

TRANSVERSAL ANALYSIS OF JUNK FOOD DIET FOR A GROUP OF MEDICAL STUDENTS AND ITS ASSOCIATION WITH METABOLIC SYNDROME

Maria Nițescu^{1,✉,*}, Adrian Streinu-Cercel¹, Marina Oțelea², Florentina Ligia Furtunescu¹

¹ University of Medicine and Pharmacy Carol Davila

² University of Polytechnics, Bucharest

* All authors have equal contribution in preparing the article.

received: July 27, 2012 accepted: August 30, 2012

available online: September 30, 2012

Abstract

Objective: to evaluate the nutritional behavior of medical students regarding junk food intake in relation with the metabolic syndrome (MS). **Material and Method:** 235 medical students completed a food frequency questionnaire; MS risk factors were recorded. Junk food was grouped in 5 categories, according to the predominant nutrient in its composition. Statistical data were processed by SPSS program. **Results:** 97% of subjects did not fully comply with the WHO recommendations of healthy nutrition. No statistically significant correlations were found between the nutritional intake of nutrients or junk food categories and waist circumference or HDLc, except the glycemic index in women ($r=-0.230$, $p=0.003$). A correlation between the intakes of different categories of junk food was found. **Conclusions:** Most subjects consume in excess nutrients considered risk factors and very few have an optimum intake of nutritional protection factors against MS. The “western diet” pattern prevalent in this population is an argument for educational interventions.

key words: saturated fat, sugar, fibers, metabolic syndrome

Introduction

Previous studies have shown that physicians who adjust their nutritional habits according to healthy nutrition recommendations will be its most active promoters, both for general population, but mainly for persons at risk [1,2]. Necessity of intervention for promoting a healthy nutrition in Romania is very high, taking into account

the increased prevalence of some risk factors, components of the metabolic syndrome (MS), namely obesity (19.1%), hypertension (49.1%) and hypercholesterolemia (47.1%), as well as a very high mortality by cardiovascular diseases (54% of the total deceases) [3]. To our best knowledge, no national studies concerning junk food intake were made previously in Romania.

✉ Dr. Calistrat Grozovici Street, no. 1, Bucharest 2, Romania; phone: +40722729672 (mobile); fax: +40213186090; corresponding author e-mail: mnitescudsp@yahoo.com

Objective: To evaluate the nutritional behavior of a group of medical students, focusing on junk food intake in relation with the constitutional parameters associated with the diagnosis of MS.

Material ad Method

The first stage of this study was developed during 2010-2011, on a conjunctural sample of 235 students of the Faculty of Medicine in Bucharest. The exclusion criteria were represented by the prior diagnosis of diabetes mellitus, hypertension or dyslipidemia before the inclusion in the study.

All subjects have signed an informed consent form concerning their participation in the study. The study was approved by the Bioethics Committee of the National Institute of Infectious Diseases “Prof Dr Matei Bals”.

Data concerning constitutional parameters, nutritional habits and physical activity were simultaneously collected.

The following were analyzed: frequency of subjects with constitutional parameters situated at risk values, the nutritional contribution of main nutrient groups, frequency and intake score for certain food considered to be junk food and the association of intake scores of junk food with two constitutional parameters of the metabolic syndrome: waist circumference (WC) and the high density lipoprotein cholesterol (HDLc) level. We selected these parameters since they were the most frequent abnormal parameters in our study group.

Evaluation of constitutional parameters

Among constitutional parameters the following were registred: systolic (SBP) and diastolic (DBP) blood pressure, weight,

height, WC. Blood samples were collected for biochemical determinations, namely glycemia, HDLc and triglycerides (TG). Blood pressure was measured three times, final data representing the average of the 3 determinations. Anthropometric measurements and biochemical measurements were performed in the National Institute of Infectious Diseases “Prof Dr Matei Bals”, according to standardized methods. Risk thresholds were defined according to the criteria of the International Diabetes Federation for the metabolic syndrome diagnosis [4] Results concerning constitutional parameters prevalence were described in a previous article [5].

Assessment of nutritional contribution of main nutrient groups

Among the retrospective methods to evaluate the diet at the individual level [6-8], respectively the 24 hours dietary recall, the frequency of food intake and the diet history, we have selected a food frequency questionnaire validated at international level as the screening method of fat/sugar/fruit and vegetables intake, namely the “Block” Fat/Sugar/Fruit/Vegetable Screener. This questionnaire correlates well with the average intake during the last year, estimated by the three 4-days diet records. [6]. The “Block” Fat/Sugar/Fruit/Vegetable Screener was translated into Romanian. Translation was verified as retroversion by an independent translator. Before filling in, subjects received guidelines concerning the modality to appreciate the size of portions. The questionnaire was self-administrated on-line, and its registration was made only after filling in all blanks. The processing of answers was automatically made, based on the

NutritionQuest methodology. This provides an estimation of the intake of saturated fats, trans fats, added sugar (intake expressed in grams) and of the intake of fruit and vegetables, expressed in number of portions. The total contribution of calories, proteins, total fats, carbohydrates and fibers (expressed in grams) is estimated by the same methodology.

The nutritional contribution for the above mentioned nutrients was analyzed from the quantitative point of view as well as frequency of subjects which exceed the values of intake threshold for different nutrient groups. Choosing the threshold values was made according to the WHO recommendations [9]. Thresholds provided in the WHO recommendations and used in the study are the following: saturated fats below 7% of the total caloric contribution, trans fats below 1% of the total caloric contribution, added sugar below 10% of the total caloric contribution, at least 5 portions of fruit and vegetables daily and alimentary fibers between 20-35g/day. According to these thresholds, the subjects were divided into 2 subgroups: those who comply with actual recommendations and those who have an unhealthy diet.

Estimation of intake frequency for foods considered as junk food

In order to analyze the frequency and intake score of junk food, questions concerning food with a high content of saturated fats, trans fats, sugar and salt and a relatively low content of healthy nutrients were selected [10]. Based on this definition, we have grouped junk food into 5 categories, according to the predominant nutrient in its composition (Table 1).

Regarding junk food intake, the following parameters were calculated:

- Intake frequency: low intake frequency (subjects who consume junk food more rarely than once a week) and high intake frequency subjects who consume junk food more frequent than 5 times a week) were calculated.
- Intake frequency for each category of junk food: for each category, the low intake frequency was calculated as subjects who consume *each* of the selected junk food item in the category less than once a week as compared to the total number of subjects.
- Intake score: was calculated for each junk food group by multiplying the intake frequency to the consumed quantity.
- The global index of junk food contribution was obtained by summing up scores corresponding to the 5 food groups.

Table 1. Junk Food Groups.

No.	Group	Food included
1.	Sweetened drinks	<ul style="list-style-type: none"> - soda with sugar (tea and lemonades) - sweet alcoholic drinks - soft drinks
2.	Sweets	<ul style="list-style-type: none"> - biscuits, muffins, bread sticks, donuts - ice-cream - cookies, cakes, chocolate, chocolate sweets or candies - other sweets
3.	Fast-food	<ul style="list-style-type: none"> - meat, sausages, cold meats, hot dog, Vienna sausages, hamburger, cheeseburger, rolls, fried chicken (including schnitzel) - pizza, French fries - pies (including pastry)
4.	Salted snacks	<ul style="list-style-type: none"> - chips, popcorn, salted biscuits/pretzels
5.	Alimentary fats	<ul style="list-style-type: none"> - butter, margarine - fats added when cooking

Statistical Analysis

All quantitative variables were tested for normality (the Kolmogorov Smirnov test).

Indicators of central tendency and dispersion were calculated for all variables (average, median, SD). For those variables that preserved their abnormal distribution, medians were calculated after logarithming. The analysis of the statistic significance of

differences according to gender, WC or HDLc was made using the Student-t test or non-parametric tests (Mann Whitney U Test), as appropriate and $p < 0.05$ was considered statistically significant.

Table 2. Nutrient contents of the diet in men.

Parameter	Men						
	Mean	95% CI for mean		Median	SD	Min	Max
		lower bound	upper bound				
Saturated fat*(g)	24.27	21.53	27.01	21.68	11.48	5	57
Trans fat*(g)	6.4	5.41	7.4	5.83	4.158	1	23
Sugar*(g)	112.2	98.8	125.58	113.89	56.16	27	254
Free sugar (g)	78.46	65.4	91.51	66.37	54.77	5	235
Fruits (cup equivalents)	1.44	1.17	1.7	1	1.131	0	5
Veggies(cup equivalents)	1.33	1.12	1.54	1.24	0.876	0	4
Fruits and veggies (cup equivalents)	2.77	2.35	3.19	2.43	1.762	0	8
Glycemic load (g)	112.5	101.54	123.35	110.67	45.73	34	254
Glycemic index* (%)	53.24	52.32	54.16	53.423	3.87	44	65
kcalories*	1828	1653.3	2002.2	1749.7	731.7	621	3938
Proteins*(g)	72.82	64.67	80.97	67.35	34.18	22	181
Total fat*(g)	71.07	63.5	78.63	66.01	31.71	21	168
Carbohydrates* (g)	223.2	202.05	244.32	214.3	88.64	68	472
Fibers (g)	11.28	10.16	12.4	10.87	4.701	4	24

*Significant differences between genders (t-student Test or Mann Whitney U Test as appropriate)
 CI = confidence interval; SD = standard deviation; Min= minimum value; Max = maximal value

The Spearman correlation was used for the analysis of associations between the WC and HDLc value with the scores obtained for the main food groups.

The definition criteria of the metabolic syndrome being different for men as compared to women, the correlation analysis between constitutional parameters and diet was differentially made, according to sex; global results were presented when this piece of information was considered relevant.

For the statistical data processing, the program of statistic analysis SPSS version 17 was used.

Results

A total of 165 women and 70 men were enrolled in the study. The feminine preponderance reflects the population structure of medical students. Age varied between 19-35 years, with an average of 21.82 years (standard deviation = 2.32, variation coefficient 10.6%). The prevalence of MS in

this population was of 1.28%; from the 5 criteria of MS, the WC and HDLc were most frequently abnormal (WC was over the threshold values in 49.4% of subjects and HDLc in 13.2%). Detailed results concerning the structure of the study group according to age, gender and the prevalence of metabolic syndrome and of its different components were described in detail in another article [5].

We underline that the results presented in this article refer to the analysis of the diet behavior at the initial moment, when subjects were enrolled in the study.

Nutritional analysis of main nutrient groups

The nutrient content of the medical students' diet are shown in [Table 2](#) and [Table 3](#).

Table 3. Nutrient contents of the diet in women.

Parameter	Women						
	Mean	95% CI for mean		Median	SD	Min	Max
		lower bound	upper bound				
Saturated fat* (g)	18.89	17.43	20.35	16.7	9.519	3	50
Trans fat*(g)	5.42	4.74	6.11	4.27	4.437	0	23
Sugar*(g)	93.55	84.69	102.4	77.98	57.61	15	362
Free sugar(g)	66.21	56.84	73.59	49.56	54.48	4	355
Fruits(cup equivalents)	1.36	1.21	1.51	1	0.972	0	4
Veggies(cup equivalents)	1.35	1.2	1.5	1.09	0.969	0	5
Fruits and veggies (cup equivalents)	2.71	2.46	2.96	2.48	1.649	0	9
Glycemic load (g)	92.94	86.24	99.65	82.85	43.61	19	243
Glycemic index* (%)	53.08	52.32	53.84	53.14	4.943	37	66
kcalories*	1442	1345	1540.2	1336.9	636.4	284	3504
Proteins*(g)	54.82	50.93	58.71	50.23	25.3	11	158
Total fat*(g)	55.77	51.62	59.93	49.27	27.03	9	149
Carbohydrates*(g)	186	172.8	199.15	162.71	85.74	42	459
Fibers(g)	10.42	9.64	11.2	9.21	5.057	1	34

*Significant differences between genders (t-student Test or Mann Whitney U Test as appropriate)

CI = confidence interval; SD = standard deviation; Min= minimum value; Max = maximal value

From the data presented in [Table 2](#) and [Table 3](#), we can notice a high non-homogeneity for the intake of all measured variables; at the same time, there are significant differences between men and women regarding the intake of total fats, saturated fats, trans fats, sugar, glycemic index, glycemic load, total caloric

contribution, proteins, total fats and carbohydrates.

Regarding the frequency of subjects with a nutrient intake beyond the threshold values recommended by the WHO, it was noticed that most subjects consume in excess nutrients considered to be risk factors and very few have an optimum contribution of alimentary

fibers, considered to be protection factors against metabolic syndrome ([Table 4](#)).

Table 4. Distribution of subjects according to the intake threshold recommended by WHO.

Nutrient	Gender	Intake within the recommended limit		Intake beyond the recommended limit	
		No. of subjects	%	No. of subjects	%
Saturated fats	Men	3	4%	67	96%
	Women	5	3%	159	97%
Trans fats	Men	4	6%	66	94%
	Women	16	10%	148	90%
Added sugar	Men	21	30%	49	70%
	Women	49	30%	115	70%
Fruit and vegetables	Men	9	13%	61	87%
	Women	19	12%	146	88%
Fibers	Men	5	7%	65	93%
	Women	9	5%	155	95%

Table 5. Intake scores for each group of junk food.

Food group	Average	Median	SD	Max	Min	p-value men vs. women*	% of persons who consume very rarely or not at all
Sweetened drinks	16.29	15	9.18	60	4	0.150	7%
Fastfood*	23.62	21	11.93	65	10	0.0001	0%
Sweets	23.66	22	10.79	65	8	0.164	0%
Salted snacks	5.73	4	3.07	24	3	0.659	0%
Alimentary fats	8.24	4	3.12	25	3	0.198	11%
Total Junk Food*	73.82	68	26.25	155	29	0.003	NA

* Mann Whitney U Test; All items values are expressed as “numerical score”

The percentage of subjects with an intake within the recommended limit range is extremely low for saturated fats (both women and men), followed by fibers and trans fat (less than 10% of all subjects). The added sugar and the fruit and vegetables intake is somehow better correlated to the recommendations ([Table 4](#)).

From total caloric intake, the average contribution of the of saturated fats represent 12%, the average contribution of trans fats is 3% of the caloric contribution for both genders, 3 times higher the recommended

value; the average intake of added sugar represented 17.22% (in women) and 16.43% (in men) of the total caloric contribution.

The average number of portions of vegetables and fruit consumed daily was of 2.71 for women ([Table 3](#)) and 2.77 for men ([Table 2](#)), without significant differences between genders. The average intake of fibers was of 11.28 g/day for men and 10.42 g/day for women; both the number of portions of fruits and vegetables and the intake of fibers represent 50% of the optimum recommended intake.

Intake frequency and score of junk foods

The average intake scores of junk food categories, as well as the percentage of those consuming them more rarely than once a week are shown in [Table 5](#).

Given the high heterogeneity of the series, the comparison of average scores on genders is not relevant. The comparison of medians has pointed out however significantly higher values in males for fastfood ($p=0.0001$) and total junk food ($p=0.003$) scores respectively.

We should underline that 50% of subjects have a moderate intake of food considered junk food, namely more rarely than twice a week. From the declared data, it came out that 88% of students consume very rarely hamburgers; they consume more rarely than once a week or not at all Vienna sausages (95% of students), pizza (95% of students), chips (90% of students), crackers (93% of students), donuts (95% of students), pie (93% of students), margarine (91% of students). However, they consume other food of the same category, so that the number of students who consume rarely or not at all fastfood, sweets and salted snacks is 0.

Only 7% of subjects do not consume or consume more rarely than once a week sodas

with sugar added and 11% of subjects consume unhealthy alimentary fats ([Table 4](#)).

The first 3 junk food consumed very frequently (>5 times/week) were (in decreasing order): sodas (16.2%), biscuits (13.2%) and chocolate (12.3%).

Although this is a young population group, we wanted to evaluate the association between the diet and the metabolic syndrome components, for the two factors which appeared more frequently as modified, namely WC and HDLc.

As a whole, no statistically significant correlations were highlighted between the alimentary contribution of main nutrients and WC and HDLc respectively, neither in men, nor in women, except the glycemic index in women ($r=-0.230$, $p=0.003$). At the same time, no statistically significant correlations were highlighted between the intake scores of junk food and WC and HDLc respectively. We tried to identify a predictive model of intake scores of junk food groups according to WC and HDLc level by using logistic regression, but the analyzed models explained in a very low percentage the variation of these two MS parameters (2% for the WC and 3% for HDLc).

Table 6. Correlations between junk food scores in men.

		Sweet drinks score	Fast food score	Sweets score	Salted snacks score	Fats score
Sweet drinks score	Pearson Correlation	1	0.359	0.276	0.243	-0.191
	Sig. (2- tailed)		0.002*	0.021*	0.043	0.114
Fast food score	Pearson Correlation	0.359	1	0.348	0.570	0.152
	Sig. (2- tailed)	0.002*		0.003*	0.0001*	0.208
Sweets score	Pearson Correlation	0.276	0.348	1	0.422	-0.047
	Sig. (2- tailed)	-0.021*	0.003*		0.0001*	0.698
Salted snacks score	Pearson Correlation	0.243	0.570	0.422	1	-0.054
	Sig. (2- tailed)	0.043*	0.0001*	0.0001*		0.658
Fats score	Pearson Correlation	-0.191	0.152	-0.047	-0.054	1
	Sig. (2- tailed)	0.114	0.208	0.698	0.658	

*Statistically significant correlations, $p < 0.05$

Table 7. Correlations between junk food scores in women.

		Sweet drinks score	Fast food score	Sweets score	Salted snacks score	Fats score
Sweet drinks score	Pearson Correlation	1	0.451	0.227	0.289	-0.055
	Sig. (2-tailed)		0.0001*	0.003*	0.0001*	0.486
Fast food score	Pearson Correlation	0.451	1	0.405	0.462	0.170
	Sig. (2-tailed)	0.0001*		0.0001*	0.0001*	0.029*
Sweets score	Pearson Correlation	0.227	0.405	1	0.512	0.031
	Sig. (2-tailed)	-0.003*	0.0001*		0.0001*	0.689
Salted snacks score	Pearson Correlation	0.289	0.462	0.512	1	0.085
	Sig. (2-tailed)	0.0001*	0.0001*	0.0001*		0.279
Fats score	Pearson Correlation	-0.055	0.170	0.031	0.085	1
	Sig. (2-tailed)	0.486	0.029*	0.689	0.279	

*Statistically significant correlations, $p < 0.05$

Additionally, statistically significant direct correlations were found between the intake scores of different junk food groups (Tables 6, 7).

Discussions

Our study aimed to make a screening of the diet content in saturated and trans fats, added sugar, fibers, fruit and vegetables for a group of medical students. The fact that we have found positive associations between the intake of different junk food categories represents a proof that this questionnaire brings important and consistent information for the investigated alimentary behavior. Therefore, this questionnaire can be used as well in other Romanian population groups, in order to evaluate unhealthy alimentary behaviors.

The main result achieved by our research is the objectification of the very high frequency of those who do not comply with the actual principles of a healthy diet, which is more surprising as the study was made on a population with an education level above that of the average population and with a medical information level by far higher than the general population of the same age. We should point out that there are many healthy diet

recommendations not complied with, including both risk and protection factors investigated by this questionnaire: over 90% of subjects consume saturated and trans fats in a very large quantity – in average over 1.5 times beyond the recommended limit, no student consumes fruit and vegetables according to recommendations and only 12 students out of 235, consume fibers in the recommended quantity.

The analysis of the European diet made by Schmidhuber [11] shows an average of the sugar intake of 10.7%, of the total caloric contribution, of fruit and vegetables intake of 623 g/day, being equivalent to approx. 5 portions /day; the intake of saturated fats in this analysis represents 14.9% of the caloric contribution. These values, except the intake of saturated fats which is high, are in line to the actual WHO recommendations for a healthy nutrition and in disagreement with what we found: 17.22% of the total caloric intake of women and 16.43% of the total caloric intake of men is represented by sugar, 12% of the total caloric intake is represented by saturated fats and the intake of fruit and vegetables is of 2.7 portions/day. The diet estimate at the European level was made by

taking into account the population as a whole, irrespective of age.

Similarly, Cordain et al. [12] report a intake of trans fats of 7.4% of the total fats consumed in the actual diet in the USA, which is equivalent to 2.2% of the total caloric intake and a large quantity of simple carbohydrates (18.6% of the total daily caloric intake); the fiber intake is below the recommended value, with an average of 15.2g/day. As compared to the USA general population of all ages, in our group the average was higher for fats and somehow lower for added sugar, but has similar values for fibers.

In order to compare it with a population from a similar age group, we used the results of a Swedish study performed on teenagers by Patterson et al. [13]. This study reported an average intake of saturated fats of 14.1% and of sugar of 12.2%. The average intake for saturated fats in this Swedish population is higher than that obtained by us (12 %); as for the sugar intake, this is below the average intake in our study (17.22 % in women and 16.43% in men). If differences between averages seem relatively small, what differs by far more is the percentage of those who comply with the recommendations of a healthy diet: thus, in the Swedish study, 30% of the teenagers comply with diet recommendations in respect to saturated fats intake and 82% for the intake of sugar [13] as compared to 3% and 30% respectively from the group we studied.

It should be noted that comparison of the studies presented above could be limited by the methods in which data collection was made, as well as by the way in which primary data were processed in order to estimate the contents in different nutrients.

However, there are studies [14] which have shown a good correlation between different types of standardized methods that were used, such as those of the food frequency questionnaire, the method we used in our study, and the 24 hours recall, the method used in the Patterson et al. study. The European [11] or the USA [12] studies used different methods to estimate food intake. However, the high frequency of subjects who have an unhealthy nutrition identified in our study allows us to conclude that the values we found are at the upper limit of intake as compared to what have been found in developed countries (Western Europe, USA).

If we use the classification in “prudent diet” and “western diet” used by other authors [15], the first being rich in food considered healthy (fruit, plants, whole cereals, fish and vegetables) and the western one rich in industrially processed meat, dairy products with a high contents in fats and concentrated sweets, the group we studied has a western pattern diet in a percentage of 97%. This type of diet was correlated in many studies with a high risk of cardio-vascular diseases [15], obesity [16] or diabetes mellitus [17,18], and even with some forms of cancer [19].

The presence of this nutrition pattern in medical students is well supported by the significant correlations we have found between the associations of different types of junk food.

Data processed by us in this stage of the study do not allow us to support a statistically significant association between abnormal modifications of the WC or of the plasmatic HDLc level and the estimated nutrient content, neither with any of the individual junk food scores nor with the global score. We consider

that this fact is due to the young age of our subjects, where biomarker modifications have not yet become evident; we also consider that it is important to communicate the diet pattern recorded in our medical students, as being a western nutrition pattern, which does not correspond to the WHO recommendations for healthy nutrition.

In conclusion, the existence of a percentage of 97% of students who do not comply with actual WHO recommendations of healthy diet, the high frequency of saturated fats, trans fats, added sugar intake and the low intake of fibers in the diet of this population group are sufficient arguments for an intervention. Thus, previous educational type interventions addressed to medical students [20] gave significant improvements. The high percentage of those with a different dietary intake from that recommended allows us to support the idea that the intervention for

behavior change should be addressed to the whole community of students. Taking into account that in the general population the level of medical education is lower than that of the population we studied, we consider that intervention for nutrition behavior change represents a priority of public health at the national level.

Conflict of interest declaration: No conflict of interest exists.

Acknowledgements: This paper was supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/89/1.5/S/64109 /. We thank the staff of the National Institute of Infectious Diseases “Prof. Dr. Matei Bals”, who contributed to the investigation, without which this study would not have been possible.

REFERENCES

1. Frank E, Wright EH, Serdula MK, Elon LK, Baldwin G. Personal and professional nutrition-related practices of US female physicians. *Am J Clin Nutr* 75: 326-332, 2002
2. Lewis CE. Disease prevention and health promotion practices of primary care physicians in the United States. *Am J Prev Med* 4[Suppl. 4]: 9-16, 1988.
3. WHO: Noncommunicable diseases country profile – Romania: http://www.who.int/nmh/countries/rou_en.pdf
4. International Diabetes Federation. The IDF consensus worldwide definition of the metabolic syndrome. <http://www.idf.org/metabolic-syndrome>
5. Nitescu M, Furtunescu FL, Otelea M, Rafila A, Streinu-Cercel A. Prevalence of metabolic syndrome parameters in a Romanian population of young adults. *Accepted for publication in The Romanian Review of Laboratory Medicine*, 2012.
6. Block G, Woods M, Potosky A, Clifford C. Validation of a self-administered diet history questionnaire using multiple diet records. *J Clin Epidemiol* 43:1327-1335, 1990
7. Thompson F, Subar A. Dietary assessment methodology. In: Coulston AM & Boushey CJ Eds, *Nutrition in the Prevention and Treatment of Disease*, 2nd ed., Elsevier Academic Press, pp 3-39, 2008.
8. Welch AA. Dietary intake measurement. In Cabalero B, Allen L, Prentice A Eds, *Encyclopedia of Human Nutrition*, Elsevier Academic Press, vol 2, pp 7-16, 2005
9. European action plan for food and nutrition policy 2007-2012. <http://www.euro.who.int/en/what-we-do/health-topics/disease-prevention/physical-activity/publications/2008/who-european-action-plan-for-food-and-nutrition-policy-2007-2012>

10. <http://health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf>
11. **Schmidhuber J.** The EU Diet – Evolution, evaluation and impacts of the CAP. Document presented at the *WHO Forum on Trade and Healthy Food and Diets Montréal, 2007* http://www.fao.org/fileadmin/templates/esa/Global_perspectives/Presentations/Montreal-JS.pdf
12. **Cordain L, Eaton SB, Sebastian A et al.** Origins and evolution of the Western diet: health implications for the 21st century. *Am J Clin Nutr* 81: 341–354, 2005.
13. **Patterson E, Warnberg J, Kearney J, Sjostrom M.** Sources of saturated fat and sucrose in the diets of Swedish children and adolescents in the European Youth Heart Study: 2010, strategies for improving intakes. *Public Health Nutr* 13: 1955-1964, 2010.
14. **Thompson F, Midthune D, Subar AF, Kipnis V, Kahle LL, Schatzkin A.** Development and evaluation of a short instrument to estimate usual dietary intake of percentage energy from fat. *J Am Diet Assoc* 107: 760-767, 2007.
15. **Fung T, Rimm E, Spiegelman D et al.** Association between dietary patterns and plasma biomarkers of obesity and cardiovascular disease risk. *Am J Clin Nutr* 73: 61–67, 2001.
16. **Murtaugh M, Herrick J, Sweeney C et al.** Diet composition and risk of overweight and obesity in women living in the Southwestern United States. *J Am Diet Assoc* 107: 1311-1321, 2007.
17. **Hu F, van dam R, Liu S.** Diabetes and risk of type II diabetes: the role of types of fats and carbohydrate. *Diabetologia* 44: 805-817, 2001.
18. **Parillo M, Riccardi G.** Diet composition and the risk of type 2 diabetes: epidemiological and clinical evidence. *Br J Nutr* 92: 7–19, 2004.
19. **Eheman C, Henley S.J, Ballard-Barbash R et al.** Annual report to the nation on the status of cancer, 1975-2008, featuring cancers associated with excess weight and lack of sufficient physical activity. *Cancer* 118: 2338-2366, 2012.
20. **Conroy MB, Delichatsios HK, Hafler JP, Rigotti NA.** Impact of a preventive medicine and nutrition curriculum for medical students. *Am J Prev Med* 27: 77-80, 2004.