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Trabajo Original

Epidemiología y dietética

Breakfast skipping, nutritional status, and physical activity in a middle-aged Latin American population: a population-based study from Ecuador

Asociación entre la omisión de desayuno, el estado nutricional y la actividad física en una población de mediana edad de Latinoamérica: un estudio poblacional de Ecuador

Melissa Lara, Ivan Sisa and Martha Cecilia Yepez; on behalf of the ELANS Study Group

School of Medicine. College of Health Sciences. Universidad San Francisco de Quito (USFQ). Quito, Ecuador

Abstract

Introduction: the failure to eat breakfast has been associated with weight gain, a lower level of physical activity, and poor diet quality.

Objective: to examine the frequency of skipping breakfast in an Ecuadorian population and its association with nutritional status and level of physical activity.

Methods: a cross-sectional study of individuals who reported breakfast omission in a national survey. Nutritional status and physical activity were evaluated through anthropometric measures and the International Physical Activity Questionnaire, respectively.

Results: the mean age of the study sample was 34.2 ± 14 years, 40% were aged 20 to 34 years, one half were women, 55% were living in the coastal region, and one half were classified as low socioeconomic status. Overall, 6.6% of participants did not mention breakfast in both recalls. Individuals who skipped breakfast were more likely to be aged 20 to 34 years (42.6% vs. 37.4%) and from the coastal region (61.1% vs. 51.8%) than those who ate breakfast. We did not find an association between skipping breakfast and being overweight or obese (35.2% vs. 36.1%), nor achieving a low level of physical activity (28.6% vs. 29.8%). In addition, breakfast consumers (vs. non-consumers) had higher intake of total energy, macronutrients (protein, carbohydrate, fat, and sugar), and micronutrients (fiber and calcium).

Conclusions: in Ecuador, ~ 7% of the population skips breakfast. The nutritional status and level of physical activity did not differ between those who ate breakfast and those who did not. However, the long-term health consequences should be avoided by changing this eating habit.

Key words:

Breakfast skipping. Obesity. Physical activity. Nutrition. Ecuador.

Resumen

Introducción: la falta de no desayunar se ha asociado con el aumento de peso, un menor nivel de actividad física y una mala calidad de la dieta.

Objetivo: evaluar la frecuencia de saltearse el desayuno en una población ecuatoriana y su asociación con el estado nutricional y el nivel de actividad física.

Métodos: estudio de corte transversal de individuos que informaron la omisión del desayuno en una encuesta nacional. El estado nutricional y la actividad física se evaluaron mediante medidas antropométricas y el cuestionario Internacional de Actividad Física, respectivamente.

Resultados: la edad media de la muestra del estudio fue de 34,2 ± 14 años, el 40% tenía entre 20 y 34 años, la mitad eran mujeres, el 55% vivía en la región costera y la otra mitad se clasificó de nivel socioeconómico bajo. En general, el 6,6% de los participantes no mencionó el desayuno en ambos recordatorios. Las personas que se saltearon el desayuno tenían más probabilidades de tener entre 20 y 34 años (42.6% vs. 37.4%) y ser de la región costera (61.1% vs. 51.8%) comparado con aquellos que si desayunaron. No se encontró una asociación entre saltarse el desayuno y tener sobrepeso u obesidad (35.2% vs. 36.1%), ni lograr un bajo nivel de actividad física (28.6% vs. 29.8%). Además, los consumidores de desayuno (vs. no consumidores) tuvieron una mayor ingesta de energía total, macronutrientes (proteínas, carbohidratos, grasas totales, y azúcares) y micronutrientes (fibra y calcio).

Conclusiones: en Ecuador, ~ 7% de la población se salta el desayuno. El estado nutricional y el nivel de actividad física no difirieron entre quienes desayunaron y quienes no lo hicieron. Sin embargo, las consecuencias de salud a largo plazo deben evitarse cambiando este hábito alimentario.

Palabras clave:

Saltarse el desayuno. Obesidad. Actividad física. Nutrición. Ecuador.

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Correspondence:

Ivan Sisa. School of Medicine. College of Health Sciences. Universidad San Francisco de Quito. Edificio de Especialidades Médicas. Hospital de los Valles. Av. Interoceánica, km. 12 ½ Cumbayá. Quito, Ecuador
e-mail: isisa@usfq.edu.ec

INTRODUCTION

Obesity has become the greatest threat to global public health in the last century, affecting approximately 1.4 billion adults in 2016 (1). Certain eating patterns, such as the omission of breakfast, have been associated with being overweight/obese compared with breakfast consumers (2,3). In a U.S. study reported among adults, the daily breakfast eaters gained 1.91 kg less than infrequent breakfast consumers (< 4 days/week) over 18 years (4). There is also literature indicating that skipping breakfast is associated with dyslipidemia, hypertension, higher risk for type 2 diabetes and cardiovascular disease (4,5). Furthermore, skipping breakfast has been associated with a lower level of physical activity (6), and individuals who eat breakfast daily are more likely to participate in strenuous physical activity than those who never eat breakfast (7).

Most of the nutritional studies regarding breakfast consumption and physical activity have been achieved in developed countries, with scarce evidence originating from other regions such as Latin America (LA). Yet, LA is one of the two most obese low-income and middle-income regions globally (8). In addition, poor diets and inadequate physical activity in the region are causing high levels of diabetes and cardiovascular disease (8,9). Ecuador, has not been the exception to this regional trend. Due to important socioeconomic and demographic changes during recent decades (10), its population has transitioned from having traditional dietary habits to unhealthy food intake and physical inactivity (11,12). Currently, the prevalence of obesity in adults in Ecuador has reached almost one half of the total population (12).

At present, data does not exist on the dietary habits of Ecuadorian residents, especially with regards to their consumption of breakfast. The objectives of this cross-sectional study were to examine whether breakfast skipping is associated with nutritional status and level of physical activity. Furthermore, we examined whether the omission of breakfast presented associations with nutritional data regarding intake of macronutrients, micronutrients, as well as demographical features including sex and geographical region. This study used data from The Latin American Survey of Nutrition and Health (LANHS) to provide population-level data in order to prevent obesity in Ecuador.

MATERIALS AND METHODS

This cross sectional study is based on the data from The Latin American Survey of Nutrition and Health -in Spanish Estudio Latinoamericano de Nutrición y Salud (ELANS)-Ecuador, whose methods have been reported elsewhere (13). In brief, this is a multicenter cross-sectional nutrition and health surveillance study of the nutritional and physical activity status of adolescents and adults in eight Latin American countries. These data were collected over a 1-year period in the following countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru and Venezuela. The current study used data collected in Ecuador from September 2014 to March 2015.

STUDY PARTICIPANTS AND DESIGN

The ELANS used a randomized complex, multistage sampling process, which was stratified by geographical location, gender, age and socioeconomic status in order to select a representative sample of the Ecuadorian population. The sample size was calculated with a confidence interval of 95% and a margin of error of 3.46%. A survey design effect of 1.75 was estimated based on guidance from the U.S. National Center for Health Statistics (14), and calculations of the minimum sample sizes required per strata (i.e. socioeconomic level, age and gender) performed for Ecuador. We analyzed data from 800 adolescent and adult participants from 15 to 65 years of age from nine cities including Guayaquil, Machala, Portoviejo, Manta, Quito, Cuenca, Ambato, Loja and Ibarra, which correspond to the coastal and highland regions of Ecuador (397 males and 403 females). We excluded pregnant and lactating women, individuals with major physical or mental impairments, adolescents without a signed consent form by their parent or legal guardian, individuals living in any residential setting other than a household, and individuals unable to read.

ETHICAL CONSIDERATIONS

The ELANS protocol was approved by the Western Institutional Review Board. In Ecuador, the Institutional Review Board of the Universidad San Francisco de Quito approved the study prior to its implementation. Each individual signed a written consent form prior to their participation in the study. Participant confidentiality was maintained via the use of numeric identification codes and all data transfer was done with a secure filing sharing system.

DATA COLLECTION

The ELANS data was collected via questionnaires administered in two household visits and objective anthropometric measurements. In the first visit, the socioeconomic level questionnaire (established by the Instituto Nacional de Estadística y Censo, Ecuador) and two 24-hour dietary recalls were applied, in non-consecutive days including weekend days, as well as anthropometric measurements taken. In the second visit, which took place 4 to 30 days later, a second 24-hour recall and the International Physical Activity Questionnaire (IPAQ) was administered to each participant. The information that came from the dietary recall questionnaires were transferred into energy, macronutrients, and micronutrient quantities using the Nutrition Data System for Research software, version 2013 (NDS-R, Minnesota University, MN, USA). NDS-R is an accurate nutrient and food group serving calculation software that utilizes the United States Department of Agriculture (USDA) Nutrient Data Laboratory as its primary source of nutrient values and nutrient composition.

PHYSICAL ACTIVITY

Based on the IPAQ questionnaire physical activity was categorized into low, moderate, and high categories. Low physical activity was considered when individuals do not meet criteria for moderate or high categories. Individuals with moderate physical activity where those who satisfied the following criteria: a) 3 or more days of vigorous-intensity activity of at least 20 minutes per day; or b) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day; or c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum total physical activity of at least 600 MET (Metabolic Task Equivalent of Task)-minutes/week. High physical activity was considered when encompassed the following: a) vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week; or b) 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

DIETARY ASSESSMENT

A single 24-hour dietary reminder is limited and usually inadequate to evaluate diet, two recalls were chosen to estimate routine food intake and to assess intraindividual variability in nutrient intake as literature shows (15). Thus dietary data were collected based on the Multiple Pass Method using two non-consecutive 24-hour dietary recalls within one week (16). The 24-hour recalls were used to divide the participants in three groups according to their morning meal behaviors: a) breakfast skippers in any one recall; b) breakfast skippers in two recalls; and c) breakfast eaters in both recalls. Breakfast was defined as a consumption of > 100 kilocalories consumed from 4 to 10 am. The 24-hour recall questionnaires were also used to describe the total energy intake of the participants, and micronutrients including calcium, total sugar and fiber.

NUTRITIONAL STATUS

The nutritional status of the participants was monitored by analyzing body weight and height, in order to calculate body mass index (BMI). BMI was categorized according to the definitions established by the World Health Organization, which divides them in underweight, normal weight, overweight and obesity (17). In order to produce a greater association between BMI and overweight/obesity, additional anthropometric measurements were analyzed, including waist circumference (WC) and neck circumference (NC). Each measurement was repeated twice to ensure accuracy, and the average used for analysis. Body weight was measured with a calibrated electronic SECA scale, model 813 with an accuracy of 0.1 kg. Height was measured with a portable SECA stadiometer, model 213 with an accuracy of 0.1 cm. The circumferences were measured with an inelastic SECA tape to the nearest 0.1 cm. Waist circumference of the participants was classified as an indicator of central obesity, if measurements for men and women exceeded 90 cm and 80 cm respectively (18). The cut-off values used for NC in this study were ≥ 37 cm in men and ≥ 35 cm in women (19). These measurements were collected by certified nutritionists/dietitians. Each measurement was repeated twice to ensure accuracy, and the average used for analysis.

STATISTICAL ANALYSIS

Descriptive statistics were used to summarize the baseline characteristics of study participants. Continuous variables are described as mean $\pm$ SD and categorical variables, as counts and percentages. We use chi-square, one-way ANOVA and Kruskal-Wallis tests to examine differences among groups, as appropriate. All tests of significance were two tailed. In addition, in order to find a correlation between neck circumference and the rest of anthropometric measurements, a Pearson's correlation test was used. Statistical significance was based on a p-value of < 0.05. Finally, in order to compare the utility of neck circumference with waist circumference, regression analysis was used. All data was analyzed by using SPSS 20.0 software and R for Mac v. 3.2.2.

RESULTS

Out of 908 eligible participants initially assessed in the first visit, 850 participants completed two visits and 800 participants met our inclusion criteria, analysis inconsistencies and partially missing data (Fig. 1).

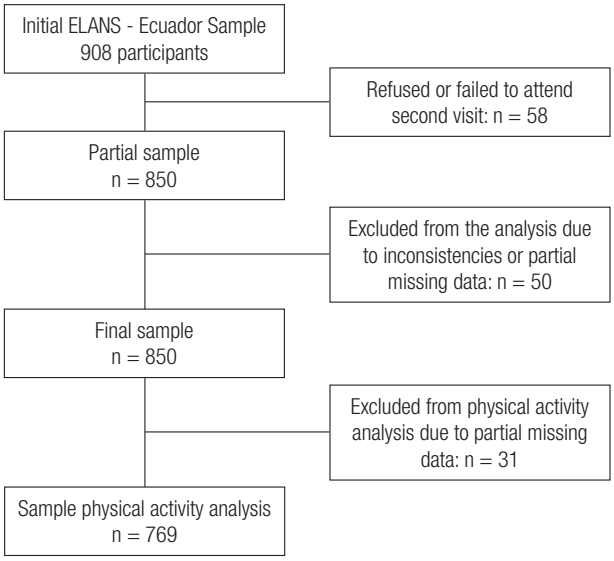

Figure 1.
STROBE flow diagram of the study participants in the Latin American Study of Nutrition and Health – Ecuador.

The study sample (n = 800) represented a population of whom 50.4% were female, 39.5% were individuals aged 20 to 34 years, 55% were living in the coastal region, and 49.9% of the participants reported a low socioeconomic status. Overall 73.1% of participants reported breakfast intake in both recalls, 20.3% of participants reported breakfast in one of two recalls, and 6.6% individuals reported to have skipped breakfast in both recalls (Table I).

The majority of the participants who skipped breakfast in one or both recalls were most likely to be young adults 20 to 34 years of age and reside in the coastal regions of the country. In addition, most of the breakfast skippers were categorized as being low socioeconomic status.

Table II shows that individuals, who were more likely to skip breakfast, had an overall poor nutritional status according to their BMI, WC and NC, although it was not statistically significant ($p > 0.05$). Approximately 59% (127) of breakfast skippers (BS) were overweight or obese according to their BMI, while 60.7% (355) of the breakfast eaters (BE) were found to be overweight or obese using the same anthropometric measurement. Furthermore, 57.1% of the total sample had a positive indicator of central obesity through their WC measurements, and 26.7% of them are breakfast skippers. Neck circumference did not demonstrate a statistical association between being overweight and not reporting breakfast consumption, with only 39% of the BS showing upper trunk adiposity ($p > 0.05$). Overall, the study sample showed that 45.4% of individuals reported a medium level of physical activity but as the breakfast skipper groups were analyzed (BS in any 1 recall and BS in 2 recalls), there is a tendency to have a low physical activity level, 28.6 vs. 41.2%, respectively ($p>0.05$).

In terms of nutritional quality, BS were most likely to consume less total calories, protein, carbohydrates, fat, sugar, fiber, and calcium compared to BE. Thus, breakfast eaters consumed a much higher amount of protein, exceeding the daily recommendation (46-56 grams/day) by ~54%. The amount of carbohydrates and total fat consumed were within acceptable ranges across all groups. Furthermore, breakfast skippers on average consume approximately 56% of the adequate intake of fiber (25-38 grams for men and women), compared to a 68% of fiber consumed by breakfast eaters (Table III).

Table I. Characteristics of study participants

Characteristic	Breakfast skippers in any 1 recall (n = 162)		Breakfast skippers in 2 recalls (n = 53)		Breakfast eaters (n = 585)		p value*
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Age (yrs)	30	12.1	28.9	13.1	35.9	14.2	*< 0.001*
	n	**%**	**n**	**%**	**n**	**%**	
Age (yrs), group	38	23.5	12	22.6	78	13.3	*< 0.001*
15-19	69	42.6	28	52.8	219	37.4	
20-34	42	25.9	7	13.2	173	29.6	
35-49	13	8	6	11.3	115	19.7	
50-65							
Sex							0.5
Female	75	46.3	26	49.1	302	51.6	
Region							
Coast	99	61.1	38	71.7	303	51.8	*< 0,01*
Higland	63	38.9	51	28.3	282	48.2	
SES							
Low	81	50	25	47.2	293	50	0,9
Medium	59	36.4	19	35.8	219	37.4	
High	22	13.6	9	17	73	12.5	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Anthropometric							
Weight (Kg)	69.8	15.9	66.9	14.5	67.9	13.9	0.2
Height (m)	1.6	9.2	1.62	9.5	1.59	9.1	*0.01*
WC (cm)	87.9	11.9	84.6	12.9	87.5	12.4	0.2
NC (cm)	35.3	3.6	34.9	3.4	35	3.7	0.6

*SES: socioeconomic status; WC: waist circumference; NC: neck circumference. *p value for the difference among breakfast skippers in any 1 recall, breakfast skippers in 2 recalls, and breakfast eaters; statistically significant value ($p < 0.05$) indicated in bold font.*

Table II. Association between breakfast patterns, anthropometric measures and level of physical activity

Characteristic	Breakfast skippers in any 1 recall (n = 162)		Breakfast skippers in 2 recalls (n = 53)		Breakfast eaters (n = 585)		p value*
	n	%	n	%	n	%	
BMI (kg/m²)†							
Underweight	6	3.7	4	7.5	18	3.1	0.6
Normal	56	34.6	22	41.5	212	36.2	
Overweight	57	35.2	18	34	211	36.1	
Obesity	43	26.5	9	17	144	24.6	
Waist circumference							
Normal	68	42	25	47.2	250	42.7	0.8
Overweight	94	58	28	52.8	335	57.3	
Neck circumference							
Normal	98	60.5	33	62.3	342	58.5	0.8
Overweight	64	39.5	20	37.7	243	41.5	
Physical activity							
Low	44	28.6	21	41.2	168	29.8	0.06
Medium	76	49.4	13	25.5	260	46.1	
High	34	22.1	17	33.3	136	24.1	

*BMI: body mass index. *p value for the difference among breakfast skippers in any 1 recall, breakfast skippers in 2 recalls, and breakfast eaters; statistically significant value (p < 0.05) indicated in bold font. †BMI groups: underweight < 18.5 kg/m²; normal 18.5-24.9 kg/m²; overweight 25-29.9 kg/m²; obesity > 30 kg/m².*

Table III. Mean daily energy intake of breakfast skippers compared to breakfast eaters

Characteristic	Breakfast skippers in any 1 recall (n = 162)		Breakfast skippers in 2 recalls (n = 53)		Breakfast eaters (n = 585)		p value*
	Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	2059	1356-2614	1719	1519-2088	2181	1655-2780	*< 0.001*
Protein (g)	79	60-101	61	48-97	86	62-111	*< 0.001*
Protein (%)	16	13-20	14	12-19	16	13-18	0.7
Carbohydrate (g)	267	181-358	235	191-319	289	215-378	*< 0.001*
Total fat (g)	65	38-90	54	39-75	71	49-97	*< 0.01*
Total sugars (g)	47	28-69	38	25-60	51	34-77	*< 0.01*
Fiber (g)	14	9-21	12	7-18	17	12-25	*< 0.001*
Calcium (mg)	428	285-677	434	264-638	666	426-904	*< 0.001*
	Mean	SD	Mean	SD	Mean	SD	
Carbohydrate (%)	54	9	54	9	55	9	0.5
Total fat (%)	30	9	29	8	30	8	0.9

**p value for the difference among breakfast skippers in any 1 recall, breakfast skippers in 2 recalls, and breakfast eaters; statistically significant value (p < 0.05) indicated in bold font.*

Male breakfast skippers on average consumed 1913 (1400-2558) kcal and female breakfast skippers reported a consumption of 1706 (1276-2365) kcal on the days they omitted the first meal of the day, neither sex reaching their total energy intake recommendation (2500 kcal and 2000 kcal for men and women, respectively). In addition, male breakfast skippers were more likely to consume lower macronutrients and micronutrient quantities with the exception of total sugar compared to male breakfast eaters. However, among women breakfast skippers only the consumption of total sugar, fiber, and calcium were lower compared to breakfast eaters (Table IV). In addition, although neither group consumed the estimated average requirement (EAR) of calcium (1000-1500 mg), both male and female breakfast skippers consumed 43% of the EAR (Table IV).

When comparing breakfast skippers from the coastal and highland regions of Ecuador, we found that BS within the coastal region in overall consume less total amount of energy, macronutrients, and micronutrients compared with BE. Further, when comparing BS from both regions there was a tendency to have a higher intake of total energy, total fat, total sugar, fiber and calcium in the highland than that of the coastal region (Supplementary Table I). Overall, the consumption of protein, carbohydrate, fiber, and calcium were higher in BE across age stratum. In addition, the consumption of sugar was higher in the younger age group (Supplementary Table II).

DISCUSSION

The present study of a nationally representative sample of the Ecuadorian population based on the ELANS study shows that ~7% of middle-aged adults have skipped breakfast. This pattern was most prevalent among those individuals aged 20 to 34 years and residing in the coastal region of the country. We were not able to find an association between skipping breakfast and being overweight/obese, nor achieving a low level of physical activity. However, several associations where established between the breakfast skipping groups and the breakfast eaters when analyzing their nutrient intake.

BREAKFAST CONSUMPTION

In our study, the prevalence of breakfast skipping was low. This is consistent with several studies worldwide. For example, studies in Croatia and the UK reported low prevalence as 1.7% and 6% of breakfast non-consumption (20,21), respectively. Although this study did not identify a predominant sex that skips breakfast, various studies have found that the female sex is more likely associated with breakfast omission (21). Furthermore, our study found that the young adult age group (ages 20 to 34) that has been identified as those who frequently skip breakfast, have a normal body adiposity distribution, which can be explained through numerous factors. First, this study does not analyze the timing or number of remaining meals of the day, which may have

Table IV. Mean daily energy intake of breakfast skippers vs. breakfast eaters according to sex

Characteristic	Male							Female							p value
	BS1 (n = 87)		BS2 (n = 27)		BE (n = 283)		p value	BS1 (n = 75)		BS2 (n = 26)		BE (n = 302)		p value	
	Median	IQR	Median	IQR	Median	IQR		Median	IQR	Median	IQR	Median	IQR		
Total energy (kcal)	2196	1680-2709	1761	1547-2300	2458	1995-3009	*< 0.001*	1706	1260-2426	1690	1341-1960	1874	1445-2462	0.2	
Protein (g)	90	65-106	59	48-98	94	77-126	*< 0.001*	70	50-87	63	48-77	74	54-100	0.1	
Carbohydrate (g)	286	226-380	254	198-320	328	265-416	*< 0.001*	221	163-332	213	177-313	254	192-337	0.07	
Total fat (g)	68	40-98	59	39-77	81	59-109	*< 0.001*	60	36-82	51	39-71	63	41-88	0.4	
Total sugar (g)	53	31-75	39	29-69	54	35-85	0.13	43	27-60	36	24-55	47	32-67	*0.02*	
Fiber (g)	16	10-21	12	8-18	20	13-27	*< 0.001*	13	9-20	12	7-18	16	11-23	*< 0.01*	
Calcium (mg)	429	302-742	402	294-493	700	462-947	*< 0.001*	409	264-632	480	260-784	621	400-856	*< 0.001*	

*BS1: breakfast skippers in any 1 recall; BS2: breakfast skippers in 2 recalls; BE: breakfast eaters. *p value for the difference among BS1, BS2, and BE by sex; statistically significant value (p < 0.05) indicated in bold font.*

Supplementary Table I. Mean daily energy intake of breakfast skippers vs. breakfast eaters according to geographical region

Characteristic	Coast							Higland						
	BS1 (n = 99)		BS2 (n = 38)		BE (n = 303)		p value	BS1 (n = 63)		BS2 (n = 15)		BE (n = 282)		p value
	Median	IQR	Median	IQR	Median	IQR		Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	1941	1347-2482	1718	1494-2236	2221	1701-2756	*< 0.001*	2182	1522-2808	1818	1547-1897	2156	1604-2811	0.2
Protein (g)	79	60-101	67	51-97	88	64-114	*< 0.01*	78	54-101	57	47-83	83	58-107	0.05
Carbohydrate (g)	251	183-344	224	193-308	292	224-371	*< 0.01*	286	183-371	291	177-321	281	213-391	0.4
Total fat (g)	65	39-86	56	39-78	71	52-95	*< 0.01*	66	36-97	49	35-67	69	47-99	0.1
Total sugar (g)	47	28-66	38	27-57	51	33-72	0.03	48	28-70	47	20-75	51	34-81	0.3
Fiber (g)	13	10-19	12	7-18	16	12-24	*< 0.001*	16	8-21	11	8-14	18	12-26	*< 0.01*
Calcium (mg)	403	281-662	448	302-643	666	439-873	*< 0.001*	455	311-690	380	168-599	664	413-959	*< 0.001*

*BS1: breakfast skippers in any 1 recall; BS2: breakfast skippers in 2 recalls; BE: breakfast eaters. *p value for the difference among BS1, BS2, and BE by sex; statistically significant value (p < 0.05) indicated in bold font.*

a compensating influence on the nutritional status (22). Secondly, the younger adult group is consistent with other studies and other obesity-related eating habits, as well as being part of a "social business eating pattern", which is characterized by busy schedules, unhealthy food choices and frequent eating out (4,21). Finally, the normal body adiposity distribution may reflect the efficiency of the metabolic rate that this younger group has in comparison to the older age groups (23).

ENERGY AND NUTRIENT INTAKE

The breakfast omission is being known to be associated with lower 24-hour energy intake; our study found that energy intake was significantly different across breakfast categories. As such breakfast consumption was usually associated with a greater reported energy intake compared to breakfast skipping, indicating a large energy intake throughout the day in accordance with their first meal of the day. Total sugar, fiber and calcium were evaluated in this study, due to its nutritional importance in the breakfast meal. An association was found between groups, when analyzing protein, carbohydrate, total fat, total sugars, fiber and calcium. It seems that skipping breakfast lead to a reduced consumption of these macro and micronutrients. This could be due to several factors, including socioeconomic status and time management. A greater amount of protein was consumed on breakfast day by men than the days that breakfast was omitted, as well as fiber and calcium, despite the recommended requirements for calcium not being met in any of the breakfast groups. Females consumed a statistically significant amount of total sugar, fiber and calcium on the days that breakfast was consumed compared to those who chose to skip breakfast. This shows the tendency for women to reach for foods with a higher amount of sugar throughout their day (24). There were notable differences in nutrient intakes when comparing participants from the coastal and highland regions of Ecuador. Thus, the amount of fiber consumed daily in the coastal region is significantly less, which should be adjusted in order to maintain bowel health, lower cholesterol levels, help control blood sugar levels and aid in achieving a healthy weight (22,23). In addition, there is evidence reporting that micronutrient-rich breakfasts and morning meals are potentially satiating and have a beneficial effect on appetite regulation, which helps balance the energy intake throughout the day and prevent overeating and subsequently obesity (4).

ANTHROPOMETRY

Our results did not demonstrate that breakfast skipping was associated with overweight or obesity in the study sample analyzed by various anthropometric indices including BMI, WC, and NC. Being as this is a cross-sectional study that analyzed only two 24-hour recalls, it does not reflect the daily eating habits of an individual. Eating breakfast may also reflect better lifestyle and food choices across the day, explaining some of the limited association we observed with anthropometric measures.

Supplementary Table II. Mean daily energy intake of breakfast skippers *vs.* breakfast eaters according to age groups

Characteristic	Age 15-19						
	BS1 (n = 38)		BS2 (n = 12)		BE (n = 78)		p value*
	Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	2070	1487-2712	1693	1500-1819	2365	1757-2881	*< 0.05*
Protein (g)	76	52-97	56	49-69	88	67-111	*< 0.001*
Carbohydrate (g)	267	226-376	211	195-263	316	231-411	*< 0.05*
Total fat (g)	66	32-101	56	49-72	76	55-99	0.1
Total sugar (g)	46	29-61	32	22-36	56	41-84	*< 0.001*
Fiber (g)	16	11-20	9	7-13	16	12-24	*< 0.01*
Calcium (mg)	418	311-685	493	400-707	702	545-903	*< 0.001*
	Age 20-34						
	BS1 (n = 69)		BS2 (n = 28)		BE (n = 219)		p value*
	Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	2110	1729-2623	1909	1607-2665	2393	1861-2979	*< 0.05*
Protein (g)	83	65-106	87	54-112	94	66-119	0.2
Carbohydrate (g)	285	205-360	266	199-361	312	236-395	0.05
Total fat (g)	67	42-95	63	39-91	82	59-109	*< 0.05*
Total sugar (g)	50	31-74	40	31-66	52	35-79	0.2
Fiber (g)	13	10-21	14	10-24	20	13-26	*< 0.01*
Calcium (mg)	450	302-701	438	300-614	701	421-980	*< 0.001*
	Age 35-49						
	BS1 (n = 42)		BS2 (n = 7)		BE (n = 173)		p value*
	Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	1726	1272-2512	1596	1425-1701	2125	1641-2641	*< 0.01*
Protein (g)	75	49-95	57	51-67	80	61-100	*< 0.05*
Carbohydrate (g)	230	165-304	191	179-248	292	208-372	*< 0.01*
Total fat (g)	63	44-81	43	39-52	67	45-93	0.1
Total sugar (g)	43	27-63	44	24-57	51	34-78	0.1
Fiber (g)	15	10-21	10	6-14	17	12-26	*< 0.01*
Calcium (mg)	383	274-624	259	164-363	596	412-813	*< 0.001*
	Age 50-65						
	BS1 (n = 13)		BS2 (n = 6)		BE (n = 115)		p value*
	Median	IQR	Median	IQR	Median	IQR	
Total energy (kcal)	1201	992-2308	1373	822-1679	1848	1359-2405	0.2
Protein (g)	63	33-95	52	34-64	78	51-100	0.1
Carbohydrate (g)	186	124-327	213	159	239	181-331	0.3
Total fat (g)	40	24-68	36	32-44	57	35-82	0.1
Total sugar (g)	33	13-57	49	10-77	44	26-63	0.8
Fiber (g)	11	8-14	11	7-21	16	11-24	0.1
Calcium (mg)	433	225-509	402	191-617	577	407-888	*< 0.05*

*BS1: breakfast skippers in any 1 recall; BS2: breakfast skippers in 2 recalls; BE: breakfast eaters. *p value for the difference among BS1, BS2, and BE by age group; statistically significant value (p < 0.05) indicated in bold font.*

Although it was not statistically significant, over half of the breakfast skippers being overweight or obese, may reflect this obesity-related behavior. In addition, most of the breakfast eaters were also classified as overweight or obese, which may be due to the nutritional quality of their diet, lack of physical activity or a combination of eating habits that should be analyzed in future studies.

PHYSICAL ACTIVITY

Our study demonstrated a self-reported medium level amount of physical activity amongst the participants who skipped breakfast in one or two recalls. This can be explained by the following reasons: the participants reported a socially-acceptable amount of physical activity, the participant consumed a compensatory meal or meals following the lack of breakfast, or their dinner time and/or amount of energy intake led to the omission of the first meal of the day. In a study that analyzed a sample of US adolescents and young adults, they reported similar results (25), in that there was no association found between skipping breakfast and meeting physical activity guidelines for age among US adolescents and young.

IMPLICATIONS

Despite the fact that two recent clinical trials conducted in lean and obese adults has not found noteworthy differences between breakfast intake and weight change (26,27), literature shows that skipping breakfast can lead to multiple health consequences with long term implications such as heart disease, atherosclerosis, and type 2 diabetes (4). Furthermore, there is evidence showing that having a regular breakfast in lean individuals can maintain insulin sensitivity and glycemic control (27,28); and a large breakfast rich in protein and fat improves glycemic control in type 2 diabetes (29). Thus, there are important health benefits of regular breakfast consumption beyond mere weight management, which should be taken into account by health professionals, key stakeholders and mass media.

STRENGTHS AND LIMITATIONS

There are several strengths that this study possesses, including the large representative sample of the Ecuadorian population. To the best of our knowledge this is the first study that analyzes the association between breakfast skipping and nutritional status, including physical activity in an ethnically diverse adult population in a Latin American country. In addition, this study utilizes a novelty anthropometric measure, neck circumference, as one of the parameters to evaluate adiposity. Numerous limitations have been identified in this study, as well. The exposure, breakfast skipping, was measured based on two 24 hour dietary recalls. It is possible that participants may have given socially desirable responses by reporting eating breakfast when they actually did not consume any food during breakfast or that they reported an incorrect amount of physical activity. Furthermore, the two recalls may not have appropriately captured participants' typical dietary behaviors. For example, it may not be accurate to classify someone who skipped breakfast on one or two days, as a breakfast skipper, even though this method has been used in previous studies, thus exposure misclassification may be possible. For future studies, should be considered to add an additional dietary recall (in total three 24-hour dietary recalls). And lastly, it does not describe the long-term effects of this eating habit and have no follow-up data on our participants due to its cross-sectional design.

CONCLUSIONS

The present study found that ~ 7% of middle-aged adults in Ecuador have skipped breakfast. This eating behavior was not associated with being overweight/obese or achieving a low level of physical activity. However, an association was found between breakfast skipping and a reduced consumption of protein, carbohydrate, fiber and calcium in their diet. It is important to consider the long-term health consequences (heart disease, atherosclerosis, and type 2 diabetes) of this unhealthy behavior that can be avoided by changing this eating habit in the population and not only see it as a mere weight management strategy.

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MEMBERS OF ELANS STUDY GROUP

Chairs: Mauro Fisberg and Irina Kovalskys.

Co-chair: Georgina Gómez Salas.

Core Group members: Mauro Fisberg, Irina Kovalskys, Attilio Rigotti, Lilia Yadira Cortés Sanabria, Georgina Gómez Salas, Martha Cecilia Yépez García, Rossina Gabriella Pareja Torres, and Marianella Herrera-Cuenca.

External advisory board: Berthold Koletzko, Luis A. Moreno, Michael Pratt, and Katherine L. Tucker.

Project Managers: Viviana Guajardo and Ioná Zalcman Zimberg.

International Life Sciences Institute (ILSI) – Argentina: Irina Kovalskys, Viviana Guajardo, Maria Paz amigo, Ximena Janezic, and Fernando Cardini.

I*nstituto Pensi- Hospital Infantil Sabara – Brazil:* Mauro Fisberg, Ioná Zalcman Zimberg, and Natasha Aparecida Grande de França.

Pontificia Universidad Catolica de Chile: Attilio Rigotti, Guadalupe Echeverría, Leslie Landaeta, and Óscar Castillo.

Pontificia Universidad Javeriana - Colombia: Lilia Yadira Cortés Sanabria, Luz Nayibe Vargas, Luisa Fernanda Tobar, and Yuri Milena Castillo.

Universidad de Costa Rica: Georgina Gómez, Rafael Monge Rojas, and Anne Chinnock

Universidad San Francisco de Quito - Ecuador: Martha Cecilia Yépez García, Mónica Villar Cáceres, and María Belén Ocampo.

Instituto de Investigación Nutricional - Peru: Rossina Pareja Torres, Maria Reyna Liria, Krysty Meza, Mellisa Abad, and Mary Penny.

Universidad Central de Venezuela: Marianella Herrera-Cuenca, Maritza Landaeta, Betty Méndez, Maura Vasquez, Guillermo Ramirez, and Pablo Hernández.

Statistical analysis: Alexandre DP Chiavegatto Filho.

Accelerometry analysis: Priscila Bezerra Gonçalves and Claudia Alberico.

Physical activity advisor: Gerson Luis de Moraes Ferrari.

Dietary intake advisor: Ágatha Nogueira Previdelli.

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