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Preliminary nutritional assessment of the Ecuadorian diet based on a 24-h food recall survey in Ecuador

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Abstract

Introduction: **Ecuador is a country with limited nutritional information, with exception of some general studies supported by Food Agriculture Organization (FAO).**

Aims: **To carry out a nutritional assessment of the Ecuadorian diet and determine the percentage of contribution to the intake of different nutrients according to the order of the meal (breakfast, morning snack, lunch, afternoon snack, and dinner snack) and Dietary Reference Intake (DRI).**

Methods: **For that purpose a pilot survey based on 24-h food recall method was carried out in three specific regions in Ecuador and collected information was processed, analyzed statistically and compared with DRIs established for Latin-American population.**

Results: **The study found significant differences for energy and certain vitamins in men and women in addition to determining that the highest energy contribution was obtained in lunch, followed by the afternoon snack and breakfast. Intermediate meals (morning snack, afternoon snack and dinner snack) contributed significantly less in the daily diet in comparison with other types of meal. Furthermore, it was observed that analyzed intakes did not meet the DRI for Carbohydrates, some vitamins (Thiamin, Pantothenic, Biotin, Folate Vitamin D and Vitamin E) and minerals (Ca, K, Cu, Mn, I and Fe). The Na intakes were quite above the DRI and Tolerable Upper Limit given by USDA, indicating a Public Health problem in relation with this electrolyte.**

Conclusions: **The present pilot survey can be considered as a starting point to get insight into the Ecuadorian diet. This will allow to determine consumption patterns affecting population welfare and to evidence attendant positive and adverse effects.**

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Key words: *24-h food recall. Nutritional assessment. Ecuadorian diet. Intake dietary intakes. Food patterns.*

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EVALUACIÓN NUTRICIONAL PRELIMINAR DE LA DIETA ECUATORIANA BASADA EN UN ESTUDIO DE RECORDATORIO DE ALIMENTOS DE 24 HORAS EN ECUADOR

Resumen

Objetivos: **Realizar una evaluación nutricional de la dieta ecuatoriana y determinar el porcentaje de contribución de la ingesta de diferentes nutrientes en función del tipo de comida (desayuno, almuerzo, comida, merienda, y cena) y de la Referencia de Ingesta Dietética (RID).**

Métodos: **Se realizó una encuesta piloto basada en el método del recordatorio de alimentación de 24 h en tres regiones concretas de Ecuador y se procesó la información recogida, se analizó y se comparó con las RID establecidas para la población latinoamericana.**

Resultados: **El estudio encontró diferencias significativas para energía y ciertas vitaminas en hombres y en mujeres, además de determinar que la mayor contribución energética se obtenía en la comida, seguida de la merienda y el desayuno. Las comidas intermedias (almuerzo, merienda y cena) contribuían de una manera significativamente menor en la dieta diaria en comparación con otros tipos de comidas. Además, se observó que las ingestas analizadas no alcanzaban las RID para hidratos de carbono, algunas vitaminas (tiamina, ácido pantoténico, biotina, folato, vitamina D y vitamina E) y minerales (Ca, K, Cu, Mn, I y Fe). La ingesta de NA estaba bastante por encima de las RID y el Límite Superior Tolerable proporcionado por la USDA, lo que indica un problema de salud pública en relación con este electrolito.**

Conclusiones: **Esta encuesta piloto puede considerarse como un punto de partida para obtener una visión más profunda de la dieta ecuatoriana. Esto permitirá determinar los patrones de consumo que afectan al bienestar de la población y establecer efectos positivos y efectos adversos del patrón de consumo en Ecuador.**

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Palabras clave: *Recordatorio de alimentación de 24 h. Evaluación nutricional. Dieta ecuatoriana. Ingesta diaria. Patrones alimenticios.*

Abbreviations

DRI: Dietary Reference Intake.
ILSI: International Life Sciences Institute.
RDA: Recommended Dietary Allowances.
DRV: Dietary Reference Values
AI: Adequate Intake.
FAO: Food and Agriculture Organization.
WHO: World Health Organization
USDA: US Agriculture Department.
FESNAD: Federación Española de Sociedades de Nutrición, Alimentación y Dietética.

Introduction

Ecuador is a country with limited nutritional information, with exception of some general studies supported by Food Agriculture Organization and World Health Organization (FAO/WHO). The last report by Moreano (2001)[1] supported by FAO corresponded to a nutritional profile for Ecuadorian population based on national food balance data and other scientific studies such as those developed by Freire et al. (1998)[2] and Larrea et al. (1998)[3] focused on infantile population (> 5 years). Given malnutrition in infancy is a prime concern in developing countries[4-5] the existing resources in Ecuador and other developing Latin-American countries are mostly allocated to studies dealing with this vulnerable population group.[6] Recently, the health ministry of Ecuador has undertook a national survey, which started in 2012, in order to assess the health and nutrition status of Ecuadorian population based on anthropometric and clinical assays, however, no data are available yet.

In developing countries, the modification of food consumption patterns derived from the acquisition of modern society habits such as introduction of new commercial product as consumer purchasing power increases and increasingly out-of-home consumption (restaurants, school food services, etc.) is driving to certain nutritional unbalances.[7,8,9,10] There are overintake of fat and calories, reduction of complex carbohydrates and dietary fiber, high consumption of refined sugar and deficit in some vitamins and minerals together with excessive intake alcohol.[11-12]

Taking all this in consideration, it is crucial that governments have information on population consumption patterns, food availability, population nutritional status so as to derive adequate food policies improving population health status and well-being[13]. With this respect, to the best of our knowledge, there is not any recent Ecuadorian study dealing with food patterns and nutritional assessment of the Ecuadorian diet. However, some examples can be found in scientific literature from other Latin-American countries such as the study by Monge-Rojas et al. (2001)[14] focused on adolescents in Costa Rica based on 24-h food recall survey or a study carried out in Colombia[15] aimed at a validating a existing Food Frequency Questionnaire based on data from a 24-h food recall survey.

Aims

Therefore, the present work carries out a nutritional assessment of Ecuadorian diet to obtain valuable information which can be used to deepen into the consumption pattern in Ecuador. To this end, a 24-hour dietary recall method was applied and the Dietary Reference Intake was used as a nutritional criterion to assess Ecuadorian diet. Finally, this study includes an assessment of traditional Ecuadorian dishes never reported before for which no existing information has been found.

Materials and methods

Geopolitical description of Ecuador

Ecuador is a country located in the North-west of South America, bounded by Colombia to the North, by Peru to the South and by the Pacific Ocean to the West. It has an extension of 256.370 km^2 and a population of more than 14 million of habitants crossed from North to South by a volcanic section of the Andes. To the West of the Andes is located the Guayaquil Gulf and a woody plain, and to the East, The Amazon. Currently, Ecuador is divided into 24 provinces from which two provinces have been recently created (Santo Domingo and Santa Elena) which do not have official information, so their data were included in the Pichincha and del Guayas provinces, respectively.[16]

Sample size and studied population

The survey consisted of a sample of 110 individuals with writing and reading skills. The sample was randomly chosen in urban areas of Central Ecuador, specifically in the cities of Guayaquil, Quevedo and El Empalme. These cities were chosen on the basis of similarities in environmental characteristics, location (coast) and food habits. The age of individuals encompassed 20 and 60 years. In addition, each interviewed individual was considered to be a significant representation of family unit since families in the survey were consolidated. Furthermore, the sample was deemed to be sufficient taking into consideration the pilot character of the present study, intended to obtain preliminary results to establish adequate and representative sampling method.

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

The 24-h food recall questionnaire was adapted to food habits of the Ecuadorian population including

Table I
The 24-h food recall form adapted to Ecuadorian food habits and applied in the present study

Number of interview:	*Date:*	
Sex:	*Location:*	
Breakfast	*Preparation/ingredients*	*Serving size (g)*
Beginning time		
End time		
Place		
Menu or foods:		
Brunch	*Preparation/ingredients*	*Serving size (g)*
Beginning time		
End time		
Place		
Menu or foods:		
Lunch	*Preparation/ingredients*	*Serving size (g)*
Beginning time:		
End time:		
Place:		
Snack or starter		
Main course		
Dessert		
Drink		
Afternoon snack	*Preparation/ingredients*	*Serving size (g)*
Beginning time		
End time		
Place		
Menu or foods:		
Evening snack	*Preparation/ingredients*	*Serving size (g)*
Beginning time		
End time		
Place		
Menu or foods:		
Dinner	*Preparation/ingredients*	*Serving size (g)*
Beginning time		
End time		
Place		
Menu or foods:		

contact information, food intake, i.e. breakfast, brunch, lunch, afternoon snack, evening snack and dinner as described in table I. The sample of 110 individuals was submitted to a 24-h recall survey, which was repeated three times in different days with one of them corresponding to weekend (i.e. Saturday or Sunday). In the used survey form, additional information was requested respondents concerning recipes and ingredients of certain dishes as well as serving size. 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,

Table II
Formulation of ingredients (%) for the 23 selected Ecuadorian traditional dishes

Type of dish	*Ingredients*
Main course	
F1. Guatita (calluses with peanuts and potatoes)	22.76 Corns (tripe), 43.17 Water, 4.32 peanut butter, potato 15.16, 1.41 sunflower oil (achiote), 2.68 tomato, red onion 5.02, 3.35 green pepper , 0.50 garlic, oregano 0.17, 0.6 salt, pepper 0.17, 0.33 cumin, coriander 0.33, 0.03 Ajino bike (Mono Sodium Glutanato).
F2. Beef steak	38.67 Beef, 11.05 red onion, 8.84 green pepper, 1.66 tomato, 6.63 sunflower oil, 29.83 water, 1.66 garlic, 1.66 parsley.
F3. Beef liver steak.	38.67 Beef liver, 11.05 red onion, 8.84 green pepper, 1.66 tomato, 6.63 sunflower oil, 29.83 water, 1.66 garlic, 1.66. parsley
F4. Chicken & juice	60.51 Chicken, 3.1 mustard, salt 0.62, 0.93 garlic, sunflower oil 1.86 (achiote), 2.6 soy sauce, 14.88 black tail, 15.5 water.
F5. Fish Casserole	12.27 green banana, 8.18 Red onion, 11.04 tomato, 8.18 green pepper, 5.07 peanut butter, 8.49 tuna fish, 1.23 garlic, 0.57 parsley, 0.33 Cumin, 0.74 salt, 0.04 pepper, 1.15 sunflower oil (achiote), 32.72 water.
F6. Sango shrimp	25.49 shrimp, 5.63 red onion, 15.19 tomato, 5.63 green pepper, 5.63 plantains, 0.84 garlic, 0.84 parsley, 0.56 salt, 0.03 pepper, 0.79 sunflower oil (achiote), 39.38Water.
F7. Green bun filled with fish	24.1 albacore (fish), 12.05 peanut paste, 31.88 green banana, 2.23 sunflower oil (achiote), 9.56 tomato, red onion 10.62, 5.31 green pepper, 2, 66 garlic, 1.59 parsley.
Rice-based dishes	
A1. Dry rice.	39.60 Rice, 52.80 water 6.6 soya oil, 1 salt.
A2. Rice with shrimp.	22.91 Shrimp, 1.01 garlic, 0.71 sunflower oil, 60.54 dry rice (cooked), 1.51 butter, 2.52 red onion, 2.52 green pepper, 4.54 tomato, 1.16 parsley, 1.82 sunflower oil (achiote), 0.24 salt, 0.05 pepper, 0.25 cumin.
A3. Special Chaulafán	22.55 cooked rice, 3.49 soy souce, 14.97 cooked chicken, 9.98 red onion, 11.28 Shrimp, 11,28 pork, 4.99 egg, 9.98 green onion, 9.98 green pepper , 1.5 sunflower oil.
A4. Rice with pork	23.57 pork, 5.24 red onion, 7.07 tomato, 0.73 garlic, 3.14 Carrot, 3.14 pea, 0.94 sunflower oil, 17.81 rice, 0.47 salt, 0.05 pepper, 2.62 green pepper, 35.1 water, 0.1 cumin.
Soups	
S1. Aguado chicken	38.41 chicken, 1.84 rice, 0.79 sunflower oil, 2.82 red onion, 2.82 green pepper, 5.08 tomato, 0.85 garlic, 0.85 parsley, 0.03 oregano, 0.28 cumin, 0.4 sunflower oil (achiote), 33.89 Water, 4.63 potatoes, 3.39 carrots, 3.39 pea, 0.51 salt, 0.03 pepper.
S2. Alewife (sardine) broth	12.17 Sardines, 11.31 potato, 8.59 carrot, 7.16 red onion, 5.73 tomato, 0.04 bay leaf, 0.29 salt, 2.15 red pepper, 0.72 parsley, 0.72 garlic, 1 sunflower oil, 50.13 water.
S3. Minestrone with pork	8.87 beans, 2.75 noodles, 0.99 butter, 8.87 pork , 3.22 potato, 3.53 milk, 3.53 tomato, 0.78 garlic, 83.92 red onion, 0.39 parsley, 0.16 salt, 0.04 Cumin, 0.78 sunflower oil (achiote), 62.77 water .
S4. Viche fish	12.35 tuna fish, 1.09 peanut butter, 5.47 ripe banana, 5.47 corn, 12.68 cassava, 2.73 red onion, 0.82 parsley, 2.73 green pepper, 0.55 garlic, 0.49 salt, 0.03 oregano, 0.11pepper, 0.82 sunflower oil (achiote), 0.11 cumin, 54.66 water.
S5. Shrimp Soup	23.13 Water, 34.97 shrimp, 3.85 raw white onion, 3.47 Milk, 5.78 noodles, 3.85 pepper, 4.63 carrot, 15.42 potato, 1.93 garlic, 0, 39 cumin, 0.54 sunflower oil (achiote), 0.69 salt, 0.19 pepper, 1.16 green weed.
Snacks and starters	
E1. Bolon chicharrón	54.05 Plantain, 7.21 lard, 36.04 cracklings, 2.70 salt.
E2. Corviche	24.61 Plantain, 18.61 tuna, 7.38 peanut paste, 16.41 red onion, 8.20 green pepper, 14.77 tomato, 1.23 pepper, 1.23 cumin, 2.46 garlic, 1.48 salt, 1.15 sunflower oil (achiote), 2.46 cilantro.
E3. Wind Pie	50.83 flour, 0.78 baking powder, 25.41 butter, 10.09 Water, 11.21 cheese, 1.68sugar.
E4. Green Pie	62.70 green banana, 7.84 egg, 3.13 butter, 15.67 grated, 7.84 white onion, 2.82 salt.
E5. Humita	60.53 mature corn, 9.53 butter, 4.77 lard, 9.53 cheese, 1.51 sugar, 12.61 egg, 1.51. salt
E6. Starch bread	64.38 cassava starch, 22.71 chonero cheese, 0.40 baking powder, 0.40 salt, 6.44 butter, 5.68 egg.
E7. Green banana tortilla	50.25 green banana, 25.13 fresh cheese , 16.75 red onion, 2.51 cilantro, 2.35 sunflower oil (achiote), 3.02 salt.

interviewers were trained by researchers in order to standardize criteria and data collection methodology.

Identification and standardization of Ecuadorian diet dishes

The 24-h food recall on the chosen sample evidenced 80 Ecuadorian diet dishes (data not shown) from which no nutritional information was found in scientific literature. These dishes were classified into four different groups (M) Main courses, (R) Rice-based dishes, (S) Soups y (E) Starter and snack, based on the time of day of food intake and Ecuadorian food habits. In order to assess above dishes, first, ingredients and their proportions were identified. The recipes were standardized based on information given by respondents and analysis of traditional recipes published in Ecuadorian Cooking books. Recipes

Table III

Proximate content (per 200 g) for 23 traditional dishes chosen from the Ecuadorian diet (F: Main courses; A: Rice-based dishes; S: Soups; E: Snacks and starters)

Type of dish	*Water (%)*	*Energy (kcal)*	*Protein (g)*	*Lipids (g)*	*Cholesterol (mg)*	*Carbohidrates (g)*	*Fiber (g)*
Main courses							
F1. Guatita (calluses with peanuts and potatoes)	87.4	60.4	4.89	2.93	0.00	3.82	0.70
F2. Beef steak	77.6	106.0	8.44	6.60	27.97	3.49	1.11
F3. Beef liver steak.	81.6	82	6.30	4.23	90.22	5.01	1.11
F4. Chicken & juice	62.1	216.9	13.91	17.13	83.66	1.53	0.23
F5. Fish Casserole.	73.9	99.1	8.54	2.30	8.79	11.98	1.77
F6. Sango shrimp	94.0	20.1	2.16	0.30	27.61	1.95	0.21
F7. Green bun filled with fish	68.9	128.9	8.22	5.46	8.36	11.88	2.09
Rice-based dishes							
A1. Dry rice.	69.1	119.2	2.47	1.18	0.00	26.27	0.57
A2. Rice with shrimp.	83.1	68.4	6.58	1.48	49.11	7.81	0.99
A3. Special Chaulafán	64.7	171.7	11.63	8.97	41.19	11.46	1.42
A4. Rice with pork	64.8	187.4	2.72	12.98	14.16	16.82	0.55
Soup							
S1. Aguado chicken	86.8	58.1	2.90	2.52	14.08	6.43	0.31
S2 Alewife (sardine) broth.	90.3	44.3	3.54	2.04	14.78	3.12	0.45
S3. Minestrone with pork	75.6	136.1	3.48	11.32	14.15	6.03	1.78
S4. Viche fish	94.6	21.7	0.84	1.05	2.717	2.29	0.26
S5. Shrimp Soup	70.7	129.6	6.18	5.69	65.12	13.32	1.15
Snacks and starters							
E1. Bolon chicharrón	58.8	266.3	3.60	23.57	22.19	10.79	1.66
E2. Corviche	61.1	229.9	4.26	18.35	7.33	13.09	1.75
E3. Wind Pie	49.6	226.2	10.85	10.14	149.68	24.13	1.16
E4. Green Pie	75.7	77.8	1.21	0.56	0.00	18.50	2.60
E5. Humita	74.7	103	4.17	3.56	8.45	13.45	1.57
E6. Starch bread	28.4	335.2	5.70	15.47	44.39	46.02	0.19
E7. Green banana tortilla	68.1	149.7	7.63	8.96	88.44	10.57	1.11

or dish formulations were expressed in % each ingredient used for preparing the dish.

Nutritional composition of Ecuadorian diet dishes according to food composition tables

The determination of the nutritional composition of chosen dishes was based on the use of suitable food composition tables. An in-house computer program designed by Universidad de Córdoba (i.e. Nutriplato software) was used for such a purpose. This software incorporates multiple well-established food composition data bases, corresponding to: *USDA* and *Latinfood*. The application allowed deriving proximate composition (table III), micronutrients (table IV) and vitamin content (table V) for each dish, which were incorporated in a new category in *Nutriplato* software. In order to take into account nutrient losses produced by thermal treatment during cooking, different loss indexes were applied according to intensity/type of treatment and nutrient.[17]

24-h food recall survey data processing

This consisted of assessing the nutrient intakes of interviewed individuals based on consumption data collected by the 24-h food recall (3 repetitions). First, consumption data were adequately tabulated and stored in Excel spreadsheet (Microsoft, Redman), and then exported to Access. That information in Access was used by *Nutriplato* to derive Energy and Nutrient daily intakes by means of a compilation algorithm in SQL. Moreover, classification factors with respect to sex and time of day of food intake were included in this analysis.

Application of Dietary Reference Intakes (DRIs)

As there are no recommended nutritional intakes for Ecuadorian population, the nutritional criterion referred to as Daily Reference Intake (DRI) in Vannucchi et al. (2011)[18] was used so as to assess the suitability of daily nutrient intakes obtained in the present study. This work, supported by ILSI (International Life Sciences Insti-

Table IV
Micronutrient contents (per 100 g) for 23 traditional dishes chosen from the Ecuadorian diet (F: Main courses; A: Rice-based dishes; S: Soups; E: Snacks and starters)

Type of dish	Ca (mg)	Mg (mg)	P (mg)	Na (mg)	K (mg)	Fe (mg)	Cu (mg)	Zn (mg)	Mn (mg)	I (µg)	Se (mg)
Main courses											
F1. Guatita (calluses with peanuts and potatoes)	9.5	21.6	30.5	96.4	96.1	0.611	0.018	0.611	0.025	1.7	0.6
F2. Beef steak	17.5	9.4	51.8	292.3	149.8	1.142	0.218	1.519	0.087	5.1	2.4
F3. Beef liver steak.	16.0	9.0	75.3	194.3	173.9	1.648	0.161	1.327	0.082	1.7	6.3
F4. Chicken & juice	16.2	18.2	93.4	355.3	146.4	1.299	0.130	0.772	0.095	7.4	4.1
F5. Fish Casserole.	13.8	36.8	92.9	204.2	310.4	0.818	0.015	0.344	0.064	7.2	29.0
F6. Sango shrimp	18.2	12.8	41.2	95.2	44.8	0.478	0.005	0.174	0.004	11.0	3.0
F7. Green bun filled with fish	13.2	50.3	105.5	102.4	247.9	0.936	0.008	0.548	0.022	7.6	26.4
Rice-based dishes											
A1. Dry rice.	6.5	10.6	35.9	133.3	60.7	0.297	0.010	0.442	0.015	4.8	0.1
A2. Rice with shrimp.	43.7	28.3	128.0	281.2	138.6	1.375	0.007	0.444	0.025	24.3	6.6
A3. Special Chaulafán	22.0	28.8	160.9	433.7	139.5	1.147	0.049	1.051	0.010	8.8	3.8
A4. Rice with pork	8.0	7.6	30.2	54.5	56.9	0.346	0.021	0.329	0.020	3.3	0.1
Soups											
S1. Aguado chicken	6.3	5.4	25.4	43.8	47.5	0.209	0.025	0.235	0.015	2.6	0.8
S2. Alewife (sardine) broth.	12.4	12.3	88.8	95.6	113.5	0.504	0.007	0.240	0.009	5.5	10.2
S3. Minestrone with pork	25.4	23.2	49.2	77.7	110.8	0.666	0.077	0.388	0.116	1.4	1.6
S4. Viche fish	8.7	8.4	3.7	94.6	43.7	0.161	0.006	0.086	0.005	0.3	2.4
S5. Shrimp Soup	56.1	27.4	114.2	236.3	166.1	1.351	0.040	0.477	0.105	25.8	6.9
Snacks and starters											
E1. Bolon chicharrón	11.8	29.2	48.4	279.4	226.3	0.672	0.039	0.386	0.037	2.3	0.8
E2. Corviche	14.1	32.5	28.0	287.0	272.5	0.677	0.043	0.262	1.950	8.3	11.3
E3. Wind Pie	236.7	12.48	270.6	419.25	87.04	1.086	0.104	0.658	0.295	19.2	3.268
E4. Green Pie	14.1	35.9	28.7	519.7	311.4	0.647	0.019	0.209	0.096	2.4	0.9
E5. Humita	54.7	15.3	84.2	281.1	95.9	0.361	0.007	0.410	0.001	6.3	1.3
E6. Starch bread	141.4	13.2	107.5	1127.1	32.2	0.602	0.033	0.815	0.003	15.7	3.3
E7. Green banana tortilla	133.3	27.9	132.7	965.7	190.6	0.668	0.040	0.975	0.002	20.7	4.9

tute), harmonized DRIs based on recommended nutritional intakes collected from different Latin-American countries in conjunction with recommendations (RDA, Recommended Dietary Allowances) given by FAO.[19] For those nutrients not included in the ILSI document, Spanish DRIs agreed by FESNAD (Federación Española de Sociedades de Nutrición, Alimentación y Dietética)[20] were used, whose values were derived from a thorough review of different nutritional dietary references taken from different countries including concepts such as RDA and Adequate Intake (AI)[21] or Dietary Reference Values (DRV).[22] Thus, daily nutrient intakes in our study were compared to selected DRIs, which were expressed in percentage; therefore values equal to or higher than 100 % mean that the nutrient intake obtained from the 24 h food recalls complies with recommendation given for this specific nutrient.

Statistical analysis

The statistical treatment was carried out by means of the software SPSS 15.0 (Statpoint Technologies, Inc., Chicago). A linear multivariate design was used to identify differences in relation to nutrient intakes in a period of 24 h considering as factors: sex (male and female) and the time of day of food intake (DE: breakfast; MM: brunch; AL: lunch; MT: afternoon snack; ME: evening snack and NO: dinner) and as quantitative variables: Energy, Protein, Lipids, Carbohydrates, Fiber and Cholesterol; Sodium (Na), Saturated, Monounsaturated and Polyunsaturated fatty acids; sugar (mono and disaccharides) and polysacharides.[23] The alcohol intake was negligible because of the specific Ecuadorian consumption patterns, in which alcoholic drinks are not consumed during meals and they are only available in recreation events. In spite of that, alcoholic consumption should not be disregarded given it is a serious and growing concern in developing countries including Latin American countries. Therefore, alcoholic intake in Ecuadorian population should be assessed in other more specific studies focused on target populations. This design allowed determining differences between levels of each factor.[24-25] The Tukey test was used to determine differences of means between levels, with a significance level of 95% ($P \leq 0.05$). In doing so, considered variables are summarized considering possible colineality by defining related characteristics by means of factorial analysis techniques.[26] In addition, Analysis of Variance was

Table V

Vitamin contents (per 100 g) for 23 traditional dishes chosen from the Ecuadorian diet (F: Main courses; A: Rice-based dishes; S: Soups; E: Snacks and starters)

Type of dish	*Thiamin (mg)*	*Riboflavin (mg)*	*Niacin (mg EN)*	*Pantothenic (mg)*	*Vit. B_6 (mg)*	*Biotin (µg)*	*Folate (µg)*	*Vit. B_{12} (µg)*	*Ascorbic ac. (mg)*	*Vit. A (µg ER)*	*Vit. D (µg)*	*Vit. E (mg a-TE)*
Main courses												
F1. Guatita (calluses with peanuts and potatoes)	0.043	0.033	1.836	0.059	0.098	0.091	11.2	–	2.11	0.08	–	0.44
F2. Beef steak	0.028	0.065	2.016	0.115	0.090	0.751	8.3	0.30	9.98	27.47	0	0.68
F3. Beef liver steak	0.055	0.648	2.918	0.066	0.294	0.450	44.1	15.04	14.49	1,681.6	0.27	0.85
F4. Chicken & juice	0.027	0.087	4.037	0.304	0.102	0.845	3.5	–	0.43	0.20	–	0.15
F5. Fish Casserole	0.042	0.037	4.737	0.052	0.340	0.109	12.3	0.66	5.11	15.12	0.57	0.47
F6. Sango shrimp	0.005	0.006	0.393	0.001	0.025	0.001	1.0	0.23	0.45	3.12	0.00	0.32
F7. Green bun filled with fish	0.045	0.044	4.568	0.041	0.325	0.085	7.8	0.59	2.66	9.91	0.47	0.81
Rice-based dishes												
A1. Dry rice.	0.022	0.012	1.000	0.008	0.105	0.066	1.2	–	0.84	0.11	–	0.11
A2. Rice with shrimp	0.064	0.032	1.002	0.021	0.071	0.070	11.2	1.03	14.00	27.28	0.0042	0.95
A3. Special Chaulafán	0.118	0.067	2.222	0.185	0.075	0.396	3.9	1.35	0.90	9.58	0.0007	0.37
A4. Rice with pork	0.014	0.008	0.573	0.013	0.050	0.057	1.8	–	1.02	47.35	-	0.06
Soups												
S1. Aguado chicken	0.011	0.019	0.865	0.061	0.039	0.186	1.9	–	0.77	36.13	–	0.04
S2. Alewife (sardine) broth	0.012	0.044	1.330	0.005	0.164	0.041	4.3	3.68	1.87	11.61	1.32	0.34
S3. Minestrone with pork	0.047	0.021	0.566	0.061	0.026	0.103	6.7	0.01	0.11	11.47	0.05	0.10
S4. Viche fish	0.007	0.021	0.528	0.001	0.084	0.001	1.1	0.12	0.52	4.94	0.44	0.07
S5. Shrimp Soup	0.063	0.016	1.371	0.097	0.120	0.311	9.1	0.49	4.09	30.58	0.18	0.99
Snacks and starters												
E1. Bolon chicharrón	0.028	0.028	1.053	0.018	0.138	0.145	11.3	–	4.12	7.17	–	0.42
E2. Corviche	0.043	0.043	2.616	0.004	0.194	0.371	15.0	0.49	4.96	26.25	0.55	0.56
E3. Wind Pie	0.109	0.055	1.996	0.153	0.053	0.809	10.5	0.07	–	149.38	0.19	0.31
E4. Green Pie	0.032	0.042	0.547	0.008	0.194	0.053	16.3	–	5.23	13.54	–	0.23
E5. Humita	0.023	0.083	1.329	0.079	0.053	0.538	11.7	0.08	0.43	36.99	0.02	0.31
E6. Starch bread	0.010	0.106	1.276	0.057	0.022	0.880	7.2	0.20	–	157.36	0.13	0.31
E7. Green banana tortilla	0.029	0.142	1.892	0.232	0.131	3.154	21.0	0.30	2.56	104.56	0.33	0.39

applied to determine the effect of factor sex on contribution to DRIs for different nutrients (proximate composition, micronutrients and vitamins).

Results and discussion

Nutritional composition of Ecuadorian traditional dishes

Due to the large amount of studied Ecuadorian dishes, only a total of 23 dishes are shown and discussed in this section. These 23 dishes were selected based on their traditional value and high consumption frequency in the Ecuadorian diet.

With respect to proximate components in main courses, F4 (Chicken & juice) showed the highest Energy, Protein, Lipid and Cholesterol content while F7 (Green bun filled with fish) obtained the highest Fiber content (table III). For rice-based dishes, A4 (Rice with pork) resulted in the highest Energy and Lipid contents while the highest protein and Fiber levels was evidenced in A3 (Special chaulafan). The highest Cholesterol and Carbohydrate levels were reported for A2 (Rice with shrimp) and A1 (Dry rice), respectively. In the category of soups, S3 (minestrone with pork) contained the highest Energy, Fiber and Lipid levels, while S5 (Shrimp soup) showed higher Protein levels, Cholesterol and Carbohydrates levels. With regard to snacks and starters, E6 (Starch bread) provided high Energy and Carbohydrate contents and E3 (Wind pie) showed high Protein and Cholesterol levels. Besides, E1 (Bolon chicharrón) had a high Lipid content and E4 (Green pie), the highest Fiber content.

Regarding micronutrients, we highlight the high Ca content estimated in A3 (Wind pie), S5 (Shrimp soup) and A2 (Rice with shrimp). Moreover, the F3 (Beef liver steak) showed a noticeable content in Fe. Main courses and soups such as F7 (Green bun filled with fish), A3 (Special chaulafan), (S5) Shrimp soup and snacks such as E3 (Wind pie) and E7 (Green bananas tortilla) provided high P levels.

In the case of vitamins, results were quite variables between types of dish. Most of the selected dishes showed low content in vitamins, which was specially remarkable for Thiamin, Riboflavin, Pantothenic, Biotin, Vitamin D and Folate. With some exceptions, such as S2 (Alewife broth), which showed a much higher content in Vitamin D than the rest of selected dishes or A3 (Beef liver) and E7 (Green banana tortilla) with remarkable levels of Folate. In the case of Niacin, main courses presented the highest values, with F5 (Fish casserole) showing the greatest Niacin contribution. For Vitamin A, the highest levels were obtained in F4 (Beef liver steak) though in general snacks and starters presented higher values of this vitamin. With respect to Ascorbic ac., high contents were estimated for F2 and F3 (Beef steak and Beef liver steak, respectively) as well as for A2 (Rice and shrimps) and E2 and E4 (Corviche and Green pie, respectively).

The study of composition of Ecuadorian traditional dishes, based on existing composition data bases, should be considered as preliminary, while essential, since no previous works have been published so far to the best of our knowledge. In relation with this, a study in Kuwait assessed nutritional value of 32 different traditional dishes by chemical analysis. This study also highlighted the need of establishing food composition tables in Kuwait and the area of the Persian Gulf.[27] There is a huge lack of this kind of studies in Latin-American region and though resources are limited in developing countries, the use of adequate food composition data bases could help to obtain reliable nutritional information about traditional foods in a country. From that, the nutritional information on traditional dishes provided in the present study could be helpful in order to assess nutritional value of Ecuadorian diet and provide nutritional recommendations.

Nutrients contribution based on the time of the day of food intake

The 24-h food recall survey was applied on a sample consisting of 51 and 49% women and men, respectively with an age range of 20-65 years. Food consumption frequencies in combination with food composition data bases allowed to estimate nutrient intakes. The nutrient intakes were statistically dependent of the time in the day of food intake ($P \leq 0.05$). The highest contribution of Energy, Proteins, Lipids, Carbohydrates, Saturated and Unsaturated fatty acids, Cholesterol and Sugars was found in lunch, which is considered in the Ecuadorian diet the main food intake often occurring from 12:30 am to 1:30 pm. The following food intakes with higher nutrient contributions were evening snack (6:00 pm) and breakfast (7:00 am). In contrast, the lowest nutrients contribution to daily diet was found in afternoon snack and dinner. In Ecuador, both times of food intake are the least relevant ones due to food habits of Ecuadorian population (table VI).

Nutritional assessment of Ecuadorian diet based on application of Dietary Reference Intakes (DRI)

Daily nutrient intakes derived from the 24-h food recall survey were compared with the corresponding DRIs, expressed in percentage, based on the selected nutrient recommendations, mentioned in materials and methods section. In table VII, %DRIs and nutrient intakes are shown for total set and sex groups. Results for % DRIs were statistically similar between men and women with the exception of the Na intake and Riboflavin, with higher % DRIs for men in both cases ($P \leq 0.05$). Nevertheless, these statistical differences should not be considered high enough (< 2%) to exert a significant effect on the health or nutritional status of population.

Tabla VI
Statistical analysis of nutrient intakes according to the time of the food intake

Energy		*Proteins*		*Fiber*		*Carbohydrates*		*Sodium (Na)*	
*Food intake**	*Mean (kcal)*	*Food intake*	*Mean (g)*	*Food intake*	*Mean (g)*	*Food intake*	*Mean of (g)*	*Food intake*	*Mean of (mg)*
NO	43.06[a]	NO	1.40[a]	NO	0.19[a]	NO	4.69[a]	NO	34.69[a]
MT	64.99[a]	MT	1.77[a]	MT	0.49[a]	MM	7.74[a]	MT	136.57[a]
MM	69.07[a]	MM	2.09[a]	MM	0.62[a]	MT	11.43[a]	MM	144.81[a]
DE	497.75[b]	DE	17.46[b]	ME	3.95[b]	DE	56.81[b]	DE	713.47[b]
ME	608.58[b]	ME	24.75[c]	DE	4.50[b]	ME	67.41[b]	ME	1161.70[c]
AM	931.17[c]	AM	38.33[d]	AM	7.17[c]	AM	119.15[c]	AM	1513.67[d]
Lipids		*Saturated fatty ac.*		*Mono-unsaturated fatty ac.*		*Poly-unsaturated fatty ac.*		*Sugar*	
*Food intake**	*Mean (g)*	*Food intake*	*Mean (g)*	*Food intake*	*Mean (g)*	*Food intake*	*Mean (g)*	*Food intake*	*Mean (g)*
MT	2.08[a]	MT	3.89[a]	MT	0.54[a]	MT	0.18[a]	NO	5.82[a]
NO	2.21[a]	NO	4.57[a]	NO	0.75[a]	NO	0.20[a]	MT	17.16[a]
MM	3.05[a]	MM	4.75[a]	MM	1.11[a]	MM	0.36[a]	MM	17.91[a]
DE	24.26[b]	DE	11.26[ab]	DE	8.31[b]	DE	2.30[b]	DE	52.19[b]
ME	28.39[bc]	ME	11.64[ab]	ME	10.34[bc]	ME	4.09[c]	ME	52.80[b]
AM	36.58[c]	AM	14.81[b]	AM	13.58[c]	AM	5.14[c]	AM	134.25[c]

*DE: Breakfast; MM: Brunch; AM: Lunch; MT: Afternoon snack; ME: Evening snack; NO: Dinner.
**Letters (a. b. c. d) in the same column represent for homogenous groups reported by DHSTukey test ($P \leq 0.05$).

Energy intake exceeded 11 % the DRI for the whole population, which means 214 kcal in excess of DRI. A similar study carried out in Colombia, country with some similarities to Ecuador, also reported an excess in the energy consumption, which was higher in men.[28]

The % DRI levels for proteins and lipids corresponded to 71.6% and 75.6%, respectively. The intake levels for Carbohydrates and Fiber were 15.2% and 32.2% below the DRI given for these dietary constituents, respectively. Regarding Cholesterol, the % DRI was 116 %, indicating an excess in the intake of this dietary component.

In minerals, Mg, *P*, *Zn,* Se, and Na showed intake levels above DRIs. Importantly, Na levels were above the Tolerable Intake level for this electrolyte given by USDA (USDA, 2011) whose value corresponds to 2,300 mg/day, while the mean level obtained in the survey was 3,704 mg/day. Although data on Na intake is still scant in Latin-American countries, it is well-known that salt-intake levels are in excess of recommendations in Latin-American countries.[29] Accordingly International guidelines and program recommend that salt intake should be reduced to minimize the risk of heart disease and strokes in populations.[30,31] In this respect, salt-related policies/activities are reported for Argentina, Brazil, Bolivia, Canada, Chile, Costa Rica, Ecuador, Guatemala, Panama, Paraguay and Uruguay. However, besides salt added at the table, a problem in managing salt reduction policies is that part of Na intake is derived from salt added to products by local vendors, which is specially difficult to assess and control.[32, 33]

On the contrary, intakes for Ca, *K, Cu*, *Mn*, *I* and *Fe* remained below their DRIs. The *Ca* intake was 30% below the corresponding DRI, while intake levels of *K*, *Mn* and Fe were around 10-20% lower than the corresponding DRIs. In the case of *Ca*, care should be taken when results are interpreted since *Ca* intake recommendations are strongly related to population-specific factors such as physical activity and solar exposition levels, which could determine lower requirements in Ecuadorian population due to its specific social and geographical characteristics.[34] Iron deficiency is the most common dietary deficiency in the world.[35] It is a Public Health Problem that affects two-thirds of children and women from the Third World[36] hence supplementation and food fortification have been proposed as effective tools to reduce the incidence of iron deficiencies in vulnerable populations.[37]

For vitamins, data indicated lack of Thiamin, Pantothenic, Biotin, Folate Vitamin D and Vitamin E, with values of 70-40% lower than DRIs. For the rest of vitamins, that is, Vitamin A, Ascorbic ac., Niacin, Vitamin B12, Vitamin B6 and Riboflavin, intake levels fulfilled the corresponding DRIs, though in some cases such as for Ascorbic ac. and vitamin B1, levels were from two to four times higher than DRI values as shown in table VII. In any case, levels were below the upper limits provided by USDA (USDA, 2011).[38] It is remarkable the fact that the mean Vitamin A intake in our survey met the requirements for this nutrient. Vitamin A deficiency is one of the most serious nutritional deficiencies in developing countries, even

Table VII

Analysis of nutrient contributions to Dietary Reference Intake (DRI) according to proposal of harmonization by International Life Sciences Institute (ILSI), expressed as % intake level with respect to DRI for eachs nutrient

Element/ nutrient	*DRI*	*Total daily nutrient intake*	*Total % DRI*	*Daily nutrient intake in men*	*(%) DRI in men*	*Daily nutrient intake in women*	*(%) DRI in women*	*Statistical significance*
Energy (kcal)	2,000	2,214.6	110.7%	2,231.0	111.5%	2,205.6	110.3%	NS
Protein (g)	50	85.8	171.6%	85.9	171.8%	85.7	171.4%	NS
Lipids (g)	55	96.6	175.6%	97.8	177.8%	96.1	174.6%	NS
Carbohydrates (g)	315	267.3	84.8%	268.6	85.3%	266.3	84.5%	NS
Fiber (g)	25	16.9	67.8%	17.1	68.3%	16.9	67.5%	NS
Ca (mg)	1,000	723.5	72.3%	723.0	72.3%	719.4	71.9%	NS
Mg (mg)	260	293.3	112.8%	294.2	113.1%	293.6	112.9%	NS
P (mg)	700	1,146.1	163.7%	1,145.9	163.7%	1,142.8	163.2%	NS
Na (mg)	2,000	3,704.9	185.2%	3,722.8	186.1%	3,690.1	184.5%	*
K (mg)	3,100	2,549.1	82.2%	2,544.0	82.1%	2,555.7	82.4%	NS
Fe (mg)	14	12.5	89.4%	12.5	89.2%	12.5	89.6%	NS
Cu (mg)	0.9	0.8	87.9%	0.79	87.8%	0.8	87.8%	NS
Zn (mg)	7	10.4	148.2%	10.3	147.7%	10.4	148.1%	NS
Mn (mg)	2.3	1.6	71.8%	1.7	72.6%	1.7	72.2%	NS
I (µg)	130	123.6	95.1%	123.4	94.9%	123.3	94.9%	NS
Se (mg)	34	58.6	172.3%	58.9	173.2%	58.8	173.0%	NS
Thiamin (mg)	1.2	0.7	60.3%	0.72	60.0%	0.7	60.8%	NS
Riboflavin (mg)	1.3	1.2	90.8%	1.2	91.5%	1.2	90.8%	*
Niacin (mg EN)	16	28.1	175.9%	28.3	176.6%	28.1	175.6%	NS
Pantothenic (mg)	5	1.7	33.2%	1.6	33.0%	1.6	33%	NS
Vit B_6 (mg)	1.3	1.9	143.1%	1.8	142.3%	1.9	143.1%	NS
Biotin (µg)	30	9.5	31.8%	9.6	31.8%	9.5	31.7%	NS
Folate (µg)	400	163.8	41.0%	162.9	40.7%	164.1	41%	NS
Vit B_{12} (µg)	2.4	7.4	307.1%	7.4	309.6%	7.4	310.4%	NS
Ascorbic ac.	45	119.0	264.5%	117.6	261.4%	119.7	266.1%	NS
Vit A (µg ER)	600	741.5	123.6%	750.2	125%	742.3	123.7%	NS
Vit D (µg)	5	1.8	36.2%	1.8	37%	1.8	36.4%	NS
Vit E (mg a-TE)	10	6.1	61.5%	6.2	61.6%	6.2	61.6%	NS
Cholesterol (mg)	300	349.0	116.3%	350.2	116.7%	348.2	116.1%	NS

*Statistical Significance ($P \leq 0.05$).
NS: Not Statistical Significance ($P \leq 0.05$).

though this mainly affects children and pregnant woman with high morbidity and mortality rates.[39-40] The low %DRI for Vitamin E found in our study was in accordance with other works reporting that the vitamin E intake in developing countries is limited because of either low food available or a poor fruit and vegetable diet.[40-42] Besides that, Vitamin E deficiency is also associated with the oxidative stressors such as malaria and HIV-infection, which are highly prevalent in developing countries.[38]

Conclusions

These results demonstrate that the use of 24-h food recalls can be useful tools to assess specific population groups and put focus on those more relevant aspects related to nutrient intake. Likewise, a first nutritional assessment is presented on specific traditional Ecuadorian dishes, which could be applied by dietitians and nutritionists to guide diet and recommendation in Ecuador. The highest contribution to nutrient intakes was estimated in lunch followed by evening snack. Regarding the compliance of DRIs, the excess of Na intake by respondents is one of the most relevant aspects to be considered together with the low intake of Carbohydrates and some specific vitamins and minerals. Although results are still preliminary and they should be considered carefully, they can be an important base to develop future and more comprehensive studies (including anthropometric studies and clinical analysis of nutritional markers) while encompassing a broad spectrum of population and geographical regions.

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