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Article

Fish Consumption Frequency in the Adult Population in Poland

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Abstract: The aim of the study was to assess the frequency of fish consumption in Poland including sea and freshwater fish species referring to some socio-economic determinants. The frequency of consumption was assessed using Food Propensity Questionnaire data from 1489 adults (722 males, 767 females) in 2019–2020. The fish consumption frequency in Polish adults was too rare compared to the recommendations (at least twice a week). About 80% of respondents consumed fish less frequently than recommended. Sea fish were mostly consumed less than once a month (31.8%) or 1-3 times a month (30.9%). The most of subjects (44.8%) consumed freshwater fish less than once a month. It was also depended on: educational level, economic status, place of residence, declared health status, and on BMI value or BMI status. However, taking into account sex, the occurrence of these relationships was different in men and women. It seems that educational activities and dissemination of proper nutrition principles is necessary in order to increase the consumption of fish in Poland. It should be important to emphasize health benefits of fish consumption in relation to possible adverse effects of their contamination.

Keywords: fish; consumption frequency; adults

1. Introduction

Fish are an important source of energy, protein and the range of other important nutrients for health maintaining, e.g. omega 3 fatty acids. It could be limited by the presence in fish some contamination like mercury and dioxins. It is necessary to emphasize the benefits of fish consumption for multiple health outcomes throughout the life course including during pregnancy, childhood and adulthood [1].

Total EU fishery and aquaculture production according the EUMOFA report from 2023 is 3.6 million tonnes by a year, which represented more than one fourth of European production. In the whole Europe the share of more than 50% referred to the five fish species like: herring (with 1.8 million tonnes produced in 2021), Alaska pollock (with 1.7 million tonnes), cod (with 1.3 million tonnes) and blue whiting and mackerel (together – more than 1.2 million tonnes) [2].

In Poland among total fish industry production the largest share was head by the processed fish products (including canned fish), which accounted to 45.2%. The highest share of this kind of products was observed in Germany - even 81%. In Poland, herring processed products accounted for the largest market share (43% in 2022). It is necessary to add that Poland is the most important producer of the salted fish products (29.3% of the total EU production in 2022) [3].

According to the results from the household budget survey which are provided by the Statistics Poland, the mean consumption of fish and fish products in 2012 in total households was 0.42 kg/person/month in which sea and fresh-water fish (fresh, chilled or frozen) was 0.26 kg/person/month [4]. In 2022 the consumption of fish and seafood and their products was 0.24 kg/person/month. In this food group 37.5% was dried, smoked or salted fish and seafood [5]. These differences may be caused by a change in the classification of fish products in the household budget survey. Currently, consumption data does not include canned and pickled fish. These data are only included in expenditures.

In accordance to food balance sheet the consumption of fish and seafood in 2022 was 13.68 kg/person/year in equivalent of a live fish [6]. Using conversion factors developed on the basis of

Polish Food Composition Tables [7] in 2022 the consumption of fish in edible parts was 7.43 kg/person/year. The most part of consumed fish in Poland was the frozen fish which share was 79.5%. In comparison to the previous year that consumption was lower about 5%. The share of freshwater fish was 16.9% [6].

The consumption of fish in Poland in 2021 based on the data from FAOSTAT was lower in comparison to the whole European Union. For sea fish it was 9.75 kg/person/year in Poland vs. 13.97 kg/person/year in European Union. In the respect of freshwater fish it was 0.92 vs. 3.78 kg/person/year respectively [8].

In addition to providing valuable nutrients, fish is also a source of contaminants, especially heavy metals. There was observed a problem of fish contamination, especially with dioxins and dioxin-like polychlorinated biphenyls (dl-PCBs) and methylmercury [9, 10, 11, 1].

According to the study provided by the National Marine Fisheries Research Institute in cooperation with National Research Institute of Animal Production, The National Veterinary Institute - National Research Institute and Eurofins Steins Laboratory in the Baltic fishes (cod, herring and salmon) the mean content of toxic metals (mercury, lead, cadmium), are low in comparison to the maximum acceptable levels for fish. It is necessary to add that the Baltic fish are more contaminated by the mercury in comparison to the other species of fish, however its values are very low in comparison to the maximum permitted limit [12].

2. Materials and Methods

2.1. Study Population

The study was a part of the Nationwide Dietary Cross-Sectional Survey in Poland which was conducted from July 2019 to February 2020 on a representative nationwide sample of adolescents (aged 10-17 years) and adults (aged ≥ 18 years) according to the European Food Safety Authority (EFSA) guidance on the EU Menu methodology [13, 14]. It included assessment of nutrition, nutritional status and physical activity level. The study protocol was approved by the Bioethics Committee at the Institute of Food and Nutrition in Warsaw, Poland (approval dated 4 June 2018). Participation in the study was voluntary. Written informed consent to participate in the study was obtained from each respondent.

The sample selection procedure consisted of the stratification of the Polish population and the random selection of individuals. Subjects were randomly selected from the PESEL register (the national register of inhabitants in Poland) [15]. The stratified sampling method was used taking into account such demographic details as gender (male, female), age (7 age cohorts), the size of the place of residence and the territorial distribution within voivodships (16 voivodships, 9 subdivisions of localities).

Individuals that were hospitalised and/or were following an enteral and parenteral nutrition because of their health conditions, and individuals whose mental condition made impossible to obtain reliable information (neurodegenerative diseases, drunkenness, state after taking drugs and other substances stimulating) were excluded from the study.

In order to prevent unforeseen circumstances or refusal and to ensure that the planned number of people was achieved, 10 times more people were randomly selected than the planned number of respondents. If a participant refused to participate in the study, withdrew from the study or met the exclusion criteria, the next person in the group was selected. The interviewers contacted 4249 persons and the response rate was 57%. The data was collected from 2432 adolescents and adults but only adults (persons ≥ 18 years old) were included in the analysis of the fish consumption frequency. Complete data on fish consumption frequency were collected from 1489 adults (722 males, 767 females).

2.2. Data Collection

Data were collected by interviewers in the respondents' homes. The CAPI technique (Computer Assisted Personal Interview) was used. Each interviewer was previously trained but also had experience in collecting data in similar studies.

The sociodemographic data was collected using a questionnaire containing questions about, among others: sex (male or female), age (in years), educational level, economic status, place of residence (rural or urban). In case of educational level the following classification was used: primary education/lower secondary education, vocational education, upper secondary education, post-secondary education and high education. The economic status was assessed according to the 5-item scale: very good, good, moderate, bad, very bad. Participants were also asked about the self-reported health status (concerned both physical and mental health).

Based on the questionnaire used by the Statistics Poland in the European Health Interview Survey (EHIS) [16], the following question was used: "How is your health in general?" with five possible answers: "very good", "good", "neither good nor bad", "bad" or "very bad".

The physical activity level was assessed using the polish version of the International Physical Activity Questionnaire (IPAQ) [17].

The food consumption frequency data including fish consumption were collected using the Food Propensity Questionnaire (FPQ). This questionnaire was based on a food frequency questionnaire from the Polish Academy of Science [18] and on the information from the project "Pilot study in the view of a Pan-European dietary survey-adolescents, adults and elderly (PANEU)" [19]. Respondents were asked about their frequency of fish consumption during the 12 months prior to the study. They could choose the following answers: "never", "less than once a month", "1–3 times a month", "once a week", "2–3 times a week", "4–5 times a week", "once a day", or "several times a day". It was also possible to choose answer: "I don't know".

Anthropometric measurements including height and body weight were performed on the respondents. Height measurements were made using a portable stadiometer ensuring the accuracy of 0.1 cm. Body weight measurements were made using electronic scales with the accuracy of 0.1 kg. The results of height and weight measurements were used to calculate the Body Mass Index (BMI) as weight divided by height square (kg/m^2). The BMI categories were identified according to WHO criteria [20].

2.3. Statistical Analysis

The data were analyzed using the computer software PQStat 1.8.2. In the case of continuous data (age, BMI values), normality of distribution was verified using the Shapiro–Wilk test. The data distribution was not normal so the significance of difference was assessed using the Mann–Whitney U test for non-parametric data. The chi-square test was used for qualitative data. Relationships between sociodemographic factors, BMI, health status, physical activity level and fish consumption frequency were examined using Spearman's correlation. For all analyses, the significance level $\alpha = 0.05$ was assumed.

3. Results

3.1. Characteristic of Subjects

Of the 1489 subjects, 48.5% were men and 51.5% were women. The average age of subjects was 51.6 ± 19.6 (18–96) and was similar in men and women (51.6 ± 19.6 and 51.5 ± 19.7 , respectively, $p = 0.8689$). The most respondents had an upper secondary education (42.7%), followed by vocational education (31.8%). More women than men had a higher education level (16.3% vs 8.7%) and more men than women had a vocational education (37.8% vs 26.1%) ($p < 0.0001$). Most subjects described their economic status as "moderate" (52.7%) or "good" (37.6%). More respondents lived urban than rural (58% vs. 42%). In the case of health status, respondents most often chose the answer "good" (45.1%), followed by "moderate" (31.6%). The most of the respondents had a moderate physical activity level

(44.3%) but one third of the participants were characterized by a high level of physical activity. The average BMI value of subjects was 26.0 ± 4.0 (16.1-41.5). Only 41.6% of them had a normal weight. The overweight or obese was observed in 57.1% persons. The mean BMI value was lower in women than men (25.2 ± 4.3 vs. 26.7 ± 3.5 , $p<0.0001$). More women than men had a normal weight (51.9% vs. 30.7%) whereas more men than women were overweight (53.3% vs. 31.4%, $p<0.0001$) (Table 1).

Table 1. Sociodemographic characteristic, health status, physical activity level and BMI status of subjects.

Parameter	Total n=1489		Men n=722		Women n=767		M vs. W
	n	%	n	%	n	%	p*
Educational level:							
Primary education/lower secondary education	142	9.5	65	9.0	77	10.0	<0.0001
Vocational education	473	31.8	273	37.8	200	26.1	
Upper secondary education	636	42.7	305	42.2	331	43.2	
Post-secondary education	50	3.4	16	2.2	34	4.4	
Higher education	188	12.6	63	8.7	125	16.3	
Economic status:							
Very bad	8	0.5	4	0.6	4	0.5	0.2711
Bad	74	5.0	27	3.7	47	6.1	
Moderate	784	52.7	384	53.2	400	52.2	
Good	560	37.6	279	38.6	281	36.6	
Very good	63	4.2	28	3.9	35	4.6	
Place of residence:							
Rural	624	42.0	304	42.3	320	41.7	0.8270
Urban	862	58.0	415	57.7	447	58.3	
Health status:							
Very bad	6	0.4	3	0.4	3	0.4	0.6300
Bad	43	2.9	26	3.6	17	2.2	
Moderate	471	31.6	226	31.3	245	31.9	
Good	672	45.1	325	45.0	347	45.2	
Very good	297	19.9	142	19.7	155	20.2	
Physical activity level:							
Low	335	22.5	148	20.5	187	24.4	0.1857
Moderate	660	44.3	325	45.0	335	43.7	
High	494	33.2	249	34.5	245	31.9	
BMI status:							
Underweight	18	1.2	2	0.3	16	2.1	<0.0001
Normal weight	620	41.6	222	30.7	398	51.9	
Overweight	626	42.0	385	53.3	241	31.4	
Obese	225	15.1	113	15.7	112	14.6	

M vs. W – men versus women; * chi-square test.

3.2. Fish Consumption Frequency during the 12 Months Prior to the Study

The assessment of fish consumption frequency in the adult population in Poland indicated that their consumption was too rare compared to the recommendations (at least 2 times a week) (Table 2). Only 20.7% of respondents (20.6% of men, 20.7% of women) consumed them twice a week or more often. Respondents most often declared that they consumed fish less than once a month (27.7%) or once a week (27.2%). There were no significant differences in the consumption frequency of total fish between men and women.

Sea fish were most often consumed less than once a month (31.8% of subjects) or 1-3 times a month (30.9% of subjects). The most of male (33%) consumed them 1-3 times a month and the most of female (32.5%) consumed sea fish less than once a month. One quarter of respondents, including both men and women, ate sea fish once a week. Only 5.1% of respondents (4.4% of men, 5.7% of women) declared more frequent consumption of sea fish.

Freshwater fish were eaten even less frequently by both men and women. The most of subjects (44.8%) consumed them less than once a month. Many respondents (29.8%) ate freshwater fish 1-3 times a month. Only 11.9% of subjects ate these fish once a week or more often.

Table 2. Fish consumption frequency in the Polish adults.

Consumption frequency	Total		Men		Women		M vs. W
	n	%	n	%	n	%	P*
Sea fish							
I don't know	28	1.9	11	1.5	17	2.2	0.3412
Never	76	5.1	39	5.4	37	4.8	
Less than once a month	474	31.8	225	31.2	249	32.5	
1-3 times a month	460	30.9	238	33.0	222	28.9	
Once a week	375	25.2	177	24.5	198	25.8	
2-3 times a week	66	4.4	29	4.0	37	4.8	
4-5 times a week	6	0.4	3	0.4	3	0.4	
Once a day	4	0.3	0	0	4	0.5	
Several times a day	0	0	0	0	0	0	
Freshwater fish							
I don't know	33	2.2	16	2.2	17	2.2	0.2173
Never	169	11.4	80	11.1	89	11.6	
less than once a month	667	44.8	317	43.9	350	45.6	
1-3 times a month	443	29.8	235	32.5	208	27.1	
once a week	141	9.5	59	8.2	82	10.7	
2-3 times a week	27	1.8	12	1.7	15	2.0	
4-5 times a week	8	0.5	2	0.3	6	0.8	
once a day	1	0.1	1	0.1	0	0	
several times a day	0	0	0	0	0	0	
Total fish							
I don't know	22	1.5	10	1.4	12	1.6	0.2428
Never	22	1.5	14	1.9	8	1.0	
Less than once a month	413	27.7	198	27.4	215	28.0	
1-3 times a month	319	21.4	157	21.7	162	21.1	
Once a week	405	27.2	194	26.9	211	27.5	
2-3 times a week	257	17.3	131	18.1	126	16.4	
4-5 times a week	37	2.5	13	1.8	24	3.1	
Once a day	12	0.8	3	0.4	9	1.2	
Several times a day	2	0.1	2	0.3	0	0.0	

Men vs. Women – men versus women; * chi-square test.

3.3. Relationships between sociodemographic factors, BMI, health status, physical activity level and Fish Consumption Frequency

Across the entire group of respondents, a significant positive relationship was observed between the consumption frequency of total fish, sea fish and freshwater fish, and educational level, economic status, place of residence, as well as health status. A negative relationship was noted in case of the

consumption frequency of freshwater fish and BMI value and the consumption frequency of sea fish and BMI status.

In men the consumption frequency of total fish, sea fish and freshwater fish were positively related to educational level and economic status as well as negatively to BMI value. Additionally, the consumption frequency of the total fish and sea fish was positively related to health status and negatively to BMI status.

In women the positive relationship was observed between the consumption of total fish and sea fish, and the place of residence, between the consumption of total fish and freshwater fish, and economic status and between freshwater fish and educational level and health status (Table 3).

Table 3. Relationships between sociodemographic factors, BMI, health status, physical activity level and fish consumption frequency in the Polish adults.

Type of fish		Total fish			Sea fish			Freswater fish		
Parameter		Total	Men	Women	Total	Men	Women	Total	Men	Women
Sex*	rs	0.0111			0.0149			-0.0062		
	p	0.6715			0.5692			0.8126		
Age	rs	-0.0112	-0.0095	-0.0121	-0.0129	-0.0084	-0.0165	-0.0391	-0.0517	-0.0267
	p	0.6672	0.801	0.739	0.623	0.8214	0.6526	0.1358	0.1704	0.4661
Educational level	rs	0.0822	0.0968	0.0659	0.0564	0.0806	0.0322	0.0877	0.0774	0.0976
	p	0.0016	0.0097	0.0703	0.0312	0.0315	0.3778	0.0008	0.0397	0.0075
Economic status	rs	0.1709	0.2352	0.1129	0.126	0.1963	0.0646	0.1245	0.143	0.1077
	p	<0.0001	<0.0001	0.0019	0.0001	<0.0001	0.0768	<0.0001	0.0001	0.0032
Place of residence**	rs	0.0779	0.0438	0.1095	0.0657	0.035	0.0937	0.0576	0.035	0.069
	p	0.0029	0.2438	0.0026	0.0121	0.3523	0.0103	0.0281	0.3523	0.0589
Health status	rs	0.0763	0.1089	0.0453	0.0656	0.101	0.0323	0.0779	0.0655	0.0894
	p	0.0034	0.0036	0.2135	0.0121	0.007	0.376	0.0029	0.0822	0.0143
BMI value	rs	-0.0403	-0.122	0.0172	-0.0459	-0.121	0.0064	-0.0565	-0.0911	-0.0398
	p	0.1227	0.0011	0.6365	0.0796	0.0012	0.8600	0.0311	0.0154	0.2761
BMI status	rs	-0.0461	-0.1005	-0.003	-0.0549	-0.1078	-0.0133	-0.0482	-0.0624	-0.0436
	p	0.0774	0.0073	0.934	0.0358	0.004	0.7163	0.0659	0.0976	0.2331
Physical activity level	rs	0.0262	0.0655	-0.0095	0.0409	0.0583	0.0262	-0.0214	0.0179	-0.0574
	p	0.3167	0.0809	0.7941	0.1183	0.1205	0.4741	0.4155	0.6343	0.1164

*range of men: 1, range of women: 2; **range of rural: 1, range of urban: 2.; rs - Spearman's rho correlation coefficient

4. Discussion

Food-based dietary guidelines in Poland recommend eating fish at least twice a week, including oily fish at least once a week [21]. Most of the studied population did not follow this recommendation; 77.8% of subjects declared that they eat fish less than twice a week and 1.5% could not specify how often.

The frequency of fish consumption was part of a study conducted in Poland in 2021-2022 among young adults aged 19-30 years. The majority of that population indicated the consumption frequency from one to three times a month: 42% of men and 36% of women. Respectively, 17% and 15% of respondents consumed fish once a week, while 14% and 10% - less than once a month [22]. Although these percentages differed from those obtained in our study, the cited study [22] confirms the low fish consumption in the Polish population. Consumption consistent with the recommendations of at least twice a week was recorded in only 15% of men and 19% of women. In our study, this percentage was slightly higher in men and similar in women.

A study conducted in 2019 among subjects aged 50 or over also confirmed the low consumption of fish in Poland [23]. Fish were usually eaten once a week or less, the percentage of subjects

consuming fish a couple times a week was 15.26%, and daily – 1.56%. Similar study was carried out in Greece, where these percentages were higher: 23.4% consumed fish a couple times a week, and 4.17% – daily [23].

Countries with low fish consumption also include Bulgaria. According to a study conducted in 2018 the largest percentage of respondents (45.8%) consumed fish 1-2 times a month, 25% 1-2 times a week, and 5% more than twice a week [24].

In the USA between 2011 and 2016, a low percentage (14%) of adults between 20–65 years consumed seafood (fish and shellfish) more than 8 times a month [25].

In contrast, countries with a high frequency of fish consumption include Portugal. Based on the study from 2012, it was estimated that 77% of respondents ate fish at least twice a week, and 13.2% once a week [26]. The same group of researchers conducted a parallel study in Brazil. In this country, the frequency of fish consumption was lower, 12% ate it at least twice a week, and 28.7% once a week [26].

Our study reported a higher consumption of sea fish than freshwater fish. Polish Food-based dietary guidelines recommend eating oily sea fish (salmon, herring, hake, mackerel, sardine, cod) at least once a week [21]. However, the majority of respondents (67.8%) consumed sea fish less than once a week, and 1.9% could not determine the frequency of consumption of these fish.

The consumption of sea fish was also examined in a nationwide study carried out by the National Institute of Public Health NIH – National Research Institute in 2018 and 2022 among subjects aged 20 or more [27]. That kind of fish was most often eaten less than once a week: by 47.1% in 2018 and by 49.4% in 2022. Only 7.8 % in 2018 and 8.1 % in 2022 consumed sea fish at least twice a week. In our study, sea fish were also most frequently consumed once a week and were very rarely consumed more frequently, but these percentages were lower than in the cited studies from 2018 and 2022.

In our study, there was no difference in fish consumption between men and women. Similarly, in a study by Frąckiewicz et al. [22] was not a differentiating factor in the case of the fish frequency consumption. A study conducted in Spain in 2009-2013 among respondents aged 9-75 also showed no differences in the consumption of fish and seafood depending on gender [28]. The frequency of consumption of marine and freshwater fish by men and women did not differ significantly in our study. We noted that the frequency of fish consumption was also influenced by educational level and economic status. A higher educational level and economic status was associated with more frequent fish consumption. Similar relationship was noted in a study conducted in the Netherlands in 2007-2013 [29]. With the increase in education or income level, also the fish consumption significantly increased. The level of education had an impact on fish consumption also in a study conducted among 25-65-year-old residents of the Subcarpathian voivodeship in Poland [30]. Higher education respondents were much more likely to choose fish than those with lower levels of education.

Our study showed, fish consumption was influenced by the place of residence; urban dwellers consumed it more often. Such relationship was not observed in the above-mentioned study from the Subcarpathian voivodeship [30].

In our study, a higher frequency of fish consumption was associated with better health. In addition, among men, a higher frequency of fish consumption was observed among respondents with a lower BMI. Similar relationships were reported in the NHANES 2011-2016 in the USA [25]. Greater seafood intake frequency was associated with healthier body measures and blood pressure and dietary intakes.

Frequent consumption of fish is associated with many health benefits. Beneficial effects of fish consumption are observed in cardiovascular diseases. A meta-analysis by Ricci et al. [31] confirmed that two servings of fish per week could reduce the cardiovascular risk by approximately 10%. In a cohort study conducted in Japan, it was shown that higher frequency of fish intake was associated with lower neutrophil/lymphocyte ratio (NLR), a marker of systemic inflammation, that may be associated with the development of coronary artery disease events [32]. A study in China found that higher fish consumption (300-450 g/week) reduced the risk of total stroke and ischaemic stroke

compared to consuming less fish [33]. In a Dutch cohort, consumption of at least 1 portion/week of fatty or lean fish reduced the incidence of ischaemic stroke [34].

Frequent fish consumption may be of particular importance for people suffering from diseases. In an analysis of 4 cohort studies, a lower risk of cardiovascular disease and total mortality was found with higher fish consumption (at least 175 g/week) among high-risk subjects or those with vascular disease. No such relationship was observed in the general population without vascular disease [35].

However, the way it is prepared is important. Studies indicate that nonfried fish consumption may be associated with a reduced risk of overall cardiovascular disease and myocardial infarction, however fried fish consumption may increase the risk of overall cardiovascular disease and myocardial infarction [36].

High consumption of fish can reduce the risk of depression [37, 38]. The anti-inflammatory properties of long-chain omega-3 polyunsaturated fatty acid contained in fish may be important in preventing depression [39]. The PREDIMED-Plus trial showed that even moderate intake of fatty fish (around 20–30 g/day) was inversely associated with depression prevalence [40].

The effect of fish consumption on reducing the risk of depression may vary depending on gender. The longitudinal study from Australia reported that women who ate fish 2 times/week or more had a significantly lower depression than those who ate fish less frequently, while for men, depression was not associated with fish consumption [41].

Fish consumption may also be beneficial for dementia. A meta-analysis of seven prospective cohort studies found that subjects with the highest category of fish consumption had a 17% reduced risk of dementia compared to those with the lowest category of consumption [42].

Data on the impact of fish consumption on the risk of cancer are not clear. According to the WCRF/AICR, limited evidence shows that fish consumption reduces the risk of colorectal and liver cancer [43]. On the other hand, it is not beneficial to eat salted fish, which can increase the risk of nasopharyngeal cancer. According to the umbrella review of meta-analyses from 2020, in most of the analysed studies, the relationship between fish and omega-3 fatty acid intake and cancer risk was insignificant or weak [44].

The literature also reports the problem of fish contamination, especially with dioxins and dioxin-like polychlorinated biphenyls (dl-PCBs) and methylmercury [1, 9, 10, 11].

Many experts emphasize that the overall health benefits of high consumption of fish high in omega-3 fatty acids may outweigh the adverse effects of contaminants [1, 45, 46]. However, special considerations should be taken to avoid potential risks due to contaminants exposure for selected population groups, such as: children, women of childbearing age, pregnant women and breastfeeding mothers [47, 48].

The relationship between fish consumption and health benefits and possible risk requires further research. In particular, it is important to conduct in-depth analyses of the consumption of individual species.

5. Conclusions

The fish consumption frequency in Polish adults was too rare compared to the recommendations (at least 2 times a week). About 80% of respondents consumed fish less frequently than recommended.

The frequency of consumption of total fish, as well as sea fish and freshwater fish, was similar in men and women and it was depended on sociodemographic factors, such as educational level, economic status, place of residence, on the declared health status, and additionally in case of freshwater fish and sea fish on BMI value or BMI status. However, taking into account sex, the occurrence of these relationships was different in men and women.

It seems that educational activities and dissemination of proper nutrition principles is necessary in order to increase the consumption of fish in Poland. It should be important to emphasize health benefits of fish consumption in relation to possible adverse effects of their contamination.

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