Original Article

Diet quality status of most Tehranian adults needs improvement

Leila Azadbakht MSc, Parvin Mirmiran MSc, Firoozeh Hosseini Bs and Fereidoun Azizi MD

Endocrine Research Center, Shaheed Beheshti University of Medical Sciences,Tehran, I.R. Iran

The healthy eating index (HEI) was developed to track the quality of diets in different societies. The aim of this study was to determine the HEI score of Tehranian adults. This study, conducted within the framework of Tehran Lipid and Glucose Study (TLGS), was a part of a dietary intake assessment carried out in 819 cases aged 19 and over. Dietary intake was assessed with two 24-hour recalls. HEI was calculated based on 9 components. The HEI score was categorized into three groups: less than 45 (poor diet), between 45-72 (needs improvement) and more than 72 (good diet). The mean score of HEI was 65.8 ± 9.6 in men and 65.9 ± 8.6 in women. The results showed that the number of servings of food groups in those with good diet was significantly higher than the two other groups (P<0.05). The percentage of observations failing to meet the estimated average requirements (EAR) in the poor diet group (HEI<45) was higher than the other diet groups for most of the nutrients. Diets were categorized into: needs improvement (74%); good (23%); and poor (3%). Since the majority of the sample needed to improve their diet, this suggests that nutrition intervention may be needed.

Key Words: diet quality, food groups, Healthy Eating Index (HEI), Tehranian adults, Iran

Introduction

It is now well accepted that dietary imbalances are associated with noncomunicable disease.[1] Healthy diet has an important role in reducing the risk factors of obesity, hypertension and hypercholesterolemia.[2] A great deal of work has been done to produce dietary recommendations for prevention of chronic disease,[1] however, less attention has been focused on measures of overall diet quality.

Predominantly, measuring dietary components is used to evaluate diet quality.[3] Dietary guidelines are designed to promote good health and reduce the risk of chronic disease and the food guide pyramid has been produced to instruct people on how to follow guidelines.[4,5] The Healthy Eating Index (HEI) is a tool for evaluating how well people conform to dietary guidelines and the food guide pyramid.[6] This index determines how well nutritional goals are met.[7] Dietary variety, as well as the amount of intake of the five food groups and fat consumption, make up the components of HEI. HEI scores show the compliance of adults to the dietary guidelines and food guide pyramid. Paying attention to the HEI score helps to prevent the incidence of under and over-consumption.[8] Since there is no information related to HEI in developing countries, the aim of this study was to determine the HEI score and its relation to intakes of nutrients and the numbers of food servings in a group of adults residing in district 13 of Tehran in 1998-2001.

Subject and methods

This study, conducted within the framework of Tehran Lipid and Glucose Study (TLGS)[9] was a part of a dietary intake assessment, carried out, according to the Food Guide Pyramid project on inviduals residing in district 13 of Tehran between 1997-2001. In the TLGS, 15005 people aged 3 years and over were selected by multistage cluster random sampling method. A representative sample of 1476 people aged 3 years and over was randomly selected for dietary assessment. Subjects with a prior history of cardiovascular disease, diabetes and stroke were excluded because of possible changes in diet. We also excluded subjects whose reported daily energy intakes were not between 800 kcal/d (3347 KJ/d) and 4200 kcal/d (17537 KJ/d) (Fung *et al.,* 2002) to identify under- and over-reporters of food intake. Among TLGS, 819 cases aged 19 and over (371 men and 448 women) who had all the relevant data participated in this study. Weight and height were determined, using a digital electronic weighing scale (Seca 707; range 0.1-150 kg) and tape meter, respectively, by using standard protocols. Body Mass Index [BMI =

Correspondence address:.Fereidoun Azizi, Endocrine Research Center, Shaheed Beheshti University of Medical Sciences,
PO Box: 19395-4763, Tehran, I.R. Iran
Tel: + 98 (21) 240 9309; Fax: + 98 (21) 240 2463
Email: azizi@erc.ac.ir
Accepted 31 January 2005

weight (kg)/height^2 (m)] was calculated.[10] All measurements were done by the same person to provide consistency in methodology. Dietary intake assessment was undertaken with 2-day, 24-hour recalls, by expert interviewers. The reliability and validity of 24-hour recalls has been proved in several studies.[11,12]

The 24-hour dietary recall describes reported intakes from midnight to midnight, meal after meal. The first recall was performed at subjects' homes and the second at a clinic visit in the diet unit of TLGS. These two days were among usual days for subjects. These two days were inconsecutive days in the week and they weren't holidays. Standard reference tables were used to convert household portions to grams for computerization.[13] Following coding of diaries, the dietary recall form was linked to a nutrient date base (Nutritionist III designed for Iranian foods) and nutrient intakes calculated using the Mosby Nutritract software for conversion of quantity to servings of food consumed. For mixed dishes, food groups were calculated according to their ingredients. HEI was calculated according to Kennedy *et al.,*[8] method, based on 9 components, each component of which indicated different aspects of a healthy diet. The first five components of the HEI were based on compliance with the USDA food guide pyramid recommendations, for grains, vegetables, fruits, milk and meat groups as expressed in servings/day. As shown in Table 1, intakes at or above recommended amounts were awarded a food score of 10 points.[7] Conversely, persons consuming no servings within a food group received a score of 0. Between 0 and 10, the scores were calculated proportionately. The next 4 components of the HEI were adapted from the dietary guidelines for Americans. Component numbers 6 and 7 show the score of the percent consumed of total fat and saturated fatty acids, respectively. Components 8 and 9 show the score of cholesterol intake and dietary variety. A full score of 10 points was awarded for diets with<30% energy from fat, <10% energy from saturated fat and <300 mg cholesterol. To assess dietary variety, the HEI score was calculated by counting the total number of different foods and food groups consumed over two days. Foods that were similar, such as two forms of white bread, were counted only once in the variety category. Mixtures were broken down into their component parts so that a single item could contribute ≥2 points to the variety index. A threshold criterion ensured that foods were counted only if they contributed at least one-half of a serving in any of the food groups. We calculate the frequency of the number of food items eaten over the 2 days of recalls. The most frequent value was contributed to 18 and the least frequent value was contributed to 8. Therefore, the value of 18 was considered as a score of 10 and the value of 8 was considered as a score of 0. We chose this modification by consulting a statistician. A score of 0 was given if 8 or fewer distinct foods were eaten over the 2 day period. A person was allocated a score of 10 if 18 or more different foods were eaten over the two-day study period. Scores between these two points were calculated proportionately. The score range of each component was 0-10. The sum score of HEI was 90. The higher scores were indicators of better compliance of subjects to recommendations of the food guide pyramid and dietary guidelines.

The method of calculation of HEI score was modified according to the USDA[3] procedures. Sodium intake was eliminated from the HEI components because of a lack of related reliable data. Therefore, the sum score of HEI reduced from 100 to 90 in this study and the category of the HEI was conducted according to the 90 score. The variety score was determined according to the numbers of foods consumed by the population of this study.[8] In this study, the HEI score was based on 2 days of dietary recall modified according to the USDA- HEI score (which was based on a one-day recall). Data on other covariates such as anthropometric[14] and lipid profiles[15] were collected. Body mass index (BMI) was measured by weight in kilogram divided by squared height in meter.

Statistical methods

HEI was reported as mean ± SD. HEI score was categorized into three groups of less than 45, 45-72 and more than 72, which indicated a "poor", "needs improvement" and "good" diets, respectively.[2,3,8] Cut-off points were defined by modifying the suggested cut-off points reported in previous studies[2,3,8] and then were calculated based on 90 score. To compare nutrients, number of servings, and the number of food items according to HEI score category, analysis of covariance (ANCOVA) was used. Since energy and HEI were strongly correlated with each other, we chose energy as a covariate. Partial correlation was used to determine the relationship between HEI, nutrients, the number of servings and the variety, which was adjusted for BMI, the level of serum lipids and energy (as these factors were correlated with HEI). The score of each component of HEI was divided into three groups: <5, 5-8 and >8,[3] which indicated poor, needs improvement and good score respectively. The percentage of people, according to the score of each component, was determined. For determining the relationship between Estimated Average Requirements (EAR) and HEI score, the percentage of individuals meeting the EAR according to HEI score was assessed. Pie chart was drawn to show the HEI score of the population. All data were analyzed by SPSS software (ver.11.00). Significance level was determined as $P<0.05$. This study was approved by the Ethics Committee of the research council of Shaheed Beheshti University of Medical Sciences. Informed written consent was obtained from each subject.

Results

The mean ages of men and women were 40 ± 13 and 36 ± 12 years old, respectively. There were 287 men and 376 women in the 19-50 year age group. There were 84 men and 72 women over the age of 50. Mean BMI was 25.4 ± 4.1 in men and 26.6 ± 5.4 kg/m^2 in women. In this study 34% of subjects were over-weight (BMI 25-29.9) and 21% were obese (BMI ≥ 30). The mean total HEI score was 64.5 ± 9.7 in 19-50 year old men and 67.5 ± 9.6 in men older than 50. This score was 64.3 ± 8.7 in 19-50 year women and 67.9 ± 8.5 in women over 50. Twenty-five percent of people were illiterate or had little formal education (primary and Guidance school), 62.2% had high school diploma and 12.8% were university

educated. HEI scores in men and women with university education were in a higher level than in subjects with lower education, but this difference was not significant. There were no significant differences in literacy levels between men and women.

Differences in nutrients and food guide pyramid group intakes, according to the three groups of HEI scores, are shown in Table 2. Results showed that the number of servings from different food groups was significantly higher in those with good diets than in the other groups (P<0.05). In contrast, the percent of total saturated fatty acid intake was lower in the good diet group than in the other groups (P<0.01). The amount of cholesterol consumed was lower in those with HEI scores greater than 72 compared to HEI scores between 45-72 (P<0.05). All nutrient intakes, except selenium, were higher in the good diet group, as compared with the poor diet group (P<0.05). The number of food items which was eaten in the diet with HEI scores more than 72 was much higher than in the other diets (P<0.001). Table 3 shows the relationship between HEI and nutrient intakes, variety and the number of servings consumed from the food guide pyramid. Table 4 shows the distribution of HEI score based on each of the 6 components. The highest number of adults having good scores for the intake of grains, vegetables and fruit were categorized as having a good diet. Most adults had poor scores (less than 5) in the milk and meat groups. Most adults had good scores (more than 8) for food variety.

The relationship between HEI scores and Estimated Average Requirements (EAR) of key nutrients is shown in Table 5. The percentage of observations failing to meet the EAR in the poor diets group (HEI<45) was higher than the two other groups for most of the nutrients. Figure 1 shows the frequency of people according to the HEI scores. The results show that the dietary patterns of 24.4% of adults were good, 2.2% poor and 73.3% needed improvement.

Table 1. Recommended number of servings per day for five components* of Healthy Eating Index (HEI) according to the age/ gender categories

Food groups	Servings per day			
	Women 19-50 years	Women ≥51 years	Men 19-50 years	Men ≥51 years
Grains	9	7.4	11	9.1
Vegetables	4	3.5	5	4.2
Fruits	3	2.5	4	3.2
Milk	2	2	2†	2
Meat	2.4	2.2	2.8	5.2

*The requirements for other components are equal for all age groups.
† About dairy group for men 19-24 aged; three serving milk per day is needed.

Discussion

The results of this study showed that the diets of most Theranian adults needed improvement. There were relationships between nutrient intakes, the number of servings from each group and the number of food items consumed. The results of US research showed the same results in all age groups, but a higher percentage of American people had poor diets and the lower percentage had good diets compared with the present study.[2]

Table 2. Adjusted* mean and standard deviation of dietary intake and food groups across three groups of Healthy Eating Index (HEI)

Variable	HEI score category		
	<45 poor diet	45-72 needs improvement	>72 good diet
Grains (Servings/day)	4.9±3.1	7.3±3.7	6.3±5.3†
Vegetables (Servings/day)	1.8±0.88	3.3±1.8	4.7±2.0†
Fruit (Servings/day)	0.82±0. 87	2.6±2.4	4.5±2.8†
Milk (Servings/day)	0.63±052	0.98±0.64	1.4±0.86†
Meat (Servings/day)	0.98±0.77	1.1±0.77	1.4±0.86†
Fat (% of energy)	36.4±7.2	30.3±7.7	28.4±5.8†
Saturated fat (% of energy)	7.9±3.9	5.8±2.2	5.2±1.8‡
Cholesterol (mg/day)	211±225	177±161	147±106§
Number of food items over 2 days	10.2±4.2	15.6±5.4	19.7±3.7¶
Energy (kcal/day)	1790±794	2307±745	2722±775
Carbohydrate (% of energy)	53±7.4	58±7.4	59±5.6
Protein (% of energy)	9.8±2.5	11.3±2.0	11.9±1.7†
Fiber (gr/day)	3.7±1.4	7.0±2.9	10±5.8†
Magnesium (mg/day)	78±37	114±58	151±70†
Vitamin C (mg/day)	64±42	115±66	151±66†
Vitamin B6 (µg/day)	0.43±0.25	0.61±0.26	0.83±0.32†
Vitamin B12 (mg/day)	1.45±1.46	1.82±1.54	2.4±2.0†
Potassium (mg/day)	1269±568	2083±678	2784±892†
Calcium (mg/day)	369±185	608±246	805±265†
Selenium (µg/day)	0.02±0.02	0.02±0.02	0.02±0.02

*Adjusted for energy intake. † P <0.05 Compared with "Poor" diet. ‡P <0.01 compared with "Needs improvement" and "Poor" diet.
§P<0.05 Compared with "Needs improvement" diet. ¶P <0.001 Compared with two other groups.

Table 3. Correlation of Healthy Eating Index (HEI) nutrients and energy intake

Variable	Correlation coefficient with HEI
Fat (% of energy)	-0.1*
Saturated fat (% of energy)	-0.1†
Cholesterol (mg/day)	-0.1†
Number of food items over 2 days	0.5*
Energy (kcal/day)	0.3*
Carbohydrate (% of energy)	0.1*
Protein (% of energy)	0.1*
Fiber (g/day)	0.4*
Magnesium (mg/day)	0.3*
Vitamin C (mg/day)	0.3*
Vitamin B6 (mg/day)	0.4*
Vitamin B12 (mg/day)	0.1*
Potassium (mg/day)	0.5*
Calcium (mg/day)	0.4*
Selenium (mg/day)	0.4†

* $P<0.001$ † $P<0.01$

Table 4. Distribution of Healthy Eating Index (HEI) scores for consumption of each of the 6 components and dietary variety

Component	*Percentage obtaining score*			
	Mean Score	Good Score >8	Needs improvement Score 5-8	Poor Score <5
Grain consumption	7.3 ± 2.3	45.4	36.5	18.1
Vegetable consumption	7.2 ± 2.7	48.1	28.1	23.8
Fruit consumption	6.6 ± 3.4	47.5	19.3	33.2
Milk consumption	5.1 ± 2.8	17.8	33.9	48.2
Meat and substitutes consumption	4.6 ± 2.4	11.0	28.0	61.0
Dietary variety	7.1 ± 3.4	55.5	20.7	23.8

Table 5. Percentage of observations failing to meet Estimated Average Requirements (EARs)

	Healthy Eating Index score		
Nutrients	<45	45-72	>72
Carbohydrate	5.6*	0.2	0
Protein	61.1*	16.6	2.6
Vitamin B1	44.4*	5.4	0
Vitamin B2	72.2*	23.2	4
Vitamin B6	100†	96.1	84.7
VitaminB12	72.2*	67.3	55.1
Vitamin C	55.6*	22.7	5.6
Iron	5.6*	1.3	0
Magnesium	100	99.3	99.5
Selenium	88.9‡	86.5	83.8
Phosphorus	78.8*	37.5	12.8

*$P<0.001$versus two other group †$P<0.05$ versus the group with | HEI score>72 ‡$P<0.05$ versus two other groups

The mean HEI scores in both men and women were higher than a similar group of American adults, although the sum score of HEI in the Tehranian sample was 90 in contrast to 100 in USA. Moreover, mean scores of grains, vegetables, fruits, and dietary variety were much higher in Tehranian adults than their American peers – the opposite was true for milk and meat scores. This result may be attributed to the higher amount of fruit and vegetables consumed by Tehranian adults.[2] There are currently no specific dietary guidelines for Iranian people and yet according to this study, it appears that there has been a dietary shift in Iran.[16]

In this study, adults with high education levels had higher HEI scores, compared with those having lower education levels. In the USA higher education was also associated with increased HEI.[3] The number of food group servings was in compliance with the food guide pyramid, except in the dairy and meat groups, suggesting that Tehranian adults may have inadequate intakes of meat and dairy foods. In the present study, HEI scores of more than 72 was associated with a higher number of food items consumed. This shows that dietary variety and dietary quality are closely associated with each other,[17] and HEI is a good indicator for both.

Considering that healthy diets contain more fiber, fruit, vegetables (source of potassium) and dairy products (source of calcium) and that there is a correlation between HEI and these nutrients, higher HEI scores could be used as predictors of meeting these nutrient requirements. Besides this, the sum score of HEI, and paying attention to each component of this index is also important.

The greater percentage of people failing to meet EAR for macronutrients and micronutrients in the poor diet group with HEI scores less than 45, shows the importance of HEI in predicting diet quality. One of the positive points of the present study was using the EAR instead of RDA for assessing nutrient intakes. Previous studies used RDA for determining the relationship of HEI and diet quality. Nowadays, the Dietary Reference Intake (DRI) committee establishes EAR to assess dietary adequacy or to plan diets for groups of people. EAR is a better standard to assess nutrient intakes of populations in studies compared to RDA.[18-24] Even the best scores are not meeting EARs for magnesium and some B vitamins, which may be due to lower consumption of meat, milk and whole grains.

In the present study, 48.2% of adults had poor scores for dairy and 61% for meat. Therefore, nutrition education for Iranian people may need to highlight the importance of dairy, meat and their substitutes. Good scores for grains, vegetables and fruit (and dietary variety) suggested that Iranian people have a preference for these foods which is in contrast to many western societies.[2,4,25] Although the proposed HEI had several strengths, it is necessary to pay attention to certain aspects of this index. For example, in this study, there was a significant positive association between energy intake and HEI. This may be a limitation when applying the index because overconsumption of food is neglected and truncating the number of servings for the first five components (the number of servings of grain, vegetable, fruit, dairy, meat) prevents inflated scores for those who simply eat a lot of food. It is

suggested that in future studies, some modification will be conducted in measuring these component scores to identify over-consumption as well as nutritional deficiency. For example, consuming more than 11 servings of grains should not be equal to the maximum score for this component of the HEI. Three of the nine components (% consumed of total fat, saturated fatty acids, cholesterol intake) of the HEI score were correlated to the total. Different kinds of fat intake have equal scores, even though different types of fatty acids which make up total fat intake have differing effects on the risk of chronic disease. It is suggested that in future studies these three components should be given three different scores, which is related to the risk of chronic disease according to the type of fat. Also, unsaturated fatty acids should be considered as a component of HEI because of the important role of these fatty acids in the health of the cardiovascular system.

In the present study, all components of HEI index were calculated according to two days of dietary recalls. In contrast, previous studies calculated the dietary variety component using three days intake and other components were assessed on one day intake. Therefore, these differences in data collection and analyses may be a limitation of this study. Other modifications chosen were the maximum of 18 and minimum of 10 on the basis of the most and least number of food items consumed by study sample.[26] As we know, fiber has an important role in health, but fiber was not a component of HEI.[27] Fiber was assessed in this study and it was found that individuals with an HEI Score of more than 72 consumed more fiber than other groups with lower HEI scores.

A limitation of this study was the inability to measure sodium intake as one component of the HEI score, because of the unavailability of accurate data on sodium intake by study subjects. The HEI score was thus measured with 9 components instead of 10 and the sum of HEI score was considered to be 90 instead of 100.

This study showed that the diet quality of most people in Tehran needs improvement and thus nutritional intervention to improve diet quality is needed.

Acknowledgement

The authors express their appreciation to the participants of the Tehran Lipid and Glucose Study for their enthusiastic support and the staff of the Endocrine Research Center, Tehran Lipid and Glucose Study unit for their valuable help in the conducting of this study.

References

1. Patterson RE, Haines PA. Diet quality Index: Capturing a multidimensional behavior. J Am Diet Assoc 1994; 94: 57-64.
2. USDA .Center for Nutrition policy and promotion. The Healthy Eating Index.2001. Version current 12 june. Available from: URL :http://www. usda.gov/cnpp (accessed 28 June 2001).
3. Hann CS, Rock CL, King I, Drewnowski A. Validation of the Healthy Eating Index with use of plasma biomarkers in a clinical sample of women. Am J Clin Nutr 2001; 74: 479-86.
4. USDHHS. Dietary Guidelines for Americans. 5th ed., Home & Garden Bulletin No.232. Government printing office, Washington DC, 2000.
5. USDA. Food Guide Pyramid Booklet. Washington DC: US Department of Agriculture,1996. Available from: URL: http://www.usda.gov/cnpp/pyramidz.htm
6. Mc-Cullough ML, Feskanich D, Stampfer MJ, Rosner BA, Hu FB, Hunter, D, Colditz GA, Willett WC Adherence to the dietary guidelines for Americans and risk of major chronic disease in women. Am J Clin Nutr 2002; 72: 1214-22.
7. Variyam JN, Blaylock J, Smallwood D, Basiotis P. USDA's Healthy Eating Index and nutrition information. Washington, DC, U.S. Dept. of Agriculture, 1998.
8. Kennedy ET, Ohls J, Carlson S, Fleming K. The Healthy Eating Index: Design and applications. J Am Diet Assoc 1995; 95: 1103-1108.
9. Azizi F, Rahmani M, Emami H, Madjid M. Tehran Lipid & Glucose Study: rationale and design. CVD Prevention 2000; 3: 242-47.
10. Jelliffe DB, Jelliffe EEP. Community nutritional assessment. New York : Oxford university press, 1989; 56-110.
11. Gersovitz M, Madden JP, Smiciklas-Wright H. Validity of the 24 hour dietary recall and seven-day record group comparisons. J Am Diet Assoc 1987; 73: 48-55.
12. Ahluwalia N, Lammi-Keefe CJ. Estimating the nutrient intake of older adults: components of variation and the effect of varying the number of 24-hour dietary recalls. J Am Diet Assoc 1991; 91: 1438-9.
13. Ghaffarpour M, Houshiar-Rad, Kianfar H. The manual for household measures, cooking yields factors and edible portion of food. Tehran: Keshaverzi press, 1999.
14. Mirmiran P, Esmaillzadeh A, Azizi F. Detection of cardiovascular risk factors by anthropometric measures in Tehranian adults: receiver operating characteristics (ROC) curve analysis. Eur J Clin Nutr 2004; Aug;58:1110-8
15. Azizi F, Rahmani M, Madjid M, Allahverdian S, Ghanbili J, Ghanbarian A, Hajipour R. Serum lipid levels in an Iranian adults population: Tehran Lipid & Glucose Study. Eur J Epidemiol 2003; 18:311-19.
16. Ghassemi H, Harison G, Mohammad K. An accelerated nutrition in Iran. Public Health Nutr 2002; 5: 149-55.
17. Mirmiran P, Azadbakht L, Esmaill Zadeh A, Azizi F. Dietary diversity score in adolescents- A good indicator of nutritional adequacy of the diet: Tehran Lipid and Glucose study. Asia Pac J Clin Nutr 2003; 13: 56-60.
18. Insel P, Turner RE, Ross D. Nutrition. Boston: American Dietetic Association: Jones and Bartlett Publishers, 2002; 43.
19. Sizer F, Whitney E. Nutrition: Concepts and Controversies. 8th ed, Australia: Wadsworth, 2000; 29.
20. National Academy Press. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline.1st ed, Washington, D.C: National Academy Press, 2000; 58-122, 150-195, 306-356.
21. National Academy Press. Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc.1st ed, Washington,D.C: National Academy Press, 2002; 290-393.
22. National Academy Press. Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids.1st ed,Washington, D.C: National Academy Press, 2000; 95-185, 284-324.

23. National Academy Press. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients).1st ed, Washington,D.C: National Academy Press, 2002.p.207-267,465-608.
24. National Academy Press. Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride.1st ed, Washington,D.C: National Academy Press, 1999; 146-249.
25. Royo-Bordonada MA, Gorgojo L, Martin-Moreno JM, Garces C, Rodriguez-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: 930-9.
26. Chung SJ, Shih C, Lentner D, Vandenbelt M, Huang YL, Koerner L, Song W, Hoerr S. The Healthy Eating Index needs further work. J Am Diet Assoc 1996; 96: 751-2.
27. Kennedy E, Ohls J, Carlson S, Fleming K. Authors reply to "the Healthy Eating Index needs further work". J Am Diet Assoc 1996; 96: 752 (letter).