ORIGINAL ARTICLE

Fish consumption and socio-economic factors among residents of Arkhangelsk city and the rural Nenets autonomous area

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ABSTRACT

Objectives. The urban Russian and the rural Indigenous populations in the Russian European North have different lifestyles, living conditions and food supplies. The objective of this study was to investigate and compare fish consumption in relation to the socio-economic characteristics of 2 communities in Arkhangelsk County.

Study design. A cross-sectional study.

Methods. In total, 166 adults (83.1% women) from Arkhangelsk city and 134 adults (80.6% women) from the village of Nelmin-Nos (of which 88.9% are Indigenous people, Nenets), in the Nenets Autonomous Area (NAO), attended a health screening. The screening included a physical examination, blood sampling and a questionnaire.

Results. The populations studied had different socio-economic characteristics. In the rural NAO group, education levels were lower, the number of full-time employees was less, the percentage of persons with low monthly income was higher and the number of children per household was higher when compared to the Arkhangelsk group. The median total fish intake was 48.8 g/day for Arkhangelsk city and 27.1 g/day for Nelmin-Nos ($p=0.009$). Locally caught whitefish constituted a major part of the total fish consumption in Nelmin-Nos, while lean marine fish species were rarely eaten. Cod and cod-family fish species were often consumed by residents of Arkhangelsk city ($p<0.001$). Fish consumption was positively related to monthly income. The frequency of fishing in the respondents from the Nelmin-Nos group predicted their fish consumption.

Conclusions. Monthly income had a significant influence on fish intake in both study populations from Northern Russia. Fishing seems to be an important factor for predicting fish consumption in the residents of the rural NAO.

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Keywords: fish consumption, socio-economic factors, Arkhangelsk County, Nenets

INTRODUCTION

Fish consumption in the Russian Federation dropped dramatically during the period of post-Soviet reforms. According to Rosstat (Russian Federal State Statistics Service), in 1994–2000 it was approximately 9–10 kg per capita per year, which was half that of Soviet times (1).

The association between fish consumption and risk of cardiovascular disease (CVD) has been extensively studied during the last 3 decades, and fish consumption has been found to reduce CVD risk factors (2–6). The main effect was attributed to long-chain ω-3 polyunsaturated fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) (7–10). The World Health Organization (WHO) recommends 1–2 servings of fish per week (11) and cardio-protective benefits have been observed with daily consumption of as little as 25 to 57 g of fish that is high in omega-3 fatty acids (8).

Russia is known as a country with a high level of CVD death. In 2008, CVD mortality in the Arkhangelsk region was 836.3 per 100,000, which is comparable to the level of CVD mortality in the Russian Federation as a whole (835.5 per 100,000). The average age of death from CVD was 66.5 for men and 77.8 for women (12). According to the 2002 Census, Ethnic Russians (n=1,258,938) make up 95% of the country's population (13).

The Nenets people are an Indigenous population group. The population is isolated, has its own language, relies on natural resources and has strong food and cultural traditions. Those who live in the Arkhangelsk region (n=7,754) are settled permanently in small, reserved communities in the Nenets Autonomous Okrug, close to the Arctic Circle (13). The traditional economy of the Nenets was based mainly on herding, breeding reindeer, fishing and hunting. During recent decades, however, the lifestyle of the Nenets people has been changing. They no longer follow a nomadic lifestyle and they now speak the Russian language. They often have poor socio-economic and living conditions as well as limited access to health services, and they live in a harsh climate. The rural Nenets Autonomous Okrug was characterized in 2008 as an area with very low life expectancy (48.2 y for men and 65.9 y for women), with a high mortality rate from accidents, alcohol poisoning, murders, suicides, drowning (432.8 per 100 000) and a high infant mortality rate (14.6%) (12).

It has been suggested that Arctic Indigenous people have a low prevalence of ischemic heart disease due to their traditional diet and lifestyle (14–16). Increasing consumption of processed food that is high in starch, fat and sugar and decreasing physical activity might lead to an increase in chronic diseases such as diabetes or cardiovascular disease among Indigenous populations (17–19).

Historically, due to their geographical location, fishing has been one of the main activities and an important way of life for residents of the Arkhangelsk region. Arkhangelsk County covers a large area (approx. 587,400 km^2) with coasts on 3 arctic seas: White, Barents and Kara. Northern fish species are a major source of essential nutrients for Arkhangelsk residents, particularly during the Arctic winter. Fish and fish product consumption, based on a survey of consumer expenditure in the Arkhangelsk region (2008), was estimated as 1.9 kg per capita per month, compared to meat and meat products at 5.5 kg per capita per month (20).

The high rate of cardiovascular mortality in Russia has been suggested to be diet related, but individual-level data on nutrition are limited

(21,22). A study on dietary intakes reported that the Russian diet has long been characterized by low fruit and vegetable consumption and high intake of saturated fat and sugar (23,24). There is a gap in the knowledge regarding fish consumption in Russia and in the selected geographical area. Poor socio-economic factors may be determinants of diets that are high in refined grains, added sugar and energy-dense foods, but also high in nutrient-poor added fats. In contrast, whole grains, lean meats, fish, low-fat dairy products, fresh vegetables and fruits are more likely to be consumed by groups of higher socio-economic status (25).

In the present study we have attempted to describe consumption of different lean and oily fish species in relation to socio-economic status in 2 populations from the Arkhangelsk region: urban residents of Arkhangelsk city, who have easy access to a variety of market fish, and indigenous Nenets people, who rely mostly on local fish species.

MATERIAL AND METHODS

Study population and design

The project was completed with the cooperation of the Norwegian Institute of Food, Fisheries and Aquaculture Research (Nofima), Tromsø, the Institute of Community Medicine, University of Tromsø and the Institute of Environmental Physiology, Ural Branch, the Russian Academy of Sciences, Arkhangelsk.

No national population registry was available for this research. In Arkhangelsk city, the participants were recruited through both verbal and written advertisements for the health screening made at randomly selected institutions (scientific institute, library, shop, cloth enterprise). In Nelmin-Nos, recruitment to the study was done primarily through advertisements for the health screening placed in various public areas (medical centre, shops, school, school canteen, kindergarten, museum, public bath). These were placed in advance by local health professionals. The screening consisted of a physical examination, blood sampling and a questionnaire. The study in Arkhangelsk city was conducted between April 2008 and April 2009. Fieldwork in the village of Nelmin-Nos was performed in February 2009.

In 2008, the total population of Arkhangelsk city was estimated to be 348,740 people (12). The Indigenous village Nelmin-Nos is located approximately 60 km from Naryan-Mar on the bank of the Pechora River, which is approximately 70 km south of the Barents Sea. A large freshwater lake, suitable for fishing, is located nearby. The village is quite isolated and can only be reached via the Pechora River using tracked vehicles in winter and by boat (an approximate 3-hour trip from Naryan-Mar) during the summer. In spring and autumn, when the ice is not solid, travel is only possible using a helicopter, which is expensive and not available to the general population. In 2008, the total population of the village of Nelmin-Nos was 806, of whom 580 were aged 18 years or older (282 women and 298 men). Nenets people constituted 94.5% of the population. In total, 166 adults aged 20–72 years old (46.3±12.7 y) from Arkhangelsk city and 134 adults aged 18–77 years old (43.3±13.4 y) from the village of Nelmin-Nos participated in the study (Fig 1).

Ethics approval

The study was approved by the Ethical Committee at the Northern State Medical University, Arkhangelsk. Written consent was obtained from each participant.

Figure 1. Study area.

In the period of the year when you eat fish, how often do you usually eat the following? (Tick one box per line only).

	never/ seldom	1 per mth.	2-3 mth.	1 wk.	2 wk.	3+ wk.
Boiled, pripjujchennaya[a] cod, haddock, saithe	☐	☐	☐	☐	☐	☐
Fried cod, haddock, saithe	☐	☐	☐	☐	☐	☐
Wolfish, flounder, redfish	☐	☐	☐	☐	☐	☐
Salmon (semga), trout	☐	☐	☐	☐	☐	☐
Mackerel	☐	☐	☐	☐	☐	☐
Herring	☐	☐	☐	☐	☐	☐
Pink salmon	☐	☐	☐	☐	☐	☐
Siberian whitefish, broad whitefish, syrok, inconnu and other similar fish	☐	☐	☐	☐	☐	☐
If you consumed another fish species, please, specify what kind of fish in the blank below and tick the frequency box.						
	☐	☐	☐	☐	☐	☐

Figure 2. Categorization of fish species in the questionnaire.

Questionnaire

The questionnaire was developed on the basis of the Norwegian Women and Cancer study (NOWAC) food frequency questionnaire (FFQ). The FFQ included a detailed fish questionnaire designed to obtain information about seasonal variations in fish consumption, frequency of consumption of different fish species and portion sizes for fried and boiled fish.

This design facilitated the use of the NOWAC questionnaire for this study, with some modifications to adapt it to Russian conditions. The questions on fish consumption had formerly been validated in the NOWAC study (26). However, the questionnaire was not validated for men or for the population groups in this study. For this present survey, a pilot study was performed in order to evaluate the questions and the time load, and some improvements were made. The final, 11-page version consisted of several sections, including personal information, social background, food frequency questionnaire and so on.

Fish species were arranged in 9 categories (Fig. 2). The whitefish species (salmon family) presented in Table I are native to the Pechora River and commonly eaten by participants from Nelmin-Nos.

Fish categories were defined according to fat content: less than 4% for lean fish (cod, haddock, saithe, wolfish, flounder and redfish) and more than 4% for oily fish (salmon, trout, mackerel, herring, pink salmon, whitefish) (27–31). Questions related to portion size were asked separately for boiled and fried cod, haddock and saithe. Responses were divided into categories: 150 grams, 225 grams, 300 grams or 450+ grams. For wolfish, flounder, redfish, whitefish and freshwater fish, portion size was calculated as an average of boiled and fried portions: (boiled+fried)/2. Because fat fish species, such as salmon, trout, mackerel, herring and pink salmon, are consumed in a wide variety of ways it would have been cumbersome to define servings separately for each preparation. We assumed the standard portion to be 150 grams for all of these fish species. Consumption in g/day was calculated collectively for all the fish categories under lean fish and oily fish, and separately for whitefish. Respondents, especially in NAO, often reported consumption of a variety of freshwater fish in the category "Other fish" (e.g., pike). Therefore, we included freshwater fish in the total fish consumption.

We used either face-to-face interviews (60.2% for Arkhangelsk, 26.5% for Nelmin-Nos) or self-administered questionnaires (39.8% for Arkhangelsk, 73.5% for Nelmin-Nos). Trained research staff conducted the interviews and provided assistance to the participants when needed. There were less face-to-face interviews vs. self-administered questionnaires in the Nelmin-Nos group compared to the Arkhangelsk city group. The differences seen in the 2 regions might be due to the difference in methods applied to collect information. To test for possible recall bias we compared fish consumption according to the questionnaire survey method. No differences were found (data not shown). Data on fish consumption were not available for 13 subjects from the Arkhangelsk city sample and for 16 subjects from Nelmin-Nos.

Table I. Latin, English and Russian names for whitefish.

Latin	English	Russian
Coregonus lavaretus	Siberian whitefish	Sig
Coregonus peled	Syrok	Pelyad
Coregonus nasus	Broad whitefish	Chir
Stenodus leucichthys nelma	Inconnu	Nelma

Socio-economic variables

We obtained information about the participants' levels of education, working status, marital status and the number of children in their households. The following question on monthly income was asked: "What is your household's overall monthly income per person on average from all sources, including wages, pensions, cash benefits, stipends and other income? (1) Less than 1,500 rubles (2) 1500, 1–2,500 rubles (3) 2,500, 1–3,500 rubles (4) 3,500, 1–4,500 rubles (5) 4,500, 1–6,000 rubles (6) 6,000, 1–8,000 rubles (7) 8,000, 1–12,000 rubles (8) more than 12,000 rubles."

We assessed fish availability with 2 additional questions:

"How often do you or members of your family go fishing? (1) Weekly (2) Once a month (3) 1–11 times a year (4) Never." "Has fish availability changed since 1991, in your own estimate? (1) Less available (2) More available (3) Not changed."

Statistics

Statistical analysis was performed using SPSS 15.0 for Windows. Categorical variables were presented as a percentage of the total. Continuous variables were presented as median and minimum-maximum range when distribution deviated from normality and as mean±SD when distribution was normal. The Mann-Whitney U-test and the chi-square test for independence were used. All participants were divided into 3 subgroups (tertiles) according to their total fish consumption. Analyses were done separately for men and women. Mean±SD (median) intake of the fish consumption categories, distributed in tertiles of total fish consumption, was calculated similarly to the method used in the NOWAC study (32). The fish consumption categories were transformed into log10. We created dummy variables: male gender (1) vs. female (0); income per capita >12,000 rubles (1) vs. ≤12,000 rubles (0); fishing frequency ≥1/month (1) vs. <1/month (0); non–full-time employee (1) vs. full-time employee (0); education less than higher and postgraduate (1) vs. higher and postgraduate (0); marital status single, divorced, widowed (1) vs. married, cohabitee (0); children in household, yes (1) vs. children in household, no (0). Hierarchical multiple linear regression was used to assess the ability of dummy variables to predict the level of fish consumption after controlling for the influence of gender, age and body mass index. Results of the regression analysis were presented as β-coefficients and 95% confidence intervals. The best predicting models with forward stepwise linear regression analyses were performed subsequently. A p-value of ≤0.05 was defined as significant.

RESULTS

Some characteristics of the study participants

Characteristics of the study sample are given in Table II.

The study population comprised 300 subjects between 18 and 77 years of age (54 males and 246 females). The proportion of females in the Arkhangelsk group was not significantly different from the proportion of females in the NAO group. The median age of males from Arkhangelsk city (39.5 [20–72] years) was comparable to that of males from Nelmin-Nos (36.5 [18–61] years). The median age for females from Arkhangelsk city was slightly higher (50.5 [21–72] years) than for females from Nelmin-Nos (46.0 [19–77] years), although the difference was not statistically significant. Arctic Indigenous people (Nenets) from rural NAO represented 88.9% of the study group. The Arkhangelsk city population consisted mainly of ethnic Russians.

The 2 populations studied had different socio-economic characteristics. The participants' education level was lower in Nelmin-Nos. Only 8.5% of the study participants from Nelmin-Nos had completed higher education, compared to 45.1% of the study participants from Arkhangelsk (p<0.001). The percentage of full-time employees was 72.9% in Arkhangelsk vs. 58.0% in Nelmin-Nos (p=0.01).There were 11% more married participants and 12.5% less single participants in the Arkhangelsk group (p=0.004). The number of children per household was higher (p<0.001) in the rural NAO group. There were 63.2% respondents without children in the household in Arkhangelsk vs. 36.5% in Nelmin-Nos. The proportion of the participants with low (less than 6,000 rubles), average (6,000, 1–12,000 rubles) and high (more than 12,000 rubles) household incomes per capita were 25.8% vs. 35%; 41.4% vs. 26% and 32.8% vs. 39% respectively in the Arkhangelsk group compared to the NAO group (p=0.049).

Fishing frequency and fish availability

Respondents in Nelmin-Nos went fishing more often than respondents in Arkhangelsk (p<0.001): weekly, 34.5% vs. 6.4%; 1–3 times a month, 24.5% vs. 7.7%; 1–11 times a year, 18.2% vs. 34.6%; never, 22.8% vs. 51.3%.

It is important to note that, among participants ≥35 years old, there were half as many from

Table II. Baseline characteristics (frequency/percent) of the study sample (n=300).

Residents	Arkhangelsk			Rural NAO		
Gender	Men	Women	Both genders	Men	Women	Both genders
Total number of participants	28/16.9	138/83.1	166/100.0	26/19.4	108/80.6	134/100.0
Age (y)						
18–34	10/35.7	29/21.0	39/23.5	12/46.2	30/27.8	42/31.3
35–49	11/39.3	34/24.7	45/27.1	7/26.9	36/33.3	43/32.1
≥50	7/25.0	75/54.3	82/49.4	7/26.9	42/38.9	49/36.6
BMI (kg/m2)[a]						
≤24.9	8/29.6	47/37.6	55/38.7	13/59.1	31/34.0	44/38.9
25–29.9	14/51.9	33/26.4	37/26.1	8/36.4	20/22.0	28/24.8
≥30	5/18.5	45/36.0	50/35.2	1/4.5	40/44.0	41/36.3
Education[a]						
Incomplete secondary	2/7.4	6/4.8	8/5.2	11/44.0	16/15.2	27/20.8
Complete secondary[b]	10/37.0	66/52.4	76/49.7	13/52.0	79/75.2	92/70.8
Complete higher, postgrad	15/55.6	54/42.9	69/45.1	1/4.0	10/9.5	11/8.5
Full-time employee[a]						
Yes	18/66.7	95/74.2	113/72.9	13/52.0	63/59.4	76/58.0
No	9/33.3	33/25.8	42/27.1	12/48.0	43/40.6	55/42.0
Monthly income per person[a]						
<6,000 rubles	2/8.7	31/29.5	33/25.8	7/38.9	28/34.2	35/35.0
6,000, 1–12,000 rubles	9/39.1	44/41.9	53/41.4	4/22.2	22/26.8	26/26.0
>12,000 rubles	12/52.2	30/28.6	42/32.8	7/38.9	32/39.0	39/39.0
Marital status[a]						
Married	16/59.3	75/59.0	91/59.1	15/57.7	48/45.8	63/48.1
Cohabitee	3/11.1	8/6.3	11/7.1	1/3.8	11/10.5	12/9.2
Divorced/separated	3/11.1	17/13.4	20/13.0	0/0.0	6/5.7	6/4.5
Single, never married	5/18.5	11/8.7	16/10.4	10/38.5	20/19.0	30/22.9
Widowed	0/0.0	16/12.6	16/10.4	0/0.0	20/19.0	20/15.3
Children in household[a]						
0	18/66.7	78/62.4	96/63.2	8/33.3	34/37.4	42/36.5
1–2	9/33.3	43/34.4	52/34.2	11/45.8	45/49.4	56/48.7
3–4	0/0.0	4/3.2	4/2.6	4/16.7	10/11.0	14/12.2
5–6	0/0.0	0/0.0	4/0.0	1/4.2	2/2.2	3/2.6

[a]n<300 due to missing values.
[b]Includes secondary, professional secondary and incomplete higher education.

Table III. Mean±SD (median) of overall intake of different fish categories and mean±SD (median) intake of different fish categories, distributed in tertiles of total fish consumption, in relation to gender in Arkhangelsk residents.

Gender	**Men** Overall value	Tertile1	Tertile2	Tertile3	**Women** Overall value	Tertile1	Tertile2	Tertile3	**Both genders** Overall value
Number of participants	27	8	10	9	126	39	45	42	153
Total fish (g/d)	93.2±89.1(73.8)	25.6±14.7(25.4)	69.6±10.9(73.0)	179.6±108.8(147.2)	54.6±50.0(39.0)	11.8±8.5(12.5)	41.2±12.7(39.0)	108.7±49.3(92.7)	61.4±60.2(48.8)
Lean fish (g/d)	51.6±53.5(42.8)	8.5±5.7(8.7)	39.0±11.9(38.2)	103.8±63.2(78.0)	31.1±36.2(19.5)	5.9±7.1(5.0)	21.9±15.4(18.7)	64.3±43.4(58.5)	34.7±40.4(22.3)
Oily fish (g/d)a	41.6±38.7(39.0)	17.1±16.0(14.4)	30.6±13.3(27.1)	75.8±48.7(58.5)	22.1±22.8(17.4)	5.9±7.1(5.0)	17.0±11.2(17.4)	42.6±26.4(37.1)	25.6±27.2(19.5)
Whitefish (g/d)	5.7±15.7(0.0)	1.8±2.9(0.0)	5.1±9.2(0.0)	9.8±25.8(0.0)	1.3±4.6 (0.0)	0.1±0.6(0.0)	0.5±2.2(0.0)	3.4±7.3(0.0)	2.1±7.0(0.0)

[a] Includes whitefish.

Table IV. Mean±SD (median) of overall intake of different fish categories and mean±SD (median) intake of different fish categories, distributed in tertiles of total fish consumption, in relation to gender in Nelmin-Nos residents.

Gender	**Men** Overall value	Tertile1	Tertile2	Tertile3	**Women** Overall value	Tertile1	Tertile2	Tertile3	**Both genders** Overall value
Number of participants	24	8	8	8	94	33	30	31	118
Total fish (g/d)	86.2±87.2(51.3)	15.8±10.7(14.0)	55.8±20.2(51.2)	186.9±78.3(168.0)	38.0±36.9(24.9)	10.7±7.8(12.5)	27.6±5.6(24.9)	77.1±40.2(65.5)	47.8±54.4(27.1)
Lean fish (g/d)	16.6±64.1(0.0)	1.5±4.4(0.0)	0.8±2.2(0.0)	47.6±108.8(0.0)	0.7±3.0 (0.0)	0.1±0.8(0.0)	0.6±3.4(0.0)	1.3±3.9(0.0)	3.9±29.3(0.0)
Oily fish (g/d)a	24.9±36.9(24.9)	9.1±5.8(10.5)	39.9±16.7(42.2)	99.8±55.8(86.5)	28.4±26.5(19.5)	8.8±7.0(7.8)	19.0±7.8(18.7)	58.3±25.3(51.4)	32.7±33.6(19.5)
Whitefish (g/d)	44.7±47.3(32.7)	7.4±5.4(5.6)	36.5±16.6(38.2)	90.2±55.5(84.0)	21.9±24.3(15.3)	7.0±6.6(5.0)	15.4±8.0(15.6)	44.0±30.6(39.0)	26.5±31.6(15.6)

[a]Includes whitefish.

Nelmin-Nos (69.9%) as from the Arkhangelsk group (30.4%) who reported that fish had become less available since the start of political reforms in 1991. There were 58.3% residents of Arkhangelsk city vs. 6.8 % residents of Nelmin-Nos who reported better availability of fish, and 11.3% vs. 23.3%, who reported the same availability of fish ($p<0.001$).

Fish consumption

Fish consumption, expressed as daily intake (g/d), did not show a normal distribution; the distribution was skewed. The median total intake of fish was 48.8 g/day for Arkhangelsk city and 27.1 g/day for Nelmin-Nos ($p=0.009$). As well, clear differences in consumption of various fish species were observed. Consumption of marine lean fish was very low in the participants from Nelmin-Nos (median intake 22.3 g/d in Arkhangelsk vs. 0 g/d; $p<0.001$). Respondents from Nelmin-Nos only consumed small amounts of navaga (*Eleginus nawaga*), cod and flounder. Similarly, the consumption of whitefish species was low in the participants from Arkhangelsk city (median intake 15.6 g/d in Nelmin-Nos vs. 0 g/d; $p<0.001$).

In terms of total fish consumption, both men and women in Arkhangelsk had higher consumption of fish compared to respondents in NAO, though this only

attained statistical significance (p=0.008) among women. Median intake was 73.8 g/d for urban Russian men vs. 51.3 g/d for rural NAO men; median intake for urban Russian women was 39.0 g/d vs. 24.9 g/d for rural NAO women.

Data on consumption of various fish categories, distributed in tertiles of the total fish consumption, are presented for each of the study populations in relation to gender in Table III and Table IV.

Table V. Hierarchical multiple linear regression analysis with total and oily fish consumption (log10-transformed in g/d) as a dependent variable in Arkhangelsk residents.

Dependent variable	Total fish consumption		Oily fish consumption	
	β	95% CI	β	95% CI
Step 1				
Gender[a]	0.19	-0.09–0.47	0.26	0.00–0.50
Age	-0.01	-0.01–0.01	0.05	-0.01–0.01
BMI	0.14	-0.01–0.03	0.04	-0.02–0.02
R^2	0.05	0.07		
Step 2				
Gender	0.14	-0.15–0.44	0.23	-0.04–0.48
Age	-0.02	-0.01–0.01	0.10	-0.01–0.01
BMI	0.16	-0.01–0.03	0.06	-0.02–0.02
Monthly income[b]	0.21	-0.06–0.41	0.26	0.01–0.40
Frequency of fishing[c]	0.02	-0.29–0.33	-0.08	-0.35–0.20
Working status[d]	0.06	-0.19–0.29	-0.06	-0.26–0.17
Level of education[e]	0.05	-0.18–0.26	-0.01	-0.20–0.18
Marital status[f]	-0.03	-0.25–0.21	0.02	-0.19–0.22
Number of children in household[g]	0.00	-0.24–0.23	0.04	-0.18–0.24
R^2 changed	0.05	0.08		

*p<0.05, **p<0.01, ***p<0.001

[a]male vs. female; [b]>12,000 rubles vs. otherwise; [c]≥ 1/month vs. otherwise; [d]full-time employee, no vs. yes; [e]less than higher vs. otherwise; [f]single, divorced, widowed vs. married, cohabitee; [g]children in household, yes vs. no

Table VI. Hierarchical multiple linear regression analysis with total and whitefish consumption (log10-transformed in g/d) as a dependent variable in Nelmin-Nos residents.

Dependent variable	Total fish consumption		Oily fish consumption	
	β	95% CI	β	95% CI
Step 1				
Gender[a]	0.26*	0.05–0.48	0.24*	0.02–0.49
Age	-0.03	-0.01–0.01	0.01	-0.01–0.01
BMI	-0.04	-0.02–0.01	0.08	-0.01–0.02
R2	0.08	0.05		
Step 2				
Gender	0.18	-0.02–0.38	0.15	-0.06–0.37
Age	-0.13	-0.01–0.00	-0.07	-0.01–0.01
BMI	-0.10	-0.02–0.01	0.01	-0.01–0.01
Monthly income[b]	0.19	-0.01–0.33	0.36**	0.13–0.49
Frequency of fishing[c]	0.31**	0.09–0.41	0.34**	0.13–0.47
Working status[d]	0.19	0.00–0.31	0.13	-0.06–0.28
Level of education[e]	-0.10	-0.43–0.15	0.02	-0.28–0.33
Marital status[f]	-0.03	-0.20–0.14	0.03	-0.16–0.21
Number of children in household[g]	-0.19	-0.35–0.03	-0.15	-0.33–0.07
R^2 changed	0.22***	0.26***		

*p<0.05, **p<0.01, ***p<0.001

[a]male vs. female; [b]>12,000 rubles vs. otherwise; [c]≥1/month vs. otherwise; [d]full-time employee, no vs. yes; [e]less than higher vs. otherwise; [f]single, divorced, widowed vs. married, cohabitee; [g]children in household, yes vs. no

Linear regression

Hierarchical multiple linear regression analysis

Socio-economic variables did not significantly predict total fish consumption and oily fish consumption among the residents of Arkhangelsk city. Male gender and monthly income tended to be positively associated with oily fish consumption, but p-values did not reach the required significance level. The model is presented in Table V.

The frequency of fishing was positively associated ($p<0.01$) with total fish consumption in the respondents from the village of Nelmin-Nos. Monthly income and frequency of fishing were positively associated with locally caught whitefish consumption ($p<0.01$). The models are presented in Table VI.

Forward stepwise multiple linear regression analyses

A monthly income was the only independent predictor and was positively associated with oily fish consumption in the urban residents ($p<0.05$). A high frequency of fishing ($p<0.01$), male gender ($p<0.05$) and high monthly income ($p<0.05$) predicted higher total fish consumption in Nelmin-Nos. Higher locally caught whitefish consumption was predicted by a high frequency of fishing ($p<0.001$) and high monthly income ($p<0.001$) (Table VII).

DISCUSSION

To our knowledge this is the first study addressing the intake of different fish species among residents of the Arkhangelsk region. One strength of the survey was that detailed data on socio-economic status were obtained and analysed together with data on fish consumption. The material is unique because the Nenets population is not readily accessible for research due to its remote geographical location. The socio-economic conditions were previously studied in the village of Nelmin-Nos in 1994 and monitored in 2007. In 1994, more than half of the respondents reported that they had to spend their entire income on food vs. 32% in 2007. As well, 25% of residents in 1994 had difficulties in buying a sufficient amount of food, compared to 13% in 2007 (33). Currently, the availability of food has improved slightly. Our data showed that socio-economic conditions are still of importance. Furthermore, socio-economic factors are the determinants of fish consumption. According to official statistical data, the subsistence minimum level for the last 3 months of 2008 was defined as a monthly income per capita of 5,661 (30 Russian rubles=1 U.S.$) for the Arkhangelsk region outside of NAO and 8,659 rubles for the Arkhangelsk region within NAO (20). The difference in subsistence minimum levels between the 2 regions resulted

Table VII. Forward stepwise multiple linear regression analyses with oily fish consumption (log10-transformed in g/d) as a dependent variable in Arkhangelsk residents, with total and whitefish consumption (log10-transformed in g/d) as a dependent variable in Nelmin-Nos residents.

Dependent variable	Oily fish consumption [a]		Total fish consumption [b]		Whitefish consumption [b]	
	β	95% CI	β	95% CI	β	95% CI
Frequency of fishing	-	-	0.33**	0.12–0.43	0.38***	0.17–0.49
Gender	-	-	0.22*	0.03–0.42	-	-
Monthly income	0.29*	0.029–0.41	0.21*	0.02–0.33	0.37***	0.16–0.48
Adjusted R^2	0.07*		0.19***		0.23***	

*p<0.05, **p<0.01, ***p<0.001

[a.] in Arkhangelsk residents b. in Nelmin-Nos residents.

from higher living expenses in NAO. The average salary in the Arkhangelsk region including NAO doubled in 2008 (41,181,1 rubles) when compared to Arkhangelsk region without NAO (18,181,3 rubles) (20). The percentage of participants with reported income less than or equal to 8,000 rubles was 49.5% in Nelmin-Nos while only 26% of participants from Arkhangelsk city reported income less than or equal to 6,000 rubles. Therefore, participants from Nelmin-Nos appeared to have, on average, an inferior economy compared to their urban counterparts. According to the data of Rosstat, 30.4% of inhabitants of Arkhangelsk region had an income of less than 6,000 rubles per person, 37.9% had an income between 6,000, 1 and 12,000 rubles and 31.7% had an income above 12,000 rubles in 2007. Thus, our urban sample was representative for the entire population of the region with respect to monthly income.

We have also attempted to obtain results comparable to those of the NOWAC study. The NOWAC study is a large, national, prospective cohort study, with thousands of women ages 30–70 having enrolled since 1991. Fish consumption and health, particularly cancer, was one of the main topics in the NOWAC study (34). Ready-made fish products generally consumed in Norway (fish balls, fish cakes, fish puddings) are non-existent in the Russian Federation. Therefore, we did not specify fish products as a category and the levels of total fish consumption were not precisely comparable. In the NOWAC study it was concluded that dietary habits differed with age. The oldest women reported a higher consumption of fish, fish products and shellfish. The median for the youngest age group (45–49 years) was 70 g/day and for the oldest group (65–69 years) 81 g/day. Practising a healthy lifestyle and having a higher socio-economic status were associated with reporting a healthier diet (35). In our study, we did not find any associations between age and fish consumption. However, we did find a relation between higher income and higher fish consumption. In the examination of fish consumption and colon cancer in the NOWAC study, which comprised 63,914 women, the mean lean fish and fat fish consumption (distributed in tertiles based on total fish consumption, including fish products) were 12.9–29.2–59.8 g/day and 8.1-16.1-30.5 g/day (32). In our study, the mean lean fish and fat fish consumption in urban women was not very different from the results obtained by NOWAC (5.9–21.9–64.3 g/day and 5.9–17.0–42.6 g/day, respectively, for lean and fat fish consumption).

The method used to access fish consumption was the food frequency questionnaire. The questionnaire's design facilitated its use for the different population groups in this comparison. However, the method also has certain limitations. For example, the respondents answered 9 cross-check questions. It has been observed that intake values are often overestimated when the number of cross-check questions increases and are underestimated when several items are summarized in one question (36,37). It is likely that fish intake was overestimated for the Arkhangelsk group because all fish items were available on the market. It is also likely that intake was underestimated for the Nenets group, simply because they reported predominantly one category – whitefish. However, whitefish consumption was strongly predicted by the frequency of fishing in NAO, and Nenets participants reported a declining availability of the fish they traditionally caught. Therefore, the difference in fish consumption between the groups was most probably due to the limited access of the Nelmin-Nos population to market food, particularly fish, a situation aggravated by

a reduction in the local whitefish population and increased fishing difficulties.

The Nenets people have traditionally relied on proteins and fats as their main sources for nutrition – mostly caribou meats and fish (28). However, current levels of fish consumption among residents of this village are inadequate. We observed lower fish intake than expected. Average fish consumption was equal to approximately 1.25 portions of 150g per week. Residents of Arkhangelsk city consumed approximately 2.25 portions of 150g per week on average. Changes in the nutrition of the Indigenous population may lead to an increase in obesity and, later, to chronic diseases (38–40).

The weaknesses of our study were related to the relatively small sample size. We had difficulties in obtaining a representative sample due to the lack of a population registry available for the survey. However, participants with different socio-economic characteristics were presented in the sample. The Nelmin-Nos group covered quite a high percentage of the total adult population (23.1%). Both samples were more representative of the female population. We provided feedback (results of the laboratory analyses) to all respondents. It is possible that participants with pre-existing health problems were more interested to participate in the study in order to gain more information on their health status.

The present study has contributed important knowledge on possible risk-factor patterns with likely public health relevance for the Arkhangelsk region. Taking into account the quite small sample size, the result may suggest, but not confirm, an unsatisfactory fish eating pattern among people in Northern Russia. Large-scale national research projects and health programs with a focus on fish consumption and health are necessary, though they will be challenging to implement.

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Conflict of interest statement

None of the authors had a conflict of interest in relation to this study.

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