

## Nutritional quality of food consumed by students in the university cafeterias as a risk factor for non-communicable chronic diseases

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### Abstract

**Background:** University students are a vulnerable group as it relates to nutrition; their family eating habits do not influence them when it comes to making eating choices. Their eating habits are guided by criteria such as fast access to food and low prices resulting in an unhealthy diet that becomes a risk factor for non-communicable chronic diseases.

**Methods:** The purpose of this observational, cross-sectional descriptive study is to analyze the nutritional quality of food consumed by students in the cafeterias of a private university. This study details the nutritional quality, including saturated fat, trans fat, simple sugars, glycemic index and glycemic load values in foods most frequently eaten by university students in the university restaurants. A food frequency questionnaire was distributed to 208 students, 32 initially and 176 former scholarships, 9% of them were male and 91% female students; additionally, the reference values of the nutritional labeling of the products, the glycemic index table of American Diabetes Association, the food composition table to estimate nutrient intake in Ecuador and an analysis of direct nutritional composition of some foods were used as instruments and sources of information.

**Results:** The results show a consumption pattern of processed foods that are high in saturated fat; in three of these foods the glycemic index is high as well as their glycemic load, and their high consumption could constitute a risk factor for Non-Communicable Chronic Diseases; only one of the pattern foods has in its composition mainly protein, low in carbohydrates and fats.

**Conclusions:** Based on the consumption of processed foods that are high in saturated fat and have a high glycemic load, university students have unhealthy eating habits.

### Background

University students are considered a vulnerable population in several aspects including nutrition. Food intake has a significant influence on health, especially the prevention of health problems, such as non-communicable chronic diseases (NCDs) [1]. Eating habits are established during childhood. Family and school influence most of these eating preferences. University students tend not to be influenced by their familial eating habits; instead their eating habits are driven by individual preferences, access to financial resources, fast food availability and greater independence influenced by esthetic patterns, particularly in females [2]. Class load, chaotic study schedule, and lack of time to exercise also make the students susceptible to developing obesity, a risk factor associated with cardiovascular disease [3].

Both, the general population and adolescents, during the last decades are part of what has been called "nutritional transition" which is characterized by low consumption of vegetables and fruits and an increase in the consumption of foods of high caloric density, that are available at a relatively low cost, this added to the change of social or cultural habits, an accelerated rhythm of life, smoking and alcohol consumption, have been related to the increase in the prevalence of NCDs such as diabetes, hypertension, overweight and obesity [2]. An inherent feature of the university students is the consumption of

unhealthy fast food; it is characterized because does not provide benefits to the body, it is high calorie and is not a source of vitamins or minerals. The university students live in a world where the study conditions, lack of time, and poor eating habits make fast food an easy and convenient choice. This fast food provides large amounts of saturated fat, trans fat and simple sugars, increasing their risk for NCDs [1].

According to the World Health Organization [4], NCDs are the main cause of global mortality and disability. The worldwide prevalence of overweight and obesity in children and adolescents (from 5 to 19 years old) has increased dramatically, from 4% in 1975 to over 18% in 2016. This increase has been similar in both sexes: 18% of girls and 19% of boys were overweight in 2016. While in 1975 less than 1% of children and adolescents aged 5 to 19 were overweight, in 2016 6% of

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**Key words:** nutritional quality of food, food consumption, saturated fat, trans fat, processed food, non-communicable chronic diseases, risk factor

**Received:** October 22, 2018; **Accepted:** November 08, 2018; **Published:** November 12, 2018

girls and 8% of boys were overweight; In recent years there has been an increase of health problems, often associated with poor eating habits; this has become a serious public health problem [5]. In Ecuador, the national health and nutrition survey (ENSANUT-ECU-2012) shows to obesity as the main modifiable risk factor for the development of NCDs. The prevalence of overweight and obesity in 2012 in the group of 19 to 29 years is 46.4%; the prevalence of overweight and obesity in the adult population is 62.8%. The prevalence of overweight and obesity is 5.5 points higher in women (65.5%) than in men (60%). The rates of overweight and obesity increases with the economic level; thus, adults in the richest quintile have the highest prevalence of overweight and obesity compared to adults in the poorest quintile (66.4% vs. 54.1%). But, in any case, the estimated prevalence constitute a real public health problem [6].

In the same study (ENSANUT-ECU-012), other information is show, as the excessive consumption of fats is related to urbanization, 29.9% of the Ecuadorian population has a high consumption of carbohydrates; in the young people aged 10 to 19 years, 81.5% report consuming foods with a high content of simple sugars. It is emphasized that the excessive consumption of this nutrient increases as the years pass [6]. The scientific evidence has shown that NCDs are associated with three modifiable risk factors namely physical inactivity, tobacco consumption and unhealthy eating habits that include little fruit and vegetables intake [7]. Based on the facts above, this study attempts to determine the nutritional quality of foods consumed by students in the university cafeterias.

## Materials and methods

This observational, cross-sectional descriptive study examined variables such as the quality of fats and carbohydrates, food consumption pattern, and the nutritional value of the most consumed foods in the university cafeterias of a large university in Ecuador, from August to December 2014. Regular attendance to classes was a criterion for inclusion in the study. The survey and the consent form were sent via email to all sixth, seventh and eighth-level students (N=208), between 19 to 22 years old; 65 of them signed the consent form, 63 completed the survey, however, the sample takes into account only the surveys that were fully completed and then were chosen for the development of this study (n=43), it seems a non-probabilistic convenience sampling. Those containing mistakes were discarded.

The food consumption frequency survey was conducted on the Internet using the Food and Nutritional Surveillance Software of SIVAN PUCE project. Upon accessing the survey, the student was able to graphically identify each food with the measure of one serving size; so that they could select the times and amount that they ate that food.

For data collection, a food list was prepared by observing the foods offered in the different cafeterias, and in some cases the foods on the menus served in the place were considered. The food frequency survey used in this study was adapted from a Colombian instrument [8]. The adapted instrument comprised 139 foods sold in the cafeterias, grouped as follows: 12 types of snacks, 7 types of chocolate, 9 types of cookies, 8 ice cream flavors, 9 sugary drinks, 8 hot drinks, 4 milk drinks and 82 processed products.

## Data analysis

The information of the students' weekly consumption established their pattern of food consumption [9,10]; through this pattern, the 10 most frequently consumed foods were identified. Afterwards, the

nutritional value of each food was analyzed, in terms of macronutrients and micronutrients, as well as its nutritional quality, according to its content of saturated fat, trans fat, simple sugars, glycemic index and glycemic load.

The sources of information used to establish the values of nutritional quality were the reference values of the nutritional labeling of the products offered in the canteens of the university [11], the glycemic index table of American Diabetes Association (ADA) [12], which contains foods similar to those of the study, the food composition table to estimate nutrient intake in Ecuador for some foods that did not have nutritional labeling [13]. Finally, bromatological analyses reports of processed foods that did not contain nutritional information were used; the analyses of these foods were previously carried out at InbioTec laboratory under the SIVAN PUCE project.

The "Nutritional labeling of processed foods" of Ecuador offers consumers information on the content of nutrients as well as messages related to food and health. This appears on the labels of food products, which include a declaration of nutrients or nutritional information, which is the standardized enumeration of the nutrient content of a food, that is, the information on energy, protein, carbohydrates, fat, vitamins and minerals contained in the food products (Ministry of Public Health, 2014).

The glycemic index table of ADA, which comprises 2,487 foods and process manufacturing products, identified according to a literature search of 205 journals indexed in MEDLINE between 1981 and 2007. To incorporate the foods into the table, ADA conducted a manual search of relevant citations; field experiments and published laboratory values were included [12,14].

The "Food composition table to estimate nutrient intake in Ecuador" consists of 672 foods and process manufacturing products distributed as follows: 56 types of legumes and oilseeds; 87 types of vegetables and by-products; 69 types of fruit and derivatives; 5 types of eggs and derivatives; 35 types of fish and shellfish; 87 types of meat and derivatives; 38 types of milk and derivatives; 15 types of fat and oil; 15 types of seasoning products; 38 industrialized and miscellaneous foods; 23 types of sugar and desserts; 35 alcoholic and non-alcoholic beverages; 121 foods prepared with standardized recipes; 48 preparations from national and international food supply chains [13].

Laboratory analyses reports obtained from the SIVAN PUCE project, which determined the nutritional value of each manufactured or prepared food, that is to say, the information on energy, fat, carbohydrates, protein, ash and humidity in 100 g of the processed food. The reports also established the percentage of the daily value of each nutrient based on a 2000 kcal diet.

The study results, on the pattern of food consumption, were obtained through the SIVAN PUCE software, which showed the food consumption in percentages based on the frequency of consumption questionnaire, previously conducted. The foods consumed by 30% of the focus group were verified [9].

After obtaining the students' food consumption pattern, univariate frequency analyses to determine the nutritional value of foods were carried out, categorizing them as high, medium or low in proteins, carbohydrates and fats; then the same analyses were made to determine the nutritional quality criteria of the foods that were high, medium or low in saturated fat, trans fat, simple sugars, glycemic index and glycemic load.

## Results

Table 1 shows the percentage of the 10 most frequently consumed foods by the university students in the canteens of PUCE; it is observed that the main foods of the consumption pattern are processed foods; there is a high consumption (47.84%) of “*chochos con tostado*”, a kind of Andean lupin and corn, that when combined are a source of protein. Foods consumed less frequently (less than 31%) are high in saturated fat, which generate excessive fat storage, affecting body weight, and increasing the risk of suffering cardio-vascular diseases, which are the main causes of death in the world [15].

Table 2 presents the nutritional value of the 10 most consumed foods by the university students based on a diet of 2000 kcal. The foods are detailed according to the percentage of macronutrients; concerning the most consumed carbohydrates, they are simple sugars and they are mostly in foods prepared with saturated fat, such as “*empanada chilena*”, “*empanada de verde*”, “*burritos*” and in processed foods such as “*chocochips*”, becoming a risk factor for the development of NCDs. It is important to point out that “*chochos con tostado*” food is the most consumed food by the students. In addition, it has a different percentage of nutrients since the value of protein (36%) exceeds the value of carbohydrates (7%) and has a lower percentage of vegetable-based fat.

Table 3 shows the content of saturated fat, trans fat, and simple sugars in a 100 g serving size of the ten most consumed foods by the university students. To analyze these variables, both fats and sugars were classified in high, medium and low levels. Among the foods that are high in saturated fat and constitute a risk factor are “*empanadas chilenas*”, “*empanadas de verde*” and vanilla cappuccino. The epidemiological studies that were developed from 1970 to 2013 show that the development of cardiovascular disease depends on the type of fatty acids consumed [15,16].

As shown in the table, foods which are medium in trans-fat are the two types of “*empanadas*”. According to a meta-analysis of prospective studies, it was found that a 2% increase of the total daily energy intake

from trans fats is associated with a 23% increased risk of cardiovascular disease besides weight gain, insulin resistance and the development of some types of cancer, especially breast and prostate cancer [16].

Concerning the consumption of simple sugars, five foods out of the ten listed are high in sugar. The value presented in the table exceeds the one recommended by WHO [17]. In fact, according to the information note on the intake of sugars recommended as a guideline for adults and children, it is advisable that the consumption of free or added sugars should not exceed 5% (25 g) of the total daily caloric intake. The high consumption of sugars is associated with overweight, obesity, liver disorders, behavioral disorders, diabetes, hyperlipidemia and tooth decay [18].

Table 4 presents the glycemic index and the glycemic load values in relation to the weight per serving size of the most consumed foods by the university students. To analyze these variables, the value was classified as high, medium and low levels. Regarding the glycemic index, 50% of the foods have a high value, and the second most consumed food by the students is “*Toni mix*” with the highest value. Concerning the glycemic load, there are two products with high values: “*empanada chilena*” and sugary drinks. This is an important and worrying issue since it has been postulated that a diet based on a high glycemic index, leads to an increase in serum glucose and insulin levels which in turn, would develop obesity, diabetes mellitus, cardiovascular diseases and cancer. Although this theory is interesting, further investigation is necessary since it has not been proven yet [19].

## Discussion

There are a few studies carried out on the quality of food consumed by the students in university canteens. In this investigation, it was observed that the focus group, presented several risk factors for NCDs which derive from the students’ food preferences during their time at university. The most consumed food was “*chochos con tostado*”. However, the students consume other foods high in carbohydrates, fats and sugars, which ingested in higher amounts than those recommended, can trigger NCDs.

**Table 1.** The 10 most frequently consumed foods by university students

N.	Foods most frequently consumed		%
	Generic name	Local labeling name	
1	Andean lupin with toasted corn	<i>Chochos con tostado</i>	47.84%
2	yogurt with cereals	<i>Toni mix</i>	39.14%
3	chocolate cookies	<i>Choco chips</i>	39.14%
4	Chilean patties	<i>Empanada Chilena</i>	39.13%
5	Soft drink tea	<i>Fuze tea</i>	36.36%
6	Soda	<i>Gaseosas</i>	34.79%
7	Fitness cookies	<i>Galletas fitness</i>	30.44%
8	Green banana patty	<i>Empanada de verde</i>	30.44%
9	Vanilla cappuccino	<i>Capuchino de vainilla</i>	30.44%
10	Mexican corn tortilla with beans and meat	<i>Burrito</i>	30.43%

**Table 2.** Nutritional value and percentage of macronutrients per serving, based on a 2000 Kcal diet, of the ten most consumed foods by the university students

Macro Nutrients		FOODS									
		<i>Chocho con tostado</i>	<i>Toni mix</i>	<i>Choco chips</i>	<i>Empanada chilena</i>	<i>Fuze tea</i>	<i>Gaseosas</i>	<i>Galletas fitness</i>	<i>Empanada de verde</i>	<i>Capuchino de vainilla</i>	<i>Burritos</i>
Carbohydrates	g	20	27	37.3	58.8	36.3	48	18.7	29.2	14	22.8
	%	7	14	12	19.7	12	16	6	10	5	12
Fat	g	4	0.8	17.8	15.48	0	0	4.16	13.8	2.1	17.05
	%	6	9	30	25.8	0	0	7	23	4	28
Protein	g	18	10	3.08	21.3	0	0	2	3.6	3.2	16.6
	%	36	12	6	42	0	0	4	7	6	36

**Table 3.** Content of saturated fat, trans fat, and sugars in 100 g serving of the ten most consumed foods by the university students

Foods	Saturated fat/g	Trans fat/g	Sugars/g
Chochos con tostado	0.09*	0 <sup>†</sup>	3.16 <sup>‡</sup>
Toni Mix	2**	0 <sup>†</sup>	12.5 <sup>‡‡</sup>
Choco chips	1.2*	0.001 <sup>††</sup>	20 <sup>‡‡‡</sup>
Empanada chilena	9.9***	0.17 <sup>††</sup>	6.6 <sup>‡‡</sup>
Fuze tea	0*	0 <sup>†</sup>	21 <sup>‡‡‡</sup>
Gaseosas	0*	0 <sup>†</sup>	24 <sup>‡‡‡</sup>
Galletas fitness	3.3**	0 <sup>†</sup>	20 <sup>‡‡‡</sup>
Empanada de verde	7.6***	0.18 <sup>††</sup>	7.8 <sup>‡‡</sup>
Capuchino de vainilla bainillabaaabbbbbbavainilla	8***	0 <sup>†</sup>	49 <sup>‡‡‡</sup>
Burrito	4.46**	0.2 <sup>††</sup>	3.6 <sup>‡</sup>

\*Low saturated-fat &lt;5 g

\*\*Mid saturated-fat 1.5–4.5

\*\*\*High saturated-fat &gt;5 g

†Low trans-fat &lt; 0.5 g

††Mid trans-fat 0.15-0.9g

‡Low in simple sugars

‡‡Medium in simple sugars

‡‡‡High in simple sugars

**Table 4.** Glycemic index and glycemic load values in relation to the weight of the 10 most consumed foods by the university students

Local food	Reference food	Glycemic index	Serving size weight (g)	Glycemic load
Chochos con tostado	Corn	52***	50	10 <sup>††</sup>
Toni mix	Muesli	66***	180	17 <sup>††</sup>
Choco chips	Dough	50**	70	18 <sup>††</sup>
Empanada chilena	Meat Empanada	51***	111	29 <sup>†††</sup>
Bebidas azucaradas (gaseosas and fuze tea)	Coca cola	63***	500	30 <sup>†††</sup>
Galletas fitness	Whole meal biscuits	49**	26	9 <sup>†</sup>
Empanada de verde	Green banana	38**	113	11 <sup>††</sup>
Capuchino de vainilla	Cappuccino	5*	250	7.4 <sup>†</sup>
Burritos	Corn tortilla	52***	160	11.8 <sup>††</sup>

†Low glycemic index &lt;35 g

\*\*Medium glycemic index 35-50 g

\*\*\*High glycemic index &gt;50 g

†Low glycemic load &lt;11 g

††Medium glycemic load 11-20 g

†††High glycemic load &gt;20 g

Source: Atkinson FS, Foster-Powell K, Brand-Miller JC (2008) International Tables of Glycemic Index and Glycemic Load Values: 2008. *Diab Care* 31.

Similar investigations were carried out in Chile, which showed that 58.6% of the students consumed junk food due to inadequate breakfast intake, skipping of certain meal times and the consumption of poor quality food prepared in university canteens, representing a risk factor for NCDs [20]. Other similar results were obtained in the study conducted by Pulido in 2015, who states that 65% of the students have unhealthy lifestyle habits, reflected in the high intake of precooked, high-fat and high-calorie foods, with little nutritional value.

Míguez [21] cites several authors who state that the changes evidenced in the university students' diet can be explained due to factors of different origin: social, cultural and economic factors besides their food preferences. Going to university leads to greater independence and the students must learn to take care of them and that includes knowing about their nutritional patterns. Leaving home can cause a series of negative changes in eating habits. In fact, culinary traditions and the consumption of fresh foods are not the students' option in front of processed and less healthy foods. On the other hand, the consumption of food outside home is a very common practice in this group of students, and often the food on the restaurants' menus is closed or semi-closed. This means that the user has no option to choose.

In addition, there is a variety of foods which are high in fat and calories at an affordable price and the portion sizes tend to be larger.

De Gorbán in the article published by De Piero [22], and Oviedo [15] states that the patterns of food consumption show that Latin American countries follow a diet model that moves away from a healthy pattern; it is characterized by a high consumption of starches, fat and fast food; this is not only due to the food availability, access linked to price, purchasing power, or the increase of fast food on offer, but above all this diet is linked to inadequate eating practices. De Piero asserts that the university students' food consumption is characterized by a "gradual increase of sugary products, processed foods and snacks", similar findings are described in this study. There is also a coincidence in the lower consumption of other food groups such as: dairy products, fruit and vegetables, among others. These patterns of consumption show that the students' diets in Latin American countries are unhealthy. De Piero [22] highlights similar insights in the study carried out by the Argentinian Association of Dieticians and Nutritionists.

This study carried out among the university students concerning their eating preferences, show a greater consumption of high-fat foods, especially saturated fat foods; an aspect that coincides with

the study carried out by [23] which affirms that 10% of the students consume foods high in saturated fat, trans fat and sugars, contained in processed products daily; in the same document the author refers to the consumption of fast foods and fats intake. 4% of the students stated that they consumed fast foods daily and 11% of the students did so 2 to 3 times a week. 9% of them added fat to their food daily and 19% did so 2 to 3 times a week. In addition, 21% of the students consumed fried foods daily and 40% of them did so 2 to 3 times a week. In addition, it turned out that male students consumed more this type of food than female students.

Regarding the glycemic index and glycemic load values of the consumed foods offered in the university canteen of PUCE, these are significantly high; thus, 50% of the most consumed foods has this characteristic; similar data are described in the studies carried out by [24,25] which state that the nutritional habits of the university population are characterized by the low consumption of fruit and water, the use of sugar and salt in the meals, the high intake of carbohydrates and foods high in sugars, such as the consumption of sugary beverages that have a high lipid-metabolic profile.

In conclusion, the results reflect that the university students' diet of PUCE is based on processed foods, poor in micronutrients, high in carbohydrates, simple sugars and saturated fats, which results in an unhealthy eating pattern, a factor that has a direct impact on the development of NCDs.

## Declarations

**Authors' contributions:** ER wrote the initial draft of the manuscript. ER, MA, NS, and SC contributed to the study design and literature search. ER, and MA carried out the data collection. ER, MA, NS and SC analyzed data and prepared data tables. All authors were involved in interpreting the data, writing the paper and had final approval of the submitted and published versions. All authors read and approved the final manuscript.

**Conflict of interest:** No conflict of interest occurs among the authors.

**Availability of data and materials:** The database analyzed during the current study available from the corresponding author on reasonable request.

**Ethics approval and consent to participate:** The research project "Implementation of a nutritional food surveillance system for PUCE students" was approved by the Research Executive committee of the Pontifical Catholic University of Ecuador, was implemented outlined in the principles, philosophy and mission of the University, and adjusted to the purposes and objectives of the PUCE guidelines and those indicated in the approved project. The investigative team obtained approval from the Dean of the Nursing faculty to address the research to the nutrition students of the Nutrition School. Students were included in the study if they sign the Informed consent, it was obtained in online way. All protocols were approved by the Institutional Review Boards of Pontifical Catholic University of Ecuador (study Code K13122).

**Acknowledgment:** The authors thank Tania Estefanía Andrade Murillo, Pamela Estefanía Vaca Castro, Gabriela Rosero and Santiago Loyola, who collaborated in the execution of the project. This article is issued taking as reference some orientations of Andrade and Vaca's dissertations.

**Funding:** This study was funded by provided by the Pontifical Catholic University of Ecuador (Small PUCE Project award 2014

"Implementation of a nutritional food surveillance system for PUCE students", Code. K13122).

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