

LOW-ENERGY FOOD INTAKE IN A GROUP OF ADULT WOMEN WISHING TO LOSE WEIGHT*Elżbieta Wierzbicka, Barbara Dąbrowska**Department of Human Nutrition, Warsaw University of Life Sciences, Warsaw, Poland*

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Seventy-five women (mean age 34.1 ± 10.2 years), who were seeking dietary advice in order to reduce their body mass (mean BMI index 26.1 ± 4.5 kg/m²), were selected to evaluate their low-energy food intake. A 3-day food-intake record and a questionnaire about eating habits were used to get information related to the types and quantities of low-energy food intake. An inappropriate structure of a daily energy intake in all examined subgroups of women, regardless of BMI was stated. The percentage of energy derived from fat exceeded recommended levels, whereas the contribution of energy from total carbohydrates was too low. It concerns especially the subgroup of women with BMI > 30. From the quantitative point of view, low-energy food intake did not differ significantly, depending on different BMI values of the women. Among low-fat or no-fat food products, almost half the women used to consume milk and cottage cheese, but considerably less yoghurts or margarines and mayonnaise. Among low-sugar and/or sugar-free products, every third woman tended to consume yoghurts and jams, whereas every second – fruit beverages and cola-type drinks. Sugar-free sweets, hard and processed cheeses were consumed the least. In all subgroups of women examined, the proper choice of food, from qualitative and quantitative point of view, should be aimed at a higher consumption of low-energy-density products.

INTRODUCTION

Nowadays, many food companies try to reformulate or introduce new products that have reduced fat, sugar or calorie count to create alternative foods and beverages. Low-energy products at the appropriate intake level are recognized as functional food with a healthy and/or disease-preventing properties. These products have at least 30% energy compared to their full-caloric version [Position ADA, 2002]. Numbers of overweight children and adults have rapidly increased in recent years. Therefore, the use of low-energy density diets has been found to be associated with reduced energy intakes, which in turn could help in weight loss or maintaining the proper body mass [Ello-Martin *et al.*, 2007; Ledikwe *et al.*, 2006; Rolls *et al.*, 2005].

Then, dietary composition – the contribution of fat and carbohydrates to energy value is essential to a consumer. Diets with a lower energy density tend to be associated with healthier lifestyle, management of proper body weight and prevention of diet-related diseases [Bellisle & Drewnowski, 2007; Position ADA; 2002; Rolls *et al.*, 2005].

The purpose of this study was to conduct a quantitative evaluation of a low-energy food intake in women who applied to dietary advisory, considering their BMI.

MATERIAL AND METHODS

From September 2006 to January 2007, seventy-five women (citizens of Warsaw and its suburbs), in the mean age of 34.1 ± 10.2 years, who were seeking dietary advice in a pri-

vate diet clinic in Warsaw in order to reduce their body mass were selected for the study. They agreed to take part in this study.

The tools applied to obtain data concerning pre-advisory period were a specially developed questionnaire about eating habits and a 3-day food intake record related to the types and quantities of food intake, especially labelled as “light type”, “light”, “with reduced energy”, “with reduced fat content”, “low-fat”, “0% of fat”, “low-sugar”, “without sugar”, “sugar-free” and “0% of sugar” *etc.* In particular, respondents were asked to note all low-energy products consumed and their usual portion sizes in grams, mL, glasses or spoons. Furthermore, they were asked to write down the label information (products and producer name). Those data were additionally verified using a survey of this type products available on the Warsaw market. The daily intake of energy and nutrients was calculated using computer software based on the National Food Composition Tables [Kunachowicz *et al.*, 2005]. Weighing household measures and a catalogue of photographs of food products and dishes were used in individual interviews to assess portion sizes.

The Body Mass Index was calculated from the measurement of body height and body weight. The mean BMI was 26.1 ± 4.5 kg/m². Forty percent of the women were overweight (BMI = 25.0-29.9 kg/m²), whereas 18.7% were obese (BMI > 30 kg/m²). It is worthy noting that 41% of the women showed a proper body mass (BMI = 18.5- 24.9 kg/m²).

A small questionnaire survey on socio-demography characteristics, eating habits and health status was conducted as well. Participants listed current and past medical conditions.

Most of the women were 25-34 years old (40%), whereas about 1/4 were at the age of 45-60 years. The remaining groups (18-24 and 35-44 years old) had a lower percentage of the respondents (approx. 17%). Almost 63% of the participants lived in Warsaw. The majority of them (64%) had higher or secondary education (35%), and evaluated their financial status as very good or good (65%). About half the women reported to suffer from chronic diseases like arthritis, hypertension, allergy and food intolerance or thyroid disorders. Amongst the obese women hypertension (43%) and diabetes (14%) were predominant. These women significantly more often declared their physical activity as low (50%) or moderate (43%).

Statistical analysis

The respondents were divided into three groups representing different BMI values. Food intake data as total means \pm standard deviation (SD) were calculated for each group separately. The results were analysed with SPSS v. 12 software. Chi² test, Tukey's test and Kruskal-Wallis non-parametric test were conducted to examine differences in a low-energy food intake among the women having different BMI values.

RESULTS AND DISCUSSION

While setting up the study sample amongst patients of a dietary advisory who wanted to reduce their body mass, a surprising observation was made that a high percentage of women (about 40%) had proper BMI values. They were eager to lose their weight despite of the fact that it was not necessary. McElhone *et al.* [1999] reported that such behaviour can be associated with self-perceived body image and in consequence may lead to the prevalence of eating disor-

ders. Moreover, only 39% of respondents from different EU countries were satisfied with their body mass. It is worth noting that the highest satisfaction indicator was noted amongst underweight women (58%) and men having proper body mass (66%). Moreover, about 20% of underweight women still wanted to reduce their body mass.

In the present study, the mean daily energy intake was 1915 kcal (Table 1). Typical energy expenditure of an adult with low and moderate levels of physical activity is about 2000 kcal. It was noticed that the energy intake was lower in the group of overweight and obese women in comparison to subjects with proper BMI, but the differences were not statistically significant.

The structure of a daily energy intake (Table 1) differed from recommendations in all groups. Diets of the obese women were characterised by the greatest contribution of energy from fat and the smallest one from sucrose. On the other hand, a diet of overweight women had the smallest contribution of energy from fat, but relatively high of that from sucrose. Likewise in the group of women with the proper body mass inappropriate balance of diet was stated.

Statistically significant differences between BMI groups and the percentage of energy from macronutrients were not found, with exception of energy from fat. The 38% input of energy from fat in obese women diets was significantly higher than 31% in overweight women diets. Regardless of BMI, in all the groups examined the contribution of energy from fats exceeded the recommended level of less than 30% [Pachocka *et al.*, 2003], whereas in the case of carbohydrates it was generally too low. The smallest percentage of fat-derived energy in the diet (47%) was stated in the groups of obese women. These differences were statistically significant.

TABLE 1. Daily energy intake and protein, fat, carbohydrate and sucrose contribution to the total energy (En%) according to BMI.

Variables	Total N=75	BMI (kg/m ²)			P*
		18.5-24.9 n=31	25-29.9 n=30	> 30 n=14	
Energy ¹⁾ (kcal)					
Mean \pm SD	1915 \pm 705	2072 \pm 729	1716 \pm 692	1993 \pm 620	NS
Range	564-3689	966-3613	564-3689	604-2846	
Protein (En%)					
Mean \pm SD	16.6 \pm 5.1	16.3 \pm 4.5	18.2 \pm 6.0	14.9 \pm 3.0	NS
Range	8.7-32.3	10.0-30.2	8.9-32.2	8.9-20.5	
Fat (En%)					
Mean \pm SD	34.1 \pm 8.5	35.1 \pm 8.5 ^a	31.1 \pm 9.2 ^{ab}	38.0 \pm 7.5 ^c	0.030
Range	9.9-54.7	19.6-54.7	9.9-46.6	21.8-50.4	
Carbohydrates (En%)					
Mean \pm SD	49.2 \pm 9.2	48.6 \pm 7.1	50.7 \pm 11.2	46.9 \pm 7.3	NS
Range	26.0-87.1	26.0-65.1	22.8-87.2	35.4-66.3	
Sucrose (En%)					
Mean \pm SD	12.8 \pm 7.8	13.6 \pm 7.2	13.2 \pm 9.4	10.2 \pm 4.9	NS
Range	1.6-42.1	1.8-35.4	1.6-42.1	3.0-20.3	

p*- significant at $p \leq 0.05$ using Tukey's test; NS – no significant differences; means with different letter scripts (a, b) are significantly different; 1) energy intake without alcohol.

In this study some data on eating habits of women seeking dietary advice was gathered as well. As shown in Table 2, milk and cottage cheese were the most preferred (63% and 45%, respectively) amongst low-fat food products. Other products, like yoghurts (13% of all respondents), mayonnaise and margarines (each of them approx. 11%), and hard or processed cheese (8%) were reported as considerably less consumed. It was found that more obese women tended to eat milk and cottage cheese (93% and 71% of all subjects, respectively) compared to the overweight ones (60% and 43%, respectively) and those having proper body mass (52% and 35%, respectively). A similar, but not statistically significant, tendency was observed for margarines and mayonnaise, whereas yoghurt intake was observed, mostly among respondents having the proper body mass (19%).

In regard to a quantitative food intake analysis, dairy products such as milk, yoghurts and cottage cheese were noted to be eagerly consumed. Differences amongst the women depending on their BMI were not statistically significant. Nonetheless, the higher the BMI value, the higher was the consumption of milk in the groups examined. It was worthy to note that the obese participants drank about 224 mL of milk whereas those having the proper body mass only 116 mL and the overweight ones a little more, *i.e.* 174 mL. The opposite tendency was observed with yoghurt intake. The obese women consumed it twice less compared to the overweight and

these having proper body mass (83 g vs. 154 g and 171 g). All women, irrespective of their BMI, consumed similar portions of cottage cheese (88 g on average). The respondents also ate processed cheese and/or hard cheese (average 34 g) and margarines (average 9 g) and mayonnaise (average 10 g). The obese women (BMI > 30 kg/m²) did not consume low-fat processed and/or hard cheese.

The majority of the women were observed not to drink light soft drinks (Table 3). A similar percentage of the respondents used to drink fruit beverages and cola-type drinks (23% and 19% of all subjects, respectively), whereas only 8% of the respondents drunk carbonated or non-carbonated beverages with artificial sweeteners. The mean intake of carbonated or non-carbonated beverages was about 358 mL, whereas that of fruit beverages and cola-type drinks about 250–270 mL. The women having the proper body mass tended to drink more fruit and carbonated or non-carbonated beverages than the others, however these differences were not statistically significant. Besides, significantly more obese participants consumed cola-type drinks (43% of all respondents) compared to the overweight (23%) and those having the proper body mass (3%).

The results presented in Table 4 showed that food products not containing sucrose and other sugars at all, were consumed very seldom. Women more rarely tended to eat these sweet products, among others: sweets (8% of all subjects), chocolate and

TABLE 2. Daily intake of low-fat and/or non-fat food products in women according to BMI.

Products	Total N=75	BMI (kg/m ²)			P*
		18.5-24.9 n=31	25-29.9 n=30	> 30 n=14	
Milk					
Number of women (n) ¹⁾	47	16	18	13	0.028
Percentage of women (%)	(62.7)	(51.6)	(60.0)	(92.8)	
Mean ± SD ²⁾ (ml)	167.9±130.0	116.3±82.6	173.7±112.9	223.6±176.7	
Yoghurts					
Number of women (n) ¹⁾	10	6	3	1	NS
Percentage of women (%)	(13.3)	(19.4)	(10.0)	(7.1)	
Mean ± SD ²⁾ (g)	157.3±127.0	171.1±157.3	154.3±86.1	83.0	
Cottage cheese					
Number of women (n) ¹⁾	34	11	13	10	0.032
Percentage of women (%)	(45.4)	(35.5)	(43.4)	(71.4)	
Mean ± SD ²⁾ (g)	87.6±55.0	83.4±70.5	94.1±50.1	83.9±44.9	
Hard cheese and/or processed cheese					
Number of women (n) ¹⁾	6	3	3	0	3)
Percentage of women (%)	(8.0)	(9.7)	(10.0)	(0)	
Mean ± SD ²⁾ (g)	33.8±18.2	45.0±19.5	22.6±8.7	–	
Margarines					
Number of women (n) ¹⁾	8	2	3	3	3)
Percentage of women (%)	(10.7)	(6.5)	(10.0)	(21.4)	
Mean ± SD ²⁾ (g)	9.4±6.9	7.5±3.5	13.3±10.4	6.7±4.2	
Mayonnaise					
Number of women (n) ¹⁾	8	1	4	3	3)
Percentage of women (%)	(10.7)	(3.2)	(13.3)	(21.4)	
Mean ± SD ²⁾ (g)	10.4±8.8	8.0	12.0±12.1	9.0±6.6	

¹⁾ p*- significant at p≤0.05 using Chi² test; ²⁾ p*- significant at p≤0.05 using Kruskal-Wallis test; ³⁾ significant analysis was not performed because of a low number of respondents; NS – not significant differences.

TABLE 3. Daily intake of non-alcoholic beverages containing artificial sweeteners in women according to BMI.

Products	Total N=75	BMI (kg/m ²)			P*
		18.5-24.9 n=31	25-29.9 n=30	> 30 n=14	
Fruit beverages					
Number of women (n) ¹⁾	17	4	9	4	NS
Percentage of women (%)	(22.7)	(12.9)	(30.0)	(28.6)	
Mean ± SD ²⁾ (ml)	274±176	332±240	251±180	265±122	NS
Cola-type drinks					
Number of women (n) ¹⁾	14	1	7	6	0.005
Percentage of women (%)	(18.7)	(3.2)	(23.4)	(42.9)	
Mean ± SD ²⁾ (ml)	252±115	267	224±143	283±88	NS
Other carbonated and non-carbonated beverages					
Number of women (n) ¹⁾	6	4	1	1	3)
Percentage of women (%)	(8.0)	(12.9)	(3.3)	(7.1)	
Mean ± SD ²⁾ (ml)	359±315	413±392	250	250	3)

¹⁾ p*- significant at p≤0.05 using Chi² test; ²⁾ p*- significant at p≤0.05 using Kruskal-Wallis test; ³⁾ significant analysis was not performed because of a low number of respondents; NS – not significant differences.

TABLE 4. Daily intake of low-sugar and/or sugar-free products in a group of women according to BMI.

Products	Total N=75	BMI (kg/m ²)			P*
		18.5-24.9 n=31	25-29.9 n=30	> 30 n=14	
Jams					
Number of women (n) ¹⁾	23	7	9	7	NS
Percentage of women (%)	(30.7)	(22.6)	(30.0)	(50.0)	
Mean ± SD ²⁾ (g)	45.4±57.0	60.3±56.6	61.3±70.1	10.1±8.9	NS
Yoghurts					
Number of women (n) ¹⁾	23	11	5	7	NS
Percentage of women (%)	(30.7)	(35.5)	(16.7)	(50.0)	
Mean ± SD ²⁾ (g)	134.9±66.3	123.7±57.8	168.4±86.2	128.6±66.3	NS
Chocolates, bars					
Number of women (n) ¹⁾	3	1	1	1	3)
Percentage of women (%)	(4.0)	(3.2)	(3.3)	(7.1)	
Mean ± SD ²⁾ (g)	41.6±14.4	50.0	25.0	50.0	3)
Wafers, cakes, biscuits					
Number of women (n) ¹⁾	1	1	0	0	3)
Percentage of women (%)	(1.3)	(3.2)	(0)	(0)	
Mean ± SD ²⁾ (g)	20.0	20.0	–	–	3)
Candies, sweets, drops					
Number of women (n) ¹⁾	6	2	3	1	3)
Percentage of women (%)	(8.0)	(6.5)	(3.3)	(7.1)	
Mean ± SD ²⁾ (g)	14.0±9.9	11.0±7.1	18.7±12.2	6.0	3)

¹⁾ p*- significant at p≤0.05 using Chi² test; ²⁾ p*- significant at p≤0.05 using Kruskal-Wallis test; ³⁾ significant analysis was not performed because of a low number of respondents; NS – not significant differences.

bars (4%) or cookies (about 1%). More respondents declared to consume no-sugar or/and light yoghurts or jams (each about 31%). The obese women used to eat more yoghurts (168 g) compared to those having proper body mass (about 124 g) and the overweight ones (about 129 g). Those differences were not statistically significant. Jam intake was observed to decrease with higher BMI. The respondents having the proper body mass consumed six times more jam than the obese ones.

According to Adamowicz & Ślusarczyk [2005], about 36% of Polish population consumed light foods, whereas 42%

of women and 18% of men used to pay attention to energy value of food that they were buying. The research carried out by SMG/KRC Poland showed that the low-energy products were purchased by up to 62% of people consuming this kind of food due to their concern of health (quoted from Adamowicz & Ślusarczyk [2005]). Flaczyk *et al.* [2006] observed that low-energy food assortment meets first of all expectations of young consumers, representing on the one hand innovative attitudes but, on the other hand, more often than on the average, showing a deep concern over their slim figure.

The subjects studied also tended to consume more low-fat food products than the low-sugar ones. Similar results were found by Bellisle *et al.* [2001]. The study of Adamowicz & Ślusarczyk [2005] confirmed a high intake of low-fat dairy products but a significantly lower intake of such products like margarines, fat mixes, carbonated and fruit beverages, and the lowest intake of no-sugar cookies or sweets. Other study related to eating habits of female students indicated that yoghurts and soft drinks were the most favourite light food products [Flaczyk *et al.*, 2006].

The study of Ostrowska *et al.* [2003] on obese and overweight people presented similar nutritional variability being a consequence of an improper selection of food and drinks. Furthermore, attention was paid to the habit of snacking between the main meals, also at night, and to the irregular time of meals. The research of Pachocka *et al.* [2003] confirmed these phenomena of an especially increased intake of fat and sugar, higher than the recommended one among obese and overweight people. The study of Szczepaniak *et al.* [2003] on subjects aged 18-50 demonstrated that more than half the respondents preferred low-fat food (53%) and that the majority of this group were women. On the other hand, low-sugar food products were chosen by about 37% of the respondents.

The increase in body mass is a consequence of an energy imbalance. Fat, carbohydrates and protein are energy-generating nutrients, and dietary fat is the most energy-dense macronutrient. An energy intake, and especially fat intake, higher than energy expenditure leads to a positive energy balance and to weight gain [Position ADA, 2002]. In this study, there is no clear evidence on the association of energy intake in a group of women with overweight and obesity. However, a positive association of the proportion of energy from macronutrient with body mass indices is observed. Obese female subjects had the highest intake of fat (expressed as percentage of energy intake) compared with women from the other groups. Our results showed that the differences in the quantitative low-energy food intake among the women having different BMI, particularly among overweight and obese ones, were not statistically significant. It has been suggested that the inconsistency of energy intake is probably related to the underestimation of dietary intake. It is common knowledge that, unlike slim persons, the obese people tend to underestimate their food intake. Macdiarmid *et al.* [1998] examining the relationship between fat and sugar intake at respondents having different BMI, confirmed this tendency. Women recorded less food consumption, especially of sweet or high-fat products, than it really was. The high intake of this type of food was connected with higher BMI values and finally led to obesity.

The intake of food containing intense sweeteners or low-fat may lead to the prevalence of the compensation phenomenon, *i.e.* consumption of these products results in energy deficit and in a consequence organism wants to replenish it by consuming more energy with food in next meals over a day [Bellisle & Drewnowski, 2007]. The effect of light food consumption among French adults was examined by Bellisle *et al.* [2001]. They showed that consuming low-fat and low-sugar products led to an increase in body mass among women compared to the control group, not consuming light products. Furthermore, users of low-sugar products had a higher blood

levels of triacylglycerols and glucose. In the case of low-fat food intake – there was noted only higher BMI, but no other changes of biochemical parameters were observed. The choice of low-fat products involved the improvement of diet quality, affected cholesterol decrease, and also caused a higher intake of micronutrients.

For overweight and obese women a well-balanced diet was recommended, taking into account their energy needs. They should largely reduce the intake of fat and easy-digestible carbohydrates to decrease energy density of their diet. Ledikwe *et al.* [2006] found that applying a diet of low-energy density positively influenced adults living in the US, who on the one hand consumed more food and on the other hand – had a lower energy intake. Those people were reported to have higher intakes of vitamin (A, C, B₆ and folate), minerals (iron, calcium and potassium) and water. Moreover, they consumed less fat, caloric carbonated drinks, but more fruits and vegetables. It was reported that the reduction of energy intake from fat led to body mass loss. This relation was observed by Astrup *et al.* [2002], in the study of whom a 10% reduction in dietary fat was predicted to produce a 4-5 kg body mass loss in subjects with BMI > 30.

The results of Ello-Martin *et al.* [2007] also indicated that a very effective method for reduction and/or control of body mass and hunger regulation was to decrease nutritive density of consumed food, in particular to decrease fat intake and to increase the intake of water-rich foods, especially fruit and vegetables. A better quality of a low-energy diet, a lower energy intake and a reduction of body mass was also confirmed by Rolls *et al.* [2005]. Dietary density can be lowered by increasing the intake of water-rich fruit, vegetables, soups and cooked grains. This kind of diet was successfully used in order to reduce energy intake without the need of consuming less and also helped in hunger regulation. Other study carried out by Bellisle & Drewnowski [2007] showed that low-calorie sweeteners and products containing them may assist in weight loss efforts.

The results of the present study confirmed that dietary fats could possibly influence BMI value. The addition of low-energy products to diets of the women examined did not contribute to the weight loss. Among low-fat or no-fat food products, almost half the women used to consume milk and cottage cheese, but considerably less yoghurts or margarines and mayonnaise. Among low-sugar and/or sugar-free products, every third women tended to consume yoghurts and jams, whereas every second – fruit beverages and cola-type drinks. Sugar-free sweets and hard and processed cheese were consumed the least. In reference to the stated inadequacy in women diets, it is crucial to promote nutritional education among people, to encourage them to choose products with a high nutritional value intentionally, and to adopt recommended food patterns.

CONCLUSIONS

1. In general, an inappropriate structure of a daily energy intake was stated in all examined groups of women, regardless of BMI. The percentage of energy derived from fat exceeded the recommended level, whereas the contribution of energy

from total carbohydrates was too low. It concerns especially the subgroup of women with BMI > 30.

2. From the quantitative point of view, a low-energy food intake did not differ significantly in women having various BMI. However, low-fat or no-fat food products were consumed by a higher percentage of subjects than low-sugar and/or sugar-free products.

3. Consumption of low-fat milk, cottage cheese, and also cola light did not lead to a reduction in the energy value of a diet. Nevertheless, the percentage of women with BMI > 30 consuming those products was significantly higher than the percentage of subjects from the other groups. It indicates that the intake of other products rich in fat was too high among the obese women.

4. In all the examined groups of women, the proper choice of food, from both the qualitative and quantitative point of view, should be aimed at a higher consumption of low-energy-density products. The use of a properly-balanced diet, together with high physical activity, may contribute to a reduction of their body mass.

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