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SUPPLEMENT 1, 2014: HEALTH RESEARCH IN THE SAKHA REPUBLIC (YAKUTIA), RUSSIAN FEDERATION

The health of populations living in the indigenous minority settlements of northern Yakutia

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This monograph contains the results of a study carried out by the Yakutsk Research Center for Complex Medical Problems, "Evaluating the health of the indigenous minorities of the Sakha Republic (Yakutia) and optimizing medical assistance using innovative technologies and telemedicine in indigenous settlements." The child population was studied in 19 indigenous minority settlements, and the adult population was studied in 12 settlements.

Keywords: *indigenous people; settlements; healthcare; health status; north; Yakutia*

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Table of Contents

Introduction
Chapter 1. Literature Review
1.1. Current demographic trends
1.2. Morphological and physiological characteristics
1.3. Ethnic and regional disease patterns
Chapter 2. Methods and Materials
2.1. Overview of the study on children
2.2. Overview of the study on adults
Chapter 3. The State of Health of the Child Population
3.1. Demographic and health indicators
3.2. Data from clinic patients
3.3. Results of screening examinations
3.4. Physical development of the child
3.5. Blood pressure and taste sensitivity to salt
3.6. Sexual development and hormonal status
3.7. Genetic heterogeneity in non-classical 21-hydroxylase deficiency
Chapter 4. The State of Health of the Adult Population
4.1. Population trends during socio-economic transition
4.2. Major health care indicators
4.3. A profile of disease prevalence
4.4. Lipid metabolism
4.5. Social and health-related characteristics
Discussion
References

Introduction

Currently, in Russia, allocation of public health resources is highly standardized across the country, without any

consideration for regional differences and ethnic-specific characteristics. Such an approach may be acceptable in European Russia, with its milder climate and relatively homogeneous population, but it is ill suited for the indigenous minority ethnic groups of Russia's Far North.

Due to its unique geography and ethnic composition, Yakutia is one of the more challenging regions in which to provide health care in Russia.

Yakutia has an area of 3,103.2 square kilometres, with a poorly developed transportation infrastructure, especially in the Far North, and a low population density. According to the Yakutia State Statistics Service (1998), the population density of the city of Yakutsk was 0.32 persons per square kilometre, while in a number of the Arctic regions, it ranged from 0.1 to 0.01 persons per square kilometre. Under these conditions, one of the most pressing public health issues is adequate provision of specialized medical care to all members of the population, regardless of location.

In 2002, the population of Yakutia was 949,300. People of Yakut ethnicity comprised 45.5% of the population, Evenks 1.9%, Evens 1.2%, Yukaghir 0.1% and Chukchi 0.1%. The northern indigenous minority peoples reside primarily in remote settlements, with poor transportation infrastructure, which understandably limits access to health care. Those who maintain a traditional lifestyle are most exposed to climate extremes. Endogamous marriages, not uncommon in remote settlements, serve to reinforce the physiological characteristics, which helped groups adapt to the environment. However, they also lead to a higher

prevalence of genetic disorders. Taking transportation costs into account, health care spending is equivalent to, or even greater than, that for city populations.

There is thus a need for region-specific mechanisms for implementing government public health policies, and to improve public health services for the northern indigenous minority populations.

Chapter 1. Literature review

1.1. Current demographic trends

The social and economic reforms since the 1990s have had a negative effect on the demographic situation in the Russian Federation. Between 1987 and 2004, the birth rate in Russia fell from 17.2 to 10.5 per 1,000 population. During the same period, the mortality rate increased from 10.5 to 16.0 per 1,000 population. As a result, a significant decline in the natural rate of increase was observed over that period (from 6.7 in 1987 to 5.5 per 1,000 population in 2004). The population in Russia declined by 10,361,400 persons over that period (1–3).

The demographic crisis in Russia has diverted attention from the situation among northern indigenous minority populations. In recent years, the number of publications dedicated to studying population migration, mortality and births in these populations has declined. Yet these issues remain relevant. Social and economic conditions in regions inhabited by the northern indigenous minority populations have deteriorated significantly over the years since perestroika. Limited access to health care and public health resources are exacerbated by the extreme climate and the uneven settlement patterns over a large geographical area (4–6). Indigenous populations also play a large role in the government's efforts to exploit the North for industrial development, transportation and energy extraction (7).

Evenks, Evens, Dolgans, Yukaghir and Chukchi comprise the indigenous minority groups living in Yakutia. The dying out of northern indigenous minority populations in the face of a growing non-native population has long been feared. This is connected to their small population, the high mortality rates, aggressive assimilation policies and other factors (8–10). This concept of the impending extinction of the indigenous minority peoples was popular in the medical establishment and often formed the conclusion when evaluating their state of health. In recent years, studies have shown that the pattern of demographic development of northern indigenous minority groups has changed significantly and is different from what statistics in previous years have shown (6,11–13).

Figure 1.1 shows population dynamics for the indigenous minority populations of Yakutia, based on population censuses in 1989 and 2002 (14,15). During the period between 1989 and 2002, the indigenous minority population of Yakutia increased by 33%. The Evenk population increased by 26%; Even, 35%; and Chukchi, 27%. The Dolgan population more than tripled, while that of the Yukaghir increased by 1.6 times. Members of indigenous minority groups comprised 2.3% of the overall population in 1989, increasing to 3.5% in 2002 (6,12,13,16).

It is remarkable that such a significant increase in the indigenous minority population of Yakutia took place during this time of demographic crisis in the Russian Federation. Beginning in 1992, a population decline never before seen during peacetime was observed. Although the same trends of decreased birth rates and increased mortality were observed, the indigenous peoples of Yakutia never experienced depopulation. During the period between 1990 and 2005, the birth rate of the northern indigenous minority populations decreased by

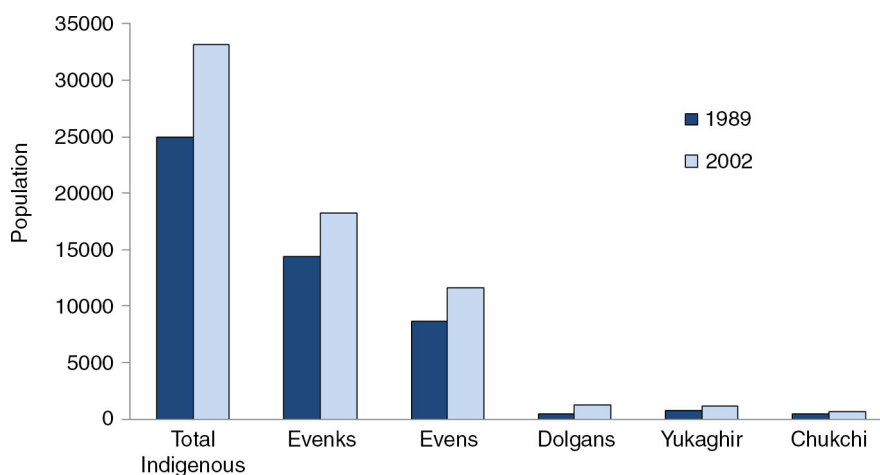


Fig. 1.1. Change in size of indigenous minority populations in Yakutia between 1989 and 2002.

38% (from 32.3 to 23.9 per 1,000 population). The mortality rate increased by 4% (from 9.4 to 10.1 per 1,000 population). The infant mortality rate, on the contrary, had declined from 25.6 per 1,000 live births during the 1990s to 15.3 per 1,000 live births during 2001–2005, a 40% reduction (6). According to the Northern Indigenous Minority Peoples Institute of the Siberian division of the National Academy of Sciences, between 1985 and 1993, the Evenk birth rate fell by 11%, the Even birth rate by 24%, the Chukchi birth rate by 70% and the Yukaghir birth rate by 42%. Over the same period, the mortality rate in the indigenous minority populations increased by 27% collectively: 19% among Evenks, 39% among Evens, and a 3-fold increase in the Yukaghir and Dolgan populations (17). Between 1990 and 2005, the average rate of natural increase of the northern indigenous minority groups decreased by 2.3 times, while remaining the highest of all ethnic groups in Yakutia. The average rate of natural increase of the minority indigenous groups was 13.8 per 1,000 population compared to 10.2 per 1,000 population for Yakuts and 2.6 per 1,000 population for the European settler population (6).

A high rate of natural increase is characteristic of most northern ethnic groups. This has been noted by researchers in the past, as well as recently (13,18–23). A high rate of natural increase over many generations speaks for this population's remarkable resilience, which can be attributed to the indigenous peoples' legacy of self-preservation, flexibility, dynamism and aptitude for social mobility (6,24). One important survival tool of the indigenous minority groups is their tendency to assimilate. According to the Northern Indigenous Peoples Institute, in 1993, among the minority indigenous groups, the number of newborns with parents from different ethnic groups was between 5 and 9 times higher than in the Yakut population, and was somewhere between 52 and 92% (17). According to Tyrylgina, 68% of members of the indigenous minority groups born between 1990 and 2005 had parents of different ethnicities, significantly higher than in the Yakut (16%) and settler populations (33%) (6).

Yet, according to the past 2 censuses, a significant growth in the indigenous minority population has been

registered in Yakutia, despite the reduction in natural increase. One important reason for this discrepancy is likely changes in record keeping. In the 1990s, the so-called nationality restoration process began. At this time, people who would previously have been considered Yakut or Russian for personal reasons or in order to better conform, including children of mixed ethnic origin, began changing their nationality to Evenk, Even and so on (11,24,25). According to Kuznetsov and Missonova, in the Even village of Dzhargalakh in Eveno-Bytantayskiy region, in 1991, 24 of 52 couples were of mixed ethnicity. All children born to these mixed couples were registered as Evens. An increase in the Dolgan population was in no small part due to assignment of natives of Anabarskiy region to their own ethnicity, when they had formerly been considered Yakut (11,24).

A special demographic feature of the indigenous minority groups is their settlement over a large territory in small groups (24–26). The indigenous minority groups live in 79 settlements in 20 administrative regions of Yakutia (27). A majority of these regions (11 of 20) are located in the Arctic. The Arctic region of Yakutia is vast and sparsely populated – the population density ranges from 0.1 to 0.3 persons per square kilometre (6,28). According to Tyrylgina, indigenous minorities comprise 24% of the population in Arctic Yakutia, a significantly higher proportion than in every other territorial zones of Yakutia (6).

According to data from 1989 to 2002, the majority of members of indigenous minority groups lived in rural areas (Evenks – 77%; Evens – 69%; Dolgans – 88%; and Yukaghir – 61%) (Table 1.1) (6). However, over that period, an increase in city dwellers was observed in all indigenous ethnic groups, which is connected to the mass migration of the rural population to cities (12–15,25). Vinokurova, a long-term observer of migration patterns of the indigenous populations, reported that the greatest influx of indigenous peoples to cities occurred during the period of political and socio-economic reform (between 1985 and 1996). Vinokurova also noted an increase in young indigenous women living in cities (24). The increase in migration of women of reproductive age to cities

Table 1.1. The indigenous minority populations of Yakutia by rural and urban residence, 1989 and 2002

	1989					2002				
	Total	Urban dwellers		Rural dwellers		Total	Urban dwellers		Rural dwellers	
		No.	%	No.	%		No.	%	No.	%
Evenks	14,428	2,411	16.7	12,017	83.3	18,232	4,221	23.2	14,011	76.8
Evens	8,668	1,909	22.0	6,759	78.0	11,657	3,569	30.6	8,088	69.4
Dolgans	408	35	8.6	373	91.4	1,272	156	12.3	1,116	87.7
Yukaghir	697	196	28.1	501	71.9	1,097	426	38.8	671	61.2

could lead to a growth in mixed marriages resulting in an increased mixed population. She considers that the urban migration contributes to increased dispersion of populations, aggravating the problem of ethnic survival (24). Genetic researchers in Yakutia view migration patterns in indigenous minority groups as increasing genetic diversity in these populations, counteracting the effects of genetic drift and decreasing the risk of certain genetic disorders (29,30). Population studies conducted in indigenous minority settlements have shown that the smaller the ethnic group, the higher the proportion of members with genetic diseases (30,31).

The mass migration of indigenous women from their traditional homeland to cities results in a gender imbalance in these populations. Currently, in all groups except Evenks, the female population exceeds the male population. According to the 2002 census, in the Evenk population, for every 100 men there were 98 women (compared to 100 women in 1989). Among Evens, there were 153 women for every 100 men (an increase from 148 women in 1989); among Dolgans, 123 women (111 women in 1989); and among Yukaghir, 107 women (109 women in 1989). According to Tyrylgin, in northern indigenous populations, there are 14% fewer men than women. In the over-60 age group, there are 1.6 times more women than men (6). Tyrylgin notes that women outnumber men in all major ethnic groups in Yakutia (Yakuts, Russians and indigenous minority groups). The proportion of men began to decrease in the 1990s, and this was observed to a greater extent in the older age groups (28). Between 1990 and 2005, the decline in the male population was 1.5 times greater than in the female population (6). This was undoubtedly connected to the high mortality rate of working-age men during the period of political and socio-economic reforms (24). In 1990, the mortality rate of working-age men exceeded the mortality rate of women in the same age group by 4.2 times, falling to 3.5 times in 2004 (32).

The literature emphasizes the demographic youthfulness of northern indigenous minority groups (6,12,13, 20,21,26,33). According to the 2002 census, the median age of Evenks was 23.8 years, 24.7 years among Evens and 24.4 years among Yukaghir. Dolgans were the youngest ethnic group in Yakutia, with a median age of

18.9 years (Table 1.2). These figures differ appreciably from those seen in the Russian Federation (37 years), the Far Eastern Federal Okrug (34 years) and Yakutia as a whole (31 years), where the population is aging. The indigenous minority groups of Yakutia had the largest proportion of the population who were children (32%) and the lowest proportion of the population who were aged 60 and older (7%). Recent studies show that the size of the northern indigenous child population continues to grow. According to Dranaeva and Burtseva, between 2005 and 2007, the absolute number of children aged 17 and younger belonging to indigenous minority groups in Yakutia increased from 9,021 to 9,414, and the number of children aged 14 and under grew from 7,433 to 7,886 (23).

The young age structure of the indigenous minority population of Yakutia can be a positive factor for the future demographic growth of these groups. However, the demographic youthfulness of the northern indigenous ethnic groups also reflects their low life expectancy (6,26,33), due to high mortality rates in the younger age groups, especially from causes such as trauma, poisoning, accidents, homicide and suicide (22,24,25,34–38). Deaths from accidental causes are directly correlated with the prevalence of binge drinking and alcoholism (33,36,39). Most researchers agree that it is predominantly young men who die from accidents associated with alcohol consumption (24,36–38,40). Average life expectancy in indigenous minority groups is between 44.7 and 54 years for men and 55.6 and 65 years for women (5,24).

Between the last 2 censuses, the number of marriages increased among the indigenous peoples. However, further analysis revealed some negative trends. Between 1989 and 2002, the number of people who had never been married increased in all indigenous ethnic groups. This was especially pronounced in the Even population among both men (45% increase) and women (51% increase). This is significantly higher than in Yakutia as a whole, where the number of unmarried men increased by 10% and the number of unmarried women increased by 39%. In 2002, the proportion of Even men who had never been married was 44.4%, compared with 28.8% in Yakutia as a whole. Nearly half of the over-16 male Even population had never been married, severely limiting the already limited opportunities for reproduction in such a small ethnic group.

Table 1.2. Median age and distribution of indigenous minority populations in Yakutia by age group, 1989 and 2002

Age	Evenks		Evens		Dolgans		Yukaghir	
	1989	2002	1989	2002	1989	2002	1989	2002
Below working age	5,530	6,222	3,093	3,857	–	540	286	381
Working age	7,789	10,523	4,854	6,705	–	657	361	630
Above working age	1,109	1,484	724	1,095	–	75	50	86
Median age (years)	25.4	23.8	26.4	24.7	–	18.9	24.8	24.4

In addition, the divorce rate sharply increased among the indigenous minority populations. During the period between censuses, the number of divorces among Evenks (men and women), Evens (women) and Yukaghir (men and women) increased by more than 2 times (13–15).

The results of the last census showed an improvement in the education level of the indigenous minority populations (Table 1.3). In 2002, 34% of Evenks over the age of 15 had a professional-level education (compared to 21% in 1989). For Evens, it increased from 23 to 34%, and from 26 to 38% for Yukaghir. In 2002, the proportion of individuals with basic general education and higher were 92% of Evenks, 91% of Evens, 91% of Dolgans and 92% of Yukaghir – slightly higher than in the Russian Federation as a whole (90%) (14,15).

In summary, the following demographic trends can be identified among the indigenous minority groups in Yakutia:

- Population growth in all ethnic groups
- Mass migration of the rural population to cities
- Young age structure
- Women outnumber men
- A growth in the number of never-married and divorced individuals alongside an increase in the number of married couples
- Increase in education level of the population

1.2. Morphological and physiological characteristics

Exposure to the environment of the Far North is a source of stress to the human body (22,41–43). These stressors

include lengthy, cold winters; extreme variation in day length; a lower partial pressure of oxygen; windy conditions; severe drops in atmospheric pressure; and variations in geomagnetic fields (22,41,42,44,45). Besides the extreme environmental conditions, the unfavourable social and economic conditions in the North have an impact on human health (4,6,22,41,46).

The peoples of the North, living for thousands of years under extreme conditions, are the product of natural selection. Genes promoting survival in such an environment were selected for in this population's evolution (20,21,45,47,48). The health of the indigenous Arctic populations is a result of the social and historical development of the population's life skills over many generations (49). Through the course of this adaptation, certain anthropometric characteristics of the indigenous populations have emerged (50,51).

The northern indigenous groups share many common features, physiologically and in terms of body composition. According to Alekseeva's concept of "adaptive types," genetically unrelated populations living in the same region under the same bioclimatic conditions share similar morphophysiological characteristics (20). This concept was confirmed by the work of Veselukhin, who found significant similarities in the physiology of 3 unrelated Arctic indigenous groups – Chukchi, Evens and Yakuts (52).

Based on her years of studying anthropological characteristics of Nenets, Chukchi, Inuit and Saami, Alekseeva identified an "Arctic adaptive type," characterized by high body density, increased musculoskeletal development, increased skeletal strength, cylindrical chest

Table 1.3. Education level of indigenous minority populations in Yakutia, 1989 and 2002

	Percent of over-15 population with highest education level attained					
	Higher (undergraduate and graduate), secondary (middle school and high school)	Including				
		Graduate	Undergraduate	Specialized secondary	High school	Middle school
Evenks						
1989	80	6	1	14	39	20
2002	82	9	3	22	30	18
Evens						
1989	81	6	2	15	37	21
2002	82	9	3	22	30	18
Dolgans						
1989	–	–	–	–	–	–
2002	84	7	4	21	30	22
Yukaghir						
1989	86	6	2	18	34	26
2002	85	11	4	23	28	19

shape and the near absence of individuals with an asthenic body type (20). Reports in the literature about body fat deposition in northern indigenous peoples are, however, contradictory. For example, Brown, studying the body fat deposition in the Inuit of North America, proposed the role of a thicker layer of subcutaneous adipose tissue as an adaptation to cold (53). Deryabin and Purundzhan have found evidence of a significantly thicker subcutaneous layer of adipose tissue in the abdomen in Yakuts (54). According to Degtyareva and Guryeva, the indigenous residents of Yakutia have a significantly higher body fat content than non-natives (55,56). However, Ducros showed that the Inuit of Greenland have a thinner layer of adipose tissue than the Japanese, Americans and Belgians (57). Similar results were obtained by Alekseeva, who found that Arctic groups had thinner adipose tissue layers than groups living in temperate or continental climates (20,21).

A number of researchers studying the morphology of indigenous northern populations noted the relatively high weight of Arctic indigenous peoples coupled with a shorter-than-average height (20,21,53–58). According to those researchers, adult men's weight varied between 56.3 and 63.0 kg, and women's varied between 47.3 and 52.7 kg. Body length in men was between 156.8 and 167.2 cm, and in women it was between 147.1 and 158.6 cm.

The majority of researchers studying the morphological features of northern indigenous populations noted a tendency towards mesomorphic features: high body density, short stature and well-developed musculature.

There is a considerable literature on the morphology of the northern indigenous populations at different periods of post-natal development (58–64). A child's physical developmental indicators are dependent on anthropologic type, formed over the course of the population's evolution under certain environmental conditions (21,65–67). The results of studies carried out in different regions of the Far North found that anthropometric indicators of most children in the study population are consistent with norms for their age group (50,62,68–70). However, several researchers found that the anthropometric indicators of indigenous children were in the lower percentiles compared with Russian and international norms (51,71,72). Moreover, many researchers found a significant lag in height and weight indicators in indigenous children compared with non-indigenous children in almost all age groups (60,61,71,73–75). According to those researchers, the observed ethnic differences are a reflection of the way of life, sociocultural status and dietary habits.

Several studies have shown that newborn children from indigenous groups show no lag in physical development compared with non-native newborns (9,58,59,68,76,77). This lack of difference in height and weight indicators persists until school age, but by puberty the difference is statistically significant (9,51,73,76,78). This led Chasnyk and

others to propose, based on data from Khanty and Nenets children, that having spent childhood in the tundra is one of the factors determining height and weight (51).

Many years of studying physical development characteristics of indigenous and non-indigenous populations in Yakutia and Taymyrsky, Evenkiysky and Yamalo-Nenetsky Autonomous Okrugs revealed significant differences in rate of sexual maturity. A majority of authors agree that sexual maturity is delayed in children from indigenous northern groups compared with settler children and children living at mid-latitudes. These studies showed that children from indigenous groups exhibit secondary sex characteristics at an older age and, in girls, later menarche (61,75,79,80).

In addition to inter-population differences, a number of intra-population differences were revealed. Among children from indigenous groups in Yakutia, differences in physical and sexual development were found based on location of residence. The further north a child lived, the lower the height and weight indicators, and the later the appearance of secondary sexual characteristics (61,81,82).

A substantial body of literature thus exists to demonstrate the significant role of the environment in the morphological development of the peoples of the Far North. The primary anthropologic features of the indigenous population is the result of a centuries-long adaptation to the harsh conditions of the North.

Human adaptation to the extreme conditions of the North is accomplished through stress and a complex restructuring of the body's homeostasis (43,49,83–85). This involves changes in thermoregulation, in order to adapt to cold temperatures. Many researchers noted a high tolerance for cold temperatures in the indigenous groups of the Arctic and Subarctic regions – Nenets, Chukchi, Inuit and Yakuts (9,20,21,41,86). Functional manifestations of adaptation to cold in the indigenous populations of the North are geared towards increasing thermoproduction and decreasing heat loss (20,21,41). Increased thermoproduction in northern peoples occurs due to increased fat stores, increase in free fatty acids in the blood and cell membranes (85,87) as well as activation of lipid peroxidation processes (87–89). Studies have shown that the northern indigenous peoples have greater peripheral circulation and a higher rate of blood circulation in cold, compared to settlers and residents of mid-latitudes (53,90,91). Those authors considered these characteristics to be part of the process of adaptation to cold, at the core of which is impaired vasoconstriction.

Thermoregulation processes of residents of the Far North are closely associated with energy processes, as energy expenditures are greater at higher latitudes compared with middle latitudes (41,90,91). There have been many studies comparing metabolism in indigenous groups to settler groups (20,21,52,53,90–93). A majority of these studies, carried out among unrelated northern

ethnic groups, found a higher energy expenditure and a greater basal metabolic rate among indigenous individuals in low temperatures (53,91,92,94). An increased basal metabolic rate was also found in the Inuit (53) as well as in Yakuts, Evens and Chukchi (91,94). In addition, Nenets, Saami, Yakuts, Evens, Chukchi and Inuit were found to have a higher oxygen consumption compared with residents of middle latitudes (20,21,94). The higher basal metabolic rate was more pronounced in winter than in summer. Seasonal variations in basal metabolic rate were due not only to climate but also to diet. In summer, the proportion of calories consumed from protein decreases significantly for indigenous individuals compared to the winter period (94). Chukchi, Yakuts and Inuit subsisting entirely on a Western diet tended to have a lower basal metabolic rate (93,94), whereas Europeans subsisting on a typical northern diet were found to have an increased basal metabolic rate (94).

Based on the available data on thermoregulation and basal metabolism, one can conclude that the populations of the Far North have a higher basal metabolic rate and higher energy expenditure, manifestations of their adaptation to the extreme northern climate.

The low temperature in the Far North has the greatest impact on the respiratory organs, as they have the most direct contact with the environment (95). The indigenous population has lower respiratory reserves than settlers to the region. Many studies have found that forced vital capacity, reserve volume, forced expiratory volume, peak flow rate and bronchial patency are lower than in the settler population (95–98).

Many studies examining the structure and function of the respiratory organs of the indigenous northern populations have shown that their morphology enhances gas exchange in extreme conditions. This was found in the significantly well-developed chest (20,21), hypertrophy of the smooth muscle of the airways (99), increased alveolar surface area and increased volume of lung microvasculature (41,43,99–102). The increased ventilation and perfusion under conditions of increased oxygen requirements were accompanied by increased smooth muscle tone in the base of the lungs, decreased patency of the bronchial tubes and increased function of the middle portion of the lungs. With this, alveolar ventilation of the lungs is not uniform, leading to regional alveolar hypoxia. As a result of these compensatory mechanisms, vascular resistance and systolic pressure of the pulmonary arteries increase, increasing the work of the right heart. These morphofunctional changes specific to high latitudes are referred to as “Northern arterial hypertension of the pulmonary circulation” or “Northern pulmonary hypertension” (43,101,103). Avtsyn and others, based on their own observations over 10 years in the field, concluded that “Northern pulmonary hypertension” is widespread among residents of all regions of the North,

regardless of ethnicity (41,103). They emphasized the high prevalence of pulmonary hypertension among the indigenous populations (Yakuts, Chukchi and Evens) (41,103). They also found that the frequency of elevated systolic pulmonary artery pressure in the indigenous population is somewhere between 25 and 80%, while it is between 15 and 56% for the settler population. The high incidence of this condition in the Arctic was confirmed by the research of Bligh and Chauca, who observed pulmonary hypertension in both humans and animals (104). Sovershaeva also found this condition in a significant proportion of the indigenous population of Arkhangelsk Oblast (105). A comparative analysis of the patency of the tracheo-bronchial tree, carried out on the indigenous and settler populations, showed a lower patency of the tertiary bronchi in the indigenous population, evidence of more stress on lobar and main bronchi, and an indirect indicator of congestion of the pulmonary circulation (95).

Most studies on the cardiovascular system of the indigenous populations of the Far North look at issues related to arterial pressures in the various ethnic groups. Despite the numerous papers which have been published on this topic, there is no unified opinion characterizing the vascular reactions in Northern indigenous peoples. Many researchers have written about hypotension compared to Europeans in most Arctic populations: Inuit (106,107), Chukchi and Koryaks (108,109). According to these authors, the average arterial pressure in men varied between 105/70 and 115/75, and in women it was between 98/67 and 108/69 mmHg. They also noted that arterial pressure remained low, even among elderly participants. Turchinsky found that, among the indigenous Nganasan residents of Taymyr, arterial pressures were within normal ranges (123/69–125/75 mmHg) (110). Similar results were obtained by Petrov and others, who noted that the average arterial pressure in indigenous residents in polar regions of Yakutia was not different from average arterial pressures in populations at middle latitudes (111). Other studies showed that pulse, cardiac output, electrocardiogram amplitude and intervals were also within or better than normal ranges for northern indigenous peoples (106,110).

The presence of hypo- or normotensive conditions in different northern populations was extensively investigated by Argunov, who studied the structure of vessels of children and young people and found a significantly thinner intima in the aorta and coronary arteries in the indigenous population. These characteristics of vessel walls were considered by Argunov to be both genetically determined and a result of diet and lifestyle (112).

The hypotension in northern indigenous populations characterized by many researchers was also observed in children. Arterial pressure studies were performed on children in Yamalo-Nenetsky and Nenetsky Autonomous Okrug (51,73). Nenets, Khanty, Selkup and Komi

children were found to have significantly lower arterial pressures than settler children in nearly all age groups. Indigenous children exhibited hypotension far more often than hypertension (51). Through these studies, indigenous children were also found to have a larger thoracic aorta diameter than settler children. Chasnyk and others carried out a study of angiotensin-converting enzyme polymorphisms in order to study a possible genetic aetiology to explain lower arterial pressure in the indigenous populations (51). Nenets children were studied, and the control group was composed of children from St. Petersburg. The study showed a near-complete absence of the DD genotype in Nenets children, which is associated with hypertension (5% in Nenets children compared with 27% of European children). As a result, the authors were able to propose a possible genetic origin of the lower blood pressure in northern indigenous populations.

Most northern indigenous populations exhibit a characteristic haemodynamics, formed through the process of adapting to the harsh Arctic conditions. It can be said with great confidence that this has a genetic basis.

The physiologic adaptations of the northern indigenous peoples also have a nutritional component, due to the unique features of the indigenous diet. Scientists studying the Arctic population found a high level of protein and fat and a low level of carbohydrates in their diet (20,21,45,52,86,113). They emphasized the fact that no adverse effects from consuming excess protein and fat were observed during their studies (20,45,93,94,114). As early as 1914, A. Krogh and M. Krogh studied the metabolic processes of Greenlandic Inuit and found adequate digestion and utilization of protein with low intake of carbohydrates (114). Rodahl and Issekutz found that the Alaskan Inuit have increased urinary excretion of nitrogen, which could be considered an enzymatic adaptation aimed at deamination of excess amino acids (93,94). Based on her own studies, as well as the work of others on metabolism of indigenous populations, Alekseeva concluded that there are specific biological mechanisms for utilization of excess protein and fats in Arctic indigenous groups (20). It is thought that the intensive digestion and utilization of proteins and fats are genetically determined (33) and are the result of nutritional adaptations of indigenous populations (115).

Nutritional adaptations undoubtedly influence homeostasis parameters of the indigenous populations of the North (94). Studies on biochemical indicators conducted among the Saami, Nenets, Yakuts, Chukchi, Even and Inuit revealed a tendency towards elevated total serum protein levels (20,21,45,94). Mean total serum protein levels in the indigenous populations were higher than in ethnic groups living at lower latitudes (20,21,94). An increase in certain amino acids was also observed – proline, tyrosine, phenylalanine, isoleucine and methionine (116). The globulin fraction in the indigenous

populations was also higher than in the European population (20,21,94,116). These characteristics of protein metabolism in the indigenous population, according to Alekseeva (20,21) and Petrova and others (45), have adaptive implications and are evidence of their bodies' increased protective properties.

Veselukhin also found in the serum of Yakuts, Chukchi and Evens increased levels of non-protein nitrogen (29.7 g/L, 23.96 g/L and 32.34 g/L, respectively), significantly higher than in the settler population (94). Veselukhin considered these findings normal, given the increased animal protein consumption in the study population.

Many researchers consider a distinguishing feature of lipid metabolism in northern indigenous populations to be the increased activity of lipolytic enzymes breaking up exogenous fats (20,21,45,85,87). Currently, it is known that the neuroendocrine system is activated in response to extreme climatic-geographic factors, stimulating lipolysis, which leads to an increase in triglycerides, free fatty acids and cholesterol in the blood and cell membranes (45,85,87,116). The effects of exposure to cold increases energy expenditures and basal metabolic rate. In addition, the lipid peroxidation process is activated – increasing cellular respiration, enzymatic activity and the quantity of reactive oxygen species (87–89,116,117). It has been established that the rate of lipid peroxidation is higher in both the indigenous and settler populations of the North than in residents of the middle latitudes (89). In addition, the indigenous population of the Far North exhibited higher antioxidant activity in blood lipids, as well as a lower level of secondary products of lipid peroxidation, than in the settler population (89,117). Therefore, the relatively high levels of endogenous antioxidants in the indigenous populations compared with the settler population arose from adaptive processes and is indicative of their greater reserves, which evolved over the course of generations (45,89,117).

Haemoglobin levels influence the degree of lipid peroxidation to a certain extent. Most of the groups studied in the Arctic exhibited lower haemoglobin levels than those at lower altitudes (94,116). It is this low level of haemoglobin which amplifies hypoxia, characteristic of people living at northern latitudes, which is another reason for metabolic processes which lead to greater free radical oxidation (116).

The strength of the antioxidant system reserves which prevent free radical oxidation depends on the vitamin levels in the organism. The literature contains many studies describing vitamin deficiencies in residents of the Far North (22,85,91,108,116–121), including ascorbic acid (11–70%), vitamin E (18–59%) and vitamin A (9–51.5%) (22,116,117,121). Seasonal vitamin D deficiencies have also been found, due to lack of exposure to sunlight in winter in children and teenagers residing in the Far North (9,122).

Of particular importance in the North is ensuring adequate intake of fat-soluble vitamins. This is because vitamins E and A are components of the antioxidant system, preventing excessive activation of lipid peroxidation processes and accumulation of reactive oxygen species (117,123,124). Boyko and others showed a pronounced deficiency in vitamin A (23% of men and 43% of women) and vitamin E (68% of men and 50% of women) in reindeer herders from indigenous minority groups (117). This group was also found to have low levels of secondary products of lipid peroxidation. Comparison of data allowed the authors to propose that the low levels of vitamin E in persons with a traditional lifestyle are caused by activation processes of free radical oxidation. Sitnikova examined 108 relatively healthy Dolgans and Evenks living in the Anabarsky region of Yakutia and found deficiencies in beta carotene, vitamin A and vitamin E in the serum of most participants, which was more pronounced during winter (120). In view of the deficiencies in fat-soluble vitamins in indigenous populations, these authors emphasized the necessity for measures to maintain optimal antioxidant levels in the Far North (117,120).

This literature review allowed us to conclude that the various ethnic groups residing the Far North share common morphophysiological characteristics, which were formed over many centuries of evolution. The role of specific environmental factors in this evolution is undisputable. Daily life in the North poses serious challenges to the human body. We can therefore conclude that a survival advantage is conferred upon those whose morphophysiological features are able to meet the demands of the extreme environment.

1.3. Ethnic and regional disease patterns

Adaptation to the conditions of the Far North involves significant stress and complex restructuring of the body's homeostatic systems (22,42,43,49,83–85). Processes aimed at supporting homeostasis under harsh environmental conditions are frequently so deep-rooted that they accompany structural injury and functional disturbances which create a certain pre-morbid setting for the development of chronic disease (41,42,99,108). Besides this, the effects of extreme environmental factors in the Far North are accompanied by great psychosocial pressures which surpass a person's adaptive capabilities (6,24,39,42). Disruption of the adaptive mechanisms of the body and the destabilization of the workings of the central nervous system have the potential to cause chronic disease in a population, including indigenous northern peoples (6,24,39,42,125,126).

Several authors studying Arctic health have shown that non-specific pathology in the indigenous population has an asymptomatic latent period (49,127–130). It should also be noted that comparison of these studies was not

always possible since many of the studies were not conducted using standardized methods and unified evaluation criteria (110,131).

Researchers have been particularly interested in the prevalence of circulatory disorders in northern indigenous populations. Most experts in recent years have held the same opinion that ischaemic heart disease and hypertensive disease are rarely found in Arctic indigenous populations. This phenomenon was thought to have a genetic basis, and to be closely associated with the traditional lifestyle and diet (91,106–108,110,132–140).

In the 1920s, Thomas, who studied the Inuit of Labrador and Greenland, did not record a single case of hypertension in persons over 60 years of age (139). In the 1950s and 1960s, various researchers reported on the low levels of hypertension and the lack of significant increase in incidence with age in the Inuit of Alaska and Canada (106,107,134,135,138,141). Hypertension among Russian indigenous populations (Komi, Saami, Dolgan, Nganasan, Evenk, Chukchi, Koryak and Yakut) was also significantly rarer than among the settler population (86,91,95,108,110,136,137).

In his 1980 monograph entitled *Ischemic heart disease in the Far North*, Turchinsky studied the Nganasan of Taymyr. Of 158 participants, ischaemic heart disease was found in 5, and he found no cases of hypertension. Turchinsky also reported that the prevalence of hypertension did not significantly increase with age, and the cases of ischaemic heart disease were all asymptomatic, and were only diagnosed through electrocardiography (110). Other researchers in Taymyr such as Polikarpov found a low morbidity rate for ischaemic heart disease among both the Dolgans (2.72 per 1,000) and Nganasan (2.01 per 1,000) (142).

Low rates of myocardial infarction were found among Inuit in Alaska by Maynard in the 1960s and 1970s (135) and in Greenland by Dyerberg and Bang (132). Feldman estimated that the rate of ischaemic heart disease among the Inuit of Alaska was one-tenth that in the US population as a whole (133).

In the 1950s, various researchers found a low rate or near absence of atherosclerosis among the Inuit of Alaska and Canada (143,144). In Yakutia, Afanasyeva showed that atherosclerosis is seen significantly more often in the settler population than in the indigenous population. Furthermore, the clinical signs of atherosclerosis in the non-native population are seen 10 years earlier than in the native population (86). A small number of patho-anatomical studies carried out primarily in Yakutia also showed a lower rate and degree of manifestation of atherosclerosis, as well as the decade delay found in the indigenous populations of the Far North compared to the settler population (86,112,145–147). Argunov compared the normal vasculature of children and young people in the indigenous and settler populations and

found that the indigenous group had a significantly thinner intima of the aorta and coronary arteries. He concluded that these features of the arterial walls developed under the influence of genetics as well as dietary and lifestyle factors (112).

The results of the majority of studies carried out among the northern populations showed a relatively low rate of vascular disease in the Arctic indigenous populations. In addition, a number of researchers have expressed the opinion that haemodynamic findings of those indigenous populations who have preserved their traditional ways should be differentiated from those consuming a more modern diet (41,110,148,149). This point of view is based on the results of multiple studies carried out comparing indigenous populations with a traditional diet and lifestyle to those with a modern lifestyle. These studies have shown that a change from a traditional lifestyle and diet gives rise to the so-called effects of acculturation – a change in the evolution-fortified haemodynamic parameters. According to a majority of these researchers, observed transformations include an increase in arterial pressure, an increase in serum cholesterol levels, and an increase in the number in the population suffering from hypertension and ischaemic heart disease among those individuals who have, for 1 reason or another, left the traditional lifestyle (33,106,112,131,138,141,146,148–153).

In recent decades, many researchers have observed an increase in circulatory disorders among the indigenous populations of the Far North (39,46,110,112,146,152,154). The primary reason for this negative trend is metabolic de-adaptation as a result of change from the traditional diet (39,42,46,155,156). Among those individuals who were compelled to stop adhering to a traditional diet, an increase in psychoemotional stress was also observed, as well as activation of the sympathetic nervous system and the hypothalamo-hypophyseal-adrenal axis, which points to significant changes in hormonal regulation of metabolism (42,156). Other effects of the sharp decrease in consumption of traditional foods are marked deficiencies in vitamin A and E, both fat-soluble vitamins. These vitamins are an important component of the antioxidant system and prevent excessive activation of lipid peroxidation processes (42,117,120). It is depletion of antioxidant protection and excessive lipid peroxidation which are primary drivers in the development of hypertension and ischaemic heart disease in northern indigenous populations (42,89).

The data provide evidence that, through adaptive processes, the Arctic indigenous peoples evolved a circulatory system genotype that is optimal for Arctic conditions, and was protective against the development of atherosclerosis and associated ailments. However, studies in recent years have shown that the influence of modern civilization and urbanization, and a deviation from

traditional lifestyle and dietary practices, has caused an increase in hypertension and ischaemic heart disease in the indigenous population.

Several studies of pulmonary problems in the Far North have found a high prevalence of respiratory disorders in northern populations, especially chronic obstructive pulmonary disease among the Inuit of Alaska and Canada (98,157–159). This is attributable to exposure to low temperatures.

The significance of cold in the pathogenesis of pulmonary disease in Northerners is well accepted among Russian researchers (42,43,160–162). The high prevalence of respiratory disorders in residents of northern territories, regardless of ethnic origin, has been reported (22,42,46,127,128,131,163–166). It has been shown that the peak of respiratory pathology is during the winter months (43,160). Fluorographic diagnosis of pneumonia by Kartseva and Graschenkova among the indigenous population of the Evenkiysky and Yamalo-Nenetsky Federal Okrugs was 32.0 per 1,000 population, compared to 7 per 1,000 population among the settlers (129). Kartseva and Graschenkova emphasized that a large proportion of pneumonia was found among indigenous hunters with a nomadic or semi-nomadic lifestyle.

The widespread prevalence of chronic, non-specific respiratory ailments among the population of the Far North is in large part due to the extreme climate. This fact helped Avtsyn to conclude that chronic respiratory disorders are endemic to most Arctic regions, with a significant impact on the overall morbidity patterns and rates in the population (161).

Many researchers have found a high prevalence of digestive disorders in Arctic indigenous populations (22,39,121,130,167), which can also be attributed to the shift away from traditional diet and lifestyle (33,131,151).

The morphological pattern of gastrointestinal disorders in the Far North has some specific characteristics. In the indigenous populations, these disorders are often localized to the oesophagus (121,168). In northern Yakutia (among Yakuts and Evens), chronic oesophagitis was found in 23–62% of the study population (168,169). In his dissertation, Tikhonov demonstrated that the prevalence of oesophagitis in the indigenous minority populations was 3 times higher than in the settler population (135 vs. 44 per 1,000 population) (121).

In the Far North, there is a high prevalence of chronic gastritis in both the indigenous and the settler populations (42,121,130,169–172). The predominant form of this disorder was atrophic gastritis (42,173). A significant proportion of indigenous individuals participating in the study in Yakutia were diagnosed with atrophic gastritis through endoscopy (166,173). In Krivoschapkin's study of 516 residents of Yakutia, 59% were diagnosed with atrophic gastritis (173). In the northern coastal zone, this figure was 75%. Atrophic changes in the digestive tract

were found at a rate 2 times than that of the settler population. Based on biopsies of the gastric mucosa of 544 participants with chronic gastritis, Loskutova found that the rate of chronic gastritis in indigenous populations was 2.2 times higher than in settlers (174). Other studies showed that the majority of cases of atrophic gastritis had a more subtle clinical progression without clinical manifestations (42,173), and is a reason for delay in seeking medical attention, which has implications for the development of gastric cancer (173).

Erosive gastritis and ulcerative disorders of the stomach and duodenum are diagnosed significantly more often in settlers than in the indigenous populations (42,121,167,175,176). In Yakutia, the prevalence of ulcerative disorders is 4 times greater among the settler population than in the indigenous population. A similar situation was observed in Khanty-Mansiysky Okrug, where the morbidity rate in the settler population was 5.8 times higher than in the indigenous population (176). There is no clear-cut explanation for such pronounced ethnic differences. It is thought that psychoemotional stresses due to the extreme environmental conditions likely play a role (42).

Infectious and parasitic diseases are another important source of pathology in the Far North (22,46,131,171). The close relationship of the indigenous populations with the environment leads to a high prevalence of zoonotic diseases (46,128,131). Opisthorchiasis is endemic in Khanty-Mansiysky and Yamalo-Nenets Okrugs. Brucellosis is endemic in Magadansky Oblast, Chukotka and Taymyr (46). Alveococcosis is endemic in Koryakia and Yakutia (131,170,177). In recent years, due to the influence of anthropogenic factors as well as climate change, a significant transformation in zoonotic infectious diseases in the Far North has been underway, evidenced by major outbreaks of certain zoonoses (33,178). International experts predict that as a result of global warming and the melting of permafrost, there is a high probability that new disease vectors are expanding northwards, introducing new diseases (179).

An increase in tuberculosis has also been observed in the Far North of Russia in recent years (5,6,39,46,131,180). The current situation is complicated by the presence of significant tuberculosis reservoirs in areas traditionally inhabited by indigenous populations (131,180). The high rate of tuberculosis among the indigenous minority populations is associated with the low socioeconomic status of those populations (5,6,128,131,180).

According to the American Association for the Study of Liver Diseases, Arctic indigenous populations are at an increased risk for contracting hepatitis B (181). Studies conducted in various regions of Yakutia found that the prevalence of hepatitis B is significantly higher among Yakuts and Evenks than in the settler population (182–184). One of the primary reasons for this increased

risk and higher morbidity rate is considered to be depressed immunoreactivity, as manifested in a low T-cell count in the majority of infected persons (42,183). Chronic viral hepatitis is one of the main risk factors for the development of hepatocellular carcinoma. The observed increase in hepatocellular carcinoma in recent years is due to the high rate of chronic viral hepatitis and viral hepatic cirrhosis in the population of the Far North (7,185–187).

Malignancies have long been of interest to scholars of Arctic medicine. There is a high incidence of gastrointestinal and bladder cancers in the indigenous populations of Labrador (188). An analysis of 840 cases of cancer between 1950 and 1975 in the Greenland Inuit found predominantly cancer of the oesophagus, cervix, salivary glands and nasopharynx (189,190). These authors also observed that a significant number of malignancies tend to be diagnosed at an advanced stage.

In northern Russia, cancer in the indigenous populations is significantly higher than in the settler populations (33,46,168,173,191). However, the most pronounced differences were found in the cancer mortality rates – as much as 4 times higher in the indigenous population of Chukotka than in the settler population, 3 times higher in Khanty-Mansiysky Okrug and 2 times higher among Evenks (33). The high mortality rate is associated with late diagnosis, due to a lack of oncologic services in predominantly indigenous areas.

Oesophageal and gastric cancers are endemic in most regions of the Far North (46,131,168,187,192). A significantly higher incidence of oesophageal cancer was found in the indigenous populations compared to the settler populations in Yakutia (168,173,187,191), Taymyr (33,131) and Chukotka (33,46). Gastric cancer was the most common cause of oncologic morbidity and mortality in the indigenous population in Koryak Autonomous Okrug, Tyumenskaya Oblast, Chukotka and Yakutia (33,46,131,173,187,193). In recent decades, the rate of lung cancer has been growing. This has been the most prevalent form of cancer in Koryaks, Chukchi and Yakuts (33,46,131). Liver and cervical cancers have also become a priority in several northern regions (33,186,194).

Thus, the literature describes a broad geographic distribution of malignancies in the Arctic regions, predominantly in the indigenous populations, who experience higher morbidity and mortality from cancer than those in the settler population.

Many researchers believe that stress plays a strong role in the many pathologies common in the indigenous populations of the Far North (4,6,24,33,39,46). Indigenous populations who have adapted to extreme environmental conditions are not as well suited to the effects of man-made social and environmental factors (24,46). The social and economic reforms of the decades since the dissolution of the Soviet Union have led to a crisis in the

traditional livelihood of indigenous minority populations, with increasing unemployment, poverty and poor living conditions affecting both their physical and mental health (5,6,24,36,39).

The increase in alcoholism, depression and suicide in the indigenous populations of the Far North offers evidence of the deterioration of their psychological health (5,24,25,36,38,39,195,196). That indigenous peoples are genetically predisposed to alcoholism due to a deficiency in the enzymes that metabolize alcohol – alcohol dehydrogenase and aldehyde dehydrogenase (11,17,197–199) – is widely accepted in Russia. However, in North America, various authors (200–202) provided evidence that the high prevalence of alcoholism in a population is not a result of a genetic deficiency or excess of those enzymes. In his 2008 monograph, *Protecting health in the Far North: Using Yakutia as an example*, Tyrylgin concluded that the problem of alcoholism in the northern indigenous populations cannot be based on their genetics but rather is the result of excessive psychological stress (6). Suicide is an extreme response to stress and the feeling of being in an inescapable situation. The fact that suicides happen at increasing rates in rural areas populated by indigenous peoples speaks for the extreme degree of social and psychological stress in these populations (24,25,36,38,195).

The health profile of the majority of indigenous Arctic populations, regardless of ethnic or regional origin, has many common features, which attest to the influence of similar environmental conditions on health. Genetics also play a role, as natural selection has taken place over the course of centuries and millenia. Many researchers in the past were of the opinion that among Arctic natives, many of the “diseases of civilization” were rarely found. In recent years, a significant increase in circulatory and digestive disorders has been observed. This trend is closely associated with the fact that the indigenous populations are no longer living in their natural environment, and have for the most part departed from the traditional way of life and diet, while experiencing new social and environmental stress.

Chapter 2. Methods and materials

This study was carried out at the Yakutsk Medical Research Centre, which is under the Siberian Division of the Russian Academy of Sciences. It was part of a public contract from the government of Yakutia entitled “Evaluating the health of the indigenous minorities of the Sakha Republic (Yakutia) and optimizing medical assistance using innovative technologies and telemedicine in indigenous settlements” (registration number 636). It was also part of a scientific initiative entitled “Neuroimmune and endocrine mechanisms of disturbances to physical and reproductive health in children and teenagers of the Sakha Republic (Yakutia)” (registration number 004).

2.1. Overview of the study on children

The register of indigenous minority settlements in Yakutia, as defined by law of the Sakha Republic (Yakutia; 22.03.2006 330-3#673-III), includes more than 70 settlements. Since 2005, we have travelled to 19 settlements (27%) in order to examine the child population. The study population was selected from the following regions (Fig. 2.1).

The number of children examined and the settlements where they came from are shown in Table 2.1. They total 2,991 children. A total of 1,565 children with their ethnic origin going back 3 generations were included in the database (Table 2.2).

The children were measured according to standardized methods using a vertical metre stick with a fold-up stool. Weight was measured on a Fairbanks medical scale. Blood pressure was measured using the Korotkoff method (203). These measurements were compared to a database belonging to a laboratory at the Yakutsk Medical Research Center responsible for monitoring the health of the child population.

Sensitivity to the taste of cooking salt was determined based on a modified K. Henkin method (204). For this, a total of 452 children were given 12 solutions of NaCl in distilled water with concentrations between 0.0025 and 5.12%.

The Tanner method was used for evaluating stage of sexual development, with modifications by Skorodok (205,206). Levels of growth hormone and gonadotropic and sex hormones were evaluated in 189 children (123 boys, 66 girls) taken from a group of essentially healthy children (stage I–II of health), living in northern or Arctic regions of Yakutia (Ust-Yansky and Nizhnekolymsky regions). Of the children studied, 87 were of Yakut ethnicity, and 102 belonged to indigenous minority groups (Yukaghir, Chukchi, Even and Evenk). A thyroid panel was performed on 259 of the children (122 boys and 137 girls), who exhibited no thyroid enlargement. Cortisol levels were measured in 82 children. These tests were performed at the biochemical laboratory within the department of molecular genetics of the Yakutsk Research Center for Complex Medical Problems (headed by Dr N.R. Maksimova). Immunofluorescent assays were performed by the Viktor-2 IFA analyser using the Accu-Bing test system (USA). The following pituitary hormones were measured: thyroid-stimulating hormone (TSH), follicle-stimulating hormone (FSH), luteinizing hormone (LH) and growth hormone. In addition, free T3 and free T4, testosterone, dehydroepiandrosterone sulphate, oestradiol and progesterone were measured.

Genetic analysis was performed taking ethnic origin into consideration. In accordance with current practices, ethnic origin was determined through self-identification. These studies were approved by the ethics committee of the Yakutsk Research Center for Complex Medical



Fig. 2.1. Map of study regions and settlements.

Problems. The following criteria were put forth for inclusion into genetic studies: an authenticated signed participation agreement, female or male, 3–17 years of age at the beginning of the study, confirmation of birth

Table 2.1. Settlements and regions of participants in study on children

Settlement	Number of children examined
Belaya Gora, Abyysky region	231
Kebergene, Abyysky region	97
Yuryung-Khaya, Anabarsky region	273
Saskylakh, Anabarsky region	238
Olenegorsk, Allaikhovskiy region	79
Chokurdakh, Allaikhovskiy region	243
Russkoe ustye, Allaikhovskiy region	43
Zhigansk, Zhigansky region	224
Kystatem, Zhigansky region	97
Khonuu, Momsky region	69
Sasyr, Momsky region	191
Saydy, Momsky region	85
Tumat, Ust-Yansky region	26
Sayylyk, Ust-Yansky region	223
Kazachye, Ust-Yansky region	130
Srednekolym'sk, Srednekolym'sky region	145
Berezovka, Srednekolym'sky region	142
Kolym'skoe, Nizhnekolym'sky region	419
Andryushkino, Nizhnekolym'sky region	274
Total	2,991

and residence in the same region, confirmation of residence of parents in the same region and a preference for parents and children older than 5 years of age to also participate in the study. A total of 321 children participated. Allele-specific polymerized chain reaction (207) was used to identify mutations in the CYP 21 –nt656g gene (“intron 2g”) and V281L (“exon 7”). Testing was performed at Mount Sinai Hospital, New York, New York, United States.

Among the team of physicians travelling to settlements were a paediatrician, a radiologist, a neurologist, an endocrinologist, a cardiologist, an otolaryngologist, a child gynaecologist, a urologist, a surgeon, an allergist and an ophthalmologist.

2.2. Overview of the study on adults

The sample was drawn from 12 settlements in 5 regions; all are officially in the register of indigenous minority settlements of Yakutia. Information was collected during 2008–2009. Also included in the sample were individuals from other ethnicities who had been permanently residing in settlements of northern indigenous groups. Between 67 and 94% of the adult population of these communities were screened.

A complete physical examination was performed on 1,324 participants. The majority were from the northern indigenous minority population – 1,001 (75.6%), including Evenks (573, 43.3%), Evens (127, 9.6%), Dolgans (232, 17.5%), Yukaghir (67, 5.1%) and Kamchadals (2, 0.2%) (Table 2.3).

Table 2.2. Ethnic origin of participants in study on children

Ethnicity	Number of participants
Yakut	535
Russian	65
Yukaghir	80
Chukchi	46
Evens	460
Evenks	166
Dolgan	213
Total	1,565

Participants' age and sex are shown in Table 2.4. The majority of participants were women (69.6%), with significantly fewer men (30.4%). Age of study participants was between 15 and 86 years of age. The average age was 44.5 years. The majority was of working age (77.3%). The employment status of participants is shown in Table 2.5.

The population's health was evaluated based on screenings conducted by the following specialists: a cardiologist, a pulmonologist, a neurologist, a gastroenterologist, an otolaryngologist, an urologist, a gynaecologist, a radiologist and an endoscopist. During the screening process, diagnoses were verified through an expert group. The procedure for this included an analysis of complaints, data from the physical examination as well as data from any laboratory or other studies. Medical documentation was also examined. The physical exam included documentation of appearance, percussion, auscultation and palpation. All participants underwent

electrocardiography and sonography of the abdominal cavity. When indicated, fibre-optic oesophagogastroduodenoscopy was performed with subsequent cytologic and histologic studies. Sonography of the pelvic organs, thyroid gland and breasts was also performed.

In order to screen for lipid metabolism disturbances, serum lipid studies were performed on 272 participants, from 20 to 73 years of age. The following tests were performed: total serum cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides and the atherogenic index. Calculation of the atherogenic index was carried out using the following equation: Total cholesterol (TC) - HDL cholesterol/HDL cholesterol (208). The following criteria were used in making the diagnosis of dyslipidaemia: hypercholesterolaemia (TC \geq 5.0 mmol/L), elevated LDL (\geq 3.0 mmol/L), low HDL (\leq 1.0 mmol/L) and hypertriglyceridaemia (\geq 1.7 mmol/L). The degree of abnormality of the atherogenic to anti-atherogenic lipid fraction ratio (atherogenic shift) was evaluated using the atherogenic index: an atherogenic index of greater than or equal to 4 units was considered elevated. All studies were carried out using standardized methods.

Participants were asked to fill out questionnaires in order to elicit more information about their lifestyle. Four groups of questions covered living conditions, material situation, family and lifestyle. In all, 1,073 participants completed the questionnaire, ranging in age from 16 to 86. The average age was 45.9. The number and ethnic composition of the surveyed participants can be found in Table 2.6.

Table 2.3. Ethnic origin and place of residence of participants in study on adults

Region and settlement	Total	Evenks	Evens	Dolgans	Yukaghir	Kamchadaly	Yakuts	Russians	Other
Anabarsky region	438	63	43	230	–	–	93	6	3
Saskylakh	226	49	40	73	–	–	59	3	2
Yuryung-Khaya	212	14	3	157	–	–	34	3	1
Verkhnekolymsky region	197	2	71	–	67	2	40	14	1
Verkhnekolymsk	92	1	53	–	19	2	16	1	–
Nelemnoe	82	–	–	–	47	–	21	13	1
Utaya	23	1	18	–	1	–	3	–	–
Zhigansky region	189	134	–	–	–	–	53	–	2
Zhigansk	88	52	–	–	–	–	34	–	2
Kystatyam	101	82	–	–	–	–	19	–	–
Oleneksky region	314	247	13	2	–	–	48	1	3
Olenek	195	144	9	2	–	–	37	–	3
Kharyyalakh	119	103	4	–	–	–	11	1	–
Ust-Maysky region	186	127	–	–	–	–	44	9	6
Kyuptyy	90	61	–	–	–	–	22	5	2
Ezhantsy	55	52	–	–	–	–	2	1	–
Petropavlovsk	41	14	–	–	–	–	20	3	4
Total	1,324	573	127	232	67	2	278	30	15

Table 2.4. Distribution of participants in study on adults by sex and age group

Sex	Age							
	Total		Under working age (under 16)		Working age (males 16–59, females 16–54)		Above working age (males 60 and older, females 55 and older)	
	No.	%	No.	%	No.	%	No.	%
Male	403	30.4	4	0.3	324	24.5	75	5.7
Female	921	69.6	3	0.2	700	52.8	218	16.5
Total	1,324	100.0	7	0.5	1,024	77.3	293	22.2

Table 2.5. Employment status of participants in study on adults

Employment status	Total		Male		Female	
	No.	%	No.	%	No.	%
Employed	916	69.2	260	64.5	656	71.2
Student	18	1.4	6	1.5	12	1.3
Retired	182	13.7	58	14.4	124	13.5
Disabled, group 1 or 2	57	4.3	22	5.5	35	3.8
Temporarily unemployed	112	8.5	57	14.1	55	6.0
Homemaker, looking after dependents	39	2.9	–	–	39	4.2
Total	1,324	100.0	403	100.0	921	100.0

Table 2.6. Ethnic origin and place of residence of participants who completed questionnaire in study on adults

Region and settlement	Total	Evenks	Evens	Dolgan	Yukaghir	Yakut	Other
Anabarsky region	258	31	20	155	–	48	4
Saskylakh	85	19	18	27	–	21	–
Yuryung-Khaya	173	12	2	128	–	27	4
Verkhnekolymsky region	190	2	71	–	65	36	16
Verkhnekolymsk	88	1	53	–	18	14	2
Nelemnoe	79	–	–	–	46	19	14
Utaya	23	1	18	–	1	3	–
Zhigansky region	189	134	–	–	–	53	2
Zhigansk	88	52	–	–	–	34	2
Kystatyam	101	82	–	–	–	19	–
Oleneksky region	250	192	13	2	–	41	2
Olenek	140	98	9	2	–	30	1
Kharyyalakh	110	94	4	–	–	11	1
Ust-Maysky region	186	127	–	–	–	44	15
Kyuptysy	90	61	–	–	–	22	7
Ezhantsy	73	52	–	–	–	20	1
Petropavlovsk	23	14	–	–	–	2	7
Total	1,073	486	104	157	65	222	39

A database was created based on the results of the screening, containing information from the survey and data from the physical examination, laboratory and other

studies, and diagnoses. In accordance with the study goals, participants were broken into general groups and sub-groups. Databases were created using Statistica for

Windows 6.0. Microsoft Excel 2003 was used to calculate ratios and means, errors, confidence intervals and Pearson correlation coefficients.

Chapter 3. The state of health of the child population

3.1. Demographic and health indicators

A comparative analysis of data on morbidity in children and teenagers in Yakutia showed that the morbidity rates of most clinical illnesses in children and teenagers were higher in Yakutia than in the Russian Federation as a whole (209).

Table 3.1 compares the crude birth rate and infant mortality rate between Yakutia as a whole and its indigenous minority regions, as reported in official statistics. The differences between the 2 groups are small. Within Yakutia, there is regional variation. The infant mortality rate in 2006 ranged from a low of 6.3 per 1,000 in the city of Yakutsk to several times higher in indigenous minority regions such as Allaikovsky (41 per 1,000), Anabarsky (37 per 1,000), Nizhnekolymsky (55 per 1,000) and Ust-Maysky 38 per 1,000).

The leading causes of death in children aged 1–14 years and 15–17 years were injury, including poisoning, followed by congenital malformations.

In 2006, the rate of officially registered disease cases among children aged 17 and younger was significantly higher in indigenous minority regions than in Yakutia as a whole. The highest rates were observed in the Arctic and Subarctic regions of Allaikovsky, Nizhnekolymsky, Oymykonky and Srednekolymsky. For children aged 14 and younger, the top 2 regions for child morbidity were Ust-Maysky and Oymykonky regions.

A comparative analysis of data on the rate of morbidities registered in children living in northern indigenous minority regions shows that, for the majority of clinical illnesses, the rate is higher than in the Russian Federation as a whole. Such data on morbidity, however, are based on the existing official statistics, which are dependent on the population seeking medical attention. Therefore, the utility of these data is limited (210). For a more detailed analysis of medical and demographic

processes in the northern indigenous minority populations, the Ministry of Health of the Russian Federation is considering including in their statistical tallies a column for ethnicity. This would undoubtedly help in obtaining objective information about the state of health of northern indigenous minorities.

3.2. Data from clinic patients

We performed a retrospective analysis of the results of examinations performed on 2,385 teenagers seen at the Pediatric Center of Republican Hospital 1 in 2005–2007. Participants ranged in age from 15 to 17 years. Participants were divided in groups based on residence in 1 of 4 medical-geographic zones: the Arctic zone (10%), Vilyusk zone (16%), Central zone (69%) and Southern zone (5%). Of the total participants, 759 (32%) resided in urban areas, and 1,626 (68%) resided in rural areas.

The most common illnesses found were nervous system disorders (24%), respiratory disorders (16%) and circulatory disorders (14%) (Fig. 3.1).

Of the nervous system disorders diagnosed, the most prevalent were encephalopathies (33%), autonomic nervous system disturbances (30%), hypoxic brain injury (17%) and epilepsy (11%). Of the respiratory disorders, 78% were in the upper respiratory tract. Of these, the most common were tonsillitis (35%); chronic rhinitis, nasopharyngitis or pharyngitis (16%); and vasomotor and allergic rhinitis (10%). The majority of circulatory disorders (56%) involved the heart, including non-rheumatic valvular defects (15%), arrhythmias (10%) and acute or chronic rheumatic disease of the heart (3%).

The distribution of the main types of illness varied significantly between the sexes. Pathologies of the nervous system, circulatory system and musculoskeletal system, as well as trauma and poisoning and other external causes, were seen significantly more often in boys than in girls. However, girls had more endocrine and urogenital disorders.

Despite differences in lifestyle and socio-economic conditions between urban and rural areas, the distribution of illnesses was very similar between teenagers living in rural and urban areas. Disorders of the genitourinary system were observed significantly more often in teenagers residing in urban areas (7.6% compared with 5.2%).

Table 3.1. Selected health indicators in Yakutia, 2002–2006

	2002	2003	2004	2005	2006
Birth rate (per 1,000 population)					
Yakutia	14.6	15.0	15.5	14.3	14.4
Indigenous minority regions	14.5	13.7	14.4	13.0	13.7
Infant mortality rate (per 1,000 livebirths)					
Yakutia	15.2	13.2	13.5	10.6	10.6
Indigenous minority regions	14.8	15.1	14.9	11.3	13.3

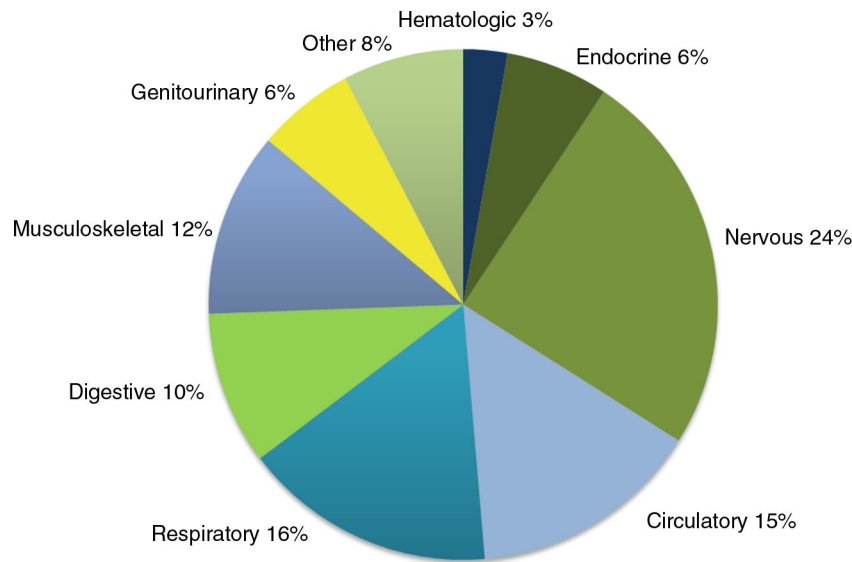


Fig. 3.1. Distribution of disorders in teenagers presenting to the Pediatric Center of Republican Hospital 1.

On the contrary, disorders of the skin and subcutaneous tissue were observed significantly more often in teenagers residing in rural areas (4.1% compared with 1.8%), as were neoplasms (0.9% compared with 0.1%). Teenage girls living in urban areas reported disorders of the reproductive organs twice as often as did teenage girls living in rural areas (9.4% compared with 4.7%). We also found that teenagers living in rural areas had infections of the skin and subcutaneous tissue, dermatitis and eczema significantly more often than those living in urban areas (2.5% compared with 0.7%). Neoplasms were diagnosed almost exclusively in rural teenagers.

3.3. Results of screening examinations

In this section, we will present the results of the screening examinations conducted on the child population of indigenous minority settlements in northern Yakutia. The child populations of 8 regions were examined: Abyysky, Anabarsky, Allaikhovsky, Zhigansky, Ust-Yansky, Momsky, Srednekolymsky and Nizhnekolymsky. The number of participants from each region was given in Chapter 2.

We determined the prevalence of health problems in children from the different ethnic groups living in indigenous minority settlements. A detailed table is available in the appendix (Appendix Table 1).

The overall prevalence of disease in children living in indigenous minority settlements in northern Yakutia was 117 cases per 100 children examined. Among Yakut and Russian children, the rate was 131 cases per 100 children; among children from indigenous minority groups of the North, it was 108 cases per 100 children. The most prevalent diseases among children were diseases of the eye and adnexa (24 per 100 children), disorders of the respiratory system (18 per 100 children), disorders of the

endocrine system and metabolism (14 per 100 children) and disorders of the genitourinary system (9 per 100 children). Among Yakut children, the most prevalent disorders were disorders of the eye and adnexa (25 per 100 children), respiratory disorders (24 per 100 children) and disorders of the endocrine system (15 per 100 children). Among Russian children, the most prevalent disorders were disorders of the eye (60 per 100 children), respiratory disorders (17 per 100 children) and disorders of the genitourinary tract (12 per 100 children). Among children from indigenous minority groups, the common disorders were that of the endocrine system (14 per 100 children), eye (21 per 100 children) and respiratory tract (15 per 100 children).

Disorders of the eye consisted predominantly of myopias of varying degrees and secondary retinal angiopathy. Disorders of the respiratory system mainly constituted disorders of the upper respiratory tract, chronic tonsillitis, adenoiditis and rhinitis. Of endocrine disorders, hypothyroidism, weight deficit, exogenous constitutive obesity and delay in puberty in teenagers were seen most often. Genitourinary disorders were predominantly urinary tract infections of non-specific aetiology, varying degrees of chronic pyelonephritis and urethritis. Many cases of disorders of the reproductive organs were also reported in children: in girls, dysmenorrhoea, oligomenorrhoea and amenorrhoea; and, in boys, varicocele, hydrocele and cryptorchidism.

Our findings provide information that can be used by medical teams planning visits to remote areas to provide health care to children. Most effective would be a team including specialists in paediatrics, radiology, otolaryngology, endocrinology, neurology, nephrology, gynaecology, urology, ophthalmology and gastroenterology.

The prevalence of disease in a particular region depends on the region's current level of access to health care. For example, in the village of Saydy, in the Momsky region, due to a lack of otolaryngology services, over several years the prevalence of ear disorders in children rose to 25 per 100 children, with all affected children having chronic otitis media.

3.4. Physical development of the child

Anthropometric studies were carried out in order to evaluate the physical development of children from indigenous minority groups of northern Yakutia. The average height and weight of Yakut boys and girls were compared to the averages for Russian, Even, Evenk, Yukaghir and Chukchi children (Tables 3.2, 3.3, 3.4 and 3.5).

As shown in Tables 3.2 and 3.3, by the teenage years, the average height for Russian children exceed that of Yakuts and the other ethnic groups.

Similarly for weight, by the teenage years, Russian boys and girls are heavier than Yakuts and children of other ethnic groups (see Tables 3.4 and 3.5).

This comparison of the anthropometric characteristics of Russian and Yakut children to northern indigenous minority children confirmed the existence of ethnicity-specific differences in height and weight. There is a need for developing regional standards for indigenous and settler children, but such efforts are hampered by small numbers. More extensive surveys are needed.

3.5. Blood pressure and taste sensitivity to salt

We compared age-specific blood pressure data of Russian children, Yakut children and children from northern indigenous minority groups. The results are displayed in Figs. 3.2 and 3.3.

Overall, it can be seen that Russian children tend to have lower systolic and diastolic blood pressure than Yakut and indigenous minority children.

The mean threshold for taste sensitivity to cooking salt in Russians was 0.369 ± 0.364 , in Yakuts 0.627 ± 0.547 , in Evens 0.654 ± 0.918 , in Evenks 0.627 ± 0.439 , in Yukaghir 0.480 ± 0.518 , in Chukchi 0.267 ± 0.092 and in Dolgan 1.291 ± 1.301 .

We found that Russian children had a significantly lower taste sensitivity threshold to cooking salt than Yakut, Even, Evenk and Dolgan children. Dolgan children had a significantly higher taste sensitivity threshold than Russian, Yakut, Even and Yukaghir children.

We investigated the correlation among age, height, weight, systolic and diastolic blood pressure and taste sensitivity threshold. As expected, age, anthropometric values and blood pressure are all highly intercorrelated. We found a low correlation between height and taste sensitivity to cooking salt ($r=0.15$), systolic arterial pressure and taste sensitivity to cooking salt ($r=0.20$) and diastolic arterial pressure and taste sensitivity to cooking salt ($r=0.22$).

3.6. Sexual development and hormonal status

We investigated ethnic differences in endocrine function by determining hormone levels at different stages of sexual development in children of northern indigenous minority groups and those of Yakut ethnicity.

There was a significant difference in FSH and LH levels between Yakut girls and indigenous minority girls from the 10- to 14-year-old age group. The average FSH level in Yakut girls was 11.13 mIU/mL, compared to 7.39 mIU/mL in indigenous minority girls. The average LH level in Yakut girls was 14.47 mIU/mL, and it was 6.95 mIU/mL in indigenous minority girls. In Yakut girls, both FSH and LH levels were higher than in indigenous minority girls. In comparing hormone levels with the development of secondary sexual characteristics, we confirmed that Yakut girls surpassed indigenous minority girls in reproductive development. Levels of other anterior pituitary hormones (TSH and growth hormone),

Table 3.2. Height-for-age in Yakut, Russian, Even, Evenk, Chukchi and Yukagir boys

Age	Yakut		Russian		Evens		Evenks		Chukchi		Yukaghir	
	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD
1	2,236	72.4 \pm 5.4	1,066	73.6 \pm 5.1	99	73.76 \pm 4.4	73	74.2 \pm 2.6	7	74.2 \pm 1.4	6	76.0 \pm 6.0
3	1,498	91.8 \pm 5.0	930	93.3 \pm 4.9	61	91.0 \pm 5.4	39	95.2 \pm 3.9	7	92.0 \pm 4.0	4	94.0
6	1,397	112.3 \pm 5.4	861	113.6 \pm 5.1	67	112.9 \pm 4.4	56	110.6 \pm 4.7	11	109.5 \pm 1.5	7	115.2 \pm 6.3
7	1,549	117.1 \pm 5.7	934	119.5 \pm 5.2	63	116.3 \pm 6.8	54	114.9 \pm 10.3	4	117 \pm 6.5	7	118.8 \pm 3.5
10	1,302	133.05 \pm 5.3	949	136.7 \pm 5.6	61	130.1 \pm 5.0	54	131.9 \pm 5.0	6	136.8 \pm 4.7	6	130.3 \pm 2.4
12	1,457	142.3 \pm 6.8	169	147.0 \pm 6.5	75	138.9 \pm 6.0	65	142.9 \pm 5.8	10	148.6 \pm 6.7	5	155 \pm 2.6
14	1,438	154.3 \pm 5.5	851	159.5 \pm 6.8	76	152.5 \pm 5.9	69	156.3 \pm 4.2	20	156.4 \pm 4	5	157.6 \pm 3.8
15	2,287	161.2 \pm 6.7	1,382	165.1 \pm 6.9	82	156.4 \pm 6.8	63	159.7 \pm 7.0	4	160.25 \pm 8.6	4	160.7 \pm 3.6
16	2,219	161.1 \pm 6.0	1,450	169.4 \pm 6.8	77	164.7 \pm 5.9	61	163.5 \pm 5.9	8	164.5 \pm 5.25	4	162.5 \pm 4.8
17	2,577	167.6 \pm 5.6	1,552	196.9 \pm 6.4	70	166.8 \pm 4.8	70	167.29 \pm 5.5	5	166.2 \pm 4.6	2	168 \pm 7.8

Table 3.3. Height-for-age in Yakut, Russian, Even, Evenk, Chukchi and Yukagir girls

Age	Yakut		Russian		Evens		Evenks		Chukchi		Yukagir	
	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD
1	2,042	71.5 \pm 5.3	991	71.8 \pm 4.7	70	73.2 \pm 3.6	64	74.1 \pm 3.6	8	71.0 \pm 3.0	8	77.5 \pm 4.5
3	1,421	91.37 \pm 5.0	928	92.6 \pm 4.5	67	90.4 \pm 4.9	41	92.2 \pm 3.6	4	92.8 \pm 2.5	5	92.6 \pm 3.6
6	1,338	110.87 \pm 5.7	881	113.6 \pm 5.0	61	110.6 \pm 5.5	53	111.9 \pm 3.6	5	105.8 \pm 2.5	8	120 \pm 2.0
7	1,425	116.8 \pm 5.2	919	118.82 \pm 5.4	63	116.0 \pm 5.3	48	115.8 \pm 4.5	10	112.5 \pm 2.5	8	115 \pm 5.5
10	1,251	132.5 \pm 6.0	852	136.2 \pm 5.4	65	131.4 \pm 4.5	67	132.2 \pm 5.4	5	139.2 \pm 2	6	132.1 \pm 4.1
12	1,543	144.3 \pm 6.4	911	148.3 \pm 6.4	81	142.2 \pm 6.8	60	139.8 \pm 7.0	6	149 \pm 4.3	6	139 \pm 4.3
14	1,316	154.2 \pm 5.5	815	157.6 \pm 5.4	66	150.9 \pm 5.2	78	154.8 \pm 4.0	5	156.5 \pm 6.5	4	154 \pm 4
15	2,276	157.9 \pm 4.8	998	159.8 \pm 5.5	83	156.1 \pm 4.5	64	156.6 \pm 4.2	5	157.5 \pm 4.5	4	153.3 \pm 2.9
16	2,024	158.9 \pm 4.7	1,141	161.8 \pm 5.4	71	155.7 \pm 5.7	58	158.1 \pm 4.2	16	159.5 \pm 3.5	6	155.2 \pm 4.9
17	2,429	160.6 \pm 4.9	1,671	163.1 \pm 5.0	85	157.7 \pm 4.5	81	159.4 \pm 3.8	5	166.2 \pm 4.6	5	156.8 \pm 5

thyroid hormones (free T4 and free T3) and sex hormones (progesterone and oestradiol) were all within normal range, and no differences among ethnicities were found. Among boys aged 10–14 years, there were differences in FSH and progesterone levels. FSH and progesterone levels were higher in Yakut boys than in indigenous minority boys in this age group. The average FSH level in Yakut boys was 8.01 mIU/mL, and in indigenous minority boys it was 5.53 mIU/mL. In Yakut boys, the average progesterone level was 1.28 ng/mL, and in indigenous minority boys it was 0.60 ng/mL. Among Yakut and indigenous minority boys aged 14–18 years, hormone levels were within the normal range for this age group.

An analysis of average levels of pituitary hormones (TSH, FSH, LH and growth hormone), thyroid hormones (free T4 and free T3) and sex hormones (testosterone, oestradiol and progesterone) in Yakut and indigenous minority boys living in identical climate and geographical conditions showed no ethnicity-associated differences in hormone levels.

In carrying out a correlational analysis of physical and sexual development and hormone levels among indigenous girls, a significant correlation was found between testosterone level and age, height, weight, quantity of pubic hair and degree of breast development; between level of dehydroepiandrosterone and height, weight, amount of axillary hair, amount of pubic hair and degree of breast development; and between progesterone and weight (Table 3.6). Among boys, there was a significant correlation between testosterone level and age, height, weight, quantity of pubic hair, volume of right and left testicle and degree of sexual development on the Tanner scale. There was a negative correlation between levels of growth hormone, TSH and thyroid hormones and physical and sexual development indicators (Table 3.7). Our results were in accordance with what is known about hormone levels and physical and sexual development from the literature.

According to the literature, the first sign of puberty is the appearance of LH spikes during sleep. In boys, a significant increase in LH and FSH levels signifies the

Table 3.4. Weight-for-age in Yakut, Russian, Even, Evenk, Chukchi and Yukagir boys

Age	Yakut		Russian		Evens		Evenks		Chukchi		Yukagir	
	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD
1	2,236	9.8 \pm 1.8	1,066	10.3 \pm 2.4	99	10.14 \pm 1.4	73	9.9 \pm 1.0	7	9.0 \pm 0.6	6	10.67 \pm 0.9
3	1,498	14.4 \pm 1.7	930	14.0 \pm 1.5	61	13.9 \pm 1.4	39	14.6 \pm 1.3	7	13.3 \pm 0.89	4	13.5 \pm 0.5
6	1,397	19.98 \pm 2.6	861	19.9 \pm 2.4	67	20.0 \pm 2.2	56	19.2 \pm 1.9	11	21.5 \pm 0.5	7	21.0 \pm 2.9
7	1,549	22.56 \pm 3.3	934	23.2 \pm 3.4	63	23.5 \pm 4.1	54	24.9 \pm 8.2	11	21.5 \pm 2.0	7	22.89 \pm 1.4
10	1,302	31.1 \pm 4.3	949	32.9 \pm 4.8	61	29.9 \pm 2.4	54	29.6 \pm 3.6	6	33.5 \pm 3.5	6	29.0 \pm 1.67
12	1,457	38.3 \pm 6.3	169	40.4 \pm 6.5	75	37.4 \pm 5.5	65	36.4 \pm 4.5	5	37.0 \pm 6.4	3	42.33 \pm 3.8
14	1,438	45.9 \pm 6.7	851	50.2 \pm 7.8	76	45.6 \pm 7.4	69	45.5 \pm 5.2	5	46.4 \pm 7.7	5	51.6 \pm 7.4
15	2,287	51.46 \pm 7.0	1,382	54.5 \pm 7.6	82	47.1 \pm 6.1	63	46.98 \pm 5.9	17	52.0 \pm 10.5	4	52.0 \pm 7.0
16	2,219	54.49 \pm 6.6	1,450	58.7 \pm 7.8	77	53.4 \pm 7.6	61	51.4 \pm 5.1	8	54.25 \pm 4.7	4	53.5 \pm 2.7
17	2,577	57.34 \pm 6.6	1,552	60.3 \pm 7.8	70	55.2 \pm 5.6	70	56.4 \pm 5.0	5	56.4 \pm 3.4	2	67.5 \pm 13.5

Table 3.5. Weight-for-age in Yakut, Russian, Even, Evenk, Chukchi and Yukagir girls

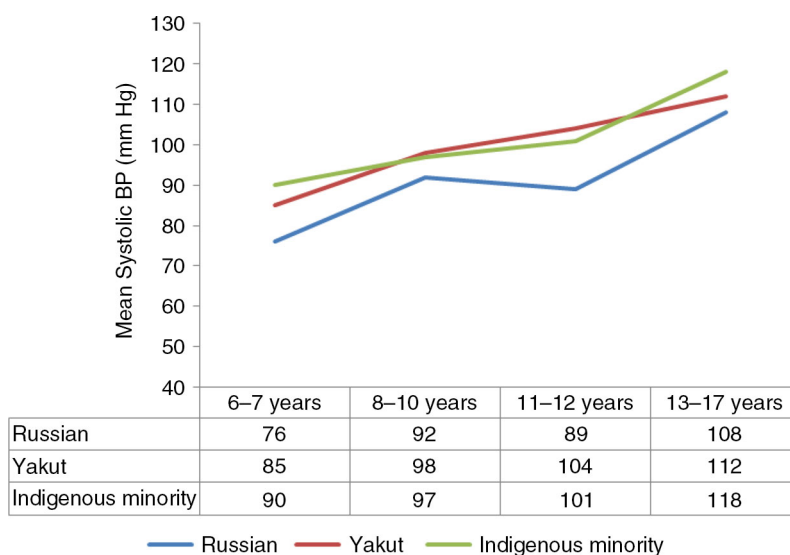
Age	Yakut		Russian		Evens		Evenks		Chukchi		Yukagir	
	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD	No.	Mean \pm SD
1	2,042	9.5 \pm 1.9	991	9.28 \pm 2.1	70	9.7 \pm 1.2	64	10.05 \pm 1.2	8	8.63 \pm 1.12	8	10.63 \pm 1.3
3	1,421	14.27 \pm 2.0	928	13.6 \pm 1.6	67	14.09 \pm 1.6	41	13.9 \pm 1.4	4	14.5 \pm 0.1	5	13.4 \pm 0.72
6	1,338	19.2 \pm 2.4	881	19.8 \pm 2.5	61	18.7 \pm 2.0	53	19.25 \pm 2.4	5	16.6 \pm 1.9	8	19.5 \pm 0.5
7	1,425	21.5 \pm 2.8	919	22.8 \pm 0	63	21.1 \pm 2.5	48	24.9 \pm 8.2	10	2.0 \pm 05	8	22.75 \pm 2.6
10	1,251	30.09 \pm 4.5	852	31.8 \pm 4.5	65	28.7 \pm 3.6	67	29.18 \pm 4.0	5	31.2 \pm 3.8	6	33.5 \pm 1.3
12	1,543	38.29 \pm 5.6	911	40.7 \pm 6.2	81	37.7 \pm 5.7	60	38.07 \pm 6.7	6	33.5 \pm 3.5	6	29.0 \pm 1.7
14	1,316	45.9 \pm 7.3	815	49.2 \pm 7.9	66	43.5 \pm 8.7	78	44.7 \pm 6.0	5	56.0 \pm 69	8	44.5 \pm 6.0
15	2,276	49.5 \pm 5.6	998	51.4 \pm 6.4	83	47.2 \pm 4.9	64	48.5 \pm 4.9	5	50.0 \pm 2.0	5	48.0 \pm 4.0
16	2,024	51.48 \pm 5.6	1,141	53.6 \pm 6.5	71	50.0 \pm 7.4	58	50.5 \pm 4.4	4	55.25 \pm 2.7	6	50.17 \pm 3.8
17	2,429	53.3 \pm 5.6	1,671	55.6 \pm 6.4	85	52.1 \pm 5.9	81	51.0 \pm 5.2	4	52.2 \pm 3.0	5	49.2 \pm 6.0

second stage of sexual development. Girls in the pre-pubertal stage, as well as throughout puberty, have higher FSH levels than boys, whose FSH levels are nearly identical throughout the sexual maturation period. An appreciable increase in testosterone in boys begins between the third and fourth stages, and by the fourth stage the testosterone level increases sharply, reaching the sexually mature level. Oestrogen levels in girls begin to be higher than boys' in the pre-puberty years. Increases in oestrogen levels are seen in boys by the second stage of sexual development. Increases in testosterone levels in girls begin in the fourth stage, according to the literature (211). Until the third stage, testosterone levels in girls are low.

Indigenous populations living in their historical homeland are better at maintaining homeostasis, evidenced by intensive pituitary activity regulating the processes of sexual development. Our study showed that children

from the indigenous population of Yakutia had elevated levels of gonadotropic hormones (FSH and LH). It is thought that, in indigenous children with a traditional lifestyle, adrenal cortical activity is low. In the pre-pubertal and pubertal ages, we found low levels of cortisol in girls and boys living in indigenous minority settlements where a traditional lifestyle is maintained (see Table 3.8).

Between Yakut and indigenous minority children living in the same climate and geographic conditions, no ethnicity-related differences were found in levels of pituitary hormones (TSH, FSH, LH and growth hormone), thyroid hormones (free T3 and free T4) or sex hormones (testosterone, oestradiol and progesterone). These hormone studies confirmed that indigenous children and teenagers have adaptive mechanisms for regulating hormones in response to the extreme conditions of the Far North.

**Fig. 3.2.** Mean systolic blood pressure of Russian, Yakut and indigenous minority children in selected age groups.

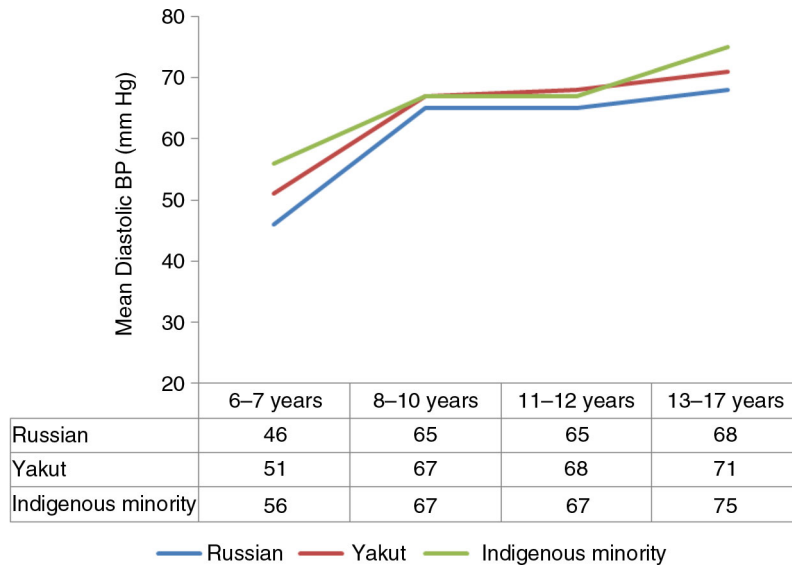


Fig. 3.3. Mean diastolic blood pressure of Russian, Yakut and indigenous minority children in selected age groups.

3.7. Genetic heterogeneity in non-classical 21-hydroxylase deficiency

Between 2004 and 2007, clinical and genetic studies were performed on 318 children between 3 and 17 years of age living in Pokhodsk, Chersky, Kolymsk, Andryushkino, Iengra, Neryungri, Zhigansk, Olenek and Yakutsk.

Table 3.9 shows the frequency of 2 mutations responsible for classical and non-classical forms of congenital adrenal hyperplasia in children, by ethnicity.

Among Evens, the mutation frequency for the classical form of congenital adrenal hyperplasia was 2.4:100. In the general population, the mutation frequency is 0.2:100. This mutation was absent in the other ethnic groups. The mutation frequency for the non-classical form of congenital adrenal hyperplasia was found most often in Yukaghir (5:100), Chukchi (4.9:100) and Evens (4.2:100). The mutation frequency in the overall population of the Far North was 2.3:100. Therefore, the mutation

Table 3.6. Association between physical and sexual development and hormone levels in indigenous girls

	TSH	T ₄	T ₃	Testosterone	GH	FSH	LH	Progesterone	Estradiol
Age	-0.04	-0.01	-0.17	0.53	-0.1	0.41	0.4	0.35	0.23
Height	-0.1	-0.02	-0.01	0.54	-0.05	0.42	0.5	0.34	0.21
Weight	-0.1	0.2	-0.01	0.61	-0.11	0.32	0.36	0.51	0.2
Axillary hair	-0.1	0.11	-0.13	0.43	-0.06	0.46	0.43	0.42	0.1
Pubic hair	-0.04	0.13	-0.2	0.52	-0.05	0.34	0.26	0.4	0.06
Breast development	-0.1	0.11	-0.01	0.6	-0.11	0.45	0.5	0.41	0.37
Tanner scale	-0.04	0.16	-0.13	0.48	-0.05	0.43	0.46	0.3	0.32

Table 3.7. Association between physical and sexual development and hormone levels in indigenous boys

	TSH	T ₄	T ₃	Testosterone	GH	FSH	LH	Progesterone
Age	-0.02	0.16	0.001	0.61	0.32	0.26	0.44	-0.11
Height	0.05	0.00	0.03	0.61	0.2	0.05	0.21	0.002
Weight	0.09	-0.03	-0.07	0.62	0.05	0.11	0.22	-0.08
Axillary hair	0.27	0.18	0.05	0.46	0.6	0.24	0.22	0.36
Pubic hair	-0.03	0.05	-0.07	0.7	0.6	0.15	0.3	-0.04
Volume, right testicle	0.06	0.08	-0.03	0.7	0.45	-0.1	0.08	-0.1
Volume, left testicle	-0.05	0.08	-0.01	0.65	0.45	-0.1	0.04	-0.1
Tanner scale	0.02	0.1	-0.03	0.57	0.63	0.21	0.31	0.04

Table 3.8. Levels of thyroid hormones and cortisol in indigenous children in Yakutia

Age		TSH mIU/mL	T4 ng/dL	T3 ng/mL	Cortisol nmol/L
Boys	10–14	2.67 ± 1.53	1.22 ± 0.11	1.51 ± 0.48	190.0 ± 136.7
	14–18	2.03 ± 1.49	1.12 ± 0.18	1.58 ± 0.59	298.8 ± 152.2
Girls	10–14	2.31 ± 1.08	1.15 ± 0.15	1.49 ± 0.40	90.38 ± 31.4
	14–18	2.77 ± 2.07	1.14 ± 0.16	1.39 ± 0.42	273 ± 143.4

Table 3.9. Frequency of mutations, by ethnicity

Ethnic group	Intron 2 g		V281L	
	Number of participants	Frequency per 100 participants	Number of participants	Frequency per 100 participants
Chukchi	39	–	41	4.9
Evens	41	2.4	48	4.2
Yukaghir	36	–	40	5.0
Evenks	98	–	106	1.9
Yakut	25	–	49	2.0
Selkup	168	–	168	1.2
Total	486	0.2	486	2.3

frequency for non-classical congenital adrenal hyperplasia is in accordance with earlier obtained data. Among the Yupik, the mutation frequency was 1.7:100 (212).

We found that the mutation frequency is correlated with the size of the population of a given ethnic group ($r = -0.74$). In the Yukaghir, with a population of 476, the mutation frequency was 0.057. In the Chukchi, with a population of 428, the mutation rate was 0.048. In the Evens, with a population of 1,793, the mutation rate was 0.048.

With this, we found that the smaller the ethnic group, the higher the mutation frequency. Our research confirmed a higher prevalence of the non-classical form of 21-hydroxylase deficiency in children from northern indigenous minority groups compared with the Yupik living in southwestern Alaska, where the mutation frequency in the CYP21 gene was 1:60 for heterozygotes (1.7:100).

Chapter 4. The state of health of the adult population

4.1. Major population trends during socio-economic transition

Since the beginning of the 1990s, the Russian Federation has experienced depopulation and a deterioration in health status brought about by significant political and socio-economic changes. The most significant negative trends observed since this transition are a decrease in the birth rate and an increase in the mortality rate. Yakutia has also experienced similar negative shifts in demographic and health status indicators since the beginning

of the 1990s. Between 1990 and 2003, the birth rate in Yakutia decreased from 19.6 to 15.0 per 1,000 population. Over this period, the mortality rate increased from 6.8 to 10.2 per 1,000 population. As a result, the rate of natural increase fell from 12.8 per 1,000 population in 1990 to 4.8 per 1,000 population in 2003. From the Federal Government Statistics Office of Yakutia, we were able to look at specific indicators for the indigenous minority populations of northern Russia in 1990, 1995 and 1999–2003. This included population size, crude birth rate, crude mortality rate and rate of natural increase.

Twenty regions of Yakutia have been designated indigenous minority areas. According to the statistics bureau, in 2003, 56,400 persons (6% of the population of Yakutia) were living in indigenous minority regions, including 21,500 in rural areas (38% of the population of these regions).

Between 1990 and 2003, the overall population of these regions decreased from 72,400 to 56,400. The rate of population decline between 1990 and 2003 was 22%. The population in indigenous minority regions as a proportion of the republic as a whole decreased from 6.5% in 1990 to 5.9% in 2003 (Table 4.1).

Such a significant decrease in the population of indigenous minority regions and in Yakutia as a whole over this period is due primarily to a significant increase in emigration since the beginning of the 1990s. Before the 1990s, immigration to Yakutia was more common. Between 1990 and 2003, the regions experiencing the most emigration were in the north, including indigenous minority regions such as Ust-Yansky, Oymyakonsky,

Table 4.1. Total population (in thousands) in indigenous minority regions

	1990	1995	1999	2000	2001	2002	2003	% Change from 1990 to 2003
Yakutia	1121.3	1035.5	988.6	986.0	982.9	981.3	949.0	- 15.4
Indigenous minority regions	72.4	68.3	63.7	62.1	61.1	60.7	56.4	- 22.1
% of total population of Yakutia	6.5	6.6	6.4	6.3	6.2	6.2	5.9	

Bulunsky, Nizhnekolymsky and Verkhnekolymsky. A significant emigration of the settler population from northern regions was undoubtedly associated with the significant increase in the cost of living in the North, the closing of many businesses and the cancellation of benefits that existed previously for living in the Far North, among other reasons.

While the total population of indigenous minority regions decreased, during this period we also observed that the number of members of indigenous minority groups living in the rural areas of these regions increased by 3.7% (from 20,718 to 21,486). The population growth rate for Evens was 12%; for Dolgans was 22%; and for Yukaghir was 18% (Table 4.2).

During the period between 1990 and 2003, the birth rate in the indigenous minority settlements fell from 23.2 to 14.1 per 1,000 population (by 39%). The rate of decline of the birth rate between 1990 and 2003 was 1.7 times higher than the average for Yakutia as a whole (24%). The mortality rate during that period increased from 8.1 to 10.6 per 1,000 population (by 31%). An especially high mortality rate over that entire period was consistently observed in the following indigenous minority regions: Allaikhovsky, Nizhnekolymsky, Ust-Maysky and Eveno-

Bytantayskiy. As a result of the above trends in birth rate and death rate, the rate of natural increase declined from 15.1 per 1,000 population in 1990 to 3.5 per 1,000 population in 2003 (Table 4.3).

Table 4.4 shows the age-sex distribution of the indigenous minority population. In 2004, the female population was greater than the male population, accounting for 51.8% of the total population. This trend was observed across all of the ethnic groups. For every 100 men, there were 104 women in Evenks; 113 in Evens; 111 in Dolgans; and 105 in Yukaghir. This trend was more pronounced in the above-working-age population. In this age category, the proportion of Evenk men was 34.2%; Evens, 31.1%; Dolgans, 34.3%; and Yukaghir, 27.6%. It should be noted that during this period, the proportion of women was also greater in the population of Yakutia as a whole, including Russians and Yakuts (6).

The rural population of indigenous minority regions also has a disproportionately high proportion of children (34% vs. 26% in Yakutia as a whole in 2004). Among Evenks, this figure was 34%; among Evens, 35%; and among Yukaghir, 35%; and it was highest among the Dolgans, with 40%. The elderly population was, by contrast, a small proportion of the population, only 0.4% of

Table 4.2. Population of indigenous minorities living in rural areas

	1990	1995	1999	2000	2001	2002	2003
Total indigenous minority settlements	20,718	21,077	21,237	20,870	20,989	21,179	21,486
Evenks	12,867	12,914	12,954	12,693	12,532	12,819	12,630
Evens	5,979	6,304	6,400	6,282	6,391	6,402	6,677
Dolgan	958	871	909	907	1,034	934	1,167
Yukaghir	491	560	547	567	612	594	579
Chukchi	408	403	408	399	400	414	414
Nenets	9	6	9	9	8	7	10
Mansi	1	1	1	1	1	1	1
Nanayts	-	5	4	4	4	4	3
Orochi	-	-	-	1	1	1	1
Tofalary	1	5	4	5	3	2	2
Ulchi	1	-	-	-	-	-	-
Khanty	1	1	-	-	-	-	-
Chuvantsy	1	-	-	-	-	-	-
Inuit	1	4	-	-	-	-	-
Tuvilts-todzhints	-	2	1	2	3	1	2
Shorts	-	1	-	-	-	-	-

Table 4.3. Birth, mortality and natural increase rate in Yakutia and indigenous minority regions

	1990	1995	1999	2000	2001	2002	2003	Rate of change between 1990 and 2003 (%)
Birth rate (per 1,000)								
Yakutia	19.6	15.3	13.0	13.5	13.6	14.3	15.0	-23.5
Indigenous minority regions	23.2	15.5	13.4	14.0	13.8	14.4	14.1	-39.2
Mortality rate (per 1,000)								
Yakutia	6.8	9.8	9.6	9.6	10.0	10.0	10.2	+50.0
Indigenous minority regions	8.1	8.2	8.5	10.0	10.2	10.6	10.6	+30.9
Rate of natural increase (per 1,000)								
Yakutia	12.8	5.5	3.4	3.9	3.6	4.3	4.8	-62.5
Indigenous minority regions	15.1	7.3	4.9	4.0	3.6	3.8	3.5	-76.8

the total population of indigenous minorities. In Evenks, they comprised 8.6%; Evens, 9.0%; Dolgans, 6.0%; and Yukaghir, 5.0%. This points to the relatively low number of people living to old age. As a whole, the overall demographic picture of the relatively high proportion of children and the low proportion of older adults in the indigenous minority population is consistent with the literature (6,26,33).

4.2. Major health care indicators

During the difficult years of social and economic reform, a key issue for the Russian public health sector was improving its efficiency. Reform of the health care system in the Russian Federation consisted of decreasing the number of hospital beds, and centralization and reorganization of health care facilities and clinics. In Yakutia, between 1990 and 2005, the total number of health care facilities decreased by 20%, while the number of hospital beds decreased by 31%. Medical and obstetrics centres

decreased by 25%. Over the same period, the number of doctors in all specialties increased by 2.6%, and the number of nurses decreased by 2.0% (6). In this section, we examine health care for the population of indigenous minority areas, as reported to Yakutia's Federal Government Statistics Office in 1990, 1995 and 1999–2003.

Between 1990 and 2003, the number of health care institutions in the indigenous minority regions decreased from 51 to 48 (by 6%). The number of hospital beds decreased from 1,009 in 1990 to 852 in 2003 (by 16%). However, due to the decline in the population, the rate of hospital beds grew from 139 to 151 per 10,000 population (by 9%) (Table 4.5).

Changes in the number of ambulatory clinics and medical and obstetrical centres are shown in Table 4.6, with the former showing an increase and the latter a decrease. The decrease in the number of medical and obstetrics centres was due to the creation of ambulatory

Table 4.4. Distribution of the rural population of indigenous minorities by sex and age, as of January 1, 2004

	Men					Women			
	Total	Age			Total	Age			
		Total	0–15 years	16–59 years		60 and older	Total	0–15 years	16–54 years
Indigenous minority settlements	21,486	10,357	3,766	5,993	598	11,129	3,614	6,303	1,212
Evenks	12,630	6,181	2,201	3,608	372	6,449	2,035	3,698	716
Evens	6,677	3,133	1,154	1,793	186	3,544	1,167	1,964	413
Dolgan	1,167	554	246	284	24	613	221	346	46
Yukaghir	579	283	94	181	8	296	108	167	21
Chukchi	414	198	69	121	8	216	81	122	13
Nenets	10	4	1	3	–	6	2	3	1
Mansi	1	–	–	–	–	1	–	–	1
Nanaytsy	3	2	1	1	–	1	–	1	–
Orochi	1	1	–	1	–	–	–	–	–
Tofalary	2	1	–	1	–	1	–	–	1
Tubints-Todzhints	2	–	–	–	–	2	–	2	–

Table 4.5. Number and rate of hospital beds in indigenous minority regions

	Total					Per 10,000 population				
	1990	1995	2002	2003	% Change from 1990 to 2003	1990	1995	2002	2003	% Change from 1990 to 2003
Yakutia	17,471	16,080	14,349	14,213	-18.6	156	155	151.3	150	-3.8
Indigenous minority regions	1,009	1,029	894	852	-15.6	139	151	158	151	+8.6

clinics from former medical and obstetrics centres in 6 out of 8 regions. This reflects the centralization process carried out as a part of the restructuring of the health care system.

During this period, significant changes also were observed in health care personnel. In indigenous minority regions, the number of physicians of all specialties decreased by 27% between 1990 and 2003, compared to a 0.6% decrease in Yakutia as a whole. A similar trend was observed with nurses (Table 4.7). In 2003, the number of physicians per 10,000 population in indigenous minority regions was half that of Yakutia as a whole (24 compared with 49 per 10,000 population). The number of nurses increased by 10%, but the proportion of the honey sisters in Yakutia is 85%.

The period of reform in Russia exacerbated existing disparities for the indigenous minority regions. There is a serious problem in the provision of health services to a population living in an extreme climate and poor socioeconomic conditions.

4.3. A profile of disease prevalence

In this section, we compare the results of comprehensive medical examinations in 6 ethnic groups (Evenks, Evens, Dolgans, Yukaghir, Yakuts and all others), living in 5 regions of Yakutia (Anabarsky, Verkhnekolymsky, Zhigansky, Oleneksky and Ust-Maysky). Information on the number and ethnic composition of participants was given in Chapter 2. Representatives from the settler population (Russians, Ukrainians, etc.) who were residing permanently in indigenous minority regions were included in the study. This group comprised 3.5% of the population and was categorized as "others."

Detailed breakdown of disease prevalence by categories and ethnic group is provided in Appendix Table 2

and by region in Appendix Table 3. The overall disease prevalence in the study population was 279.6 per 100 participants, or an average of 2 conditions per participant. The highest disease prevalence was among the Yukaghir (315 cases per 100 participants) and Evens (311 cases per 100 participants). The lowest disease prevalence was in the Dolgans (223 cases per 100 participants) and the settler population (226 cases per 100 participants).

The 5 most prevalent categories of diseases were diseases of the digestive (70 per 100), genitourinary (49 per 100), circulatory (48 per 100), respiratory (37 per 100) and musculoskeletal (29 per 100) systems. These 5 diseases played an important role in the health of participants in all of the ethnic groups being studied.

The Evenk and Yakut populations had similar disease patterns, among whom diseases of the circulatory system were the second most common type of disorder, whereas in the other groups it was genitourinary disorders.

Among digestive disorders, the most prevalent were chronic gastritis (53 per 100), chronic pancreatitis (48 per 100) and chronic cholecystitis (44 per 100). The prevalence of chronic gastritis was particularly high in the Yukaghir population (79 per 100). The Dolgans and the settler population had the lowest prevalence of digestive disorders.

The most common genitourinary disease, across all ethnic groups, was chronic pyelonephritis. This disorder was seen at a rate 2 times higher in Evens and Yukaghir (65 and 58 per 100, respectively) than in Evenks (33 per 100), Dolgans (34 per 100), Yakuts (38 per 100) and others (38 per 100). The Even, Yukaghir and other groups showed a higher prevalence of cystic kidney disease.

Among circulatory disorders, the most prevalent were arterial hypertension, ischaemic heart disease and cerebrovascular disorders. The highest prevalence of arterial

Table 4.6. Number of ambulatory clinics and medical and obstetrical centres in indigenous minority regions

	1990	1995	2000	2002	2003	% Change from 1990 to 2003
Ambulatory clinics						
Yakutia	402	665	630	597	602	+49.8
Indigenous minority regions	48	63	50	49	55	+14.6
Medical and obstetrical centres						
Yakutia	306	250	255	234	236	-22.9
Indigenous minority regions	35	28	29	27	28	-20.0

Table 4.7. Number and rate of physicians and nurses in indigenous minority settlements

	1990	1995	1999	2000	2001	2002	2003	% Change from 1990 to 2003
Number of physicians								
Yakutia	4,695	4,555	4,328	4,412	4,449	4,579	4,669	-0.6
Indigenous minority regions	190	163	144	140	130	132	138	-27.4
Rate (per 10,000) of physicians								
Yakutia	42	44	44	45	45	48	49	+16.7
Indigenous minority regions	26	24	23	22	21	23	24	-7.7
Number of nurses								
Yakutia	13,193	13,460	12,624	12,688	12,668	12,887	13,154	-0.3
Indigenous minority regions	780	727	654	658	641	651	674	-13.6
Rate (per 10,000) of nurses								
Yakutia	118	130	128	129	129	136	139	+17.8
Indigenous minority regions	108	106	103	105	105	115	119	+10.2

hypertension was seen in Yakuts (42 per 100) and Evenks (41 per 100), and it was lowest among the Dolgans (25 per 100). Yakuts and Evenks had significantly higher rates of ischaemic heart disease compared with all groups except for the “other” (i.e. settler) group. Five of the ethnic groups (Evenks, Evens, Yukaghir, Yakut and settler) had similar rates of cerebrovascular disease, between 19 and 20 per 100. Dolgans had a much lower prevalence of cerebrovascular disease (9 per 100).

Chronic bronchitis was the most common respiratory disorder in the study population. The highest prevalence was found in the Yukaghir (42 per 100) and Evenks (36 per 100). The “other” group had a significantly lower prevalence of chronic bronchitis (15 per 100).

Evenks and Yakuts had similar prevalence of musculoskeletal disorders. Evens and Yukaghir had a higher prevalence of arthropathies than the others. The “other” group had the lowest prevalence of dorsopathies, and arthropathies were completely absent.

Overall, we found similarities in the pattern and prevalence of disease between the Evens and Yukaghir and also between the Evenks and Yakuts. We propose that such similarities could be due to the genetic similarities between these groups, based on the analyses of mitochondrial DNA and Y chromosomes by Fedorova (213).

In terms of regional variation, we found that in Zhigansky, Oleneksky and Ust-Maysky regions, the most prevalent disorders were circulatory and musculoskeletal disorders. In Verkhnekolymsky region, digestive and genitourinary disorders predominated. Anabarsky region can be characterized by a lower overall disease prevalence compared to the other regions. It is likely that geographical and environmental conditions play a role in the regional patterns observed.

4.4. Lipid metabolism

The high prevalence of digestive and circulatory disorders found in the indigenous minority settlements would alert

one to a possibly high prevalence of lipid disorders in this population. We investigated the lipid profile consisting of TC, HDL, LDL, very-low-density lipoprotein (VLDL), triglycerides and the atherogenic index. The atherogenic index (207) was calculated by the formula $(TC - HDL)/HDL$. The following criteria were used in making the diagnosis of dyslipidaemia: hypercholesterolaemia (total cholesterol ≥ 5.0 mmol/L), elevated LDL (≥ 3.0 mmol/L) and low HDL (≤ 1.0 mmol/L) or hypertriglyceridaemia (≥ 1.7 mmol/L). An atherogenic index of greater than or equal to 4 units was considered elevated.

A total of 272 participants between the ages of 20 and 73 years were studied. The average age was 43.6 ± 9.9 years. More women (62%) than men (38%) were studied. Participants were divided by ethnicity: Evenks (51%), Evens (10%), Dolgans (13%), Yukaghir (11%), Yakuts (13%) and others (3%).

Table 4.8 compares the average serum lipid concentrations among the ethnic groups separately for men and women.

These results are consistent with findings from studies of other Arctic populations, which have shown elevated total cholesterol (20,21,94,138,144). Average LDL cholesterol was above normal in all ethnic groups. Average LDL cholesterol was highest in the “other” group and lowest in the Dolgan group. Average HDL cholesterol was also within normal limits, but in the Dolgan population, especially men, a more pronounced shift towards an anti-atherogenic level was observed. Statistically significant differences were found when comparing HDL cholesterol in Dolgan men to that of men from the “other” group. No appreciable difference was observed between the study groups when comparing triglyceride levels. Evenks had the highest serum triglycerides level, and Dolgans the lowest. The tendency for the “other” group to exhibit more atherogenic lipid levels and for the Dolgan group to have anti-atherogenic levels is reaffirmed in

these groups' index of atherogenicity. The index of atherogenicity in the "other" group was the highest, and it was lowest in the Dolgan group. These differences were more pronounced among men.

In the under-50 age group, there were no significant differences in average lipid levels. Ethnicity-related differences were observed when comparing indicators in the over-50 age group. The differences were predominantly in the atherogenic-to-anti-atherogenic lipid fraction ratio. In the Dolgan population, the average level of anti-atherogenic lipids was significantly higher than in the "other" and Even populations, and the atherogenic index was significantly lower than in the "other," Even and Yakut populations. These results are a reflection and confirmation of the previously discussed trends regarding the tendency in the Dolgan population towards higher anti-atherogenic lipid levels and lower atherogenic lipid levels.

The prevalence of lipid metabolism abnormalities in different ethnic groups is shown in Table 4.9. There was at least 1 abnormal lipid metabolism indicator in 100% of the "other" group, 96% of Evens, 86% of Evenks, 86% of Yakuts, 80% of Yukaghir and 71% of Dolgans. Hypercholesterolaemia was found in 59–77% of participants, with no statistically significant difference between ethnic groups. We found that elevated LDL cholesterol was found in all 7 participants (100%) from the "other"

group. The Dolgans had a significantly lower rate of elevated LDL cholesterol (44%). In addition, the Dolgan population exhibited a significantly lower prevalence of hypoalphacholesterolaemia. The highest rates of hypoalphacholesterolaemia were in the Even (417%) and Evenk (37%) groups. The settler population had the highest rate of above-normal atherogenic index (43%).

4.5. Social and health-related characteristics

This section presents the results of social surveys carried out in indigenous minority settlements. A total of 1,073 individuals participated in the survey. Of these, 258 were residing in Anabarsky region, 190 in Verkhnekolymsky region, 189 in Zhigansky region, 250 in Oleneksky region and 186 in Ust-Maysky region. The majority of those surveyed were of indigenous minority origin (76%) including Evenks (45%), Evens (10%), Dolgans (15%) and Yukaghir (6%). Of the respondents, 30% were men and 70% were women.

Respondents varied in age between 16 and 86 years. The average age of the male respondents was 46.2 ± 1.5 years, and the average age of the female respondents was 45.8 ± 1.5 years. The average age of all respondents was 45.9 ± 1.5 years.

Appendix Table 4 summarizes several socio-economic indicators in the different regions. The proportion of

Table 4.8. Mean serum lipid levels and index of atherogenicity, by ethnic group and sex (\pm standard deviation)

Ethnic group	Sex	Mean lipid values					
		Total cholesterol (mmol/L)	LDL (mmol/L)	VLDL (mmol/L)	HDL (mmol/L)	Triglycerides (mmol/L)	Index of atherogenicity
Evenks	M	5.42 ± 1.34	3.59 ± 0.71	0.37 ± 0.2	1.43 ± 0.9	1.0 ± 0.57	3.38 ± 1.41
	F	5.63 ± 1.46	3.6 ± 0.84	0.39 ± 0.14	1.31 ± 0.66	1.11 ± 0.56	3.25 ± 1.35
	Total	5.56 ± 1.42	3.59 ± 0.79	0.38 ± 0.17	1.36 ± 0.76	1.07 ± 0.56	3.3 ± 1.38
Evens	M	5.03 ± 0.99	3.3 ± 0.75	0.44 ± 0.29	1.28 ± 0.39	0.97 ± 0.63	3.08 ± 0.87
	F	5.41 ± 0.93	3.68 ± 0.75	0.47 ± 0.23	1.25 ± 0.41	1.03 ± 0.51	3.71 ± 1.5
	Total	5.3 ± 0.96	3.57 ± 0.77	0.46 ± 0.25	1.26 ± 0.4	1.01 ± 0.55	3.53 ± 1.37
Dolgan	M	5.33 ± 0.9	2.92 ± 0.68	0.35 ± 0.12	2.07 ± 0.56	0.8 ± 0.28	1.78 ± 1.03
	F	5.50 ± 1.09	3.09 ± 0.79	0.33 ± 0.14	2.04 ± 0.48	0.75 ± 0.3	1.75 ± 0.46
	Total	5.43 ± 1.0	3.01 ± 0.74	0.34 ± 0.13	2.06 ± 0.52	0.77 ± 0.29	1.77 ± 0.78
Yukaghir	M	5.68 ± 0.93	3.84 ± 0.83	0.39 ± 0.19	1.45 ± 0.41	0.85 ± 0.42	3.27 ± 1.54
	F	6.0 ± 1.1	4.12 ± 1.1	0.5 ± 0.27	1.38 ± 0.26	1.09 ± 0.61	3.51 ± 1.2
	Total	5.86 ± 1.03	3.99 ± 0.98	0.44 ± 0.24	1.41 ± 0.34	0.98 ± 0.54	3.4 ± 1.38
Yakut	M	5.01 ± 1.2	3.69 ± 0.91	0.3 ± 0.07	1.34 ± 0.64	0.75 ± 0.28	3.28 ± 1.31
	F	5.86 ± 0.9	4.21 ± 0.82	0.43 ± 0.26	1.19 ± 0.48	1.21 ± 0.79	3.65 ± 1.29
	Total	5.56 ± 1.1	3.99 ± 0.9	0.37 ± 0.21	1.25 ± 0.55	1.04 ± 0.69	3.5 ± 1.31
Other	M	5.53 ± 1.0	4.01 ± 1.02	0.45 ± 0.2	1.07 ± 0.13	1.0 ± 0.43	4.17 ± 0.76
	F	6.4 ± 0.88	4.63 ± 0.9	0.3 ± 0.12	1.46 ± 0.17	0.65 ± 0.27	3.46 ± 0.96
	Total	5.9 ± 1.04	4.27 ± 1.02	0.39 ± 0.19	1.24 ± 0.24	0.85 ± 0.41	3.86 ± 0.92
Total	M	5.37 ± 1.19	3.51 ± 0.84	0.37 ± 0.19	1.46 ± 0.52	0.91 ± 0.49	3.06 ± 1.44
	F	5.68 ± 1.28	3.71 ± 0.94	0.41 ± 0.21	1.46 ± 0.49	1.07 ± 0.59	3.19 ± 1.4
	Total	5.56 ± 1.26	3.63 ± 0.9	0.39 ± 0.2	1.46 ± 0.5	1.01 ± 0.56	3.13 ± 1.42

Table 4.9. Prevalence of lipid metabolism abnormalities, by ethnicity

Lipid metabolism indicators	Evenks (n = 138)		Evens (n = 27)		Dolgans (n = 34)		Yukaghir (n = 30)		Yakuts (n = 36)		Other (n = 7)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
At least 1 indicator within normal range	19	13.8	1	3.7	10	29.4	6	20.0	5	13.9	0	0
Hypercholesterolaemia	86	62.3	16	59.3	22	64.7	23	76.7	27	75.0	5	71.4
High LDL	103	74.6	20	74.1	15	44.1	23	76.7	23	63.9	7	100.0
Hypoalphacholesterolaemia	51	37.0	11	40.7	1	2.9	5	16.7	9	25.0	2	28.6
Hypertriglyceridemia	18	13.0	3	11.1	0	0	4	13.3	3	8.3	0	0
Atherogenic index = 4	38	27.5	10	37.0	1	2.9	8	26.7	9	25.0	3	42.9

pensioners in Zhigansky region (30%) was significantly higher than in the other regions. Ust-Maysky and Anabarsky regions had the greatest proportion of working individuals (66%). There was no significant difference between regions in the proportion of respondents belonging to the other employment categories.

Approximately half of the surveyed population (51%) possessed professional (higher or special secondary) education. The proportion was highest in Oleneksky region (59%) and lowest in Verkhnekolymsky region (43%). The proportion of respondents with no education was 2%, and this varied between 1.2 and 2.4% among the regions.

Significant differences between regions were found when comparing marital status. Regions with the highest proportion of married respondents were: Anabarsky (74%) and Ust-Maysky (67%). This figure was much lower in Verkhnekolymsky (61%), Zhigansky (62%) and Oleneksky (54%) regions.

There are significant gender differences in the unmarried population. The proportion of unmarried women was significantly higher than unmarried men in all regions (39% compared to 29%). This is in part attributable to the greater number of widowed women compared to men. Widowed women outnumbered men in the Ust-Maysky region by 4.3 times, in the Zhigansky region by 4.2 times, in the Verkhnekolymsky region by 3.7 times, in the Oleneksky region by 3.6 times and in the Anabarsky region by 2.8 times. With the exception of the Ust-Maysky region, the proportion of men who had never been married exceeded the proportion of women who had never been married. This difference was most pronounced in the Verkhnekolymsky region (30% compared to 14%).

In terms of family size, distinct differences in number of family members were seen by region (Fig. 4.1). In the Arctic zone (Anabarsky, Zhigansky and Oleneksky regions), there were more families with 6 or more members. In Ust-Maysky region, located in the mixed zone with a mixed ethnic composition and both agricultural and manufacturing industries, 5-member families predominated. The Verkhnekolymsky region, also located in the mixed zone, had predominantly smaller

families with 2 members. This is the result of a high level of poverty and broken families among the respondents.

The number of children in homes is correlated with the total size of the family, and the same regional pattern is observed. The proportion of respondents with 3 or more children was around 50% in the 3 Arctic zones of Anabarsky, Zhigansky and Oleneksky. In the mixed zone, the proportion of respondents with 3 or more children was lower (37% in Verkhnekolymsky and 41% in Ust-Maysky). The regions with the greatest number of childless respondents were Verkhnekolymsky (23%) and Zhigansky (22%).

Of the 338 women of reproductive age surveyed, a mere 41% reported planning to have children in the future. Further analysis revealed that women without children were more than 2 times more likely than women with children to plan on having children in the future (66% compared to 36%). A woman's reproductive plans was not associated with education. Among women with professional education, 39% reported planning on having children in the future, while 45% of women with only general education reported planning on having children.

We investigated the possible barriers to having children. The most important factor for women in Zhigansky, Oleneksky and Ust-Maysky regions was poor health. This was the second most important factor for women in Anabarsky and Verkhnekolymsky regions. In these 2 regions, material and housing problems were the main barrier to having children. One of the most important factors preventing women from having children in Zhigansky and Ust-Maysky regions was the lack of an official marriage, which reflected the local marriage customs in those regions.

Housing conditions among respondents are summarized in Table 4.10. Overall, 42% of respondents were living in a house and 53% in an apartment. The majority of respondents were living in an apartment. An analysis of respondents' accommodation by date built showed a decay in housing resources in indigenous minority settlements. A mere 31% of respondents were living in accommodations built after 1995. In this regard, the most

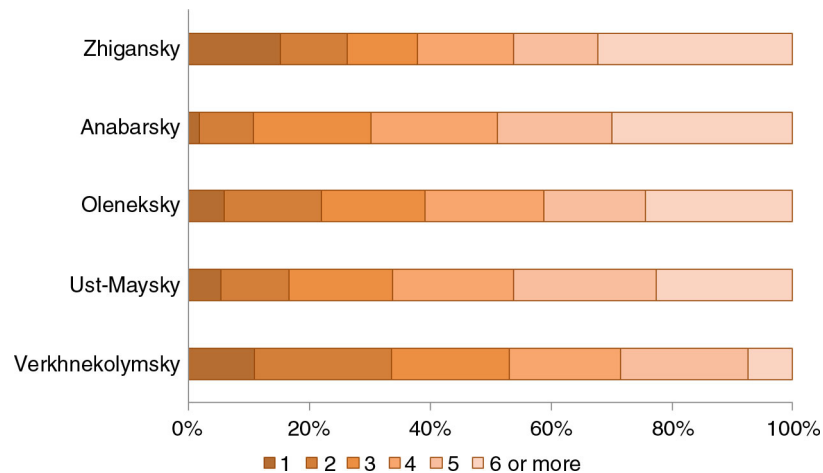


Fig. 4.1. Distribution of respondents by family size and region.

favourable trends were seen in Anabarsky region, where 47% of respondents were living in homes built after 1995.

The survey showed a low number of homes with indoor amenities in the study regions. Central heating was present in 68% of the homes. The regions with the fewest respondents with central heating were Ust-Maysky (19%) and Zhigansky (45%). Running water, sewage lines and hot water were found in only 39% of respondents' homes in Verkhnekolymsky and 14% of homes in Zhigansky region. A complete absence of indoor plumbing and hot water was found among participants living in Anabarsky, Oleneksky and Ust-Maysky regions.

This lack of indoor amenities was reflected in respondents' own evaluation of their living conditions (Fig. 4.2). A mere 15% of respondents rated their living conditions as "good." The greatest proportion of individuals rating their living conditions as "good" were in Anabarsky region (23%). Anabarsky region also had the lowest proportion of respondents who described their living conditions as "unsatisfactory" (23%). Due to the conditions in the villages of Kyuptysy, Ezhantsy and Petropavlovsk of Ust-Maysky region, the number of respondents rating their living conditions as "unsatisfactory" was the highest among all regions, at 43%. Among the primary reasons for respondents' dissatisfaction with living conditions were deterioration of their residential space and lack of amenities. However, the relative importance of these factors varied by region (Fig. 4.3).

In comparing responses to questions about their material situation, no significant difference was found between regions. For nearly a quarter of all respondents in all regions, there was only enough money to buy food. For nearly one-third of respondents, there was enough to buy food and essential goods. For 4–12% of respondents, there was not enough money even for food (Fig. 4.4).

Due to the more favourable climate, environmental and socio-economic conditions in the mixed zone, the

proportion of respondents with subsistence farms was significantly higher than in the Arctic zone. In the indigenous agricultural communities of Anabarsky, Zhigansky and Oleneksky regions, there was virtually no domestic farming or animal husbandry. With regard to animal husbandry, only domestic reindeer were kept by respondents in the Arctic region (Anabarsky, 21%; Zhigansky, 10%; and Oleneksky, 7%).

Among respondents, 89% characterized their way of life as settled, while 11% considered themselves as nomadic or semi-nomadic (hunters, reindeer herders and tent workers). The proportion of nomads and semi-nomads was highest in the Anabarsky and Verkhnekolymsky regions (17 and 16%, respectively). Among ethnic groups, Dolgans (45%) and Evenks (32%) had the highest reported proportion of nomads and semi-nomads.

The results of this survey allowed us to identify problems related to the marriage structure, living conditions and material situation of the surveyed population. The analysis of the marriage structure revealed a high proportion of single people, including those who were widowed and the never-married. Living conditions of the surveyed population can be characterized by deteriorating accommodations and an extremely low level of indoor amenities. The majority of the population of indigenous agricultural communities have significant material difficulties.

Discussion

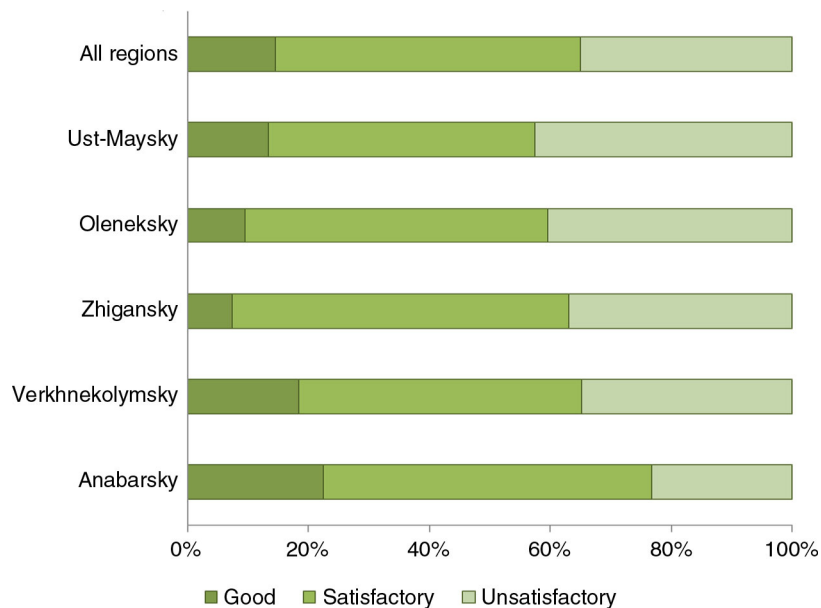
An analysis of the main medical and demographic indicators of northern indigenous minority regions of Yakutia from 1990, 1995 and 1999–2003 revealed a number of negative trends in the demographic development of these regions during the period of social and economic reform: population decline, a decrease in the birth rate, an increase in the mortality rate and a decrease in natural population increase. The age–sex structure of

Table 4.10. Distribution of respondents by housing conditions and region

	All regions		Anabarsky		Verkhnekolymsky		Zhigansky		Oleneksky		Ust-Maysky	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Accommodation												
House	445	41.5	86	33.3	54	28.4	65	34.4	96	38.4	144	77.4
Apartment	570	53.1	160	62.0	122	64.2	112	59.3	141	56.4	35	18.8
Dormitory	25	2.3	6	2.3	3	1.6	8	4.2	5	2.0	3	1.6
Shack	7	0.7	3	1.2	3	1.6	–	–	–	–	1	0.6
Rental	26	2.4	3	1.2	8	4.2	4	2.1	8	3.2	3	1.6
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0
Date of housing built												
Before 1945	17	1.6	6	2.3	2	1.0	2	1.1	4	1.6	3	1.6
1946–1956	25	2.3	1	0.4	5	2.6	10	5.3	7	2.8	2	1.1
1957–1970	107	10.0	34	13.2	19	10.0	25	13.2	26	10.4	3	1.6
1971–1995	590	55.0	96	37.2	131	69.0	106	56.1	134	53.6	123	66.1
After 1995	334	31.1	121	46.9	33	17.4	46	24.3	79	31.6	55	29.6
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0
Indoor amenities												
Running water	101	9.4	–	–	74	38.9	27	14.3	–	–	–	–
Sewer line	101	9.4	–	–	74	38.9	27	14.3	–	–	–	–
Central heating	728	67.8	245	95.0	158	83.2	85	45.0	205	82.0	35	18.8
Hot water	101	9.4	–	–	74	38.9	27	14.3	–	–	–	–
Bathtub/shower	101	9.4	–	–	74	38.9	27	14.3	–	–	–	–
Gas	–	–	–	–	–	–	–	–	–	–	–	–
No indoor amenities	345	32.2	13	5.0	32	16.8	104	55.0	45	18.0	151	81.2
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0

the indigenous peoples can be currently characterized by a high proportion of children and a low proportion of individuals above working age. This is evidence of the fact that a significant proportion of the population does not

live to old age. The period of reforms in Russia also had a negative impact on health care in these regions. Our analysis showed that these reforms resulted in a decrease in the number of health care institutions, medical and

**Fig. 4.2.** Respondents' evaluation of living conditions by region.

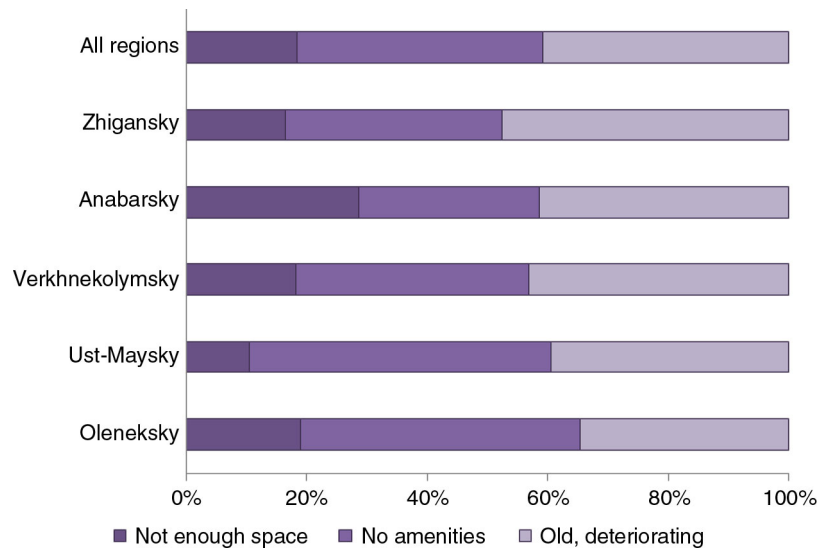


Fig. 4.3. Distribution of respondents by reason for dissatisfaction with housing, by region.

obstetrics centres, hospital beds and health care professionals (physicians and nurses) in these regions.

The persistence of acute socio-economic, medical and demographic problems in predominantly indigenous areas is manifested in chronic population stress, which is the main pathophysiological mechanism affecting their psychological and physical health. Based on our results, we can say that the health of the adult study population is not satisfactory. The average survey participant had 2–3 health conditions. The most common disorders were of the digestive, genitourinary, circulatory, respiratory and musculoskeletal systems.

The surveys carried out in predominantly indigenous minority regions brought a number of problems to light. These were related primarily to the marriage structure, living conditions and material situation of the surveyed population. The analysis of the marriage structure

showed a large proportion of single people, including widowed and never-married individuals. Living conditions could be characterized by deteriorating housing and an extremely low level of indoor amenities. The majority of the population of indigenous agricultural communities, by their own acknowledgement, reported having significant material difficulties. Overall, we found similarities in the pattern and prevalence of disease between the Evens and Yukaghir and also between the Evenks and Yakuts. We propose that such similarities could be due to the genetic similarities between these groups.

Based on the results of our comparative analysis of the study regions, we found that the most prevalent disorders in Zhigansky, Oleneksky and Ust-Maysky regions were of the circulatory and musculoskeletal systems. The most prevalent disorders in Verkhnekolymsky region were of the digestive and genitourinary systems. Anabarsky

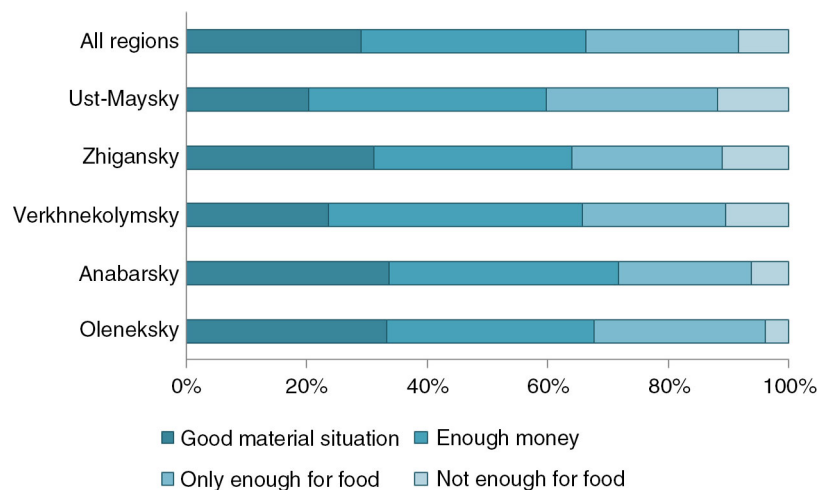


Fig. 4.4. Respondents' evaluation of their material situation, by region.

region had the lowest disease prevalence of all study regions. The patterns discussed here are connected to the specifics of the environment – the geographic location, climate, territorial and other characteristics of the study regions.

Our analysis of lipid metabolism indicators in the adult population showed that in all ethnic groups, all indicators except total cholesterol and LDL cholesterol were within normal limits. In our opinion, the fact that total cholesterol was outside normal limits in most of the study population speaks to the necessity of creating regional standards based on the results of studies of a representative sample of northern indigenous populations. Ethnicity-specific differences were observed when comparing indicators in the over-50 age group. The differences were predominantly in the atherogenic-to-non-atherogenic lipid fraction ratios. With the exception of the Dolgan population, dyslipidaemia in the different ethnic groups was atherogenic. The Dolgan population was distinct in the predominantly anti-atherogenic fractions in the majority of the population.

Our comparative analysis of official disease statistics showed that for the majority of clinical disorders, the morbidity in children in indigenous minority regions was higher than in Yakutia and the Russian Federation as a whole. Because these official statistics are dependent on presentation to health care facilities, this is invariably understated. For a more detailed analysis of medical and demographic processes in the northern indigenous minority populations, a column for ethnicity should be included in statistical tallies. This will help in collecting more objective information about the health status of ethnic minorities.

The results of our analysis of morbidity in teenagers, based on data collected from the paediatric centre, allowed us to conclude that among the teenage study population, the most prevalent disorders were diseases of the nervous, respiratory and circulatory systems. However, the disease patterns in teenagers differed based on region of residence. Endocrine disorders were seen most often in children living in Arctic and central zones of Yakutia. The health of teenagers is significantly affected by the specifics of his or her environment, and different approaches to diagnosis are required for different regions.

Through the course of their adaptation to the harsh climate of the Far North, the indigenous populations likely acquired certain unique anthropometric features. Our comparison of height, weight and arterial pressures of indigenous minority children and Yakut children revealed differences in height and weight between the 2 groups. This points to the need for regional height and weight standards for children.

It is widely accepted that there are ethnicity-associated differences in endocrine function. Our analysis of pituitary hormones (TSH, FSH, LH and growth hormone),

thyroid hormones (free T3 and free T4) and sex hormones (testosterone, oestradiol and progesterone) in Yakut and indigenous minority children exposed to the same environmental conditions did not reveal any differences between the 2 groups. We found that children from the indigenous groups had high levels of gonadotropic hormones (FSH and LH). We also found low levels of cortisol in girls and boys living in indigenous minority settlements in the pre-pubertal and pubertal ages. Our study of hormone levels showed that children and teenagers from the indigenous populations of Yakutia have developed adaptive mechanisms for hormone regulation to cope with the extreme conditions of the North.

Isolation of the population is one of the most important factors contributing to the prevalence of non-lethal genetic disorders in Yakutia. We found that the frequency of the V281L mutation in our study population was 2.4:100, with a higher mutation frequency in Chukchi (5.1:100) and Yukaghir (5:100). A moderate association was found between the mutation frequency and number of individuals in the ethnic group.

The government order under which this project was conducted was a social project. The Yakutsk Research Center for Complex Medical Problems managed to bring qualified medical assistance to 28 communities, for which they were very grateful.

A small network of village first-aid stations exist to aid in the provision of health care to these sparsely populated regions. These stations are staffed by an internist or paediatrician or often just a medical assistant or nurse. As a result, the population is often compelled to travel to the regional centre for many types of medical care. Indeed, half of all trips out of the indigenous minority settlements are for seeking some sort of medical care. One of the most pressing problems for public health in the Far North is how to protect the health of a population living in such remote, harsh conditions, with poor transportation infrastructure.

In recent years, the idea of using mobile medical clinics in these areas of low population density has been discussed more and more. In Yamalo-Nenets Okrug, for example, there have been mobile medical units equipped for winter, water and off-road conditions. The Adaptation Medical Engineering Center has become involved in development of such mobile clinics. They have developed and launched 3 types of mobile medical clinics: asphalt based; together with the Vektor manufacturing company, van based; and, together with the Shumerlinsky factory, clinics for desert-like conditions.

For Yakutia, the most effective option would be a mobile clinic comprising all of the functions of a traditional clinic. The legal aspect of this endeavour is extremely important: (a) strengthening the relationship of the mobile clinic with the responsible institution,

(b) ensuring staffing in accordance with the number of patients expected and (c) establishing a rotation for staff.

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Appendix Table 1. Rates of illness (per 100 children examined) by diagnostic category and ethnicity among children from indigenous minority settlements of northern Yakutia

Disease classification (ICD-10)	Yakut	Yukaghir	Chukchi	Evens	Evenks	Dolgan	Russian
Total examined	535	80	46	460	166	213	65
A00–B99	4	–	–	3	–	–	–
Certain infectious and parasitic diseases							
C00–D48	8	–	–	2	4	7	–
Malignant tumours							
D50–D89	1	–	1	1	1	–	–
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism							
E00–E90	80	17	7	95	3	8	4
Endocrine, nutritional and metabolic diseases							
G00–G99	40	2	1	28	30	21	–
Diseases of the nervous system							
H00–H59	133	44	–	158	1	1	39
Diseases of the eye and adnexa							
H60–H95	46	1	1	28	12	–	5
Diseases of the ear and mastoid process							
I00–I99	47	7	1	34	10	11	4
Diseases of the circulatory system							
J00–J99	127	6	14	86	31	11	11
Diseases of the respiratory system							
K00–K93	40	2	2	24	23	13	5
Diseases of the digestive system							
L00–L99	28	7	3	18	12	13	2
Diseases of the skin and subcutaneous tissue							
M00–M99	23	2	5	12	5	3	–
Diseases of the musculoskeletal system and connective tissue							
N00–N99	45	12	2	39	23	5	8
Diseases of the genitourinary system							
Q00–Q99	36	2	1	20	20	15	2
Congenital malformations, deformations and chromosomal abnormalities							
S00–T98	42	8	11	33	19	2	5
Injury, poisoning and certain other consequences of external causes.							
Total	700	110	49	581	194	110	85

Appendix Table 2. Prevalence (per 100 examined) of diseases by category and ethnic group

Disease classification (ICD-10)	Total population	Evenks	Evens	Dolgan	Yukaghir	Yakut	Other
A00–B99 Certain infectious and parasitic diseases	5.4	7.2	3.1	4.3	4.5	5.0	–
C00–D48 Malignant tumours	2.1	2.4	0.8	1.3	1.5	2.9	2.1
E00–E90 Endocrine, nutritional and metabolic diseases	11.8	12.4	18.1	10.3	9.0	10.4	6.4
F00–F99 Mental and behavioural disorders	3.3	5.2	1.6	–	4.5	3.2	–
G00–G99 Diseases of the nervous system	16.7	17.5	21.3	14.6	23.9	11.9	23.4
H60–H95 Diseases of the ear and mastoid process	3.4	4.4	3.1	–	7.5	4.0	–
I00–I99 Diseases of the circulatory system	47.5	52.0	44.1	35.3	44.8	51.8	40.4
J00–J99 Diseases of the respiratory system	36.9	41.9	35.4	30.6	43.3	34.5	17.0
K00–K93 Diseases of the digestive system	69.9	69.3	78.7	57.8	86.6	72.7	74.5
M00–M99 Diseases of the musculoskeletal system and connective tissue	29.4	33.7	30.7	22.8	22.4	29.9	12.8
N00–N99 Diseases of the genitourinary system	49.4	46.2	66.9	45.3	64.2	48.2	46.8
Q00–Q99 Congenital malformations, deformations and chromosomal abnormalities	2.7	3.1	7.1	0.9	–	2.2	2.1
S00–T98 Injury, poisoning and certain other consequences of external causes	1.0	1.4	–	–	3.0	1.1	–
Total	279.6	296.7	311.0	223.3	314.9	277.7	225.5

Appendix Table 3. Prevalence (per 100 examined) of diseases by category and region

Disease classification (ICD-10)	Total population	Anabarsky	Verkhnekolymsky	Zhigansky	Oleneksky	Ust-Maysky
A00–B99	5.4	3.7	3.0	10.6	9.2	0.5
Certain infectious and parasitic diseases						
C00–D48	2.1	2.1	1.0	3.7	1.0	3.8
Malignant tumours						
E00–E90	11.8	11.4	7.1	9.5	22.6	22.0
Endocrine, nutritional and metabolic diseases						
F00–F99	3.3	0.2	4.6	0.5	9.6	1.6
Mental and behavioural disorders						
G00–G99	16.7	11.9	21.8	20.6	18.5	15.6
Diseases of the nervous system						
H60–H95	3.4	–	4.6	12.7	3.8	–
Diseases of the ear and mastoid process						
I00–I99	47.5	36.8	46.7	51.3	56.1	55.4
Diseases of the circulatory system						
J00–J99	36.9	30.6	40.6	50.8	39.8	40.3
Diseases of the respiratory system						
K00–K93	69.9	60.7	88.3	78.3	63.4	74.7
Diseases of the digestive system						
M00–M99	29.4	22.6	25.9	29.1	34.1	41.4
Diseases of the musculoskeletal system and connective tissue						
N00–N99	49.4	41.1	69.5	57.7	47.5	42.5
Diseases of the genitourinary system						
Q00–Q99	2.7	1.4	2.5	2.1	2.9	6.5
Congenital malformations, deformations and chromosomal abnormalities						
S00–T98	1.0	–	1.0	1.1	0.3	4.3
Injury, poisoning and certain other consequences of external causes						
Total	279.6	222.3	316.8	328.0	308.6	308.6

Appendix Table 4. Distribution of respondents by selected socio-economic indicators and region

	All regions		Anabarsky		Verkhnekolymsky		Zhigansky		Oleneksky		Ust-Maysky	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Employment status												
Employed	664	61.9	170	65.9	121	63.7	98	51.8	152	60.8	123	66.1
Student	18	1.7	5	2.0	4	2.1	2	1.1	6	2.4	1	0.5
Retired	187	17.4	31	12.0	30	15.8	57	30.2	45	18.0	24	12.9
Disabled, group 1 or 2	60	5.6	7	2.7	6	3.1	13	6.9	25	10.0	9	4.9
Temporarily unemployed	104	9.7	29	11.2	23	12.1	12	6.3	18	7.2	22	11.8
Homemaker, looking after dependents	40	3.7	16	6.2	6	3.2	7	3.7	4	1.6	7	3.8
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0
Education												
Professional	542	50.5	135	52.3	81	42.6	84	44.4	147	58.8	95	51.1
Higher	160	14.9	43	16.7	22	11.6	25	13.2	49	19.6	21	11.3
Special secondary	382	35.6	92	35.6	59	31.0	59	31.2	98	39.2	74	39.8
General	512	47.7	120	46.5	106	55.8	101	53.4	97	38.8	88	47.3
High school	329	30.7	60	23.2	72	37.9	63	33.4	73	29.2	61	32.8
Middle school	127	11.8	42	16.3	27	14.2	25	13.2	15	6.0	18	9.7
Elementary school	56	5.2	18	7.0	7	3.7	13	6.9	9	3.6	9	4.8
No education	19	1.8	3	1.2	3	1.6	4	2.1	6	2.4	3	1.6
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0
Marital status												
Married												
Official marriage	586	54.6	157	60.8	95	50.0	101	53.4	123	49.2	110	59.1
Unofficial marriage	99	9.2	34	13.2	21	11.0	16	8.5	13	5.2	15	8.1
Unmarried												
Divorced	55	5.1	16	6.2	6	3.2	6	3.2	19	7.6	8	4.3
Widowed	140	13.1	24	9.3	30	15.8	26	13.7	44	17.6	16	8.6
Never-married	193	18.0	27	10.5	38	20.0	40	21.2	51	20.4	37	19.9
Total	1,073	100.0	258	100.0	190	100.0	189	100.0	250	100.0	186	100.0