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Избыточная масса и ожирение у сельских школьников российской Арктики и Севера в 1994–2019 гг.

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АННОТАЦИЯ

Введение. До 2017 г. в РФ не существовало единых критериев оценки избыточной массы у детей. В результате информация о распространении ожирения у школьников сёл и малых городов оставалась фрагментарной. Это затрудняет оценку темпов изменений в удалённых северных регионах.

Цель. По единой методике оценить распространение избыточной массы тела и ожирения с 1994 по 2019 гг. у детей 6–17 лет, проживающих в сельских областях некоторых северных регионов России.

Методы. Данные (пол, возраст, масса и длина тела) получены в ходе профилактических медицинских осмотров 7548 сельских детей 6–17 лет в одних и тех же населённых пунктах в 1994, 1997–1998, 2005–2009 и 2016–2019 гг. в Мурманской области, Ханты-Мансийском автономном округе — Югре, Республике Коми, Коми-Пермяцком округе. Выявление индивидов с избыточной массой тела (по значениям индекса массы тела) проводили по методике ВОЗ.

Результаты. Доля детей с избыточной массой росла во всех локациях. В целом, в 1994–1998 гг. избыточная масса регистрировалась у 4–7% школьников (включая ожирение у 0,6–0,8%), в 2005–2009 гг. — у 7,5–18,7% (ожирение 0,9-5,0%), в 2016–2019 гг. — 23,9–26,6% (ожирение 7,7–11,9%). Согласно данным 2019 г., по частоте встречаемости избыточной массы школьники сёл, малых городов, крупных индустриальных центров и Москвы не различались.

Заключение. Быстрое распространение избыточной массы и ожирения у детей России относится ко второму десятилетию XXI в. Географические (Арктика, внеарктический Север, Центральная Россия) и социально-экономические факторы (различия в уровне урбанизации) на негативную динамику существенно не влияют.

Ключевые слова: индекс массы тела; дети; подростки; сельское население; урбанизация.

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Overweight and obesity among rural schoolchildren of the Russian Arctic and North in 1994–2019

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ABSTRACT

BACKGROUND: There was not enough information on the spread of obesity among schoolchildren in rural settlements and small towns of Northern Russia in recent years. This study aimed to trace the prevalence of overweight and obesity in children aged 6–17 years living in rural areas of Northern Russia between 1994 and 2019.

METHODS: Data, including sex, age, body weight, and stature, were collected during regular medical examinations of 7548 children aged 6–17 years living in the rural settlements of Murmansk Oblast, Khanty-Mansi Autonomous Okrug, Komi Republic, Komi-Permyak Okrug in 1994, 1997–1998, 2005–2009, and 2016–2019. Individual assessments were made using body mass indices according to the procedures and cutoffs recommended by the World Health Organization.

RESULTS: The prevalence of excess body weight has substantially increased in all localities. It was 4–7% (including 0.6%–0.8% obesity) in 1994–1998, 7.5–18.7% (obesity 0.9–5.0%) in 2005–2009, and 23.9–26.6% (obesity 7.7–11.9%) in 2016–2019. As 2019 data showed, no difference was found between schoolchildren residing in rural settlements, small towns, large industrial centers, and Moscow.

CONCLUSION: A rapid spread of overweight and obesity among Russian children occurred in the second decade of the 21st century. The northern populations encounter this process in the same degree and extent as others. Geographic (Arctic, non-Arctic North, and Central Russia) and socioeconomic (various levels of urbanization) factors do not play a major role in that negative dynamics.

Keywords: body mass index; children; adolescents; rural population; urbanization.

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INTRODUCTION

Overweight and obesity spread rapidly in rural areas worldwide [1, 2]. As many scholars show, populations of the northern (higher than 60°N) regions are also vulnerable to this process [3, 4]. For example, 64% of Canada's Inuit were overweight or obese [5]. Among middle-aged Greenland Inuit, the proportion of obese individuals increased from 12.6% in 1993 to 27.3% in 2014 [6]. In 2010, 15.8% of all Greenlandic children were overweight and 6.8% were obese at school entry [7]. According to recent reports, the proportion of children with body mass index (BMI) above the norm in Greenland settlements, excluding Nuuk's residents, is 28.8% [8].

Indigenous northerners of Russia also face widespread fat metabolism disorders [9]. Surveys conducted in the mid-2010s have reported excessive body weight (including obesity) in 62%–63% of the Nenets and Khanty people living in large settlements or a big city in Northwestern Siberia [10, 11].

The studies on the prevalence of obesity in the indigenous adult population of the northern regions of Russia are scarce, but since different authors use common criteria for excessive weight, they provide an integrated picture. In children, the situation is different.

Until the beginning of the 2000s, Russian practitioners used regional evaluation tables to assess the growth of children. Tables were constructed based on the average measurements of children's body in every region. They also had updated data every 7–10 years, reflecting the change in the anthropometric characteristics of the population. It was only in 2017 that the Ministry of Health of the Russian Federation recommended using the child growth standards and references of the World Health Organization (WHO) for screening examinations. These circumstances make it difficult to estimate the change in obesity prevalence when a researcher has no access to primary data and should judge using published reports. We considered this issue elsewhere [12].

The outcome of the studies where the criteria for overweight and obesity were consistent with those of the WHO growth reference allows us to see the following picture. Between 1992 and 1998, the percentage of children with excessive weight in Russia fell from 15.6% to 9.0%, but it has slowly started to increase. In 1999–2001, the obesity rate was 5.6% in the rural and 8.4% in urban children aged 6–18 years [13], and in 2004, the prevalence of obesity among those aged 10–18 years reached 11.1% [14]. A study conducted in 2010 found that 19.9% of urban children were overweight and 5.6% were obese. That is, the proportion of children having BMI above the recommended values reached 22.5% [15].

These reports reflect the situation that has developed in large urban centers. Information on how childhood obesity spreads in rural settlements and small towns remained fragmented, making the assessment of the rate of change in remote northern regions difficult. Thus, our data collected for some years in the same settlements and processed by the common protocol enlightens the picture.

This study aimed to assess the prevalence of overweight and obesity in children aged 6–17 years living in rural areas of some northern regions of the Russian Federation from 1994 to 2019.

MATERIALS AND METHODS

The main data were collected during annual medical check-ups of children aged 6–17 years living in Murmansk Oblast, Khanty-Mansi Autonomous Okrug-Yugra (KMAO), Komi Republic, and Komi-Permyak Okrug (KPO) in Perm Krai. Additionally, in KPO and KMAO, information about schoolchildren in administrative centers of the districts of Kudymkar (population 30904 in 2019) and Berezovo (7050 inhabitants) were collected. From 1994 to 2019, data were collected subsequently in the same localities and schools in a region.

The map in the Fig. 1 shows the localization of the data collection sites. The ethnic composition of the study groups is shown in Table 1. The number of participants by the year of data collection is presented in Table 2. The total number of participants is 7548.

No data are available on the ethnicity of schoolchildren in Lovozero (Murmansk region) for 2016, but in 1997, ethnic Sami accounted for 69%, and in 2005, they made up 60%

Рис. 1. Географическое положение мест сбора данных. Цифрами обозначены места сбора данных на территориях: 1 — Республика Коми; 2 — Коми-Пермяцкий округ (Пермский край); 3 — Ханты-Мансийский автономный округ — Югра.

Fig. 1. Geographic locations of data collection sites. Numbers depict data collecting localities: 1 — The Komi Republic; 2 — Komi-Permyak Okrug (Perm Krai); 3 — Khanty-Mansi Autonomous Okrug – Yugra.

Таблица 1. Этнический состав обследованных групп
Table 1. Ethnic composition of the study groups

Residence	Ethnic composition
Murmansk Oblast, Lovozero settl.	Sami, Komi, mixed
Khanty-Mansi Autonomous Okrug, rural settlements	Khanty, Mansi
Khanty-Mansi Autonomous Okrug, Berezovo town	Mixed
Komi Republic, Kortkeros and Palevitsy settlements	Komi (Zyrian)
Komi-Permyak Okrug, rural settlements	Komi-Permyak, mixed
Komi-Permyak Okrug, Kudymkar town	Komi-Permyak, mixed

of the study participants. Among those under examination in Komi Republic, >90% were Komi. Moreover, 82% of the study participants in the rural areas of KMAO belong to the indigenous peoples of the North (Mansi, 52%; Khanty, 30%); 18% are representatives of other ethnic groups, mainly Russians. The medical records on the schoolchildren of the Berezovo town (KMAO) did not contain information about ethnicity. However, according to an estimate based on data from Russian Statistical Agency [16], approximately 95% are of non-indigenous descent and approximately 5% are ethnic Mansi, Khanty, or Nenets. In Komi-Permyak Okrug, based on the school archive records, 85% of the students of rural schools were ethnic Komi-Permyaks, whereas in Kudymkar, it was 59% (we do not have data on the ethnicity of our study participants).

In those examinations where the ethnicities of the participants were known (Lovozero, 1997 and 2005; Komi-Permyak Okrug, 1994 and 2009; Khanty-Mansi AO, 2019), we did not reveal significant differences in body weight estimates between the representatives of the indigenous and non-indigenous populations [17, 18]. In this study, we disregard ethnicity and only consider the region of residence. However, we keep in mind that the rural groups in our study have ethnic specificity.

The data set was formed by total population sampling. The number of participants is shown in Table 2. Measurements were taken according to the WHO procedure [12, 19]. In the first half of the day, in school medical facilities, the participants, while wearing light clothes, underwent direct weight and height measurements using a calibrated medical scale (resolution 0.1 kg) and anthropometer (resolution, 0.1 cm).

The WHO-recommended method and reference BMI values for children aged 5–19 years [19] were used to estimate the individual weight status. According to this technique, each BMI value undergoes standardization, i.e., transformation into a Z-score, using the reference standard deviation (SD) and median (M) for the appropriate sex and age group:

$$Z=(BMI - M)/SD$$

Then, depending on the range in which the Z-score value fell, an estimate on the individual weight status is obtained according to the following rules:

Таблица 2. Размеры выборок по годам исследований (школьники 6–17 лет)
Table 2. Number of participants by year of data collection (schoolchildren aged 6–17 years)

Residence	Region	Year	Number of participants		
			Sex		Total
			M	F	
Rural settlements	Komi-Permyak Okrug	1994	169	186	355
		1998	355	435	790
		2009	293	269	562
		2019	245	262	507
	Komi Republic	2008	216	250	466
		2018	283	270	553
	Murmansk Oblast	1997	177	174	351
		2005	165	168	333
		2016	108	114	222
	Khanty-Mansi AO	2019	115	128	243
Administrative centers (towns)	Komi-Permyak Okrug, Kudymkar	1994	147	165	312
		2009	370	349	719
		2019	661	633	1294
	Khanty-Mansi AO, Berezovo	2019	408	433	841

$-2 \leqslant Z \leqslant 1$, normal;
$1 < Z \leqslant 2$, overweight;
$Z > 2$, obesity.

Hereinafter, we use the term *excessive body weight* to refer to the combined weight class that includes overweight and obesity estimates.

As far as the individual estimates account for the sex and age of a participant, we can characterize a region- and time-specific study group by the percentage of participants falling into the mentioned weight ranges (classes).

The authors obtained body height and weight data by either measurements or copying from schoolchildren's medical records. A comparison of the weight class frequency distributions in the measurement- and record-derived data study groups in the Murmansk region and the Komi Republic (2016 and 2018, respectively) did not reveal significant differences in the ranking results (in both cases, $p > 0.51$). In our analysis, we combined data measured and extracted from medical records).

Statistical analysis consisted of group comparison using the Chi-square test adjusted for maximum likelihood. The significance level was set at 0.05.

RESULTS

The prevalence of overweight and obesity in children aged 6–17 years living in rural areas of the Murmansk region, Khanty-Mansi AO, Komi Republic, and Komi-Permyak Okrug of Perm Krai are presented in Table 3.

The proportion of children with excessive body weight has increased over time in all the locations. As shown in Table 4, in the 1990s, 4%–7% of schoolchildren had BMI above the norm; in the 2010s, the percentage increased substantially in all localities. By the end of the second decade of the 21st century, 23%–26% of the children aged 6–17 years living in the northern regions of the Russian Federation were overweight or obese.

The prevalence of excessive body weight and obesity by the year of data collection are presented in Table 4.

A comparison of data sets collected at a close time (less than a decade) revealed no considerable differences between the regions, except for the cases when the prevalence of obesity in 2005–2009 was lower in Lovozero settlement of the Murmansk region (0.9%) than in the Komi Republic (5%) and Komi–Permyak Okrug (3.3%, $p < 0.05$ in both cases). In 2016–2019, it was virtually higher in Kudymkar town (KPO) than in Berezovo town of KMAO (10.2 and 7.9%, respectively, $p = 0.058$).

The materials collected in Komi–Permyak Okrug and Berezovo districts of Khanty-Mansi AO allowed us to consider the differences between children living in settlements and administrative centers of the rural areas (Table 3).

In Komi-Permyak Okrug, there were no such differences in the percentage of either overweight or obese participants

Таблица 3. Частота проявлений избыточной массы тела у школьников 6–17 лет в северных регионах Российской Федерации (в процентах, без учёта этнической принадлежности)

Table 3. Prevalence of excessive body weight among children aged 6–17 years in the northern regions of the Russian Federation (per cent, disregarding ethnic belonging)*

Years	Region, residence	Body weight, by classes, %		
		1	2	1+2
		Overweight	Obesity	Excessive
1994	KPO, rural settl.	3.4	0.6	4.0
	KPO, Kudymkar town	6.4	0.6	7.0
1997–1998	Murmansk Obl., Lovozero settl.	3.9	0.8	4.7
	KPO, rural settl.	6.3	0.6	6.9
2005–2009	Murmansk Oblast, Lovozero settl.	6.6	0.9	7.5
	Komi Republic, rural settl.	13.7	5.0	18.7
	KPO, rural settl.	11.7	3.3	15.0
	KPO, Kudymkar town	8.9	4.0	12.9
2016–2019	Murmansk Oblast, Lovozero settl.	16.2	7.7	23.9
	Komi Republic, rural settl.	17.4	9.2	26.6
	KMAO, rural settl.	11.1	11.9	23.0
	KMAO, Berezovo town	17.7	7.9	25.6
	KPO, rural settl.	17.8	8.3	26.1
	KPO, Kudymkar town	14.6	10.2	24.8

* Abbreviations: KMAO, Khanty-Mansi Autonomous Okrug; KPO, Komi-Permyak Okrug.

Таблица 4. Частота проявлений избыточной массы тела и ожирения у детей 6–17 лет по годам обследования
Table 4. Prevalence of excessive body weight and obesity in children aged 6–17-years by year of data collection

Site, year		Sample size	Excessive body weight, %	*p**	Obesity, %	*p**
Komi-Permyak Okrug, rural settl.	1994	355	4.0	—	0.6	—
	1998	790	6.9	0.039	0.6	0.889
	2009	562	15.0	0.001	3.3	0.001
	2019	505	26.1	0.001	8.3	0.001
Komi-Permyak Okrug, Kudymkar town	1994	312	7.0	—	0.6	—
	2009	719	12.9	0.004	4.0	0.001
	2019	1292	24.8	0.001	10.2	0.001
Murmansk Oblast, Lovozero settl.	1997	351	4.7	—	0.8	—
	2005	333	7.5	0.103	0.9	0.946
	2016	222	23.9	0.001	7.7	0.001
Komi Republic, rural settl.	2008	466	18.7	—	5.0	—
	2018	553	26.6	0.003	9.2	0.008

* Significance of the difference from the value in the previous line.

in all three consecutive data sets for 1994, 2009, and 2019 (p >0.1 in all cases).

In 2019, excessive weight was roughly equally prevalent among the children from settlements and Berezovo town of Khanty-Mansi AO (p=0.42), although the former had a higher rate of obesity cases than towners, with the level of significance close to the critical value (11.9 and 7.9%, respectively, p=0.055).

DISCUSSION

Our observations affirm that overweight and obesity in children spread rapidly in rural areas of northern parts of Russia (Tables 3 and 4). The changes were occurring simultaneously in various geographically remote areas such as Murmansk Oblast and the Komi Republic, which belong to the Barents region, Komi-Permyak Okrug in the northern Urals, and Khanty-Mansi AO in the north of Western Siberia. The prevalence of excessive body weight in 1994–1998 was 4%–7% (including obesity 0.6%–0.8%); in 2005–2009, it became 7.5%–18.7% (including obesity 0.9%–5.0%), and in 2016–2019, it further increased to 23.9%–26.6% (including obesity, 7.7%–11.9%).

Comparing our results with the conclusions of other researchers is difficult because of the lack of no uniform national criteria for children's growth assessment in Russia until recently [12]. According to technically commensurable data, 16.40% of children towners in KMAO had BMI above the norm in 2009 [20]. Moreover, 18.5% of children living in rural settlements in the Arkhangelsk region had excessive body weight in 2010 [21]. Both of these estimates are close to the values obtained in the current study for the settlement residents of the Komi Republic in 2008 (18.7%, Table 4). Our findings are also in concert with the figures reported for children living in Nordic

Таблица 5. Частота проявлений избыточной массы и ожирения у школьников г. Москвы, г. Перми, г. Кудымкара и сёл Коми-Пермяцкого округа

Table 5. Prevalence of excessive body mass and obesity in schoolchildren of Moscow, Perm, Kudymkar (KPO small town), and rural settlements of KPO

Locality	Population (in thousands)	Sample size (N)	Excessive (incl. obesity), %	Obesity, %
Moscow City (COSI, 4th round) [1]	12655.1	2162	24.7	8.4
Perm City [2]	1049.2	748	23.4	6.9*
Kudymkar town (Perm Krai)	29.8	1294	24.8	10.2*
Settlements (KPO, Perm Krai)	1.3	507	26.1	8.3

1 — [24] (7-year-old, sexes combined, assessment made under condition of equal proportion of boys and girls.
2 — M. Otavina (2021), personal data
* — Difference between two values is significant, p=0.012

countries that are part of the Barents Region. In the NordChild 2011 cross-sectional survey, 16.5% of Finnish and 15.3% of Norwegian children aged 2–17 years were overweight or obese [22]. According to 2013 Global Burden of Disease Study, at least 20% of individuals aged <19 years in developed countries have bodyweights above normal [23]. Our data obtained in 2016–2019 comply with this assessment (Table 3).

In the present study, the prevalence of overweight and obesity are close in children living in rural settlements and neighboring small towns (Table 3). We previously reported on the similarity in the distribution of weight classes in schoolchildren living in rural settlements and large industrial centers in Perm Krai (2005–2009), Arkhangelsk (2010), and Murmansk (2012–2016) regions [21]. Data obtained in 2019 made it possible to compare the prevalence of overweight and obesity in school-age children in Moscow (largest city in Russia), Perm (main city of Perm Krai), the small town of Kudymkar, and small settlements of Kudymkar district of Perm Krai (Table 5). Pairwise comparisons revealed no significant differences in the prevalence of excess body weight (p >0.3 in all the cases). The obesity level in Kudymkar town (10.2%) was higher (p=0.012) than that in Perm City (6.9%). It was the only instance of significant difference.

The study results not only enlighten the particular regional situation. Up to the beginning of the 2000s, some Russian scholars supposed that the indigenous people of the North were physiologically protected from fat metabolism disorders, including obesity [25]. Our observations over the last 20–25 years deflate this view. Excess weight among Russian children is almost equally prevalent in the populations of various geographic areas (Arctic, non-Arctic North, and Central Russia) irrespective of the type of residency (settlement, small town, large urban center, and metropolis).

Environmental specifics of the North even heighten the risk of obesity in children. Long winters, low temperatures, and harsh winds limit the time children spend outside, which lead to restricted physical activity [26]. The deficit in natural light during long northern winters may trigger seasonal affective disorder, which is associated with carbohydrate craving [27]. Concurrently, the consumption of carbohydrates in the northern regions of Russia has considerably increased, in amount and variety, over the past 30 years. The recent type of nutrition, contrasting to traditional diets, is a risk factor for the development of overweight and metabolic disorders [28]. From an evolutionary perspective, as sugars were scarce in the northern environment, the pressure of selection to support the activity of disaccharidase enzymes was weak. Consequently, the carriers of the alleles that determine a restricted production of lactase, trehalase, sucrase-isomaltase, and salivary and pancreatic amylase are in a high frequency in the northern populations. Given the high availability of dietary carbohydrates, such genotypes increase the risk of obesity, including in childhood [29, 30].

The environmental, nutritional, and genetic risks of metabolic disorders are at play simultaneously in modern indigenous northern populations. This supposition requires further investigation. The groups need closer attention from doctors, nutritionists, age physiologists, and healthcare providers.

CONCLUSION

A rapid spread of overweight and obesity among Russian children appertains to the second decade of the 21st century. The northern populations are subjected to this process to the same degree and extent as others. Geographic (the Arctic, non-Arctic North, and Central Russia) and socioeconomic (various levels of urbanization) factors do not play a major role in that negative dynamics.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ / ADDITIONAL INFORMATION

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Authors contribution. In cooperation, A .Kozlov and G. Vershubskaya conceived the study, organized and performed data collection, statistical processing, and analysis, and discussed the results. A.Kozlov wrote the manuscript with input from G.Vershubskaya. All authors confirm that their authorship meets the international ICMJE criteria (all authors have made a significant contribution to the development of the concept, research and preparation of the article, read and approved the final version before publication).

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