

## Dietetic characteristics of a sample of Mayan dual burden households in Merida, Yucatan, Mexico

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**SUMMARY.** The Maya are the most populous and shortest in stature Native American ethnic group. The Maya provide us a good opportunity to study the dietetic characteristics of a group who experience nutritional dual burden (the combination of under and overnutrition) at the individual, mother-child dyad and population level. The aim of this study is to describe general dietetic patterns of a sample of Maya mothers and children who experienced nutritional dual burden and were living in the city of Merida, Yucatan, Mexico. From February to July 2010 we applied food frequency questionnaires (FFQ) to 58 dyads of Maya mothers and their children (7-9 years old). The FFQ was developed by staff of the Department of Human Ecology at Cinvestav and included 78 foods, grouped in: cereals and tubers, foods of animal origin, leguminous vegetables, fats, fruits, vegetables, sugars, and daily products. The frequencies of consumption were classified in four levels: 1) no consumption, 2) low (1-2 days/week), 3) medium (3-4 days/week), high (5-7 days/week). The observed pattern suggests a low consumption of fruits and vegetables, a medium consumption of pork, eggs, oil and lard, and a high consumption of soda and whole milk. From these frequencies we extrapolated that the dietetic pattern is characterized by a low intake of fibre and micronutrients and high intake of fat and sugars, findings supported by previous National and regional studies. Our observations suggest that the studied group have a dietetic pattern that has moved away from a traditional Maya diet.  
**Key words:** Food, nutrition, micronutrients, Mexico

**RESUMEN.** Características dietéticas de una muestra de hogares mayas con doble carga nutricional de Mérida, Yucatán, México. Los mayas, uno de los grupos étnicos más importantes en Mesoamérica y con menor estatura. Ellos nos otorgan la oportunidad de estudiar las características dietéticas de un grupo que muestra doble carga nutricional (DCN) (coexistencia de desnutrición y sobrepeso/obesidad) a nivel individual, en pares de madre-hijo y de población. El objetivo de este estudio es describir de manera general el patrón dietético de una muestra de madres e hijos mayas con DCN y que viven en la ciudad de Mérida, Yucatán, México. Entre febrero y julio de 2010 aplicamos cuestionarios de frecuencia de consumo de alimentos (CFCA) a 58 pares de madre-hijo (7-9 años de edad). Los CFCA, que fueron diseñados por el personal del Departamento de Ecología Humana del Cinvestav, incluyeron 78 alimentos agrupados en cereales y tubérculos, de origen animal, leguminosas, grasas, frutas, verduras, azúcares y lácteos. Las frecuencias de consumo fueron clasificadas en: 1) sin consumo, 2) bajo (1-2 días por semana), 3) medio (3-4 días por semana) y 4) alto (5-7 días por semana). El patrón observado sugiere un consumo bajo de frutas y verduras, consumo medio de carne de cerdo, huevo, aceite y manteca de cerdo y consumo elevado de refrescos embotellados y leche entera. En conclusión, sugerimos que el patrón dietético encontrado, se caracteriza por una ingesta pobre en fibra y micronutrientes y alto en grasa y azúcares, resultados que muestran similitudes con estudios nacionales y regionales. Nuestras observaciones también sugieren que el grupo estudiado se ha alejado de un patrón dietético maya tradicional.

**Palabras clave:** Alimentos, nutrición, micronutrientes, México

### INTRODUCTION

Humans, like any other species, have the ability to express in their biological status the effects of the surrounding environment. Diet is one of several factors which shapes the nutritional status of children and adults (1). Anthropometry is one methodology used to assess nutritional status, as reflected by

height, weight and other morphological characteristics.

The existent literature shows the paradoxical coexistence of overweight/obesity, indicating over-nutrition, and short stature, indicating under-nutrition, in several communities or households in developing countries (2), including Mexico (3) and the Mexican state of Yucatan (4). The coexistence of overweight/obesity and short stature is often called the nutritional dual-burden (5). It has

been suggested that a nutritional transition, defined as the change in the dietary pattern from a traditional, locally produced diet to a globalized, imported diet tends to maintain the high prevalence of undernutrition (stunting) and increases the rate of overweight/obesity. The globalized diet is characterized by a high energy, sugar, and fat intake but low intake of micronutrients, especially vitamins and minerals such as folate and iron (6). The impact of a globalized diet is exacerbated for ethnic groups such as the Maya with a history of adverse social, economic, and political ecologies (7).

Most of the Mexican Maya people live in the southeast region of the country, in the states of Chiapas, Yucatan, Quintana Roo and Campeche. In the Yucatan, the Mayas are a social group which has been historically subject to marginalization and poverty (8). The primary industry in the Yucatan was the sisal agroindustry, which collapsed in the 1980s. Since the collapse, the capital city, Merida, has grown with migrants from rural Maya villages searching for jobs and new opportunities (9). According to official sources, the population of Merida rose from 241,964 inhabitants, in 1970, to 830,732 inhabitants in 2010 (10, 11), an increase of 293% in 40 years.

In general, the Maya of Yucatan belong to a group who have experienced, and continue to experience, adverse socioeconomic conditions. One sign of this is that the southern neighborhoods of the city, which is a low socioeconomic status area and geographically segregated from the central and northern regions (12), had in the year 2000 a population comprised of more than 19% of Maya speaking people, the highest percentage in the city. Other high Maya populations are the East and North of Merida (13).

The present article is derived from a research project aimed to identify long- and short-term causes of the nutritional dual burden in an urban-living Maya sample (14). We have previously shown that the combination of stunting and overweight/obesity (z-score of height-for-age < -1.645; >85th percentile of BMI-for-age using the NHANES III reference data for the United States) was as high as 3.4% for individual children and 74.1% for individual mothers. Moreover, the combination of maternal overweight/obesity and child stunting was present in the 27.6 % of the dyads (15).

The purpose of this article is to describe general dietetic patterns of a sample of Maya mothers and children who experience nutritional dual burden and were

living in the South of Merida. This paper contributes to fill the lack of information on dietetic characteristics in dual burden populations in general and in Maya groups in particular.

## MATERIALS AND METHODS

### Sample

Dietetic data were collected between February and July 2010 in a sample of 58 mother-child dyads. The age of studied women was between 22 and 49 years with a mean age of 34.30 years ( $\pm 6.28$ ). The 58 children (boys = 31) were between 7 and 9 years old (mean = 8.42,  $\pm 0.79$ ).

The sample size was estimated using a power analysis (16) in which the dependent variable was child's nutritional status. Independent variables were mother's current nutritional status, mother's early life nutritional status, early determinants of child's health, child's energy expenditure, and mother-child feeding habits, with age and sex as covariates. The power analysis indicated that, with a power at 0.90, a sample size of 58 child-mother pairs provides the power to detect a medium effect size with significance set at  $p=0.05$ .

### Instruments

Food frequency questionnaires (FFQ) are instruments commonly used in nutrition and dietetics to identify patterns of consumption of specific foods at individual and community level. The kind and number of foods or products included in the questionnaire depend on the purpose of the study (17, 18, 19). Our FFQ included 78 foods, grouped in the following categories: 1) cereals with high and low fibre content, 2) meat and beans, 3) milk and eggs, 4) fats, 5) sugar, including sweetened drinks and honey, 6) fruits and 7) vegetables. In part, we defined these categories based on a recent proposal for Mexican food nutritional composition (20). In the case of fruits and vegetables, the FFQ only included those products available from February to June, the months of the year in which we collected the data. The FFQ was developed by the staff of the Human Ecology Group at Cinvestav, Merida. In large part, we based the design of the FFQ on our fieldwork experiences with Maya families in the same neighbourhoods as the present report (21). We followed two major criteria to construct the FFQ. The first

was to include only foods that are part of the alimentary culture of the group studied. By this we mean both traditional local foods that have been eaten by Maya for the past decades, as well as newer foods, often imported or factory processed such as soft drinks and packaged foods, which are commonly eaten today. The designed FFQ allowed us to get some information about the nutritional transition for these Maya families. The second criterion was to include those foods and products which, according to their nutritional content, are mostly likely to have the most important effect on the nutritional status of mothers and children. These 'most important' foods are those which contribute measurable amounts of macro-nutrients, vitamins, and minerals. We did not include, for example, rarely eaten foods or foods/snacks eaten occasionally as a 'treat' which have little or no nutrient content. The FFQ was applied in a pilot way to families which have socioeconomic and cultural characteristics similar to those of the Maya families we studied. Based on the pilot some adjustments were made. We did not apply any accuracy and reliability test to this instrument. This is the first publication of data obtained with this instrument and the provisional nature of the results is evaluated on the Discussion section.

We visited the families at their homes and applied the FFQ to the mothers getting information about their own food consumption during the previous week and that of their son/daughter who participated in the study. We followed a standardized methodology to apply the FFQ (22) and, based on our field work applying FFQs, we are confident that most of the foods consumed in the homes were recorded.

### Statistical procedures

The statistical processing focused on the description of the main consumption patterns. We analysed the foods as grouped into the seven categories given above.

We classified the frequencies of consumption in four levels: 1) no consumption, 2) low (1-2 days/week), 3) medium (3-4 days/week), high (5-7 days/week). We recognize that the categories for intake we are using, i.e., high, middle, low, are arbitrary, and that they are not intended to measure the intake of a given nutrient or group of nutrients, but rather to describe in general the pattern of food consumption. Finally we compared the soda and packaged food

consumption between mothers and children. The data were processed with the SPSS 18.0 software (SPSS Inc., Chicago, IL). The research protocol was approved by the Bioethics Committee of the Research and Advanced Studies Center of the National Polytechnic Institute of Mexico (Cinvestav – IPN) and by the Loughborough University Ethics Advisory Committee (approval number: R09-P145). Both written informed consent for the participation of each mother and child and their verbal agreement was obtained.

## RESULTS

### *Mothers and children consumption*

#### *Cereals*

Mothers and children showed in general a high consumption of maize tortilla and locally produced wheat baguette, known as pan francés (Table 1). Dough-based products, soft bread made from refined wheat flour (pan blanco) and soft wheat flour breads with added sugar (pan dulce), rice and pasta showed medium to low consumption. 'Masa products' are made from a maize-based dough mixture. This mixture is used for tortillas and many other foods in Mexico. With the exception of maize tortilla, mothers and children had a low consumption of masa products and a low consumption of cereals with high content of dietary fibre, for example oats and wheat bread.

#### *Meats, beans, eggs and milk*

The group of meats, milk, eggs and beans is characterized by its content of proteins and fat, as well as some micronutrients such as iron and zinc. In general mothers and children reported no consumption or a low consumption of beef and fish (Table 2) and a low consumption of chicken. Pork consumption was more frequent, with 44.8% of the mothers and 36.2% of children reported consuming pork 3 to 4 days per week. In contrast to generally lower frequencies of animal protein intake, we found that 60% of the mothers and 69% of children have a medium to high consumption of beans. Beans may be one the main sources of protein, as well as fibre and some micronutrients (folate, magnesium, iron).

In general we found that the 82.8% of mothers and 74% of children reported a consumption of eggs between 1 and 4 days per week (Table 3). The mothers have a slightly higher consumption of this food.

In relation to the milk consumption, we found that

TABLE 1. Consumption of cereals with high and low fibre content by mothers (n=58) and children (n=58)

Consumption	High fibre content						Low fibre content									
	Oats		Tortilla		Doug based products		Bread		Rice		Baguette		Soft bread*		Pasta	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Mothers																
No consumption	25	43.1	2	3.4	10	17.2	48	82.8	2	3.4	1	1.7	12	20.7	1	1.7
Low	27	46.6	1	1.7	46	79.4	9	15.5	35	60.3	10	17.3	30	51.7	41	70.8
Medium	4	6.9	0	-	2	3.4	1	1.7	18	31.1	13	22.4	10	17.3	14	24.1
High	2	3.4	55	94.9	0	-	0	-	3	5.2	34	58.6	6	10.3	2	3.4
Total		100		100		100		100		100		100		100		100
Children																
No consumption	29	50.0	3	5.2	14	24.1	28	48.3	3	5.2	2	3.4	14	24.1	2	3.4
Low	22	37.9	3	5.2	43	74.2	26	44.8	39	67.3	15	25.9	24	41.5	35	60.5
Medium	4	6.9	2	3.4	1	1.7	4	6.9	12	20.6	12	20.7	11	18.9	19	32.7
High	3	5.2	5	86.2	0	-	0	-	4	6.9	29	50.0	9	15.5	2	3.4
Total		100		100		100		100		100		100		100		100

\*Soft wheat flour breads with added sugar and sometimes spices; F: Frequency; Low: 1-2 days per week; Medium: 3-4 days per week; High: 5-7 days per week

TABLE 2. Meat and beans consumption by mothers and children

Consumption	Chicken		Beef		Fish		Pork		Beans	
	F	%	F	%	F	%	F	%	F	%
Mothers										
No consumption	0	-	21	36.2	21	36.2	2	3.4	1	2
Low	38	65.6	35	60.4	37	63.8	30	51.8	22	38
Medium	17	29.3	2	3.4	0	-	26	44.8	24	41
High	3	5.1	0	-	0	-	0	-	11	19
Total		100		100		100		100		100
Children										
No consumption	2	3.4	26	44.8	25	43.1	8	13.8	1	2
Low	37	63.9	32	55.2	33	56.9	29	50.0	17	29
Medium	18	31.0	0	-	0	-	21	36.2	25	43
High	1	1.7	0	-	0	-	0	-	15	26
Total		100		100		100		100		100

F: Frequency; Low: 1-2 days per week; Medium: 3-4 days per week; High: 5-7 days per week

TABLE 3. Milk and eggs consumption by mothers and children

Consumption	Skimmed		Semi-skimmed		Whole		Eggs	
	F	%	F	%	F	%	F	%
Mothers								
No consumption	56	96.6	53	91.5	23	39.7	3	5.2
Low	-	-	2	3.4	26	44.9	28	48.3
Medium	1	1.7	2	3.4	2	3.4	20	34.5
High	1	1.7	1	1.7	7	12	7	12
Total		100		100		100		100
Children								
No consumption	58	100	54	93.1	9	15.5	6	10.3
Low	-	0	1	1.7	12	20.7	27	46.5
Medium	-	0	-	0	6	10.3	16	27.5
High	-	0	3	5.2	3	5.3	9	15.7
Total		100		100		100		100

F: Frequency; Low 1-2 days per week; Medium: 3-4 days per week; High: 5-7 days per week

mothers and children report in general a higher consumption of whole milk in comparison to skimmed and semi-skimmed milk. In particular 84.5% of children and 60.3% of mothers consume only whole milk and one half of these children consume this food between 5 and 7 days per week. These findings could have important implications in the overall intake of fat.

#### Fats

Since oil, lard, mayonnaise and margarine are regularly consumed in local context, we ask for their frequencies. We found that oil and mayonnaise are the products with the highest consumption.

Almost 70% of the mothers and 64% of the children consume oil at least 5 days per week and 40% and 50% of mothers and children respectively consume mayonnaise between 3 and 7 days per week (Table 4). Most of participants reported a low consumption of lard, but 13.8% of mothers and 15.5% of children consume this food between 3 and 7 days per week.

#### Sugars

Both mothers and children had a relatively high consumption of soft drinks (Table 5). About 40% of the mothers and children report consuming soft drinks (mainly Coca Cola™) between 5 and 7



TABLE 4. Fat consumption of mothers and children

Consumption	Oil		Lard		Mayonnaise		Margarine	
	F	%	F	%	F	%	F	%
Mothers								
No consumption	2	3.4	26	44.8	13	22.4	23	39.7
Low	5	8.6	24	41.4	22	37.9	29	50.0
Medium	11	19.0	4	6.9	11	19.0	1	1.7
High	40	69.0	4	6.9	12	20.7	5	8.6
Total		100		100		100		100
Children								
No consumption	1	1.7	27	46.6	8	13.8	20	34.5
Low	7	12.1	22	37.9	21	36.2	31	53.4
Medium	13	22.4	5	8.6	17	29.3	4	6.9
High	37	63.8	4	6.9	12	20.7	3	5.2
Total		100		100		100		100

F: Frequency; Low: 1-2 days per week; Medium: 3-4 days per week;  
High: 5-7 days per week

TABLE 5 Sugar consumption of mothers and children

Consumption	Soft drinks		Sugar		Honey	
	F	%	F	%	F	%
Mothers						
No consumption	2	3.4	3	5.2	36	62.1
Low	15	25.9	10	17.3	18	31.1
Medium	16	27.6	10	17.3	3	5.1
High	25	43.1	35	60.2	1	1.7
Total		100		100		100
Children						
No consumption	5	8.6	11	19.0	30	51.7
Low	22	37.9	11	19.0	22	38.0
Medium	8	13.8	5	8.6	5	8.6
High	23	39.7	31	53.4	1	1.7
Total		100		100		100

F: Frequency; Low: 1-2 days per week; Medium: 3-4 days per week;  
High: 5-7 days per week

days per week. Virtually all Coca Cola consumed is sugar-sweetened. Sugar is also commonly used to prepare typical beverages even those prepared from fruits. More than 50% of mothers and children showed a high consumption of sugar. Honey is a product consumed at very low level by both mothers and children.

#### *Fruits and vegetables*

Except for the consumption of banana and orange in children, in general both mothers and children reported very low frequencies of consumption of fruits (Table 6). As we expected, the lowest frequencies of consumption were registered in non-local fruits (apple, pear, grapes and strawberry) which are more expensive than local fruits (banana, watermelon, papaya and orange).

We found the same trend in relation to vegetables consumption. Particularly, we found low frequencies of

consumption in local vegetables, excepting cucumbers that had a medium consumption (Table 7). The FFQ included vegetables which are common in the food culture of urban and rural groups of Yucatan. Tomato and onion, both in mothers and children, showed the highest levels of consumption, although these vegetables tend to be used in relatively low quantities in the culinary culture of Yucatan, mostly as a garnish and flavouring for other dishes. Most participants fall into the category of low consumption for the rest of vegetables.

## DISCUSSION

The food pattern observed in the sample suggests a low consumption of fruits and vegetables, a medium consumption of pork, eggs, oil and lard, and a high consumption of sugar, especially from soda, and whole milk. This panorama would suggest that in nutritional terms this sample show a low consumption of dietary fibre, vitamins and minerals and a high intake of simple sugars and fat.

Most of the food and products with a high content of dietary fibre (such as oats, corn dough, fruits and vegetables) are consumed at low levels. On the other hand, products with low content of fibre such as baguette show a medium consumption.

Pork, eggs, oil, and whole milk are products consumed frequently by the mothers and children interviewed. Food guides, such as the Expert Committee of the Beverage Consumption Recommendations for the Mexican Population (23), recommend providing whole milk to only children younger than two years of age due to its high fat content. The problem of high consumption of whole milk is not only seen among children, 60% of the mothers consume this product. Combined with the levels of consumption of pork, eggs, oil and lard, the drinking of whole milk probably results in an excessive intake of fat.

The current diet of the Maya mothers and children in our sample is very different from the past. Since pre-

TABLE 6. Consumption of local and non local fruits by mothers and children

Consumption	Local								Non local							
	Banana		Watermelon		Papaya		Orange		Apple		Pear		Grape		Strawberry	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Mothers																
No consumption	1	1.7	17	29.3	40	69.0	25	43.1	17	29.3	39	67.2	33	56.9	47	81.0
Low	34	58.7	34	58.6	17	29.3	19	32.8	33	56.9	18	31.1	23	39.7	11	19.0
Medium	13	22.4	3	5.2		-	6	10.3	4	6.9	1	1.7	2	3.4	0	-
High	10	17.2	3	5.2		-	4	6.9	4	6.9	0	-	0	-	0	-
Seasonal	0	-	1	1.7	1	1.7	4	6.9	0	-	0	-	0	-	4	-
Total		100		100		100		100		100		100		100		100
Children																
No consumption	1	1.7	12	20.7	45	77.6	18	31.0	6	10.3	30	51.7	32	55.1	44	75.9
Low	23	39.6	35	60.4	11	19.0	20	34.5	44	75.9	26	44.9	24	41.5	13	22.4
Medium	15	26.0	8	13.8	2	3.4	4	6.9	4	6.9	0	-	2	3.4	1	1.7
High	19	32.7	2	3.4	0	-	8	13.8	3	5.2	2	3.4	0	-	0	-
Seasonal	0	-	1	1.7	0	-	8	13.8	1	1.7	0	-	0	-	0	-
Total		100		100		100		100		100		100		100		100

F: Frequency; Low: 1-2 days per week; Medium: 3-4 days per week; High: 5-7 days per week; Seasonal: consumed only when the product is available according to its production during the year.

TABLE 7. Current consumption of local vegetables by mothers and children

Consumption	Pumpkin		Carrot		Squash		Lettuce		Tomato		Cucumber		Cabbage		Onion	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Mothers																
No consumption	10	17.2	6	10.3	8	13.8	14	24.1	1	1.7	14	24.1	12	20.7	4	6.9
Low	41	70.8	39	67.4	40	69.0	31	53.5	5	8.6	16	27.5	30	51.7	9	15.5
Medium	5	8.6	11	18.9	8	13.8	9	15.5	16	27.5	21	36.4	12	20.7	10	17.3
High	2	3.4	2	3.4	2	3.4	4	6.9	36	62.1	6	10.3	4	6.9	35	60.4
Seasonal	-	-	-	-	-	-	-	-	0	-	1	1.7	0	-	0	-
Total		100		100		100		100		100		100		100		100
Children																
No consumption	14	24.1	9	15.5	14	24.1	26	44.8	5	8.6	12	20.7	21	36.2	21	36.2
Low	32	55.2	38	65.5	33	57.0	27	46.7	17	29.3	30	51.7	26	44.9	9	15.6
Medium	9	15.5	8	13.8	10	17.2	2	3.4	15	25.8	12	20.7	9	15.5	6	10.3
High	3	5.2	3	5.2	1	1.7	3	5.1	21	36.3	3	5.2	2	3.4	22	37.9
Seasonal	-	-	-	-	-	-	-	-	0	-	1	1.7	0	-	0	-
Total		100		100		100		100		100		100		100		100

F: Frequency; Low: 1-2 days per week; medium: 3-4 days per week; high: 5-7 days per week; seasonal: consumed only when the product is available according to its production during the year.

Columbian times the traditional Maya diet consists basically of a mix of crops including several kinds of beans, pumpkin, chili, fruits and corn as their central element. This diet changed during the Colonial and Independent period, incorporating foods from Europe, Asia and Africa. The Maya diet continues to change as a consequence of urbanization and food globalization.

One of the most relevant findings in this study was the very high consumption of soft drinks (mostly Coca Cola) shown by both mothers and children. According to our experience, based on previous studies developed in the south of Merida, we have noted that all family members, including children, tend to consume soft drinks at all meals -breakfast, lunch or dinner. Mo-

reover, this consumption tends to increase during weekends. In this context, Leatherman and Goodman (24) have reported what they call "Coca-colonization" to refer to an alarming consumption of sweetened carbonated beverages in coastal and inland villages of Yucatan. An increase in Coca-Cola consumption followed the building of the road network to rural areas and the growth of the tourism industry. Being urban, diets in Merida likely changed from a traditional consumption pattern to the Coca-colonized pattern before the change in the rural areas. The diet change involved many types of foods, with a net effect toward high energy density and low nutrient content (6).

In addition, television and radio advertisements

play an important role on the consumption of products such as the soft drinks. Particularly those advertisements which sell images of happiness accompanied with the consumption of products that by itself give happiness. Other forms of advertisement come from soda and beer companies which provide plastic tables and chairs that are widely used in homes and schools. These tables and chairs have the logo of the company prominently displayed. In this way, there is a constant advertisement for the product built into people's homes. We have also seen Coca-Cola Company supplied refrigerators in a school director's office. This refrigerator had the name and distinctive colours of Coca-Cola.

According to our observations the families from the south of Merida depend largely on small local stores (in Mexico called *tiendas*) for their food supply. Small local stores offer basic staples, mainly beans, rice, pasta and sugar, canned products, sodas, snacks as a chips, cookies and candy. Some of these small businesses do sell vegetables such as tomatoes, onion, pumpkin, carrots, cabbage, and chicken and pork. Most of the food for sale, however, is processed, and not fresh, unprocessed food. Most of the items are energy dense but low in essential nutrients. This situation in a low income Maya neighbourhood of south Merida is similar to that of many low income urban and rural areas in the United States. Some researchers label these poverty-stricken regions as 'food deserts' (25).

The south of Merida has historically been marginalized from economic development of the city. In addition, there is lack of educational, health and recreational services. We hypothesize that the patterns of consumption found in this sample represent a strategy to adapt to the low purchasing power shown by the families. Many of the products and foods frequently consumed are sold at the lowest prices in the small stores. Perhaps more important, these products satisfy immediate hunger and energy requirements of the family. Based on data collected in the field during November 2013, we found that a litre of soft drink costs \$3 Mexican pesos (around \$0.25 USA dollar) more than a litre of still water. Our knowledge of local customs suggests us that people are willing to pay the difference because they prefer the taste and the immediate energy provided by the soft drinks.

The findings presented in this article suggest that the families of our sample have gone through a nutri-

tional transition process, showing a pattern of high consumption of refined carbohydrates, saturated fat and low intake of dietary fibre and micronutrients. The particulars of the consumption patterns of the nutrition transition in Merida are shaped and exacerbated by the poverty of the Maya families.

One limitation of this report is that it is based only on a food frequency questionnaire. A more typical methodology is to apply a food frequency questionnaire along with a 24 hour food intake recall. The combination of these two instruments describes with a greater certainty the patterns of food consumption of a sample. As a consequence we have no information that allows us to quantify the amounts consumed of each food and product. We recognize these limitations and our results need to be treated with some caution. Even so, our findings are in keeping with research on other low socioeconomic groups of people in developing nations.

For purposes of this article we reviewed the results of the last Mexican National Health and Nutrition Survey (*Encuesta Nacional de Salud y Nutrición*) of 2006 (Instituto Nacional de Salud Pública 2007) (26). The Mexican National Health and Nutrition Survey was a carefully constructed, representative investigation of the Mexican population. In Yucatan, the survey included 6,985 persons living in 1,553 households. A detailed FFQ, including portion sizes of foods eaten, was included. The FFQ included 101 foods and participants were asked for each food item how many times it was eaten in past 7 days, the number of days per-week the item was eaten, the number of times per day, the portion size (later converted to a weight) eaten, and number of portions eaten each day (27). This allowed for the estimation of intakes of specific nutrients.

The findings for 5–11 years old children of the lower socioeconomic status (SES) were that total energy intake was only 81% of requirement and that there were inadequate intakes of vitamin A, folates, heme iron, zinc, and calcium (Instituto Nacional de Salud Pública 2007)(26). These estimates are for the whole of the Yucatan region, both rural areas as well as all of the city of Merida, and for children from all low SES families, not only Maya families.

Even when our results are not comparable with the results reported by the Mexican National Health and Nutrition Survey, both of them suggests a common pattern of consumption reduced in micronutrients, many of them essentials for physical growth.

## CONCLUSIONS

Our findings, combined with those of the Mexican National Health and Nutrition Survey, add to the understanding of the reasons for the persistence of short stature along with the additional nutritional dual burden of overweight/obesity among the Maya.

The observed pattern suggest a diet low in fibre and micronutrients (i.e. vitamins and minerals) and a high intake of fat and sugars. The deficiencies in micronutrients are likely one cause of short stature, while the energy density of the diet likely leads to overweight. Of relevance by its health implications was the finding of a high consumption of sugar-sweetened soft drinks among mothers and children, even when the cost of these products is high given the low income of the studied group. Our observations suggest that the studied group have a dietetic pattern that has moved away from a traditional Maya diet. Studies with more precise techniques for nutrient intake analysis are needed to know the dietetic characteristics of groups such as the Maya where there coexists a high prevalence of nutritional dual burden.

## ACKNOWLEDGMENTS

The authors thank the Wenner-Gren Foundation (#IRCG-93) for funding this research and to Janice Tut-Be for her collaboration in fieldwork.

## REFERENCES

1. Norgan NG, Bogin B, Cameron N. Nutrition and growth. In: Cameron N, Bogin B, editors: Human growth and development. London: Academic Press; 2012. p. 123-52.
2. Popkin BM, Richards MK, Monteiro CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. *J Nutr.* 1996; (126):3009-16.
3. Barquera S, Peterson KE, Must A, Rogers BL, Flores M, Houser R, Monterrubio E, Rivera-Dommarco JA. Coexistence of maternal central adiposity and child stunting in Mexico. *Int J Obesity.* 2007; (31):601-7.
4. Varela-Silva MI, Azcorra H, Dickinson F, Bogin B, Frisancho AR. Influence of maternal stature, pregnancy age, and infant birth weight on growth during childhood in Yucatan, Mexico: A test of the Intergenerational Effects Hypothesis. *Am J Hum Biol.* 2009; (21):657-63.
5. Doak CM, Adair LS, Bentley M, Monteiro C, Popkin BM. The dual burden household and the nutrition transition paradox. *Int J Obesity.* 2005; (29):129-36.
6. Bogin B, Azcorra H, Wilson H, Vázquez-Vázquez A, Avila ML, Castillo-Burguete MT, Varela-Silva I, Dickinson F. Globalization and children's diets: The case of Maya of Mexico and Central America. *Anthropol Rev.* 2014; 77 (1): 11-32.
7. Wells JCK. Obesity as malnutrition: The role of capitalism in the obesity global epidemic. *Am J Hum Biol.* 2012; (24):261-276.
8. Bracamonte y Sosa P, Lizama Quijano J. Marginalidad indígena: una perspectiva histórica de Yucatán. *Desacatos.* 2003; (13):83-98.
9. Lizama Quijano. El perfil Maya de la blanca Mérida. 1ª ed. Mérida, Yucatán: CIESAS; 2012.
10. INEGI. IX Censo General de Población y Vivienda 1970 [Página principal en Internet], México, D. F.: Instituto Nacional de Estadística, Geografía e Informática; 1970 [acceso octubre de 2013]. <http://www3.inegi.org.mx/sistemas/tabuladosbasicos/LeerArchivo.aspx?ct=953&c=16763&s=est&f=1>.
11. INEGI. Censo de población y vivienda 2010 [CD-ROM]. Aguascalientes: Instituto Nacional de Estadística, Geografía e Informática; 2010.
12. Pérez Medina S. Segregación, recreación y calidad de vida en Mérida. México, D. F. 1ª ed. México, D.F.: Universidad Nacional Autónoma de México; 2010.
13. López-Falfán IS. Arbolado urbano en Mérida, Yucatán y su relación con aspectos socioeconómicos, culturales y de la estructura urbana de la ciudad [Tesis]. Mérida, Yucatán: Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional; 2008.
14. Varela-Silva MI, Frisancho AR, Bogin B, Chatkoff D, Smith PK, Dickinson F, Winham D. Behavioral, environmental, metabolic and intergenerational components of early life undernutrition leading to later obesity in developing nations and in minority groups in the USA. *Coll Antropol.* 2007; 31 (1): 39-46.
15. Varela Silva MI, Dickinson F, Wilson H, Azcorra H, Griffiths PL, Bogin B. The nutritional dual-burden in developing countries – how is it assessed and what are the health implications? *Coll Antropol.* 2012; (36):39-45.
16. Borenstein M, Rothstein H, Cohen J. Power and precision. 1a ed. Englewood, NJ: Biostat Inc. 2001.
17. Gibson R. Principles of nutritional assessment. 1ª ed. Oxford: Oxford University press; 1990.
18. Sabaté J. Estimación de la ingesta dietética: métodos y desafíos. *Med Clínica.* 1993; (100):591-96.
19. Thompson FE, Byers T. Dietary assessment resource manual. *J Nutr.* 1994; (124):2245-2317.
20. Pérez Lizaur AB, Palacios González B, Castro Becerra



- AL. Sistema mexicano de alimentos equivalentes. 2ª ed. México, D. F.: Fomento de Nutrición y Salud; 2008.
21. Azcorra H, Dickinson F, Rothenberg S. Family migration and physical growth in Merida, Yucatan, Mexico. *Am J Hum Biol.* 2009; (21):398-400.
22. Madrigal Fritsch H, Martínez Salgado H. Manual de encuestas de dieta. 1ª ed. México, D. F.: Instituto Nacional de Salud Pública; 1996.
23. Rivera JA, Muñoz-Hernández O, Rosas-Peralta M, Aguilar-Salinas CA, Popkin BM, Willet W. Consumo de bebidas para una vida saludable: recomendaciones para población mexicana. *Salud Pública Mex.* 2008; (50):173-95.
24. Leatherman TL, Goodman AH. Coca-colonization of diets in the Yucatan. *Soc Sci Med.* 2005; (61):833-46.
25. Drewnowski A, Specter SE. Poverty and obesity: The role of energy density and energy costs. *Am J Clin Nutr.* 2004; (79):6-16.
26. INSP-SSP, 2007. Encuesta Nacional de Salud y Nutrición 2006 (ENSANUT 2006). Resultados por entidad federativa, Yucatán. Cuernavaca: Instituto Nacional de Salud Pública- Secretaría de Salud.
27. Rodríguez-Ramírez S, Mundo-Rosas V, Jiménez-Aguilar A, Shamah-Levy T. Methodology for the analysis of dietary data from the Mexican National Health and Nutrition Survey 2006. *Salud Pública Mex.* 2009; 51 (Suppl 4):523-29.

Recibido: 29-11-2013  
Aceptado: 07-02-2014