

Original

## Dynamics of the components of energy intake between Spanish and Mexican preschool children: energy density and food volume in two contexts

F. Capdevila<sup>1</sup>, B. Vizmanos<sup>2</sup>, J. Escribano<sup>1</sup>, R. Closa<sup>1</sup>, L. Martínez-Lomeli<sup>2</sup> and F. Márquez-Sandoval<sup>2</sup>

<sup>1</sup>Unidad de Pediatría. Facultad de Medicina y Ciencias de la Salud. Universidad Rovira i Virgili. Reus. España. <sup>2</sup>UDG-CA-454. Laboratorio de Evaluación del Estado Nutricio. Departamento de Reproducción Humana, Crecimiento y Desarrollo Infantil. División de Disciplinas Clínicas. Centro Universitario de Ciencias de la Salud. Universidad de Guadalajara. Jalisco. México.

### Abstract

**Objective:** To determine the differences in the dynamics of dietary energy density (ED), food volume (FV) and energy intake (EI) between two groups of healthy children, in normal conditions, from Spain and Mexico.

**Methods:** Cross-sectional study which analyses the habitual diet of two healthy children groups, 1-4 years old, from Reus (Spain, n = 203) and Guadalajara (Mexico, n = 147). Dietary intake was assessed using the 24-hour recall. Anthropometric data were also obtained. We estimated Z-score of weight, height and BMI, and EI (kcal/day), ED (kcal/g), FV (g/day), EI/kg body weight (kcal/kg/day) and FV/kg body weight (g/kg/day).

**Results:** The Spanish children consumed significantly more cereals ( $p < 0.05$ ), vegetables, meat, fish and eggs than the Mexican children ( $p < 0.001$ ), while the latter consumed significantly more sweets ( $p < 0.001$ ). The mean EI/kg body weight was  $107.7 \pm 36.2$  kcal/kg/day in the children from Reus, and  $102.4 \pm 38.8$  kcal/kg/day in the children from Guadalajara, without significant differences. While the ED was significantly higher ( $p < 0.001$ ) in the Spanish sample ( $1.41 \pm 0.35$  kcal/g) than in the Mexican one ( $1.19 \pm 0.37$  kcal/g), we observed the contrary on FV per kilogram of weight: it was significantly ( $p < 0.001$ ) greater in Mexicans ( $91.0 \pm 36.1$  g/kg/day) than in Spanish ( $79.5 \pm 27.5$  g/kg/day).

**Conclusion:** In two populations with different contexts, the balance between energy intake and energy requirements is achieved in different ways, allowing energy intake per unit of weight and growth to be adequate. Future studies are needed to clarify the factors of a possible alteration of this equilibrium through time, in such a way, that it would probably contribute to the development of overweight and obesity in several environments.

(Nutr Hosp. 2011;26:495-500)

DOI:10.3305/nh.2011.26.3.4595

Key words: Energy intake. Preschool children. Diet. Cross cultural comparison.

**Correspondence:** Barbara Vizmanos Lamotte.  
Laboratorio de Evaluación del Estado Nutricio.  
Departamento de Reproducción Humana, Crecimiento  
y Desarrollo Infantil. División de Disciplinas Clínicas.  
Centro Universitario de Ciencias de la Salud.  
Universidad de Guadalajara.  
Hospital No. 320, primera planta.  
C.P. 44280 Guadalajara, México.  
E-mail: bvizmanos@yahoo.com.mx

Recibido: 11-IX-2009.  
1.ª Revisión: 12-XI-2009.  
Aceptado: 5-III-2010.

### DINÁMICA DE LOS COMPONENTES DE LA INGESTA ENERGÉTICA ENTRE NIÑOS PREESCOLARES DE ESPAÑA Y MÉXICO: DENSIDAD ENERGÉTICA Y VOLUMEN ALIMENTARIO EN DOS CONTEXTOS

### Resumen

**Objetivo:** Determinar las diferencias en la dinámica de la densidad energética (DE), volumen de alimentos (FV) e ingesta energética (IE), entre dos grupos de niños sanos, en condiciones de vida habitual, de España y México.

**Metodología:** Estudio transversal que analiza la dieta habitual de niños sanos, entre 1-4 años, originarios de Reus (España, n = 203) y Guadalajara (México, n = 147). La ingesta dietética fue evaluada con el recordatorio de 24 horas. Se valoraron algunos parámetros antropométricos. Se calculó puntuación-Z para el peso, talla e IMC, y la IE (kcal/día), DE (kcal/g), FV (g/día), IE/kg de peso corporal (kcal/kg/día) y FV/kg de peso corporal (g/kg/día).

**Resultados:** Los niños españoles presentaron una mayor ingesta de cereales ( $p < 0.05$ ), verduras, carne, pescado y huevo, que los mexicanos ( $p < 0.001$ ), mientras que estos últimos tuvieron una mayor ingesta de azúcares ( $p < 0.001$ ). La media de IE/kg de peso fue de  $107.7 \pm 36.2$  kcal/kg/día en niños de Reus, y  $102.4 \pm 38.8$  kcal/kg/día en niños de Guadalajara, sin diferencias significativas. Mientras la DE fue significativamente mayor ( $p < 0.001$ ) en los españoles ( $1.41 \pm 0.35$  kcal/g) que en los mexicanos ( $1.19 \pm 0.37$  kcal/g), observamos lo contrario en FV/kg de peso: este fue significativamente mayor ( $p < 0.001$ ) en los niños mexicanos ( $91.0 \pm 36.1$  g/kg/día) que en los españoles ( $79.5 \pm 27.5$  g/kg/día).

**Conclusión:** En dos poblaciones con contextos diferentes, el equilibrio de la IE se logra por diferentes vías, permitiendo un aporte energético por unidad de peso y crecimiento adecuados. Se precisan futuros estudios que aclaren los factores mediante los cuales este equilibrio se altera a través del tiempo, y que quizá, contribuye al desarrollo de sobrepeso u obesidad, en diversos entornos.

(Nutr Hosp. 2011;26:495-500)

DOI:10.3305/nh.2011.26.3.4595

Palabras clave: Ingesta energética. Niños preescolares. Dieta. Comparación transcultural.

## Abbreviations

BMI: Body mass index.  
ED: Energy density.  
EI: Energy intake.  
FV: Food volume.

## Introduction

The mechanisms by which human beings adequate their energy intake (EI) from food to cope with their energy requirements have been the point of interest of several studies. These mechanisms are surely affected by physiological, emotional and environmental factors. One of these factors is represented by food intake and its components: energy density (ED) and volume of food consumed. There is also, the influence of the nutrients from where energy is obtained (fats, proteins and carbohydrates) on EI. The interaction between all of them allows achieving an EI according to the requirements of each individual, although it is not clear how and to what extent human beings can regulate these factors.<sup>1</sup>

The conclusions of previous studies who have analyzed these interactions differ so far, due to the different conditions in which they were applied. It seems that adults, in *ad libitum* conditions,<sup>2,3</sup> tend to consume an almost constant food volume (FV), so the ED of the food becomes the main factor that influences the total EI.<sup>4</sup> Other studies, on the other hand, support the hypothesis that young children have a greater capacity to regulate the amount of food that they consume, thus adjusting the energy contribution and adapting it to their somatic needs and the variations in the ED of the diet.<sup>5,6</sup>

Nowadays, however, there is an abundance of food, and this adaptive mechanism of taking the maximum energy from food can lead to an energy imbalance, favouring the increase in body weight.<sup>7,8</sup> This takes part in the phenomenon of nutritional transition in developed and developing countries,<sup>9,10</sup> where the prevalence of obesity in adults and children is reaching alarming proportions and becoming an important health issue. Although various studies suggest that this increase in the prevalence of obesity is closely related to sedentarism and, therefore, to a decrease in energy expenditure,<sup>11</sup> it is also certain that in some countries the daily EI has also increased considerably.<sup>12</sup>

So far, the effect of FV and ED on EI has been evaluated with intervention studies which have controlled one of them.<sup>13,14</sup> However, there is not too much information available about what happens in children in "normal" conditions,<sup>15</sup> put in other words, with spontaneous intakes and with no controlled intervention of the amount of food consumed, nor on the energy density of the diet, to identify the habitual dynamics or processes that produce different adequacy inside this system.<sup>16</sup>

In addition, foods that have a high ED are often more palatable than those with a high water content and lower ED. Therefore, it is also important to know which are the main food groups where energy is obtained, according to a certain context.

In this study, we aim to determine the diet characteristics, energy and nutritional intake of two groups of apparently healthy children living in normal conditions, with different food systems—preschool children from Reus (Spain) and Guadalajara (Mexico)—, in order to analyse the habitual dynamics between ED and FV in these samples, to achieve the recommended daily EI.

## Materials and methods

This study was conducted from 2003 to 2004, with a sample consisting of a group of healthy non hospitalised children, aged between 1 and 4.5 years old. We selected those children with a birthweight greater than 2,500 g and who had no disease that might interfere in any way in their growth, development or nutrition. The children from Guadalajara (Mexico) (n = 147) were included at random from those who attended routine review at the *Hospital General de Occidente*. The children from Reus (Spain) (n = 203) were randomly recruited from several nursery schools in this same city. The children whose mothers (or the people in charge of looking after them most of the time) did not speak the local languages were not included in the study.

Dietary intake was assessed using the 24-hour recall method. During the interviews, a photograph album showing standard dishes in which the food has been previously weighed was used to help in the quantification of food consumption. Some foods were measured in units (e. g. pieces of fruit of different varieties and sizes) and others were measured using previously established measures (glass, spoonful, teaspoonful, etc.) and different portion sizes. To evaluate the amount of some ingredients (such as the oil used to prepare the meals), we used tables showing the amounts used in standard recipes as a reference value.

We obtained the intake values of each one of the foods (grams/day), which were subsequently grouped in the following categories:

- Meat, fish and eggs: all sorts of meat, cold meats and viscera, fish, shellfish and eggs.
- Dairy products: milk, yoghurt and other fermented products, cheeses and dairy desserts.
- Visible fat: oil, butter, margarine, lard.
- Cereals: pasta, bread, breakfast cereals, pastries, flour, etc.
- Vegetables: greens, roots, tubers and pulses.
- Fruit.
- Sweets: sugar, chocolate, sweets, honey and sweet drinks.

In order to estimate the nutritional content of the intake, we used the INSERM-ISTNA and Mataix food composition tables.<sup>17,18</sup> For the most commonly consumed Mexican foods, we also used the table for the Chemical Composition and Nutritional Value of the Most Frequently Consumed Foods in Mexico.<sup>19</sup> These tables were used to quantify the daily intake of energy and macronutrients.

Body weight was determined using a scale (Seca) with 0.1 kg precision. The height was measured with a stadiometer (Seca) with precision of 0.1 cm.

We estimated EI (kcal/day), total FV (g/day), ED of the diet (kcal/g), EI per unit of body weight (kcal/kg/day), FV per unit of body weight (g/kg/day) and the percentage of the total energy provided by each macronutrient. Body Mass Index (BMI = weight (kg)/height<sup>2</sup> (m)) was also calculated. The Z scores of weight and height variables were determined according to the standard values of the two countries.<sup>20,21</sup> In order to analyse if anthropometric measures of the studied populations were different from those of each reference table, the mean of Z scores was compared. The Z scores for BMI were also calculated with respect to Spanish standard values,<sup>20</sup> as there are no BMI Mexican reference tables.

All ethical principles were observed according to the Research Committees and Declaration of Helsinki being in force at the moment of the study.

For statistical analysis, we used the statistical package SPSS 10.0 for Windows (Chicago, Inc. 1999). Student t-test was used to study the differences between the two countries regarding the variables analysed. The 2-sided level of significance was set at  $p < 0.05$ . The results of the variables are presented as mean (standard deviation).

## Results

Table I shows some general characteristics of the studied children. It can be seen that the two groups of children are comparable in terms of age. The mean weight of the Spanish children is significantly greater ( $p < 0.05$ ) than that of the Mexicans, and height is also

**Table I**  
Characteristics of the sample

	Reus	Guadalajara	<i>p</i> between countries
N	203	147	
Age (years)	2.86 (1.08)*	2.74 (1.06)	0.302
Weight (kg)	14.75 (3.40)	13.92 (2.72)	<b>0.017</b>
Height (cm)	94.14 (10.28)	91.95 (9.98)	0.053
BMI (kg/m <sup>2</sup> )	16.57 (2.00)	16.60 (2.11)	0.896

\*Data expressed as mean (standard deviation).  
BMI = Body Mass Index.  
*p* value calculated with Student t-test.

**Table II**  
Z-score of the anthropometric values

	Reus	Guadalajara	<i>p</i> between countries
Z-score of weight with Spanish reference values	0.54 (1.15)*	0.35 (1.23)	0.139
Z-score of weight with Mexican reference values	0.94 (1.67)	0.65 (1.64)	0.107
Z-score of height with Spanish reference values	1.08 (1.56)	0.88 (1.85)	0.275
Z-score of height with Mexican reference values	1.03 (1.55)	0.80 (1.86)	0.209
Z-score of BMI with Spanish reference values	-0.15 (1.45)	-0.19 (1.60)	0.808

\*Data expressed as mean (standard deviation).  
BMI = Body Mass Index.  
*p* value calculated with Student t-test.

somewhat greater, although in this case the difference is not significant ( $p = 0.053$ ). Mean BMI is similar in children from both countries.

When comparing Z scores of weight and height variables between Spanish and Mexican children according to both of their reference values (table II), neither of them showed significant differences between the two groups studied. BMI Z scores of both groups compared with the Spanish references (in the absence of availability of Mexican tables, as said before), did not showed significant differences either.

Table III shows the results obtained from the comparison of the EI, FV and ED of the diet, between Spanish and Mexican children. The mean EI of the Spanish sample is significantly greater ( $p < 0.01$ ) than that of Mexicans. The same is observed when comparing the diet's ED of the two countries, since this variable is significantly greater in the case of Spanish children's diet ( $p < 0.001$ ). On the other hand, the volume of food consumed is significantly greater in the Mexican children studied ( $p < 0.01$ ).

**Table III**  
Energy intake, energy density of the diet and food volume consumed

	Reus	Guadalajara	<i>p</i> between countries
Energy intake (kcal/day)	1,542.67 (464.03)*	1,389.92 (484.97)	<b>0.003</b>
Energy density (kcal/g)	1.41 (0.35)	1.19 (0.37)	<b>&lt;0.001</b>
Food volume (g/day)	1,112.97 (286.07)	1,217.84 (402.61)	<b>0.005</b>

\*Data expressed as mean (standard deviation).  
*p* value calculated with Student t-test.

**Table IV**  
Energy intake and food volume as a function of body weight

	Reus	Guadalajara	<i>p</i> between countries
Energy intake per unit of body weight (kcal/kg/day)	107.72 (36.20)*	102.40 (38.84)	0.197
Food volume per unit of body weight (g/kg/day)	79.47 (27.48)	91.00 (36.10)	<b>&lt;0.001</b>

\*Data expressed as mean (standard deviation).  
*p* value calculated with Student *t*-test.

Table IV shows the EI and the FV for these children, expressed in each case per unit of body weight. The EI relative to weight is slightly greater in children from Reus, although the difference is not significant. The FV per kg of weight, however, is significantly greater ( $p < 0.001$ ) in children from Guadalajara.

**Table V**  
Percentage of total energy provided by each macronutrient

	Reus	Guadalajara	<i>p</i> between countries
Proteins (%)	16.86 (3.25)*	16.88 (9.73)	0.978
Lipids (%)	36.85 (8.32)	34.86 (10.27)	<b>0.044</b>
Saturated fatty acids (%)	14.67 (4.27)	13.69 (5.02)	<b>0.049</b>
Monounsaturated fatty acids (%)	17.61 (5.79)	14.26 (5.74)	<b>&lt;0.001</b>
Polyunsaturated fatty acids (%)	4.55 (1.44)	6.86 (4.15)	<b>&lt;0.001</b>
Carbohydrates (%)	45.77 (9.09)	47.61 (10.92)	0.085

\*Data expressed as mean (standard deviation).  
*p* value calculated with Student *t*-test.

Regarding nutritional balance (table V), there were noticeable differences between both groups concerning fat distribution and also, fat subtypes. The contribution of fats to EI is 36.85% in the Spanish children and slightly lower in the Mexican children at about 35% ( $p = 0.044$  between both countries). The percentage of total energy provided by saturated fatty acids is slightly higher in the Spanish sample (14.7% vs 13.7%,  $p = 0.049$ ). In addition, in children from the Mediterranean city of Reus, monounsaturated fatty acids provided 17.6% of energy, in comparison to 14.3% in the children from Guadalajara ( $p < 0.001$  between both countries). In the Mexican children, however, polyunsaturated fatty acids provide a significantly higher percentage of EI than in the Spanish sample ( $p < 0.001$ ).

The percentage of total energy provided by proteins is very similar in both countries (about 16.9%). The percentages of energy provided by carbohydrates are 47.6% in the Mexican children and 45.8% in the Spanish ones, though the difference is not statistically significant.

Figure 1 shows the mean consumption of the main food groups in both countries. Spanish children have a

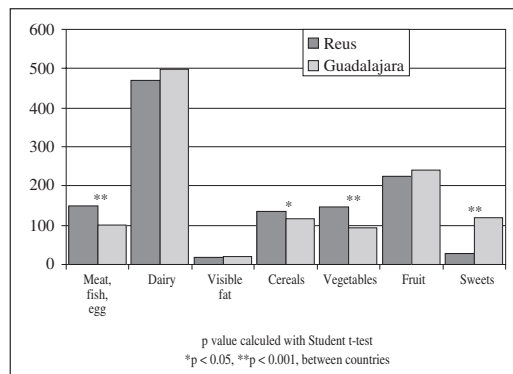


Fig. 1.—Daily intake (g/day) of the main food groups.

significantly greater consumption of meat, fish and eggs group ( $p < 0.001$  between both countries) and they also consume more vegetables ( $p < 0.001$ ) and cereals ( $p < 0.05$ ) than their Mexican counterparts. On the other hand, children from Guadalajara have a much higher consumption of sweets ( $p < 0.001$ ). In both cases, there is considerable variability in the consumption of this latter food group. The intake of dairy products is similar in the children from both countries, as well as the intake of fruit and visible fat.

## Discussion

The present study is the first in our knowledge that compares different components of EI between Spanish and Mexican healthy preschool children in free-living conditions. Our findings suggest that energy requirements fulfilled by EI are accomplished through different ways for each population, in which are involved the energetic density of foods, FV, and remarkably food groups and food composition.

When analysing EI, it showed by itself, several points that need to be consider. We observed significant differences in EI between compared children from Reus and Guadalajara. However, this evaluation was not sufficiently adequate, so we decided to adjust it for unit of body weight. When calculating the EI per unit body weight (kcal/kg/day) and volume of food per unit weight (g/kg/day), it was intended to have more objective parameters based on individual needs.

Moreover, the observed significant differences in weight and height (table I), become imperceptibles when showed in Z score (table II). This suggests that finally, there are not established differences that may affect the growing and development process in these two groups of children. In addition, the absence of differences in EI when it is estimated in relation to body weight (table III), permits us to assume that the dynamics conforming the EI of each group are appropriate to achieve growing according to their potential.



Spanish children had a mean EI that is in accordance with -and even slightly above- the recommendations for their age and sex.<sup>22</sup> In Mexican children between 1 and 3 years old, the mean intakes are also similar to the recommended ones for these ages, while the mean intake of children older than three years is below the 1,500 kcal/day recommended for children in this age.<sup>23</sup>

Regarding FV and ED, there are two findings worth to be underlined. Firstly, in the Spanish children, ED of the diet was significantly higher ( $p < 0.001$ ), than in Mexican children. Second of all, in the Mexican sample the FV was significantly greater ( $p < 0.001$ ) than in the Spanish one. But at the end, apparently these significant differences in both, FV and ED, do not affect directly EI, since there was no significant difference in the latter when estimated per kg of weight. These findings are consistent to support previous studies hypothesis which have pointed out the capacity of young children to regulate their energy consumption according to their somatic needs.<sup>5,6,15</sup> However, this point needs further research, since this mechanism seems to work differently in adults. Studies have observed that FV in adults remained more or less constant so is the ED that in this case, determines the total IE.<sup>4</sup>

It would be also interesting to conduct longitudinal studies to find out what happens with the relationship between these three elements through the years, assessing how and when this regulation mechanism begins to be altered, considering different approaches. For example, since the Mexican children studied consume a bigger FV than the Spanish ones, probably this volume would be maintained or increased through the years. However, given the multiplicity of food choices and the development of preferences and habits in taste (including more palatable and high ED foods) ED would probably be increased through the years, potentially affecting also the EI. On the other hand, Spanish children have access to high ED foods since they are young. Certainly, energy requirements continue to increase until a certain age of growth and development. If along with these requirements, FV also increases and they keep maintaining this highly ED intakes, when having lower requirements (in adulthood), they would probably have a positive energy balance.

Concerning the macronutrients from where energy is obtained, we observed differences in their distribution in the diet between the two countries. Protein intake represented more than 16% of the total EI. This coincides with the results of other Spanish<sup>24</sup> and Mexican studies, such as the National Survey on Nutrition in Mexico,<sup>25</sup> which found that the intake of protein in children was higher than the intake recommendations. The percentage of energy provided by lipids in the total consumption is high in both countries, but slightly higher in the Spanish children, as reported in other studies.<sup>24,25</sup> Therefore in the two groups, lipid and protein contribution is to the detriment of energy's percentage provided by the carbohydrates. The contribution of carbohydrates is slightly greater in Mexican

children, although the difference is not significant, and in both cases it is below 50%, which is the minimum percentage recommended for contribution to total EI.

Existing differences between the diets of both groups are certainly implied by their different food systems, which include physiological, sociological, cultural, economic and psychological factors.

Diet of children from Reus is characterised by a high consumption of cereals (particularly wheat), vegetables and by the use of olive oil as the main added fat. The intake of dairy products, meat and fish is also important.<sup>26</sup> Diet of children of Guadalajara, is rich in complex carbohydrates, provided mainly by maize and maize-based products (*tortillas*, *tacos*, *tamales*, etc.), beans, rice and, occasionally, bread; the protein content of this diet is mainly provided by eggs, meat and pulses, while the consumption of fish is notably lower.

Little information has been published on the intake of different food groups in the Mexican child population. The different methodology and older population used in the study by Jiménez Cruz et al.<sup>27</sup> makes it difficult to be compared with the present study; however, their results showed that, *grosso modo*, the intakes of the different food groups are similar, with the exception of fruits, which are higher in the present study. This could be partly explained because their population was from the north of the country and inter-regional food landscape of Mexico has a large diversity.

As far as the Reus population is concerned, the intake of the different food groups is similar to the intake found in children aged between 2 and 5 years old in the enKid study, which analysed the dietary and nutritional intake of Spanish children and young people between 2 and 24 years old.<sup>28</sup>

There were also considerable differences observed in the consumption of sugars and sweet foods between the children of the two countries. Mexicans had a significantly greater intake due to the frequent consumption of sweets, but also to the high intake of sweetened drinks<sup>27,29</sup> and the widespread habit of drinking *agua fresca*—water combined with blended fruits (or aromas) and sweetened with sugar—, instead of natural water.

One limitation of this study is the determination of food intake by the 24 hour recall. As it is well known, this method depends on subject's capacity to remember not only the foods they consumed a day before, but also the amounts of them.

## Conclusion

These data show that existing differences concerning the consumption of food groups, ED and FV, and furthermore, belonging to a certain food system, contribute to achieve an underlying balance in EI that allows adequate growth.

Further studies are needed to understand how these mechanisms interact with the environment, in order to

explain how this equilibrium does take place. The interest of its characterization is also to identify how it may be altered through the years in certain subjects, so that appropriately made interventions would reach this balance, preventing the development of potential health problems (as obesity, diabetes, metabolic syndrome, etc.).

### Acknowledgements

We would like to thank all children and their parents/tutors who kindly participate in this study. We want also thank Dr. Miguel Ángel Ortiz-Ortega, for his support in the recruitment of the Mexican sample, and the students of the Nutrition Bachelor's Degree in the CUCS, Berta Alicia Olivares-Aviña and Beatriz Rodríguez-López, for their help in the field work. We also want to thank Dr. MF Bernal-Orozco for her valuable contributions and the helpful comments of reviewers that enriched the paper.

### References

- Rolls BJ. The relationship between dietary energy density and energy intake. *Physiol Behav* 2009 [Epub ahead of print].
- Bell EA, Castellanos VH, Pelkman CL, Thorwart ML, Rolls BJ. Energy density of foods affects energy intake in normal-weight women. *Am J Clin Nutr* 1998; 67: 412-420.
- Stokey JD. Energy density, energy intake and weight status in a large free-living sample of Chinese adults: exploring the underlying roles of fat, protein, carbohydrate, fiber and water intakes. *Eur J Clin Nutr* 2001; 55 (5): 349-350.
- Martí-Henneberg C, Capdevila F, Arija V, Pérez S, Cucó G, Vizmanos B, Fernández-Ballart J. Energy density of the diet, food volume and energy intake by age and sex in a healthy population. *Eur J Clin Nutr* 1999; 53: 421-428.
- Birch LL, Deysler M. Conditioned and unconditioned caloric compensation: evidence for self regulation of food intake by young children. *Learn Motiv* 1985; 16: 341-355.
- Birch LL, Deysler M. Caloric compensation and sensory specific satiety: evidence for self regulation of food intake in young children. *Appetite* 1986; 26: 153-174.
- Friedrich MJ. Epidemic of obesity expands its spread to developing countries. *JAMA* 2002; 287: 1382-1386.
- Silventoinen K, Sans S, Tolonen H, Monterde D, Kuulasmaa K, Kesteloot H et al. Trends in obesity and energy supply in the WHO MONICA Project. *Int J Obes Relat Metab Disord* 2004; 28: 710-718.
- Caballero B. Introduction. Symposium: Obesity in developing countries: biological and ecological factors. *J Nutr* 131 2001; (Suppl. 3): s866-870.
- Braguinsky J. Prevalencia de obesidad en América Latina. *An Sis San Navarra* 2002; (Suppl. 1): s109-115.
- Prentice AM, Jebb SA. Energy intake/physical activity interactions in the homeostasis of body weight regulation. *Nutr Rev* 2004; 62 (Suppl. 7): 98s-104s.
- US Department of Agriculture. Data tables; results from USDA's 1994-1996 Continuing Survey of Food Intakes by Individuals, December 1997. Available at: <http://www.barc.usda.gov/bhnrc/foodsurvey/home>. Accessed May 10, 2006.
- Cecil J, Palmer C, Wrieden W, Murrie I, Bolton-Smith C, Watt P, Wallis D, Hetherington M. Energy intake of children after preloads: adjustment, no compensation. *Am J Clin Nutr* 2005; 82 (2): 302-308.
- Fisher J, Liu Y, Birch L, Rolls B. Effects of portion size and energy density on young children's intake at a meal. *Am J Clin Nutr* 2007; 86: 174-179.
- Kral TV, Stunkard AJ, Berkowitz RI, Stallings VA, Brown DD, Faith MS. Daily food intake in relation to dietary energy density in the free-living environment: a prospective analysis of children born at different risk of obesity. *Am J Clin Nutr* 2007; 86 (1): 41-47.
- Drewnowski A. Sensory control of energy density at different life stages. *Proc Nutr Soc* 2000; 59: 239-244.
- Favier JC, Ireland-Ripert J, Toque C, Feinberg M. Répertoire général des aliments. Table de composition. Paris: TEC & DOC Lavoisier-INRA, 1997.
- Mataix-Verdú J, Mañas M, Llopis J, Martínez E. Tabla de Composición de Alimentos Españoles. 2nd ed. Granada: Ciencias de la Salud. Monográfica Universidad de Granada, 1995.
- Ledesma A, Muñoz M, Chávez A, Calderón E, de Anda C. Composición Química y Valor Nutritivo de los Alimentos de Mayor Consumo en México. México: Base de datos multimedia, 1998.
- Carrascosa A, Delgado P, Ferrández-Longás A, García-Dihinx J, Hernández-Rodríguez M, Romo A, Sobradillo B. Patrones de crecimiento y desarrollo en España. Atlas de gráficas y tablas. 1ra ed. Madrid: Ediciones Ergon, 2004.
- Galvan R. Somatometría pediátrica. Estudio semilongitudinal en niños de la ciudad de México. *Arch Invest Med* 1975; 6 (1): 83-396.
- Reports of the scientific committee for food. Nutrient and energy intake for the European Community, 1992. Available at: [http://ec.europa.eu/food/fs/sc/scf/out\\_89.pdf](http://ec.europa.eu/food/fs/sc/scf/out_89.pdf).
- Nutripac. Tablas de recomendaciones de nutrimentos para México, 1997. Available at: <http://www.nutripac.com.mx/software/rec-mex.pdf>
- Royo-Bordonada MA, Gorgojo L, Martín-Moreno JM, Garcés C, Rodríguez-Artalejo F, Benavente M, Mangas A, de Oya M. Spanish children's diet: compliance with nutrient and food intake guidelines. *Eur J Clin Nutr* 2003; 57: 930-939.
- Rivera J, Cuevas L, Shamah T, Villalpando S, Ávila MA, Jiménez A. Estado nutricional. En: Olaiz G, Rivera J, Shamah T, Rojas R, Villalpando S, Hernández M, Sepúlveda J, editores. Encuesta Nacional de Salud y Nutrición. Cuernavaca: Instituto Nacional de Salud Pública 2006; pp. 97-120.
- Serra-Majem L, García Álvarez A, Ngo de la Cruz J. Mediterranean Diet. Characteristics and health benefits. *Arch Latinoam Nutr* 2004; 54 (2 Suppl. 1): s44-51.
- Jiménez-Cruz A, Bacardí-Gascón M, Jones EG. Consumption of fruits, vegetables, soft drinks and high-fat-containing snacks among Mexican children on the Mexico-U.S. border. *Arch Med Res* 2002; 33: 74-80.
- Serra-Majem LI, Ribas L, García-Closas R, Pérez-Rodrigo C, Peña L, Aranceta J. Hábitos alimentarios y consumo de alimentos en la población infantil y juvenil española (1998-2000): variables socioeconómicas y geográficas. En: Serra-Majem LI, Aranceta J, editores. Alimentación infantil y juvenil: estudio enKid. Vol. 3. Barcelona: Editorial Masson, 2002; pp. 29-40.
- Maupomé G, Sánchez V, Laguna S, Andrade LC, Díez de Bonilla A. Patrón de consumo de refrescos en una población mexicana. *Salud Pública Mex* 1995; 37: 323-328.