Journal of Nutrition & Food Sciences
ISSN: 2155-9600
Neira-Mosquera et al., J Nutr Food Sci 2018, 8:2
DOI: 10.4172/2155-9600.1000687
Research Article
Open Access

Nutritional Assessment of the Immigrant Ecuadorian Population in Spain Based on a 24-h Food Recall

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Abstract

There is little information on diet of Ecuadorian immigrant population in Spain. The study carried out a nutritional assessment of the diet of the Ecuadorian immigrant population in Spain to determine differences in food patterns and possible nutritional deficiencies. The nutritional assessment was based on a 24-h food recall survey applied to the Ecuadorian population residing in Murcia (Spain) in combination with the application of national and international food composition data bases. Nutrient intake levels and fulfillment of Dietary Reference Intakes (DRIs) were estimated and statistically tested for social, sex, age and geographical factors. Macronutrient distributions and nutrient intake levels in relation with DRIs were adequate in most cases. Importantly, Ecuadorian food habits were still present in immigrant population, with rice being the main energy source. Intakes levels were significantly different for several nutrients depending on age group, sex, place of residence and professional.

Keywords: Ecuadorian diet; Food patterns; Dietary reference intakes; Immigration; Folates; Vitamin-E

Introduction

Public health problems derived from diet, due to lack of nutrients, are a serious handicap in societies with major inequalities and/or low incomes. However, increasing improvements derived from developed societies are minimizing nutrient deficiencies, while new threats are arising related to the appearance of diet-related diseases [1-3].

The Ecuadorian emigrant population constitutes an important population group in Spain, which mostly resides in the most populated cities of Spain. The modification of food habits of the Ecuadorian population in Spain are dependent upon different factors, such as Ecuadorian food product availability and influencing environmental factors, increase in purchasing power, consumption (restaurant, companies canteens, school food services, etc.). These could be important drivers in the development of nutritional disequilibria with special emphasis on high fat and energy intakes, reduction in complex carbohydrates and fiber, high simple sugar consumption and specific deficits of certain vitamins and minerals, together with an excessive consumption of alcohol [4,5]. Given the impact of immigration on food habits, it is of relevant interest to assess the nutritional quality of the diet of Ecuadorians in Spain and their possible repercussions on the health and welfare of this specific subpopulation in Spain. Estimating food consumption or habits is not an easy task given the great variability between individuals. However, so far, food consumption surveys are the most suitable and feasible tools to measure food consumption in any specific population, even though it is well-known that for specific nutrients other techniques can be applied. However, these can imply higher costs, require high-qualified staff and their outcomes show great dependence on the reliability of responses [6]. Nevertheless, it is worthy to highlight that all assessment methods possess drawbacks and advantages inherent to the technique [7,8]. The method of 24-h food recall can help to obtain a good approximation of the real intake, provided questionnaires are applied at least on two different days (preferably 3) and none of them include weekend intake in which diet usually differs from the rest of the week. Based on this information, the nutritional value of diet can be theoretically estimated, thereby providing a preliminary assessment of the nutritional status of these population groups. The objective of this study was to assess, nutritionally, the diet of the Ecuadorian population in Spain by means of a 24-h food recall survey and determine the predominant food consumption patterns in this population.

Materials and Methods

Theoretical simple size was estimated based on statistics of the Ecuadorian population in Spain according to the Spanish Institute of Statistics (INE) [9] assuming an estimation error below 5% for a confidence interval of 90% according to the parameters used by the project PESA-FAO (2007) [10] for the Central American population; the nominal section was carried out by means of simple random sampling of the population registered in the census [11]. The result obtained corresponded to 200 individuals residing in the region of Murcia, from which data were collected in the cities of Murcia, Cartagena and Lorca. The region includes 13% Ecuadorian population in Spain, which means 3% of the total population in Murcia, this being the region with the highest concentration of Ecuadorians in Spain [9]. This sampling location was chosen because of the numerous Ecuadorian community and networks in this region, which allowed a better development of the survey (e.g. accessibility, facilities and individual selection), an optimization of resources, while it was considered a representative sample for this population in Spain. The selected individual ages ranged between 14 and 69 years old and diverse professional occupations in Spain. The survey was carried out by means of 24-h food recall questionnaires, considering two different days in the week and one during the weekend in different months over a year (three-month interval between interviews). Due to the emigration flow as a

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Received January 17, 2018; **Accepted** February 05, 2018; **Published** February 12, 2018

Citation: Neira-Mosquera JA, Sanchez-Llaguno SN, Pérez-Rodríguez F, Moreno-Rojas R (2018) Nutritional Assessment of the Immigrant Ecuadorian Population in Spain Based on a 24-h Food Recall. J Nutr Food Sci 8: 687. doi: 10.4172/2155-9600.1000687

consequence of the Spanish crisis, only 184 individuals comprised the following study. This number was still deemed sufficient for extracting significant conclusions regarding the diet of Ecuadorians in Spain.

24-h Food recall questionnaire design and food consumption data collection

The 24-h food recall questionnaire was designed to include contact information, food intake (i.e. breakfast, brunch, lunch, afternoon snack, evening snack and dinner), serving size (g) and type of serving. This information was collected to estimate consumption frequency, comparison with DRIs (Dietary Reference Intakes), deficit or excess of nutrients and differences between distinct studied factors [12]. Regarding serving size, when possible, photographs and/or weight were taken from the dishes in order to contrast information given by respondents. Prior to the survey, interviewers were trained by researchers in order to standardize criteria and the data collection methodology.

Data treatment and nutritional assessment of the surveyed population

For the nutritional assessment, information from the 24-h food recall survey was tabulated in Excel (Microsoft, Redman). For conversion of food consumption data and dish formulations, included in the questionnaire, to nutrient intakes, Nutriplato software [13] (www.nutriplato.es) was used based on the food composition data base for Spanish (BEDCA) [14] foods together with values retrieved from other existing data bases (LatinFood, USDA and from scientific literature). Nutritional information was expressed in total energy and nutrient intakes per food and then added so as to obtain intake values for the time of day of food intake and whole day (i.e. daily). The latter was used for comparison with DRIs through the estimation of the percentage (%) of compliance with established DRIs (i.e. % DRIs). In addition, specific classification factors were considered for statistical study such as: sex (man and woman), age groups (14-19, 20-29, 39-39, 40-49, 50-59, 60-69), professional occupation (restaurants, services, administrative, farmer, construction workers) and city (Murcia, Lorca and Cartagena).

Application of dietary reference intakes (DRIs)

For the estimation of the contribution of the diet studied to daily nutrient needs, DRIs proposed by Federación Española de Sociedades de Nutrición, Alimentación y Dietética (FESNAD) [12] for the Spanish population were applied to calculate the percentage of nutrient intakes with respect to these reference values. The used DRIs were "Recommended Intakes" which are defined as the intake of a nutrient that is recommended to meet the requirement of 97.5% healthy Spanish population, expressed for person/day [12]. The exception was Na, whose DRI corresponded to the upper tolerable limit (i.e. safe intake) for this electrolyte. Therefore, conclusions for this electrolyte would be different if DRI were exceeded.

Statistical analysis

The statistical treatment was carried out by means of the software SPSS 15.0 for Windows (Statpoint Technologies, Inc., Chicago). In order to identify differences in relation to %DRI, a multivariate factorial design was used (MANOVA), considering as factors: sex (male and female), age group, occupation and city and as quantitative variables: energy, protein, lipids, carbohydrates, fiber and cholesterol; calcium, magnesium, phosphorus, sodium, potassium, iron, selenium, zinc, manganese, cupper, iodine, vitamin A, vitamin E, ascorbic acid, thiamine, riboflavin, niacin, panthotenic ac., biotin, vitamin B6, vitamin B12, folates, saturated (SFA), monounsaturated (MUFA) and polyunsaturated fatty acids (PUFA); sugar (mono and disaccharides) and polysaccharides. This design allowed determining differences between levels of each factor. In addition, as exclusion criterion of biased responses to the questionnaire, inaccurate reports of energy intake were assessed by the method suggested by Willet and Lenart [7]. The dietary data were excluded for women, when <500 kcal/day or >3500 kcal/day were reported and for men, when these values were <850 kcal/day or >4000 kcal/day [15]. Multivariate models were built on the basis of the social-economic, cultural and personal indicators described above [16]. When significant differences were found for more than two classification factors, a post-hoc analysis was performed based on multiple range Tukey test with a significance level of 95% ($p<0.05$).

Results and Discussion

An assessment of the most consumed foods by Ecuadorian immigrant population was carried out based on the 24-h food recall survey. In Table 1, mean food intakes organized into different food categories are shown, expressed as grams per day (g/day) [17,18]. In this Table, data evidence that the Ecuadorian population, immigrant in Spain, still maintains original [19,20] Ecuadorian food habits since, for example, average rice consumption was high, with of 272 g/day. In addition, a noticeable consumption of yucca or manioc and banana was observed, but it was in smaller amounts than those found in Ecuador due to probably lower availability and higher prices on the Spanish market [17,18]. In addition, high consumption levels were estimated for coffee drinks which were in concordance with Ecuadorian habits. Regarding new food habits acquired in Spain due to the culture shock, pork meat, olive oil, bread and pasta among others showed considerably high consumption level in comparison with those found in Ecuador [17].

Translating these consumption levels into nutrient intakes (Figure 1), it can be observed that the food category with the highest contribution to protein intake was meat and meat products. Energy was mainly obtained from rice, meat and meat products and bread and carbohydrates were obtained from rice and bread [17]. Lipid contribution was mostly derived from sunflower oil and other oils, meat and meat products and milk products. Looking at the fatty acid profile, saturated and monounsaturated fatty acids were obtained from pork, poultry and beef meat and polyunsaturated fatty acids from sunflower oil. Finally, cholesterol was obtained from eggs, poultry and pork meat and Ca intakes from yoghourt and whole milk.

Macronutrient distributions in diet

Macronutrient distributions observed in the studied diet can be considered adequate according to national and international recommendations. In Figure 2, average distributions for carbohydrates, proteins and lipids with respect of their energy contribution are represented. Regarding the fatty acid profile, the major contribution to the energy intake was observed in monounsaturated fatty acids (67%), followed by saturated fatty acids (20%) and finally by polyunsaturated fatty acids (13%). Nevertheless, none exceeded 10% diet calories and the ratio between the sum of monounsaturated and polyunsaturated fatty acids and saturated fatty acids was over 2, whose value is in agreement with recommendations given by national and international organisms [19,20]. This fact supports the fact that the lipid percentage in diet may be in the range 30-35% as recommended for diets with high content of monounsaturated fatty acids.

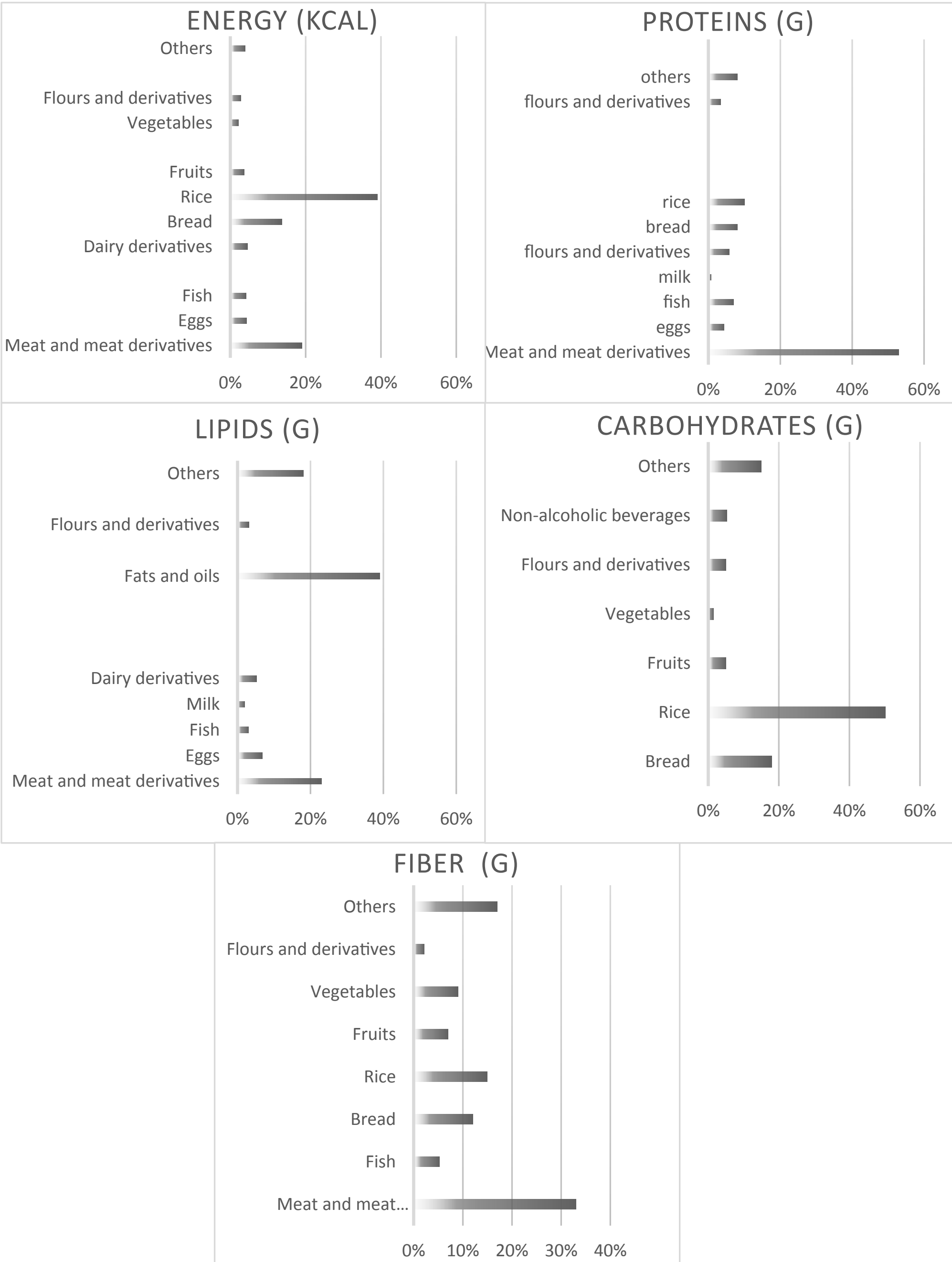
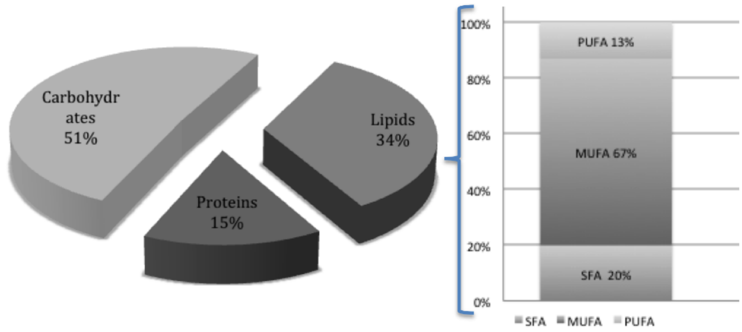


Figure 1: Contribution of different food groups in the intake of protein, energy, lipids, carbohydrates and fiber in the diet of Ecuadorian immigrants in Murcia (Spain). The category "Others" includes several food groups presenting contribution values<1% (Root vegetable, beverages, sugar and sweets, etc.).

Fulfilment of DRIs in the diet of Ecuadorian immigrants in Spain

Overall, results indicated that Ecuadorian immigrants in Spain show relatively high intakes for most nutrients, fulfilling DRIs, although some exceptions were found that will be commented below (Table 2). More specifically, with respect to men, proteins, P, Na, Fe, Mn, thiamin, niacin, vitamin B6, ascorbic ac. and vitamin A are provided in diet at levels above DRIs for all age groups. Moreover, intake levels for energy, lipids, carbohydrates, Ca, Mg, K, Cu, Zn and cholesterol were considered adequate (≥90% DRIs). However, a clear deficiency was detected for fiber, I, Se, folates and vitamin E. With respect to minerals and electrolytes, DRIs were fulfilled for Ca, Mg, K, Fe, Cu and Zn. However, for Mn, P and Na, intakes duplicated the recommended amount. In the case of Mn, the excess was still far from the upper tolerable limit for this element [19,20] However, recommendations for Na used here are given as upper tolerable limits; therefore, the levels found in this study could be considered as a public health problem, especially



Note: PUFA: Polyunsaturated Fatty Acids; MUFA: Monounsaturated Fatty Acids; SFA: Saturated Fatty Acids.

Figure 2: Distribution of energy over macronutrients in the diet of Ecuadorian immigrants in Murcia (Spain).

Meat and meat products (g)	Seafood (g)	Milk and dairy products (g)	Bread and cereals (g)	Legumes and nuts (g)	Vegetables and fruits (g)	Root vegetables (g)	Sugar and sweets (g)	Oils and fats (g)	Non-alcoholic beverages (g)	Alcoholic beverage (g)
(288.5)[1]	(72.3)	(107.4)	(435)	(59.4)	(277)	(136)	(25.7)	(17.2)	(848.4)	(90.7)
Beef 43.6	White fish 27.4	Skimmed milk 10.1	White wheat bread 93.1	Legumes (lentis, frijols) 48.3	Ají (ecuadorian pepper)[2] 1.8	Potato 90.2	Refine sugar 11.1	Sunflower oil 10.5	Coffee 416.8	Beer 75.5
Pork 89.7	Oily fish 9.4	Whole milk 160.9	Whole wheat bread 6.2	Broad bean 4.5	Cabbage 7.0	Yuca 12.6	Brown sugar 0.6	Olive oil 6.7	Chocolate 45.3	Wine 12.5
Poultry 82.8	Freshwater fish 1.2	Semiskimmed milk 10.2	Rice 272.0	Peanut 3.6	Lettuce 28.3	Plantain 33.1	Candies and sweeties 6.4	Palm oil 6.7	Sodas 142.1	Spirit drink 2.7
Sheep 0.6	Tuna 20.3	Fresh cheese 38.7	Pasta 45.7	Other nuts (walnut, hazelnut) 3.0	Pepper 21.3		Honey 1.0		Tea 108.1	
Guinea pig 0.7	Sardine 4.4	Hard/semi hard cheese 1.7	Mote 3.9		Tomate 52.6		Mermelade 6.6		Fruit juices 136.1	
Rabbit 4.9	Prawns 6.9	Skimmed youghurt 0.4	Choclo 6.1		Carrot 33.0					
Cow liver 5.6	Bivalves 1.8	Whole youghurt 65.4	Lupin 3.8		Spanish fruits 67.6					
Cow intestine 8.7	Crab 0.9	Butter 1.2			Guineo 47.9					
Pork intestine 1.1					Avocado 6.5					
Other parts 12.7					Tamarillo 1.1					
Ham 13.9										
Sausages 24.7										

Note: [1]Total intake (g) for the food category; [2]Ecuadorian pepper variety

Table 1: Mean food intakes organized into different food categories in Ecuadorian immigrant population of Murcia (Spain) based on a 24-h food recall survey.

for their relationship with cardiovascular diseases and hypertension [5]. In the case of P, a high intake is not a special concern, provided the ratio with respect to Ca is kept to 1/1 (Ca/P) or as maximum 1/1.5 [21]. However, results in our study reveled a ratio Ca/P=1/1.7, slightly over recommendations. To reach a definitive conclusion regarding Ca deficiency, other relevant factors should be assessed such as sunlight exposure, which is a paramount factor needed to synthesize vitamin D and whose main function is to increase Ca absorption in intestine [22]. Nevertheless, Murcia, as a Mediterranean region, possesses one of the highest levels of sunshine hours with 2797 h yearly [23], which would

	Men												Women									
	14-19 Years		20-29 Years		30-39 Years		40-49 Years		50-59 Years		60-69 Years		14-19 Years		20-29 Years		30-39 Years		40-49 Years		50-59 Years	
	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI	Intake	%DRI
Energy (Kcal)	2789.5	93	2502.1	86.9	2770.3	95.5	2637.5	93.2	2649.8	115.2	3210.7	139.6	2887.6	131.3	2522.3	112.8	2592.5	117.8	2830.2	143.8	2597.1	133.6
Proteins (g)	96.9	164.3	99.9	171.8	105.7	167.8	99	158.3	105.3	167.1	105.6	167.6	124.5	282.9	90.7	194.1	95.7	191.4	103.2	202.1	104.1	203.2
Lipids (g)	121.9	110.8	99.2	95.3	109.1	103.9	105.1	102.6	104.6	123	120.6	141.8	101.9	127.3	103.8	127.5	95.1	118.9	109.4	151	107.7	150.4
Carbohydrates (g)	349.1	93.1	321.1	89.7	359.9	100	344.3	97.9	341.1	117.6	451.2	155.6	388.7	141.3	327.5	117.4	360.5	131.1	379.7	152.9	321.8	130.9
Fiber (g)	16.5	43.4	17.7	46.8	18.6	49	16.2	43.8	19.4	64.6	17.7	59.1	17.6	67.7	16.8	65.5	18.8	75	18.7	85.5	18.5	85.9
Ca (mg)	939.1	93.9	907.4	100.8	926.7	103	893	99	949.7	105.5	880.3	88	969.1	96.9	840.4	93.4	792	88	847.5	94.2	915.9	92.4
Mg (mg)	308.2	88.1	325.9	93.1	343.4	98.1	320	91.7	324	92.6	395.8	113.1	291.9	97.3	302.9	99.9	327.2	109.1	299.2	98.3	322	105.7
P (mg)	1628.3	203.5	1507.4	215.3	1563.5	223.4	1449.7	207.1	1471.6	210.2	1473.3	210.5	1589.5	198.7	1360.2	194.3	1380	197.1	1412.3	201.8	1469.3	209.9
Na (mg)	4200.1	280	4727.8	316.7	4875	325	4369.3	295.1	4819	370.7	5708.7	453.8	4849.6	323.3	4800.6	320	4559.3	304	4717.3	314.5	4846.2	372.8
K (mg)	2946	95	2927	94.4	3137.9	101.2	2850.1	91.9	2961.6	95.5	3345.8	107.9	2545	82.1	2711.5	87.5	2970.1	95.8	2985	96.3	2952.2	95.2
Fe (mg)	12.9	117	14.8	164.4	15.9	176.9	14.5	159.3	15.8	175.1	14.4	144.1	16	106.8	14	83.3	14.4	80	15.1	92	15.5	108.8
Cu (mg)	1.1	114	1.1	98.4	1.2	107.3	1.1	97.2	1.1	102.2	1.4	128.6	0.6	57.5	1.1	97.1	1.2	107.2	1	91	1.1	100.4
Zn (mg)	10.1	92	10.2	107.2	11.8	123.9	10.6	112.7	11.7	123.6	12.6	125.9	10.4	130.1	9.9	139.5	10.7	152.2	11.2	153.9	11.1	155.4
Mn (mg)	5.8	261.9	4.5	196.9	4.2	181.9	3.2	139.4	4.6	199.7	8.1	350.7	7.1	445.7	5	274.9	3.5	194.8	4.1	222.2	3.3	178
I (ug)	103.9	69.3	91.5	61	88.9	59.3	93.7	62.4	109.1	72.8	94.6	63.1	78.6	52.4	93.6	62.4	92	61.4	86.7	57.8	97.6	65.1
Se (mg)	45.2	90.3	46.8	85.1	40.4	73.5	41.3	75.2	54.3	98.7	36.7	66.8	19.8	44	42.1	76.6	43.5	79.1	38.3	69.6	43.1	78.3
Thiamin (mg)	1.7	143.4	1.8	151.2	2	163.7	1.8	152.4	1.8	152.3	2.4	214	1.8	180.4	1.6	159.2	1.8	179	2	195.2	1.6	161
Riboflavin (mg)	2.2	143.9	1.3	81.9	1.5	93.8	1.5	96.7	1.8	110.1	1.4	89.5	1.3	110.2	1.4	106.7	1.6	121.4	1.7	129.3	1.7	127.4
Niacin (mg EN)	36.7	244.4	36.2	201.3	39.8	220.9	37.1	207.9	39.4	231.7	43.2	260.6	41.9	299	36.7	257.8	36.9	263.3	38.9	269.4	36.5	256.8
Vitamin B6 (mg)	2	142.7	1.9	129.7	2.2	145.5	2	133.2	2.2	144.1	2.5	156.2	2.1	160.7	2	160.4	2.1	174	2.1	173.5	2.1	168.8
Folates (ug)	198.6	66.2	217.3	72.4	264	88	244.7	81.6	257.8	85.9	270.9	90.3	183.5	61.2	239.9	80	243.2	81.1	264.8	88.3	208.6	69.5
Ascorbic ac.	82.1	136.8	136.9	228.2	147.4	245.7	136.4	226.8	158.6	264.3	139.5	199.3	66.1	110.2	132.2	220.3	130.5	217.5	143.7	239.5	103.3	172.1
Vitamin A (ug ER)	831.2	103.9	788.2	112.6	967.2	138.2	900.5	129	1102.6	157.5	898.3	128.3	2008.9	334.8	881.9	145.3	802.2	133.7	999.6	161.8	1074.7	177.2
Vitamin E (mg a-TE)	6.4	42.8	7.4	49.4	7.9	52.5	7.7	51.7	7.2	48	5.3	35.2	3.2	21.3	6.8	45.4	7.2	47.8	7.6	50.5	7	46.6
Cholesterol (mg)	347.1	115.7	345	115	346.9	115.6	367.7	122.6	372.6	124.2	264	88	365.9	122	318	106	356.8	118.9	361.5	120.5	390.5	130.2

Table 2: Estimated mean intake values and % Dietary Reference Intakes (%DRIs) of different nutrients, given by sex and age group, in the Ecuadorian immigrant population in Murcia (Spain), based on data obtained from a 24-h food recall survey.

imply a major synthesis of vitamin D. Concerning I and Se, intakes were above 50% DRI and for Se, in some specific cases, reaching nearly 100%. The combination of selenium and iodine deficiency is considered a potential determining factor in the development of myxedematous or nervous form of endemic cretinism [24]. However, these results should be taken with caution regarding their possible impact on public health since food composition data bases usually lack reliable information for these elements resulting in more uncertain intake estimates. In the case of Se, the type of soil where foods are obtained is determinant for the Se content in foods. For I content in foods, the type of salt used in processed foods (i.e. iodized salt, mineral or marine salt) is also an important factor affecting variability in I content, which is barely included in food composition data bases or determined through 24h food recall surveys.

For women, in Table 2, it can be noted that %DRI exceeded 100% in all age groups for energy, protein, lipids, carbohydrates, P, Na, Zn, Mn, thiamine, riboflavin, niacin, vitamin B6, ascorbic ac and cholesterol. In contrast, diet was deficient on fiber, K, I, Se, folates and vitamin E as observed for men. There were values close to 100% that varied depending on age group in Ca, Mg and Cu. The most noticeable differences between age groups could be observed in energy and carbohydrates, where the diet of the 14-49 years groups were slightly deficient for these elements while the 50-69 years group and increasing age groups reached 100% DRIs.

Concerning the statistical test applied to the factor "age group", this reported that the 60-69 years group obtained the highest %DRI for energy, carbohydrates, Na, Mn and thiamin, with nearly all analyzed nutrients showing intake values above DRIs (Table 3). The age group showing the lowest %DRI corresponded to the 20-29 years group. In relation to fiber, the age group with the highest %DRI was the 50-59 years group (Table 3). There were no significant differences for the rest of nutrients.

With respect to differences in %DRIs between men and women, these were statistically significant ($p<0.05$) for energy, proteins, lipids, carbohydrates, fiber, Fe, Zn, Mn, thiamin, riboflavin, niacin and vitamin B6, having higher % in women than men for these above-mentioned nutrients (Table 2). These results are expected since intakes were similar for men and women, however recommendations are usually lower for women, except for Fe whose DRI is much higher for women than for men (15-18 and 9-10 mg/day, respectively).

In regards to professional occupation, statistical analysis showed that restaurant and services workers showed the highest %DRI for energy, protein, lipids, carbohydrates, fiber, Fe, Zn, thiamin, riboflavin, niacin and vitamin B6, while construction workers obtained lower %IDR for most of these nutrients (Table 4). For the rest of nutrients, there were no significant differences. Looking at %DRI, energy values were above DRIs in restaurant and services workers. For proteins, all groups showed intake values above DRIs. Concerning lipids and carbohydrates, their intakes were slightly above DRIs, while there was deficiency in the diet of all professional groups with respect to fiber intake as already mentioned above. In general, vitamin intakes can be considered adequate according to obtained %DRIs for all studied professional collectives with the exceptions of folate and vitamin E intakes, which have already been mentioned above. Regarding the low %DRI for folates, it could be related to a relatively low consumption of some of the sources of this vitamin such as leafy greens (spinach), citric fruits and legumes. In this respect, data from our study showed that the only significant consumption of leafy greens corresponded to lettuce with around 28 g/day. Besides, it is known that there are important data gaps in the folate compositions for certain traditional ingredients or foods which could hamper obtaining more reliable intake estimates for this nutrient [25]. Also, vitamin E intakes were below its DRI. However, once again, limitations in food composition data bases can be a probable cause for this result, since not all chemical

	Age groups (Years)					
	14-19	20-29	30-39	40-49	50-59	60-69
Energy (Kcal)	102.5 ± 34.9a[1]	96.4 ± 23.4a	101.8 ± 21.1a	104.1 ± 30.9a	121.3 ± 25.2ab	139.5 ± 30.5b
Carbohydrates	105.1 ± 36.5a	99.8 ± 31.2a	108.7 ± 26.3a	109.7 ± 37.8a	122.1 ± 26.5ab	155.5 ± 34.9b
Fiber (g)	49.5 ± 18.8a	53.7 ± 16.0ab	56.3 ± 17.7ab	52.8 ± 23.2ab	71.6 ± 23.1b	59.1 ± 9.3ab
Na (mg)	290.8 ± 69.7a	317.9 ± 85.1a	319.1 ± 86.9a	299.2 ± 78.8a	371.3 ± 120.7ab	453.7 ± 137.3b
Mn (mg)	307.8 ± 169.7ab	225.6 ± 169.1ab	185.5 ± 123.1ab	157.2 ± 107.6a	192.4 ± 108.6ab	350.7 ± 294.7b
Thiamin (mg)	152.6 ± 31.9a	154.1 ± 43.1ab	168.0 ± 42.2ab	161.6 ± 50.4ab	155.1 ± 47.4ab	213.9 ± 73.2b

Note: [1]Letters in rows show homogenous group derived from the multiple range Turkey test ($p<0.05$)

Table 3: Mean and standard deviation for % Dietary Reference Intakes (DRIs) of those nutrients showing significant differences between age groups.

	Professional occupation			
	Administration	**Construction worker**	**Retaurants and services**	**Farmers**
Energy (Kcal)	102.9 ± 24.8a[1]	100.9 ± 25.3a	126.8 ± 28.5b	99.4 ± 23.7a
Proteins (g)	176.8 ± 40.56ab	171.3 ± 43.2a	196.9 ± 35.6b	168.1 ± 35.7a
Lipids (g)	114.9 ± 39.07a	113.7 ± 38.2a	132.1 ± 45.5b	106.0 ± 28.4a
Carbohydrates (g)	106.4 ± 30.17a	102.9 ± 26.6a	135.1 ± 32.8b	105.4 ± 31.2ab
Fibers (g)	54.8 ± 17.74a	51.4 ± 15.1a	80.2 ± 24.3b	52.1 ± 16.7a
Fe (mg)	123.6 ± 45.33a	167.9 ± 39.8b	106.4 ± 56.8a	154.2± 47.6b
Zn (mg)	121.1 ± 33.57a	121.3 ± 33.6a	152.1 ± 32.4b	121.2 ± 28.9a
Thiamin (mg)	146.8 ± 35.7a	166.1 ± 45.5ab	184.6 ± 48.8b	158.4 ± 47.3a
Riboflavin (mg)	96.8 ± 41.68a	105.2 ± 45.1ab	125.5 ± 51.7b	95.54± 38.8a
Niacin (mg EN)	223.1 ± 55.83a	222.5 ± 52.8a	268.9 ± 46.1b	221.7 ± 54.0a
Vitamin B6 (mg)	142.4 ± 30.46a	143.9 ± 39.2a	176.1 ± 31.3b	141.5 ± 34.8a

Note: [1]Letters in rows show homogenous group derived from the multiple range Turkey test (($p< 0.05$)

Table 4: Mean and standard deviation for % Dietary Reference Intakes (DRIs) of those nutrients showing significant differences between professional occupations.

forms of vitamin E with biological activity are included or reported for all ingredients. In addition, given that it is a liposoluble vitamin, a sporadic high consumption can still ensure an adequate intake due to its bioaccumulation in tissues acting as reservoirs (e.g. adipose, liver, muscle, etc.) [26]; however this fact is barely detected in surveys based on the 24-h food recall method and it should be better assessed in mid-term studies where daily diet is surveyed for longer periods. Apart from this, it is worthy to highlight that vitamin 12 was until 5-fold higher than its DRI, in some cases. Nevertheless its intake values varied with those of the professional collective, thus restaurant and services doubled the intakes observed in farmers or administration workers. Obviously, this value ranges as function of the amount of animal origin foods that are consumed.

The place of residence significantly affected %DRI levels for certain nutrients (Table 5). Murcia showed the highest %DRI levels of energy, lipids, carbohydrates, fiber, Mg, Mn, niacin, vitamin B6, folates and ascorbic ac. Whereas Lorca showed the highest intake levels of P, K and Fe. For these same nutrients, Cartagena obtained the lowest %DRI. The rest of nutrients were statistically similar for the different surveyed populations.

Comparing nutritional data of population in Ecuador and Ecuadorian immigrants in Spain

Data generated in the present work were compared to those reported in a previous study [17] on a nutritional assessment of Ecuadorian population in Ecuador based on the 24 h food recall method. This previous work evidenced a diet with several vitamin deficiencies such as thiamin, pantothenic ac., biotin, folates, vitamin D and vitamin E, with values of 70-40% lower than DRIs. Conversely, the diet of immigrant population in our study only had a relevant deficiency in folates and vitamin E, which were also below DRIs in the previous study. This result could be more directly related to limitations in food composition databases and other factors commented above rather than to the consumption pattern itself. For minerals, mainly Ca, K, Mn and Fe intakes resulted in values below %DRI, which does not match results in immigrant population, where I and Se were the most remarkable deficiencies in mineral intake. In the case of Ecuador, soils are generally deficient in Se, with exception of some specific regions (e.g. Riobamba, in Chimborazo) [27]. This is also more relevant in volcanic areas such as the Ecuadorian Andean region, since volcanic soils are usually lacking in this element [24]. Therefore, deficiency in Se when applied to the population in Ecuador becomes more relevant than that reported in this study for the immigrant population in Spain. To the best of our knowledge, the only published international study on selenium nutritional status in Ecuador is the one dealing with children living in the Andean region. This study reported low serum selenium concentrations in this group of population and it was pointed out that 17% of Ecuadorian children with normal weight are selenium-deficient [28]. With relation to this, rice could play an important role in Se intakes since this cereal is the most consumed staple food in Ecuador [17,29], which is also relevant for Ecuadorian immigrant population in Spain according to our results. Most rice consumed in Ecuador is produced in the country [29] and although no data are reported for Se-content in Ecuadorian rice, it is expected to be low because of the low selenium content in the soil. This fact may lead one to think that Se fortification in soils intended for the rice crop could be a reasonably way to increase Se intakes in Ecuador. Iodine deficiency is among the three most common deficiencies worldwide [30].

	Location		
	Cartagena	Lorca	Murcia
Energy (Kcal)	98.1 ± 24.1a[1]	101.3 ± 23.2a	112.5 ± 30.7b
Lipids (g)	102.1 ± 20.7a	110.6 ± 30.6ab	122.4 ± 47.1b
Carbohydrates (g)	105.6 ± 37.1a	105.5 ± 28.7a	117.7 ± 33.1b
Fiber (g)	51.6 ± 15.7a	54.7 ± 20.0a	62.2 ± 22.2b
Mg (mg)	88.3 ± 23.5a	98.2 ± 23.1ab	100.2 ± 23.8b
P (mg)	193.9 ± 55.5a	218.2 ± 48.7b	206.6 ± 49.2ab
K (mg)	87.8 ± 18.5a	97.7 ± 19.4b	96.2 ± 18.6ab
Fe (mg)	134.7 ± 56.3a	154.7 ± 47.4b	134.6 ± 52.7a
Mn (mg)	147.8 ± 116.5a	191.0 ± 130.0ab	216.6 ± 148.1b
Niacin (mg EN)	214.9 ± 41.14a	228.1 ± 56.9ab	238.6 ± 57.65b
Vitamin B6 (mg)	137.0 ± 30.5a	146.3 ± 36.1ab	154.5 ± 38.6b
Folates (ug)	73.2 ± 22.7a	82.1 ± 22.7ab	85.7 ± 23.1b
Ascorbic ac.	182.3 ± 100.5a	230.3 ± 90.5ab	251.9 ± 111.8b

Note: [1]Letters in rows show homogenous group derived from the multiple range Turkey test ((p< 0.05)

Table 5: Mean and standard deviation for % Dietary Reference Intakes (DRIs) of those nutrients showing significant differences between locations.

Developing countries are the most affected countries, particularly preschool children and pregnant women, due to both a lower availability of products with added iodine (e.g. iodized salt) and a diet less diversified (i.e. food availability) that leads to a lower iodine intake [30]. Although developed countries such as European countries, have established programs to increase production of iodized salt as a nutritional measure for increasing iodine intake, Spain still shows significant levels of this deficiency, mostly of mild to moderate degree [31]. The absence of sustained campaigns for promotion of use of iodized salt is one of the possible causes for this nutritional deficiency in Spain. By taking into consideration this fact, results in our study regarding iodine deficiency in Ecuadorian immigrant population are not surprising, despite the major iodized salt availability and diet diversity in Spain as compared to Ecuador.

Regarding fiber, both studies showed a diet with intake levels below 70% DRI. This can be related to a lower consumption of vegetable and fruits. This fact is usually observed in poor and developing countries [32], which also occurred in the Ecuadorian immigrant population in Spain (Table 1). In addition, the types of cereal consumed could significantly affect fiber intake. For example, the most consumed cereals in this study corresponded to white rice and bread (Table 1) in which fiber content is expected to be lower. In contrast to this, legumes, being considered a significant source of fiber (and proteins), showed a relatively high consumption in our study, even over the levels observed in the Spanish population [33].

As with our study, in Ecuador, surveyed diets did not reach DRIs for proteins, lipids and carbohydrates (<85% DRIs). Finally, Na intakes were above the upper limit, as expected, since excess Na intake is a worldwide health problem affecting both developed and developing countries [34].

Conclusions

Results indicated that nutrient intake levels for the Ecuadorian immigrant population in Spain were moderately high for most studied nutritional components showing, in general, a better nutritional status as compared to Ecuador. Nevertheless deficiency in fiber, vitamin E, folates, I and Se were observed in the diet of both populations, although limitations in food composition data bases for these elements and other pitfalls inherent to the 24-h food recall method did not allow a more definitive conclusion regarding this outcome. Finally, the results in the present study could be helpful to complete the scarce nutritional information regarding the Ecuadorian diet so as to derive suitable nutritional recommendations or interventions for Ecuadorian population, in Ecuador and Spain.

Acknowledgement

This work has been supported and funded by the National Secretary of Superior Education, Science and Technology (SENESCYT) and Ecuadorian Institute of Educative Credit (IECE) official organisms of the Ecuadorian Government.

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