

Comparison of the consumption of n-3 and n-6 acids by adults following a vegetarian and traditional diet [†]

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Abstract: The aim of the study was to compare the consumption of n-3 and n-6 acids by adults using a vegetarian and traditional diet. The study was conducted on a group of 170 adults (18–50 years old), including 94 respondents following a traditional diet (56 women and 38 men) and 76 people following a vegetarian diet (52 women and 24 men). The research used the method of a 24-hour interview from four days a week (Monday, Wednesday, Friday, Sunday). The record included the quantity and quality of individual meals and drinks. The study showed that people consuming traditional diets fulfilled the demand for EPA and DHA fatty acids to a significantly higher degree than people following a vegetarian diet. Men preferring the traditional diet significantly better fulfilled the daily requirement for DHA and EPA acids than women. A reverse tendency was found among respondents who consumed a vegetarian diet. The supply of LA acid with the vegetarian diet exceeded the recommended daily amount (especially among men), while with the traditional diet it was too low in relation to the recommended values.

Keywords: n-3 acid, n-6 acid, vegetarian diet, survey research

1. Introduction

Everyone's life is inextricably linked with food. With increasing prosperity and access to newer and newer food products from almost all over the world, a consumer begins to be more interested in what he eats and how it affects his body. Some scientific theories are quickly questioned, while others face the test of time, bringing information that becomes another puzzle that reveals to us a part of phenomena, which is the good functioning human body. As well as the influence of the world on its functioning, including the lifestyle and food consumed. This study describes n-3 and n-6 acids in terms of their impact on the human body, and examined whether and to what extent the consumption of these acids differs depending on the diet (vegetarian diet and traditional diet). In addition to key issues such as the overall effect of n-3 and n-6 acids on improving the health of people suffering from diseases such as type 2 diabetes, atherosclerosis, hypertension, and coronary heart disease, attention was also drawn to the extent to which the diet models studied are able to meet the demand for some essential fatty acids (in line with the guidelines of the Polish Food and Nutrition Institute).

According to that the aim of the study was to compare the consumption of n-3 and n-6 acids by adults using a vegetarian and traditional diet.

2. Methods

The study was conducted in a group of 170 adults (18-50 years old), including 94 respondents following a traditional diet (56 women and 38 men) and 76 people following a vegetarian diet (52 women and 24 men). The research used the method of a 24-hour interview from four days a week (Monday, Wednesday, Friday, Sunday). The record included the quantity and quality of individual meals and drinks. The respondents defined the portion size with the help of the "Album of photos and food products" [1]. In order to clarify doubts, the results were checked by the interviewer and consulted with the interviewee. The respondents also completed a questionnaire containing questions about gender, body weight, height, supplementation used and place of residence. The intakes of individual ingredients were calculated using the Dieta software, version 5.0, developed by the National Food and Nutrition Institute in Warsaw (Poland). The software contains food composition database based on Polish food composition tables. However, for the analysis of the results, the MS Excel software was used, in which additionally the compatibility test, the relationship between the consumption of n-3 and n-6 acids was estimated depending on gender and the type of diet used. The "Dieta 5.0" program used gave the results for individual fatty acids in relation to their sum formula, therefore the value for GLA (γ -linolenic acid) and ALA (α -linolenic acid) acids was given as a sum (C18: 3). In order to be able to perform a comparative analysis of the consumption of fatty acids, the result of which was given in grams, with the energy obtained from the diet, the result of which was given in kilocalories, the formula that 1 g equals 9 kcal of fat (fatty acids) was used. The data recommended by the Polish Food and Nutrition Institute were used to calculate the percentage of the recommended daily intake for EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid). Statistical significance was determined using chi-square test (MsExcel). For normally distributed variables, the unpaired Student's t test was applied to investigate statistically significant differences, whereas for skewed variables – the non-parametric Mann–Whitney U test was used due to the uneven gender balance. The significance level was set at $P \leq 0.05$.

3. Results and Discussion

The conducted research has shown that there are no significant relationships between diet and gender in relation to the consumption of individual fatty acids and total fatty acids. Hence, the discussed results were presented as the average consumption of the population. Statistically significant differences were shown using the chi-squared test only in the case of the recommended daily consumption of LA (linolenic acid), DHA and EPA acids in for gender and diet.

Table 1. Daily fatty acid consumption among women and men following traditional and vegetarian diets

Fatty acid	gender	Traditional diet				Vegetarian diet			
		X±SD	consumption			X±SD	consumption		
			Min.	Max.	Me		Min.	Max.	Me
EPA	Men	0,05 ± 0,23	0,00	3,03	0,00	0,01 ± 0,08	0,00	1,03	0,00
	Women	0,06 ± 0,22	0,00	1,47	0,00	0,002 ± 0,02	0,00	0,13	0,00
DHA	Men	0,13 ± 0,37	0,00	4,75	0,04	0,05 ± 0,23	0,00	3,19	0,00
	Women	0,17 ± 0,57	0,00	4,45	0,03	0,02± 0,05	0,00	0,32	0,00
LA	Women	6,91 ± 4,78	0,62	36,52	5,82	12,84 ± 8,77	2,46	56,69	10,66
GLA + ALA	Men	1,39 ± 1,71	0,12	14,73	0,92	1,99 ± 2,48	0,09	16,48	1,10
	Women	1,22 ± 1,20	0,16	9,10	0,87	3,05 ± 3,92	0,1534	23,66	1,70
AA	Men	0,09 ± 0,12	0,00	1,21	0,04	0,02 ± 0,06	0,00	0,49	0,00
	Women	0,13 ± 0,15	0,00	0,81	0,03	0,01 ± 0,08	0,00	0,23	0,00

Min. – minimal value; Max. – maximal value; Me- median; X- average; SD – standard deviation

As an example it is worth to emphasize that the average daily consumption of individual fatty acids among women using the traditional diet was 0.05 g for EPA, DHA 0.13 g, LA 7.06 g, the sum of GLA and ALA 1.39 g, AA (arachidonic acid) 0.09 g, the same model of nutrition consumption of the above-mentioned the acids was 0.06; 0.17; 6.91; 1.22; 0.13 g. On the other hand, the average daily consumption of individual fatty acids among women preferring a vegetarian diet was: EPA 0.01 g, DHA 0.05 g, LA 8.53 g, GLA and ALA 1.99 g, AA 0.02 g. Fatty acid intake was found at the level of: EPA 0.002 g, DHA 0.02 g, LA 12.84 g, GLA and ALA 3.05 g, AA 0.02 g (Table 1.). The performed statistical analysis did not show statistically significant differences ($p > 0.05$) in the amount of consumed acids and the gender of the respondents or the type of their diet. The obtained results differ from the available literature data, showing slightly higher values for EPA and DHA and lower parameters for LA acids (regardless of gender) [2].

The average daily intake of n-3 fatty acids in the traditional diet was 1.57 g among women, and 1.46 g among men. Respondents preferring a vegetarian diet consumed the above-mentioned acids 2.05 and 3.08 g (Table 2). Statistical analysis showed no significant differences in the uptake of these acids, neither by gender nor by type of diet. N-3 acids in the traditional diet constituted 2.71% (women) and 2.20% (men), and in the vegetarian diet 4.42% (women) and 5.51% (men) of total fat during the day (Table 2). In the case of the traditional diet, a slightly higher consumption of these fatty acids was recorded among women, while the vegetarian diet among men. Statistical analysis showed no significant differences in the uptake of n-3 acids depending on the feeding model. In the study by Jabłonowska et al. [3] the mean daily consumption of n-3 among women following a traditional diet was similar to the presented data and amounted to 1.58 ± 1.09 g, and among men it was higher than the results discussed (2.24 ± 1.24 g). It was demonstrated [2] higher mean daily consumption of n-3 fatty acids with a traditional diet, amounting to 2.48 g in girls, and 2.53 g in boys.

Table 2. Daily n-3 and n-6 acid consumption respondents following traditional and vegetarian diets

gender	Traditional diet				Vegetarian diet			
	X±SD	consumption			X±SD	consumption		
		Min.	Max.	Me		Min.	Max.	Me
Average daily consumption of n-3 acids depending on gender and nutrition model (g / d)								
Women	1,57 ± 1,84	0,17	14,92	1,05	2,05 ± 2,48	0,20	16,48	1,16
Men	1,46 ± 1,45	0,16	9,19	0,99	3,08 ± 3,91	0,16	23,66	1,70
Percentage of total fat content of acids from the n-3 family								
Women	2,71 ± 2,18	0,67	17,38	2,03	4,42 ± 3,91	0,46	25,21	3,21
Men	2,20 ± 1,74	0,48	12,98	1,73	5,51 ± 6,06	0,82	40,21	3,85
Average daily consumption of n-6 acids depending on gender and nutrition model (g / d)								
Women	8,53 ± 6,15	0,70	45,17	6,83	10,54 ± 8,11	0,81	60,25	8,42
Men	8,26 ± 5,68	0,80	44,79	7,03	15,91 ± 10,35	2,69	58,76	13,47
Percentage of total fat content of acids from the n-6 family								
Women	15,17 ± 6,09	4,25	36,31	14,15	23,16 ± 10,10	2,34	51,77	22,12
Men	12,59 ± 5,11	4,29	39,31	11,69	28,21 ± 10,59	10,64	56,96	27,40

Min. – minimal value; Max. – maximal value; Me- median; X- average; SD – standard deviation

The average daily consumption of n-6 fatty acids with the traditional diet was 8.53 g among women, and 8.26 g among men. In the case of a vegetarian diet, these values were 10.54 and 15.91 g, respectively (Table 8). There was no significant differentiation in the uptake of these acids depending

on the type of diet and gender. N-6 fatty acids in the traditional diet accounted for 15.17 (women) and 12.59% (men), and in the vegetarian diet 23.16 (women) and 28.21% (men) of total fat consumed during the day (Table 2).

In the traditional diet, the consumption of n-6 fatty acids among both sexes was almost identical, while in the vegetarian diet it was slightly higher among men. In the studies published by Stachura et al. [2] the mean daily consumption of n-6 acids was higher and was 10.1 g among girls following the traditional diet, and 10.9 g among boys.

The data on fat and energy supply (Table 3) show that the average daily energy value of the traditional diet was $1,907.92 \pm 904.65$ kcal among women, and $2,067.33 \pm 811.36$ kcal among men. On the other hand, the energy value of a vegetarian food ration was slightly lower for both women (1475.44 ± 600.81 kcal) and men (1687.59 ± 665.87 kcal). However, according to Jabłonowska et al. [3] the average energy value of the daily traditional ration was 1700 ± 712 kcal, with 1548 ± 611 kcal among women and 2199 ± 834 among men. In the study by Kornek et al. [22] the average amount of energy per day among women on vegan and lacto-ovo-vegetarian diets was slightly higher than in the study in question and amounted to 1670-1692 kcal. Davey et al. [4] showed that women who preferred the traditional diet supplied less energy per day from food, only 1686 kcal, while higher results were obtained by men on the traditional diet (2192 kcal) and women and men on a vegetarian diet (1686 kcal and 2097 kcal, respectively). The average daily total fat consumption with the traditional diet was 57.92 ± 37.87 g among women, and 69.61 ± 44.09 g among men. In turn, in the vegetarian diet among women it was 48.07 ± 42.61 g, and among men 57.21 ± 30.84 g. Statistical analysis did not show that there is a relationship between fat consumption and gender or diet. Jabłonowska et al. [3] showed that the average daily fat consumption among women with a traditional diet was 56.0 ± 27.9 g, so it was similar to the presented data for this sex. However, among men it was higher and amounted to 93.5 ± 46.1 g.

Table 3. Average supply of total energy and fat with traditional and vegetarian diets

gender	Traditional diet				Vegetarian diet			
	X±SD	consumption			X±SD	consumption		
		Min.	Max.	Me		Min.	Max.	Me
Average energy supply (kcal / d) with traditional and vegetarian diets								
Women	1907,92 ± 904,65	578,33	6079,49	1755,49	1475,44 ± 600,81	566,18	6223,32	1412,66
Men	2067,33 ± 811,36	341,12	4360,47	1987,33	1687,59 ±665,87	695,78	5249,73	1598,38
Average total fat supply (g / d) in traditional and vegetarian diets								
Women	57,92 ± 37,87	4,70	275,56	49,98	48,07 ± 42,61	5,86	476,89	43,25
Men	69,61 ± 44,09	4,32	275,50	59,64	57,21 ± 30,84	8,22	183,65	53,00
The percentage of total fat in the daily caloric supply								
Women	27,82 ± 11,28	3,87	64,62	27,28	27,54 ± 11,77	6,35	89,81	26,49
Men	29,28 ± 10,60	6,29	56,96	28,99	30,03 ± 10,61	8,79	66,97	30,01

Min. – minimal value; Max. – maximal value; Me- median; X- average; SD – standard deviation

The sum of polyunsaturated fatty acids analyzed in the study per day in the traditional diet among women was 10.10 ± 7.58 g, and among men 9.72 ± 6.70 g. On the other hand, in the vegetarian diet it was 12.59 ± 10.07 g and 18.99 ± 12.97 g, respectively (Table 4). The statistical analysis did not show any significant differentiation of this parameter depending on the sex of the respondents and their diet. Slightly higher results were obtained by Stachura et al. [2]. However, in the research of Jabłonowska et al. [3] the average daily PUFA intake by women on a traditional diet was slightly lower than the presented data and amounted to 9.6 ± 5.9 g, while among men it was higher and equaled 13.6 ± 6.8 g.

In the presented study, PUFAs provided 4.90% of daily energy in the traditional diet among women, and 4.13% among men. On the other hand, in the vegetarian diet, this parameter accounted for 7.38%, respectively, and 10.21% of total energy among men (Table 4). In this case, the statistical analysis also showed significant differentiation either by gender or diet. Similar data were obtained by Stachura et al. [2], who showed that the energy from PUFA among girls using the traditional diet was 4.9%, while among boys it was 5.0%. In the research by Jabłonowska et al. [3] the average daily PUFA consumption among women and men consuming the traditional diet was slightly higher and amounted to 5.6% of energy. In a study by Davey [4] et al. PUFA in the traditional diet provided 5.19% of energy among women, and 5.21% among men. The vegetarian diet, on the other hand, provided 5.29% (among women) and 5.67% (among men) of total energy with PUFA.

Table 4. Supply of PUFA with traditional and vegetarian diets

gender	Traditional diet				Vegetarian diet			
	X±SD	consumption			X±SD	consumption		
		Min.	Max.	Me		Min.	Max.	Me
Average daily PUFA supply in traditional and vegetarian diets (g / d)								
Women	10,10 ± 7,58	0,92	57,29	8,01	12,59 ± 10,07	1,25	72,98	9,95
Men	9,72 ± 6,70	0,97	53,08	8,11	18,99 ± 12,97	2,85	67,45	15,66
Percentage of daily energy supply supplied by PUFAs								
Women	4,90 ± 2,91	0,38	18,29	4,12	7,38 ± 4,64	0,97	33,51	6,45
Men	4,13 ± 1,90	1,11	12,39	3,59	10,21 ± 6,65	2,33	40,96	9,22

Min. – minimal value; Max. – maximal value; Me- median; X- average; SD – standard deviation

People eating the traditional diet did not meet the recommended daily allowance. The percentage of the recommended daily consumption, which according to the IŻŻ, amounts to 4% of the daily energy requirement for LA (n-6) [5], was 85.91% among women and 73.12% of men consuming a traditional diet. On the other hand, among the respondents preferring a vegetarian diet, it was 125.92% and 168.69%, respectively (Table 5). Statistical analysis showed that there is a significant differentiation in the fulfillment of energy demand from LA acid, depending on both gender and diet. In the study by Kornek et al. [6] the obtained results were significantly lower than those presented and amounted to 70-83% of the daily demand for LA for vegans and lacto-ovo-vegetarians, while women following the traditional diet covered only 44% of the demand.

Table 5. Percentage of the recommended daily intake for LA acid and the sum of EPA and DHA acids

gender	Traditional diet				Vegetarian diet			
	X±SD	consumption			X±SD	consumption		
		Min.	Max.	Me		Min.	Max.	Me
Percentage of the recommended daily allowance for LA acid								
Women	5,91 ±49,39	5,06	360,10	76,05	125,92 ±73,34	13,37	450,71	113,09

Men	73,12 ±32,53	14,87	188,79	64,93	168,69 ±85,44	47,48	497,88	150,85
Percentage of the recommended daily intake for EPA and DHA								
Women	73,14 ±242,05	0,00	3112,00	18,52	24,18 ±124,10	0,00	1687,64	0,00
Men	93,82 ±309,69	0,00	2369,20	17,02	9,59 ±24,12	0,00	178,96	0,00
Min. – minimal value; Max. – maximal value; Me- median; X- average; SD – standard deviation								

The percentage of the recommended daily intake recommended by the Institute of Food and Drug Administration for EPA and DHA (n-3) acids is 250 mg /d [5]. In the analyzed study, the intake of these acids with a traditional diet was demonstrated, allowing women to meet the needs of 73.14% and 93.82% by men. Even lower values were found in the group of respondents consuming a vegetarian diet. These values were only 24.18% among women and 9.59% among men (Tables 5). In the case of these acids, the level of achievement recommendations differed significantly depending on gender and diet. In the presented study, none of the groups managed to meet the recommended daily intake of the sum of EPA and DHA acids. Statistical analysis showed that in the case of a vegetarian diet, these results were significantly lower than the data obtained for people on a traditional diet. As well as among the respondents consuming a vegetarian diet, men obtained a significantly lower result than women, while in relation to the traditional diet, the opposite correlation was shown. In the data presented by Kornek et al. [6] there is a similar relationship between people following traditional and vegetarian diets. In the cited study, none of the vegans and lacto-ovo-vegetarians covered the demand for DHA + EPA. In the case of women on a traditional diet, only 25% of them consumed the appropriate amount of these acids.

4. Conclusion

The analyzed data show that the average supply of n-3 fatty acids in grams per day did not differ depending on the diet used. The mean daily consumption of n-6 fatty acids in grams / day was similar among respondents eating traditional and vegetarian diets. The consumption ratios of n-6: n-3 fatty acids were slightly lower among those consuming a vegetarian diet than in a traditional diet. The study showed that people consuming traditional diets fulfilled the demand for EPA and DHA fatty acids to a significantly higher degree than people following a vegetarian diet. Men preferring the traditional diet significantly better fulfilled the daily requirement for DHA and EPA acids than women. The opposite tendency was found among respondents who consumed a vegetarian diet. The supply of LA acid with the vegetarian diet exceeded the recommended daily amount (especially among men), while in the traditional diet it was too low in relation to the recommended values. On the basis of the presented research results, it should be stated that both in people consuming a vegetarian and a traditional diet, the supply of n-3 and n-6 acids should be modified to ensure an adequate amount of these nutrients in both study groups. Particularly, the supply of n-3 acids should be increased in order to maintain the best n-3: n-6 ratio. Such a modification would to some extent help prevent, among others, diet-related diseases such as type 2 diabetes, atherosclerosis, hypertension or ischemic heart disease, as well as bring many other positive health consequences for our body [7].

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