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ASSESSMENT OF *n-3* AND *n-6* POLYUNSATURATED FATTY ACID INTAKE IN THE AVERAGE POLISH DIET

Ewa Dybkowska, Bożena Waszkiewicz-Robak, Franciszek Świderski

Department of Dietetics and Functional Foods, Faculty of Human Nutrition and Consumer Sciences, Warsaw Agricultural University – SGGW, Warsaw

Key words: the survey of household budgets, the source of fat in the Polish diet, energy in the average Polish diet, the intake of fatty acids, polyunsaturated fatty acids *n*-3 and *n*-6

The aim of the study was to establish the intake level of *n*-3 and *n*-6 polyunsaturated fatty acids intake in the average Polish diet. The intake of fatty acids *n*-3 and *n*-6 in an average Polish diet was estimated using data gathered by the Central Statistical Office in 1998 using food composition tables. The consumption of polyunsaturated fatty acids *n*-6 constituted 5.21% of the total energy in the diet (13.10 g/day), while *n*-3 only 0.95% of energy (2.40 g/day). The intake of PUFA *n*-3 alpha-linolenic acid was 0.9% of energy and was close to recommended levels (1%), but the intake of long-chain forms PUFA *n*-3 DHA and EPA amounted to 0.04% of energy and was much too low (recommended 0.3%). The intake of PUFA *n*-6 linoleic acid equalled 5% of energy and was much higher than the recommended upper limit (3% of energy). The results indicate that it is necessary to increase the intake of long chain PUFA *n*-3 by greater consumption of fish and fish products or EPA and DHA-enriched foods or supplements.

INTRODUCTION

Diet has a huge influence on human health. Cardiovascular diseases are the main cause of death in many countries. They are the results of a long-term evolution of arteriosclerosis. One of the leading causes of arteriosclerosis is excessive consumption of fats in a diet [McPherson Spiller, 1996]. A reduction in the consumption of saturated fatty acids and increased polyunsaturated fatty acid intake is the most effective method of decreasing cholesterol level in blood [Gertig & Przysławski, 1994, 1995; McPherson & Spiller, 1996]. Many studies indicate that communities consuming a diet rich in polyunsaturated fatty acids *n*-3 are characterised by less frequent occurrence of cardiovascular diseases (arteriosclerosis, coronary heart disease, atherothrombotic endpoints), some types of cancer and symptoms of allergies [Connor, 2000; Nettleton, 1995; Simopoulos, 1991]. Excessive consumption of *n*-6 acids upsets the metabolism of *n*-3 acids and disturbs the physiological balance of compounds that are synthesised from these acids [Newton, 1996; Simopoulos, 1991].

There are alpha-linolenic, docosahexaenoic (DHA) and eicosapentaenoic (EPA) acids in *n*-3 acid group. The linoleic and arachidonic acids belong to *n*-6 acid group. In 1999, the International Society for the Study of Fatty Acids and Lipids recommended the following intake of particular polyunsaturated fatty acids for adults: alpha-linolenic acid – 1% energy (2.22 g/day), DHA and EPA – 0.3% energy (0.65 g/day), and linoleic acid – 2% energy (4.4 g/day). Docosahexaenoic and eicosapentaenoic acids should make up at least 0.2% of energy in the diet (0.44 g/day), while the upper limit for intake of linoleic acid was established at 3% of energy (6.67 g/day). This organisation recommended not exceeding 8% energy from saturated fatty acids [Simopoulos *et al.*, 1999]. The physiological ratio of *n*-6/*n*-3 fatty acids is about 1:1 to 4:1 [Simopoulos, 1996].

AIM

The aim of the study was to establish the level of polyunsaturated fatty acids *n*-3 and *n*-6 intake in the average Polish diet.

MATERIALS AND METHODS

The average daily intake of particular groups of products was calculated from the research results of household budgets, elaborated by the Central Statistical Office [Household budgets in 1998; Laskowski, 2000]. They surveyed the intake of over 90 foodstuffs per person monthly. The survey included households representing the basic socio-economic groups of the population, established on the basis of the exclusive or primary source of income [Methods of survey..., 1999]. The survey covered 0.3% of the total number of households (32,000). The survey of household budgets recorded the amount of food that was bought in a household per person. The survey did not include food lost in households and consumption outside households – in canteens, restaurants, bars. The data obtained was reduced by 10% – the average accepted for losses during preparing

Author's address for correspondence: Ewa Dybkowska, Department of Dietetics and Functional Foods, Faculty of Human Nutrition and Consumer Sciences, Warsaw Agricultural University – SGGW, ul. Nowoursynowska 159 C, 02-776 Warszawa, Poland

of dishes and leftovers. The Polish food composition table [Kunachowicz *et al.*, 1998] was used to compute the average daily intake of energy and nutrients.

RESULTS

Vegetable and vegetable products dominated among products consumed in Polish diet – they amounted to 30% of consumption, while bread and cereal products constituted 19%, and milk and milk products 17%. The consumption of meat and meat products amounted to 11%, fruit and fruit products to 10%, sugar and confectionery to 6%. The consumption of other products was much lower: fats 3%, eggs 2%, fish and fish products 1% and other products 1% (Figure 1). The consumption of margarine predominated in consumed fatty products – it amounted to 40% of the consumption of products in this group, while the consumption of vegetable oils was 24%, butters – 21% and other animal fats – 15%. The consumption of fish and fish products was very low in Polish diet and it was 11 g/person/day, while it is recommended to consume sea fish 2–3 times a week (about 300 g of fish weekly).

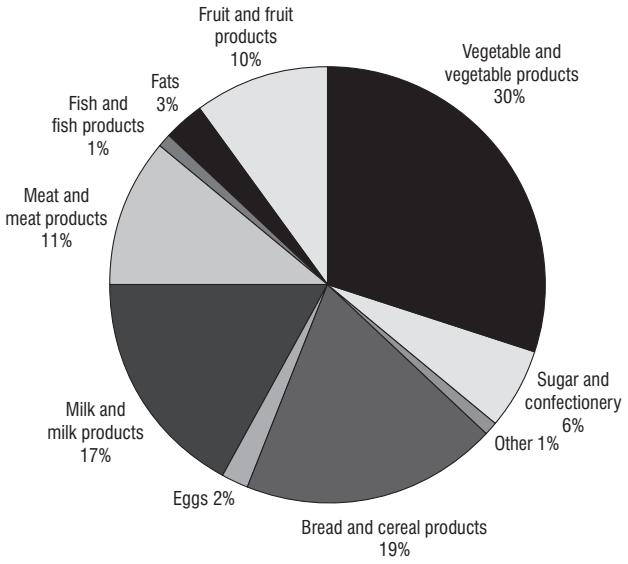

FIGURE 1. The consumption of products in the average Polish household.

The average value of energy in an average Polish diet was 2266 kcal/person/day. The main sources of energy in Polish diet were bread and cereal products – they amounted to 33% of energy, meat and meat products to 15%, fats to 15%, sugar and confectionery to 15%. A lower value of energy in Polish diet was supplied by milk and milk products – 9 %, vegetable and vegetable products 9%. Products such as fruit and fruit products, fish and fish products and others supplied 5 % of energy altogether (Figure 2).

In the diet, 35% of energy came from fats, while the recommended intake should not exceed 30%. The main source of fat in Polish diet were fatty products. They supplied 44% of fat (margarine 13%, oil 13%, butter 10%, other meat fat 8%). Meat and meat products supplied 29% (meat – 15 %, meat products – 14%) of fat in Polish diet, milk and milk products 12%, confectionery 5%, bread and cereal products 5%, eggs 3% and other products supplied together 2% of fat (Figure 3).

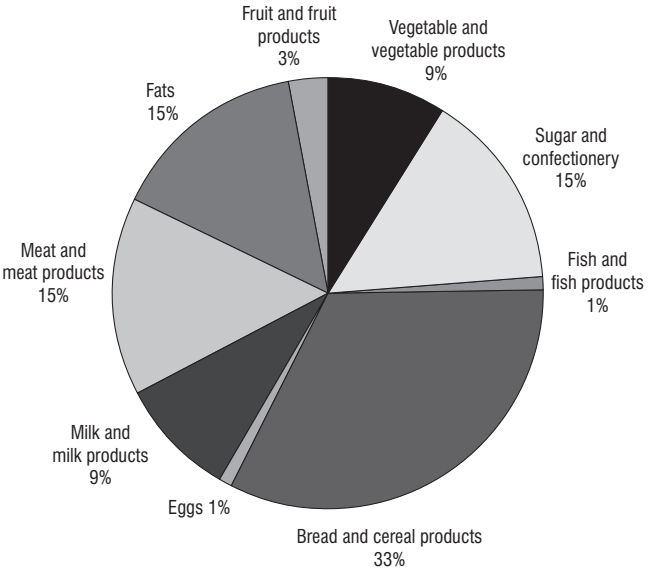

FIGURE 2. The value of energy in different groups of products in the average Polish household.

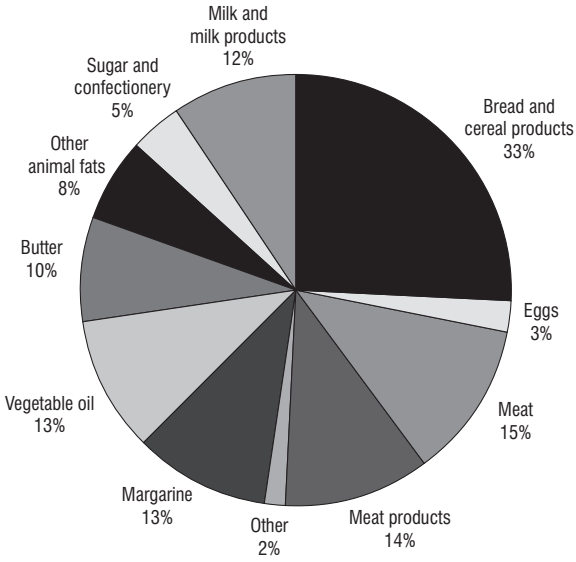

FIGURE 3. The level of fat in different groups of products in the average Polish household.

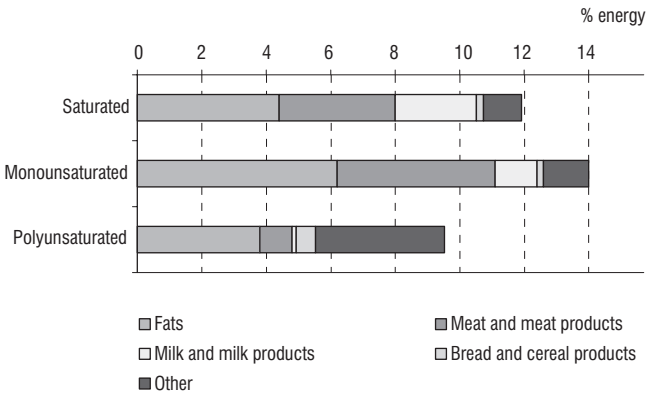

FIGURE 4. The intake of saturated, monounsaturated and polyunsaturated fatty acids in different groups of products in the average Polish household.

The intake of saturated fatty acids supplied about 12% of energy in Polish diet, while it is recommended not to exceed 8% of energy from this group of fats [Simopoulos *et al.*, 1999]. Saturated fatty acids in Polish diet came in 37% from fats (mainly animal fats), in 30% from meat and meat products and in 21% from milk and milk products (Figure 4). The intake of monounsaturated fatty acids made up more than 14% of energy in Polish diet. The source of monounsaturated fatty acids in Polish diet were fats (44%), mainly vegetable fats (margarine and oils), meat and meat products (35%). The average intake of polyunsaturated fatty acids in Polish diet made up about 6% of energy (15.5 g/day). The source of polyunsaturated fatty acids in Polish diet were fats (63%) mainly vegetable fats (margarine and oils). A lower amount of these acids were in meat and meat products (15%) and also bread and cereal products (11%).

The consumption of polyunsaturated fatty acids *n*-6 constituted 5.21% of total energy in the diet (13.10 g/day), while *n*-3 – 0.95% of energy (2.40 g/day) (Figure 5), which produces a ratio of *n*-6 to *n*-3 of about 5.5:1.

It was shown that the highest source of PUFA *n*-3 in Polish diet were fats. They supply 63% of these acids (vegetable oil 37%, margarine 19%). A lower amount of PUFA *n*-3 came from meat and meat products (10%), bread and cereal products (7%) and also milk and milk products (6%). The main source of PUFA *n*-6 were fats – 63% (vegetable oil 35%, margarine 23%), meat and meat products (16%) and also bread and cereal products (12%) (Figure 5).

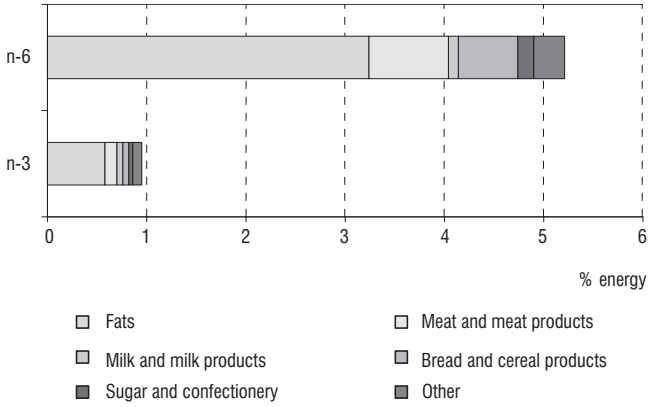

FIGURE 5. The intake of fatty acids *n*-6 and *n*-3 in different groups of products in the average Polish household.

The intake of linoleic acid was 5.14% of the total energy in the diet (12.93 g/day). The intake of alpha-linolenic acid was 0.91% of energy (2.29 g/day), arachidonic acid 0.06% (0.17 g/day), docosahexaenoic and eicosapentaenoic acids 0.04% of energy (0.10 g/day). The main source of linoleic acid in the Polish diet were fats, they supply 63% of this acid (vegetable oil 36%, margarine 24%). Meat and meat products supply 15% of this acid and bread and cereal products supply 12%. The main source of alpha-linolenic acid were fats, which supply 66% of this acid (vegetable oil 38%, margarine 20%). Other products supply lower amounts of this acid: meat and meat products 9%, bread and cereal products 8% milk and milk products 6%, vegetable and vegetable products 4%. Arachidonic acid from *n*-6 group in 81% came from meat and meat products in Polish diet, 8% of this acid supplied eggs and 5% animal fats. The main source of long-chain PUFA *n*-3 DHA and EPA in the Polish diet were fish and fish products; they supplied 51% of these acids, while eggs supplied 24% of these acids, and meat and meat products 20% (Figure 6).

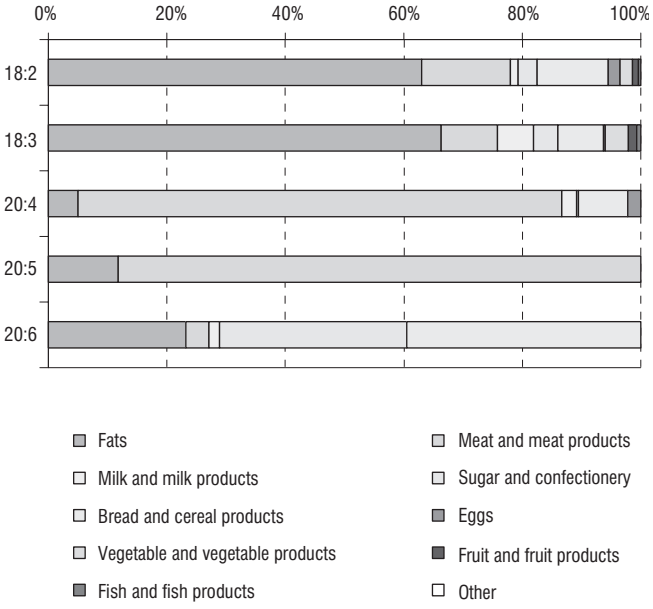

FIGURE 6. The intake of particular fatty acids in different groups of products in the average Polish household.

The comparison of Polish diet with the recommendation of the International Society for the Study of Fatty Acids and Lipids shows that the intake of *n*-3 alpha-linolenic acid was close to recommended (2.29 g/day *i.e.* 0.91% of energy – recommended 1%) but the intake of long-chain PUFA *n*-3 DHA and EPA was much too low (0.10 g/day *i.e.* 0.04% of energy – recommended 0.3%). The intake of PUFA *n*-6 linoleic acid was 12.93 g/day (*i.e.* 5.14% of energy) and was much higher than recommended (2% of energy) (Figure 7).

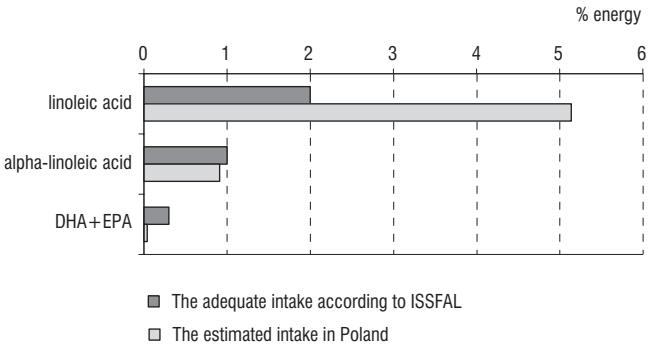

FIGURE 7. The adequate and estimated intake of polyunsaturated fatty acids.

The results indicate that there is a necessity to increase the intake of long chain PUFA *n*-3 by greater consumption of fish and fish products or EPA and DHA-enriched foods or supplements.

There is no sufficient data estimating the intake of particular *n*-3 and *n*-6 fatty acids. There was a study conducted in Norway, Denmark and Great Britain. The participation of n-6 fatty acids in total energy was close in Polish and British diet (5.2% of energy) [Sanders, 2000], but the intake

of these fatty acids was lower in Norway (4.41% of energy) [Johansson *et al.*, 1998]. The intake of *n*-3 fatty acids was 0.91% of energy in Norway [Johansson *et al.*, 1998] and was close to the intake in Poland, the intake of these fatty acids was lower in Great Britain (0.75% of energy) [Sanders, 2000].

In comparing the Norwegian and Danish diets with the Polish diet, the participation of linoleic acid and alpha-linolenic acid was similar and amounted to approximately 4.35% and 0.59% of the energy in the Norwegian diet [Johansson *et al.*, 1998], 5.60% and 0.83% of the energy in the Danish diet [Tjonneland *et al.*, 1993], 5.14% and 0.91% of energy in the Polish diet. The average Norwegian and Dane consumed high levels of EPA and DHA, which together amounted to 0.32% of energy in the Norwegian diet [Johansson *et al.*, 1998], 0.24% of energy in the Danish diet and 0.04% of energy in the Polish diet.

Research concerning the comparison of *n*-3 and *n*-6 polyunsaturated acids intake in the average Polish diet (estimated using household budgets and three-day dietary records) has shown a great convergence of data. It has been shown that these two methods may be used alternately in the process of establishing the intake level of PUFA [Dybkowska *et al.*, 2003].

The intake of antioxidants in the Polish diet amounted to: vitamin A (equivalent of retinol) 1089 μg, vitamin E (equivalent of alfa-tocopherol) 11.3 mg, vitamin C 82.8 mg, and was consistent with the Polish recommendations presented by Ziemlański (The National Food and Nutrition Institute) [Ziemlański, 1998].

CONCLUSIONS

1. The participation of fat and saturated fatty acids in the diet consumption was higher than recommended. The participation of polyunsaturated fatty acids in the total energy in the diet consumption was close to recommended levels.

2. The intake of PUFA *n*-3 alpha-linolenic acid was 0.9% of energy and was close to the recommended level (1%), but the intake of long-chain forms PUFA *n*-3 DHA and EPA was 0.04% of energy and was much too low (recommended 0.3%). The intake of PUFA *n*-6 linoleic acid was 5% of energy and was much higher than the recommended upper limit (3% of energy). The ratio of polyunsaturated fatty acids *n*-6 and *n*-3 in the Polish diet was 5.5:1 and was higher than physiologic ratio (1–4:1).

3. Excessive consumption of fats in the diet, especially saturated fatty acids, was the result of excessive consumption of butter and other animal fats. It is recommended to replace animal fats with margarine or rape oil rich in alpha-linolenic acid. The results indicate that it is necessary to increase the intake of long chain PUFA *n*-3 by greater consumption of fish and fish products or EPA and DHA-enriched foods or supplements.

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OCENA WIELKOŚCI SPOŻYCIA WIELONIENASYCONYCH KWASÓW TŁUSZCZOWYCH *n-3* I *n-6* W PRZECIĘTNEJ POLSKIEJ RACJI POKARMOWEJ

Ewa Dybkowska, Bożena Waszkiewicz-Robak, Franciszek Świderski

Katedra Dietetyki i Żywności Funkcjonalnej, Szkoła Główna Gospodarstwa Wiejskiego w Warszawie

Celem pracy jest ocena poziomu spożycia wielonienasyconych kwasów tłuszczowych typu *n*-3 i *n*-6 w przeciętnej polskiej racji pokarmowej. Poziom spożycia wielonienasyconych kwasów tłuszczowych typu *n*-3 i *n*-6 w przeciętnej polskiej diecie oszacowano w oparciu o dane pochodzące z badań budżetów gospodarstw domowych Głównego Urzędu Statystycznego z 1998 roku przy wykorzystaniu tabel składu i wartości odżywczej produktów spożywczych.

Stwierdzono, że poziom spożycia wielonienasyconych kwasów tłuszczowych z grupy *n*-6 stanowi 5,21% wartości energetycznej diety (13,10 g dziennie), podczas gdy poziom spożycia kwasów typu *n*-3 stanowi jedynie 0,95% energii (2,40 g dziennie) (rys. 5). Spożycie kwasu alfa-linolenowego z rodziny *n*-3 stanowiło 0,9 % energii i było zbliżone do zalecanego (1%), natomiast spożycie długołańcuchowych form *n*-3 EPA i DHA wynosiło 0,04 % wartości energetycznej diety i było znacznie niższe od zalecanego (0,3% energii) (rys. 7). Spożycie kwasu linolowego (*n*-6) wynosiło 5% wartości energetycznej i znacznie przekraczało zalecaną górną granicę (3% energii) (rys. 7). Wyniki te wskazują na potrzebę zwiększenia spożycia długołańcuchowych form kwasów tłuszczowych z rodziny *n*-3 przez zwiększenie spożycia ryb i przetworów rybnych, wzbogacanie żywności lub suplementację.