

# Consumption of fruits and vegetables and health status of Mexican children from the National Health and Nutrition Survey 2012

Alejandra Jiménez-Aguilar, MSc,<sup>(1)</sup> Elsa Berenice Gaona-Pineda, MSc,<sup>(1)</sup> Fabiola Mejía-Rodríguez, MSc,<sup>(1)</sup> Luz María Gómez-Acosta, MSc,<sup>(1)</sup> Ignacio Méndez-Gómez Humarán, MSc,<sup>(2)</sup> Mario Flores-Aldana, MD, PhD.<sup>(1)</sup>

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## Abstract

**Objective.** To characterize the current consumption of fruits and vegetables based on the international recommendations, as well as its relationship to certain variables of interest in Mexican children aged 6 to 12 years. **Materials and methods.** Adherence to the international recommendations for the consumption of fruits and vegetables was estimated based on data from the 2012 National Health and Nutrition Survey (Ensanut 2012). Logistic regression models were developed. **Results.** Only 34.4% of children met the recommendations. Their age (years) (OR:0.74;  $p < 0.01$ ) and the fact that they lived in the Central (OR:2.48;  $p < 0.01$ ) or Southern (OR:2.66;  $p < 0.01$ ) regions of Mexico or in Mexico City (OR:2.37;  $p < 0.01$ ) versus the Northern region were significantly associated with adherence. An interaction was observed between the educational level of the head of the family and his or her kinship with the child. **Conclusions.** Only 3 out of every 10 Mexican children meet the recommendations; therefore, the implementation of a public policy with the appropriate legislation, financing and regulation is required.

**Kew words:** fruits; vegetables; food consumption; children; nutrition surveys; Mexico

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## Resumen

**Objetivo.** Caracterizar el consumo actual de frutas y verduras tomando como referencia las recomendaciones internacionales y su relación con algunas variables de interés en niños mexicanos de 6 a 12 años de edad. **Material y métodos.** Con datos de la Ensanut 2012 se estimó el apego hacia las recomendaciones internacionales del consumo de frutas y verduras. Se desarrollaron modelos de regresión logística. **Resultados.** El 34.4% de los niños cumplió con las recomendaciones. La edad (años) (RM:0.74;  $p < 0.01$ ) y vivir en las regiones centro (RM:2.48;  $p < 0.01$ ), Ciudad de México (RM:2.37;  $p < 0.01$ ) y sur (RM:2.66;  $p < 0.01$ ), con respecto a vivir en la región norte, se asociaron significativamente con el cumplimiento. Se observó una interacción entre el nivel educativo del jefe de familia y su parentesco con el niño. **Conclusiones.** Sólo 3 de 10 niños mexicanos cumplen con las recomendaciones, por lo que se requiere de la implementación de una política pública con legislación, financiamiento y regulación adecuados.

**Palabras clave:** frutas; verduras; consumo de alimentos; niños; encuestas nutricionales; México

(1) Centro de Investigación en Nutrición y Salud, Instituto Nacional de Salud Pública. México, Cuernavaca, México

(2) Centro de Investigación en Matemáticas. Aguascalientes, México

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Corresponding author: Dr. Mario E. Flores. Center of Research in Nutrition and Health, National Institute of Public Health. Av. Universidad 655, col. Santa María Ahuacatitlán. 62100 Cuernavaca, Morelos, México.  
E-mail: mario.flores@insp.mx

The World Health Organization (WHO) estimates that each year 1.7 million lives worldwide could be saved if the consumption of fruits and vegetables conformed to a recommended minimum of 400g/day.<sup>1</sup> These foods play an important role in the prevention of major chronic non communicable diseases.<sup>2-5</sup>

According to data from the 2006 National Health and Nutrition Survey (Ensanut 2006), less than 30% of the Mexican population have an adequate intake of fruits and vegetables; more specifically, only 17% of the children aged 5-11 years adhere to the international recommendations.<sup>6,7</sup>

Parallel to this low consumption of fruits and vegetables, the diet in developing countries like Mexico has changed rapidly, with an increase in the consumption of foods rich in saturated fats and sugar,<sup>8</sup> and therefore the rates of overweight and obesity in Mexican children have risen significantly in recent years. Data of the 2012 Ensanut show that the combined national prevalence of overweight and obesity in Mexican school-age children is 34.4%, which indicates a slowing down of the increase in the prevalence of overweight and obesity in Mexican children compared to that observed for 2006. This could be the result of regulatory actions by the government,<sup>9</sup> which since 2010 Mexico has played an active role in countering the epidemic of obesity through the development of the National Agreement for Nutritional Health (ANSA).<sup>10</sup> One of the objectives of ANSA is to promote the consumption of fruits and vegetables among the population, especially among Mexican children. Furthermore, and based on the goals of ANSA, the Ministries of Public Health and Education have jointly developed the Action Program in the School Context (PACE), an intervention that has highlighted the need to ensure the availability of an adequate nutrition within the public and private institutions of basic education. This program is currently under evaluation.

Based on this, a scenario of greater availability of healthy foods in schools is contemplated to increase fruit and vegetable consumption among school-age children.

Therefore, the aim of this study was to characterize the current consumption of fruits and vegetables, using the international recommendations as a reference, and to explore the manner in which this categorization is associated with variables of interest in the Mexican population aged 6-12 years.

## Materials and methods

### Population and study design

This is a cross-sectional observational study using data from Mexican school-age children from the most

recent National Nutrition and Health Survey (Ensanut 2012), a probabilistic multi-topic survey with national, state, urban and rural representation which collected information from approximately ~50 000 Mexican households.<sup>9</sup>

### Data collection

*Food consumption.* Dietary data were collected using a semi-quantitative food frequency questionnaire (FFQ) in a subsample of the study population (1 out of every 6 subjects by population group). The FFQ was based on the FFQ used in the 2006 Ensanut survey.<sup>11</sup>

Compared to the 2006 FFQ, the 2012 questionnaire included 39 additional foods. Information was gathered for a total of 140 food and beverages. The following data were recorded for each food: intake frequency per week (0 to 7 days), intake frequency per day (1 to 5 times), portion size (i.e. very small, small, medium, large and very large), and number of portions consumed each time (i.e. number of pieces, cups, spoonfuls, etc.). This FFQ made reference only to the last seven days before the survey.

The questionnaire for children aged 6 to 11 years was applied to the child's parent or caregiver and directly to children aged 12 or more years.

*Height and weight.* Height and weight were measured by trained personnel using Lohman<sup>12</sup> techniques, according to the methodology proposed by Habicht.<sup>13</sup> A Tanita scale with a 100-g precision, calibrated daily, was utilized for measuring the weight. For the height, a Dynatop stadiometer with a 1-mm accuracy was used.

*Socioeconomic, demographic and morbidity data.* The collected data included: demographic (gender, age), economic (household characteristics, property ownership and household appliances), social (area of residence and region), current school attendance, health beneficiary of various institutions (both public and private), and morbidity based on the presence of any condition or disease in children during the two weeks prior to the interview. Within the household questionnaire, information was also collected about the head\* of the household in terms of kinship to the study population, gender, age and educational level.

\* The head of the household is recognized by the members of the home (group of people with or without kinship ties who normally sleep under the same roof, benefitting from a common income provided by one or more of the members of the home) for being the most important person in the group because he or she is normally present in the home and has a greater authority on the decisions made or is the main provider of economic support.

## Ethics

Consent by the children who participated in the study and informed consent by their parents or guardians were obtained. The protocol was previously approved by the Research Ethics Committee and Committee on Biosafety and Research of the Instituto Nacional de Salud Pública (INSP).

## Variables

*Consumption of fruits and vegetables.* The variable of consumption of fruits and vegetables was constructed for each subject by adding consumption (in grams per day) of fruits and vegetables included in the FFQ applied in the 2012 Ensanut,\* with the exception of vegetables used in preparations such as desserts, soups and creams, as well as crystallized fruits and fruits contained in syrup and in juices. This exclusion was due the change in nutritional composition of such items, especially when sugar was added, or to the loss of nutrients during processing.<sup>14-16</sup> The methodology for analyzing the questionnaire has been previously described by Rodríguez and colleagues.<sup>11</sup>

## Adherence to recommendations

*Adherence and nonadherence* categories for the fruit and vegetable consumption variable were established based on international recommendations for daily intake of fruits and vegetables. Cut-off points were determined according to Ramirez and colleagues,<sup>6</sup> i.e. as 300g/day for children 5-8 years of age based on the recommendations of the AHA<sup>17</sup> and 400g/day for the population aged 9 or more years based on the recommendations of the WHO.<sup>18</sup>

## Independent variables

### Demographics variables

*Gender and age.* Gender was dichotomized as male and female. Age was analyzed continuously (6-12 years).

*Region.* Regions in the country were divided according to their geographical location into North, Central, Mexico City and South.\*

*Urban and rural areas.* Areas having a population of 2 500 inhabitants or more were defined as urban, while those with <2 500 inhabitants were defined as rural.

*Socioeconomic tertile (SET).* A socioeconomic index was constructed using principal components analysis with variables of housing and availability of goods and services. The first component, which, accumulated, represents 40.5% of total variability with a value (lambda) of 3.24, was selected as the index. The index was classified into three categories using tertiles of the distribution as cut-off points.

*School attendance.* This variable was categorized into two groups: those who attended school and those who did not attend school at the time of the survey.

*Health insurance or affiliation.* This was classified according to two categories: 1) those with insurance coverage (public or private) or affiliation with government agencies and 2) those without any type of insurance or who were not affiliated with any institution.

### Characteristics of the head of the family

*Kinship of the head of the family to the child.* The options for kinship were parent, grandparent, or other, such as aunt/uncle, cousin, sibling, etc.

*Gender and age of the head of the family.* Both the gender and the age of the head of the family were taken into consideration.

*Education of the head of the family.* The highest level of schooling reported by the head of the family was taken into consideration, according to four categories: 1) elementary school or lower, 2) secondary level, 3) high school or equivalent and 4) bachelor's degree (or higher).

### Nutrition

*Energy obtained from other sources.* Energy from all foods included in the FFQ was estimated (including fruits and vegetables) using the food composition tables compiled by the INSP as a reference.\* After this, only the energy

\* Fruits and vegetables included in the analysis: avocado, *poblano* peppers, white cabbage, corn, cactus, cucumber, leafy green vegetables, carrots, strawberry, guava, jicama, mango, papaya, pineapple, banana, grapefruit, grapes, precooked packaged vegetables such as sweet peas, carrots, corn, etc., orange or tangerine, apple or pear, melon or watermelon, peach or apricot, tomato, *chayote*, zucchini, broccoli or cauliflower, lettuce, and onion.

\* 1) North: Baja California and Baja California South, Coahuila, Chihuahua, Durango, Nuevo Leon, Sonora and Tamaulipas; 2) Central: Aguascalientes, Colima, Guanajuato, Jalisco, State of Mexico, Michoacan, Morelos, Nayarit, Queretaro, San Luis Potosi, Sinaloa and Zacatecas; 3) Mexico City and 4) South: Campeche, Chiapas, Guerrero, Hidalgo, Oaxaca, Puebla, Quintana Roo, Tabasco, Tlaxcala, Veracruz and Yucatan.

† INSP. Bases de datos del valor nutritivo de los alimentos. Compilación del Instituto Nacional de Salud Pública. México, 2012. Unpublished document.

from fruits and vegetables was recorded and subtracted from the total energy to estimate the energy obtained from other sources.

#### Health status

**BMI.** The BMI Z score was calculated ( $BMI=kg/m^2$ ) by age. According to the WHO reference, children were classified as overweight when they had a Z score between +1 and +2 SD, while those higher than +2 SD were classified as obese.<sup>19</sup>

**Presence of prior illness.** The presence of diseases was categorized into two groups (yes and no) based on the report of having had an illness (gastrointestinal, respiratory, oral/dental, or contagious/infectious diseases, nutritional deficiency such as anemia, etc.) during the two weeks prior to the application of the survey.

#### Data analysis

From a sample of 3 593 children and adolescents aged 6-19 years, we included only 1 506 children, aged 6-12 years.

Energy adequacy was calculated using as a reference the information from the U.S. Institute of Medicine,<sup>20</sup> and data of children with an energy adequacy of +5 SD of the general distribution as well as the observations of energy adequacy <25%.<sup>11</sup> Approximately 5% of the sample (74 cases) was excluded thereby.

Demographic variables in regard to nutritional, socioeconomic and health status were stratified according to the categories of adherence and nonadherence to the international recommendations for consumption of fruits and vegetables. Differences between these categories were analyzed using statistical tests such as chi-squared independence test or linear regressions, according to the variable scale. Also, a bivariate logistic model regression was carried out to explore the relationship of each variable with adherence. All variables were included in a multivariate logistic regression model where interactions among the variables were tested (i.e. the schooling and age of the household head and his or her kinship to the child). A final model including only statistically significant ( $p<0.05$ ) or biologically important variables according to the literature was considered. The same criteria were applied to the interactions, which were tested by the logistic regression analysis. All analyses were adjusted in accordance with the design of the survey using the SVY module of the Stata v.12 program.

## Results

Data were analyzed from a total of 1 432 participants representing just over 15.8 million Mexican children

aged 6-12 years. Thirty four percent (34.4%) of the children followed the recommendations.

The child's age was inversely associated to adherence to the recommendations for fruits and vegetables (F&V) consumption. A much higher adherence percentage was observed in children aged 6-9 years, compared to children aged 10-12 years ( $p<0.01$ ).

Energy intake from other (non-F&V) sources was higher among those children who adhered to the recommendations than among those who did not adhere to them ( $p<0.01$ ).

The children from the northern region of the country had the lowest adherence rates compared to the rest of the regions ( $p=0.01$ ).

A positive trend was observed between the education level of the head of the family and the adherence rate; this was higher when the head of the family had a bachelor's or higher degree ( $p=0.05$ ) (table I).

The bivariate logistic regression analysis (table II) showed that children aged 6-9 years had 2.6 times the odds of adhering to the recommendations, compared to children aged 10-12 years ( $p<0.01$ ).

The children of the Central region and of Mexico City had approximately 2.4 times the odds of adhering to the recommendations, while the children of the southern region had 2 times the odds of the children of the northern region ( $p<0.01$ ).

The children of households whose head had a bachelor's or higher degree had 2 times the odds of adhering to the recommendations of the children of households where the head of the family had a lower educational level ( $p=0.01$ ).

The associations observed in relation to the child's age and region of residence persisted after adjusting for potential confounders in a multivariate logistic regression model (table III).

A statistically significant interaction was observed between the educational level of the head of the family and his or her kinship to the child and the odds of adhering to the recommendations. Very high odds of adhering to these were observed when the head of the household was a grandfather with a high educational level ( $p<0.1$ ).

Figure 1 shows that adherence was 98% in children in a household where the head of the family was a grandparent with a bachelor's or higher degree, whereas if the head of the family was another relative (aunt/uncle, cousin, etc.) with a high-school education, the adherence rate was a mere 2.5% (figure 1). Figure 2 shows graphically that the (adjusted) adherence rate is significantly lower in the children from Northern Mexico than in those of other regions of the country.

**Table I**  
**CHARACTERISTICS OF MEXICAN CHILDREN 6-12 YEARS OF AGE ACCORDING TO THEIR ADHERENCE TO INTERNATIONAL RECOMMENDATIONS FOR CONSUMPTION OF FRUITS AND VEGETABLES. MEXICO, ENSANUT 2012**

Variables	n*		Adherence				p <sup>‡</sup>
			Yes		No		
Adherence with recommendations (n, %)	1 432	100	442	34.4	990	65.6	–
<b>Demographics</b>							
Age (years) (mean ± SE)	9.3	0.1	8.5	0.1	9.6	0.1	<0.01
Age (n, %)							
6 to 9 years	539	50.9	214	44.9	325	55.1	<0.01
10 to 12 years	893	49.1	228	23.5	665	76.5	
Gender (n, %)							
Male	749	52.9	227	32.3	522	67.7	0.21
Female	683	47.1	215	36.7	468	63.3	
<b>Nutrition</b>							
Consumption (g/day) of fruits and vegetables (mean ± SE)	304.9	9.0	564.2	13.0	169.0	4.0	<0.01
Energy (kcal/day) from other sources (mean ± SE)	1 531	23	1 655	35	1 467	28	<0.01
<b>Socioeconomic</b>							
Area (n, %)							
Urban	929	72.2	295	35.1	634	64.9	0.44
Rural	503	27.8	147	32.4	356	67.6	
Socioeconomic tertile (SET) (n, %)							
SET 1	508	32.0	135	30.1	373	69.9	0.23
SET 2	510	33.8	161	36.4	349	63.6	
SET 3	414	34.2	146	36.4	268	63.6	
School attendance (n, %)							
Yes	1 387	96.7	428	34.5	959	65.5	0.82
No	45	3.3	14	32.3	31	67.7	
Region (n, %)							
North	347	20.6	76	21.4	271	78.6	0.01
Central	497	31.3	170	39.2	327	60.8	
Mexico City	104	16.3	41	40.1	63	59.9	
South	484	31.8	155	35.2	329	64.8	
Kinship of the head of the family with the child (n, %)							
Parent	1 131	78.1	365	35.2	766	64.8	0.44
Grandparent	230	16.7	59	34.0	171	66.0	
Other	71	5.2	18	24.3	53	75.7	
Gender of the head of the family (n, %)							
Male	1 155	79.1	364	35.3	791	64.7	0.34
Female	277	20.9	78	30.8	199	69.2	
Age (years) of the head of the family (mean ± SE)	43.3	0.4	42.0	0.8	44.0	0.5	0.04
Educational level of the head of the family (n, %)							
Primary or lower	728	48.2	199	30.7	529	69.3	0.05
Secondary	410	27.2	129	34.2	281	65.8	
High school or equivalent	196	16.5	67	38.6	129	61.4	
Bachelor degree or higher	98	8.1	47	48.4	51	51.6	
Health insurance or affiliation (n, %)							
Yes	1 178	80.0	370	34.1	808	65.9	0.74
No	254	20.0	72	35.5	182	64.5	
<b>Health status of the child</b>							
Classification of BMI (n, %) <sup>§</sup>							
Normal	861	64.5	267	34.0	594	66.0	0.35
Overweight	280	20.1	79	32.1	201	67.9	
Obese	232	15.4	78	40.3	154	59.7	
Prior illness (n, %) <sup>‡</sup>							
Yes	163	13.3	48	27.8	115	72.2	0.18
No	1 269	86.7	394	35.4	875	64.6	

\* n= 1 432; n expanded=15 800 387 children

‡ Difference between categories of adherence evaluated using  $\chi^2$  or lineal regression model, according to the variable scale

§ n for this variable was 1 373, representative of 14 892 698



**Table II**  
**BIVARIATE ASSOCIATIONS AMONG VARIABLES OF INTEREST AND ADHERENCE TO INTERNATIONAL RECOMMENDATIONS FOR CONSUMPTION OF FRUITS AND VEGETABLES IN MEXICAN CHILDREN 6-12 YEARS OF AGE. MEXICO, ENSANUT 2012)\*†‡**

Variables	OR	95% CI	p
<b>Nutrition</b>			
Energy (kcal) obtained from other sources	1.00	(1.00-1.00)	<0.01
<b>Demographics</b>			
Age			
10 to 12 years	1.00	–	–
6 to 9 years	2.64	(1.96-3.56)	<0.01
Gender			
Female	1.00	–	–
Male	0.83	(0.61-1.11)	0.21
<b>Socioeconomic</b>			
Area			
Rural	1.00	–	–
Urban	1.13	(0.83-1.53)	0.44
Socioeconomic tertile (SET)			
SET 1	1.00	–	–
SET 2	1.33	(0.92-1.92)	0.13
SET 3	1.33	(0.91-1.94)	0.15
School attendance			
Yes	1.00	–	–
No	0.91	(0.40-2.05)	0.82
Region			
North	1.00	–	–
Central	2.37	(1.55-3.62)	<0.01
Mexico City	2.46	(1.34-4.52)	<0.01
South	2.00	(1.33-3.00)	<0.01
Kinship of the head of the family with the child			
Parent	1.00	–	–
Grandparent	0.95	(0.61-1.47)	0.81
Other	0.59	(0.26-1.34)	0.21
Gender of the head of the family			
Female	1.00	–	–
Male	1.22	(0.81-1.86)	0.34
Age (years) of the head of the family	0.99	(0.97-1.00)	0.05
Educational level of the head of the family			
Primary school or lower	1.00	–	–
Secondary	1.17	(0.81-1.70)	0.39
High school or equivalent	1.42	(0.91-2.22)	0.12
Bachelor degree or higher	2.12	(1.20-3.73)	0.01
Health insurance or affiliation			
No	1.00	–	–
Yes	0.94	(0.65-1.35)	0.74
<b>Health status of the child</b>			
Classification of BMI			
Normal	1.00	–	–
Overweight	0.92	(0.61-1.38)	0.69
Obese	1.31	(0.87-1.98)	0.20
Prior illness§			
No	1.00	–	–
Yes	0.70	(0.42-1.18)	0.18

\* n= 1432; n expanded=15 800 387children

† Bivariate logistic model regression was carried out for each of the variables

§ Gastrointestinal, respiratory, oral-dental, infectious/contagious disease, nutritional deficiencies such as anemia, among others

BMI: Body mass index

Table III

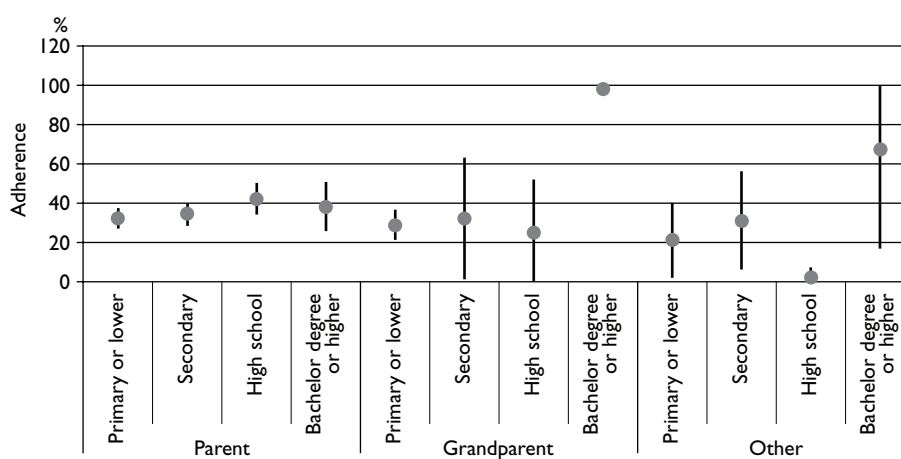
**MULTIVARIATE ASSOCIATIONS BETWEEN VARIABLES OF INTEREST AND ADHERENCE TO INTERNATIONAL RECOMMENDATIONS FOR CONSUMPTION OF FRUITS AND VEGETABLES IN MEXICAN CHILDREN 6-12 YEARS OF AGE. MEXICO, ENSANUT 2012\***

Variables	OR	95%CI	P
<b>Age</b>			
10 to 12 years	1.00	—	—
6 to 9 years	2.72	(1.98-3.73)	<0.01
Male	0.84	(0.61-1.15)	0.27
Female	1.00	—	—
Energy from other sources (kcal)	1.00	(1.00-1.00)	0.00
Age (years) of the head of the family	0.98	(0.96-1.00)	0.06
<b>Educational level of the head of the family</b>			
Primary or lower	1.00	—	—
Secondary	1.09	(0.70-1.68)	0.71
High school	1.28	(0.80-2.04)	0.31
Bachelor degree or higher	1.01	(0.52-1.97)	0.97
<b>Kinship of the head of the family</b>			
Parent	1.00	—	—
Grandparent	1.01	(0.51-1.99)	0.99
Other	0.85	(0.26-2.70)	0.78
Primary & parent <sup>‡</sup>	1.00	—	—
High school & other relationship <sup>‡</sup>	0.04	(0.00-0.40)	0.01
Bachelor degree & grandparent <sup>‡</sup>	95.48	(10.07-904.81)	0.00
<b>Region</b>			
North	1.00	—	—
Central	2.42	(1.56-3.74)	0.00
Mexico City	2.27	(1.32-3.92)	0.00
South	2.55	(1.66-3.91)	0.00

\* n= 1 432; n expanded=15 800 387children

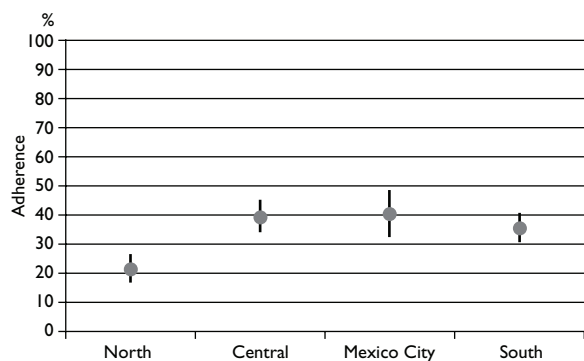
‡ Term associated with the interaction. Only statistically significant interactions are presented

F test= 0.00



\*Adjusted according to the variables of the final model (table III)

**FIGURE 1. PERCENTAGE\* OF ADHERENCE TO INTERNATIONAL RECOMMENDATIONS FOR CONSUMPTION OF FRUITS AND VEGETABLES IN MEXICAN CHILDREN 6-12 YEARS OF AGE, ACCORDING TO THE KINSHIP OF THE HEAD OF THE FAMILY AND LEVEL OF EDUCATION. MEXICO, ENSANUT 2012**



\*Adjusted according to the variables of the final model (table III)

**FIGURE 2. PERCENTAGE\* OF ADHERENCE TO INTERNATIONAL RECOMMENDATIONS FOR THE CONSUMPTION OF FRUITS AND VEGETABLES IN MEXICAN CHILDREN 6-12 YEARS OF AGE ACCORDING TO REGION OF THE COUNTRY. MÉXICO, ENSANUT 2012**

## Discussion

This study was based on the most recent national health and nutrition data in Mexico and has shown that currently only 3 out of every 10 children aged 6-12 years (34.4%) meet the international recommendations for consumption of fruits and vegetables. According to the 2006 Ensanut, only 17% of children aged 5-11 years had an adequate intake of fruits and vegetables.<sup>6</sup> This, compared to the results of the present study, shows an increase in fruit and vegetable consumption among children. This apparent increase may be related to the implementation of the ANSA and the PACE, which is derived from the Agreement on Guidelines for the Sale of Food and Beverages within the elementary schools, which became mandatory early in 2010. Early results have shown that within these schools there is a significant availability of fruits and vegetables (11% of total foods offered). For this reason, the authors assume that these Guidelines were effective in promoting access to fruits and vegetables among elementary school children in Mexico.<sup>21</sup>

Based on the above, the current outlook is more encouraging than that observed in 2006; however, at a national level, a significant proportion of school-age children remain without reaching the recommended minimum consumption of fruits and vegetables each day. Also, certain population subgroups, such as children of the northern region of the country, have shown a low adherence to respect to the other regions. Since 2006, ~80% of the school children in northern Mexico have been observed not to adhere to the recommended intake of fruits and vegetables.<sup>6</sup> This low consumption

may depend on factors beyond the economic situation of the region, such as the rapid growth of the food industry, the accelerated pace of life, social influences, the cultural and economic life of the U.S., as well as climate issues and, of course, individual tastes and preferences. These aspects need further investigation.

Age proved to be an important factor in adherence to the recommendations, noting that as age increases, the consumption of fruits and vegetables decreases. This phenomenon was also observed in the 2006 Ensanut<sup>6</sup> in Canadian children<sup>22</sup> and in adolescents,<sup>23</sup> as well as in American children.<sup>24</sup> One possible explanation for this relationship may be that, as children grow, supervision of food intake by parents or caretakers decreases.<sup>25</sup> However, this independence of food choices is not usually accompanied by a nutritional orientation. The widespread availability and marketing of cheap, energy-dense, micronutrient-poor foods, could work against the consumption of fruit and vegetables<sup>26</sup> if these foods continue to be prevalent at home.<sup>27</sup>

The results showed a significant relationship with the level of education of the head of the household, which has been observed in other studies.<sup>28-30</sup> Moreover, this relationship was based not on the gender, age or socioeconomic level, but on the kinship ties to the child, primarily when the level of education was high (bachelor's or higher degree). When the head of the household was the grandparent, a high adherence rate was observed (98%). This relationship differentiated by kinship had not been previously documented, and in this study the number of cases in which this happens is very small, a fact that is reflected in confidence intervals associated to interaction (table III). However, it is possible to propose some hypothesis based on the existing literature. Some studies have reported better nutritional conditions in young children who live in "extended" families because this allows for a greater interaction among its members, facilitating child care and provision of all the necessities of life, regardless of their income.<sup>28-31</sup> It has also been shown that cohabitation of a person 60 years of age or older in large homes generates a support for child care or in performing household chores that facilitates the ability of other members of the household to be employed.<sup>32</sup> This may encourage paying better attention to nutrition within the home. On the other hand, it is possible that this relationship may be due to factors not considered in the analysis, for example, the health status and nutrition of the head of the household. A better educational level has been associated with greater adherence to health recommendations and guidelines. Thus, a higher consumption of fruits and vegetables is promoted among the rest of the family. These hypotheses are only proposals that should be interpreted with caution and researched further.



The results of this study should be interpreted taking its limitations into account. Because it is cross-sectional, causality or temporality cannot be established. However, it has the advantage of providing information that is representative of the Mexican population and of being comparable to the 2006 Ensanut.

Use of the FFQ is subject to various errors in its application and reporting; therefore, staff were trained and standardized to apply it equally to all subjects. As for the reporting, it has been documented that fruits and vegetables are foods that tend to be overreported because they are considered to be healthy. This is more common in overweight persons or mothers of overweight children.<sup>33</sup> In the present study a positive but not statistically significant tendency was observed between adherence and obesity.

The present study documented that there is currently greater adherence to international recommendations of fruit and vegetable consumption. However, two-thirds of the children aged 6-12 years still do not adhere to the recommendations. Therefore, it is urgent to promote a solid public policy with adequate legislation, financing and regulation, in order to facilitate fruit and vegetable consumption among Mexican children.

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## References

1. Organización Mundial de la Salud. Estrategia mundial sobre régimen alimentario, actividad física y salud. Fomento del consumo mundial de frutas y verduras. OMS, 2012 [Accessed August 2, 2012] Available at: <http://www.who.int/dietphysicalactivity/fruit/es/>
2. Carlton B. Dietary intake of fruit and vegetables and management of body weight. Geneva: WHO, 2005.
3. Cooper AJ, Forouhi NG, Ye Z. Fruit and vegetable intake and type 2 diabetes: EPIC-Inter Act prospective study and meta-analysis. *Eur J Clin Nutr* 2012; 66(10):1082-1092.
4. Reddy KS, Katan MB. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. *Public Health Nutr* 2004;7(1A):167-186.
5. World Cancer Research Fund/American Institute for Cancer Research. Fruit and vegetables. Handbook of cancer prevention. London/Washington DC: WCRF/AICR, 2003: 8.
6. Ramirez I, Rivera J, Ponce X, Hernández M. Fruit and vegetable intake in the Mexican population: results from the Mexican National Health and Nutrition Survey 2006. *Salud Publica Mex* 2009;51(suppl 4):S574-S585.
7. Shamah T, Palma O, Morales MA, Mendoza AJ, Villalobos A. Encuesta de salud en estudiantes de escuelas públicas en México. SS, SEP, INSP, 2010 [accessed December 10, 2013]. Available at: [http://0305.nccd.net/4\\_2/000/000/055/027/libro\\_completo-ENSE-29-abri-10.pdf](http://0305.nccd.net/4_2/000/000/055/027/libro_completo-ENSE-29-abri-10.pdf)
8. Popkin BM, Gordon P. The nutrition transition: worldwide obesity dynamics and their determinants. *Int J Obes* 2004;28:S2-S9.
9. Gutierrez JP, Rivera J, Shamah T, Villalpando S, Franco A, Cuevas L, et al. Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública, 2012.
10. Secretaría de Salud. Acuerdo Nacional para la Salud Alimentaria. Estrategia contra el sobrepeso y la obesidad. México: SSA, 2010 [accessed November 20, 2013]. Available at: [www.promocion.salud.gob.mx](http://www.promocion.salud.gob.mx)
11. Rodríguez S, Mundo V, Jiménez A, Shamah T. Methodology for the analysis of dietary data from the Mexican National Health and Nutrition Survey 2006. *Salud Publica Mex* 2009;51(suppl 4):S523-S529.
12. Lohman T, Roche A, Martorell R. Anthropometric standardization reference manual. Champaign, IL: Human Kinetics, 1988.
13. Habicht JP. Estandarización de métodos epidemiológicos cuantitativos sobre el terreno (Standardization of anthropometric methods in the field). *PAHO Bull* 1974;76:375-384.
14. Agte V, Tarwadi K, Mengale S, Hinge A, Chipplonkar S. Vitamin profile of cooked foods: how healthy is the practice of ready-to-eat foods? *Int J Food Sci Nutr* 2002;53(3):197-208
15. Han JS, Kozukue N, Young KS, Lee KR, Friedman M. Distribution of ascorbic acid in potato tubers and in home-processed and commercial potato foods. *J Agric Food Chem* 2004;52(21):6516-6521.
16. Mareschi JP, Belliot JP, Fourlon C, Gey KF. Changes in vitamin C content of Bintje potatoes during storage and usual culinary preparations. *Int J Vitam Nutr Res* 1983; 53(4):402-411.
17. Gidding SS, Dennison BA, Brich LL, Daniels SR, Gillman MW, Lichtenstein AH, et al. American Heart Association. Dietary recommendations for children and adolescents: a guide for practitioners. *Pediatrics* 2006; 117:544-559.
18. World Health Organization/Food and Agriculture Organization. Dieta, nutrición y prevención de enfermedades crónicas. Technical series 916. Geneva: WHO/FAO, 2003.
19. WHO. Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: World Health Organization, 2006.
20. Institute of Medicine. Protein. In: Dietary Reference Intakes for Energy, Carbohydrates, Fiber, Fat, Protein and Amino Acids (Macronutrients). Washington DC: Institute of Medicine, The National Academies Press, 2005:589-630.
21. López N, Shamah T, Morales C, Theodore F, Bonvecchio A, Tolentino L, et al. Disponibilidad de alimentos y bebidas en los planteles de educación básica en México. In: Libro de Resúmenes. 15 Congreso de Investigación en Salud Pública. Cuernavaca, México. Evidencia para la cobertura Universal y Efectiva. México: INSP, 2013:128.
22. Black JL, Billette JM. Do Canadians meet Canada's Food Guides recommendations for fruits and vegetables? *Appl Physiol Nutr Metab* 2013;38:234-242.
23. Riediger ND, Shoostari S, Moghadasian HM. The influence of socio-demographic factors on patterns of fruit and vegetable consumption in Canadian adolescents. *J Am Diet Assoc* 2007;107:1511-1518.
24. Lorson BA, Melgar HR, Taylor CA. Correlates of fruit and vegetable intakes in US children. *J Am Diet Assoc* 2009;109:474-478.
25. Mahan L, Escott S. Chap. 11 Nutrición en la adolescencia In: Nutrición y Dietoterapia de Krause. 10 ed. New York: McGraw-Hill, 2001: 271-272

26. Tolentino ML, Galán GA, Hernández E, Barquera S. Caracterización de los alimentos y bebidas que se venden alrededor de escuelas primarias públicas. In: Libro de Resúmenes. 15 Congreso de Investigación en Salud Pública. Cuernavaca, México. Evidencia para la cobertura Universal y Efectiva. México: INSP, 2013:117.
27. Shamah T, Cuevas L, Méndez I, Jiménez A, Mendoza AJ, Villalpando S. La obesidad en niños mexicanos en edad escolar se asocia con el consumo de alimentos fuera del hogar: durante el trayecto de la casa a la escuela. *Arch Latinoam Nutr* 2011;61:288-295.
28. Moreno E. Análisis de la política social de desarrollo infantil en el Ecuador. Caso modelo programa Nuestros Niños/Fondo de Desarrollo Infantil (tesis). Ecuador, Quito: FLACSO, 2011.
29. Rodenburg G, Oenema A, Kremers S, van de Mheen D. Parental and child fruit consumption in the context of general parenting, parental education and ethnic background. *Appetite* 2012;58:364-372.
30. Cribb V, Jones L, Rogers I, Ness A, Emmett P. Is maternal education level associated with diet in 10-year-old children? *Public Health Nutr* 2011;14:2037-2048.
31. Pelcastre B, Riquer F, León VD, Reyes H, Gutiérrez G, Bronfman M. ¿Qué se hace para no morir de hambre? Dinámicas domésticas y alimentación en la niñez en un área rural de extrema pobreza de México. *Salud Publica Mex* 2006;48:490-497.
32. Instituto Nacional de Estadística y Geografía. (Inegi). [Accessed April 20, 2013] Available at:<http://www.inegi.gob.mx/inegi/contenidos/espanol/prensa/Contenidos/estadisticas/2007/familia07.pdf>.
33. Johansson L, Solvoll K, Bjørneboe GE, Drevon CA. Under-and over-reporting of energy intake related to weight status and lifestyle in a nationwide sample. *Am J Clin Nutr* 1998;68:266-274.