

Surveys of food deserts and adherence to a Mediterranean diet among university students

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ABSTRACT

Objective: The objective of this study was to determine and describe the presence of institutional food deserts based on access to healthy food via a level of adherence to a Mediterranean diet in higher education Metropolitan Area institutions in Valle de Aburrá, Colombia.

Materials and methods: The Food Deserts Survey -EDA- and the Mediterranean Diet Adherence Test -KIDMED was administered to 419 university students.

Results and Discussion: Results evidenced that participants had an average adherence (58.5%) to a Mediterranean diet, indicating that university students need to improve their dietary pattern to adapt it to a Mediterranean model. Regarding the EDA, most reported that the food they consumed was nutritious (69.0%), fresh (77.3%) and healthy (61.3%). They stated they usually ate breakfast (74.7%), lunch (44.2%) and dinner (85.0%) at home during the week, and usually bought and consumed food in supermarkets and traditional stores (73.3%).

Conclusion: The study concluded that regardless of gender, participants need to improve their dietary pattern to adapt it to a Mediterranean model, which could indicate a hidden presence of food deserts.

KEYWORDS

Right to food, food insecurity, food desert, Mediterranean diet, higher education institutions, university students.

INTRODUCTION

Obesity and overweight in the world are increasing. By 2030, 51% of the world's population will suffer from them¹. These conditions directly affect people's health status and constitute the main risk of noncommunicable diseases. The impact of diet-related diseases on health systems is expected to be 57% of direct costs². In Colombia, the outlook is not encouraging. According to the National Survey on the Nutritional Situation ENSIN 2015³, among adults of ages ranging from 18 to 64, one out of three is overweight (37.7%), while one out of five is obese (18.7%). In this sense, 56.4% of the Colombian population is overweight.

Poor quality diets have been identified as determinants of malnutrition, so access, availability and adequacy are key components in guaranteeing the right to food. Specifying the composition of a healthy diet varies according to individual particularities, culture, and habits, but its basic constituent principles are the same². Given the impossibility of defining the value and meaning of a healthy diet regarding specific foods and quantities for all countries, and a lack of data on individual dietary intake that would allow comparisons, there is difficulty to conduct a global assessment of food consumption and dietary quality. A precise analysis methodology to evaluate access to healthy food via a healthy diet contributes valuable information that helps individual, institutional and public policy decision-making. As a contribution to the study of this topic, this article aims to determine and describe the

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access and availability to healthy foods through a level of adherence to a Mediterranean diet and determine the existence of food deserts in higher education institutions in the Metropolitan Area of Valle de Aburrá, Colombia. Although the variable adherence to a Mediterranean diet has already been documented in children and adolescents⁴, and in university settings⁵, a reading of the phenomenon through variable food deserts is novel and contributes significantly to the state of the question.

Food deserts are “[...] urban or rural areas where inhabitants have difficulties accessing healthy food [...]”⁶. Generally, these are peripheral areas on urban land with low qualitative and quantitative levels of infrastructure and equipment to provide public services, and high levels of socio-spatial and socio-economic exclusion, or rural lands that have lost their productive agricultural vocation and/or are far from food distribution channels and flows⁶. A literature review on food deserts as a category for the territorial analysis of the right to food was conducted in Molina-Saldarriaga, Restrepo-Yepes, and Giraldo-Ramírez⁷ and subsequently updated^{6,8}. Those studies analyzed the definition, characteristics, causes, consequences and care strategies of food deserts based on relevant published scientific literature.

Studies continue to focus their reflections on an analysis of the relationship between distance and food access^{9,10,11}. However, this scope has been under reassessment in recent years as spatial scale and aggregation practices lead to inconsistent conclusions regarding food access and the arising of food deserts¹². Studies have begun to focus on the causes of food desertification processes^{13,14}, like barriers in supply chains¹⁵; the impacts of food deserts on food hardship and participation in food access programs¹⁶; obesity¹⁷⁻¹⁹, socio-spatial segregation^{20,21} and age²².

On the other hand, some studies have focused on implementing new methodologies to identify food deserts^{11,12,23}; the common and differentiating characteristics of areas categorized as food deserts²⁴; and their relationship to infrastructure and service facilities such as parks²⁵. Other research projects inquire into the perceptions of communities inhabiting food deserts²⁶, strategies to address food-access issues in food deserts²⁷⁻³¹ and critiques of the concept of food desert³². Studies reach relevant conclusions like the direct relationships between the existence of food deserts and obesity food problems¹⁷⁻¹⁹; and the impact of political forces on the feasibility of strategies to address food desertification²⁷.

As evidenced herein, there are no relevant studies that analyze the existence of food deserts at institutional scales (for instance work, education, or recreation centers) or that evaluate access, availability and adequacy of food supply in residence scenarios that occupy a significant part of people’s time, and likewise have an impact on the guarantee of the right to food. Hence, this is the relevance of the proposal.

METHOD

Participants

A total of 419 university students, who are residents in the Antioquia Department in Colombia, and ages 17 to 40, participated, who were recruited by non-random sampling method. The general characteristics of the study sample is described in Table 1. The data were taken before the Covid-19 pandemic, so this event could alter the exposed values, in the sense of showing an increase in overweight and obesity.

Instruments

Food Desert Survey -EDA

Molina-Saldarriaga, et al.^{6,8} developed it and it was validated by judges in 2017. It measures food availability, access, and adequacy, and consists of 20 questions divided into three factors: food beliefs (7 items), places to eat (8 items) and food purchasing (5 items). It also considers some sociodemographic aspects such as characteristics of the sample (sex, age, level of education, etc.) and participants’ socioeconomic level (area where they live and have access to drinking water). Each category is scored via frequencies.

Mediterranean Diet Quality Test -KIDMED

Serra-Majem, et al.⁴ developed it and Vinaccia, et al.⁵ adapted it; this test measures the degree of adherence to a Mediterranean diet in child and adolescent population, but it was successfully validated in a Colombian sample of university students³³ as well as in other studies carried out in Spanish and Mexican university centers^{34,35}. The KIDMED consists of 16 questions that are answered on a dichotomous scale (Yes/No). To interpret it, values lower than 3 points indicate low adherence, from 4 to 7 points medium adherence, and values over 8 indicate high adherence.

Procedure

To apply the instruments of this study, an open population was considered via the Internet, with the support of some contacts of the authors of the study and the databases of the universities to collect the study sample. Informed consent was obtained from all study participants.

Data Analysis

Descriptive analysis for continuous (self-reported anthropometric measures: height and weight, used for calculating Body Mass Index [BMI]) and discrete (age, hours you practice or exercise, hours you usually sleep, months you have been overweight) variables. The mean was used as a measure of central tendency. Likewise, the standard deviation (D.T.) and the minimum (Min.) and maximum (Max.) scores were calculated. And, regarding the nominal variables (sex, marital status, with whom they live, occupation, university

Table 1. Sociodemographic characteristics of study participants

	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
Sex	313 (74.7%)	106 (25.3%)	419	
Age				
17-20	154 (49.2%)	47 (44.3%)	201 (48.0%)	
21-25	110 (35.1%)	38 (35.8%)	148 (35.3%)	
26-30	23 (7.3%)	8 (7.5%)	31 (7.4%)	
31-35	15 (4.8%)	8 (7.5%)	23 (5.5%)	
36-40	11 (3.5%)	5 (4.7%)	16 (3.8%)	
Average age (DS)	22.1 (4.6)	22.7 (5.2)	22.2 (4.8)	0.801
Minimum-Maximum	17-40	17-39	17-40	
Marital status				0.917
Single	287 (91.7%)	96 (90.6%)	383 (91.4%)	
Married	12 (3.8%)	5 (4.7%)	17 (4.1%)	
Cohabiting	14 (4.5%)	5 (4.7%)	19 (4.5%)	
With Whom?				0.061
Family	270 (86.3%)	85 (80.2%)	355 (84.7%)	
Friends	15 (4.8%)	12 (11.3%)	27 (6.4%)	
Alone	28 (8.9%)	9 (8.5%)	37 (8.8%)	
Occupation				0.917
Student	109 (34.8%)	36 (34.0%)	145 (34.6%)	
Studies and independent worker	84 (26.8%)	27 (25.5%)	111 (26.5%)	
Studies and dependent worker	120 (38.3%)	43 (40.6%)	163 (38.9%)	
Level of Schooling				0.252
Undergrad	303 (96.8%)	100 (94.3%)	403 (96.2%)	
Postgrad	10 (3.2%)	6 (5.7%)	16 (3.8%)	
School/Program				0.404
Law	174 (55.6%)	72 (67.9%)	246 (58.7%)	
Psychology	84 (26.8%)	18 (17.0%)	102 (24.3%)	
Optometry	28 (8.9%)	8 (7.5%)	36 (8.6%)	
Others	27 (8.5%)	8 (7.5)	35 (8.4%)	

n= Participants; SD= Standard Deviation.

where they study, faculty/program, municipality and area where they live, affiliated health system, access to drinking water, practice of some sport, diagnosis of sleep disorder, was or has been overweight, food belief, place of eating and buying food and the different KIDMED variables) and ordinal (level of education, socioeconomic status, weight classification and health risk) percentages were obtained. According sex, for comparisons between variables, chi square test was used. For all statistical tests, the level of significance was set at $\alpha = 0.05$. We used SPSS (version 23.0, SPSS Statistics; IBM, Corp, Armonk, NY, USA)

RESULTS

The statistical results of the research are presented below. For the presentation of the statistical results, the following order of the tables was followed. First, the sociodemographic characteristics (Table 1) and the lifestyle regarding sports and sleep (Table 2) of the study participants are shown. It ends by showing the results of the Food Desert Survey (EDA) and its different factors such as dietary beliefs (Table 3), places to eat (Table 4) and food purchases (Table 5) and the Mediterranean diet quality test -KIDMED (Table 6).

Table 2. Lifestyles (sport and sleep) of the study participants

	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
Does sports				< 0.001 *
NO	201 (64.2%)	47 (44.3%)	248 (59.2%)	
YES	112 (35.8%)	59 (55.7%)	171 (40.8%)	
How many hours a week do you train or exercise?				
0	159 (50.8%)	33 (31.1%)	192 (45.8%)	
1-5	98 (31.3%)	37 (34.9%)	135 (32.2%)	
> 6	56 (17.8%)	36 (33.9%)	92 (21.9%)	
Mean (SD)	2 (3.5)	4 (4.5)	3 (3.8)	0.002 *
Minimum-Maximum	0-22	0-25	0-25	
On average, how many hours do you usually sleep per night?				
3-4	23 (7.3%)	9 (8.5%)	32 (7.6%)	
5-6	171 (54.6%)	62 (58.5%)	233 (55.6%)	
7-8	101 (32.3%)	34 (32.1%)	135 (32.2%)	
>9	18 (5.8%)	1 (0.9%)	19 (4.5%)	
Mean (SD)	6 (1.5)	6 (1.2)	6 (1.4)	0.345
Minimum-Maximum	(3-12)	(3-9)	(3-12)	
If you have a sleep disorder, what is it called?				0.430
Has none	295 (94.2%)	102 (96.2%)	397 (94.7%)	
Insomnia	11 (3.5%)	2 (1.9%)	13 (3.1%)	
Sleep paralysis	1 (0.3%)	1 (0.9%)	2 (0.5%)	
Others	6 (1.9%)	1 (0.9%)	7 (1.7%)	

n= Participants; SD= Standard Deviation.

Table 3. Study Participants' Food Desert. EDA Factor 1: Dietary beliefs

EDA Factor 1: Dietary beliefs				
	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
1. Do you think the food you eat is nutritious?				0.978
NO	97 (31.0%)	33 (31.1%)	130 (31.0%)	
YES	216 (69.0%)	73 (68.9%)	289 (69.0%)	
2. Do you believe that the food you eat is fresh?				0.177
NO	76 (24.3%)	19 (17.9%)	95 (22.7%)	
YES	237 (75.7%)	87 (82.1%)	324 (77.3%)	
3. Do you think the food you eat is healthy?				0.997
NO	121 (38.7%)	41 (38.7%)	162 (38.7%)	
YES	192 (61.3%)	65 (61.3%)	257 (61.3%)	
4. Do you believe that the food you eat allows you to control your weight?				0.452
NO	161 (51.4%)	59 (55.7%)	220 (52.5%)	
YES	152 (48.6%)	47 (44.3%)	199 (47.5%)	
5. Do you prefer food labeled low-calorie?				0.017 *
NO	162 (51.8%)	69 (65.1%)	231 (55.1%)	
YES	151 (48.2%)	37 (34.9%)	188 (44.9%)	
6. Do you use organic products?				0.003 *
NO	147 (47.0%)	32 (30.2%)	179 (42.7%)	
YES	166 (53.0%)	74 (69.8%)	240 (57.3%)	
7. Do you check that the food you buy or consume is certified, either by INVIMA, ICA or ICONTEC?				0.829
NO	215 (68.7%)	74 (69.8%)	289 (69.0%)	
YES	98 (31.3%)	32 (30.2%)	130 (31.0%)	

n= Participants.

Description of the sample according to sociodemographic and socioeconomic characteristics

Table 1 shows that 419 university students participated in this study: 313 women and 106 men. Total participants' mean age was 22, with an age range from 20 to 40 years old. The majority of university students reside in the city of Medellín and its Metropolitan Area of Valle de Aburrá (MAAV) (93.3%), in the urban area (95.5%) in the Antioquia Department in Colombia, with a medium level (3 and 4) of socioeconomic

status (63.0%), and are affiliated with a health service provider (80.0%). On the other hand, they report having access to drinking water in their utilities (99.3%). Comparison between sex, significant differences were not found according to sociodemographic and socioeconomic characteristics.

Lifestyle

Sport and sleep Lifestyle: Table 2 shows that most of the participants do not do any sports. According to sex, significant differences were found ($p \leq 0.002$), the majority of women re-

Table 4. Study Participants' Food Desert. EDA Factor 2: Place to eat

EDA Factor 2: Place to eat				
	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
1. Where do you usually eat during the week? [Breakfast] [Breakfast]				0.030*
At Home	228 (72.8%)	85 (80.2%)	313 (74.7%)	
Brings food	31 (9.9%)	5 (4.7%)	36 (8.6%)	
Restaurant (Work or school)	50 (16.0%)	14 (13.2%)	64 (15.3%)	
Fast food establishment	0 (0.0%)	2 (1.9%)	2 (0.5%)	
Neighborhood store	4 (1.3%)	0 (0.0%)	4 (1.0%)	
2. Where do you usually eat during the week? [Lunch]				0.188
At Home	129 (41.2%)	56 (52.8%)	185 (44.2%)	
Brings food	74 (23.6%)	18 (17.0%)	92 (22.0%)	
Restaurant (Work or school)	108 (34.5%)	31 (29.2%)	139 (33.2%)	
Fast food establishment	2 (0.6%)	1 (0.9%)	3 (0.7%)	
3. Where do you usually eat during the week? [Dinner]				0.551
At Home	268 (85.6%)	88 (83.0%)	356 (85.0%)	
Brings food	14 (4.5%)	5 (4.7%)	19 (4.5%)	
Restaurant (Work or school)	17 (5.4%)	8 (7.5%)	25 (6.0%)	
Supermarket	1 (0.3%)	0 (0.0%)	1 (0.2%)	
Fast food establishment	13 (4.2%)	4 (3.8%)	17 (4.1%)	
Neighborhood store	0 (0.0%)	1 (0.9%)	1 (0.2%)	
4. Where do you usually eat on the weekend? [Breakfast]				0.539
At Home	298 (95.2%)	98 (92.5%)	396 (94.5%)	
Brings food	1 (0.3%)	2 (1.9%)	3 (0.7%)	
Restaurant (Work or school)	10 (3.2%)	5 (4.7%)	15 (3.6%)	
Supermarket	1 (0.3%)	0 (0.0%)	1 (0.2%)	
Fast food establishment	1 (0.3%)	0 (0.0%)	1 (0.2%)	
Neighborhood store	2 (0.6%)	1 (0.9%)	3 (0.7%)	

n= Participants.

Table 4 continuation. Study Participants' Food Desert. EDA Factor 2: Place to eat

EDA Factor 2: Place to eat				
	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
5. Where do you usually eat on the weekend? [Lunch]				0.471
At Home	212 (67.7%)	73 (68.9%)	285 (68.0%)	
Brings food	11 (3.5%)	7 (6.6%)	18 (4.3%)	
Restaurant (Work or school)	82 (26.2%)	26 (24.5%)	108 (25.8%)	
Supermarket	1 (0.3%)	0 (0.0%)	1 (0.2%)	
Fast food establishment	6 (1.9%)	0 (0.0%)	6 (1.4%)	
Neighborhood store	1 (0.3%)	0 (0.0%)	1 (0.2%)	
6. Where do you usually eat on weekends? [Dinner]				0.518
At Home	147 (47.0%)	50 (47.2%)	197 (47.0%)	
Brings food	7 (2.2%)	5 (4.7%)	12 (2.9%)	
Restaurant (Work or school)	105 (33.5%)	33 (31.1%)	138 (32.9%)	
Fast food establishment	52 (16.6%)	16 (15.1%)	68 (16.2%)	
Neighborhood store	2 (0.6%)	2 (1.9%)	4 (1.0%)	
7. [YES] Do you believe that the food you consume at ____ is good quality?				0.020*
At Home	293 (93.6%)	92 (86.8%)	385 (91.9%)	
Brings food	4 (1.3%)	3 (2.8%)	7 (1.7%)	
Restaurant (Work or school)	7 (2.2%)	8 (7.5%)	15 (3.6%)	
Supermarket	2 (0.6%)	0 (0.0%)	2 (0.5%)	
Fast food establishment	0 (0.0%)	1 (0.9%)	1 (0.2%)	
Neighborhood store	0 (0.0%)	1 (0.9%)	1 (0.2%)	
No reply	7 (2.2%)	1 (0.9%)	8 (1.9%)	
8. [[NO] Do you think that the food you eat at ____ is good quality?				0.633
At Home	19 (6.1%)	11 (10.4%)	30 (7.2%)	
Brings food	22 (7.0%)	9 (8.5%)	31 (7.4%)	
Restaurant (Work or school)	66 (21.1%)	18 (17.0%)	84 (20.0%)	
Supermarket	3 (1.0%)	0 (0.0%)	3 (0.7%)	
Fast food establishment	97 (31.0%)	35 (33.0%)	132 (31.5%)	
Neighborhood store	11 (3.5%)	4 (3.8%)	15 (3.6%)	
No reply	95 (30.4%)	29 (27.4%)	124 (29.6%)	

n= Participants.

Table 5. Study Participants' Food Desert. EDA Factor 3: Food purchase

EDA Factor 3: Food purchase				
	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
1. Do you think the prices of the food you eat are fair?				0.455
NO	173 (55.3%)	63 (59.4%)	236 (56.3%)	
YES	140 (44.7%)	43 (40.6%)	183 (43.7%)	
2. Are you the one who buys the food you eat?				0.409
NO	171 (54.6%)	53 (50.0%)	224 (53.5%)	
YES	142 (45.4%)	53 (50.0%)	195 (46.5%)	
3. Who buys it?				0.177
Mom	73 (23.3%)	20 (18.9%)	93 (22.2%)	
Dad	14 (4.5%)	6 (5.7%)	20 (4.8%)	
Parents	47 (15.0%)	5 (4.7%)	52 (12.4%)	
Family (Everyone)	12 (3.8%)	7 (6.6%)	19 (4.5%)	
Mom and I	5 (1.6%)	1 (0.9%)	6 (1.4%)	
Me	23 (7.3%)	6 (5.7%)	29 (6.9%)	
Spouse	1 (0.3%)	1 (0.9%)	2 (0.5%)	
Grandmother	6 (1.9%)	3 (2.8%)	9 (2.1%)	
Relatives (Aunt, cousin, etc.)	14 (4.5%)	6 (5.7%)	20 (4.8%)	
Boarding house owner / other	4 (1.3%)	2 (1.9%)	6 (1.4%)	
Housekeeper	1 (0.3%)	2 (1.9%)	3 (0.7%)	
No reply	113 (36.1%)	47 (44.3%)	160 (38.2%)	
4. Where do you usually buy and eat your food?				0.972
Traditional stores	45 (14.4%)	16 (15.1%)	61 (14.6%)	
Hypermarkets	10 (3.2%)	4 (3.8%)	14 (3.3%)	
Supermarkets	230 (73.5%)	77 (72.6%)	307 (73.3%)	
Fairs or marketplaces	19 (6.1%)	7 (6.6%)	26 (6.2%)	
Specialty Stores	7 (2.2%)	2 (1.9%)	9 (2.1%)	
Diet/herbalist stores	2 (0.6%)	0 (0.0%)	2 (0.5%)	

n= Participants.

Table 5 continuation. Study Participants' Food Desert. EDA Factor 3: Food purchase

EDA Factor 3: Food purchase				
	Female	Male	Total sample	Chi-Square Test
	n (%)	n (%)	n (%)	P Value
5. Another place? Which one?				0.264
Supermarkets	4 (1.3%)	4 (3.8%)	8 (1.9%)	
Neighborhood/traditional stores	12 (3.8%)	3 (2.8%)	15 (3.6%)	
Specialty Stores	4 (1.3%)	0 (0.0%)	4 (1.0%)	
Marketplaces/Markets	6 (1.9%)	1 (0.9%)	7 (1.7%)	
Different places (neighborhood stores, Supermarkets, squares, etc.)	1 (0.3%)	2 (1.9%)	3 (0.7%)	
University cafeteria	1 (0.3%)	0 (0.0%)	1 (0.2%)	
Has no other place	285 (91.1)	96 (90.6%)	381 (90.9%)	

n= Participants.

port not participating in sports activities and the majority of men report having some sports activity. Regarding sleep, the majority, independent of sex, report sleeping around 6 hours at night, and do not report having been diagnosed with any sleep disorder; however, a much lower percentage report having suffered from insomnia.

Height/weight Lifestyle: Regarding height, women's average height is 161cm (range= 147-181cm) and men's is an 175cm (range= 159-193cm).

Regarding weight, independent of sex, most are not or were ever overweight (68.7%). However, some indicated having suffered from this condition. Of the 419 participants, only 10 women and 5 men (n=404) who reported being overweight did not respond to the number of months they had been overweight. Among the 404 participants who responded to the number of months they had been overweight (women n=303 and men n=101), the mean was 8 months with this condition and the range of time ranged from 0 to 360 months (30 years). According to sex, women had been overweight for about 7 months (range 0-360) and men for 11 months (range 0-120). Regardless of sex, in the last three months, there was an average weight gain of 2 kilograms (2.4%) and also a weight loss of 1 kilogram (2.1%). Regarding weight, women's average 59kg (range= 40-90kg) and men 73kg (range= 50-120kg).

When determining BMI by sex, it is observed that women have an average of 22.6 (BMI range= 14.9-36.8) and men 23.8 (BMI range= 16.8-37.0). According to the World Health Organization (WHO) classification of obesity and health risk,

the majority are grouped in the normal weight category and have an average health risk (66.3%). According to sex, 70.0% of the women and 55.7% of the men have healthy weight (normal weight). According to height and weight, significant differences were found ($p < 0.001$).

Food Desert Survey

Table 3, 4 y 5 shows the descriptive results on the Food Desert Survey (EDA, in Spanish).

Dietary beliefs: Regardless of sex in the *food belief factor* (Table 3), the majority reported that the food they consume is nutritious, fresh and healthy. As to whether they prefer foods whose labeling states that they are low in calories. As for the consumption of organic products, 57.3% prefer them. On the other hand, 69.0% reported that they do not check that the food they buy or consume is certified, either by the National Institute for Drug and Food Surveillance -INVIMA-, the Colombian Agricultural Institute -ICA- or the Colombian Institute of Technical Standards and Certification -ICONTEC-, yet 31.0% do. There were significant differences at foods whose labeling states that they are low in calories and consumption of organic products ($p < 0.020$).

Place to eat: Regardless of sex, in the *place to eat factor* (Table 4), most reported that they usually eat breakfast (74.7, 94.5%), lunch (44.2, 68.0%) and dinner (85.0, 47.0%) at home in the week and weekends, respectively. The vast majority believe that the food consumed at home is good quality. There were significant differences at to eat breakfast at home and the food quality ($p \leq 0.030$).

Table 6. Mediterranean diet quality test in university students

Test KIDMED	Female	Male	Total sample	Chi-Square Test
	n= (%)	n (%)	n (%)	P Value
1. Do you eat a fruit or drink a natural juice every day?	205 (65.5%)	70 (66.0%)	275 (65.6%)	0.919
2. Do you eat two servings of fruit every day?	63 (20.1%)	21 (19.8%)	84 (20.0%)	0.944
3. Do you eat fresh or cooked vegetables (salads) regularly once a day?	218 (69.6%)	66 (62.3%)	284 (67.8%)	0.160
4. Do you eat fresh or cooked vegetables regularly more than once a day?	98 (31.3%)	34 (32.1%)	132 (31.5%)	0.883
5. Do you eat fish regularly, at least 2 to 3 times a week?	39 (12.5%)	17 (16.0%)	56 (13.4%)	0.349
6. Do you go once or more a week to fast food places such as hamburger joints, pizzerias, sandwich shops, hot dogs, etc.?	201 (64.2%)	66 (62.3%)	267 (63.7%)	0.718
7. Do you like legumes and eat them more than once a week?	237 (75.7%)	73 (68.9%)	310 (74.0%)	0.165
8. Do you eat pasta or rice almost daily, at least 5 days or more a week?	236 (75.4%)	90 (84.9%)	326 (77.8%)	0.042*
9. Do you eat a cereal or byproducts (bread, etc.) for breakfast?	227 (72.5%)	82 (77.4%)	309 (73.7%)	0.328
10. Do you eat nuts (walnuts, almonds, peanuts, grapes, and prunes, etc.) regularly, at least 2 to 3 times a week?	135 (43.1%)	40 (37.7%)	175 (41.8%)	0.330
11. Do you use olive oil at Home?	161 (51.4%)	62 (58.5%)	223 (53.2%)	0.208
12. Actually, do you never eat breakfast?	110 (35.1%)	29 (27.4%)	139 (33.2%)	0.141
13. Do you have dairy foods for breakfast (yogurt, milk, cheese, cheese, etc.)?	245 (78.3%)	75 (70.8%)	320 (76.4%)	0.115
14. Do you eat breakfast with bakery or fried foods?	126 (40.3%)	55 (51.9%)	181 (43.2%)	0.037*
15. Do you eat two servings of yogurt and/or a slice of cheese (40 grams) every day?	107 (34.2%)	39 (36.8%)	146 (34.8%)	0.626
16. Do you eat sweets and candies several times a day?	160 (51.1%)	56 (52.8%)	216 (51.6%)	0.760
KIDMED Index				
Mean (SD)	6.3 (2.3)	6.3 (2.3)	6.0 (2.3)	
Minimum-Maximum	1-12	0-12	0-12	
KIDMED Index				0.149
< 3 (low adherence)	33 (10.5%)	14 (13.2%)	47 (11.2%)	
4 to 7 (medium adherence)	185 (59.1%)	60 (56.6%)	245 (58.5%)	
> 8 (high adherence)	95 (30.4%)	32 (30.2%)	127 (30.3%)	

n= Participants; SD= Standard Deviation.

Food purchase: Regardless of sex, in the food purchase factor (Table 5), regarding food prices, 56.3% do not believe that the prices of the food they eat are fair, while 43.7% report the opposite. As for who buys the food, 53.5% of the participants report not buying it, and 46.5% buy it themselves. Parents and family, -mom, dad, parents, family (all), mom and me- predominate (45.3%) as those who buy their food although mom is the one who has the highest frequency in the study sample (22.2%). The usual places to purchase their food are supermarkets (73.3%). Significant differences were not found between variables.

Mediterranean diet quality test KIDMED

Table 6. shows the 419 participants' descriptive results on the Mediterranean diet quality test. Regardless of sex, the participants had a mean adherence (mean= 6.3; range 0-12). Indicating that the university students in this study need to improve their dietary pattern to adapt it to the Mediterranean model. Significant differences were found at consumption of pasta, rice, bakery or fried foods ($p < 0.05$).

DISCUSSION

The objective of this research was to determine and describe the presence of food deserts in institutional settings based on the level of adherence to the Mediterranean diet. For this purpose, the Food Deserts Survey -EDA- and the Mediterranean Diet Adherence Test -KIDMED- were applied to students from higher education institutions in the Metropolitan Area in Valle de Aburrá, Colombia. The study results indicate, on the one hand, an average level of adherence to the Mediterranean diet. On the other hand, an average level of food desertification in higher education institutions in the area under study.

In first place, studies on food desertification have focused on the analysis of the phenomenon in territorial zones of urban areas: peripheral areas with low levels of infrastructure and equipment for the supply of public services, and high levels of socio-spatial and socio-economic exclusion; or rural areas that have lost their productive agricultural vocation and/or are located far from food distribution channels and supply chains⁶. Thus, the categories analyzed in studies have been supermarket, distance and food characteristics distance and food access⁹⁻¹¹. Hence, this study proposes the category of 'institutional food deserts', defined as institutional infrastructures of long-term people accommodation, where food is demanded by those who stay in them and whose supply does not satisfy qualitatively and/or quantitatively the nutritional needs. This definition includes educational institutions (schools, colleges, and universities), public squares, recreational parks, large-scale industrial, commercial, or service companies, and others. Universities are considered in this study as places where students spend a significant amount of their day and, in that sense, where they should demand

healthy food. In this way, universities are a suitable place to examine institutional food desertification.

The EDA application indicates that the university population satisfies its food demand at home: breakfast (74.7%), lunch (44.2%) and dinner (85.0%), and usually buys and consumes food in supermarkets and traditional shops (73.3%). These data suggest that the universities do not have an adequate food offer and that food prices are exceeding the financial possibilities of the university population to buy food. The KIDMED results indicate that adherence to the Mediterranean diet is average in the population under study (58.5%). The data collected indicate that students should improve their eating habits in some elements to adjust them to the Mediterranean pattern, given the very low percentage of consumption: increase the consumption of fruits (20.0%), fresh or cooked vegetables (31.5%), fish (13.4%), nuts (41.8%) and yoghurts or cheeses (34.8).

According to the data from both instruments -EDA and KIDMED- the need to improve the dietary pattern to adapt it to the Mediterranean model and the characteristics of the demand for food in university facilities by students may indicate a hidden presence of food desertification in higher education institutions in Medellín and its Metropolitan Area. In this sense, it is recommended that university authorities, in collaboration with the entire university community (students, teachers, administrative and support staff), design, implement and evaluate strategies to provide access to and the availability of adequate food within their facilities. In this way, public authorities must, on the one hand, regulate the supply of food and, on the other hand, design, implement and evaluate public policies geared towards guaranteeing access to and the availability of adequate food in educational institutions. These institutional strategies and public policies should include increasing the supply of healthy and Mediterranean-style foods, and price controls on the supply of these foods within educational institutions.

CONCLUSIONS

There is a clear global trend of increasing overweight and obesity in adults, and its increase in all regions and sub regions of the world. Therefore, it is necessary to propose appropriate clear strategies to reverse the condition and the complex negative repercussions on other systems, such as health and food systems. A determining factor in overweight and obesity is diet, conditioned by access, availability, and adequacy of food. Thus, the difficulty in access or availability, or the lack of an adequate diet are linked to the presence and increase of food insecurity and, therefore, to the multiple forms of malnutrition. Given the need to act quickly and effectively against the rise of obesity and overweight, it is necessary to contribute to the study of this threat in different scenarios, individual and collective, through the evaluation of food consumption and diet quality.

After applying the EDA and the KIDMED test to university students in The Metropolitan Area of the Aburrá Valley the results showed that the participants had average adherence (58.5%) to the Mediterranean diet, which implies that they need to improve their dietary pattern to adapt it to the Mediterranean model. On the other hand, regarding the EDA, most reported that the food they consume is nutritious (69.0%), fresh (77.3%) and healthy (61.3%) and they usually eat breakfast (74.7%), lunch (44.2%) and dinner (85.0%) at home in the week. This leaves a significant margin of food supply in higher education institutions to which they are linked.

The KIDMED data showed that regardless of gender, participants need to improve their dietary pattern to fit the Mediterranean model, which could indicate a hidden presence of food deserts. This is consistent with the relationship between food desertification and obesity eating problems¹⁷⁻¹⁹ and makes evident the need to incentivize healthy food offerings in institutional settings^{14,15,28,29,36-38}.

RECOMMENDATIONS

Hence, based on the results of this study, it is recommended that strategies and public policies be adopted to address the hidden food desertification that is present in higher education institutions in Medellín and its Metropolitan Area. These should guarantee the participation of the entire university community and include the improvement of food offerings and price control. This improvement in offer should lead to increased consumption of fruit, fresh or cooked vegetables, fish, nuts and yoghurt or cheese. Price controls should have an impact on increasing the demand for food in university facilities. Finally, the objective is to contribute to improving the adherence of the university population to the Mediterranean diet, to reduce institutional food desertification in universities and, thus, to guarantee the right to nourishment and food nutritional security.

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