DOI: https://doi.org/10.17816/humeco633042 EDN: SODBSJ

Quantitative Assessment of Traditional and Imported Meat Consumption by Indigenous and Local Caucasian Populations of the Modern Arctic

Fatima A. Bichkaeva, Ekaterina V. Nesterova, Olga S. Vlasova, Boris A. Shengof, Alexandra V. Strelkova, Nina F. Baranova, Tatyana B. Gretskaya

N. Laverov Federal Center for Integrated Arctic Research of the Ural Branch of the Russian Academy of Sciences, Arkhangelsk, Russia

ABSTRACT

BACKGROUND: A healthy, balanced diet is essential for preserving metabolic health in high-latitude environments. Indigenous peoples' traditional lifestyles have shifted from nomadic to settled due to socioeconomic changes caused by industrial growth and urbanization in northern regions. This transition has affected dietary patterns and, consequently, metabolic health.

AIM: To conduct a comparative quantitative assessment of traditional and imported meat product consumption by indigenous and local Caucasian populations of the modern Arctic.

METHODS: During field expeditions to the Yamalo-Nenets and Nenets Autonomous Okrugs, 839 people's dietary habits were assessed using a questionnaire-based survey. Retrospective data were collected on the consumption of traditional and imported meat products over the preceding 12 months among both indigenous (nomadic and settled) and local Caucasian Arctic residents.

RESULTS: Indigenous populations consumed more traditional meat products, whereas local Caucasian populations consumed more imported meat, both lean and fatty. Among indigenous populations, nomadic people consumed significantly more traditional meat, whereas settled people consumed more fatty imported meat. There were no significant differences in processed meat consumption between the three groups.

CONCLUSION: The abundance of imported meat products in the diet, previously uncharacteristic of the Russian Arctic's indigenous peoples, has not completely replaced traditional cuisine. Among indigenous populations, nomadic people consume meat in ways that are more similar to traditional diets than their settled counterparts. However, retrospective data indicate a decline in the consumption of reindeer meat, a dietary staple among the Nenets. Therefore, to ensure a high quality of life and good health, indigenous populations of northern regions should stick to their centuries-old traditional dietary patterns, maintaining a high proportion of locally sourced foods.

Keywords: traditional diet; meat products; indigenous populations; Nenets; local Caucasian populations; Arctic.

To cite this article:
Bichkaeva FA, Nesterova EV, Vlasova OS, Shengof BA, Strelkova AV, Baranova NF, Gretskaya TB. Quantitative assessment of traditional and imported meat consumption by indigenous and local Caucasian populations of the modern Arctic. *Ekologiya cheloveka (Human Ecology).* 2025;32(2):100–109.
DOI: 10.17816/humeco633042 EDN: SODBSJ

Received: 31.05.2024 **Accepted:** 21.05.2025 **Published online:** 18.06.2025

DOI: https://doi.org/10.17816/humeco633042 EDN: SODBSJ

Оценка количественного потребления традиционной и привозной мясной продукции среди аборигенного и европеоидного населения Арктики на современном этапе

Ф.А. Бичкаева, Е.В. Нестерова, О.С. Власова, Б.А. Шенгоф, А.В. Стрелкова, Н.Ф. Баранова, Т.Б. Грецкая

Федеральный исследовательский центр комплексного изучения Арктики им. акад. Н.П. Лаверова Уральского отделения Российской академии наук, Архангельск, Россия

АННОТАЦИЯ

Обоснование. Важную роль в поддержании метаболического здоровья человека в условиях высоких широт имеет наличие полноценного и сбалансированного питания. Социально-экономические изменения, связанные с промышленным освоением и урбанизацией северных территорий, обусловили модификацию исторически сложившегося уклада жизни коренного населения при смене с традиционного кочевого образа жизни на оседлый в посёлках, что отразилось на рационе питания, и, как следствие, на метаболическом здоровье.

Цель. Сравнительный анализ количественного потребления традиционной и привозной мясной продукции среди аборигенного и местного европеоидного населения Арктики на современном этапе.

Материалы и методы. Во время экспедиционных выездов на территории Ямало-Ненецкого и Ненецкого автономных округов был изучен характер питания анкетно-опросным методом у 839 человек. Собрана ретроспективная информация о потреблении традиционной и привозной мясной продукции за предшествующий 12-месячный период у аборигенного (кочующего и оседлого) и местного европеоидного населения Арктики.

Результаты. Потребление традиционной мясной продукции выше среди аборигенов, а привозного мяса, как диетического, так и жирного, у местного европеоидного населения. При этом потребление традиционной мясной продукции значимо выше у кочующих аборигенов, по сравнению с оседлыми, а привозной жирной мясной продукции, наоборот, у оседлых. Потребление переработанного мяса мало различалось в трёх группах.

Заключение. Обилие привозной мясной продукции в рационе, ранее не характерной для коренных народов арктической зоны Российской Федерации, не до конца вытеснило традиционные блюда. При этом у аборигенного населения, ведущего кочевой образ жизни, потребление мясных продуктов ближе к традиционному типу питания в сравнении с оседлыми аборигенами. Но при этом потребление оленины — основы рациона ненцев — в ретроспективе снижается. Следовательно, для подержания достойного уровня жизни и здоровья коренных жителей северных территорий им необходимо придерживаться традиционной выработанной веками модели питания с сохранением доли продуктов, произведённых в регионе проживания.

Ключевые слова: традиционная диета; мясная продукция; аборигены; ненцы; местное европеоидное население; Арктика.

Как цитировать:
Бичкаева Ф.А., Нестерова Е.В., Власова О.С., Шенгоф Б.А., Стрелкова А.В., Баранова Н.Ф., Грецкая Т.Б. Оценка количественного потребления традиционной и привозной мясной продукции среди аборигенного и европеоидного населения Арктики на современном этапе // Экология человека. 2025. Т. 32, № 2. С. 100–109. DOI: 10.17816/humeco633042 EDN: SODBSJ

Рукопись поступила: 31.05.2024 **Рукопись одобрена:** 21.05.2025 **Опубликована online:** 18.06.2025

DOI: https://doi.org/10.17816/humeco633042 EDN: SODBSJ

当前阶段北极地区原住民与欧洲裔居民传统与外来肉类产品摄入量的定量评估

Fatima A. Bichkaeva, Ekaterina V. Nesterova, Olga S. Vlasova, Boris A. Shengof, Alexandra V. Strelkova, Nina F. Baranova, Tatyana B. Gretskaya

N. Laverov Federal Center for Integrated Arctic Research of the Ural Branch of the Russian Academy of Sciences, Arkhangelsk, Russia

摘要

论证。在高纬度地区，营养全面且均衡的膳食对于维持人体代谢健康具有重要作用。随着北方地区工业开发与城市化带来的社会经济变迁，原住民逐渐由传统的游牧生活方式转变为定居于聚居地的生活方式，这一变化影响了膳食结构，进而对代谢健康产生影响。

目的。比较分析当前阶段北极地区原住民与当地欧洲裔居民对传统与外来肉类产品的定量摄入情况。

材料与方法。在Yamalo-Nenets自治区和Nenets自治区开展实地考察，通过问卷调查法评估839名居民的膳食情况。收集了北极地区原住民（包括游牧与定居群体）及当地欧洲裔居民在过去12个月内对传统与外来肉类产品的摄入情况的回顾性数据。

结果。原住民的传统肉类摄入量高于当地欧洲裔居民，而后者则摄入更多的外来肉类产品，包括瘦肉和肥肉。游牧原住民摄入的传统肉类显著高于定居原住民，而后者摄入的外来肥肉类产品相对较多。三组人群在加工肉制品的摄入量方面差异不大。

结论。外来肉类产品在膳食结构中的增多尚未完全取代俄罗斯联邦北极地区原住民的传统食物。与定居原住民相比，仍维持游牧生活方式的原住民，其肉类摄入模式更接近传统饮食类型。但与此同时，作为涅涅茨人饮食基础的驯鹿肉，其摄入量在回顾性分析中呈下降趋势。因此，为保障北方原住民的生活质量与健康，应倡导保留并延续世代形成的传统膳食模式，并维持本地生产食品在膳食中的比例。

关键词：传统饮食；肉类产品；原住民；涅涅茨人；当地欧洲裔居民；北极。

引用本文：
Bichkaeva FA, Nesterova EV, Vlasova OS, Shengof BA, Strelkova AV, Baranova NF, Gretskaya TB. 当前阶段北极地区原住民与欧洲裔居民传统与外来肉类产品摄入量的定量评估. *Ekologiya cheloveka (Human Ecology).* 2025;32(2):100–109. DOI: 10.17816/humeco633042 EDN: SODBSJ

收到: 31.05.2024 **接受:** 21.05.2025 **发布日期:** 18.06.2025

BACKGROUND

A wholesome, balanced diet is essential for preserving health. Nutrition is the foundation of human health. A person needs food to build the cellular structures of organs, which is a source of energy used by the body. Historically, the traditional diet of the Arctic indigenous people has differed from the food culture of the population in moderate and middle latitudes and has developed to improve the body's adaptation to extreme living conditions [1–4]. Historically, the key traditional activity of the Nenets was large-scale nomadic reindeer herding; fishing was also widespread, i.e. the staples of their unique diet included reindeer meat, fish, and game (bears, elks, upland game birds, and waterfowl). In addition, the Nenets consumed fresh or boiled reindeer blood. Indeed, for a long time, blood consumption has been actually the only way for the peoples of the North to receive the essential micronutrients [5, 6]. The meat was eaten raw immediately after the animal was slaughtered or dried and frozen. However, in most cases, the peoples of the North consumed heated animal meat as they usually boiled it in a cauldron. The broth was drunk from teacups, chasing it with pieces of boiled meat rather than bread [7]. The indigenous population considered deer heart, liver, fat, bone marrow, and brain as delicacies. In addition, nutritional qualities of these foods (high content of vitamins, proteins, and polyunsaturated fatty acids) were suitable for wholesome nutrition in the extreme natural conditions of the North; their regular consumption contributed to preserving health [8, 9].

Indigenous peoples' traditional lifestyles have shifted from nomadic to the settled one due to socioeconomic changes in Russia caused by industrial growth and urbanization in northern regions. Subsequently, many of them shifted from a nomadic lifestyle in the tundra to a settled lifestyle in villages [10]. Their diet has westernized: consumption of traditional products available through reindeer herding, hunting, and fishing decreased; on contrary, dependence on purchased products rich in saturated fats and refined carbohydrates, previously not typical for the indigenous population, increased [6, 11]. In addition, the indigenous population cooking methods have changed: they started frying meat in a frying pan, cooking soups that were previously uncommon for them (e.g. borscht, cabbage soup), using semi-finished products and pastry (pies, sweet buns). The traditional diet of indigenous peoples was rich in animal proteins and fats; whereas today, plant carbohydrates and proteins are becoming more common in the diet of the indigenous population of the North [3, 6, 12].

AIM: To conduct a comparative quantitative assessment of traditional and imported meat product consumption by indigenous and local Caucasian populations of the contemporary Arctic.

MATERIALS AND METHODS

We conducted a cross-sectional single-center observational study to investigate the consumption of traditional and imported meat products by the nomadic and settled indigenous population in the Arctic region and the local Caucasian population.

The areas were selected for the study based on the importance of the lands included in the list of the Arctic zone land territories of the Russian Federation (Executive Order of the President of Russia dated May 02, 2014), including the Nenets and Yamalo-Nenets Autonomous Okrugs, and Mezen Municipal District of the Arkhangelsk Region.

This study used materials from 2009–2017 expeditions. We examined a total of 839 people living in villages and the tundra of the Yamalo-Nenets Autonomous Okrug (YNAO: Krasnoselkup village, Syo-Yakha village, Tolka village, Antipayuta village, Nori village, Nyda village, Gyda village, Tazovsky settlement), the Nenets Autonomous Okrug (NAO: Nelmin-Nos village, Nes village), and the Mezensky District of the Arkhangelsk Region (Dolgoshchelye village, Sovpolye village, Soyana village). 126 nomadic participants (NP), 422 settled participants (SP), who moved from the tundra to the settlement and live together with the local Caucasian population, and 291 participants of the local Caucasian population (LCP) of the settlement were interviewed. The study involved participants aged 22 to 60 years with the mean age of 44 [35; 52] years. By ethnic groups, indigenous population is mainly represented by Nenets and the Caucasian population is mainly represented by Russians [13].

The study complies with the biomedical ethics principles and standards (the 2010 Helsinki Declaration of the World Medical Association, as amended in 2013). The examination procedure was as follows: during expeditions to villages (in the winter and spring), respondents were invited to medical stations. After an explanation of the idea behind the examination, they signed a voluntary consent approved by the Biomedical Ethics Committee at the Natural Adaptations Physiology Institute of the Federal State Budgetary Research Institution Scientific Research Center of the Ural Branch of the Russian Academy of Sciences and filled a questionnaire.

The frequency method of nutritional research is based on recording the frequency of meat consumption. The study identified four groups of meat consumed by the indigenous and local Caucasian population of the North over a 12-month period: 1) traditional (venison, deer liver, game); 2) imported healthy meat (beef, poultry, minced meat, canned goods based on these types of meat); 3) imported fatty meat (pork, lamb, and their offal); 4) processed meat (smoked and cooked sausage, frozen semi-finished products, links, and link sausage) [14]. An analysis of the data identified the frequency of consumption and converted it into numerical daily consumption. The amount of food consumed was assessed using the Album of Portion Sizes of Foods and Courses [15].

Statistical analysis of the results was performed using Microsoft Excel 2010 and SPSS 22.0 for Windows software package. A normality test (Shapiro–Wilk test) was performed. Given the partial asymmetry of the distribution series of the studied parameters in the analyzed groups, we used nonparametric statistical methods. To characterize the variation series, the median (Me), arithmetic mean (M), percentiles (25; 75), and standard mean error (m) were determined. For preliminary assessment of significant differences between independent samples, we used nonparametric Kruskal–Wallis test (H-test). In addition, for assessment of statistical significance of differences between independent samples, we used the Mann–Whitney test. The statistical significance of differences was considered to be established at a probability of type II error of $p < 0.05$. To adjust the probability of type I error when comparing the analyzed groups, we used a Bonferroni correction of 3 (for three comparisons).

RESULTS

The survey of respondents showed that meat products are quite widely consumed by the indigenous and local Caucasian population of the Arctic. Moreover, the total consumption of meat and meat products is higher in the indigenous population as compared to the non-indigenous population (p <0.001); the consumption of non-traditional meat products (imported healthy (low-fat) and fatty meat) gradually and significantly increases in groups from NP to LCP (p <0.001; see Table 1).

Consumption of traditional meat products was highest in the NP group as compared both to SP ($p_{1–2}$=0.029) and LCP ($p_{1–3}$ <0.001). A similar trend was identified in relation to SP as compared to LCP ($p_{2–3}$ <0.001). The average daily consumption of venison and other game in the NP and SP groups is significantly higher as compared to the local Caucasian population ($p_{1–3}$ <0.001; $p_{2–3}$ <0.001; $p_{1–3}$=0.006, $p_{2–3}$ <0.001 respectively). Analysis of deer liver consumption did not show any significant differences in the analyzed groups. The consumption of deer blood was significantly higher in the NP group as compared to SP and LCP (p <0.001).

The consumption of imported healthy meat products is significantly higher in the LCP group ($p_{1–3,\ 2–3}$ <0.001; see Table 2). However, the consumption of this meat in all studied groups was higher as compared to imported fatty meat products (see Table 3).

A significantly higher consumption of chicken meat ($p_{1–2,\ 1–3}$ <0.001) and minced meat ($p_{2–3}$=0.005) was found in the SP and LCP groups as compared to NP. Despite the highest daily consumption of beef by the LCP group, no significant differences were found between the analyzed groups. An analysis of the consumption of canned meat showed significant differences between the groups ($p_{1–2}$ <0.001; $p_{1–3}$=0.040; $p_{2–3}$=0.007) with the highest daily consumption in the SP group (see Table 2).

An analysis of the average daily consumption of imported fatty meat showed that it was significantly lower in the NP group diets ($p_{1–2}$=0.027, $p_{1–3}$ <0.001) as compared to SP and LCP ($p_{2–3}$=0.001). An analysis of some fatty meat products showed the highest consumption of pork in SP, offal in LCP, and lamb in SP. However, there were no significant differences (see Table 2).

We believe that all this would, first and foremost, impair the energy balance and the balance of essential nutrients in the indigenous population, especially in the SP group.

An analysis of the consumption of processed meat showed no significant difference in their overall consumption, neither in the indigenous nor local Caucasian population (see Table 3). However, for individual products, we can see that the NP group less often consumed cooked and smoked sausages and significantly less often consumed links and linked sausage ($p_{1–2}$=0.015, $p_{1–3}$=0.001) as compared to SP and LCP. Nevertheless, the NP group is inferior only to SP in terms of consumption of frozen semi-finished products ($p_{1–2}$=0.045; $p_{2–3}$ <0.001 as compared to SP and LCP, respectively).

DISCUSSION

The ethnically specific activity of the indigenous peoples of the Russian Arctic is reindeer breeding [15]. This determines the nomadic or semi-nomadic lifestyle of reindeer breeders. The venison is valued for its nutrition properties, making it an indispensable product in the diet of the indigenous population of the North. Venison is a dietary protein that sets favorably apart from natural meat of other domestic animals due to its low energy value, delicate taste, and low fat content. It has high bioavailability as it contains 16 amino acids, B vitamins, tocopherols, ascorbic acid, and some bioelements (K, Mg, Na, Fe, Se, Mn, Zn, Cu, and P) [16–18]. Large-scale urbanization of the Arctic strongly affects the indigenous lifestyle, traditional work associated with breeding of domestic reindeer, fishing, and hunting. In recent years, there has been a decrease in the reindeer population, leading to reindeer meat shortage in the diet of indigenous people [17]. Summarizing the numerical data on the consumption of venison by indigenous populations of the Russian Arctic in 1960–2010 from literature, the average daily consumption was about 440 g in the range of 149–700 g [4, 8, 10]. Our study showed a lower venison consumption, 294 g in the NP group and 259 g in the SP group.

Khasnulin [19] noted that for the indigenous population of the Khanty-Mansi Autonomous Okrug, the lowest daily requirement for animal protein (120 g) is met by 640 g of meat or 800 g of fish. Robbek et al. [16] showed that consumption of 500 g of venison covers all human body needs (according to the Russian standards) in nutrients, such as animal proteins, critical amino acids, fatty acids, including polyunsaturated, some macro- and micronutrients, and vitamins. Thus, our study confirms the new trend of decreasing venison consumption in the indigenous peoples of the North.

DOI: https://doi.org/10.17816/humeco633042

Table 1. Quantitative overall consumption (g/day) of meat and meat-containing products, non-traditional meat products (imported lean and fatty meat), and traditional meat products by indigenous and local Caucasian populations of the Arctic

Food products	Lifestyle	M±m	Me (p25; p75)	Kruskal–Wallis test and *p*-values
Meat and meat-containing products	NIP (1)	387.4±36.1	200.0 (149.6; 613.3)	Kruskal–Wallis test=25.3
	SIP (2)	398.1±19.7	207.6 (112.4; 653.2)	**p <0.001**
	LCP (3)	274.8±18.2	150.2 (98.9; 289.2)	p_{1-2}=0.528
				p_{1-3} <0.001
				p_{1-3} <0.001
Non-traditional meat products	NIP (1)	63.7±9.0	33.8 (17.9; 69.6)	Kruskal–Wallis test=49.4
	SIP (2)	129.5±10.3	53.3 (20.9; 128.6)	**p <0.001**
	LCP (3)	157.9±13.5	78.7 (40.0; 171.9)	**p_{1-2}=0.004**
				p_{1-3} <0.001
				p_{1-3} <0.001
Traditional meat products:	NIP (1)	333.4±35.1	134.3 (132.5; 542.9)	Kruskal–Wallis test=136.7
	SIP (2)	277.3±15.4	134.3 (86.5; 413.3)	**p <0.001**
	LCP (3)	122.0±11.8	41.5 (26.7; 113.8)	**p_{1-2}=0.029**
				p_{1-3} <0.001
				p_{2-3} <0.001
Reindeer meat	NIP (1)	293.9±29.0	114.3 (114.3; 450.0)	Kruskal–Wallis test=147.7
	SIP (2)	258.6±15.1	114.3 (71.4; 400.0)	**p <0.001**
	LCP (3)	103.5±11.7	16.7 (6.7; 114.3)	p_{1-2}=0.050
				p_{1-3} <0.001
				p_{2-3} <0.001
Reindeer liver	NIP (1)	50.0±16.9	13.3 (13.3; 31.7)	Kruskal–Wallis test=5.9
	SIP (2)	27.9±4.3	13.3 (6.7; 26.7)	p=0.053
	LCP (3)	27.5±7.7	13.3 (6.7; 25.0)	p_{1-2}=0.051
				p_{1-3}=0.228
				p_{2-3}=2.168
Reindeer blood	NIP (1)	40.7±9.9	19.3 (6.7; 28.6)	Kruskal–Wallis test=23.2
	SIP (2)	47.8±13.9	6.7 (2.6;14.3)	**p <0.001**
	LCP (3)	10.0±5.2	3.3 (1.7; 6.8)	**p_{1-2} <0.001**
				p_{1-3}=0.001
				p_{2-3}=0.400
Game meat	NIP (1)	6.1±1.0	5.0 (5.0; 5.0)	Kruskal–Wallis test=23.9
	SIP (2)	6.0±0.5	5.0 (5.0; 5.0)	**p <0.001**
	LCP (3)	13.3±1.5	5.0 (5.0; 5.0)	p_{1-2}=2.177
				p_{1-3}=0.006
				p_{2-3} <0.001

Note: NIP, nomadic indigenous populations; SIP, settled indigenous populations; LCP, local Caucasian populations; bold indicates significant differences ($p < 0.05$).

Based on our study, we can also conclude that the consumption of venison by the Nenets is less than recommended and required for the indigenous peoples of the Russian Arctic.

The ever declining consumption of traditional products affects the health of indigenous people. Disruption of the ethnic diet principles can lead to an increased prevalence of metabolic disorders, endocrine diseases, cardiovascular diseases, and malignant tumors [20]. Bersamin et al. [21] and Little et al. [22] showed that for Arctic indigenous populations in Canada and Alaska the replacement of traditional diets with so-called Western diets contributed to aggravation of several chronic conditions, including obesity, cardiovascular diseases, and type 2 diabetes mellitus. Some authors have provided evidence that a diet rich in venison helps to increase antiatherogenic fractions of blood lipids [3, 19–24], which, in turn, helps to prevent myocardial infarctions and ischemic strokes.

Thus, only adequate nutrition in the context of human lifestyle allows to maintain his or her normal functional performance and the level of adaptation to extreme environmental conditions can be defined as satisfactory. This convinces us that traditional dietary habits of the indigenous population must be preserved.

CONCLUSION

The analysis of meat and meat product consumption showed a significantly higher consumption of traditional meat by the indigenous population as compared to the local Caucasian population (LCP). However, the consumption of venison and game is significantly higher in the nomadic population (NP) as compared to the settled population (SP). At the same time, nomadic indigenous populations much less frequently consumed poultry, beef, pork, lamb, and processed meat

Table 2. Quantitative consumption (g/day) of imported fatty and lean meat products by indigenous and local Caucasian populations of the Arctic

Food products	Lifestyle	M±m	Me (p25; p75)	Kruskal–Wallis test and *p*-values
Imported lean meat products:	NIP (1)	35.3±5.1	20.0 (6.7; 47.0)	**Kruskal–Wallis test=47.3**
	SIP (2)	58.9±5.6	25.6 (10.7; 55.9)	**p <0.001**
	LCP (3)	87.6±8.3	42.9 (20.4; 88.6)	p_{1-2}=0.112
				p_{1-3} <0.001
				p_{2-3} <0.001
Beef	NIP (1)	31.7±10.8	20.0 (10.0; 40.0)	Kruskal–Wallis test=3.4
	SIP (2)	67.5±11.6	28.6 (20.0; 85.7)	p=0.176
	LCP (3)	78.3±13.0	32.1 (16.7; 85.7)	p_{1-2}=0.222
				p_{1-3}=0.209
				p_{2-3}=2.881
Poultry (chicken, etc.)	NIP (1)	17.5±3.7	5.0 (2.5; 20.0)	**Kruskal–Wallis test=6.8**
	SIP (2)	40.8±4.3	13.3 (6.3; 38.6)	**p <0.001**
	LCP (3)	43.4±4.4	20.0 (6.3; 40.0)	**p_{1-2} <0.001**
				p_{1-3} <0.001
				p_{2-3}=0.408
Canned meat	NIP (1)	7.8±2.3	1.7 (1.7; 1.7)	**Kruskal–Wallis test=20.8**
	SIP (2)	11.9±1.1	4.2 (1.7; 16.7)	**p <0.001**
	LCP (3)	10.3±1.6	1.7 (1.7; 13.3)	**p_{1-2} <0.001**
				p_{1-3}=0.040
				p_{2-3}=0.007
Minced meat (cutlets)	NIP (1)	16.79±3.1	2.5 (2.5; 42.9)	**Kruskal–Wallis test=9.2**
	SIP (2)	8.97±1.1	2.5 (2.5; 10.7)	**p=0.010**
	LCP (3)	11.68±0.8	6.3 (2.5; 21.4)	p_{1-2}=0.765
				p_{1-3}=1.714
				p_{2-3}=0.005
Imported fatty meat products	NIP (1)	6.9±1.5	2.5 (2.5; 2.5)	**Kruskal–Wallis test=29.2**
	SIP (2)	24.4±4.6	2.5 (2.5; 18.6)	**p <0.001**
	LCP (3)	31.6±3.9	10.7 (2.5; 37.5)	**p_{1-2}=0.027**
				p_{1-3} <0.001
				p_{2-3}=0.001
Pork	NIP (1)	14.4±1.7	13.8 (9.6; 20.0)	Kruskal–Wallis test=5.2
	SIP (2)	59.0±11.1	23.4 (13.3; 80.3)	p=0.073
	LCP (3)	41.4±6.9	13.3 (6.7; 40.0)	p_{1-2}=0.215
				p_{1-3}=2.091
				p_{2-3}=0.127
Mutton	NIP (1)	9.2±1.1	9.2 (7.1; 11.3)	Kruskal–Wallis test=1.6
	SIP (2)	15.0±3.9	14.2 (7.9; 22.9)	p=0.448
	LCP (3)	30.2±4.7	16.7 (6.7; 28.6)	p_{1-2}=0.728
				p_{1-3}=0.706
				p_{2-3}=2.077
Offal	NIP (1)	3.9±1.4	2.5 (2.5; 2.5)	**Kruskal–Wallis test=8.0**
	SIP (2)	3.7±0.6	2.5 (2.5; 2.5)	**p=0.018**
	LCP (3)	4.9±0.5	2.5 (2.5; 2.5)	p_{1-2}=0.765
				p_{1-3}=0.064
				p_{2-3}=0.143

Note: NIP, nomadic indigenous populations; SIP, settled indigenous populations; LCP, local Caucasian populations; bold indicates significant differences ($p < 0.05$).

products. However, the consumption of imported healthy meat is significantly higher in the Caucasian population. It is worth noting that the consumption of this meat in all studied groups was higher than the consumption of fatty meat. It is quite predictable that a reduced consumption of traditional meat in the SP group was due to departure from the traditional nature management (nomadic reindeer herding) and reduced availability of its products. Consumption of traditional products by local non-indigenous populations indicates a certain assimilation of Caucasians due to the use of local food sources in their diet.

Thus, the increase of imported meat products, previously not used often by indigenous peoples of the Arctic zone of the Russian Federation, did not replaced all traditional foods. In the nomadic indigenous population, the consumption of meat products is closer to the traditional diet as compared to the settled indigenous population. However, the consumption of venison, a staple of the Nenets diet, has been declining

Table 3. Quantitative consumption (g/day) of processed meat by indigenous and local Caucasian populations of the Arctic

Food products	Lifestyle	M±m	Me (p25; p75)	Kruskal–Wallis test and *p*-values
Processed meat	KA (1) | NIP (1)	37.7±8.3	15.1 (8.7; 35.7)	Kruskal–Wallis test=3.64
	OA (2) | SIP (2)	72.2±7.1	21.4 (8.7; 57.1)	p=0.162
	ME (3) | LCP (3)	51.6±6.5	19.7 (8.7; 49.6)	p_{1-2}=0.184 p_{1-3}=0.435. p_{2-3}=1.585
Smoked sausage	KA (1) | NIP (1)	28.9±13.5	13.3 (6.7; 24.1)	Kruskal–Wallis test=4.69
	OA (2) | SIP (2)	58.4±7.6	13.3 (6.7; 85.7)	p=0.096
	ME (3) | LCP (3)	63.6±11.7	26.7 (6.7; 42.9)	p_{1-2}=0.950 p_{1-3}=0.067 p_{2-3}=0.359
Boiled sausage	KA (1) | NIP (1)	29.6±12.2	13.3 (6.7; 38.9)	Kruskal–Wallis test=4.7
	OA (2) | SIP (2)	58.8±7.5	14.3 (6.7; 80.0)	p=0.050
	ME (3) | LCP (3)	67.9±13.1	42.9 (7.1; 42.9)	p_{1-2}=1.109 p_{1-3}=0.066 p_{2-3}=0.309
Frozen semi-finished products (e.g., dumplings)	KA (1) | NIP (1)	19.9±3.9	5.0 (2.5; 26.7)	**Kruskal–Wallis test=23.5**
	OA (2) | SIP (2)	23.5±2.0	10.7 (5.0; 26.8)	**p <0.001**
	ME (3) | LCP (3)	15.7±2.1	5.0 (2.5; 20.0)	**p_{1-2}=0.045** p_{1-3}=2.275 **p_{2-3} <0.001**
Frankfurters and sausages	KA (1) | NIP (1)	6.1±1.4	3.3 (3.3; 3.3)	**Kruskal–Wallis test=14.6**
	OA (2) | SIP (2)	10.2±1.2	3.3 (3.3; 14.3)	**p=0.001**
	ME (3) | LCP (3)	11.8±1.0	3.3 (3.3; 14.3)	**p_{1-2}=0.015** **p_{1-3} <0.001** p_{2-3}=0.442

Note: NIP, nomadic indigenous populations; SIP, settled indigenous populations; LCP, local Caucasian populations; bold indicates significant differences ($p < 0.05$).

against past periods. Therefore, to maintain a decent living and health standards, the indigenous people of the northern regions need to adhere to the traditional diet developed over centuries and maintain the share of products produced in the region of residence.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

Вклад авторов. Ф.А. Бичкаева — организация и дизайн исследования, редакция и утверждение окончательного варианта статьи; Е.В. Нестерова — обзор литературы, сбор и обработка данных, анализ литературных источников, подготовка и написание текста статьи; О.С. Власова — сбор и анализ литературных источников и написание текста статьи; Б.А. Шенгоф — сбор и обработка данных; А.В. Стрелкова — обзор литературы; Н.Ф. Баранова — обработка данных; Т.Б. Грецкая — обработка данных. Все авторы подтверждают соответствие своего авторства международным критериям ICMJE (все авторы внесли существенный вклад в разработку концепции, проведения исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией).

Этическая экспертиза. Проведение исследования одобрено локальным этическим комитетом Института физиологии природных адаптаций УрО РАН и ФГБУН ФИЦКИА УрО РАН от 02.02.2009, 04.02.2013, 09.11.2016.

Согласие на публикацию. Все участники исследования добровольно подписали форму информированного согласия до включения в исследование.

Источники финансирования. Работа выполнена в соответствии с планом Федерального исследовательского центра комплексного изучения Арктики им. акад. Н.П. Лаверова Уральского отделения Российской академии наук по теме «Гормональное обеспечение и характер питания в регуляции метаболических процессов у практически здоровых жителей Арктики на современном этапе» (FUUW-2025-0015), гос. регистрация № 125021902587-6.

Раскрытие интересов. Авторы заявляют об отсутствии отношений, деятельности и интересов за последние три года, связанных с третьими лицами (коммерческими и некоммерческими), интересы которых могут быть затронуты содержанием статьи.

Оригинальность. При создании настоящей работы авторы не использовали ранее опубликованные сведения (текст, иллюстрации, данные).

Доступ к данным. Редакционная политика в отношении совместного использования данных к настоящей работе не применима, новые данные не собирали и не создавали.

Генеративный искусственный интеллект. При создании настоящей статьи технологии генеративного искусственного интеллекта не использовали.

Рассмотрение и рецензирование. Настоящая работа подана в журнал в инициативном порядке и рассмотрена по обычной процедуре. В рецензировании участвовали два внешних рецензента, член редакционной коллегии и научный редактор издания.

ADDITIONAL INFORMATION

Author contributions: F.A. Bichkaeva: conceptualization, methodology, writing—review & editing; E.V. Nesterova: formal analysis, investigation, data curation, writing—original draft; O.S. Vlasova: formal analysis, writing—original draft; B.A. Shengof: investigation, data curation; A.V. Strelkova: formal analysis; N.F. Baranova, T.B. Gretskaya: data curation. All authors confirm that their authorship meets the international ICMJE criteria (all authors made substantial contributions to the conceptualization, investigation, and manuscript preparation, and reviewed and approved the final version prior to publication).

Ethics approval: The study was approved by the Local Ethics Committee of the Institute of Physiology of Natural Adaptations, Ural Branch of the Russian Academy of Sciences, and the Federal Research Center for Comprehensive

Study of the Arctic, Ural Branch of the Russian Academy of Sciences, on February 2, 2009; February 4, 2013; and November 9, 2016.

Consent for publication: All participants provided written informed consent prior to inclusion in the study.

Funding sources: The study was conducted as part of the research plan of the N. Laverov Federal Center for Integrated Arctic Research, Ural Branch of the Russian Academy of Sciences "The Effect of Hormonal Regulation and Dietary Patterns on Metabolic Control in Apparently Healthy Arctic Residents in the Modern" (project ID: FUUW-2025-0015, state registration number: 125021902587-6).

Disclosure of interests: The authors have no relationships, activities, or interests for the last three years related to for-profit or not-for-profit third parties whose interests may be affected by the content of the article.

Statement of originality: No previously published material (text, images, or data) was used in this work.

Data availability statement: The editorial policy regarding data sharing does not apply to this work, as no new data was collected or created.

Generative AI: No generative AI technologies were used to prepare this article.

Provenance and peer-review: This paper was submitted unsolicited and reviewed following the standard procedure. The peer review process involved two external reviewers, a member of the editorial board, and the in-house scientific editor.

REFERENCES | СПИСОК ЛИТЕРАТУРЫ

1. Mataev SI, Vasilkova TN. *Metabolic syndrome in the Far North*. Tyumen: TyumGNGU; 2011. 131 p. (In Russ.) EDN: QMBRHB
2. Ladodo KS, Borovik TE, Semenova NN, Surzhik A.V. Formation of correct eating behavior. *Lechaschi Vrach*. 2009;(1):54–57. (In Russ.) EDN: PYKQLX
3. Andronov SV, Lobanov AA, Kobelkova IV, et al. Seasonality of consumption of traditional products of reindeer husbandry and river fishing by indigenous people of the arctic zone of western siberia in the context of climate change. *Hygiene and Sanitation*. 2021;100(6):610–616. doi: 10.47470/0016-9900-2021-100-6-610-616 EDN: GBLJHB
4. Yakovleva NV. *Traditional food of the inhabitants of the North*. Arkhangelsk: Pomor University; 2005. 242 p. (In Russ.) EDN: QLMYNN
5. Adamova VI, Kovalev NI. Amino acid composition of reindeer meat proteins. *Problems of Nutrition*. 1974;(4):58–59. (In Russ.)
6. Pershina IV. Features of food residents of the Far North. *Scientific Bulletin of the Arctic*. 2019;(6):97–107. EDN: HPNTCX
7. Levina MG, Potapova LP, editors. *Peoples of Siberia*. Moscow; Leningrad: Izd-vo Akad. nauk SSSR; 1956. 1083 p. (In Russ.)
8. Lapenko IV, Korchin VI, Korchina TYa. *Features of the metabolic profile, elemental and micronutrient status of the indigenous and newcomer populations of the urbanized North*. Voronezh: Rhythm; 2021. 316 p. (In Russ.) EDN: HJSKRD
9. Andronov SV, Lobanov AA, Kostritsyn VV, et al. The traditional food of indigenous inhabitants of the Yamal-Nenets Autonomous District and prevention of development of hypertension, chronic bronchitis, and overweight. *Scientific Bulletin of the Yamal-Nenets Autonomous District*. 2017;(2):13–16. EDN: XNBGAP
10. Vasilkova TN, Evay AV, Martynova EP, Novikova NI. *Indigenous peoples and industrial development of the Arctic (ethnological monitoring in the Yamal-Nenets Autonomous District)*. Moscow: Shadrinskii dom pechati; 2011. 267 p. (In Russ.) EDN: QURJVV
11. Troshina TI, Morozova OM, Vorobyeva NA. Transformation processes and nutrition factor in the Far North residents' resilience system. *Arctic and North*. 2021;(43):190–214. doi: 10.37482/issn2221-2698.2021.43.190 EDN: VAHYSM
12. Lobanov AA, Andronov SV, Bogdanova EN. The impact of traditional nutrition on maintaining the indigenous peoples in the Russian Arctic. In: *Arctic research: from extensive development to integrated development: materials of the II International scientific and practical conference*. Arkhangelsk; 2020. P. 239–242. EDN: CRNMDX
13. Bichkaeva FA, Gretskaya TB. Pancreatic hormones, the composition of saturated fatty acids and their relationship with glucose levels, depending on the body mass index in Arctic residents. *Proceedings of the Russian Academy of Sciences. Biological Series*. 2022;(4):412–426. doi: 10.31857/S1026347022030040 EDN: LFSLUD
14. Martinchik AN, Baturin AK, Baeva VS, Peskova EV. Study of actual nutrition using food consumption frequency analysis, creation of a questionnaire and assessment of the reliability of the method. *Russian Journal of Preventive Medicine and Public Health*. 1998;(5):14–19. (In Russ.)
15. Martinchik AN, Baturin AK, Baeva VS, et al. *Album of portions of food and dishes*. Moscow; 1995. 64 p. (In Russ.)
16. Robbek NS, Barashkova AI, Reshetnikov AD, et al. The role of venison in nutrition of the North natives. *Agrarian Bulletin of the Urals*. 2015;(9): 25–31. EDN: UMKXCH
17. Bikbulatova LN, Lapenko VV. Adaptation and health of the population of the Arctic zone of the Russian Federation (using the example of the Yamal-Nenets Autonomous District). Moscow: Rhythm; 2023. 308 p. (In Russ.) EDN: KKDCGH
18. Bogdan EG, Turshuk EG. Characteristics of venison. The research of vitamin and fatty acid composition of the meat of domesticated reindeer. Bulletin of the Murmansk State Technical University. 2016;19(4):842–847. doi: 10.21443/1560-9278-2016-4-842-847 EDN: XHMWUZ
19. Khasnulin VI. Health, the northern type of metabolism and the need for fish in the diet in the North. In: *Problems of maintaining health in the North and Siberia: works on medical anthropology*. St. Petersburg: Tipografiya "Novosti"; 2009:55–77. (In Russ.) EDN: VBZSYP
20. Nikiforova VA, Lapina SF, Kiryutkin SA. Traditional food as the basis for preserving the health of the indigenous population of the north of the Krasnoyarsk territory and the Irkutsk region. *Issues of Social-Economic Development of Siberia*. 2021;(3):115–124. doi: 10.18324/2224-1833-2021-3-115-124 EDN: MGNXYL
21. Bersamin A, Luick BR, King IB, et al. Westernizing diets influence fat intake, red blood cell fatty acid composition, and health in remote Alaskan Native communities in the center for Alaska Native health study. *J Am Diet Assoc*. 2008;108(2):266–273. doi: 10.1016/j.jada.2007.10.046
22. Little M, Hagar H, Zivot C, et al. Drivers and health implications of the dietary transition among Inuit in the Canadian Arctic: a scoping review. *Public Health Nutr*. 2021;24(9):2650–2668. doi: 10.1017/S1368980020002402
23. Sanders MA, Oppezzo M, Skan J, et al. Demographic and cultural correlates of traditional eating among Alaska Native adults at risk for cardiovascular disease. *PLoS One*. 2022;17(9):e0275445. doi: 10.1371/journal.pone.0275445
24. Ryman TK, Boyer BB, Hopkins S, et al. Associations between diet and cardiometabolic risk among Yup'ik Alaska Native people using food frequency questionnaire dietary patterns . *Nutr Metab Cardiovasc Dis*. 2015;25(12):1140-1145. doi: 10.1016/j.numecd.2015.08.003

AUTHORS' INFO

*** Ekaterina V. Nesterova;**
address: 23 Severnoy Dviny nab, Arkhangelsk, Russia, 163000;
ORCID: 0000-0001-8467-2514;
eLibrary SPIN: 7445-8730;
e-mail: ekaterina29reg@mail.ru

Fatima A. Bichkaeva, Dr. Sci. (Biology);
ORCID: 0000-0003-0727-3071;
eLibrary SPIN: 3562-3921;
e-mail: fatima@fciarctic.ru

Olga S. Vlasova, Cand. Sci. (Biology);
ORCID: 0000-0002-6956-6905;
eLibrary SPIN: 3457-9822;
e-mail: olgawlassova@mail.ru

Boris A. Shengof;
ORCID: 0000-0002-3776-1474;
eLibrary SPIN: 2259-0799;
e-mail: b-shengof@yandex.ru

Alexandra V. Strelkova, MD, Cand. Sci. (Medicine);
ORCID: 0000-0002-9077-889X;
eLibrary SPIN: 1890-4879;
e-mail: al.strelkova@yandex.ru

Nina F. Baranova;
ORCID: 0000-0002-7527-8088;
eLibrary SPIN: 4542-0994;
e-mail: baranova.nfb@yandex.ru

Tatyana B. Gretskaya;
ORCID: 0000-0002-8513-1848;
eLibrary SPIN: 1661-3095;
e-mail: tatyana-rab@yandex.ru

ОБ АВТОРАХ

*** Нестерова Екатерина Васильевна;**
адрес: Россия, 163000, Архангельск, наб. Северной Двины, д. 23;
ORCID: 0000-0001-8467-2514;
eLibrary SPIN: 7445-8730;
e-mail: ekaterina29reg@mail.ru

Бичкаева Фатима Артемовна, д-р биол. наук;
ORCID: 0000-0003-0727-3071;
eLibrary SPIN: 3562-3921;
e-mail: fatima@fciarctic.ru

Власова Ольга Сергеевна, канд. биол. наук;
ORCID: 0000-0002-6956-6905;
eLibrary SPIN: 3457-9822;
e-mail: olgawlassova@mail.ru

Шенгоф Борис Александрович;
ORCID: 0000-0002-3776-1474;
eLibrary SPIN: 2259-0799;
e-mail: b-shengof@yandex.ru

Стрелкова Александра Витальевна, канд. мед. наук;
ORCID: 0000-0002-9077-889X;
eLibrary SPIN: 1890-4879;
e-mail: al.strelkova@yandex.ru

Баранова Нина Федотовна;
ORCID: 0000-0002-7527-8088;
eLibrary SPIN: 4542-0994;
e-mail: baranova.nfb@yandex.ru

Грецкая Татьяна Борисовна;
ORCID: 0000-0002-8513-1848;
eLibrary SPIN: 1661-3095;
e-mail: tatyana-rab@yandex.ru

* Corresponding author / Автор, ответственный за переписку