloric intake (59).
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46 503 The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost
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48 504 significance after multivariate adjustment, suggests that major sociodemographic factors (older
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50 505 age) and a higher BMI are the true factors explaining a lower reported dietary intake in persons
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52 506 with diabetes. In any event, these differences did not result in increased odds of achieving dietary
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54 507 recommended intakes of key nutrients, as only reaching the %TCI from protein was independently
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56 508 associated with diabetes status.
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5 510 Despite reporting quantitatively less intake of most nutrients, the relative proportion of
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7 511 macronutrients from each source in participants with diabetes was remarkably similar to that of
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9 512 people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA
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11 513 represented a comparable share of TCI regardless of diabetes status. This points out that
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13 514 individuals with diabetes (many of whom already know about of their diabetes status), are
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15 515 not modifying enough their diets to intentionally increase the percent of Calories from MUFA, as
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17 516 well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from
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19 517 general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis,
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21 518 which had descended to 11.9% by four years after diagnosis (60). This is still far from the
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23 519 recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with
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25 520 diabetes seems to be a ubiquitous problem.

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26 522 The intake of dietary fiber was equally concerning, in this case because of too little
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28 523 consumption, a problem that was more evident in participants who were younger, male, or lived
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30 524 in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich
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32 525 in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose
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34 526 by 9.9 mg/dL in persons with diabetes (61). Hence, a low consumption of dietary fiber constitutes
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36 527 a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful
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38 528 cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is
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40 529 restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at
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42 530 high baseline risk for cardiovascular disease, like people with diabetes or older people (61). We
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44 531 found that only one in every five individuals with diabetes was achieving this goal, and the odds
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46 532 of achieving it were significantly lower with younger age or higher SES, probably in relation with
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48 533 a higher consumption of processed, industrialized foods (62). TFA intake is an independent
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50 534 predictor of total and cardiovascular mortality (63), so extreme efforts should be put in place in
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52 535 order to limit their consumption both in the general population and among persons with diabetes.

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52 537 Our results bring out many areas of potential intervention for nutritional prevention, which
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54 538 are particularly relevant in our context. Nutritional education of people with diabetes in developing
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56 539 countries is an urgent measure with large potential benefits and minimal risks.

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5 541 Limitations of our study include the entirely urban sample, given the recent increase in
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7 542 obesity in rural areas in the continent (64) and Colombia (65). It is important, however, that the
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9 543 proportion of total population living in urban centers is in Colombia is 77.1% (66), a result of
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11 544 accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic
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13 545 profile of the country (14). Another relevant limitation was the unavailability of oral glucose
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15 546 tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma
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17 547 glucose measurement and diabetes self-report, which may lead to underestimation of the true
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19 548 disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would
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21 549 have imposed great complexities on the logistics of the study. We acknowledge that the
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23 550 prevalences we report, high as they seem, are most likely an underestimation. The use of FFQs for
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25 551 dietary intake assessment has advantages and disadvantages, as FFQs inquire about usual (rather
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27 552 than recent) intake and can be quite comprehensive, but tend to overestimate total caloric intake
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29 553 and to be less accurate than 24-hour diet recalls in the short-term. Finally, our study did not collect
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31 554 detailed information on lifestyle variables like smoking or physical activity, which may explain or
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33 555 correlate with the described dietary intakes.
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36 557 In summary, our results confirm a continued progression of the diabetes epidemic in
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38 558 middle-income countries, and its relationship with demographic and socioeconomic factors. We
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40 559 also found remarkably low rates of achievement of key nutritional goals among individuals with
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42 560 diabetes, and identified factors associated with their achievement. Further research focused in rural
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44 561 areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the
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46 562 developing world.
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3 827 **Figure legends**
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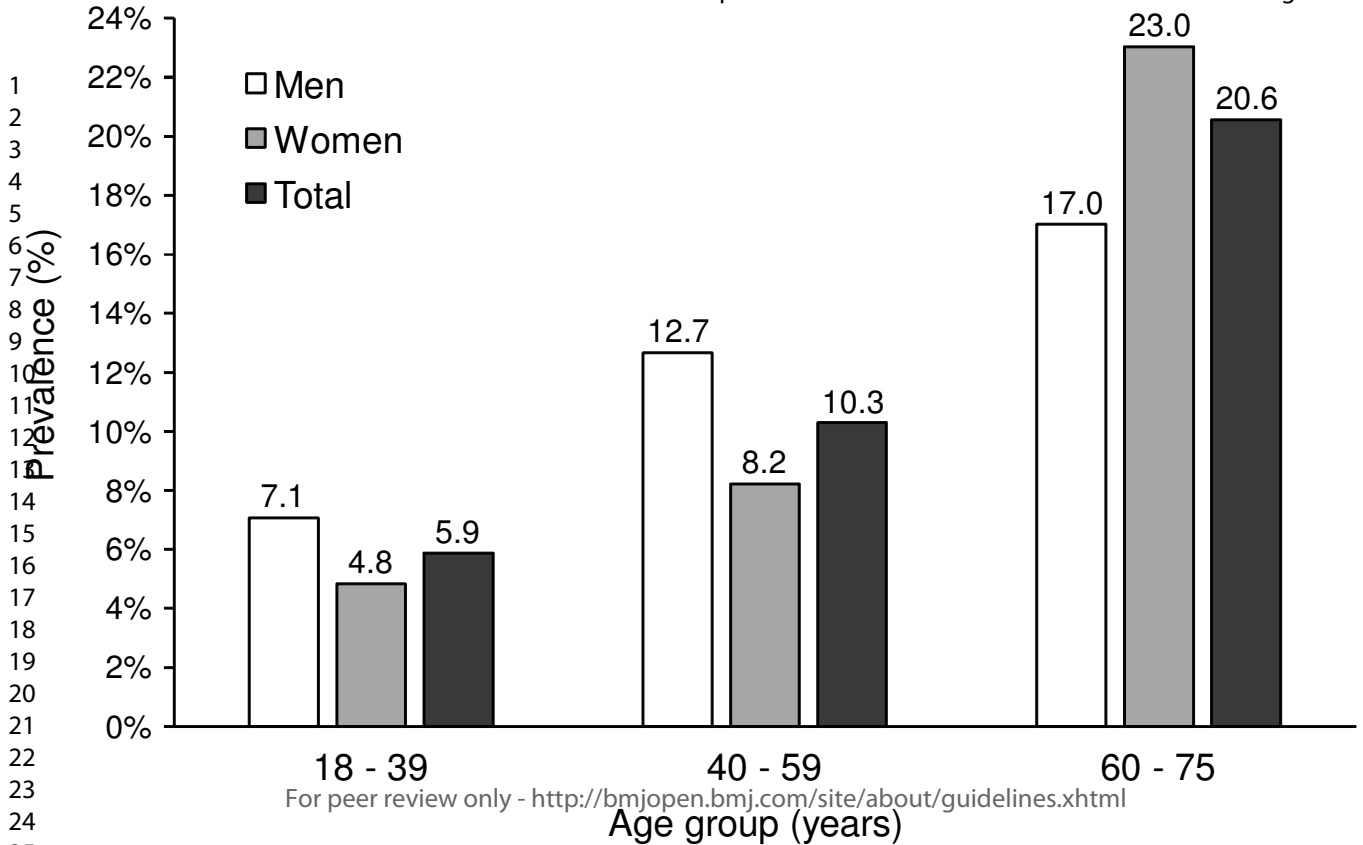
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7 829 **Figure 1.** Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights.
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9 830 P-value for the overall difference in prevalence among age groups <0.001 . P-value for the trend in
10 831 diabetes prevalence with increasing age group <0.001 .

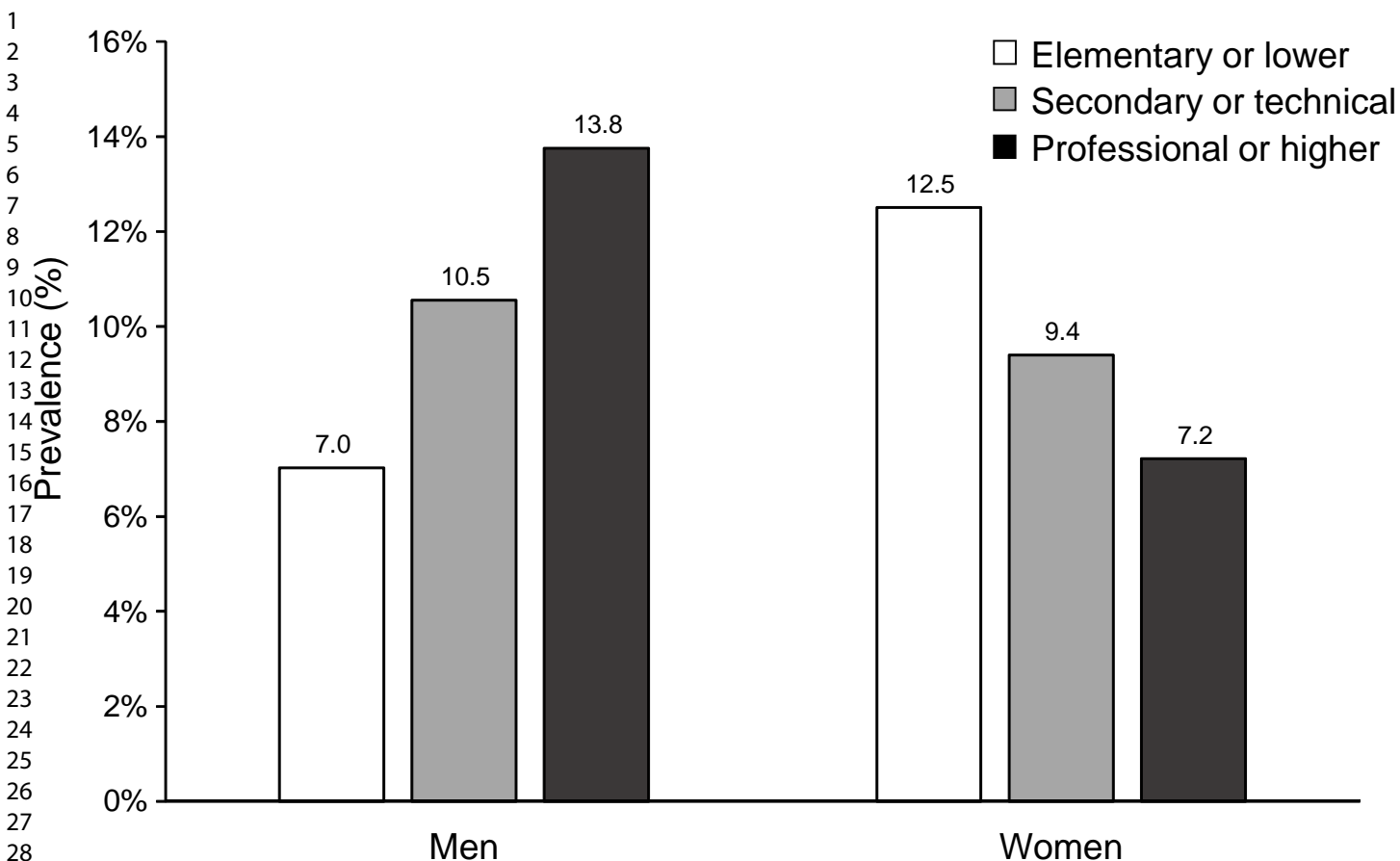
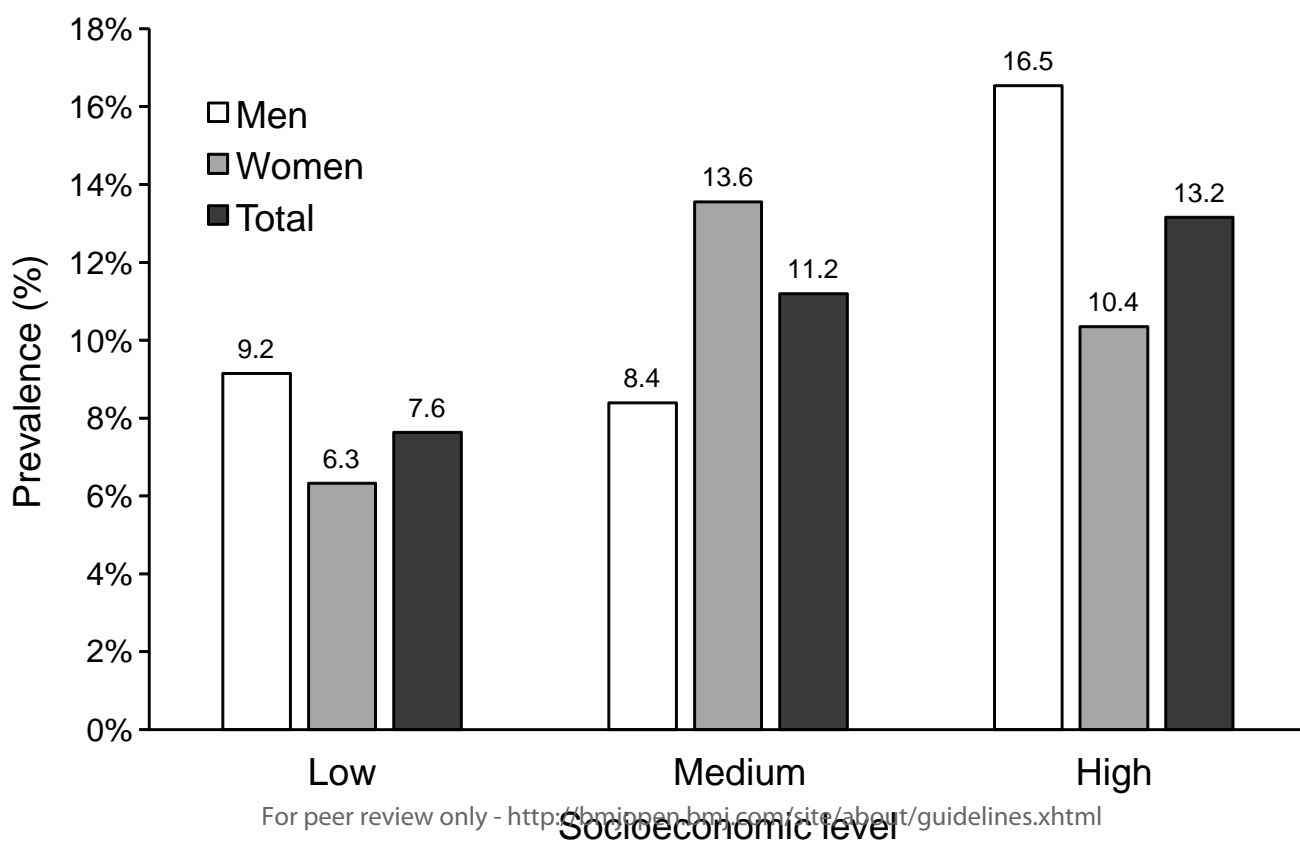
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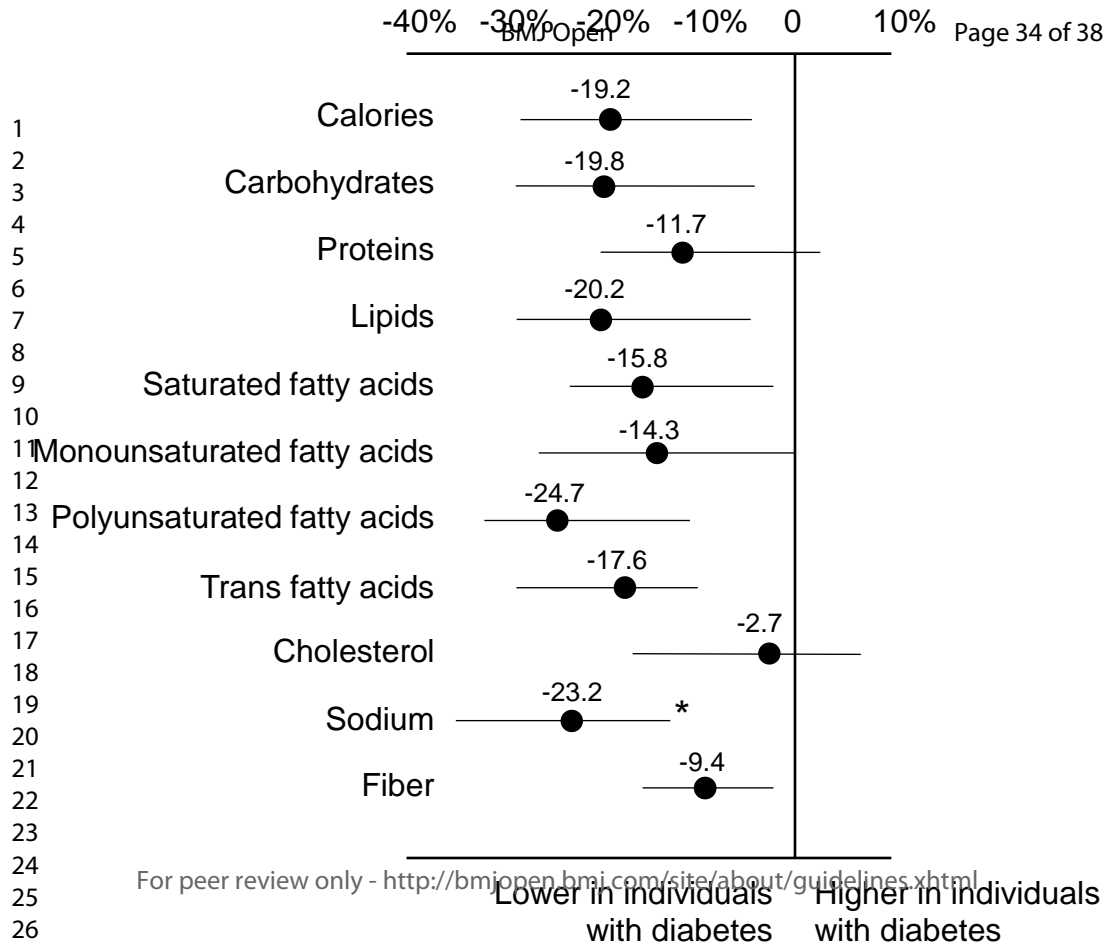
13 833 **Figure 2.** Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel
14 834 B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL)
15 835 was classified according to Colombia's official Statistics Department-DANE stratification
16 836 scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL
17 837 includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall
18 838 difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in
19 839 diabetes prevalence with increasing socioeconomic level=0.04.
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27 841 **Figure 3.** Difference in age, sex, BMI and SEL-adjusted nutrient intake (in g/d), between
28 842 individuals with diabetes and individuals without diabetes. Dots represent medians and lines
29 843 represent Q1-Q4. * $p=0.013$ for the adjusted comparison versus individuals without diabetes.
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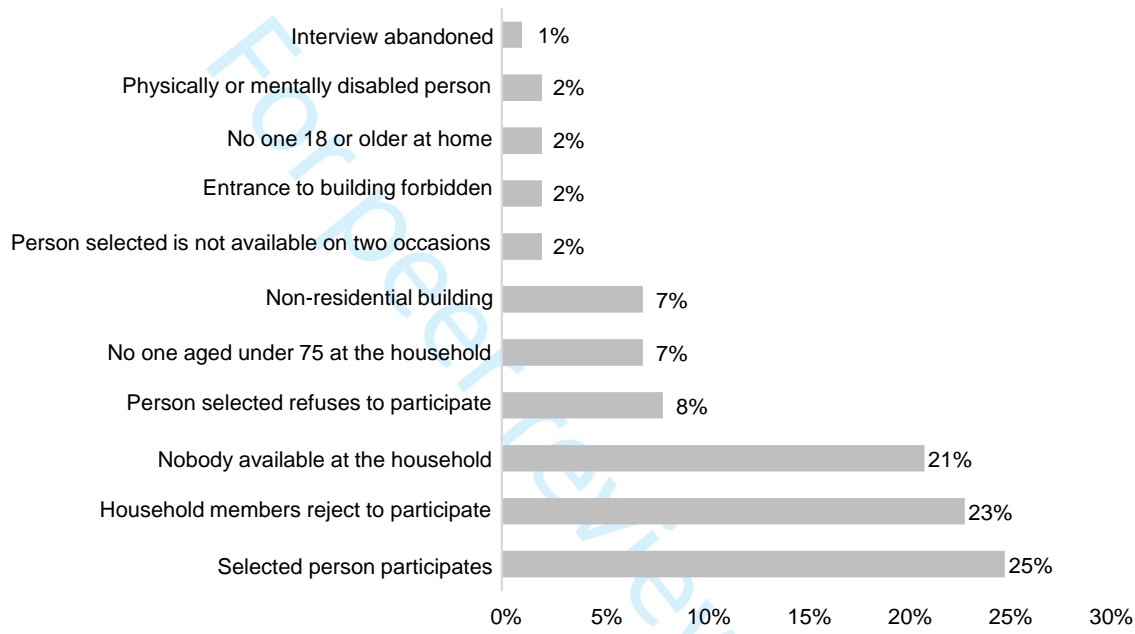
A**B**



**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.



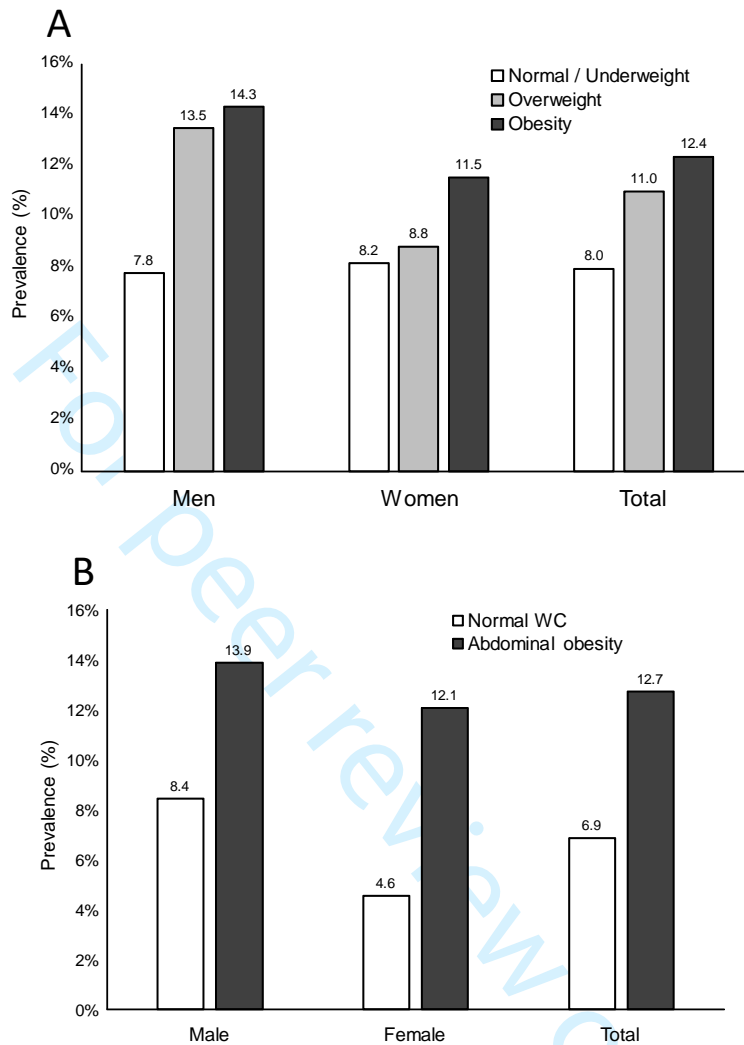
10 **Supplemental table 1.** Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes
 11 diagnosis. SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA:
 12 Polyunsaturated fatty acids. Data are means using sampling weights \pm SD.

	Diabetes diagnosis		Difference	Univariate p-value
	No	Yes		
Calories (Cal/Kg/day)	58.5 \pm 31.2	44.1 \pm 22.4	-14.4	<0.001
Carbohydrates (g/Kg/day)	7.08 \pm 3.9	5.18 \pm 3.1	-1.90	0.002
Protein (g/Kg/day)	2.03 \pm 1.2	1.72 \pm 0.8	-0.31	0.076
Lipids (g/Kg/day)	2.35 \pm 1.4	1.79 \pm 1	-0.56	<0.001
SFA (g/Kg/day)	0.73 \pm 0.5	0.58 \pm 0.4	-0.14	0.017
MUFA (g/Kg/day)	0.96 \pm 0.6	0.79 \pm 0.4	-0.17	0.01
PUFA (g/Kg/day)	0.56 \pm 0.4	0.39 \pm 0.3	-0.17	<0.001
Trans fatty acids (mg/day)	2.4 \pm 1.8	2.0 \pm 1.2	-0.41	0.005
Cholesterol (mg/day)	702.5 \pm 494.3	647.8 \pm 442.1	-54.7	0.75
Sodium (mg/day)	5330 \pm 2767	3840 \pm 1913.2	-1490	<0.001
Fiber (g/day)	37.9 \pm 16.9	33.2 \pm 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/m²), 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 <40% 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)
MFA >=40% 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 0.47 (0.26-0.84)	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)

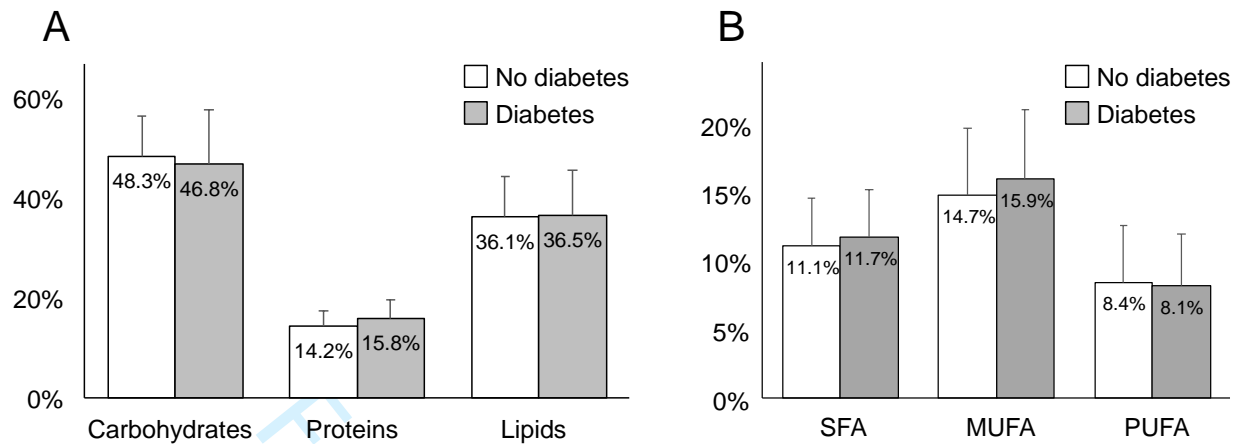
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28 **Supplemental Figure 2.** Prevalence of diabetes, by body-mass index (Panel A) and waist
 29 circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than
 30 18.5 Kg/m², normal weight as a BMI between 18.5 and less than 25 Kg/m², overweight as a BMI
 31 between 25 and less than 30 Kg/m², and obesity as a BMI of 30 or higher. Abdominal obesity was
 32 defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data
 33 are prevalences using sampling weights.

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

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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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Running title: Diabetes and diet in Colombian cities

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Contributorship statement: COM participated in study conception, supervised study activities, participated in its execution, data analysis and in manuscript writing. SAG participated in study execution, data analysis and manuscript writing, MJPJ participated in study execution, data analysis and manuscript writing, LDNV participated in study execution, data analysis and manuscript writing, AMR participated in study execution, data analysis and manuscript writing, ECBV participated in study conception, and participated in study execution, data analysis and in manuscript writing.

Competing Interest statement: This study was funded by Team Foods Colombia, but the sponsor had no direct influence in the study design, execution or analysis, or on the decision to publish.

32 ABSTRACT

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

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

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41 **Participants:** Between June and November 2018, we studied 736 non-pregnant participants aged
42 18 or older. Diabetes was defined as a random plasma glucose ≥ 200 mg/dL, self-reported prior
43 diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also
44 fulfilled a detailed 157-item food frequency questionnaire (FFQ).

45
46 **Primary and secondary outcome measures:** Prevalence of diabetes, dietary intake of key
47 nutrients, achievement of dietary goals among individuals with diabetes.

48
49 **Results:** The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6%
50 in women, 10.8% in men, $p=0.43$). The association between diabetes and education level depended
51 on sex, diabetes was more prevalent among more educated men and less educated women.
52 Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a
53 163% increase in women. Individuals with diabetes reported lower mean consumption of all
54 nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their
55 lower sodium consumption remained significant ($p=0.013$). The proportion of non-achievement
56 of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for
57 sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was
58 the strongest independent correlate of diabetes.

59 60 Conclusions

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

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3 63 residence, SEL and educational level. The proportion of individuals with diabetes meeting
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5 64 dietary recommendations was alarmingly low.
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3 **65 Strengths and limitations of this study**
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5 **66**
6 **67** - The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well
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8 **68** as their relationship to key demographic factors.
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12 **70** - The study had a population-based, probabilistic sample from five cities in Colombia.
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14 **71**
15 **72** - Dietary intake was assessed with a food frequency questionnaire adapted to national and
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17 **73** regional dietary habits, and inquiring about usual behavior, rather than recent intake.
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19 **74**
20 **75** - Random plasma glucose and self-reported diabetes may underestimate the real diabetes
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22 **76** prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.
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24 **77**
25 **78** - Our study did not include any participants from rural areas, whose diabetes prevalence and
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27 **79** associated diet may differ significantly from those of urban populations.
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31 **81 Data sharing statement**

32 **82** The study dataset and its associated variable definitions file have been publicly deposited in the
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34 **83** dryad repository, they can be consulted under the following link:

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36 **84** <https://doi.org/10.5061/dryad.sqv9s4n2n>
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85 INTRODUCTION

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

91
92 In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5%
93 in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated
94 countries in the region, occupy respectively the fifth and sixth position in the ranking of countries
95 with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across
96 Latin American countries. Current data show that Puerto Rico and Mexico are the countries with
97 the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and
98 Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents
99 the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in
100 Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold
101 increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes
102 epidemic in Latin America (10).

103
104 It is expected that, over the coming decades, the largest increase in people with diabetes will occur
105 in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban
106 and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and
107 sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%),
108 lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

109
110 Colombia is a South American country of about 48 million inhabitants, in which no recent
111 population-based studies exploring the prevalence of diabetes or the comparative characteristics
112 of dietary intake among individuals with diabetes are available. In Colombia, the urbanization
113 phenomenon has been further complicated by the internal displacement of hundreds of thousands
114 of citizens as a result a protracted internal conflict that only came to an end in the recent years
115 (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil,

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3 116 Mexico and Venezuela (9). The official sources of information about the burden of diabetes in
4
5 117 Colombia are not population-based studies, but claim databases like the High-Cost Account
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7 118 (*Cuenta de Alto Costo - CAC*) (15), a registry kept by an association of Colombian health insurance
8
9 119 companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de*
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11 120 *Protección Social - Integrated Social Protection Information System*) (www.sispro.gov.co), a
12
13 121 database that compiles all health services and procedures provided by the Colombian health system
14
15 122 (16). These sources are useful for planning the provision of health services, but they cannot provide
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17 123 estimations of diabetes and its associated factors at the population level. For instance, the CAC
18
19 124 reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed
20
21 125 from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these
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23 126 official sources based on care provision do not register relevant lifestyle variables, so they do not
24
25 127 allow the exploration of dietary habits of people with diabetes in the general population. There
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27 128 are, however, some sources of estimates for the population prevalence of diabetes, but they are
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29 129 confined to a specific population group. Thus, the SABE (from the Spanish SALud, Bienestar y
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31 130 Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported
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33 131 diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%)
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35 132 was found in the SABE Bogotá survey of older adults in the country's capital (20).

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37 133
38 134 In Colombia, population-based surveys have demonstrated a notorious increase in both child and
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40 135 adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and
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42 136 other Latin-American countries, suggesting that the recent phenomena of mass urbanization,
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44 137 westernization of dietary habits and adoption of sedentary behaviors are translating into a
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46 138 demographic and nutrition transition in the whole region (22). These changes have
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48 139 disproportionately affected more economically vulnerable segments of the population (23).

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50 140
51 141 In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained
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53 142 increase in life expectancy that started in the second half of the 20th century, especially among
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55 143 women (24). The combination of these factors greatly favors the development of diabetes and other
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57 144 chronic diseases, hence the exploration of the current of diabetes and its associated dietary
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59 145 behaviors is of great importance.

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3 147 Dietary behavior is a crucial determinant of the degree of control and the development of chronic
4 148 complications among individuals with diabetes. Dietary habits have a large impact on various
5 149 parameters directly related to the risk of chronic complications, among them blood glucose levels,
6 150 plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the
7 151 dietary habits of this population is of the utmost importance to guide clinical strategies and public
8 152 health policies aimed at persons with diabetes. Despite the multiple combinations of
9 153 macronutrients that may be adjusted to each person's requirements and cultural preferences, most
10 154 guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes
11 155 control, and prevention of chronic complications (26). These goals usually comprise the
12 156 distribution of calories among the different macronutrients, the restriction of dietary trans fats,
13 157 sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected
14 158 that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given
15 159 the known association of diabetes with excess body weight and hence a net positive caloric
16 160 balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.
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29 162 Colombia is a geographically, racially and culturally diverse country with marked differences
30 163 among the five most populated regions: i. Central plateau (administrative and economic center of
31 164 the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations,
32 165 iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most
33 166 of the Afro-Colombian population resides, iv. Northwestern or "paisa" region, where there are
34 167 many local traditions and there is a larger degree of European and Jewish ancestry and v.
35 168 Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of
36 169 indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers,
37 170 we undertook a study in five cities, one from each region, in order to answer the following research
38 171 question: What is the prevalence of diabetes by self-report or random plasma glucose in the main
39 172 urban centers of Colombia, and how does the nutrient intake of these individuals compare to that
40 173 of people without diabetes? An ancillary goal of the study was to explore to what extent do people
41 174 with diabetes achieve the internationally recommended dietary goals for individuals with diabetes.
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176 Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we
177 expected to find a diabetes prevalence greater than that estimated from prior national surveys, but
178 still lower than that of the largest Latin American countries Brazil and Mexico.

For peer review only

179 METHODS

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

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

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3 210 to double-check the accuracy of the information provided on date of birth, sex, city of residence,
4 211 marital status, job status, educational level and date of initial contact. We confirmed data on date
5 212 of birth, sex, city of residence, SES, marital status job status, educational level and date of initial
6 213 contact. In all variables, we had over 95% concordance with the values originally reported. All
7 214 data were collected between June and November 2018. Supplemental Figure 1 summarizes the
8 215 scheme of participant recruitment for the study.
9 216

15 217 **Patient and Public Involvement**

16 218 Patients and the public were not involved in the design of the study, but aggregated results will be
17 219 presented to local and national authorities to inform public health policies concerning nutrition and
18 220 primary prevention of diabetes.
19 221

22 222 **Measurements**

23 223 We collected information on sex, date of birth, SEL, marital status, educational level and
24 224 employment status using a standardized questionnaire. Since diabetes incidence rises sharply at
25 225 age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three
26 226 groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one
27 227 registered in DANE for that particular block. After a brief introduction about the importance of
28 228 the accuracy of the measurements to be performed, we measured height and weight in all
29 229 participants, and waist circumference in participants aged 18 and older. Height was measured using
30 230 a portable stadiometer supported on a firm surface, taking care that the participant was barefoot,
31 231 standing right and with heels and calves touching the stadiometer. Weight was measured in a solar
32 232 digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated
33 233 simultaneously the day before the study start, and every week afterwards. Waist circumference
34 234 was measured by a sitting observer, directly over the participant's skin, at the midpoint between
35 235 the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All
36 236 measurements were performed in duplicate, and if there was a between-measures discrepancy
37 237 greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement
38 238 was collected. For analyses we used the average of each anthropometric measure.
39 239

240 Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata
241 according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being
242 the highest) (28). Residential dwellings are classified according to their physical characteristics
243 and environment. The methodology for this classification creates homogeneous strata taking as
244 input information about land use, public utilities, access routes, topography, land valuation and
245 property characteristics. The stratification unit is the sub-zone, corresponding generally to a block.
246 Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their
247 characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise,
248 they are considered outliers and their stratum is assessed based on their particular characteristics.
249 This information is very well established, updated and freely accessible for all the country. Given
250 that sociodemographic, income and human development indicators are more similar for
251 individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups,
252 corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was
253 classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced.
254 Educational level was analyzed as the highest completed level in three categories: i. Elementary
255 or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according
256 to the cut points proposed by the World Health Organization (WHO): Underweight ($BMI < 18.5$
257 Kg/m^2), normal weight ($BMI \geq 18.5$ and < 25 Kg/m^2), overweight ($BMI \geq 25$ and < 30 Kg/m^2)
258 and obesity ($BMI \geq 30$ Kg/m^2). We defined abdominal obesity as a waist circumference ≥ 90 cm
259 for women, and ≥ 94 cm for men, according to the proposed cutoffs for Latin American adults
260 (29).

262 Capillary blood specimens were collected by trained staff following standardized procedures,
263 blood glucose levels were promptly measured and registered using an Accu-Check meter. Since
264 fasting could not be guaranteed, we considered that an individual had diabetes if he/she met one
265 of these three conditions: 1. A capillary blood glucose level ≥ 200 mg/dL, 2. A self-reported prior
266 diagnosis of diabetes or 3. Self-reported use of any oral or injectable antidiabetic medication (s)
267 (30).

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

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

290 **Data analysis**

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

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3 302 individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since
4
5 303 a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, we
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7 304 also performed multivariable linear regression analyses in which age, sex, BMI, SEL and diabetes
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9 305 status were the predictors and the daily consumption of each nutrient was the dependent variable
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11 306 (one model per nutrient). We explored the achievement of dietary recommendations among
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13 307 individuals with diabetes, expressed as the percent of individuals with diabetes who met the protein
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15 308 ($\geq 15\%$ of total caloric intake [TCI]), saturated fat (SFA) ($< 7\%$ of TCI), monounsaturated fat
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17 309 (MUFA) ($\geq 12\%$ of TCI) and trans fat ($< 1\text{g/day}$) recommendations set by the by the Latin-
18
19 310 American Diabetes Association (30) and the fiber (14 g per each 1,000 Calories) and sodium
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21 311 ($< 2300\text{ mg/day}$) goals set by the American Diabetes Association (34). In order to explore factors
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23 312 associated with achievement of dietary goals, we also built a series of nested multivariable logistic
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25 313 models, in which achievement of each dietary goal was the outcome. Model 1 had as predictors
26
27 314 only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables in
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29 315 model 2 plus city, model 4 had all variables in model 3 plus BMI, and model 5 had all variables in
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31 316 model 4 plus diabetes status. All analyses were performed in SPSS for Windows, v.21 (Cary, NC,
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33 317 USA).

318

319 **Ethical aspects**

34 320 All participants provided written informed consent. All study procedures were performed
35
36 321 according to the principles of the Helsinki Declaration, and to local rules and regulations as
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38 322 provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was
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40 323 approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de
41
42 324 Investigaciones), according to minute 1016 of April 27, 2018.

325 RESULTS

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

334
335 **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)

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

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

341
342 Compared to the official population data from Colombia reported to the UN (35), the sex and
343 marital status distribution of urban adults aged 20-75 in Colombia was similar to that of our
344 sample. We had a mild overrepresentation of adults aged 60-75 (28.9 *versus* 14.5% in the general
345 population). Since we only included the five major cities, we believe this may be due to better
346 living conditions and healthcare in large metropolitan areas that cause a greater longevity in large
347 urban centers.

348
349 The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%),
350 with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men;
351 $p=0.43$, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence
352 was highest in Medellín (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/-
353 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the
354 prevalence of diabetes increased monotonically with age in both men and women (p for the
355 difference among age groups and p -trend both <0.001). For age groups 18-39 and 40-59, men had
356 a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite
357 was true (Figure 1). The association between educational level and diabetes prevalence was
358 dependent on sex. Among men, prevalence went from 7.0% for those with elementary education
359 or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes
360 prevalence among women decreased steadily with higher education, going from 12.5% in the
361 elementary or lower education group, to 7.2% in the professional or higher educational level group
362 (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the
363 highest SEL almost doubled that of the lowest SEL (Figure 1, panel B) (P -value for the trend in
364 diabetes prevalence with increasing socioeconomic level=0.04.).

365
366 Diabetes was more common as BMI increased, going from 8.0% in the normal/underweight
367 category to 12.4% for obesity (p -trend <0.001). While diabetes was almost equally prevalent
368 among normal weight men and women, it was far more common in the male sex in the overweight
369 and obesity categories (Supplemental Figure 2, panel A). Abdominal obesity was strongly
370 associated with diabetes. The relative increase in diabetes prevalence for individuals with

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

373
374 Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower
375 consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake
376 was significantly lower for people with diabetes. This trend was observed for carbohydrates, total
377 lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and
378 fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2
379 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but
380 still much higher than the recommended limit of maximum 1g/day. Similarly, persons with
381 diabetes had a significantly lower intake of dietary sodium (3840+/-1913 mg/day *versus* 5330+/-
382 2767 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber,
383 that did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

384
385 The macronutrient composition of the diet showed only small variations by diabetes status.
386 For individuals with and without diabetes, the proportions of TCI from each macronutrient were,
387 respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5%
388 *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant
389 (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight
390 differences according to diabetes status. The proportions of TCI coming from each type of fat in
391 individuals with *versus* without diabetes were, respectively: 11.7% *versus* 11.1% for SFA, 15.9%
392 *versus* 14.7% for MUFA and 8.1% *versus* 8.4% for PUFA (Supplemental Figure 3, panel B). The
393 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

394
395 When assessing the compliance of self-reported nutrient intake with current guidelines, the
396 proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%.
397 Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats
398 (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

399
400 The achievement of dietary goals was associated with demographic factors and with the
401 presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium

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3 402 (5.4% *versus* 11.4% in women) and fiber (8.5% *versus* 13.1% in women) recommendations.
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5 403 Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than
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7 404 their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium
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9 405 intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of
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11 406 the recommended amount of dietary fiber was particularly low in Medellín (4.2%). The proportion
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13 407 of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite
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15 408 the observed differences in mean nutrient intake between persons with or without diabetes, the
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17 409 degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0
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19 410 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).
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23 412 In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL
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25 413 and educational level as covariates, only age group ($p < 0.001$) and city of residence ($p = 0.019$) were
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27 414 significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI:
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29 415 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
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31 416 notorious difference in diabetes prevalence between men and women depending on SEL and
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33 417 educational level, the respective interaction terms were not statistically significant ($p = 0.074$ for
34
35 418 the sex*SEL interaction, $p = 0.24$ for the sex*educational level interaction term). In this model, the
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37 419 adjusted prevalence of diabetes was significantly higher among men than women in the low SEL
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39 420 ($p = 0.035$).
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43 422 After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake
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45 423 between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7 for
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47 424 polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and
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49 425 body-mass index, however, only the lower consumption of sodium among individuals with
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51 426 diabetes retained statistical significance ($p = 0.013$).
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430 **Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis.**

431 SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty
432 acids. Data are means using sampling weights \pm SD.

433

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

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437 In nested logistic models, the variables significantly associated with attainment of dietary
438 recommendations were different for each goal in the fully adjusted model (Table 3). Despite the
439 reported lower intake of most nutrients by participants with diabetes, diabetes status only had a
440 significant independent association with meeting the goal for dietary protein (OR 2.03, 95%CI
441 1.26-3.26). Male sex showed a negative association with meeting the dietary recommendations for
442 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,
443 95%CI 0.35-0.96). On the other hand, age was positively associated with meeting the
444 recommendations for TFA (OR 1.019 per year, 95%CI 1.007-1.031), sodium (OR 1.026 per year,
445 95%CI 1.008-1.044) and fiber (OR 1.036 per year, 95%CI 1.019-1.053). Participants from high
446 SEL were more likely to meet the goals for protein (OR 2.01, 95%CI 1.38-2.93), but less likely to
447 meet the goal for SFA (OR 0.16, 95%CI 0.06-0.42). Individuals with obesity were more likely to
448 reach the dietary protein recommendation (OR 2.02, 95% CI 1.33-3.07). Participants from Cali or
449 Bucaramanga were more likely to attain the TFA goal (compared to Bogota), while those from
450 Medellin were more less likely to meet the dietary fiber goal.

451

452 **Table 3. Predictors of achievement of different dietary recommendations (goals) in**
 453 **multivariate, mutually adjusted logistic regression models.**
 454

	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)

455 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables
 456 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
 457 diabetes status. Data are OR (95%CI).TCI: Total caloric intake.

458 DISCUSSION

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

474
475 The reported prevalence of diabetes in Colombia varies widely across different studies and
476 official documents, reflecting a lack of accurate population-level data, a problem common to many
477 developing countries. The International Diabetes Federation Diabetes Atlas 2019 estimated an
478 adjusted diabetes prevalence of 7.4% for the Colombian population (36), and the World Health
479 Organization in its 2016 Diabetes Country Profiles reported a total prevalence of 8.0% (12).
480 Meanwhile, the above-mentioned PURE study reported a prevalence of 11.1% for the population
481 aged 35 to 70 from upper-middle income countries (13), much higher than the national survey
482 done by Colombian government in 2007 (37), which found a 3.5% prevalence of self-reported
483 diabetes in adults aged 18 to 69 (38). Results from regional studies are similarly heterogeneous.
484 The CARMELA Study, a population-based study in large Latin American cities, found a diabetes
485 prevalence of 8.1% in Bogotá in 2006 (39), similar to the 8.9% found in the Colombian Caribbean
486 city of Cartagena in 2005 (40). A comparison of our findings with prior studies reveals that the
487 diabetes epidemic seems to be progressing faster in smaller cities in Latin America. For example,
488 diabetes prevalence in a 2006 study of adults in Bucaramanga was only 4%, while we found 7.4%

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3 489 in the same city (41). We found a comparable diabetes prevalence for most of the cities except for
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5 490 Medellin, where we found a much larger figure. A population study undertaken in Medellin and
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7 491 its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose
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9 492 >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by
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11 493 diabetes self-report or random plasma glucose>200 mg/dL, despite the different definition. By
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13 494 comparison with results from both IDF and WHO estimates and from national studies, our results
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15 495 seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further
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17 496 studies are needed in order to identify potential genetic, demographic or cultural reasons for the
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19 497 high prevalence of hyperglycemia in this region of the country.
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21 499 Worldwide, the prevalence and societal burden of diabetes have been increasing steadily
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23 500 in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted
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25 501 life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid
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27 502 expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely
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29 503 populated Asian countries (China and India) (44), but also by sustained prevalence increases in
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31 504 developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019,
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33 505 diabetes prevalence among adults in the North America and Caribbean region was estimated at
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35 506 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease
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37 507 Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly
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39 508 place the prevalence of diabetes among urban adults from Colombia at a level close to that of
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41 509 developed countries, and to that of Latin American countries traditionally leading diabetes
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43 510 prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an
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45 511 estimate of diabetes prevalence much more plausible and coherent with international projections
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47 512 than data from existing national health surveys.
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50 514 The most important independent correlate of diabetes in our study was increasing age, as
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52 515 has been described for most populations worldwide (43). Our study found an estimated prevalence
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54 516 of diabetes among older adults remarkably close to that encountered in recent surveys from the
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56 517 SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed
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58 518 in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an
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60 519 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

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3 551 with diabetes. In any event, these differences did not result in increased odds of achieving dietary
4 552 recommended intakes of key nutrients, as only reaching the %TCI from protein was independently
5 553 associated with diabetes status.
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10 555 Despite reporting quantitatively less intake of most nutrients, the relative proportion of
11 556 macronutrients from each source in participants with diabetes was remarkably similar to that of
12 557 people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA
13 558 represented a comparable share of TCI regardless of diabetes status. This points out that
14 559 individuals with diabetes (many of whom know already know about of their diabetes status), are
15 560 not modifying enough their diets to intentionally increase the percent of Calories from MUFA, as
16 561 well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from
17 562 general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis,
18 563 which had descended to 11.9% by four years after diagnosis (62). This is still far from the
19 564 recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with
20 565 diabetes seems to be a ubiquitous problem.
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31 567 The intake of dietary fiber was equally concerning, in this case because of too little
32 568 consumption, a problem that was more evident in participants who were younger, male, or lived
33 569 in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich
34 570 in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose
35 571 by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes
36 572 a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful
37 573 cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is
38 574 restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at
39 575 high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We
40 576 found that only one in every five individuals with diabetes was achieving this goal, and the odds
41 577 of achieving it were significantly lower with younger age or higher SEL, probably in relation with
42 578 a higher consumption of processed, industrialized foods (64). TFA intake is an independent
43 579 predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in
44 580 order to limit their consumption both in the general population and among persons with diabetes.
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3 582 Our results bring out many areas of potential intervention for nutritional prevention, which
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5 583 are particularly relevant in our context. Nutritional education of people with diabetes in developing
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7 584 countries is an urgent measure with large potential benefits and minimal risks.
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10 586 Limitations of our study include the entirely urban sample, given the recent increase in
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12 587 obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the
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14 588 proportion of total population living in urban centers in Colombia is 77.1% (68), a result of
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16 589 accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic
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18 590 profile of the country (14). Another relevant limitation was the unavailability of oral glucose
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20 591 tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma
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22 592 glucose measurement and diabetes self-report, which may lead to underestimation of the true
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24 593 disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would
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26 594 have imposed great complexities on the logistics of the study. We acknowledge that the
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28 595 prevalences we report, high as they seem, are most likely an underestimation. Concerning the
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30 596 instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather
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32 597 than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible
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34 598 to modification by recent diet as food diaries. They do have the limitations of tending to
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36 599 overestimate total Caloric intake, and of having to be adjusted for different populations. However,
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38 600 the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries,
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40 601 which are seldom used in epidemiology. FFQs have been shown to successfully assess average
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42 602 dietary intake up to 4 years prior to their application (69). Finally, our study did not collect
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44 603 detailed information on lifestyle variables like smoking or physical activity, which may explain or
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46 604 correlate with the described dietary intakes.
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49 606 In summary, our results confirm a continued progression of the diabetes epidemic in
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51 607 middle-income countries, and its relationship with demographic and socioeconomic factors. We
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53 608 also found remarkably low rates of achievement of key nutritional goals among individuals with
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55 609 diabetes, and identified factors associated with their achievement. Further research focused in rural
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57 610 areas is needed in order to build a complete the picture of evolution of the diabetes epidemic in the
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59 611 developing world.
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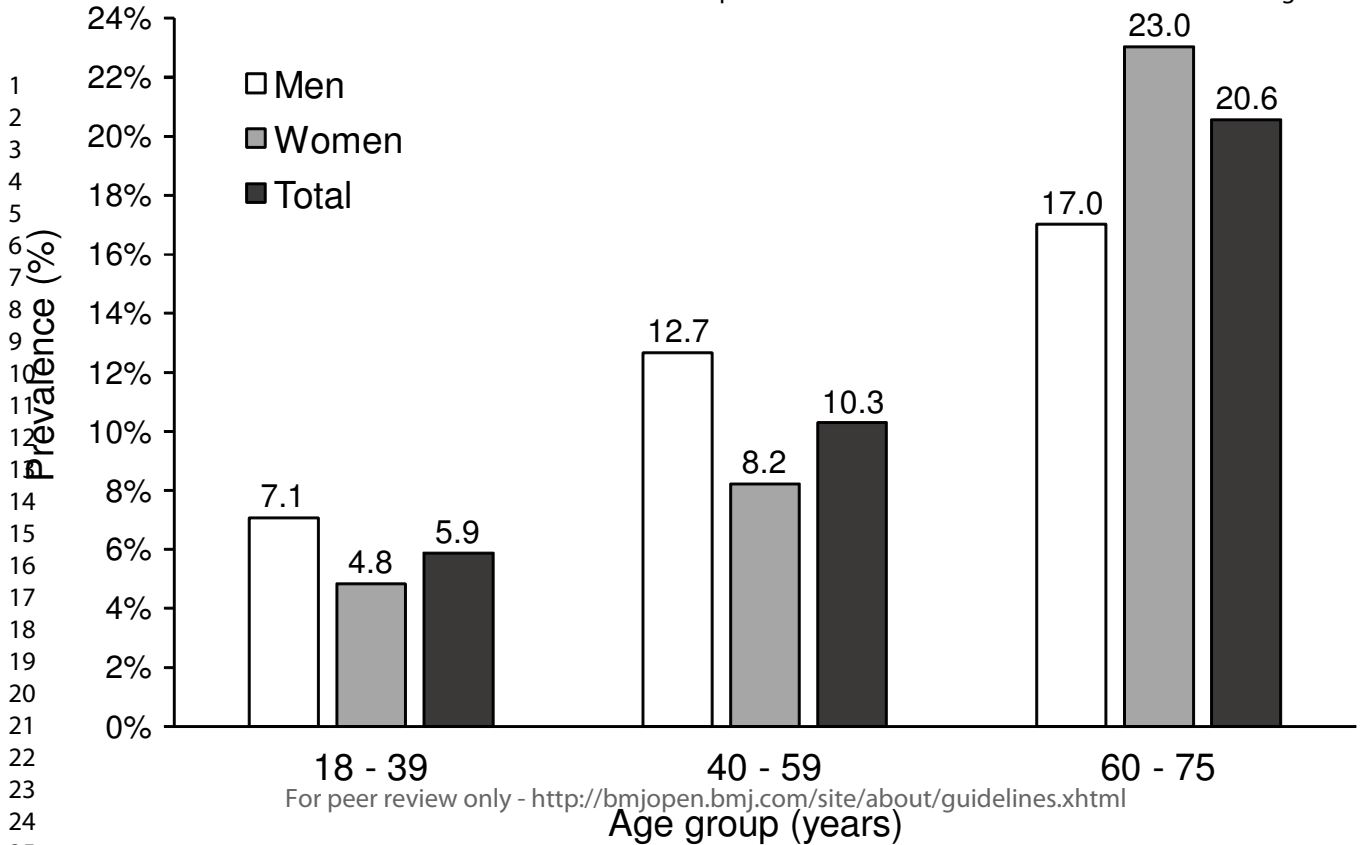
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3 889 **Figure legends**
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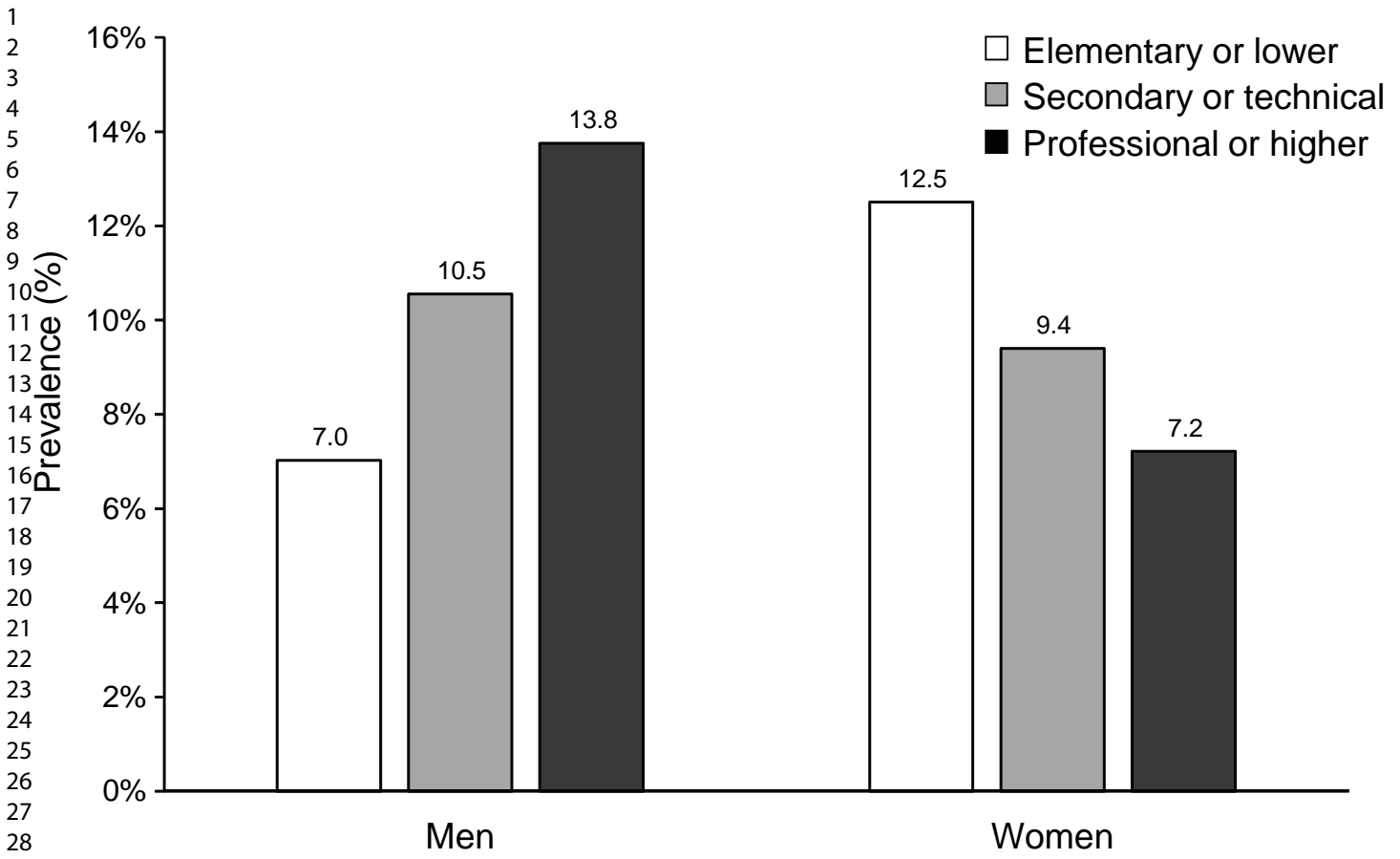
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7 891 **Figure 1.** Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights.
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9 892 P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in
10 893 diabetes prevalence with increasing age group <0.001.

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12 894
13 895 **Figure 2.** Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel
14 896 B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL)
15 897 was classified according to Colombia's official Statistics Department-DANE stratification
16 898 scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL
19 899 includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall
20 900 difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in
21 901 diabetes prevalence with increasing socioeconomic level=0.04.
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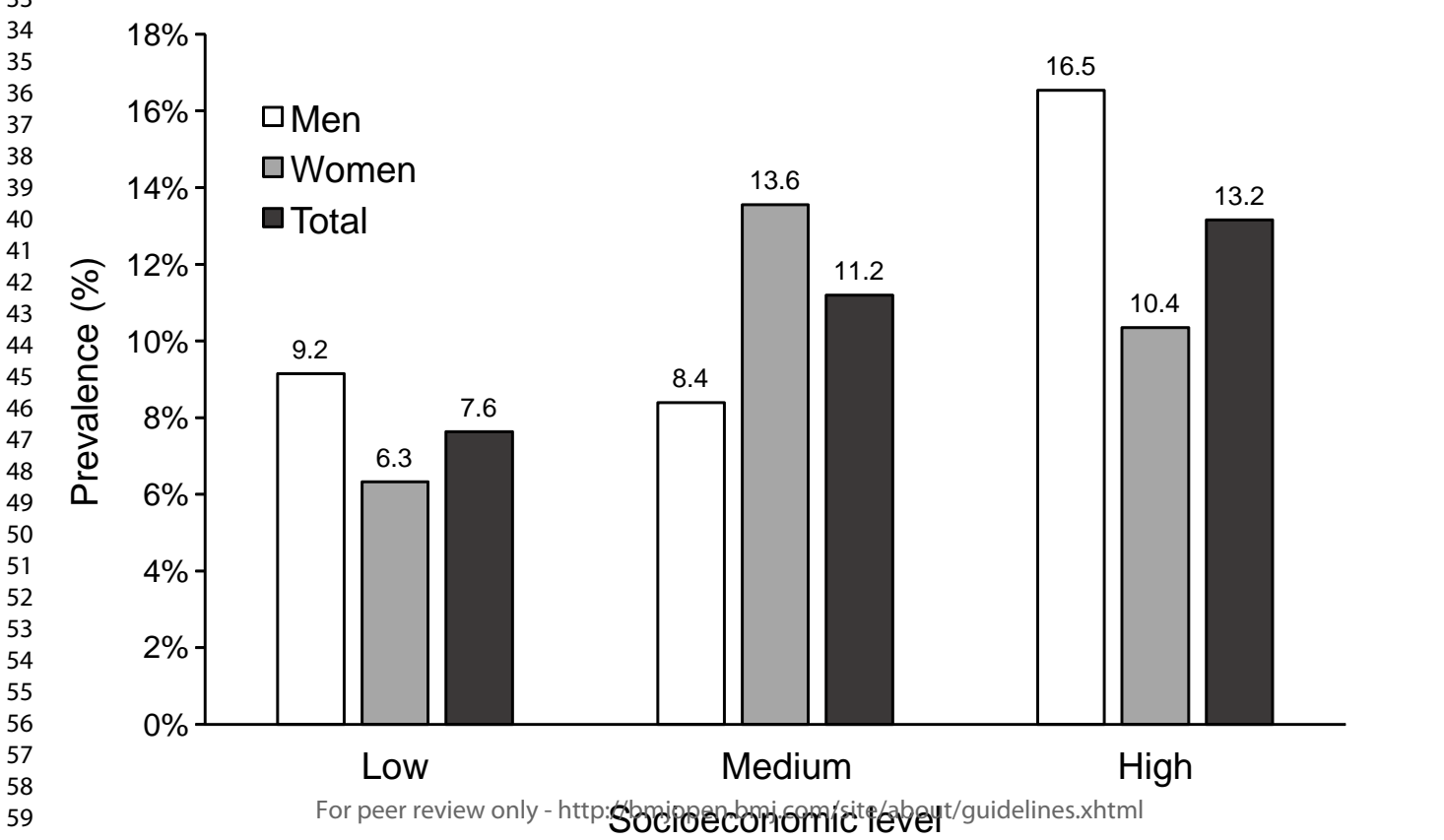
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27 903 **Figure 3.** Difference in age, sex, BMI and SEL-adjusted nutrient intake (in g/d), between
28 904 individuals with diabetes and individuals without diabetes. Dots represent medians and lines
29 905 represent Q1-Q4. *p=0.013 for the adjusted comparison versus individuals without diabetes.
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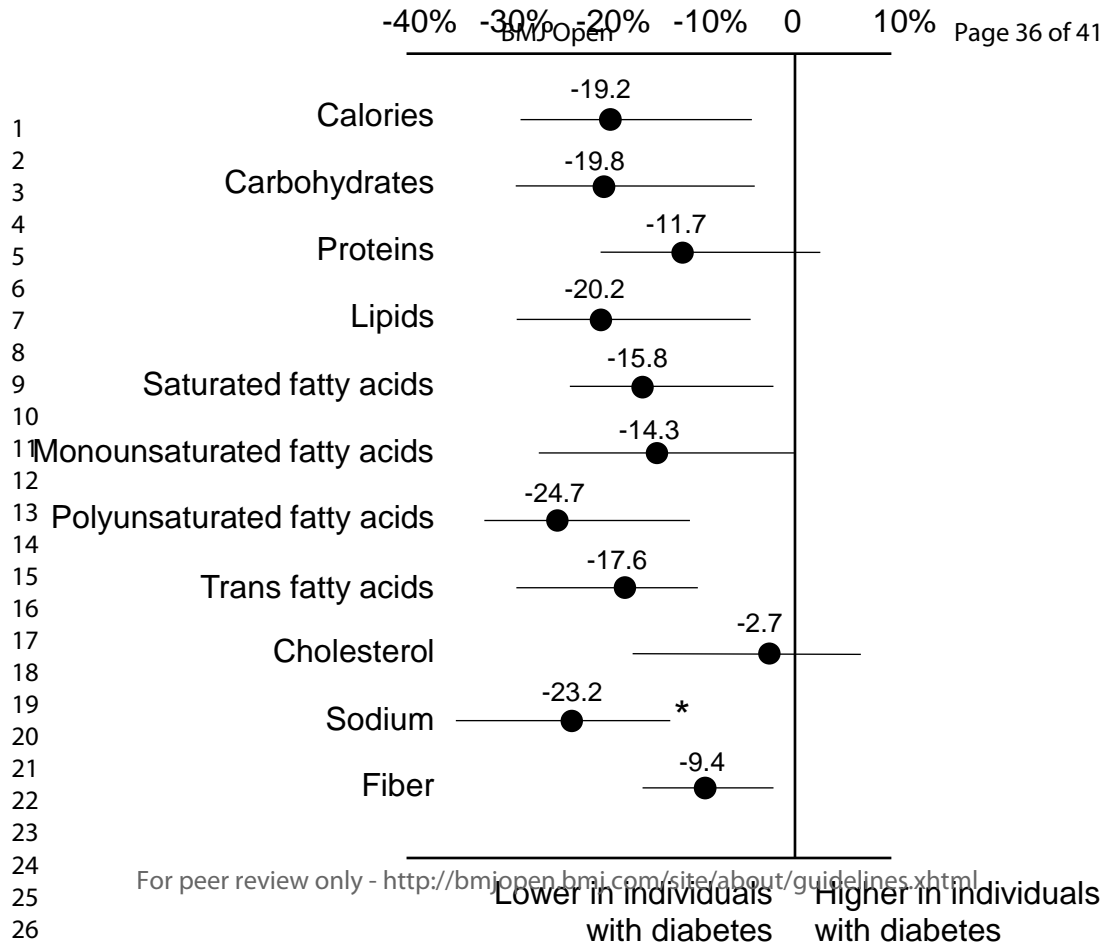


A



B



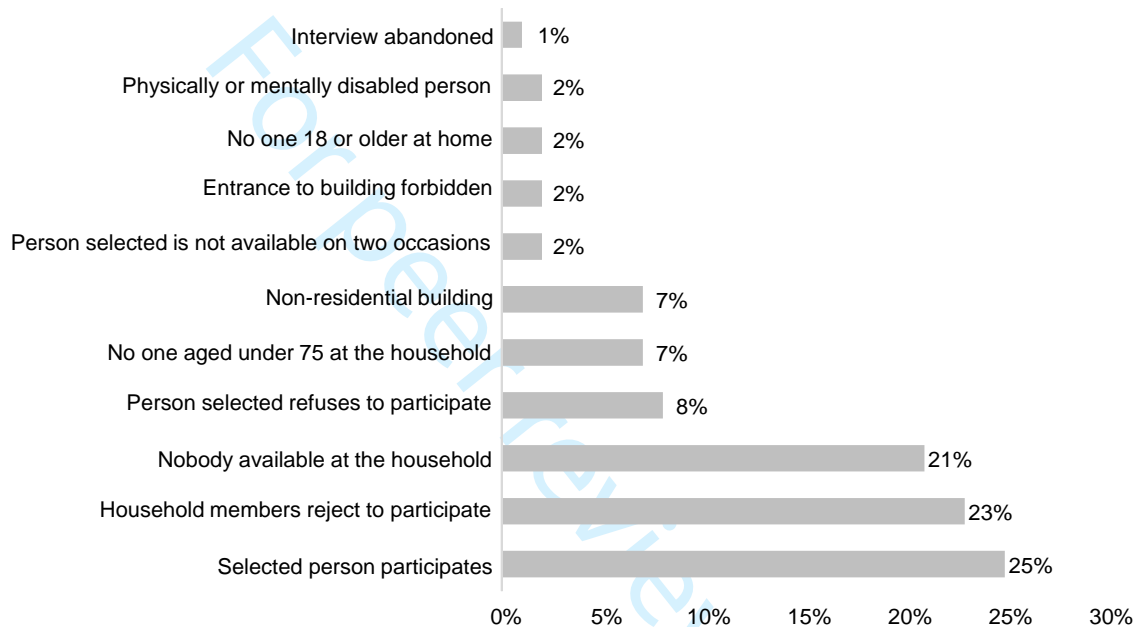


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**Dietary intake among urban adults with diabetes:
COPEN (Colombian Nutritional Profiles), a cross-sectional study**

Supplementary Material

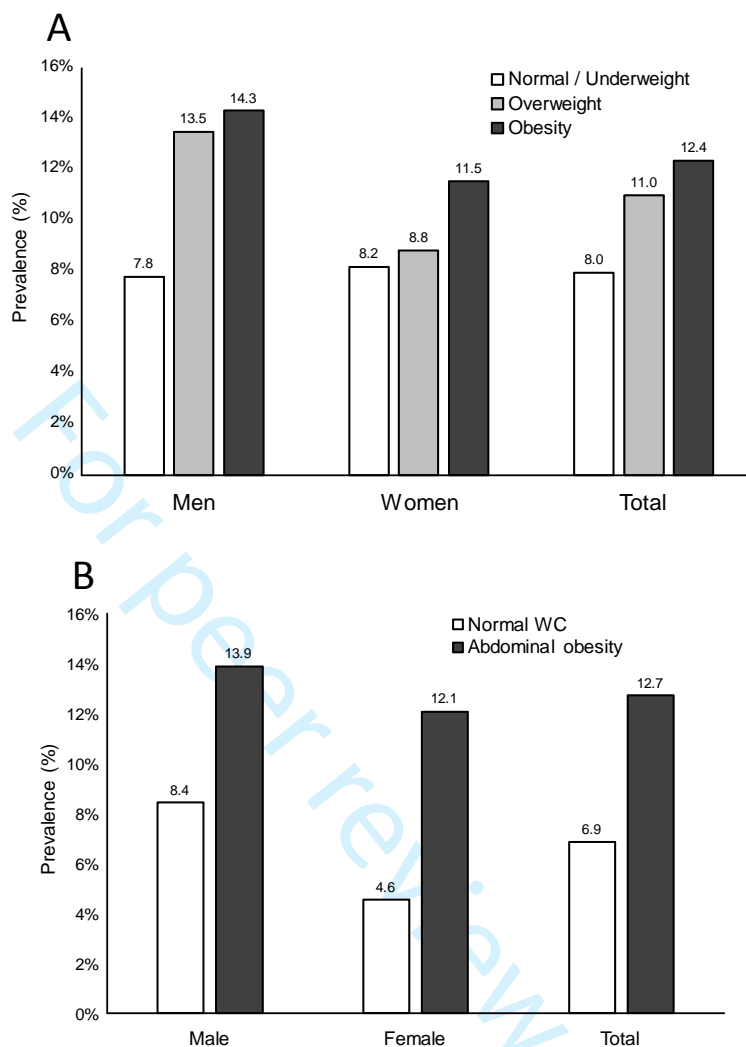
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



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

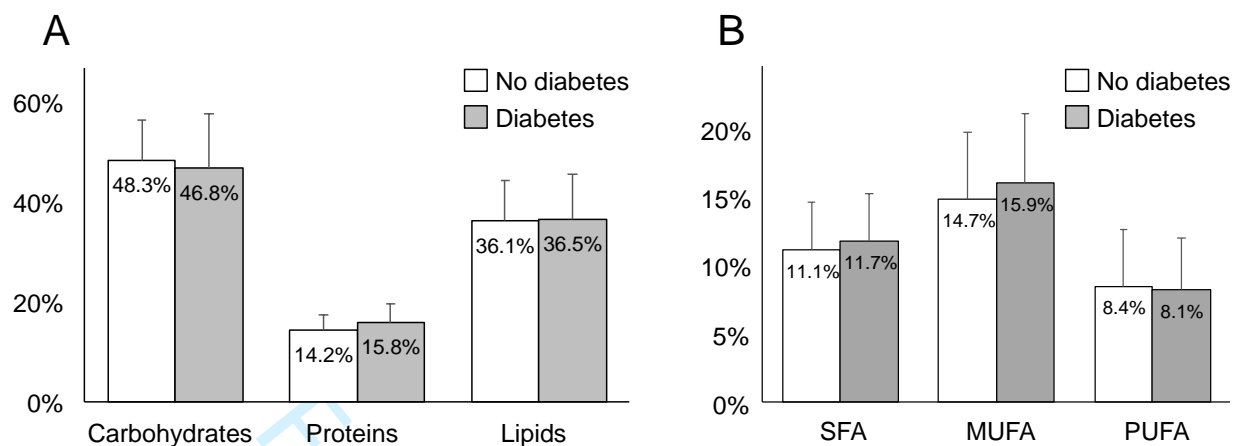
		Trans fat <1g/day	Sodium <2300 mg/day	Protein ≥15% of TCI	SFA <7% of TCI	MUFA ≥12% of TCI	Fiber ≥14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (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%)

12 Data are n (%).



13
14 **Supplemental Figure 2.** Prevalence of diabetes, by body-mass index (Panel A) and waist
15 circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than
16 18.5 Kg/m^2 , normal weight as a BMI between 18.5 and less than 25 Kg/m^2 , overweight as a BMI
17 between 25 and less than 30 Kg/m^2 , and obesity as a BMI of 30 or higher. Abdominal obesity was
18 defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data
19 are prevalences using sampling weights.

20



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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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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185 (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —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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32 ABSTRACT

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

36
37 **Setting:** The Colombian Study of Nutritional Profiles (COPEN) was a population-based, cross-
38 sectional, multi-stage probabilistic sampling survey designed to represent the five main Colombian
39 cities.

40
41 **Participants:** Between June and November 2018, we studied 736 non-pregnant participants aged
42 18 or older. Diabetes was defined as a random plasma glucose ≥ 200 mg/dL, self-reported prior
43 diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also
44 fulfilled a detailed 157-item food frequency questionnaire (FFQ).

45
46 **Primary and secondary outcome measures:** Prevalence of diabetes, dietary intake of key
47 nutrients, achievement of dietary goals among individuals with diabetes.

48
49 **Results:** The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6%
50 in women, 10.8% in men, $p=0.43$). The association between diabetes and education level depended
51 on sex, diabetes was more prevalent among more educated men and less educated women.
52 Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a
53 163% increase in women. Individuals with diabetes reported lower mean consumption of all
54 nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their
55 lower sodium consumption remained significant ($p=0.013$). The proportion of non-achievement
56 of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for
57 sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was
58 the strongest independent correlate of diabetes.

59 60 Conclusions

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

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3 63 SEL and educational level. The proportion of individuals with diabetes meeting dietary
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5 64 recommendations was alarmingly low.
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3 65 **Strengths and limitations of this study**
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5 66
6 67 - The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well
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8 68 as their relationship to key demographic factors.
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12 70 - The study had a population-based, probabilistic sample from five cities in Colombia.
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14 71
15 72 - Dietary intake was assessed with a food frequency questionnaire adapted to national and
16
17 73 regional dietary habits, and inquiring about usual behavior, rather than recent intake.
18

19 74
20 75 - Random plasma glucose and self-reported diabetes may underestimate the real diabetes
21
22 76 prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.
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24 77
25 78 - Our study did not include any participants from rural areas, whose diabetes prevalence and
26
27 79 associated diet may differ significantly from those of urban populations.
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29 80
30
31 81 **Data sharing statement**

32 82 The study dataset and its associated variable definitions file have been publicly deposited in the
33
34 83 dryad repository, they can be consulted under the following link:

35
36 84 <https://doi.org/10.5061/dryad.sqv9s4n2n>

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38 85 All questions about these data are welcome and should be directed to corresponding author.
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86 INTRODUCTION

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

92
93 In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5%
94 in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated
95 countries in the region, occupy respectively the fifth and sixth position in the ranking of countries
96 with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across
97 Latin American countries. Current data show that Puerto Rico and Mexico are the countries with
98 the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and
99 Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents
100 the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in
101 Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold
102 increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes
103 epidemic in Latin America (10).

104
105 It is expected that, over the coming decades, the largest increase in people with diabetes will occur
106 in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban
107 and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and
108 sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%),
109 lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

110
111 Colombia is a South American country of about 48 million inhabitants, in which no recent
112 population-based studies exploring the prevalence of diabetes or the comparative characteristics
113 of dietary intake among individuals with diabetes are available. In Colombia, the urbanization
114 phenomenon has been further complicated by the internal displacement of hundreds of thousands
115 of citizens as a result a protracted internal conflict that only came to an end in the recent years
116 (14). The estimated cost of diabetes in Colombia is the fourth largest in the region below Brazil,

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3 117 Mexico and Venezuela (9). The official sources of information about the burden of diabetes in
4
5 118 Colombia are not population-based studies, but claim databases like the High-Cost Account
6
7 119 (*Cuenta de Alto Costo - CAC*) (15), a registry kept by an association of Colombian health insurance
8
9 120 companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de*
10
11 121 *Protección Social - Integrated Social Protection Information System*) (www.sispro.gov.co), a
12
122 database that compiles all health services and procedures provided by the Colombian health system
13
14 123 (16). These sources are useful for planning the provision of health services, but they cannot provide
15
16 124 estimations of diabetes and its associated factors at the population level. For instance, the CAC
17
18 125 reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed
19
20 126 from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these
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22 127 official sources based on care provision do not register relevant lifestyle variables, so they do not
23
24 128 allow the exploration of dietary habits of people with diabetes in the general population. There
25
26 129 are, however, some sources of estimates for the population prevalence of diabetes, but they are
27
28 130 confined to a specific population group. Thus, the SABE (from the Spanish SALud, Bienestar y
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30 131 Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported
31
32 132 diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%)
33
34 133 was found in the SABE Bogotá survey of older adults in the country's capital (20).

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36 134
37 135 In Colombia, population-based surveys have demonstrated a notorious increase in both child and
38
39 136 adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and
40
41 137 other Latin-American countries, suggesting that the recent phenomena of mass urbanization,
42
43 138 westernization of dietary habits and adoption of sedentary behaviors are translating into a
44
45 139 demographic and nutrition transition in the whole region (22). These changes have
46
47 140 disproportionately affected more economically vulnerable segments of the population (23).

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49 141
50 142 In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained
51
52 143 increase in life expectancy that started in the second half of the 20th century, especially among
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54 144 women (24). The combination of these factors greatly favors the development of diabetes and other
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56 145 chronic diseases, hence the exploration of the current of diabetes and its associated dietary
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58 146 behaviors is of great importance.

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3 148 Dietary behavior is a crucial determinant of the degree of control and the development of chronic
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5 149 complications among individuals with diabetes. Dietary habits have a large impact on various
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7 150 parameters directly related to the risk of chronic complications, among them blood glucose levels,
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9 151 plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the
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11 152 dietary habits of this population is of the utmost importance to guide clinical strategies and public
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13 153 health policies aimed at persons with diabetes. Despite the multiple combinations of
14
15 154 macronutrients that may be adjusted to each person's requirements and cultural preferences, most
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17 155 guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes
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19 156 control, and prevention of chronic complications (26). These goals usually comprise the
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21 157 distribution of calories among the different macronutrients, the restriction of dietary trans fats,
22
23 158 sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected
24
25 159 that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given
26
27 160 the known association of diabetes with excess body weight and hence a net positive caloric
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29 161 balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.
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33 163 Colombia is a geographically, racially and culturally diverse country with marked differences
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35 164 among the five most populated regions: i. Central plateau (administrative and economic center of
36
37 165 the country), ii. Caribbean region, with culture and costumes similar to those of Caribbean nations,
38
39 166 iii. Pacific coast, a very industrialized region but also with high indexes of poverty and where most
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41 167 of the Afro-Colombian population resides, iv. Northwestern or "paisa" region, where there are
42
43 168 many local traditions and there is a larger degree of European and Jewish ancestry and v.
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45 169 Northeastern/Andean region, mostly cold, very mountainous and with a larger degree of
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47 170 indigenous ancestry. Given that 81% of the Colombian population lives currently in urban centers,
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49 171 we undertook a study in five cities, one from each region, in order to answer the following research
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51 172 question: What is the prevalence of diabetes by random plasma glucose, self-report or medication
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53 173 use in the main urban centers of Colombia, and how does the nutrient intake of these individuals
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55 174 compare to that of people without diabetes? An ancillary goal of the study was to explore to what
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57 175 extent do people with diabetes achieve the internationally recommended dietary goals for
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59 176 individuals with diabetes.
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177 Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we
178 expected to find a diabetes prevalence greater than that estimated from prior national surveys, but
179 still lower than that of the largest Latin American countries Brazil and Mexico.

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180 METHODS

181
182 COPEN (Estudio Colombiano de Perfiles Nutricionales – Colombian Study of Nutritional
183 Profiles) was a population-based, cross-sectional, multi-stage sampling survey designed to
184 represent five cities, one from each of Colombia's major regions: Bogotá (Central plateau),
185 Barranquilla (Caribbean region), Cali (Pacific region), Medellín (Northwest or "paisa" region) and
186 Bucaramanga (Northeast/Andean region). The sampling frame was obtained from the last census
187 of the Colombian population, cartography was obtained from the national geostatistical frame
188 developed by the Colombian National Department of Statistics (Departamento Administrativo
189 Nacional de Estadística - DANE) and data on socioeconomic level (SEL) came from the National
190 Superintendence of Public Services. In the first stage of sampling we selected cartographic sectors,
191 within sectors we selected blocks (on average 8 per cartographic sector), within blocks we selected
192 households, and within households we selected individual participants. Within each household,
193 individuals were randomly selected employing a Kish grid. The sample was stratified by city, sex,
194 age group and SEL. With this design and including the design effect, the complete study sample
195 yielded an overall sampling error of 2.2%. The sampling errors for each city were respectively:
196 Bogotá 4.0%, Medellín 5.0%, Cali 5.0%, Barranquilla 5.6% and Bucaramanga 6.8%. We excluded
197 foreigners living in Colombia, individuals in hemodialysis or peritoneal dialysis therapy and
198 persons with disabilities that precluded a reliable fulfillment of the study questionnaire. The
199 complete study for COPEN was 1942 individuals, from which a random subsample of 736 non-
200 pregnant participants aged 18 or older (representing 47.8% of all non-pregnant adults in COPEN)
201 participated in the analyses reported in this paper. This was mainly due to cost constraints that did
202 not allow us to perform blood tests in all 1942 COPEN participants. We selected individuals living
203 in the household, regardless of whether they were family members or working at the household.
204 We performed at least two attempts to interview the selected adult. If the individual selected was
205 still not present or declined to participate, he/she was replaced by someone from the same sampling
206 stratum in a different household.

207
208 Information was captured using a tablet device containing digital forms with proper validation
209 rules, developed for the study. All staff in charge of data collection was extensively trained by the
210 study Principal Investigator. A random 10% of participants were re-contacted by phone in order

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3 211 to double-check the accuracy of the information provided on date of birth, sex, city of residence,
4 212 marital status, job status, educational level and date of initial contact. We confirmed data on date
5 213 of birth, sex, city of residence, SES, marital status job status, educational level and date of initial
6 214 contact. In all variables, we had over 95% concordance with the values originally reported. All
7 215 data were collected between June and November 2018. Supplemental Figure 1 summarizes the
8 216 scheme of participant recruitment for the study.
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15 218 **Respondents and Public Involvement**

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17 219 Respondents and the public were not involved in the design of the study, but aggregated results
18 220 will be presented to local and national authorities to inform public health policies concerning
19 221 nutrition and primary prevention of diabetes.
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23 223 **Measurements**

24 224 We collected information on sex, date of birth, SEL, marital status, educational level and
25 225 employment status using a standardized questionnaire. Since diabetes incidence rises sharply at
26 226 age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three
27 227 groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one
28 228 registered in DANE for that particular block. After a brief introduction about the importance of
29 229 the accuracy of the measurements to be performed, we measured height and weight in all
30 230 participants, and waist circumference in participants aged 18 and older. Height was measured using
31 231 a portable stadiometer supported on a firm surface, taking care that the participant was barefoot,
32 232 standing right and with heels and calves touching the stadiometer. Weight was measured in a solar
33 233 digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated
34 234 simultaneously the day before the study start, and every week afterwards. Waist circumference
35 235 was measured by a sitting observer, directly over the participant's skin, at the midpoint between
36 236 the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All
37 237 measurements were performed in duplicate, and if there was a between-measures discrepancy
38 238 greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement
39 239 was collected. For analyses we used the average of each anthropometric measure.
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241 Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata
242 according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being
243 the highest) (28). Residential dwellings are classified according to their physical characteristics
244 and environment. The methodology for this classification creates homogeneous strata taking as
245 input information about land use, public utilities, access routes, topography, land valuation and
246 property characteristics. The stratification unit is the sub-zone, corresponding generally to a block.
247 Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their
248 characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise,
249 they are considered outliers and their stratum is assessed based on their particular characteristics.
250 This information is very well established, updated and freely accessible for all the country. Given
251 that sociodemographic, income and human development indicators are more similar for
252 individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups,
253 corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was
254 classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced.
255 Educational level was analyzed as the highest completed level in three categories: i. Elementary
256 or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according
257 to the cut points proposed by the World Health Organization (WHO): Underweight ($BMI < 18.5$
258 Kg/m^2), normal weight ($BMI \geq 18.5$ and < 25 Kg/m^2), overweight ($BMI \geq 25$ and < 30 Kg/m^2)
259 and obesity ($BMI \geq 30$ Kg/m^2). We defined abdominal obesity as a waist circumference ≥ 90 cm
260 for women, and ≥ 94 cm for men, according to the proposed cutoffs for Latin American adults
261 (29).

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

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

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3 272 dietary recalls, a shorter version of the FFQ showed a percent of classification in the same quartile
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5 273 of nutrient intake between 61 and 83%, and Pearson correlation coefficients between 0.51 for
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7 274 protein and 0.77 for carbohydrate (32). Portion sizes were established according to the reference
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9 275 unit most frequently consumed for each food. There were 9 possible ingestion frequencies: i.
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11 276 Never, ii. One to three times/month, iii. At least once/week, iv. Two to four times/week, v. Five to
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13 277 six times/week; vi. Once a day, vii. Two to three times a day, viii. Four to five times a day and ix.
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15 278 Six or more times a day. Participants were asked to make their selections based on their usual
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17 279 intake over the last year. FFQs were individually administered by study staff. The nutrient
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19 280 contribution of each food was calculated according to composition tables by the Colombian
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21 281 Institute for Family Welfare (Instituto Colombiano de Bienestar Familiar - ICBF), the United
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23 282 States Department of Agriculture and manufacturer's information. We only had very general data
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25 283 on physical activity from the IPAQ (International Physical Activity Questionnaire), short form.
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27 284 This instrument has 7 questions on the frequency and duration of light, moderate or intense
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29 285 physical activity and approximate number of sitting hours (sedentary behavior), but we considered
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31 286 that the degree of detail in the variable did not allow for its use as a covariate for adjustment in our
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33 287 analyses. The COPEN protocol and COPEN field materials (in Spanish) are provided as
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35 288 Supplementary Material 1 and 2, respectively.

34 290 **Data analysis**

36 291 Prevalence of diabetes was estimated using sampling weights reflecting city, sex, age group and
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38 292 SEL-specific expansion factors according to the study multi-stage sampling design. We did not
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40 293 have any missing data points for sociodemographic factors, diabetes status and dietary intake
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42 294 variables. The overall diabetes prevalence, as well as the prevalence for men and women were age-
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44 295 adjusted using the WHO standard population as reference population (33). The univariate
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46 296 associations between nominal predictors and diabetes status were examined using chi-square
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48 297 independence tests. To test for a linear trend in the association between ordinal predictors and
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50 298 diabetes status, we report the p-value associated with a rank-correlation (Spearman) test between
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52 299 predictor and outcome. We also ran multivariable logistic models in which sex, age group, SEL
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54 300 and educational level were the independent variables and diabetes status was the outcome. We
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56 301 initially compared mean consumption of macronutrients and micronutrients of interest between
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58 302 individuals with or without diabetes using a one-way ANOVA, with diabetes as fixed factor. Since

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3 303 a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, linear
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5 304 regressions were used to estimate nutrient intakes in participants with or without diabetes adjusted
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7 305 for age, sex, BMI and SEL (one model per nutrient). We explored the achievement of dietary
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9 306 recommendations among individuals with diabetes, expressed as the percent of individuals with
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11 307 diabetes who met the protein ($\geq 15\%$ of total caloric intake [TCI]), saturated fat (SFA) ($< 7\%$ of
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13 308 TCI), monounsaturated fat (MUFA) ($\geq 12\%$ of TCI) and trans fat ($< 1\text{g/day}$) recommendations set
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15 309 by the by the Latin-American Diabetes Association (30) and the fiber (14 g per each 1,000
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17 310 Calories) and sodium ($< 2300\text{ mg/day}$) goals set by the American Diabetes Association (34). In
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19 311 order to explore factors associated with achievement of dietary goals, we also built a series of
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21 312 nested multivariable logistic models, in which achievement of each dietary goal was the outcome.
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23 313 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model
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25 314 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model
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27 315 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for
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29 316 Windows, v.21 (Cary, NC, USA).

317

318 **Ethical aspects**

319 All participants provided written informed consent. All study procedures were performed
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33 320 according to the principles of the Helsinki Declaration, and to local rules and regulations as
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35 321 provided by Resolution 8430 of 1993 of the Colombian Ministry of Health. The study was
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37 322 approved by the IRB of Universidad de los Andes (Comité de Ética de la Vicerrectoría de
38
39 323 Investigaciones), according to minute 1016 of April 27, 2018.

324 RESULTS

325
326 We studied 736 adults (45% men): 132 from Barranquilla, 250 from Bogotá, 86 from
327 Bucaramanga, 126 from Cali and 142 from Medellín. Mean age was 46.1 +/- 17.6 years, about a
328 third of participants were older than 60. Mean BMI was higher in women than men. There were
329 similar proportions of single and married participants, while widowed or divorced individuals were
330 the minority. There was approximately one third of the sample in each of the low, medium and
331 high SEL categories. Only a fifth of study participants had a college or higher degree, and about a
332 fifth had only elementary or lower education (Table 1).

333
334 **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)

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

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

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

348 The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%),
349 with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men;
350 $p=0.43$, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence
351 was highest in Medellín (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/-
352 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the
353 prevalence of diabetes increased monotonically with age in both men and women (p for the
354 difference among age groups and p -trend both <0.001). For age groups 18-39 and 40-59, men had
355 a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite
356 was true (Figure 1). The association between educational level and diabetes prevalence was
357 dependent on sex. Among men, prevalence went from 7.0% for those with elementary education
358 or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes
359 prevalence among women decreased steadily with higher education, going from 12.5% in the
360 elementary or lower education group, to 7.2% in the professional or higher educational level group
361 (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the
362 highest SEL almost doubled that of the lowest SEL (Figure 2, panel B) (p -value for the trend in
363 diabetes prevalence with increasing socioeconomic level=0.04.).

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

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3 370 abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental
4 371 Figure 2, panel B).

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8 373 Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower
9 374 consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake
10 375 was significantly lower for people with diabetes. This trend was observed for carbohydrates, total
11 376 lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and
12 377 fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2
13 378 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but
14 379 still much higher than the recommended limit of maximum 1g/day. Similarly, persons with
15 380 diabetes reported a significantly lower intake of sodium (3840+/-1913 mg/day *versus* 5330+/-2767
16 381 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that
17 382 did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).

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19 383
20 384 The macronutrient composition of the diet showed only small variations by diabetes status.
21 385 For individuals with and without diabetes, the proportions of TCI from each macronutrient were,
22 386 respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5%
23 387 *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant
24 388 (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight
25 389 differences according to diabetes status. The proportions of TCI coming from each type of fat in
26 390 individuals with *versus* without diabetes were, respectively: 11.7% *versus* 11.1% for SFA, 15.9%
27 391 *versus* 14.7% for MUFA and 8.1% *versus* 8.4% for PUFA (Supplemental Figure 3, panel B). The
28 392 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).

29 393
30 394 When assessing the compliance of self-reported nutrient intake with current guidelines, the
31 395 proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%.
32 396 Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats
33 397 (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).

34 398
35 399 The achievement of dietary goals was associated with demographic factors and with the
36 400 presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium

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3 401 (5.4% *versus* 11.4% in women) and fiber (8.5% *versus* 13.1% in women) recommendations.
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5 402 Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than
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7 403 their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium
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9 404 intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of
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11 405 the recommended amount of dietary fiber was particularly low in Medellín (4.2%). The proportion
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13 406 of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite
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15 407 the observed differences in mean nutrient intake between persons with or without diabetes, the
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17 408 degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0
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19 409 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).
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21 410
22 411 In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL
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24 412 and educational level as covariates, only age group ($p < 0.001$) and city of residence ($p = 0.019$) were
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26 413 significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI:
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28 414 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
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30 415 available upon request). Despite the notorious difference in diabetes prevalence between men and
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32 416 women depending on SEL and educational level, the respective interaction terms were not
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34 417 statistically significant ($p = 0.074$ for the sex*SEL interaction, $p = 0.24$ for the sex*educational level
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36 418 interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among
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38 419 men than women in the low SEL ($p = 0.035$).
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40 420

41 421 After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake
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43 422 between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7%
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45 423 for polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and
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47 424 body-mass index, however, only the lower consumption of sodium among individuals with
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49 425 diabetes retained statistical significance ($p = 0.013$).
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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 \pm SD.

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

448 **Table 3. Predictors of achievement of different dietary recommendations (goals) in**
 449 **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)

451 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables
452 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
453 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%

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3 485 in the same city (41). We found a comparable diabetes prevalence for most of the cities except for
4 486 Medellin, where we found a much larger figure. A population study undertaken in Medellin and
5 487 its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose
6 488 >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by
7 489 random plasma glucose >200 mg/dL or diabetes self-report, despite the different definition. By
8 490 comparison with results from both IDF and WHO estimates and from national studies, our results
9 491 seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further
10 492 studies are needed in order to identify potential genetic, demographic or cultural reasons for the
11 493 high prevalence of hyperglycemia in this region of the country.
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20 495 Worldwide, the prevalence and societal burden of diabetes have been increasing steadily
21 496 in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted
22 497 life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid
23 498 expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely
24 499 populated Asian countries (China and India) (44), but also by sustained prevalence increases in
25 500 developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019,
26 501 diabetes prevalence among adults in the North America and Caribbean region was estimated at
27 502 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease
28 503 Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly
29 504 place the prevalence of diabetes among urban adults from Colombia at a level close to that of
30 505 developed countries, and to that of Latin American countries traditionally leading diabetes
31 506 prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an
32 507 estimate of diabetes prevalence much more plausible and coherent with international projections
33 508 than data from existing national health surveys.
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46 510 The most important independent correlate of diabetes in our study was increasing age, as
47 511 has been described for most populations worldwide (43). Our study found an estimated prevalence
48 512 of diabetes among older adults remarkably close to that encountered in recent surveys from the
49 513 SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed
50 514 in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an
51 515 accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most
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3 516 part, the relationship between socioeconomic status and diabetes is consistent in high-income
4 517 countries: a lower position increases risk (46-49). Meanwhile, the magnitude and direction of this
5 518 association in middle- and low-income countries is conflicting across studies, perhaps due to
6 519 imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic
7 520 and nutritional transitions that affect them in ways different from what takes place in the developed
8 521 world (50-52). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be
9 522 explained at least partially by increased access to medical care and diabetes screening with higher
10 523 income (53).

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19 525 Prior studies had found an interaction between sex and educational level, so that more
20 526 educated women had a lower prevalence of diabetes. A large multi-national study reported
21 527 increasing odds of diabetes as education increased among men from middle-income countries. For
22 528 women, the association was flat or slightly negative (54). Other studies of the associations between
23 529 socioeconomic variables and diabetes have also found a different pattern according to sex (55,56).
24 530 Studies from Mexico (57) Argentina (58) and Brazil (59) have also documented higher rates of
25 531 obesity and diabetes among more educated males and less educated females. Many factors could
26 532 explain these results, but one that may apply to our context is a larger degree of body dissatisfaction
27 533 among women, that increases with higher education. A study in Bogotá showed that women with
28 534 higher education were more likely to identify thinner body silhouettes as their preferred ones (60).
29 535 Our results complement a body of evidence suggesting that education of women may be a tool in
30 536 the fight against the diabetes epidemic in developing countries.

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37 538 We were surprised to find a lower self-reported weight-adjusted intake of calories and all
38 539 macronutrients among persons with diabetes. An optimistic interpretation of this finding would be
39 540 that it shows good adherence to dietary recommendations. However, such interpretation should be
40 541 made with caution, as it is known that people with diabetes and obesity frequently underreport
41 542 their caloric intake (61).

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51 544 The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost
52 545 significance after multivariate adjustment, suggests that major sociodemographic factors (older
53 546 age) and a higher BMI are the main factors explaining a lower reported dietary intake in persons

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3 547 with diabetes. In any event, these differences did not result in increased odds of achieving dietary
4 548 recommended intakes of key nutrients, as only reaching the %TCI from protein was independently
5 549 associated with diabetes status.
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10 551 Despite reporting quantitatively less intake of most nutrients, the relative proportion of
11 552 macronutrients from each source in participants with diabetes was remarkably similar to that of
12 553 people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA
13 554 represented a comparable share of TCI regardless of diabetes status. This points out that
14 555 individuals with diabetes (many of whom know already know about of their diabetes status), are
15 556 not modifying their diets enough to intentionally increase the percent of Calories from MUFA, as
16 557 well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from
17 558 general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis,
18 559 which had descended to 11.9% by four years after diagnosis (62). This is still far from the
19 560 recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with
20 561 diabetes seems to be a ubiquitous problem.
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31 563 The intake of dietary fiber was equally concerning, in this case because of too little
32 564 consumption, a problem that was more evident in participants who were younger, male, or lived
33 565 in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich
34 566 in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose
35 567 by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes
36 568 a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful
37 569 cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is
38 570 restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at
39 571 high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We
40 572 found that only one in every five individuals with diabetes was achieving this goal, and the odds
41 573 of achieving it were significantly lower with younger age or higher SEL, probably in relation with
42 574 a higher consumption of processed, industrialized foods (64). TFA intake is an independent
43 575 predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in
44 576 order to limit their consumption both in the general population and among persons with diabetes.
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3 578 Our results bring out many areas of potential intervention for nutritional prevention, which
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5 579 are particularly relevant in our context. Nutritional education of people with diabetes in developing
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7 580 countries is an urgent measure with large potential benefits and minimal risks.
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10 582 Limitations of our study include the entirely urban sample, given the recent increase in
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12 583 obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the
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14 584 proportion of total population living in urban centers in Colombia is 77.1% (68), a result of
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16 585 accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic
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18 586 profile of the country (14). Another relevant limitation was the unavailability of oral glucose
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20 587 tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma
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22 588 glucose measurement and diabetes self-report, which may lead to underestimation of the true
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24 589 disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would
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26 590 have imposed great complexities on the logistics of the study. We acknowledge that the
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28 591 prevalences we report, high as they seem, are most likely an underestimation. Concerning the
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30 592 instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather
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32 593 than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible
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34 594 to modification by recent diet as food diaries. They do have the limitations of tending to
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36 595 overestimate total Caloric intake, and of having to be adjusted for different populations. However,
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38 596 the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries,
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40 597 which are seldom used in epidemiology. FFQs have been shown to successfully assess average
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42 598 dietary intake up to 4 years prior to their application (69). Finally, our study did not collect
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44 599 detailed information on lifestyle variables like smoking or physical activity, which may explain or
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46 600 correlate with the described dietary intakes.
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49 602 In summary, our results confirm a continued progression of the diabetes epidemic in
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51 603 Colombia, a middle-income country, and its relationship with demographic and socioeconomic
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53 604 factors. We also found remarkably low rates of achievement of key nutritional goals among
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55 605 individuals with diabetes, and identified factors associated with their achievement. Further
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57 606 research focused in rural areas is needed in order to build a complete the picture of evolution of
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59 607 the diabetes epidemic in the developing world.
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3 **885 Figure legends**

4 **886 Figure 1.** Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights.

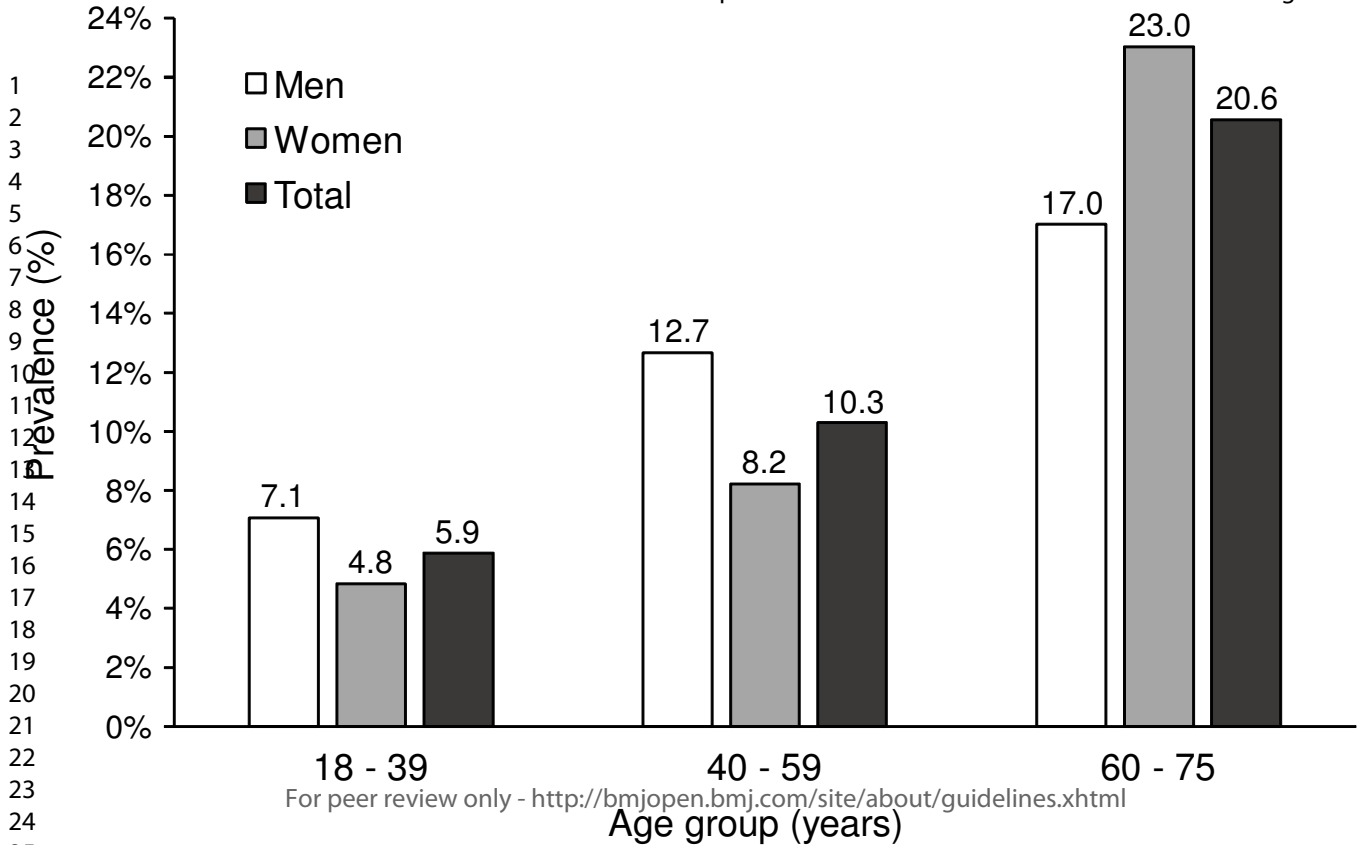
5 **887** P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in

6 **888** diabetes prevalence with increasing age group <0.001.
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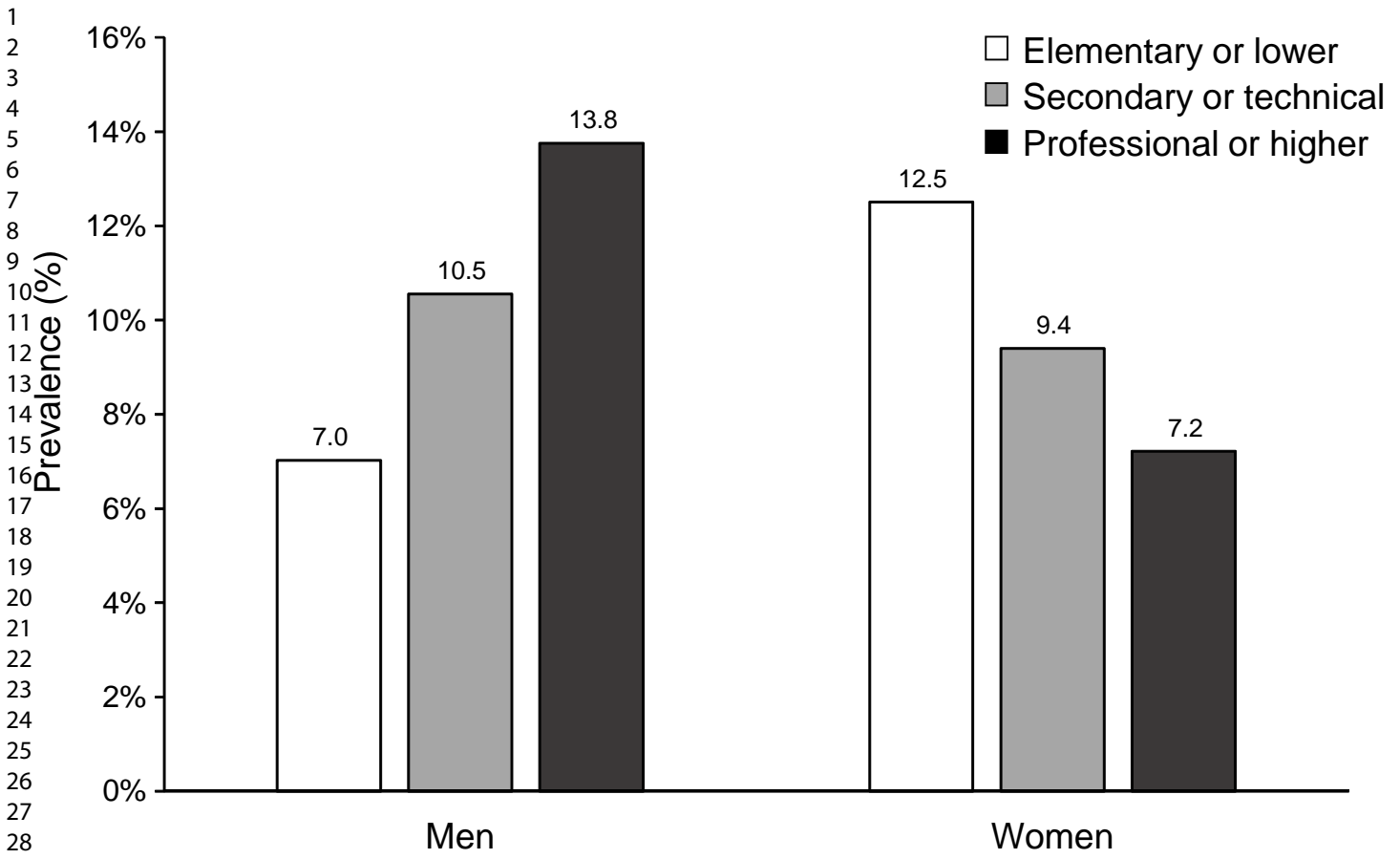
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3 889 **Figure 2.** Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel
4 890 B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL)
5 891 was classified according to Colombia's official Statistics Department-DANE stratification
6 892 scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL
7 893 includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall
8 894 difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in
9 895 diabetes prevalence with increasing socioeconomic level=0.04.
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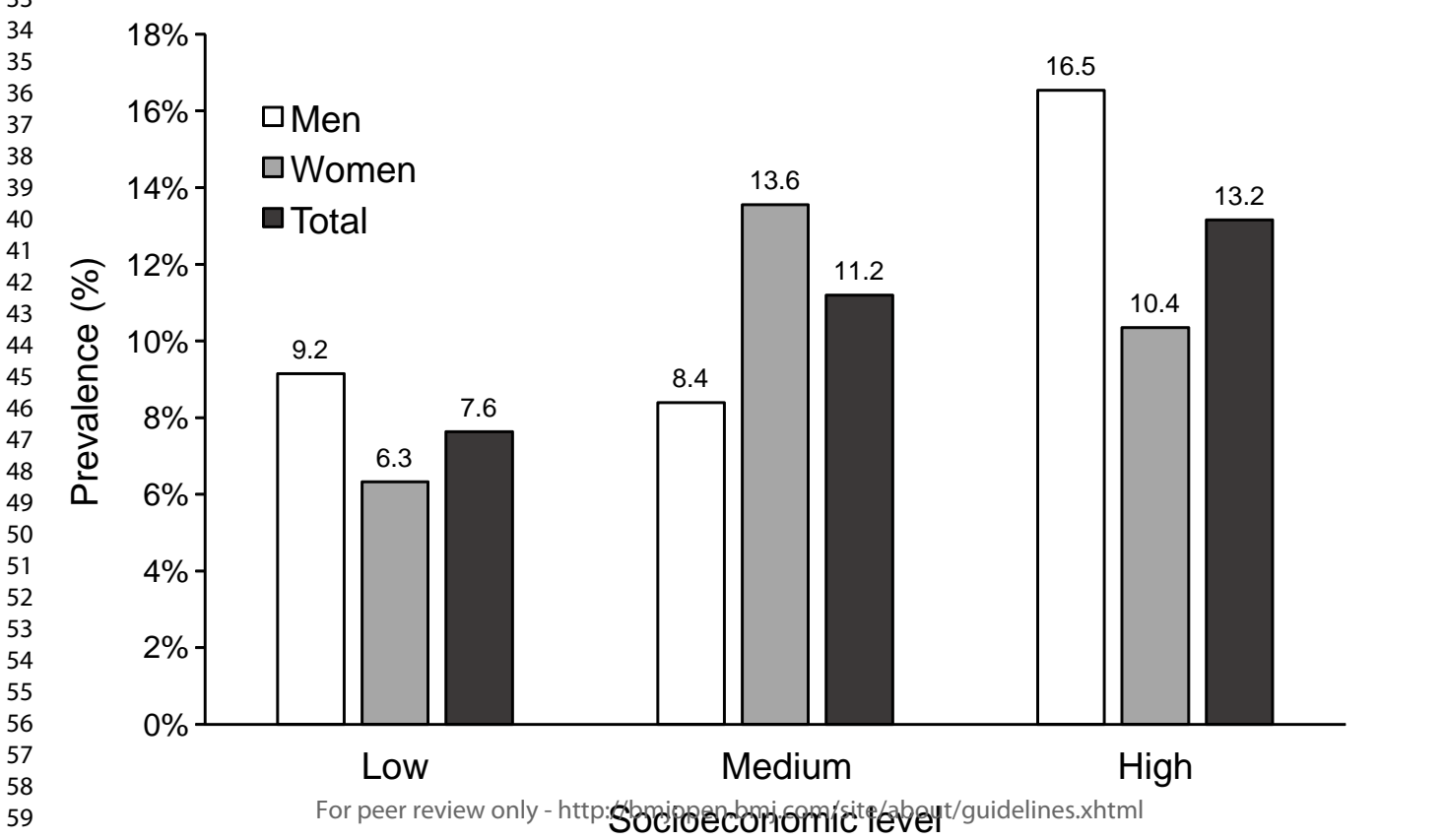
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3 896 **Figure 3.** Difference in adjusted nutrient intake (in g/d), between individuals with diabetes and
4 individuals without diabetes. Dots represent medians and lines represent Q1-Q4. Differences were
5 897
6 898 estimated using linear regressions including diabetes status, age, sex, BMI and SEL as predictors.
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8 899 *p=0.013 for the adjusted comparison of individuals with versus without diabetes.
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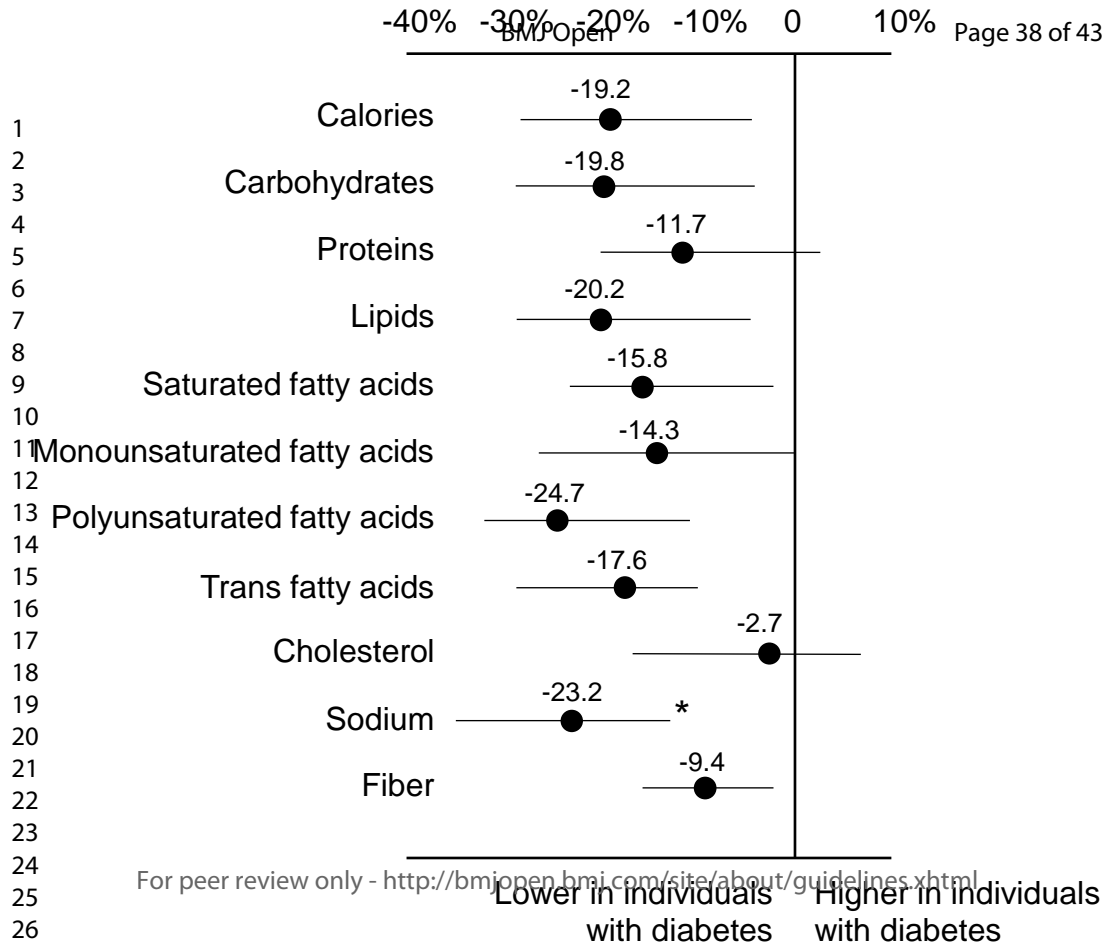


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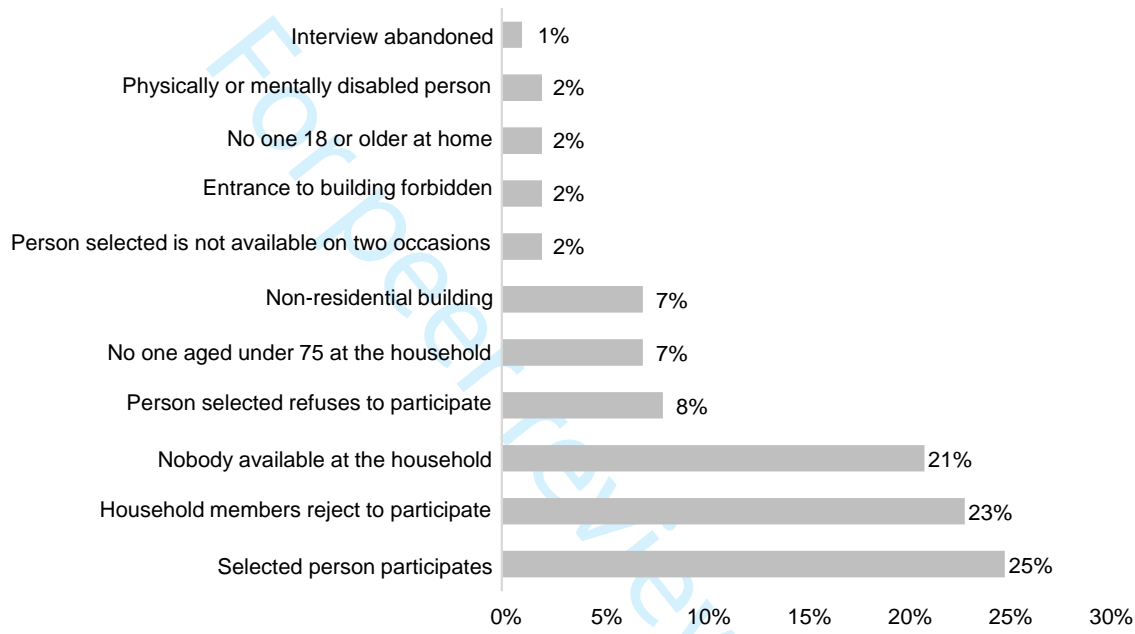




**Dietary intake among urban adults with diabetes:
COPEN (Colombian Nutritional Profiles), a cross-sectional study**

Supplementary Material

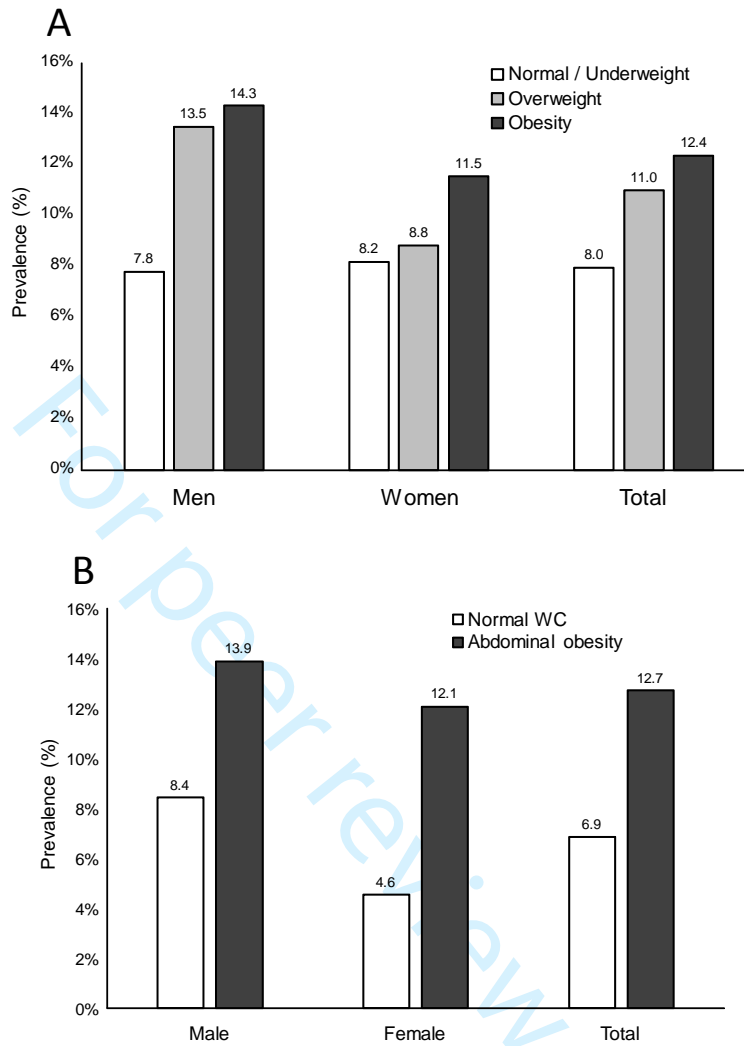
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



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

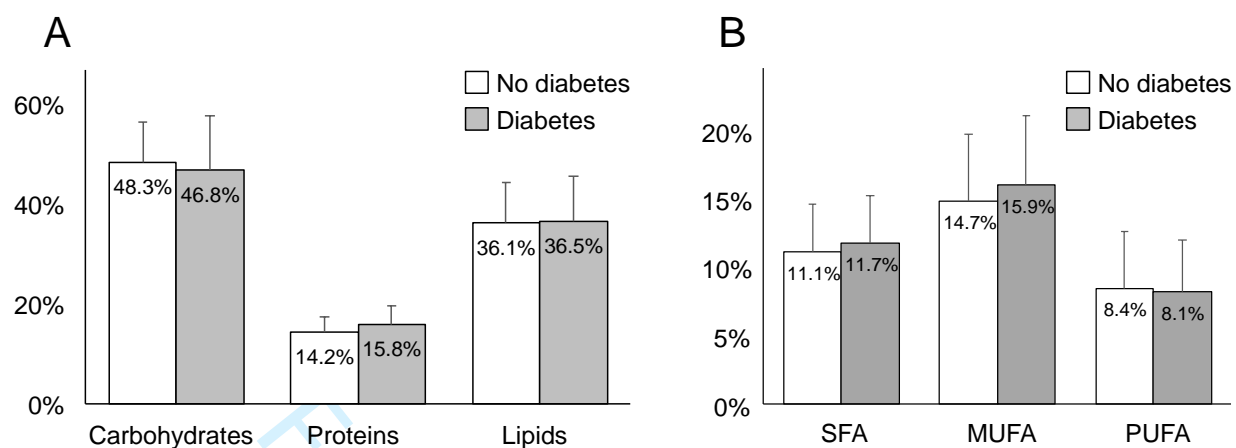
		Trans fat <1g/day	Sodium <2300 mg/day	Protein ≥15% of TCI	SFA <7% of TCI	MUFA ≥12% of TCI	Fiber ≥14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (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%)

12 Data are n (%).



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14 **Supplemental Figure 2.** Prevalence of diabetes, by body-mass index (Panel A) and waist
15 circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than
16 18.5 Kg/m^2 , normal weight as a BMI between 18.5 and less than 25 Kg/m^2 , overweight as a BMI
17 between 25 and less than 30 Kg/m^2 , and obesity as a BMI of 30 or higher. Abdominal obesity was
18 defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data
19 are prevalences using sampling weights.

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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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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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185 (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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](#)
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- (e) Describe any sensitivity analyses
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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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —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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Secondary Subject Heading:	Nutrition and metabolism, Public health
Keywords:	General diabetes < DIABETES & ENDOCRINOLOGY, PREVENTIVE MEDICINE, EPIDEMIOLOGY, NUTRITION & DIETETICS

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

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Contributorship statement: COM participated in study conception, supervised study activities, participated in its execution, data analysis and in manuscript writing. SAG participated in study execution, data analysis and manuscript writing, MJPJ participated in study execution, data analysis and manuscript writing, LDNV participated in study execution, data analysis and manuscript writing, AMR participated in study execution, data analysis and manuscript writing, ECBV participated in study conception, and participated in study execution, data analysis and in manuscript writing.

Competing Interest statement: This study was funded by Team Foods Colombia, but the sponsor had no direct influence in the study design, execution or analysis, or on the decision to publish.

32 ABSTRACT

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

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

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41 **Participants:** Between June and November 2018, we studied 736 non-pregnant participants aged
42 18 or older. Diabetes was defined as a random plasma glucose ≥ 200 mg/dL, self-reported prior
43 diagnosis of diabetes or use of any oral or injectable antidiabetic medication(s). Participants also
44 fulfilled a detailed 157-item food frequency questionnaire (FFQ).

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

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49 **Results:** The overall estimated prevalence of diabetes was 10.1%, with no difference by sex (9.6%
50 in women, 10.8% in men, $p=0.43$). The association between diabetes and education level depended
51 on sex, diabetes was more prevalent among more educated men and less educated women.
52 Abdominal obesity was associated with a 65% increase in diabetes prevalence among men, and a
53 163% increase in women. Individuals with diabetes reported lower mean consumption of all
54 nutrients, but after adjustment by sex, age, socioeconomic level and body-mass index, only their
55 lower sodium consumption remained significant ($p=0.013$). The proportion of non-achievement
56 of dietary intake goals among participants with diabetes was 94.4% for saturated fats, 86.7% for
57 sodium, 84.4% for fiber and 80% for trans fats. In multivariate logistic regression models, age was
58 the strongest independent correlate of diabetes.

59 60 Conclusions

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

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3 63 SEL and educational level. The proportion of individuals with diabetes meeting dietary
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5 64 recommendations was alarmingly low.
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3 **65 Strengths and limitations of this study**
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5 66
6 67 - The study explored the prevalence of diabetes and its associated dietary nutrient intake, as well
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8 68 as their relationship to key demographic factors.
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12 70 - The study had a population-based, probabilistic sample from five cities in Colombia.
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14 71
15 72 - Dietary intake was assessed with a food frequency questionnaire adapted to national and
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17 73 regional dietary habits, and inquiring about usual behavior, rather than recent intake.
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19 74
20 75 - Random plasma glucose and self-reported diabetes may underestimate the real diabetes
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22 76 prevalence compared to oral glucose tolerance tests or glycated hemoglobin measurement.
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25 78 - Our study did not include any participants from rural areas, whose diabetes prevalence and
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27 79 associated diet may differ significantly from those of urban populations.
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31 **81 Data sharing statement**

32 82 The study dataset and its associated variable definitions file have been publicly deposited in the
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34 83 dryad repository, they can be consulted under the following link:

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36 84 <https://doi.org/10.5061/dryad.sqv9s4n2n>
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38 85 All questions about these data are welcome and should be directed to corresponding author.
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86 INTRODUCTION

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

92
93 In South and Central America, the age-adjusted prevalence of diabetes has been estimated at 8.5%
94 in 2019 and is expected to advance to 9.9% by 2045 (2,3). Brazil and Mexico, the most populated
95 countries in the region, occupy respectively the fifth and sixth position in the ranking of countries
96 with the most people with diabetes worldwide (2). The prevalence of diabetes varies widely across
97 Latin American countries. Current data show that Puerto Rico and Mexico are the countries with
98 the highest prevalence in the region (13.7% and 13.5% respectively), while Ecuador (5.5%) and
99 Argentina (5.9%) have the lowest (1, 4-8). Latin America is the region where diabetes represents
100 the largest proportion of total health expenditure (around 20% of total) (2). The cost of diabetes in
101 Latin America and the Caribbean in 2015 was estimated at 103-142 billion dollars, a 6 to 7-fold
102 increase relative to 2000 (9). Rapid urbanization and aging are the two main drivers of the diabetes
103 epidemic in Latin America (10).

104
105 It is expected that, over the coming decades, the largest increase in people with diabetes will occur
106 in countries experimenting the low to middle-income transition (1,11, 12). The Prospective Urban
107 and Rural Epidemiology (PURE) study found that lower-income countries had the highest age and
108 sex-adjusted prevalence of diabetes (average 12.3%), followed by upper-middle (average 11.1%),
109 lower-middle (average 8.7%) and high income countries (average 6.6%) (13).

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

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3 117 Mexico and Venezuela (9). The official sources of information about the burden of diabetes in
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5 118 Colombia are not population-based studies, but claim databases like the High-Cost Account
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7 119 (*Cuenta de Alto Costo - CAC*) (15), a registry kept by an association of Colombian health insurance
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9 120 companies. Another frequently cited source is SISPRO (*Sistema Integrado de Información de*
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11 121 *Protección Social - Integrated Social Protection Information System*) (www.sispro.gov.co), a
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122 database that compiles all health services and procedures provided by the Colombian health system
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14 123 (16). These sources are useful for planning the provision of health services, but they cannot provide
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16 124 estimations of diabetes and its associated factors at the population level. For instance, the CAC
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18 125 reported a diabetes prevalence of 2.2% between July 2016 and June 2017, a figure far removed
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20 126 from all worldwide data in similar countries and from IDF projections (2,5,17,18). Similarly, these
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22 127 official sources based on care provision do not register relevant lifestyle variables, so they do not
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24 128 allow the exploration of dietary habits of people with diabetes in the general population. There
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26 129 are, however, some sources of estimates for the population prevalence of diabetes, but they are
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28 130 confined to a specific population group. Thus, the SABE (from the Spanish SALud, Bienestar y
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30 131 Envejecimiento – Health, well-being and ageing) Colombia study found a rate of self-reported
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32 132 diabetes of 18.5% among adults aged over the age of 60 in 2015 (19). A similar prevalence (17.5%)
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34 133 was found in the SABE Bogotá survey of older adults in the country's capital (20).

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37 135 In Colombia, population-based surveys have demonstrated a notorious increase in both child and
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39 136 adult obesity over the last two decades (21). Such increases parallel those observed in Mexico and
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41 137 other Latin-American countries, suggesting that the recent phenomena of mass urbanization,
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43 138 westernization of dietary habits and adoption of sedentary behaviors are translating into a
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45 139 demographic and nutrition transition in the whole region (22). These changes have
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47 140 disproportionately affected more economically vulnerable segments of the population (23).

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50 142 In addition to the recent rise in obesity, Colombia has also experienced a slow but sustained
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52 143 increase in life expectancy that started in the second half of the 20th century, especially among
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54 144 women (24). The combination of these factors greatly favors the development of diabetes and other
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56 145 chronic diseases, hence the exploration of the current of diabetes and its associated dietary
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58 146 behaviors is of great importance.

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3 148 Dietary behavior is a crucial determinant of the degree of control and the development of chronic
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5 149 complications among individuals with diabetes. Dietary habits have a large impact on various
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7 150 parameters directly related to the risk of chronic complications, among them blood glucose levels,
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9 151 plasma lipids and blood pressure (25). Hence, the adequate documentation and exploration of the
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11 152 dietary habits of this population is of the utmost importance to guide clinical strategies and public
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13 153 health policies aimed at persons with diabetes. Despite the multiple combinations of
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15 154 macronutrients that may be adjusted to each person's requirements and cultural preferences, most
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17 155 guidelines agree on a few universal goals whose attainment predicts a larger probability of diabetes
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19 156 control, and prevention of chronic complications (26). These goals usually comprise the
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21 157 distribution of calories among the different macronutrients, the restriction of dietary trans fats,
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23 158 sodium and cholesterol, and the provision of an adequate amount of dietary fiber. We expected
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25 159 that most persons with diabetes would attain these dietary goals in Colombian cities. Also, given
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27 160 the known association of diabetes with excess body weight and hence a net positive caloric
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29 161 balance, we expected caloric and nutrient intake to be higher among individuals with diabetes.
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33 163 Among the Latin American nations, Colombia is characterized by a high degree of geographical,
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35 164 racial and cultural diversity, with five clearly defined regions: i. The urban central plateau, where
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37 165 the capital city of Bogota is located, ii. The northern Caribbean region, very similar to countries
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39 166 like Cuba or the Dominican Republic, iii. The Pacific coast, with major agricultural and industrial
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41 167 development but also with widespread poverty and a high proportion of Afro-Colombian
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43 168 population, iv. The northwestern or "paisa" region, with a higher Caucasian ancestry and a
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45 169 generally traditionalist population and v. The northeastern/Andean region, very mountainous and
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47 170 with extensive native Colombian ancestry. Given that 81% of the Colombian population lives
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49 171 currently in urban centers, we undertook a study in five cities, one from each region, in order to
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51 172 answer the following research question: What is the prevalence of diabetes by random plasma
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53 173 glucose, self-report or medication use in the main urban centers of Colombia, and how does the
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55 174 nutrient intake of these individuals compare to that of people without diabetes? An ancillary goal
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57 175 of the study was to explore to what extent do people with diabetes achieve the internationally
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59 176 recommended dietary goals for individuals with diabetes.
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3 177 Given the recent rise in obesity rates, rapid urbanization and increased life expectancy, we
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5 178 expected to find a diabetes prevalence greater than that estimated from prior national surveys, but
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7 179 still lower than that of the largest Latin American countries Brazil and Mexico.
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180 METHODS

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

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

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3 211 to double-check the accuracy of the information provided on date of birth, sex, city of residence,
4 212 marital status, job status, educational level and date of initial contact. We confirmed data on date
5 213 of birth, sex, city of residence, SES, marital status job status, educational level and date of initial
6 214 contact. In all variables, we had over 95% concordance with the values originally reported. All
7 215 data were collected between June and November 2018. Supplemental Figure 1 summarizes the
8 216 scheme of participant recruitment for the study.
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218 **Patients and public involvement**

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

224 We collected information on sex, date of birth, SEL, marital status, educational level and
225 employment status using a standardized questionnaire. Since diabetes incidence rises sharply at
226 age 40 and peaks approximately at age 60 (27), age was operationalized for most analyses in three
227 groups: 18-39, 40-59 and 60-75 years. The SEL that we employed for analyses was the one
228 registered in DANE for that particular block. After a brief introduction about the importance of
229 the accuracy of the measurements to be performed, we measured height and weight in all
230 participants, and waist circumference in participants aged 18 and older. Height was measured using
231 a portable stadiometer supported on a firm surface, taking care that the participant was barefoot,
232 standing right and with heels and calves touching the stadiometer. Weight was measured in a solar
233 digital scale with 100g sensitivity and 200 Kg capacity, all study scales were calibrated
234 simultaneously the day before the study start, and every week afterwards. Waist circumference
235 was measured by a sitting observer, directly over the participant's skin, at the midpoint between
236 the las rib and the anterosuperior iliac crest, using a flexible metallic measuring tape. All
237 measurements were performed in duplicate, and if there was a between-measures discrepancy
238 greater than 1 cm for height, 100g for weight or 1 cm for waist circumference, a third measurement
239 was collected. For analyses we used the average of each anthropometric measure.
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241 Socioeconomic level is classified in Colombia by the Statistics Department DANE in 6 strata
242 according to characteristics of the residence (with stratum 1 being the lowest and stratum 6 being
243 the highest) (28). Residential dwellings are classified according to their physical characteristics
244 and environment. The methodology for this classification creates homogeneous strata taking as
245 input information about land use, public utilities, access routes, topography, land valuation and
246 property characteristics. The stratification unit is the sub-zone, corresponding generally to a block.
247 Residential dwellings are classified in the predominant stratum of the sub-zone, as long as their
248 characteristics do not differ ostensibly from the predominant conditions in the group. Otherwise,
249 they are considered outliers and their stratum is assessed based on their particular characteristics.
250 This information is very well established, updated and freely accessible for all the country. Given
251 that sociodemographic, income and human development indicators are more similar for
252 individuals living in strata 4 to 6 than among the other strata (28), we analyzed SEL in three groups,
253 corresponding to strata 1-2 (low SEL), 3 (medium SEL) and 4-6 (high SEL). Marital status was
254 classified in three categories: i. Single, ii. Married or in cohabitation and iii. Widowed or divorced.
255 Educational level was analyzed as the highest completed level in three categories: i. Elementary
256 or lower, ii. Secondary or technical and iii. Professional or higher. We interpreted BMI according
257 to the cut points proposed by the World Health Organization (WHO): Underweight (BMI<18.5
258 Kg/m²), normal weight (BMI ≥18.5 and <25 Kg/m²), overweight (BMI ≥25 and <30 Kg/m²)
259 and obesity (BMI ≥30 Kg/m²). We defined abdominal obesity as a waist circumference ≥ 90 cm
260 for women, and ≥ 94 cm for men, according to the proposed cutoffs for Latin American adults
261 (29).

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

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

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

289

290 **Data analysis**

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

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3 303 a higher BMI is associated with diabetes risk and also with a higher dietary nutrient intake, linear
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5 304 regressions were used to estimate nutrient intakes in participants with or without diabetes adjusted
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7 305 for age, sex, BMI and SEL (one model per nutrient). We explored the achievement of dietary
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9 306 recommendations among individuals with diabetes, expressed as the percent of individuals with
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11 307 diabetes who met the protein ($\geq 15\%$ of total caloric intake [TCI]), saturated fat (SFA) ($< 7\%$ of
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13 308 TCI), monounsaturated fat (MUFA) ($\geq 12\%$ of TCI) and trans fat ($< 1\text{g/day}$) recommendations set
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15 309 by the by the Latin-American Diabetes Association (30) and the fiber (14 g per each 1,000
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17 310 Calories) and sodium ($< 2300\text{ mg/day}$) goals set by the American Diabetes Association (34). In
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19 311 order to explore factors associated with achievement of dietary goals, we also built a series of
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21 312 nested multivariable logistic models, in which achievement of each dietary goal was the outcome.
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23 313 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model
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25 314 3 had all variables in model 2 plus city, model 4 had all variables in model 3 plus BMI, and model
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27 315 5 had all variables in model 4 plus diabetes status. All analyses were performed in SPSS for
28
29 316 Windows, v.21 (Cary, NC, USA).

317

318 **Ethical aspects**

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

324 RESULTS

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

333
 334 **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)

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

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

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

348 The overall estimated prevalence of diabetes was 10.1% +/- 3.2% (age-adjusted 9.44 +/- 3.0%),
349 with no significant difference between sexes (9.6% +/- 4.3% in women, 10.8% +/- 4.7% in men;
350 $p=0.43$, age-adjusted 9.5% +/- 4.1% in women, 9.2% +/- 4.0% in men) (Figure 1). The prevalence
351 was highest in Medellin (20.5% +/- 7.2%), followed by Cali (9.2% +/- 7.5%), Bogotá (8.1% +/-
352 5.3%), Barranquilla (8.0% +/- 7.9%) and Bucaramanga (7.4% +/- 9.9%). As expected, the
353 prevalence of diabetes increased monotonically with age in both men and women (p for the
354 difference among age groups and p -trend both <0.001). For age groups 18-39 and 40-59, men had
355 a numerically higher prevalence of diabetes than women, while in the 60-75 age group the opposite
356 was true (Figure 1). The association between educational level and diabetes prevalence was
357 dependent on sex. Among men, prevalence went from 7.0% for those with elementary education
358 or lower, to 13.8% for those with a professional or higher degree. On the other hand, diabetes
359 prevalence among women decreased steadily with higher education, going from 12.5% in the
360 elementary or lower education group, to 7.2% in the professional or higher educational level group
361 (Figure 2, panel A). Conversely, diabetes prevalence increased with SEL, so that prevalence in the
362 highest SEL almost doubled that of the lowest SEL (Figure 2, panel B) (p -value for the trend in
363 diabetes prevalence with increasing socioeconomic level=0.04.).

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

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3 370 abdominal obesity vs. without it was 65% in men and 163% (2.63-fold) in women (Supplemental
4 Figure 2, panel B).
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8 373 Unexpectedly, in analyses of dietary nutrient intake, people with diabetes reported a lower
9 consumption of virtually all the nutrients. Consequently, the mean reported daily caloric intake
10 374 was significantly lower for people with diabetes. This trend was observed for carbohydrates, total
11 375 lipids, protein, SFA, MUFA, and polyunsaturated fats (PUFA), trans fats, cholesterol, sodium and
12 376 fiber (Table 2). The mean daily consumption of trans fats by individuals with diabetes (2.0+/-1.2
13 377 g/day) was significantly lower than in individuals without diabetes (2.4+/-1.8 g/day, p=0.005), but
14 378 still much higher than the recommended limit of maximum 1g/day. Similarly, persons with
15 379 diabetes reported a significantly lower intake of sodium (3840+/-1913 mg/day *versus* 5330+/-2767
16 380 mg/day, p<0.001). People with diabetes showed a trend towards lower consumption of fiber, that
17 381 did not reach statistical significance (33.2+/-14.1 g/day *versus* 37.9+/-16.9 g/day, p=0.077).
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20 384 The macronutrient composition of the diet showed only small variations by diabetes status.
21 385 For individuals with and without diabetes, the proportions of TCI from each macronutrient were,
22 386 respectively: Carbohydrates 46.8% *versus* 48.3%, proteins 15.8% *versus* 14.2%, and lipids 36.5%
23 387 *versus* 36.1%. Only the slightly higher proportion of TCI from protein was statistically significant
24 388 (p<0.001) (Supplemental Figure 3, panel A). In terms of fat types, there were also very slight
25 389 differences according to diabetes status. The proportions of TCI coming from each type of fat in
26 390 individuals with *versus* without diabetes were, respectively: 11.7% *versus* 11.1% for SFA, 15.9%
27 391 *versus* 14.7% for MUFA and 8.1% *versus* 8.4% for PUFA (Supplemental Figure 3, panel B). The
28 392 1.8% higher TCI from MUFA in the diabetes group was statistically significant (p=0.031).
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31 395 When assessing the compliance of self-reported nutrient intake with current guidelines, the
32 396 proportion of people with diabetes not meeting the dietary goal for SFA was an alarming 94.4%.
33 397 Goal non-achievement was similarly high for sodium (86.7%), dietary fiber (84.4%) and trans fats
34 398 (80%). For protein and MUFA goals, these proportions were lower (45.6 and 16.7%, respectively).
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37 401 The achievement of dietary goals was associated with demographic factors and with the
38 402 presence of diabetes (Supplemental Table 1). Men were much less likely to achieve the sodium
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3 401 (5.4% *versus* 11.4% in women) and fiber (8.5% *versus* 13.1% in women) recommendations.
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5 402 Participants aged 18 to 39 were less likely to meet the trans fats and sodium recommendations than
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7 403 their older counterparts. Achievement of the trans fats goal was lowest in Bogotá, while for sodium
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9 404 intake the lowest degree of achievement was found in Barranquilla (only 3.8%). Consumption of
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11 405 the recommended amount of dietary fiber was particularly low in Medellín (4.2%). The proportion
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13 406 of people from a high SEL meeting the SFA recommendation was also very low (2.3%). Despite
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15 407 the observed differences in mean nutrient intake between persons with or without diabetes, the
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17 408 degree of goal achievement was only markedly different for sodium (13.3% in diabetes *versus* 8.0
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19 409 in no diabetes) and protein (54.4% in diabetes *versus* 36.4% in no diabetes).
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22 411 In a mutually adjusted logistical model that included sex, age, city of residence, BMI, SEL
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24 412 and educational level as covariates, only age group ($p < 0.001$) and city of residence ($p = 0.019$) were
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26 413 significant predictors of diabetes status. The ORs relative to age group 18-39 were 2.12 (95% CI:
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28 414 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
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30 415 available upon request). Despite the notorious difference in diabetes prevalence between men and
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32 416 women depending on SEL and educational level, the respective interaction terms were not
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34 417 statistically significant ($p = 0.074$ for the sex*SEL interaction, $p = 0.24$ for the sex*educational level
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36 418 interaction term). In this model, the adjusted prevalence of diabetes was significantly higher among
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38 419 men than women in the low SEL ($p = 0.035$).
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42 421 After adjusting for sex, age, SEL and BMI, the relative difference in nutrient intake
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44 422 between persons with versus without diabetes ranged between -2.7% for cholesterol and -24.7%
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46 423 for polyunsaturated fatty acids (Figure 3). After adjustment by sex, age, socioeconomic level and
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48 424 body-mass index, however, only the lower consumption of sodium among individuals with
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50 425 diabetes retained statistical significance ($p = 0.013$).
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3 **426 Table 2. Daily intake of macronutrients, cholesterol, sodium and fiber, by diabetes diagnosis.**

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5 **427** SFA: Saturated fatty acids, MUFA: Monounsaturated fatty acids, PUFA: Polyunsaturated fatty
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7 **428** acids. Data are means using sampling weights \pm SD.

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

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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.

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

451 Model 1 had as predictors only sex and age, model 2 had all variables in model 1 plus SEL, model 3 had all variables
452 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
453 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%

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3 485 in the same city (41). We found a comparable diabetes prevalence for most of the cities except for
4 486 Medellin, where we found a much larger figure. A population study undertaken in Medellin and
5 487 its suburbs in 2008-2010 (42) found a prevalence of high plasma glucose (fasting plasma glucose
6 488 >100 mg/dL or taking antidiabetic medication) of 19.8%, quite comparable to our 20.1% by
7 489 random plasma glucose >200 mg/dL or diabetes self-report, despite the different definition. By
8 490 comparison with results from both IDF and WHO estimates and from national studies, our results
9 491 seem to confirm a sizable increase in the prevalence of diabetes in Colombian cities. Further
10 492 studies are needed in order to identify potential genetic, demographic or cultural reasons for the
11 493 high prevalence of hyperglycemia in this region of the country.
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20 495 Worldwide, the prevalence and societal burden of diabetes have been increasing steadily
21 496 in recent years. Diabetes has moved from being the tenth most relevant cause of disability-adjusted
22 497 life years (DALYs) lost in 1990, to being the fourth in 2005, and the third in 2015 (43). The rapid
23 498 expansion of the diabetes epidemic is being driven mostly by small prevalence increases in largely
24 499 populated Asian countries (China and India) (44), but also by sustained prevalence increases in
25 500 developed countries in Europe and North America. According to the IDF Diabetes Atlas 2019,
26 501 diabetes prevalence among adults in the North America and Caribbean region was estimated at
27 502 13.3%, while in Europe it was 8.9% (36). The most recent estimate of the US Centers for Disease
28 503 Control places diabetes prevalence in the USA at 13.0% (45). Thus, our estimations worryingly
29 504 place the prevalence of diabetes among urban adults from Colombia at a level close to that of
30 505 developed countries, and to that of Latin American countries traditionally leading diabetes
31 506 prevalence statistics like Brazil (11.4%) and Mexico (15.1%) (36). Overall, our study led to an
32 507 estimate of diabetes prevalence much more plausible and coherent with international projections
33 508 than data from existing national health surveys.
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46 510 The most important independent correlate of diabetes in our study was increasing age, as
47 511 has been described for most populations worldwide (43). Our study found an estimated prevalence
48 512 of diabetes among older adults remarkably close to that encountered in recent surveys from the
49 513 SABE study (17.5% in SABE Bogotá, executed in 2012 (20); 18.5% in SABE Colombia, executed
50 514 in 2015 (19) and 20.6% in COPEN, executed in 2018). Thus, recent data support the idea of an
51 515 accelerated increase in the prevalence of diabetes among older adults in Colombia. For the most
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3 516 part, the relationship between socioeconomic status and diabetes is consistent in high-income
4 517 countries: a lower position increases risk (46-49). Meanwhile, the magnitude and direction of this
5 518 association in middle- and low-income countries is conflicting across studies, perhaps due to
6 519 imperfect data, to the use of different proxies for SEL, or to the rapid development of demographic
7 520 and nutritional transitions that affect them in ways different from what takes place in the developed
8 521 world (50-52). In Colombia, the higher prevalence of *diagnosed* diabetes with higher SEL may be
9 522 explained at least partially by increased access to medical care and diabetes screening with higher
10 523 income (53).

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12 525 Prior studies had found an interaction between sex and educational level, so that more
13 526 educated women had a lower prevalence of diabetes. A large multi-national study reported
14 527 increasing odds of diabetes as education increased among men from middle-income countries. For
15 528 women, the association was flat or slightly negative (54). Other studies of the associations between
16 529 socioeconomic variables and diabetes have also found a different pattern according to sex (55,56).
17 530 Studies from Mexico (57) Argentina (58) and Brazil (59) have also documented higher rates of
18 531 obesity and diabetes among more educated males and less educated females. Many factors could
19 532 explain these results, but one that may apply to our context is a larger degree of body dissatisfaction
20 533 among women, that increases with higher education. A study in Bogotá showed that women with
21 534 higher education were more likely to identify thinner body silhouettes as their preferred ones (60).
22 535 Our results complement a body of evidence suggesting that education of women may be a tool in
23 536 the fight against the diabetes epidemic in developing countries.

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25 538 We were surprised to find a lower self-reported weight-adjusted intake of calories and all
26 539 macronutrients among persons with diabetes. An optimistic interpretation of this finding would be
27 540 that it shows good adherence to dietary recommendations. However, such interpretation should be
28 541 made with caution, as it is known that people with diabetes and obesity frequently underreport
29 542 their caloric intake (61).

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31 544 The fact that the lower mean intake of all nutrients but sodium in people with diabetes lost
32 545 significance after multivariate adjustment, suggests that major sociodemographic factors (older
33 546 age) and a higher BMI are the main factors explaining a lower reported dietary intake in persons

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3 547 with diabetes. In any event, these differences did not result in increased odds of achieving dietary
4 548 recommended intakes of key nutrients, as only reaching the %TCI from protein was independently
5 549 associated with diabetes status.
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10 551 Despite reporting quantitatively less intake of most nutrients, the relative proportion of
11 552 macronutrients from each source in participants with diabetes was remarkably similar to that of
12 553 people without diabetes. This finding also applied to fat subtypes: SFA, MUFA and PUFA
13 554 represented a comparable share of TCI regardless of diabetes status. This points out that
14 555 individuals with diabetes (many of whom know already know about of their diabetes status), are
15 556 not modifying their diets enough to intentionally increase the percent of Calories from MUFA, as
16 557 well as reducing their intake of SFA and TFA. A survey of patients with type 2 diabetes from
17 558 general practices in the Netherlands found a 15% mean TCI from SFA at the moment of diagnosis,
18 559 which had descended to 11.9% by four years after diagnosis (62). This is still far from the
19 560 recommendation of <7% TCI from SFA. Thus, excessive consumption of SFA by people with
20 561 diabetes seems to be a ubiquitous problem.
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31 563 The intake of dietary fiber was equally concerning, in this case because of too little
32 564 consumption, a problem that was more evident in participants who were younger, male, or lived
33 565 in Medellin. A meta-analysis of randomized controlled trials concluded that diets with foods rich
34 566 in fiber up to 42.5 g/day reduced glycated hemoglobin by a mean 0.55% and fasting plasma glucose
35 567 by 9.9 mg/dL in persons with diabetes (63). Hence, a low consumption of dietary fiber constitutes
36 568 a lost opportunity for improving the health of persons with diabetes. Dietary TFA are a powerful
37 569 cardiovascular risk factor, even at intakes as low as 2% of TCI. For this reason, their intake is
38 570 restricted by most dietary guidelines to less than 1g/day, with special emphasis on populations at
39 571 high baseline risk for cardiovascular disease, like people with diabetes or older people (64). We
40 572 found that only one in every five individuals with diabetes was achieving this goal, and the odds
41 573 of achieving it were significantly lower with younger age or higher SEL, probably in relation with
42 574 a higher consumption of processed, industrialized foods (64). TFA intake is an independent
43 575 predictor of total and cardiovascular mortality (65), so extreme efforts should be put in place in
44 576 order to limit their consumption both in the general population and among persons with diabetes.
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3 578 Our results bring out many areas of potential intervention for nutritional prevention, which
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5 579 are particularly relevant in our context. Nutritional education of people with diabetes in developing
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7 580 countries is an urgent measure with large potential benefits and minimal risks.
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10 582 Limitations of our study include the entirely urban sample, given the recent increase in
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12 583 obesity in rural areas in the continent (66) and Colombia (67). It is important, however, that the
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14 584 proportion of total population living in urban centers in Colombia is 77.1% (68), a result of
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16 585 accelerated urbanization induced by years of internal conflict that has impacted the epidemiologic
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18 586 profile of the country (14). Another relevant limitation was the unavailability of oral glucose
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20 587 tolerance test (OGTT) data, so our ascertainment of diabetes status relied on random plasma
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22 588 glucose measurement and diabetes self-report, which may lead to underestimation of the true
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24 589 disease prevalence. OGTT is the most sensitive test for diabetes diagnosis but performing it would
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26 590 have imposed great complexities on the logistics of the study. We acknowledge that the
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28 591 prevalences we report, high as they seem, are most likely an underestimation. Concerning the
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30 592 instrument to measure dietary intake, FFQs have the advantage of inquiring about usual (rather
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32 593 than recent) intake, to be more comprehensive than 24-hour dietary recalls, and not as susceptible
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34 594 to modification by recent diet as food diaries. They do have the limitations of tending to
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36 595 overestimate total Caloric intake, and of having to be adjusted for different populations. However,
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38 596 the problems inherent to recall bias exist for all dietary assessment tools, except for food diaries,
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40 597 which are seldom used in epidemiology. FFQs have been shown to successfully assess average
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42 598 dietary intake up to 4 years prior to their application (69). Finally, our study did not collect
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44 599 detailed information on lifestyle variables like smoking or physical activity, which may explain or
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46 600 correlate with the described dietary intakes.
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49 602 In summary, our results confirm a continued progression of the diabetes epidemic in
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51 603 Colombia, a middle-income country, and its relationship with demographic and socioeconomic
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53 604 factors. We also found remarkably low rates of achievement of key nutritional goals among
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55 605 individuals with diabetes, and identified factors associated with their achievement. Further
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57 606 research focused in rural areas is needed in order to build a complete the picture of evolution of
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59 607 the diabetes epidemic in the developing world.
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3 **885 Figure legends**

4 **886 Figure 1.** Prevalence of diabetes, by age and sex. Data are prevalences using sampling weights.

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6 **887** P-value for the overall difference in prevalence among age groups <0.001. P-value for the trend in

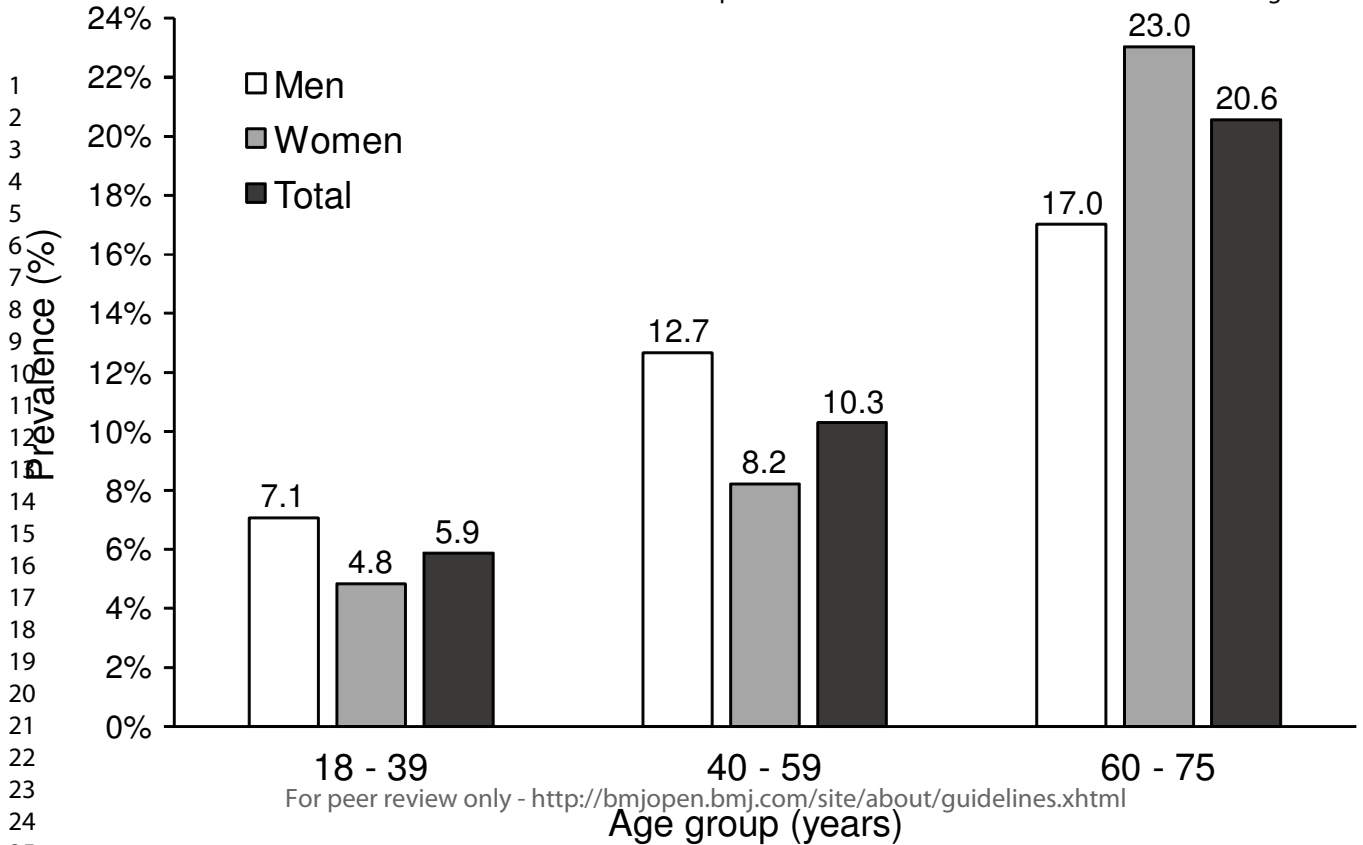
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8 **888** diabetes prevalence with increasing age group <0.001.
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3 889 **Figure 2.** Prevalence of diabetes, by educational level (Panel A) and socioeconomic level (Panel
4 890 B), and sex. Educational level refers to the highest level completed. Socioeconomic level (SEL)
5 891 was classified according to Colombia's official Statistics Department-DANE stratification
6 892 scheme. Low SEL includes strata 1 and 2, medium SEL includes only stratum 3, and high SEL
7 893 includes strata 4, 5 and 6. Data are prevalences using sampling weights. P-value for the overall
8 894 difference in diabetes prevalence among socioeconomic levels=0.11. P-value for the trend in
9 895 diabetes prevalence with increasing socioeconomic level=0.04.

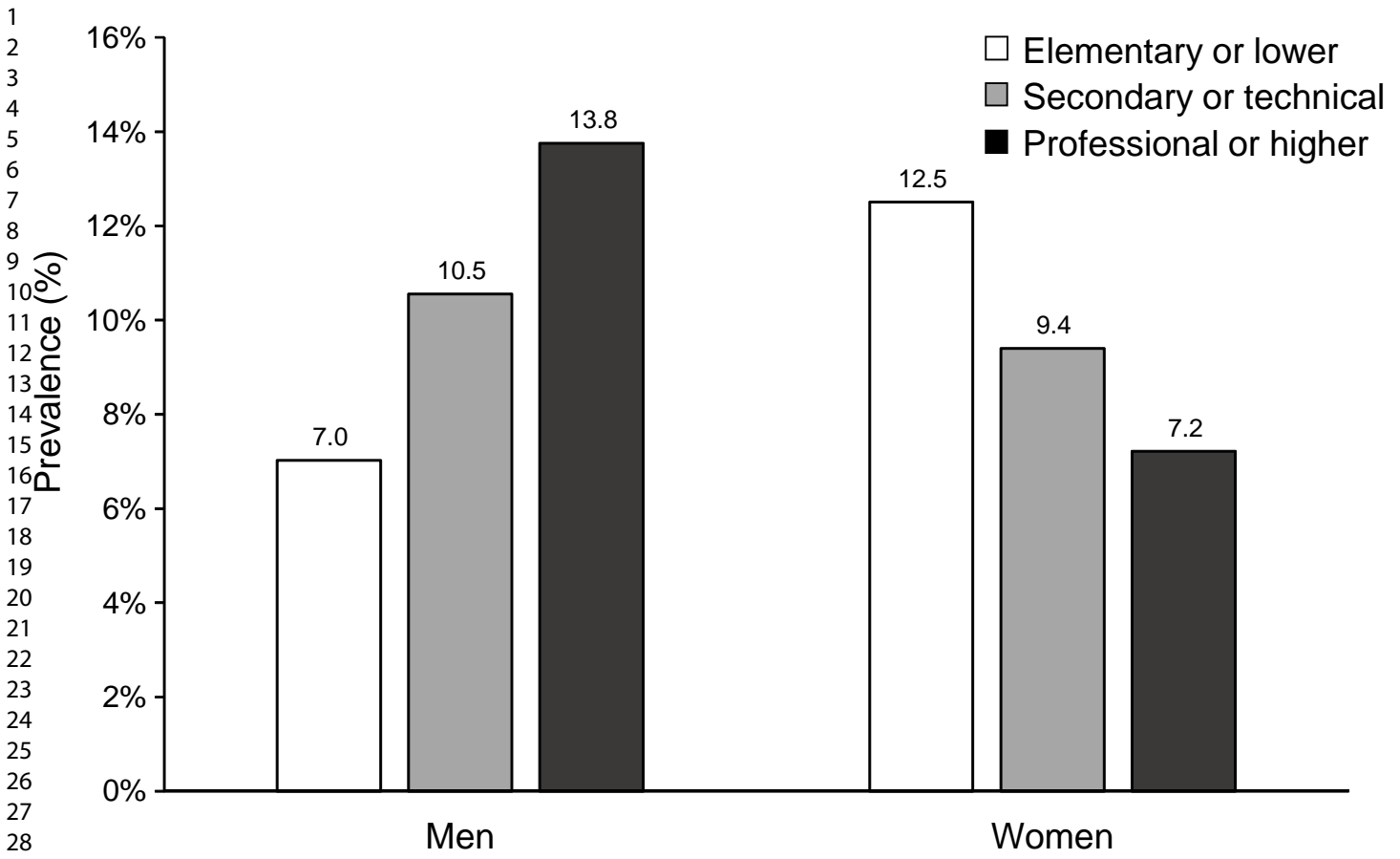
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3 896 **Figure 3.** Difference in adjusted nutrient intake (in g/d), between individuals with diabetes and
4 individuals without diabetes. Dots represent medians and lines represent Q1-Q4. Differences were
5 897
6 898 estimated using linear regressions including diabetes status, age, sex, BMI and SEL as predictors.
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8 899 *p=0.013 for the adjusted comparison of individuals with versus without diabetes.
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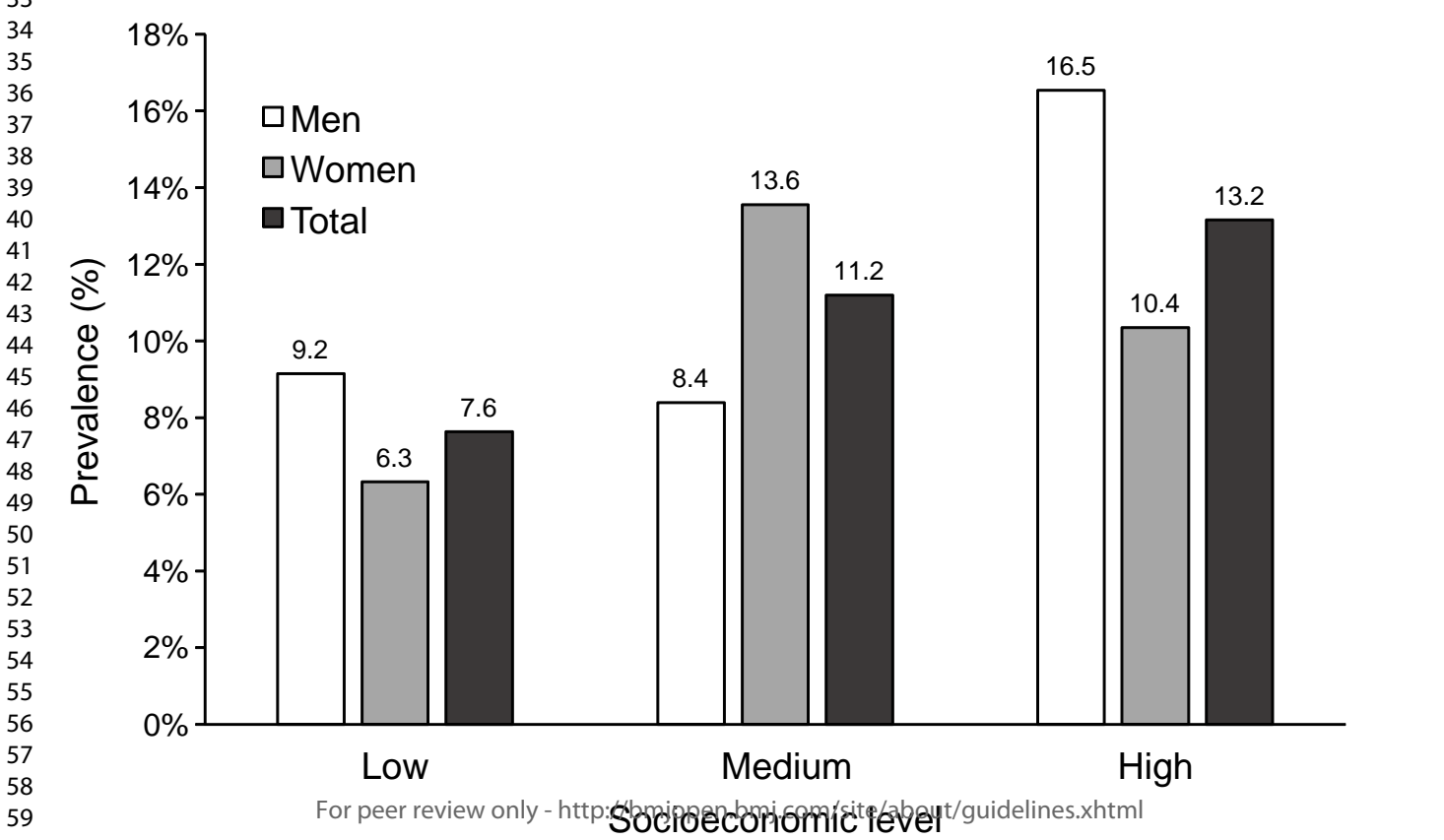
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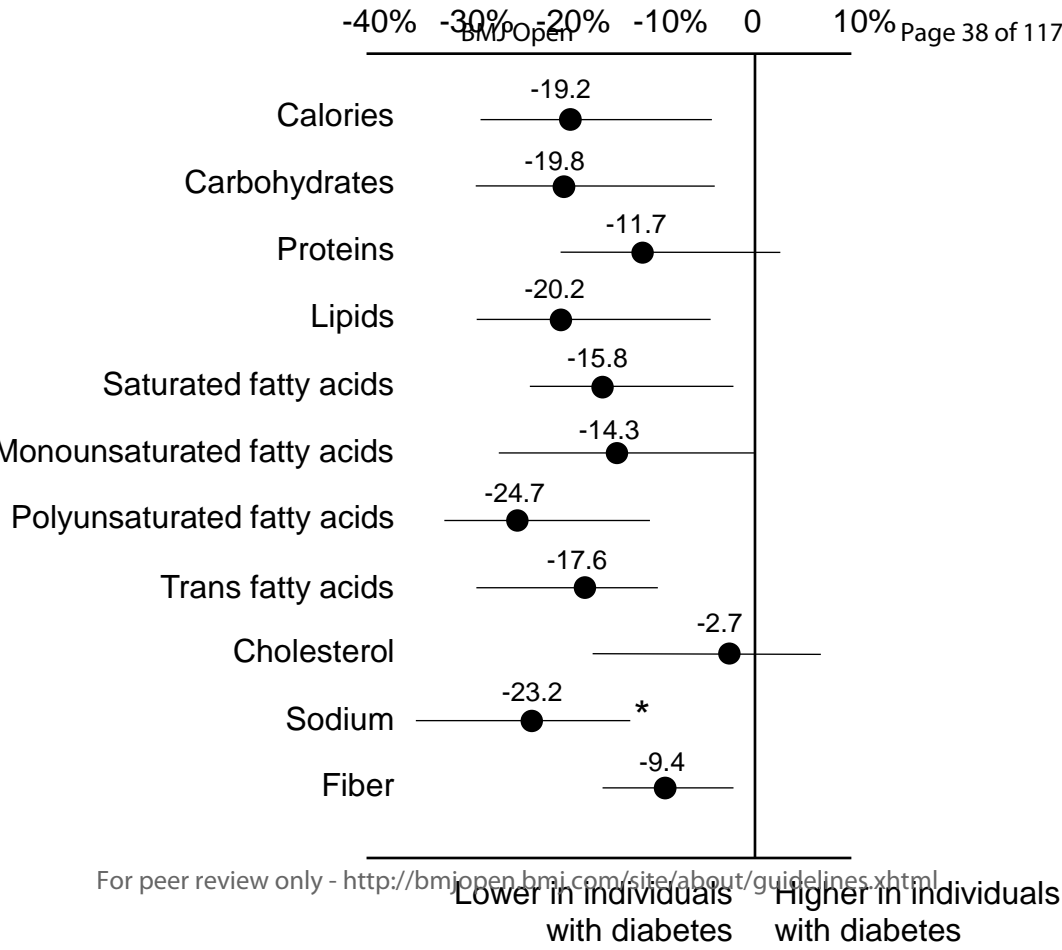
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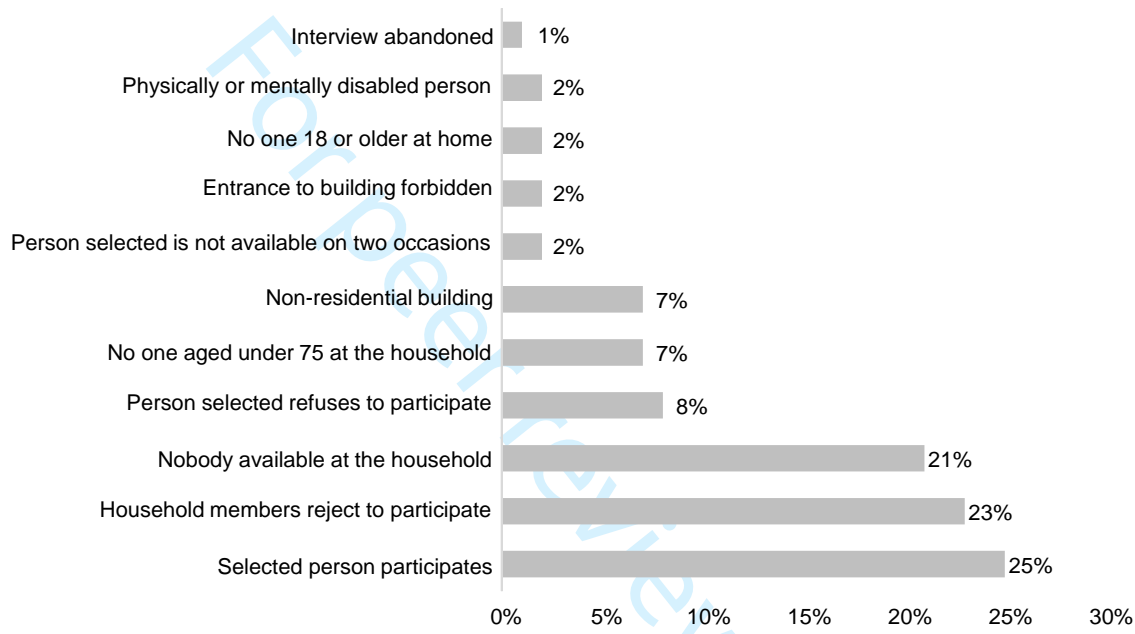
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**Dietary intake among urban adults with diabetes:
COPEN (Colombian Nutritional Profiles), a cross-sectional study**

Supplementary Material

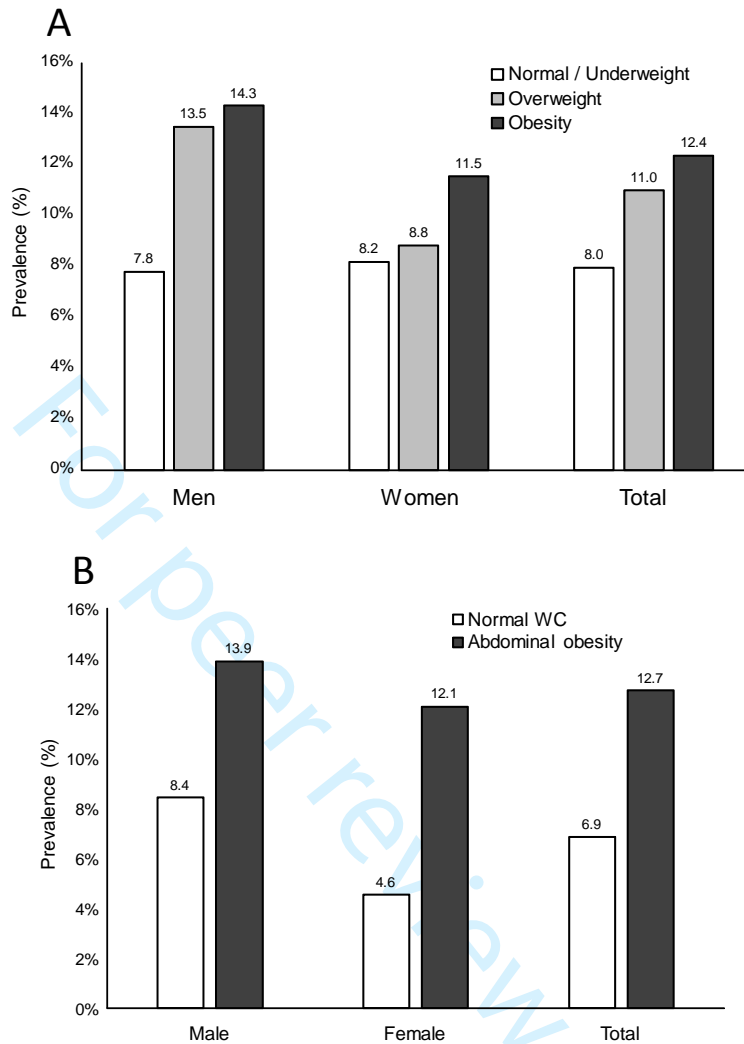
Supplemental Figure 1. Results of 7640 contacts for recruitment of study participants.



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

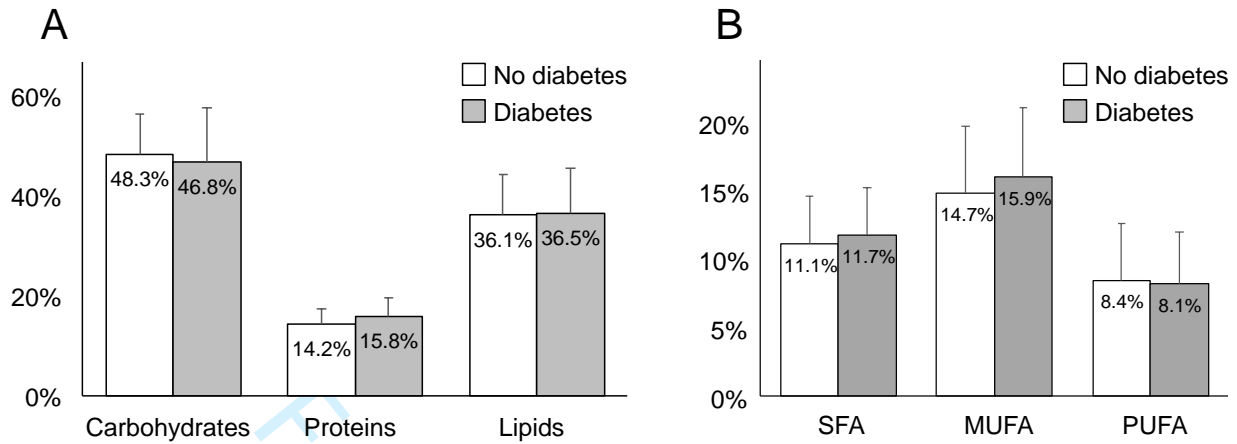
		Trans fat <1g/day	Sodium <2300 mg/day	Protein ≥15% of TCI	SFA <7% of TCI	MUFA ≥12% of TCI	Fiber ≥14 g / 1,000 Cal
Sex	Male n=331	66 (19.9%)	18 (5.4%)	129 (39%)	29 (8.8%)	246 (74.3%)	28 (8.5%)
	Female n=405	76 (18.8%)	46 (11.4%)	155 (38.3%)	29 (7.2%)	331 (81.7%)	53 (13.1%)
Age group	18 to 39 n=288	42 (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%)

12 Data are n (%).



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14 **Supplemental Figure 2.** Prevalence of diabetes, by body-mass index (Panel A) and waist
15 circumference (Panel B) status. Underweight was defined as a body mass index (BMI) of less than
16 18.5 Kg/m^2 , normal weight as a BMI between 18.5 and less than 25 Kg/m^2 , overweight as a BMI
17 between 25 and less than 30 Kg/m^2 , and obesity as a BMI of 30 or higher. Abdominal obesity was
18 defined as a waist circumference of 90 cm or higher in women, and 94 cm or higher in men. Data
19 are prevalences using sampling weights.

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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:

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	Fecha de la Versión
	02 de septiembre de 2018
	Título del Proyecto
	Estudio Colombiano de Perfiles Nutricionales – COPEN - 2018
	Investigadores
	<i>Carlos O Mendivil, MD, PhD</i> Profesor Asociado, Facultad de Medicina, Universidad de los Andes <i>Eddy Carolina Betancourt, MSc</i> Nutrition and Health Manager, Team Foods Colombia. <i>Angélica Montaña Rodríguez, RD, Esp</i> Nutricionista, Especialista en Epidemiología. <i>María Carolina Chacón Vargas</i> Directora de Estudios, Centro Nacional de Consultoría <i>Alejandra Campuzano Acero</i> Directora de Estudios, Centro Nacional de Consultoría
	Duración del proyecto (Meses)
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	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 de 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 mirístico, ácido palmítico, ácido esteárico, ácido oleico, ácido linoleico, ácido gamma-linolénico, ácido miristoléico, ácido alfa-linolenico, ácido vaccénico, ácido eicosapentaenoico, ácido docosaheptaenoico, 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:

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

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

21 En caso de que en la vivienda seleccionada exista más de un hogar se seleccionará el hogar de la persona que abrió la
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Selección de personas:

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

Selección de sectores y manzanas:

Controles en oficina:

38 La selección se efectúa partiendo de la combinación de las bases estratificadas de los municipios y las bases digitales
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40 de la cartografía DANE, es de anotar que las dos bases están al nivel de sector sección y manzana. Estas bases se unen
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42 en el paquete de georreferenciación ArcView lo cual asegura su correcta combinación. La base resultante de la
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44 combinación es la fuente para seleccionar la muestra independientemente para cada ciudad y estrato en forma
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46 completamente aleatoria.
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- 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 versión más 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 18 años o más 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).

IMAGEN

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)

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13 **Figura 3. Balanza digital solar**
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17 **5.3.3.3 Circunferencia de Cintura**

18 Esta medida se tomará a todos participantes de 18 años de edad en adelante. No se tomará en mujeres en embarazo
19 o que hayan tenido un parto en los tres meses anteriores. Se empleará una cinta métrica metálica flexible, retráctil, de
20 lectura en mm, de 2 metros de longitud más 10 centímetros en blanco antes del 0.
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36 **Figura 4. Cinta metálica antropométrica**
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40 El encuestador le solicitará permiso al participante para tomar la medida y explicará brevemente en qué consiste el
41 procedimiento. Si el participante tiene zapatos altos, se le solicitará que se los quite.
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49 El procedimiento se describe a continuación (Klein, 2007):
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- 51 1. Se pide al participante que se descubra la cintura y afloje un poco su pantalón o si usa una sudadera o
52 pantalón con resorte que lo baje un poco. **La medida debe tomarse directamente sobre la piel.**
- 53 2. El participante estará de pie, de frente al examinador, con los brazos a los lados del tronco para permitir que
54 la cinta corra alrededor del abdomen.
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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).

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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

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

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

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10 1. La enfermera coloca una nueva microlanceta en el puncionador.
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12 2. La enfermera oprime el botón superior del puncionador, el botón lateral cambia al color amarillo.
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14 3. La enfermera toma el dedo medio de la mano no dominante del participante y lo limpia con una toallita de alcohol.
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16 5. Oprimiendo **firmemente** el puncionador sobre la cara lateral del pulpejo del dedo medio, la enfermera oprime el botón
17 amarillo y se realiza la punción, virtualmente indolora.
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19 6. La enfermera oprime suavemente el dedo hasta que se vea una gota de aproximadamente 3 mm de diámetro

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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.

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9 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
10 subirá al capilar
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22 11. La enfermera deposita el capilar lleno en el tubo rojo marcado con el código del participante y agita fuertemente por 10
23 segundos.
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26 12. La enfermera coloca el tubo rojo en la neverita de transporte.
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28 13. La enfermera deposita la tira de glucometría y la microlanceta en el frasco guardián.
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30 5.3.5 Actividad física

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32 Como una primera aproximación somera a la asociación entre los patrones nutricionales y el nivel de actividad física, a
33 cada participante se le solicitará diligenciar el Cuestionario Internacional de Actividad Física (IPAQ), versión de 7
34 preguntas (Mantilla-Tolosa 2007).
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39 5.4 Plan de análisis:

40 5.4.1 Ingesta dietaria

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43 La frecuencias absolutas de consumo para cada uno de los alimentos en el cuestionario se calcularán para la muestra
44 en su totalidad, así como para subgrupos de interés por sexo, edad y ciudad de residencia. Para cada ciudad de
45 determinará el o los alimentos con mayor frecuencia absoluta, también los alimentos más representados dentro de
46 cada una de las 10 categorías de alimentos. Mediante un análisis de factores - componentes principales, se explorará
47 que alimentos representan la mayor variabilidad en la ingesta total de alimentos, y en la ingesta calórica diaria, para la
48 muestra total y por grupos de interés.
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57 Para la estimación de la ingesta de nutrientes se emplearán (Willett, 2013):
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59 - Un factor de ponderación que lleva la frecuencia promedio reportada a un valor de número de porciones estándar
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por día.

- 1 - En el caso de los alimentos cuya composición está definida por 100 gramos, un factor que convierte ese número de
- 2 porciones estándar en un número de porciones de 100 gramos.
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- 5 - Un factor de parte comestible que oscila entre 0 y 100%, y está definido en las Tablas de Composición para cada
- 6 alimento.
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- 9 - La composición de nutrientes del alimento según la Tabla de Composición de Alimentos Colombianos del ICBF (ICBF,
- 10 2015), o en casos en que el alimento no se encuentre en dicha tabla, empleando la información del productor o el
- 11 ítem más cercano u homologable de la tabla de composición de alimentos del Departamento de Agricultura de
- 12 Estados Unidos (USDA, 2018). De cada alimento se extraerán datos sobre contenido energético (Calorías), así como
- 13 de macro y micronutrientes, a saber: carbohidratos, lípidos, proteína, fibra dietaria, ácidos grasos saturados, ácidos
- 14 grasos monoinsaturados, ácidos grasos poliinsaturados, ácidos grasos trans, colesterol, ácido láurico, ácido mirístico,
- 15 ácido palmítico, ácido esteárico, ácido oleico, ácido linoleico, ácido gamma-linolénico, ácido miristoléico, ácido alfa-
- 16 linolenico, ácido vaccénico, ácido eicosapentaenoico, ácido docosahexaenoico, vitamina A, vitamina E, vitamina K,
- 17 vitamina D, tiamina, riboflavina, niacina, vitamina_c, folato, zinc, hierro, fósforo, calcio, sodio y potasio.
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29 Los participantes se dividirán en cuartiles de consumo de los nutrientes de interés, y para cada nutriente si se explorará

30 la asociación entre cuartiles de ingesta y variables sociodemográficas, estado nutricional por IMC, nivel de actividad

31 física y presencia de estados pre-diabéticos o diabetes mellitus.

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36 5.4.2 Antropometría

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40 La interpretación de datos antropométricos varía según la edad del individuo, como se ha establecido para Colombia

41 en la Resolución 2465 de 2016 (Ministerio de Salud y Protección Social, 2016). En el caso de los adultos, la definición

42 del estado nutricional según índice de masa corporal (IMC) se definirá como Bajo peso ($IMC < 18.5 \text{ Kg/m}^2$), peso normal

43 ($IMC \geq 18.5$ y $< 25 \text{ Kg/m}^2$), sobrepeso ($IMC \geq 25$ y $< 30 \text{ Kg/m}^2$) u obesidad ($IMC \geq 30 \text{ Kg/m}^2$). Para menores de edad, sin

44 embargo, es necesario comparar a cada niño con el percentil de peso para su edad y género, talla para su edad y género

45 o IMC para su edad y género. Las Figuras 6 y 7 resumen los puntos de corte para participantes en estos grupos de edad

46 (INCAP, 2012).

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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 colaboradores (Atalah, 1997), con valores de referencia para la semana gestacional 6 a la 42 (Figura 8).

SEMANAS DE GESTACION	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 los 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

8. Referencias

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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.

For peer review only - <http://bmjopen.bmj.com/site/about/guidelines.xhtml>

1 *Personas que pueden darle información adicional*

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

5 Dr. Carlos O Mendivil, Profesor Asociado Universidad de los Andes.

6 Teléfono: (1) 339.4949 Ext. 3803, 3780 o 1248. Email: carlosolimpo@gmail.com

8 Comité de Ética de la Universidad de los Andes

9 Teléfono (1) 339.4949 ext. 5339 o 3211. Email: comite-etica-investigaciones@uniandes.edu.co.

12 Eddy Carolina Betancourt, Investigadora en Nutrición, Team Foods.

13 Teléfono: (1) 770 9000 Email: eddy.betancourt@gmail.com

15 **Declaración de consentimiento informado**
16 **Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018**

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

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

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

33 En constancia, firmo a continuación:

34 Nombre: _____

35 Firma: _____

36 Fecha: _____

40 **Testigo 1:**

42 Nombre: _____

43 Relación: _____

44 Firma: _____

40 **Testigo 2:**

42 Nombre: _____

43 Relación: _____

44 Firma: _____

48 Nombre completo del profesional que obtuvo el consentimiento:

49 _____

52 Firma del profesional que obtuvo el consentimiento:

53 _____

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.

¿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:

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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

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medicina.uniandes.edu.co | e-mail: facmedicina@uniandes.edu.co

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Reconocimiento personería jurídica: Resolución 28 del 23 de febrero de 1949 Minjusticia.

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Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	<i>Centro Nacional de Consultoría Ltda.</i> Calle 82 No. 6- 51 Teléfono: 339 4888	PERFILES NUTRICIONALES <u>Frecuencia de consumo</u>
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 Montaña, 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 OBJECCIÓN 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

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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:

- POR FAVOR LEA AL **ENCUESTADO CADA CATEGORIA ALIMENTOS:** " PIENSE EN EL HABITOS DE CONSUMO EN LOS **ULTIMOS 12 MESES** "
- 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 PORCIONES
- 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.
- PARA LA PREGUNTA C LUGAR DE CONSUMO RECUERDE:
 - 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"
 - 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

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

Ítem	Alimento (LEER)	Porción (LEER)	Tamaño porción	A. Consumo promedio durante el último año										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									
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) <small>Tarjeta sin pensar en marca</small>		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 ÚLTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

- A. ¿Con qué frecuencia usted consume __ (REEMPLACE 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 __ (REEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- D. ¿En qué momento del día consume __ (REEMPLACE 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	

1	langostinos																			
2	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
3																				
4	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
5																				
6	ENCUESTADOR RECUERDE: OTROS ALIMENTOS NO INCLUIDOS – MOSTRAR TARJETA Y REGISTRAR LAS DOS OPCIONES MAS FRECUENTES																			
7		¿Algún otro alimento no incluido? ____			0	1	2	3	4	5	6	7	8	1	2	1	2	3	4	5
8		¿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 LEGUMINOSAS Y HARINAS EN LOS ULTIMOS 12 MESES** POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

- ¿Con qué frecuencia usted consume ___(REEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA)
- Cada vez que consume ___(REEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
- ¿Donde usted consume ___(REEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- ¿En qué momento del día consume ___(REEMPLACE 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								
37	Lentejas	1 cucharón mediano	100 g	0	1	2	3	4	5	6	7	8	1	2	1	2	3	4	5
38	Frijol	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 (Extradelgada 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 (1/2 pocillo)	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, espagueti 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	

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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 __ (REEMPLACE 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 __ (REEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- D. ¿En qué momento del día consume __ (REEMPLACE 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
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, GUIOS 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

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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" PIENSE EN LAS PREPARACIONES EN LAS CUALES SE ADICIONA ACEITES Y GRASAS EJ: FRITOS, ENSALADAS, CARNES, POLLO, PESCADO FRITO

- A. ¿Con qué frecuencia usted consume ___(REEMPLACE 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 ___(REEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- D. ¿En qué momento del día consume ___(REEMPLACE 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
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

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
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 Confitos	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

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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"

- ¿Con qué frecuencia usted consume ___(REEEMPLACE POR ALIMENTO, PORCION)? (LEA ESCALA Y ENTREGUE TARJETA NO. 1) – RESPUESTA ÚNICA
- Cada vez que consume ___(REEEMPLACE POR PORCION Y ALIMENTO)? ¿Cuánto consume? (ESPONTÁNEA – REGISTRE DATO EXACTO SUMINISTRADO POR EL ENCUESTADO)
- ¿ Donde usted consume ___(REEEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- ¿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										
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 ÚLTIMOS 12 MESES POR FAVOR RESPONDA LAS SIGUIENTES PREGUNTAS"

- A. ¿Con qué frecuencia usted consume __ (REEMPLACE 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 __ (REEMPLACE POR ALIMENTO, PORCION)? (LEA OPCIONES- RESPUESTA ÚNICA)
- D. ¿En qué momento del día consume __ (REEMPLACE 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
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, whisky, vodka, ginebra)	1 copa	45 mL	0	1	2	3	4	5	6	7	8	///	1	2	1	2	3	4	5

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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

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								
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 (FÍSICAS 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 ALERGIAS O INTOLERANCIA, DIETA LÍQUIDA PRE O POSQUIRÚRGICA.

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

1
1

*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 DILIGENCIA 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 azúcares 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	<i>Centro Nacional de Consultoría Ltda.</i> 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

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

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

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Visita 2			
Visita 3			

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Persona sorteada accede a participar	10	Encuesta Efectiva																

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

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DATOS DEL SELECCIONADO	
Nombre completo el entrevistado:	
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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 Montaña, 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 camino 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	_____

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

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5
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Horas al día	1	_____
Minutos al día	2	_____
No sabe/ no está seguro	9	_____

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12 **CONTINUE CON FORMULARIO NO.3 MEDIDAS ANTROPOMÉTRICAS**
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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 Montaña, 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 TOMA LAS MEDIDAS SEGÚN LAS INDICACIONES

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

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

BALANZA- PESO		
Medida	Resultado	Condición
1. Peso (Kg) –primera medida-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	ENC: EN CASO DE PESAR MENOS DE 100 KG, EN EL PRIMER ENTERO SE DEBE INCLUIR UN CERO
2. Peso (Kg) –segunda medida-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	
3. Peso (Kg) –tercera medida-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	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-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	ENC: EN CASO DE P MEDIR MENOS DE 100 CM, EN EL PRIMER ENTERO SE DEBE INCLUIR UN CERO
2. Cintura(cm) –segunda medida-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	
3. Cintura(cm) –tercera medida-	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/>	Realizar medida en caso que la diferencia entre $ C1-C2 $ sea menor o igual a 1cm

REHUSA TOMA DE MEDIDA DE CIRCUNFERENCIA ____9

CONTINUE CON FORMULARIO NO.4 GLUCOMETRIA Y MUESTRA CAPILAR



Estudio Colombiano de Perfiles Nutricionales - COPEN - 2018	<i>Centro Nacional de Consultoría Ltda. Calle 82 No. 6- 51 Teléfono: 339 4888</i>	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 Montaña, 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 ENFERMERA Y CONFIRME CADA DATO DOS VECES

RESULTADO GLUCOMETRIA	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
NUMERO DE IDENTIFICACIÓN DE TUBO DE MUESTRA CAPILAR (Numeración Asignada por la Universidad de los Andes)	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

ENCUESTADOR: ANTES DE HACER EL CIERRE DE LA ENCUESTA JUNTO CON LA ENFERMERA 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 a Campo APROBADO/RECHAZADO					ACCIÓN: 5 Anular- 6 Verificar- 7 Recuperar- 8 Devolver		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

20-042050 on 17 June 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

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TARJETA PORCIONES

-Medidas caseras-

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Imagen	Imagen	Imagen
<p>1 CUCHARITA ≈7g</p>	<p>1 CUCHARA SOPERA ≈15g</p>	<p>1 CUCHARARÓN MEDIANO ≈100g</p>

TARJETA PORCIONES

-Volumen-

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

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TARJETA PORCIONES -Volumen-

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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)

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TARJETA LACTEOS

-Otros alimentos-

<p>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.</p>	<p>Imagen</p>	<p>YOGURT GRIEGO 150g Yogurt descremado de leche de vaca o cabra, doble proteína 1 vaso (150 gramos)</p>	<p>Imagen</p>	<p>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.</p>	<p>Imagen</p>
<p>YOX DEFENSIS 100 ml bebida láctea acidificada</p>	<p>Imagen</p>	<p>ALPINETTE 140g Postre de leche entera con dulce de frutas</p>	<p>Imagen</p>	<p>YOGURT CUCHAREABLE 150g Consistencia firme</p>	<p>Imagen</p>

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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. <small>For peer review only - http://bmjopen.bmj.com/site/about/guidelines.xhtml</small>	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

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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

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TARJETA FRUTAS

BMJ Open

-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

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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

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TARJETA ACEITES No.1

20-042950-17 June 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

<p>Aceite de Oliva</p>	<p>Imágenes</p>
<p>Aceite de Maiz</p>	<p>Imágenes</p>
<p>Aceite de girasol (Girasol en la etiqueta)</p>	<p>Imágenes</p>

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TARJETA ACEITES No.2

20-042950-17 June 2021. Downloaded from <http://bmjopen.bmj.com/> on April 18, 2024 by guest. Protected by copyright.

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

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TARJETA ACEITES

-Margarinas y mantequillas-

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<p>MANTEQUILLA</p>	<p>MARGARINA DE MESA</p>	<p>MARGARINA DE COCINA</p>	<p>MANTECA</p>

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TARJETA ACEITES

-Otros alimentos-

Imágenes	Imágenes
<p>COCO RALLADO 2 CUCHARADITA 14 GRAMOS.</p>	<p>MANTEQUILLA DE MANÍ O ALMENDRAS 1 CUCHARADITA 10 GRAMOS</p>

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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 cucharadita 5 gramos	Postres: flan, esponjado o mousse, cheesecakes, pie. 1 porción 100 gramos.

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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.

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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.

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TARJETA SUPLEMENTOS No.2

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

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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) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —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 <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants Page 8, lines 175-185 (b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —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) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time <i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure <i>Cross-sectional study</i> —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