ETHNIC DIFFERENCES IN RISK FACTORS AND PREVALENCE OF TYPE 2 DIABETES IN THE ADULT POPULATION OF THE RUSSIAN FEDERATION

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BACKGROUND: Russia is one of the most multinational states in the world. Identification of ethnic groups with a higher risk of developing DM2, analysis of risk factors for the development of DM2 will allow developing personalized approaches to the prevention and treatment of DM2.
AIMS: To reveal ethnic features of the prevalence of carbohydrate metabolism disorders and risk factors for the development of DM2 in the adult population of the Russian Federation.
MATERIALS AND METHODS. A retrospective analysis of the database of the national epidemiological cross-sectional study NATION was carried out. Depending on the self-specified nationality, on the basis of anthropological characteristics, the following ethnic groups were identified: "Mongoloid population", "Peoples of the Volga region", "Peoples of the North Caucasus", "Peoples of Transcaucasia", "Russians". The analysis consisted of several stages and included: analysis of the anthropometric features of the selected groups, taking into account the presence of carbohydrate metabolism disorders (MO); study of the prevalence of violations of the MA in the selected ethnic groups; analysis of ethnic characteristics of risk factors for the development of type 2 diabetes; analysis of the frequency of violations of the MA in various ethnic groups, taking into account the territory of residence. MR disorders were defined as the presence of DM and/or prediabetes. In accordance with the WHO criteria, $HbA_{1c} \geq 6.5\%$ corresponded to the diagnosis of DM, HbA_{1c} values in the range of $5.7\% \leq HbA_{1c} < 6.5\%$ to the diagnosis of prediabetes.
RESULTS: The highest frequency of violations of the MA was observed in the group «Peoples of the Volga region» (31.2%), the lowest in the «Peoples of the North Caucasus» (15.6%). BMI in the group "Peoples of the Volga region" was significantly lower than in the group "Peoples of the North Caucasus. Violations of MR were more often observed in the abdominal nature of obesity, obesity of the 1st stage, age over 45 years in the groups «Mongoloid population» and «Peoples of the Volga region» than in the peoples of the «Northern Caucasus» and «Transcaucasia». The frequency of occurrence of SR violations among representatives of the Volga Peoples group living in their historical territories was higher than among Russians living in the same regions: 32.5% and 24.3% ($p<0.001$ $\chi 2$ criterion), and also higher than in the Russian CFD: 32.5% and 27.4%, respectively, $p=0.001$ ($\chi 2$ test). The prevalence of violations of the MA among the peoples of the North Caucasus was less than among the Russians of the Central Federal District — 13.9% and 27.36%, respectively ($p<0.001$ $\chi 2$ criterion). The prevalence of MR violations among representatives of the "Peoples of the North Caucasus" group living in their historical territories (n=598) was less than among those living in other regions of the Russian Federation (n=164) (13.9% and 21.95%, p= 0.012 criterion $\chi 2$).
CONCLUSION: In the present work, for the first time, we analyzed the prevalence of MR disorders in various ethnic groups of the population of the Russian Federation, identified certain ethnic characteristics of DM2 risk factors and their contribution to the development of the disease. The obtained results should be used for planning preventive programs in various regions of the Russian Federation.

KEYWORDS: diabetes mellitus; carbohydrate metabolism disorders; ethnic groups; prevalence; risk factors; anthropometric features

ЭТНИЧЕСКИЕ РАЗЛИЧИЯ ФАКТОРОВ РИСКА И РАСПРОСТРАНЕННОСТИ САХАРНОГО ДИАБЕТА 2 ТИПА У ВЗРОСЛОГО НАСЕЛЕНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ

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ОБОСНОВАНИЕ. Россия — одно из самых многонациональных государств мира. Выделение этнических групп с более высокой распространенностью сахарного диабета 2 типа (СД2), анализ факторов риска его развития позволят разработать персонализированные подходы к профилактике и лечению заболевания.
ЦЕЛЬ. Выявить этнические особенности распространенности нарушений углеводного обмена (НУО) и факторов риска развития СД2 у взрослого населения РФ.
МАТЕРИАЛЫ И МЕТОДЫ. Проведен ретроспективный анализ базы данных национального эпидемиологического кросс-секционного исследования NATION. В зависимости от самостоятельно указанной национальности на основании антропологических признаков были выделены следующие этнические группы: «монголоидное население»,

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«народы Поволжья», «народы Северного Кавказа», «народы Закавказья», «русские». Анализ состоял из нескольких этапов и включал: анализ антропометрических особенностей выделенных групп; изучение распространенности НУО в выделенных этнических группах; анализ этнических особенностей факторов риска развития СД2; анализ частоты НУО в различных этнических группах с учетом территории проживания. НУО определялись как наличие СД и/или предиабета. В соответствии с критериями ВОЗ диагнозу СД соответствовал уровень гликированного гемоглобина (HbA_{1c})≥6,5%, диагнозу «предиабет» — значения HbA_{1c} в диапазоне 5,7%≤HbA_{1c}<6,5%.

РЕЗУЛЬТАТЫ. Наибольшая частота НУО наблюдалась в группе «народы Поволжья» (31,2%), самая низкая — у «Народов Северного Кавказа» (15,6%), при этом индекс массы тела в группе «Народы Поволжья» был значимо ниже, чем в группе «Народы Северного Кавказа». В группах «Народы Поволжья» и «Монголоидное население» НУО более часто наблюдались при абдоминальном характере ожирения, ожирении I степени, возрасте старше 45 лет, чем у «Народов Северного Кавказа» и «Народов Закавказья». Частота встречаемости НУО у представителей группы «Народы Поволжья», проживающих на своих исторических территориях, была выше, чем у русских, проживающих в этих же регионах: 32,5 и 24,3% (p<0,001 критерий χ^2), а также выше, чем у русских ЦФО: 32,5 и 27,4% соответственно, p=0,001 (критерий χ^2). Распространенность НУО у «Народов Северного Кавказа» была меньше, чем у «Русских» — 13,9 и 27,36% соответственно (p<0,001 критерий χ^2). Распространенность НУО у представителей группы «Народы Северного Кавказа», проживающих на своих исторических территориях (n=598), была меньше, чем у проживающих в других регионах РФ (n=164) (13,9 и 21,95%, p=0,012 критерий χ^2).

ЗАКЛЮЧЕНИЕ. В настоящей работе впервые проведен анализ распространенности НУО в различных этнических группах населения РФ, выявлены определенные этнические особенности факторов риска СД2 и их вклад в развитие заболевания. Полученные результаты необходимо использовать для планирования профилактических программ в различных регионах РФ.

КЛЮЧЕВЫЕ СЛОВА: сахарный диабет; нарушения углеводного обмена; этнические группы; распространенность; факторы риска; антропометрические особенности

BACKGROUND

Diabetes is an immense medical and social problem worldwide. Numerous studies in international journals point to existence of race-specific and ethnic-specific features in the T2D pathogenic mechanism. Several ethnic groups with especially high T2D prevalence have been identified [1]. Rapid growth of Asian economies and urbanisation in the region have resulted in a surge of diabetes prevalence [2]. Studies conducted in that area have pointed to existence of certain genetic specifics among the population of South and Southeast Asia [3] and identified several factors that may account for faster progress of diabetes, such as high ratio of smokers in the population and widespread consumption of refined carbohydrates (white rice). Given equal body weight gains in the general population, diabetes occurs in younger age and much more frequently among the population of Asia vs. that of Europe.

Relatively higher prevalence of diabetes is observed not only among indigenous peoples worldwide but also among such indigenous peoples which have moved out of their native lands. Thus, T2D prevalence is alarmingly high among the UK ethnic minorities: it is three to five times higher vs. that among the white UK population; moreover, the onset of T2D among the UK ethnic minorities occurs 10 to 12 years earlier [4]. Similar findings have been obtained by studies in the USA. Development of efficient social programmes to reduce T2D risk in such groups will require further inquiries into the way various genetic, physiological, socioeconomical, and other factors affect the ethnic-specific features of diabetes prevalence.

As per the Russian Federal Diabetes Register, the total number of registered diabetes patients in Russia on 1 January 2021 was 4,799,552 (3.23% of the total population); within that number, 92.5% (4.43 million) were T2D patients. Between 2016 and 2020, T2D prevalence grew from 2,709 to 3,022 per 100,000 population. Most of T2D patients in the country are 65 to 69 [5].

Russia is one of the world's most multinational countries. Two major races are present in the population: the Caucasoid and the Mongoloid ones. It is roughly estimated that 90% of the country's population are of the Caucasoid race, whereas another 9% are various anthropological types represented by a mix of the Caucasoid and the Mongoloid races in different proportions. The total Mongoloid population is estimated to be slightly over 1,000,000 [6].

T2D onset and development are affected by both genetic-specific and external factors; however, the ethnic component's contribution to T2D risk and prevalence in the population of Russia has been underexplored. Instead, all prior studies inquired into the association of isolated genetic markers with T2D prevalence in various ethnic groups. By identifying ethnic groups with higher T2D risk and analysing various factors contributing to T2D risk and prevalence the healthcare community will be enabled to develop a programme to curb T2D prevalence and eventually to modify treatment patterns for certain ethnic groups.

OBJECTIVE: Identify ethnic-specific features affecting the prevalence of carbohydrate metabolism disorders and T2D risk factors in the adult population of the Russian Federation and thereby to substantiate personalised approaches to T2D prevention and treatment.

MATERIALS AND METHODS

Study design

A retrospective analysis of the database of the NATION nation-wide epidemiological cross-sectional study was carried out [7]. NATION was the first nation-wide epidemiological cross-sectional study conducted in Russia in order to evaluate real T2D prevalence in the country. It was carried out from September 2013 to February 2015. In order to obtain a representative sample, adult subjects (aged 20 to 79) were stratified by age, sex, location and type of their community. Subjects were invited in high-traffic public venues. T2D was

diagnosed based on glycated haemoglobin (HbA1c) level (HbA1c ≥6,5% for diabetes; 5.7<HbA1c <6.5% for prediabetes [8]). Socio-demographic data and anthropometrics were recorded at the same time. In total, the 26,620 subjects were entered into the NATION database; the following fields were filled: age at the time of observation, place of residence, anthropometrics (height, body weight, waist circumference, hip circumference), and HbA1c level. Subjects were also asked to fill a specially prepared questionnaire by stating the following details: ethnicity, hereditary history of diabetes, smoking status, physical activity level, arterial hypertension status, etc. The sample in the NATION study was selected so as to ensure maximum representativity vs. the entire population of Russia (subject to the subjects' distribution in terms of sex, age and type of community within the sample and within the population in general) [7].

Our study included data of those subjects of the NATION study who stated their ethnicity in the questionnaires. Russia's ethnic diversity, as well as many questionnaires with omitted "ethnicity" field and a dominant proportion of Russians in the population prevented us from identifying any statistically significant monoethnic groups. Thus, based on the subjects' self-declared ethnicity and anthropometrics the following ethnic groups were identified:

- **"Mongoloid population"**. This group includes ethnicities anthropologically possessing mongoloid features and linked to a common origin. The group comprises northern mongoloids: Buryats, Yakuts, Kalmyks, Dolgans, Evens, Evenks, Eastern Mongoloids (Koryaks, Koreans), as well as those of mixed South Siberian type - Kazakhs, Kyrgyz, and Khakasses [9–11]. The Bashkirs who have traditionally inhabited the Volga region are a very heterogeneous group in anthropological terms: the presence of a Caucasoid component in the South Siberian type is stronger; nevertheless, Mongoloid traits are to a great extent characteristic of the Trans-Ural, Eastern and South-Eastern Bashkirs. The former considerations were slightly outweighed by the latter, and thus Bashkirs were included into the Mongoloid group [12].

All in all, the **"Mongoloid population"** group within the sample comprised the following subjects: Buryats (n=180), Dolgans (1), Kazakhs (62), Kalmyks (58), Kyrgyz (43), Koreans (30), Koryaks (1), Nanajs (1), Selkups (2), Tofalars (1), Khakasses (1), Chuvans (1), Evenks (9), Evens (1), Yukagirs (1), Yakuts (139), and Bashkirs (182) **(713 in total)**.

All other ethnic and regional groups were anthropologically Caucasoid.

- **"Peoples of Transcaucasia"**. This group includes ethnicities of Southern Caucasoid anthropological type which are part of the Balkan-Caucasian (Abkhazians, Georgians, Armenians and Udins) and Indo-Mediterranean (Azerbaijanis, Turks) races: Abkhazians (5), Azerbaijanis (127), Armenians (261), Georgians (44), Turks (4), and Udins (1) **(442 in total)**.
- **"Peoples of the Northern Caucasus"**. This group includes ethnicities of Southern Caucasoid anthropological type which are part of the Balkan-Caucasian race: Abazins (1), Avars (23), Aguls (4), Adygeans (3), Balkars (25), Dagestani (26), Dargins (10), Ingush (5), Kabardins (277), Karachays (4), Kumyks (6), Laks (4), Lezgins (11), Nogais (3), Ossetians (28), Rutuls (20), Tabasarans (2), Circassians (4), and Chechens (306) **(762 in total)**.
- **"Peoples of the Volga region"**. This group includes ethnicities of Eastern and Southern Caucasoid anthropological types mixed with some Ural type component: Komis (35), Permian Komis (1), Maris (12), Mordvins (21), Tatars (1,124), Udmurts (82), and Chuvash (271) **(1,546 in total)**.
- **"Russians".** Total number of Russians observed in the NATION study was 20,995. Out of this group, the following subjects were included in our analysis: Russians residing in the Central Federal District (5,043) and Russians residing in the native lands of the ethnic groups defined above (1,567, including 816 residing in the native lands of peoples of the Volga region, 722 residing in the native lands of the Mongoloid population group, and 29 residing in the native lands of peoples of the Northern Caucasus; see Appendix 3).

The mechanism of group formation is presented on Figure 1.

Inclusion criteria

Inclusion criteria.

1. Subjects of the NATION study.
2. Age 20–79.
3. Self-declared their ethnicity.
4. Self-declared ethnicity matches one of the ethnic groups defined herein.

Exclusion criteria.

1. No data on ethnicity.
2. Self-declared ethnicity matches none of the ethnic groups defined herein.
3. T1D.

Data analysis

Data analysis included several stages.

Stage 1: Analysis of the defined ethnic groups' anthropometrics linked to carbohydrate metabolism disorders.

We carried out a comparative analysis of the defined ethnic groups' anthropometrics linked to carbohydrate metabolism disorders. We evaluated the following parameters:

- Height
- Body weight, body mass index (BMI, kg/m^2)
- Waist circumference (WC) and hips circumference (HC)
- Waist-to-hip ratio (WHR)
- Waist-to-height ratio (WHtR).

Stage 2: Analysis of prevalence of carbohydrate metabolism disorders in the defined ethnic groups.

We carried out an analysis of diabetes and prediabetes prevalence in the defined ethnic groups. In accordance with the WHO criteria, HbA1c≥6.5% was interpreted as diabetes, whereas values in the range of 5.7%≤HbA1c<6.5% as prediabetes. We defined carbohydrate metabolism disorders as diabetes and/or a prediabetes condition.

In order to identify sex-specific and age-specific BMI and WC factors as the key parameters characteristic for adnominal obesity, we have defined four groups of subjects: males under 45, males over 45, females under 45, and females over 45. In these groups, we conducted a comparative analysis of BMI and WC linked to carbohydrate metabolism disorders.

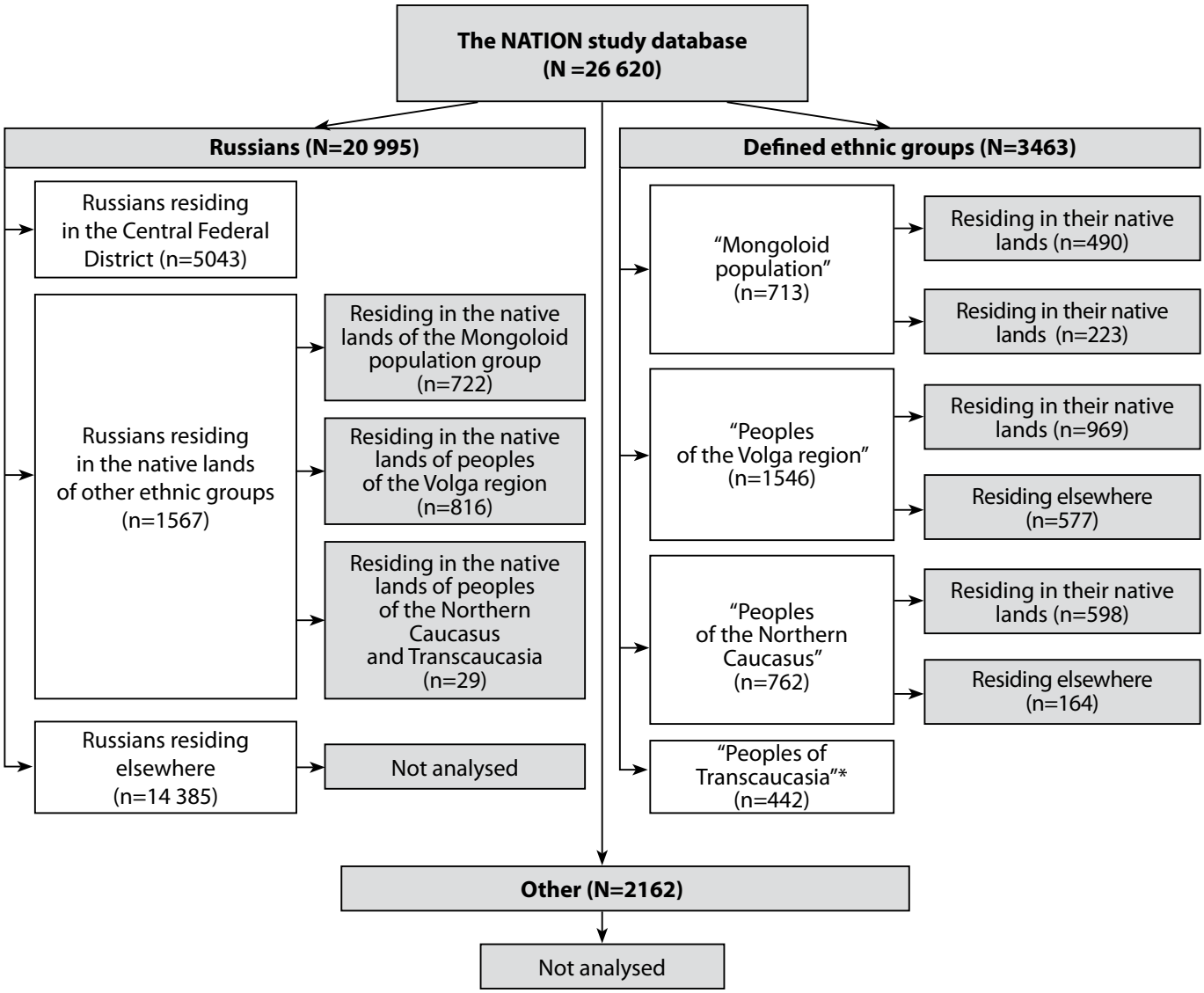

Figure 1. Mechanism of group formation.

*Residence locations of all subjects from the "Peoples of Transcaucasia" group were evenly distributed across the Central Federal District (Moscow and Moscow Region) and Southern Federal District (Krasnodar Territory, Rostov Region).

Stage 3: Analysis of ethnic-specific factors of T2D risks and their contribution to T2D onset and development.

Within every ethnic group, we analysed the prevalence of carbohydrate metabolism disorders among the subjects possessing individual T2D risk factors: age over 45; overweight; Stage 1/2/3 obesity; hereditary history of diabetes, WC growth, arterial hypertension, positive smoking status.

Then we analysed the impact of key T2D risk factors and their combinations on the risk of carbohydrate metabolism disorders within every ethnic group.

Stage 4: Analysis of prevalence of carbohydrate metabolism disorders (diabetes + prediabetes) within different ethnic groups by residence area location.

We carried out a comparative analysis of prevalence of carbohydrate metabolism disorders within ethnic groups by location of such ethnic groups' areas of residence: those residing in their native lands vs. those residing elsewhere in Russia. Our control groups were comprised of Russians residing in the native lands of the respective ethnic groups.

Statistical analysis

To run a statistical analysis, we used Statistica 13 (StatSoft, USA) software.

Descriptive statistics on quantitative variables are presented as median values followed by 1st and 3rd quartiles (Me [Q1; Q3]). Descriptive statistics of qualitative variables are presented as absolute and relative frequency.

For quantitative data, any two independent groups were compared through Mann-Whitney test; any three or more groups, through Kruskal-Wallis test and a further post-hoc analysis. Binary indicators' frequencies were compared though chi-squared test (χ^2). Where necessary, Yates' correction was used.

Relative risk was calculated with an online calculator https://statpages.info/ctab2x2.html. Whenever an indicator's frequency was zero, relative risk was calculated using Haldane-Anscombe correction.

Confidence intervals (CIs) for the frequencies we determined were defined using Clopper–Pearson interval.

Statistical significance threshold applicable to any statistical hypothesis was deemed to be 0.05.

Ethical review

Prior to any procedures, all subjects of the NATION study provided an informed consent thereto. The study was consistent with all applicable ethical guidelines embedded in the Helsinki Declaration and Good Clinical Practice. The study design was approved by Russia's Independent Interdisciplinary Ethics Committee on Ethical Review for Clinical Studies [13, 14].

RESULTS

1. Anthropometrics analysis among the defined ethnic groups has identified several significant differences (Appendix 1).

The "Mongoloid population" group in general had a significantly lower body weight and height vs. the "Russians", the "Peoples of the Northern Caucasus", and the "Peoples of Transcaucasia" groups. The WC among the "Mongoloid population" group was significantly lower vs. the "Russians" and the "Peoples of Transcaucasia" groups.

The "Peoples of the Northern Caucasus" group in general, despite a younger age at the time of observation (38), did not significantly differ from the "Russians" and the "Peoples of Transcaucasia" groups. The WC among this group was significantly lower vs. the "Russians" and the "Peoples of Transcaucasia" groups. The "Peoples of the Northern Caucasus" group had significantly higher height and body weight vs. the "Mongoloid population" and the "Peoples of the Volga region" groups. The waist-to-height ratio among the "Peoples of the Northern Caucasus" group was significantly lower vs. the "Mongoloid population", the "Peoples of the Volga region" and the "Peoples of Transcaucasia" groups.

The "Peoples of Transcaucasia" group possessed the highest WC value which was significantly higher vs. the "Mongoloid population", the "Peoples of the Northern Caucasus", and the "Peoples of the Volga region" groups.

The "Peoples of the Volga region" group had lower body weight, height, and BMI vs. the "Russians", the "Peoples of the Northern Caucasus", and the "Peoples of Transcaucasia" groups (a statistically significant difference was identified between the "Peoples of the Volga region" and the "Peoples of the Northern Caucasus" groups). No statistically significant differences were found to exist between the "Peoples of the Volga region" group, on the one hand, and the "Mongoloid population" and the "Peoples of the Volga region" groups, on the other.

2. Ethnic-specific factors of carbohydrate metabolism disorders.

No statistically significant differences in diabetes prevalence were found to exist among the defined ethnic groups. However, as we analysed the prevalence of carbohydrate metabolism disorders in general (diabetes + prediabetes), statistically significant differences were identified (Table 1).

The highest prevalence of carbohydrate metabolism disorders in general (diabetes + prediabetes) was found among the "Peoples of the Volga region" group, whereas the lowest – among the "Peoples of the Northern Caucasus" group (15.6%).

3. Ethnic-specific factors of T2D risk.

Subjects with carbohydrate metabolism disorders from the "Peoples of the Volga region" group were younger and had significantly lower BMI, WC, and HC vs. the subjects having carbohydrate metabolism disorders from the "Russians" and "Peoples of Transcaucasia" groups. Moreover, subjects with carbohydrate metabolism disorders from the "Peoples of the Volga region" group had significantly lower BMI vs. their peers from the "Peoples of the Northern Caucasus" group (Appendix 1, Tables 1–3). Subjects with carbohydrate metabolism disorders from the "Peoples of the Volga region" group had significantly lower WC vs. those from the "Russians" and "Peoples of Northern Caucasus" groups.

Subjects with carbohydrate metabolism disorders from the "Peoples of Northern Caucasus" group did not significantly differ from their peers from the other groups in terms of BMI, WC, and HC (expect their significantly higher BMI vs. their peers from the "Peoples of the Volga region" group).

Subjects with carbohydrate metabolism disorders from the "Mongoloid population" group had significantly lower body weight, height, and HC vs. their peers from the "Russians" group and lower BMI than their peers from the "Peoples of Transcaucasia" group.

We analysed the increment of probability of carbohydrate metabolism disorders (diabetes + prediabetes) in the defined ethnic groups depending on T2D risk factors and their combination (Table 2, Appendix 2). In all groups except "Peoples of Transcaucasia", age ≥45 and obesity were statistically significant factors of carbohydrate metabolism disorders. In the "Peoples of Transcaucasia" group, obesity was not a statistically significant factor of carbohydrate metabolism disorders. A combination of obesity and age over 45 increased the risk of carbohydrate metabolism dis-

Table 1. Prevalence of carbohydrate metabolism disorders in general (diabetes + prediabetes) among the defined ethnic groups

Ethnic group	N	Normal range, n (%)	Prediabetes, n (%)	Diabetes, n (%)	Disorder prevalence (diabetes + prediabetes), %	p, c
Mongoloid population	713	516 (72.4)	157 (22.0)	40 (5.6)	27.6	
Peoples of Transcaucasia	442	343 (77.6)	71 (16.1)	28 (6.3)	22.4	
Peoples of the Volga region	1,546	1,064 (68.8)	404 (26.1)	78 (5.1)	31.2	p<0.001 p_{1-4}<0.001 p_{2-3}=0.031 p_{3-4}<0.001 p_{5-4}<0.001
Peoples of the Northern Caucasus	762	643 (84.4)	77 (10.1)	42 (5.5)	15.6	
Russians residing in the Central Federal District	5,043	3,663 (72.7)	1,139 (22.6)	241 (4.8)	27.4	

orders to a greater extent than any of these factors alone did (a statistically significant increment of risk was identified in the "Russians residing in the Central Federal District" group only).

Hereditary history of diabetes and arterial hypertension did not significantly affect the risk of carbohydrate metabolism disorders. A combination of age ≥45 and hereditary history of diabetes virtually did not increase that risk to any greater extent than just one of those factors (age ≥45) did.

In every group, the frequency of carbohydrate metabolism disorders progressively increased where several risk factors were present. In the "Russians residing in the Central Federal District" group, relative risk of carbohydrate metabolism disorders was significantly higher whenever the following three risk factors coincided (higher age, hereditary history of diabetes, and obesity) vs. just hereditary history of diabetes and obesity. We did not find the addition of arterial hypertension to the following three risk factors (higher age, hereditary history of diabetes, and obesity) to increase the overall risk in any of the groups. Interestingly, hereditary history of T2D alone did not increase the overall risk of carbohydrate metabolism disorders in any of the groups. However, when combined with other risk factors (such as obesity, age over 45, or arterial hypertension), this factor significantly increased the risk of carbohydrate metabolism disorders in all ethnic groups we studied (Table 2).

When analysing the frequency of carbohydrate metabolism disorders among the subjects having individual risk factors, we found the following specific features among the defined ethnic groups (Table 3).

Age over 45 provided greater contribution to carbohydrate metabolism disorders in the "Mongoloid population" and "Peoples of the Volga region" groups vs. the "Russians" and "Peoples of Northern Caucasus" groups (χ^2<0.05).

Stage 1 obesity was associated with carbohydrate metabolism disorders more often in the "Mongoloid population", "Peoples of the Volga region" and "Russians" group vs. the "Peoples of Northern Caucasus" and "Peoples of Transcaucasia" groups (p<0.05, χ^2 test).

Stage 1 or Stage 2 obesity alone, or a combination of any stage of obesity (BMI≥30 kg/m^2 or ≥27.5 kg/m^2 for Mongoloid males) with higher WC (WC>94 cm for males (>90 cm for Mongoloid males); WC>80 cm for females) provided the smallest contribution to carbohydrate metabolism disorders in the "Peoples of Northern Caucasus" group.

Stage 3 obesity was the strongest factor of carbohydrate metabolism disorders risk in all ethnic groups we studied.

Abdominal obesity was most often associated with carbohydrate metabolism disorders in the "Peoples of the Volga region" group (WC>94 cm for males (>90 cm for Mongoloid males); WC>80 cm for females). This factor was least often associated with carbohydrate metabolism disorders in the "Peoples of Northern Caucasus" group.

Table 2. Relative risk of carbohydrate metabolism disorders in the defined ethnic groups in correlation with key factors of T2D risk

Risk factor	Russians residing in the Central Federal District (N=5,043)	Mongoloid population (N=713)	Peoples of Northern Caucasus (N=762)	Peoples of Transcaucasia (N=442)	Peoples of the Volga region (N=1,546)
Возраст ≥ 45 лет	4.8 [3.7; 6.3]	6.4 [3.2; 13.4]	5.8 [2.7; 13.1]	9.2 [2.8; 38.4]	4.4 [3.0; 6.5]
Hereditary history of T2D	1.25 [0.8; 1.9]	0.9 [0.2; 3.0]	0.5 [0.02; 3.6]	0.7 [0.03; 6.9]	1.1 [0.55; 2.0]
Obesity (BMI≥ 30 kg/m^2)	3.2 [2.2; 4.7]	4.4 [1.7; 9.9]	4.78 [2.1; 11.2]	3.1 [0.5; 13.4]	2.9 [1.55; 5.1]
Arterial hypertension	1.4 [0.5; 3.5]	2.95 [0.7; 10.1]	2.4 [0; 20.3]	7.0 [0; 40.1]	2.0 [0.6; 5.1]
Age ≥45 + hereditary history of T2D	5.6 [4.1; 7.7]	6.1 [2.45; 14.5]	8.32 [3.0; 21.3]	7.35 [1.6; 37.4]	5.3 [3.4; 8.2]
Age ≥45 + BMI≥ 30 kg/m^2	9.4 [7.4; 12.1]	9.0 [4.55; 18.6]	9.32 [4.6; 19.9]	13.3 [4.4; 55.0]	7.3 [5.05; 10.5]
Hereditary history of T2D + BMI≥ 30 kg/m^2	4.1 [2.7; 6.2]	8.85 [3.8; 18.9]	7.4 [1.7; 23.3]	7.2 [1.4; 38.6]	3.3 [1.5; 6.55]
Age ≥45 + hereditary history of T2D + BMI≥ 30 kg/m^2	10.8 [8.3; 18.8]	11.8 [4.4; 20.4]	18.28 [7.55; 34.6]	10.3 [2.6; 48.2]	7.1 [4.4; 10.5]
Age ≥45 + hereditary history of T2D + BMI≥ 30 kg/m^2 + arterialhypertension	12.1 [9.6; 15.2]	12.78 [6.2; 21.5]	4.6 [0.7; 18.4]	24.25 [8.7; 91.35]	8.3 [5.45; 11.6]

In the "Mongoloid population" group, carbohydrate metabolism disorders most often occurred in association with the following risk factors: Stage 2 or Stage 3 obesity (54.9% and 51.7%, respectively), age ≥ 45 (48.6%) or a combination of obesity and high WC value (>90 cm for males; >80 cm for females) (46.8%).

Similar impact of risk factors on the risk of carbohydrate metabolism disorders was also observed in the "Peoples of the Volga region" group. Obesity of any degree (with Stage 1, the frequency of carbohydrate metabolism disorders amounted to 47.9%), yet distinctly the strongest contributors to carbohydrate metabolism disorders were Stage 2 and Stage 3 degrees (59.8% and 70.6%, respectively), abdominal obesity (53.1%), and age over 45.

Within the "Peoples of Transcaucasia" group, abdominal obesity was not associated with a high risk of carbohydrate metabolism disorders; it was Stage 2 and Stage 3 obesity, as well as arterial hypertension that turned out to be the strongest risk factors in this regard (58.1%, 56% and 55.9%, respectively).

Within the "Peoples of Northern Caucasus" group, Stage 2 and Stage 3 obesity, as well as arterial hypertension were the strongest risk factors of carbohydrate metabolism disorders; however, such disorders occurred in this group much more seldom than they did in the "Peoples of the Volga region" and "Mongoloid population" groups. Carbohydrate metabolism disorders were found only in 25.6% of subjects with Stage 1 obesity, 33.8% with Stage 2, and 44% with Stage 3 obesity. Higher WC values in males and females, as well as a combination of obesity and higher WC were associated with carbohydrate metabolism disorders to a lesser extent than they did within other ethnic groups.

4. Prevalence of carbohydrate metabolism disorders (diabetes + prediabetes) in different ethnic groups by residence area.

Analysis of prevalence of carbohydrate metabolism disorders among ethnic groups residing in their native lands vs. the same groups residing elsewhere in Russia and vs. Russians residing in the ethnic groups' native lands is presented in Table 4.

Table 3. Prevalence of carbohydrate metabolism disorders (n) among subjects having certain T2D risk factors (N) within the defined ethnic groups (%)

Risk factor	Russians residing in the Central Federal District (Group 1), n/N (%)	Mongoloid population (Group 2), n/N (%)	Peoples of Northern Caucasus (Group 3), n/N (%)	Peoples of Transcaucasia (Group 4), n/N (%)	Peoples of the Volga region (Group 5), n/N (%)	p, χ^2 test
Age ≥ 45	1,152/ 2,620 (44.0)	153/ 315 (48.6)	90/ 292 (30.8)	90/ 234 (38.5)	392/ 807 (48.6)	p_{1-3}<0.05 p_{1-5}<0.05 p_{2-3}<0.05 p_{3-5}<0.05
Stage 1 obesity	479/ 1,064 (45.0)	86/ 203 (43.4)	43/ 168 (25.6)	24/ 99 (24.2)	139/ 290 (47.9)	p_{1-3}<0.05 p_{1-4}<0.05 p_{2-3}<0.05 p_{2-4}<0.05 p_{3-5}<0.05 p_{4-5}<0.05
Stage 2 obesity	186/ 412 (45.1)	39/ 71 (54.9)	22/ 65 (33.8)	25/ 43 (58.1)	52/ 87 (59.8)	p_{1-3}<0.05 p_{3-5}<0.05
Stage 3 obesity	64/ 166 (38.6)	15/ 29 (51.7)	11/ 25 (44.0)	25/ 43 (56.9)	24/ 34 (70.6)	-
Hereditary history of diabetes	426/ 1,362 (31.3)	52/ 183 (28.4)	24/ 130 (18.5)	35/ 141 (24.8)	134/ 420 (31.9)	p_{1-3}<0.05 p_{3-5}<0.05
WC >94 cm in males (>90 cm in Mongoloid males) or >80 cm in females	1,138/ 2,793 (40.7)	171/ 430 (39.8)	100/ 386 (25.9)	85/ 244 (34.8)	373/ 852 (43.8)	p_{1-3}<0.05 p_{2-3}<0.05 p_{3-5}<0.05
Arterial hypertension	617/ 1,238 (49.8)	83/ 177 (46.9)	30/ 84 (35.7)	38/ 68 (55.9)	176/ 359 (49.0)	-
Smoker	268/ 1,472 (18.2)	50/ 214 (23.4)	17/ 98 (17.3)	16/ 118 (13.6)	91/ 375 (24.3)	-
Obesity + WC >94 cm in males (>90 cm in Mongoloid males) or >80 cm in females	792/ 1,569 (50.5)	137/ 293 (46.8)	73/ 235 (31.1)	63/ 159 (39.6)	214/ 403 (53.1)	p_{1-3}<0.05 p_{2-3}<0.05 p_{3-5}<0.05 p_{4-5}<0.05

Table 4. Prevalence of carbohydrate metabolism disorders (diabetes + prediabetes) in different ethnic groups by residence area

Ethnic group	Total (regardless of residence area)	Residing in their native lands	Residing elsewhere in Russia	Russians residing in the respective ethnic group's native lands
Peoples of the Volga region	32.1% (n=1,546)	32.5% (n=969)	28.9% (n=577)	24.3% (n=816)
Peoples of Northern Caucasus	15.6% (n=762)	13.9% (n=598)	21.9% (n=164)	24.1% (n=29)
Mongoloid population	27.6% (n=713)	28.8% (n=490)	25.1% (n=223)	22.3% (n=722)
Russians residing in the Central Federal District	27.36% (n=5,043)			

Peoples of the Volga region

The majority (62.3%) of subjects from the "Peoples of the Volga region" group were residing in their native lands within the Volga Federal District (Appendix 3): Republic of Tatarstan – 26.65%, Republic of Bashkortostan – 17.85%, Chuvash Republic – 12.10%, and Udmurt Republic – 6.08% (969 in total). These subjects comprised one group, compared against a group of Russians (n=816) residing in the same regions (Appendix 4, Table 1).

Analysis of prevalence of carbohydrate metabolism disorders revealed a higher prevalence among the "Peoples of the Volga region" group vs. Russians residing in the same regions: 32.5% vs. 24.3% ($p<0.001$, χ^2 test) (Table 5). The average BMI values were close in both groups; however, waist-to-hip ratio was significantly higher among the "Peoples of the Volga region" group.

Statistically significant differences were revealed when comparing the prevalence of carbohydrate metabolism disorders among the subjects from the "Peoples of the Volga region" group residing in their native lands vs. Russians residing in the Central Federal District. The former group had a higher prevalence vs. Russians residing in the Central Federal District: 32.5% vs. 27.4% ($p=0.001$, χ^2 test).

No statistically significant differences were found in the prevalence of carbohydrate metabolism disorders between the subjects from the "Peoples of the Volga region" group residing in their native lands (n=969) vs. those residing elsewhere in Russia (n=577).

Peoples of Northern Caucasus

Most of the subjects from this combined group were residing in the Chechen Republic (38.71%) and the Kabardino-Balkarian Republic (39.76%) (598 in total). They would have been properly compared against Russians residing in the same regions; however, there were only 29 such subjects, which was not enough to obtain a reliable comparison of the prevalence of carbohydrate metabolism disorders. Thus, the peoples of Northern Caucasus residing in their native lands were compared against Russians residing in the Central Federal District (the "Russians" group").

Among the subjects from the "Peoples of Northern Caucasus" group residing in the Chechen and Kabardino-Balkarian Republics, the aforementioned prevalence was lower than among Russians residing in the Central Federal District: 13.9% vs. 27.36% ($p<0.001$, χ^2 test; Table 2, Appendix 4). No significant differences in BMI, WC and waist-to-hip ratio were revealed.

Interestingly, the prevalence of carbohydrate metabolism disorders among the subjects from the "Peoples of Northern Caucasus" group residing in their native lands (n=598) was significantly lower vs. the subjects from the same group residing elsewhere in Russia (n=164): 13.9% vs. 21.95% ($p=0.012$, χ^2 test).

As we compared the lifestyle patterns among the subjects from "Peoples of Northern Caucasus" group residing elsewhere in Russia vs. the subjects from the same group residing in their native lands, we found that the former subgroup had significantly higher ratios of smokers: 23.17% vs. 10.03% ($p<0.001$, χ^2 test), those not walking enough: 31.1% vs. 16.05% ($p<0.001$, χ^2 test), those working indoors: 52.5% vs. 30.19% ($p<0.001$, χ^2 test), and those with sitting work position: 50.8% vs. 30.5% ($p<0.001$, χ^2 test).

Mongoloid population

Within the NATION study database, we identified 713 subjects of the Mongoloid group. Out of this number, 68.7% (490) were residing in their native lands: Sakha Republic (Yakutia) – 21.46%, Bashkortostan Republic – 15.43%, Buryat Republic – 15.29%, Irkutsk Oblast – 9.26%, and Kalmyk Republic – 7.29%. The NATION study database also included 722 Russians residing in the aforementioned regions; we used these subjects as a control group.

The prevalence of carbohydrate metabolism disorders among the subjects from the "Mongoloid population" group residing in their native lands amounted to 28.78%, whereas it was 22.3% among Russians residing in the same regions ($p=0.010$, χ^2 test, Table 3, Appendix 4).

Most of the Russian subjects were residing in urban areas (83.7% vs. 16.4% in rural areas), whereas nearly one half of the Mongoloid population (49.2%) were rural residents.

No statistically significant differences in hereditary T2D history were found between the two groups.

Neither did we find any statistically significant differences in the prevalence of diabetes between the aforementioned Mongoloid group and Russians residing in the Central Federal District; nor were there any statistically significant differences in the prevalence of diabetes between the subjects from Mongoloid group residing in their native lands vs. the Mongoloid subjects residing elsewhere in Russia.

Peoples of Transcaucasia

We could not establish any prevalent area of residence of the subjects from the "Peoples of Transcaucasia" group. Their residence locations were evenly spread across the Central Federal District (Moscow and Moscow Region) and the Southern Federal District (Krasnodar Territory and Rostov Region).

DISCUSSION

At present, Russia is home for about 200 ethnic groups, each with their own origins, traditions, and culture. Our study is the first ever attempt to analyse T2D prevalence among different ethnic groups within Russia's population. Our analysis is based on the NATION study database. In total, 26,620 subjects were included in the study: 20,995 Russians and 5,625 subjects representing 80 other ethnic groups. Apart from Russians, the most numerous ethnic groups included in our study were Tatars (n=1,124). Somewhat smaller representation had Chechens (n=306), Kabardins (n=277), Chuvash (n=271), Armenians (n=261), Bashkirs (n=182), and Buryats (n=180). Other ethnic groups were represented by much lesser numbers of subjects. Some ethnic groups were underrepresented to such an extent that none of them could be analysed as a monoethnic group; thus, combined groups based on common anthropological features were proposed for the purposes of this study.

The "Mongoloid population" sample included subjects from ethnic groups that have common origins (Northern, Eastern, and Central Asian Mongoloids, and mixed South Siberian ones with a Ural component). Scholars have identified most common body dimension features that are characteristic for a Central Asian morphological type: relatively low stature, relatively tall torso and shorter legs, relatively well-developed muscles (especially on the extremities), and a greater degree of fat in the abdominal area. Despite certain morphological deviations from this type observed in the Siberian groups, such groups are beyond any doubt closer to this type than to any other ethnic group in Russia [15]. Bashkirs are primarily a so called mixed or contact race, *i.e.*, a South Siberian one with a predominant Mongoloid component, nevertheless. Kazakhs and Kyrgyz belong to the same race. Although they are geographically close to the peoples of the Volga region, they significantly differ. Thus, peoples of the Volga region are mostly of the Eastern Caucasian type, sometimes mixed with a Ural component. Up to the 18th century, Bashkirs were seminomadic herdsmen, and even nowadays they are closer to Mongoloid peoples in dietary patterns (consuming lamb, horse meat, koumiss, etc.)

In the areas of active interaction between the two major racial stems (Caucasoid and Mongoloid ones), *i.e.*, in the Volga region, Kazakhstan and Kyrgyzstan, an Eastern morphological type is widespread. It is typically shallow-bodied, having relatively small body dimensions and relatively larger amounts of fat on the torso [15]. It has to be noted that, except for the torso length, all groups of the Volga region are close to one another in terms of body circumferences and subdermal fat deposits.

In terms of body outlook, Peoples of Transcaucasia, Northern Caucasus may be placed into the Caucasian morphological type, though they will somewhat differ from one another in torso length. In general, this type possesses medium stature, relatively long torso and relatively short legs. The most distinct morphological features of the Caucasian type are body circumferences and subdermal fat deposits, *i.e.*, large WC, large HC and relatively large fat deposits on the torso [15].

On terms of morphology, Russians are typical representatives of the Eastern European type, which possesses high stature, tall and wide frame and large body dimensions (especially extremities). This type typically has the largest chest circumference, somewhat smaller WC, relatively large fat deposits on lower extremities and relatively small ones in the abdominal area [15].

Ethnic-specific T2D risk factors are primarily confirmed by morphological differences in body outlook between different ethnic groups. Thus, prior studies conducted among young males (students) who were ethnic Altaians, Mongols and Russians revealed significant differences between these groups in terms of most somatic parameters, such as body weight, frame length and width, body circumferences and fat deposit locations/measurements. Generally, Russian students were found to be the tallest and Mongol ones – the shortest. Mongol students possessed low body weight, low body circumferences and narrow skeletal epiphyses, which means a relatively smaller frame [16].

Analysis of anthropometrics among the groups we defined confirms the existence of morphological specifics described by prior studies conducted among those ethnic entities. We found the "Mongoloid population" group to possess significantly lower stature and body weight. In terms of BMI, the "Peoples of Northern Caucasus" group did not significantly differ from Russians and peoples of Transcaucasia; moreover, such parity was observed both among subjects with normal carbohydrate metabolism and among those with carbohydrate metabolism disorders. However, the "Peoples of Northern Caucasus" group had significantly greater BMI than the "Peoples of the Volga region" group; this difference was observed both among subjects with normal carbohydrate metabolism and among those with carbohydrate metabolism disorders.

The NATION was a population screening study; it found that the average T2D prevalence among the adult population in Russia (aged 20 to 79) was 5.4%, and prediabetes – 19.3%. Unfortunately, that study lacked in statistical power and thus we could not establish significant differences in diabetes prevalence between the ethnic groups we defined. Therefore, we analysed a combined prevalence of diabetes and prediabetes as a metric of carbohydrate metabolism disorders.

The highest prevalence of carbohydrate metabolism disorders was observed in the "Peoples of the Volga region" group: 31.2%. This was higher than the prevalence of carbohydrate metabolism disorders among Russians residing in the Central Federal District (the "Russians" group); the same difference was found to exist between the subjects from in the "Peoples of the Volga region" group residing in their native lands vs. Russians living in the same regions. Moreover, the subjects from in the "Peoples of the Volga region" group residing in their native lands had higher prevalence of carbohydrate metabolism disorders vs. Russians residing in the Central Federal District.

It is noteworthy that, even though BMI among the "Peoples of the Volga region" group was significantly

lower vs. the "Peoples of Northern Caucasus" group, higher body weight (even up to Stage 1 obesity only) or greater WC among the subjects from the "Peoples of the Volga region" group were significantly more frequently associated with carbohydrate metabolism disorders than was the case in the "Peoples of Northern Caucasus" or the "Peoples of Transcaucasia" groups.

Such risk factors as abdominal obesity, Stage 1 obesity, or age over 45 were significantly more frequently associated with carbohydrate metabolism disorders among the "Mongoloid population" group than was the case in the "Peoples of Northern Caucasus" or the "Peoples of Transcaucasia" groups.

Analysis of the probability of carbohydrate metabolism disorders in correlation with diabetes risk factors and their combinations did not reveal any significant ethnic-specific differences. Interestingly, hereditary T2D history alone did not increase the probability of carbohydrate metabolism disorders in any of the ethnic groups; however, the same risk factor combined with other ones (arterial hypertension, obesity or high age) increased the risk of carbohydrate metabolism disorders by a factor of 4.1 to 24.25. A similar increase of the risk in question was established by T. Schnurr *et al*. who analysed hereditary T2D history combined with obesity and other risk factors [17]. These data once again indicate that merely having a hereditary T2D history does not mean that diabetes will occur. Careful management of such modifiable risk factors as blood pressure, body weight, and dietary patterns will prevent prediabetes and T2D.

Our analysis of the prevalence of carbohydrate metabolism disorders among ethnic groups residing in their native lands vs. Russians residing in the same regions (*i.e.*, the same climate environment and dietary patterns) yielded very interesting results. It is well known that T2D risk is to a large extent affected by such external factors as dietary patterns and physical activity. Russia's territory stretches almost 10,000 kilometres east to west and over 4,000 kilometres north to south. It includes 11 time zones. Different climates strongly affect people's occupation, physical activity level, and dietary patterns. Our analysis revealed significant differences in the prevalence of carbohydrate metabolism disorders among ethnic groups residing in their native lands vs. Russians residing in the same regions, which indicates the existence of genetic factors affecting T2D risk.

Moving to another region often results in substantial shifts of one's dietary patterns, pace of life, and physical activity; sometimes, it leads to stress due to the need to adapt to a new environment [18]. All these factors may negatively affect one's health condition. Our study revealed that the prevalence of carbohydrate metabolism disorders among the subjects from the "Peoples of Northern Caucasus" group residing in their native lands was lower vs. the subjects from the same ethnic group residing elsewhere in Russia: 13.9% vs. 21.95% (p=0.012, χ^2 test), and this may be due to external factors.

The waist-to-height ratio (WHtR) is used as a metric of fat distribution in the body; it correlates with the degree of abdominal obesity [19]. The higher the WHtR value, the greater the risk of cardiovascular diseases linked to obesity. Interestingly, even though the "Peoples of Northern Caucasus" group possessed higher BMI and body weight vs. the "Peoples of the Volga region" group, the former ethnic group had lower WHtR value vs. the "Peoples of the Volga region", the "Mongoloid population" or the "Peoples of Transcaucasia" groups. The fact that abdominal obesity is not characteristic for the "Peoples of Northern Caucasus" group will go some way towards explaining the results of our study in terms of low prevalence of carbohydrate metabolism disorders among this group.

LIMITATIONS.

The strongest limitation of our study is a wide diversity of the ethnic and regional groups' sizes, which caused us to combine anthropologically remote populations into larger samples. Thus, the "Mongoloid population" group included not only indigenous population of Siberia and Russia's Far East but also subjects from a South Siberian contact (mixed) race (*i.e.*, Kazakhs, Kyrgyz, etc.), sometimes with a significant Ural component (Bashkirs, Selkups).

CONCLUSION

This study was the first attempt to use the database of the NATION nation-wide epidemiological cross-sectional study to analyse the prevalence of carbohydrate metabolism disorders (T2D + prediabetes) across different ethnic groups of Russia. The highest prevalence of carbohydrate metabolism disorders was observed among the "Peoples of the Volga region" group (31.2%), the lowest – among the "Peoples of the North Caucasus" group (15.6%). Such traditional T2D risk factors as obesity or age over 45 did more often increase the risk of carbohydrate metabolism disorders among the "Mongoloid population" and the "Peoples of the Volga region" groups vs. the "Peoples of Northern Caucasus" and the "Peoples of Transcaucasia" groups. The prevalence of carbohydrate metabolism disorders among ethnic groups residing in their native lands was different from that among Russians residing in the same regions, which indicates that various ethnic groups possess some genetic factors associated with T2D risk. Further studies will be needed to inquire into T2D genetic markers and predictors among various ethnic groups of Russia. The prevalence of carbohydrate metabolism disorders among the subjects from the "Peoples of Northern Caucasus" group residing in their native lands was lower vs. the subjects from the same ethnic group residing elsewhere in Russia: 13.9% vs. 21.95% (p=0.012, $\chi 2$ test), and this may be due to external factors. Our findings will help plan efficient preventive programs among various populations in various regions of the Russian Federation.

ADDITIONAL INFORMATION

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Authors' contribution. Irina V. Kononenko: data analysis, interpretation of results, article drafting and pre-publication preparation; Irina A. Khomyakova: the idea and concept of the study, article editing, conclusion; Alina R. Elfimova: data analysis, statistical processing, tables

& figures, interpretation of results; Marina V. Shestakova: the idea and concept of the study, interpretation of results, article editing, conclusion; Alexandra P. Buzhilova: the idea and concept of the study, conclusion, final draft approval; Natalya G. Mokrysheva: the idea and concept of the study, final draft approval. Every author approved the final version of the text prior to publication and agreed to accept responsibility for all aspects of this study, which implies due investigation and resolution of any issue related to the accuracy or integrity of any part thereof.

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APPENDIX 1.

Table 1. Defined ethnic groups' anthropometrics (includes subjects with normal carbohydrate metabolism + those with diabetes + those with prediabetes)

Metric	Russians residing in the Central Federal District (N=5,043) (Group 1)	Mongoloid population (N=713) (Group 2)	Peoples of Northern Caucasus (N=762) (Group 3)	Peoples of Transcaucasia (N=442) (Group 4)	Peoples of the Volga region (N=1,546) (Group 5)	p, Kruskal-Wallis test, post-hoc analysis
Age (years)	45 [32; 59]	42 [29; 54]	38 [28; 52]	46 [31; 55]	45 [31; 56]	P<0.001 P_{1-2}<0.05 P_{1-3}<0.05 P_{2-5}<0.05 P_{3-4}<0.05 P_{3-5}<0.05
Waste-to-hip ratio	0.86 [0.79; 0.92]	0.87 [0.81; 0.92]	0.86 [0.77; 0.93]	0.87 [0.80; 0.93]	0.87 [0.81; 0.93]	-
WHtR	0.53 [0.47; 0.59]	0.54 [0.47; 0.60]	0.53 [0.45; 0.59]	0.55 [0.48; 0.61]	0.54 [0.47; 0.59]	P_{2-3}<0.05 P_{3-4}<0.05 P_{3-5}<0.05
Body mass index (kg/m^2)	27 [23; 31]	26 [23; 30]	27 [23; 31]	27 [24; 32]	26 [23; 30]	P_{2-4}<0.05 P_{3-5}<0.05
HC (cm)	104 [97; 111]	102 [96; 108]	102 [95; 110]	104 [97; 113]	102 [96; 108]	P_{1-2}<0.05 P_{2-4}<0.05 P_{1-3}<0.05 P_{3-4}<0.05
WC (cm)	90 [80; 100]	89 [79; 99]	88 [77; 100]	91.5 [80; 102]	90 [80; 99]	-
Height (m)	1.68 [1.62; 1.75]	1.64 [1.58; 1.72]	1.68 [1.61; 1.74]	1.67 [1.60; 1.74]	1.65 [1.60; 1.73]	P_{1-2}<0.05 P_{2-3}<0.05 P_{2-4}<0.05 P_{2-5}<0.05 P_{3-5}<0.05
Body weight (kg)	77 [66; 88]	71 [62; 83]	76 [65; 89]	78 [65; 90]	72 [63; 84]	P_{1-2}<0.05 P_{2-3}<0.05 P_{2-4}<0.05 P_{3-5}<0.05

WHtR – Waist-to-height ratio (waist circumference (cm) to height (cm) ratio); WC – waist circumference; HC – hip circumference

Table 2. Defined ethnic groups' anthropometrics (includes subjects with normal carbohydrate metabolism only)

Metric	Russians residing in the Central Federal District (N=3,663) (Group 1)	Mongoloid population (N=516) (Group 2)	Peoples of Northern Caucasus (N=643) (Group 3)	Peoples of Transcaucasia (N=343) (Group 4)	Peoples of the Volga region (N=1,064) (Group 5)	p
Age (years)	39 [29; 53]	35 [27; 48]	35 [27; 49]	38 [29; 51]	38 [28; 51]	P<0.001 P_{1-2}<0.05 P_{1-3}<0.05 P_{3-5}<0.05
Waste-to-hip ratio	0.84 [0.78; 0.90]	0.85 [0.79; 0.91]	0.84 [0.77; 0.92]	0.86 [0.78; 0.925]	0.85 [0.79; 0.91]	P=0.004 P_{1-5}<0.05
WHtR	0.51 [0.45; 0.56]	0.52 [0.45; 0.58]	0.51 [0.45; 0.58]	0.53 [0.47; 0.59]	0.51 [0.46; 0.56]	P=0.002 P_{1-4}<0.05 P_{3-4}<0.05
Body mass index (kg/m^2)	26 [23; 29]	25 [22; 29]	26 [22; 30]	26 [23; 30]	25 [22; 28]	P<0.001 P_{1-5}<0.05 P_{2-3}<0.05 P_{2-4}<0.05 P_{3-5}<0.05 P_{4-5}<0.05

End of table 2

HC (cm)	102 [96; 108]	100 [94; 106]	100 [94; 110]	102 [96; 110]	100 [94; 106]	P<0.001 P_{1-2}<0.05 P_{1-5}<0.05 P_{2-4}<0.05 P_{4-5}<0.05
WC (cm)	86 [77; 96]	85 [75; 95]	86 [75; 98]	89 [78; 98]	85 [77; 96]	P=0.040 P_{2-4}<0.05 P_{4-5}<0.05
Height (m)	1.69 [1.63; 1.76]	1.65 [1.59; 1.73]	1.68 [1.62; 1.74]	1.68 [1.60; 1.75]	1.67 [1.60; 1.74]	P<0.001 P_{1-2}<0.05 P_{1-3}<0.05 P_{1-4}<0.05 P_{1-5}<0.05 P_{2-3}<0.05 P_{2-4}<0.05
Body weight (kg)	74 [64; 85]	70 [60; 80]	75 [64; 88]	75 [63; 86]	70 [61; 80]	P<0.001 P_{1-2}<0.05 P_{1-5}<0.05 P_{2-3}<0.05 P_{2-4}<0.05 P_{3-5}<0.05 P_{4-5}<0.05

WHtR – Waist-to-height ratio (waist circumference (cm) to height (cm) ratio); WC – waist circumference; HC – hip circumference

Table 3. Defined ethnic groups' anthropometrics (includes subjects with carbohydrate metabolism disorders (diabetes + prediabetes))

Metric	Russians residing in the Central Federal District (N=1,380) (Group 1)	Mongoloid population (N=197) (Group 2)	Peoples of Northern Caucasus (N=119) (Group 3)	Peoples of Transcaucasia (N=343) (Group 4)	Peoples of the Volga region (N=482) (Group 5)	p
Age (years)	59 [49; 67]	53 [45; 61]	53 [45; 59]	55 [50; 60]	55 [48; 64]	P<0.001 P_{1-2}<0.05 P_{1-3}<0.05 P_{1-5}<0.05
Waste-to-hip ratio	0.90 [0.84; 0.95]	0.90 [0.86; 0.96]	0.91 [0.86; 0.97]	0.90 [0.85; 0.96]	0.91 [0.86; 0.96]	P=0.019 P_{1-5}<0.05
WHtR	0.60 [0.55; 0.66]	0.60 [0.55; 0.65]	0.61 [0.56; 0.66]	0.63 [0.56; 0.69]	0.59 [0.54; 0.65]	P=0.006 P_{4-5}<0.05
Body mass index (kg/m^2)	30 [27; 34]	30 [27; 33]	31 [28; 35]	33 [27; 38]	29 [26; 32]	P<0.001 P_{1-5}<0.05 P_{2-4}<0.05 P_{3-5}<0.05 P_{4-5}<0.05
HC (cm)	110 [103; 117]	107 [101; 112]	108 [102; 116]	113 [102; 121]	106 [100; 113]	P<0.001 P_{1-2}<0.05 P_{1-5}<0.05 P_{2-4}<0.05 P_{4-5}<0.05
WC (cm)	99 [90; 108]	97 [89; 105]	100 [92; 109]	102 [93; 111]	97 [89; 106]	P=0.002 P_{1-5}<0.05 P_{4-5}<0.05
Height (m)	1.64 [1.58; 1.72]	1.62 [1.55; 1.69]	1.65 [1.57; 1.72]	1.64 [1.57; 1.70]	1.64 [1.57; 1.72]	P<0.001 P_{1-2}<0.05 P_{2-5}<0.05
Body weight (kg)	84 [73; 95]	77 [69; 89]	85 [74; 98]	85 [74; 102]	77 [68; 90]	P<0.001 P_{1-2}<0.05 P_{1-5}<0.05 P_{2-3}<0.05 P_{2-4}<0.05 P_{3-5}<0.05 P_{4-5}<0.05

WHtR – Waist-to-height ratio (waist circumference (cm) to height (cm) ratio); WC – waist circumference; HC – hip circumference

APPENDIX 2

Table 1. Regions of residence of the subjects from the defined ethnic groups, as per the NATION study findings

Region	Mongoloid population	Peoples of Transcaucasia	Peoples of the Volga region	Peoples of Northern Caucasus
Altay Territory	2	1		1
Arkhangelsk Region			1	
Astrakhan Region	9	1	19	1
Belgorod Region	1	4	1	1
Bryansk Region			1	1
Vladimir Region		2		1
Volgograd Region	2	8	11	4
Vologda Region		1		
Voronezh Region		7	1	1
Moscow	16	75	65	52
Saint Petersburg	9	9	18	5
Transbaikal Territory	3		1	
Ivanovo Region			3	5
Irkutsk Region	66	1	1	1
Kabardino-Balkarian Republic	1	4		303
Kaliningrad Region			3	
Kaluga Region		3		1
Kamchatka Territory	1			1
Kemerovo Region		1	5	1
Krasnodar Territory	6	59	5	4
Krasnoyarsk Territory	4	4	5	9
Kurgan Region			5	2
Kursk Region	1		1	
Leningrad Region	2	3	2	
Lipetsk Region				1
Magadan Region	1	1	1	
Moscow Region	28	64	29	15
Murmansk Region			3	
Nizhny Novgorod Region		1	17	1
Novosibirsk Region	1	1	4	
Omsk Region	10		14	
Orenburg Region	22	5	39	2
Penza Region		2	9	
Perm Territory	2	1	22	
Primorsky Territory	1		1	
Republic of Bashkortostan	110	2	276	
Republic of Buryatia	109	1	1	
Republic of Kalmykia	52			
Republic of Karelia		1	1	

End of table 1

Republic of Komi	1		37	
Republic of Sakha (Yakutia)	153	1	1	
Republic of Tatarstan	4	3	412	3
Rostov Region	2	78	7	13
Ryazan Region		1	2	2
Samara Region	8	9	44	2
Saratov Region	5	3	15	1
Sakhalin Region	9		2	1
Sverdlovsk Region	15	25	38	1
Smolensk Region		1		
Stavropol Territory	2	25	5	21
Tambov Region		2	1	
Tver Region	2	1	3	2
Tula Region	2	1	1	2
Udmurt Republic		1	94	
Ulyanovsk Region		1	53	1
Khabarovsk Territory	2		2	
Chelyabinsk Region	42	9	58	2
Chechen Republic			1	295
Chuvash Republic	1	1	187	
Yamalo-Nenets Autonomous Area	5	18	18	3
Yaroslavl Region	1			

Mongoloid population:

- Republic of Sakha (Yakutia) – 21.46%
- Republic of Bashkortostan – 15.43%
- Republic of Buryatia – 15.29%
- Irkutsk Region – 9.26%
- Republic of Kalmykia – 7.29%
- Chelyabinsk Region – 5.89%
- Moscow Region – 3.93%
- Orenburg Region – 3.09%
- Moscow – 2.24%
- Sverdlovsk Region – 2.10%
- Omsk Region – 1.40%
- Astrakhan Region, Saint Petersburg, Sakhalin Region – 1.26%
- Samara Region – 1.12%
- Krasnodar Territory – 0.84%
- Saratov Region, Yamalo-Nenets Autonomous Area – 0.70%
- Krasnoyarsk Territory, Republic of Tatarstan – 0.56%
- Transbaikal Territory – 0.42%
- Altay Territory, Volgograd Region, Leningrad Region, Perm Territory, Rostov Region, Stavropol Territory, Tver Region, Tula Region, Khabarovsk Territory – 0.28%
- Belgorod Region, Kabardino-Balkarian Republic, Kamchatka Territory, Kursk Region, Magadan Region, Novosibirsk Region, Primorsky Territory, Republic of Komi, Chuvash Republic, Yaroslavl Region – 0.14%

Peoples of Transcaucasia

- Rostov Region – 17.65%
- Moscow – 16.97%
- Moscow Region – 14.48%

- Krasnodar Territory – 13.35%
- Sverdlovsk Region, Stavropol Territory – 5.66%
- Yamalo-Nenets Autonomous Area – 4.07%
- Chelyabinsk Region, Saint Petersburg, Samara Region – 2.04%
- Volgograd Region – 1.81%
- Voronezh Region – 1.58%
- Orenburg Region – 1.13%
- Krasnoyarsk Territory, Belgorod Region, Kabardino-Balkarian Republic – 0.90%
- Saratov Region, Republic of Tatarstan, Leningrad Region, Kaluga Region – 0.68%
- Republic of Bashkortostan, Vladimir Region, Penza Region, Tambov Region – 0.45%
- Republic of Sakha (Yakutia), Republic of Buryatia, Irkutsk Region, Astrakhan Region, Altay Territory, Perm Territory, Tver Region, Tula Region, Magadan Region, Novosibirsk Region, Chuvash Republic, Vologda Region, Kemerovo Region, Nizhny Novgorod Region, Republic of Karelia, Ryazan Region, Smolensk Region, Udmurt Republic, Ulyanovsk Region – 0.23%

Peoples of the Volga region

- Republic of Tatarstan – 26.65%
- Republic of Bashkortostan – 17.85%
- Chuvash Republic – 12,10%
- Udmurt Republic – 6.08%
- Moscow – 4.20%
- Chelyabinsk Region – 3.75%
- Ulyanovsk Region – 3.43%
- Samara Region – 2.85%
- Orenburg Region – 2.52%
- Sverdlovsk Region – 2.46%
- Republic of Komi – 2.39%
- Moscow Region – 1.88%
- Perm Territory – 1.42%
- Astrakhan Region – 1.23%
- Yamalo-Nenets Autonomous Area – 1.16%
- Saint Petersburg – 1.16%
- Nizhny Novgorod Region – 1.10%
- Saratov Region – 0.97%
- Omsk Region – 0.91%
- Volgograd Region – 0.71%
- Penza Region – 0.58%
- Rostov Region – 0.45%
- Krasnodar Territory, Stavropol Territory, Krasnoyarsk Territory, Kemerovo Region, Kurgan Region – 0.32%
- Novosibirsk Region – 0.26%
- Tver Region, Ivanovo Region, Kaliningrad Region, Murmansk Region – 0.19%
- Leningrad Region, Ryazan Region, Sakhalin Region, Khabarovsk Territory – 0.13%
- Voronezh Region, Belgorod Region, Tambov Region, Republic of Sakha (Yakutia), Republic of Buryatia, Irkutsk Region, Tula Region, Magadan Region, Republic of Karelia, Transbaikal Territory, Kursk Region, Primorsky Territory, Arkhangelsk Region, Bryansk Region, Chechen Republic – 0.06%

Peoples of Northern Caucasus

- Kabardino-Balkarian Republic – 39.76%
- Chechen Republic – 38.71%
- Moscow – 6.82%
- Stavropol Territory – 2.76%
- Moscow Region – 1.97%
- Rostov Region – 1.71%
- Krasnoyarsk Territory – 1.18%
- Saint Petersburg, Ivanovo Region – 0.66%
- Volgograd Region, Krasnodar Territory – 0.52%
- Republic of Tatarstan, Yamalo-Nenets Autonomous Area – 0.39%
- Chelyabinsk Region, Samara Region, Orenburg Region, Kurgan Region, Tver Region, Ryazan Region, Tula Region – 0.26%
- Ulyanovsk Region, Sverdlovsk Region, Astrakhan Region, Nizhny Novgorod Region, Saratov Region, Kemerovo Region, Sakhalin Region, Voronezh Region, Belgorod Region, Irkutsk Region, Bryansk Region, Kaluga Region, Vladimir Region, Altay Territory, Kamchatka Territory, Lipetsk Region – 0.13%

APPENDIX 3.

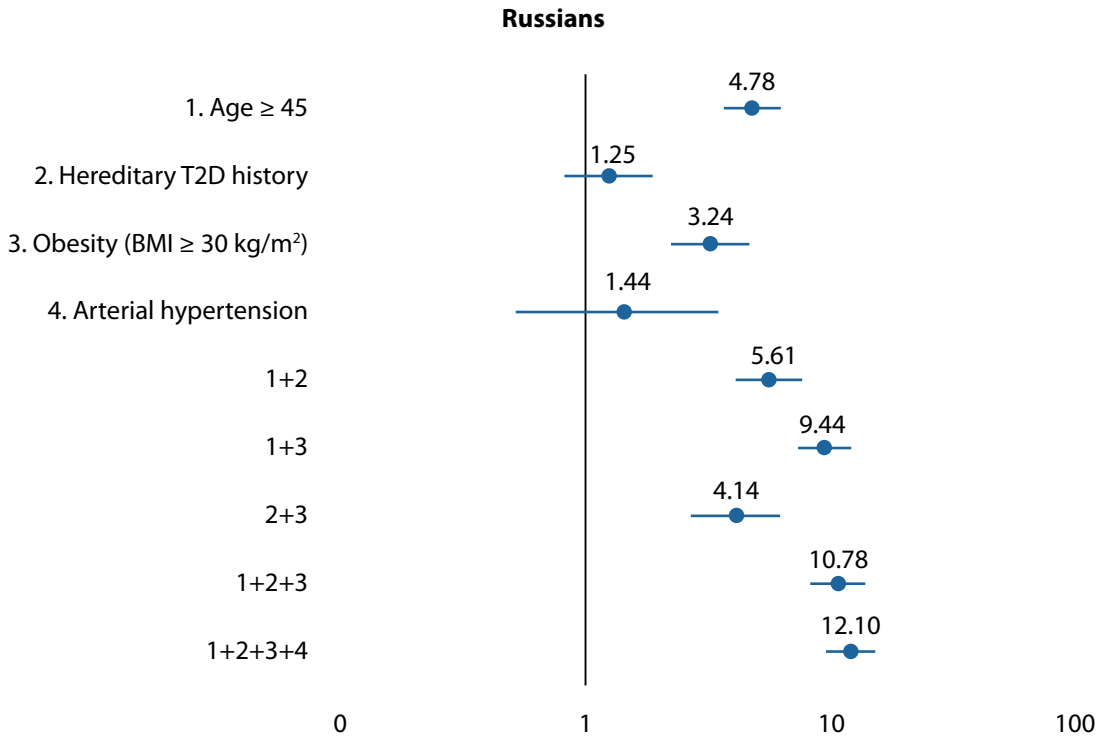

Figure 1. Relative risk of carbohydrate metabolism disorders among the "Russians residing in the Central Federal District" group driven by T2D risk factors.

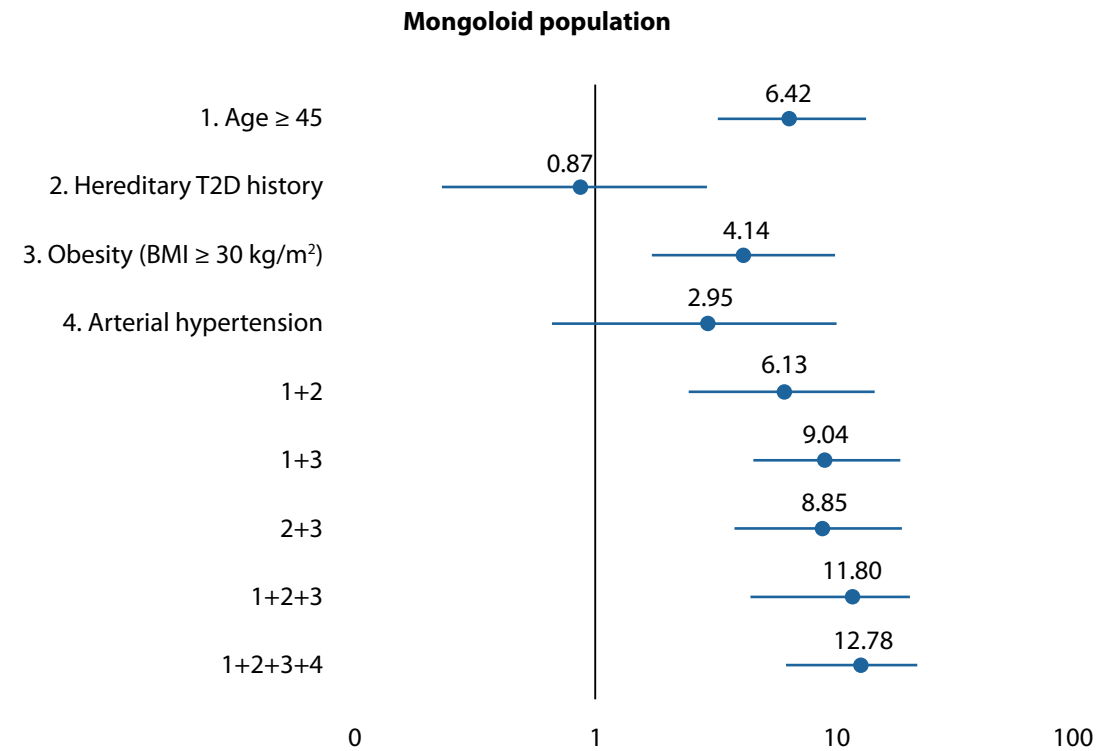

Figure 2. Relative risk of carbohydrate metabolism disorders among the "Mongoloid population" group driven by T2D risk factors.

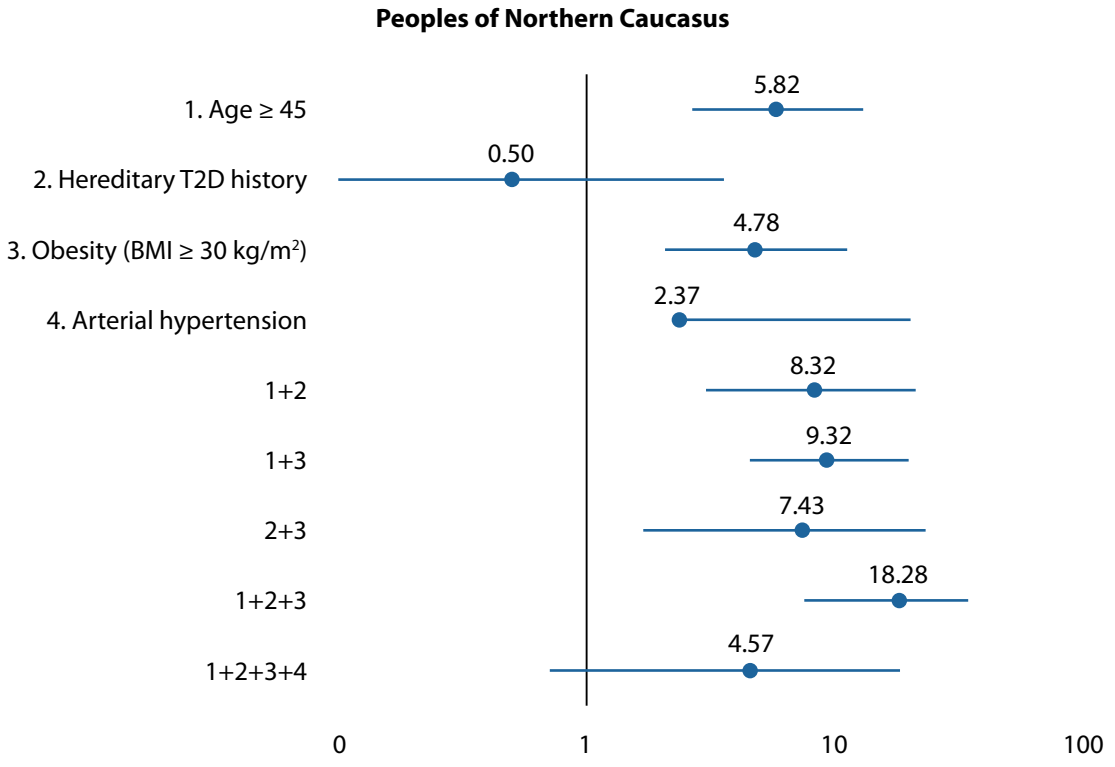

Figure 3. Relative risk of carbohydrate metabolism disorders among the "Peoples of Northern Caucasus" group driven by T2D risk factors.

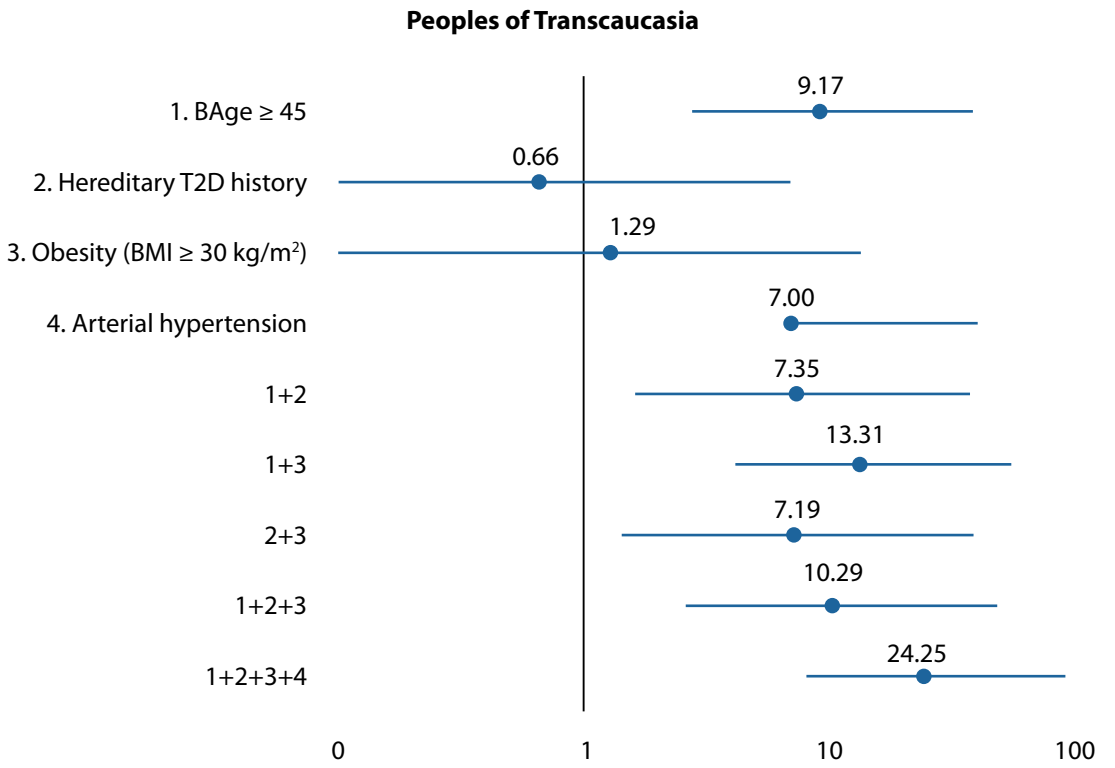

Figure 4. Relative risk of carbohydrate metabolism disorders among the "Peoples of Transcaucasia" group driven by T2D risk factors.

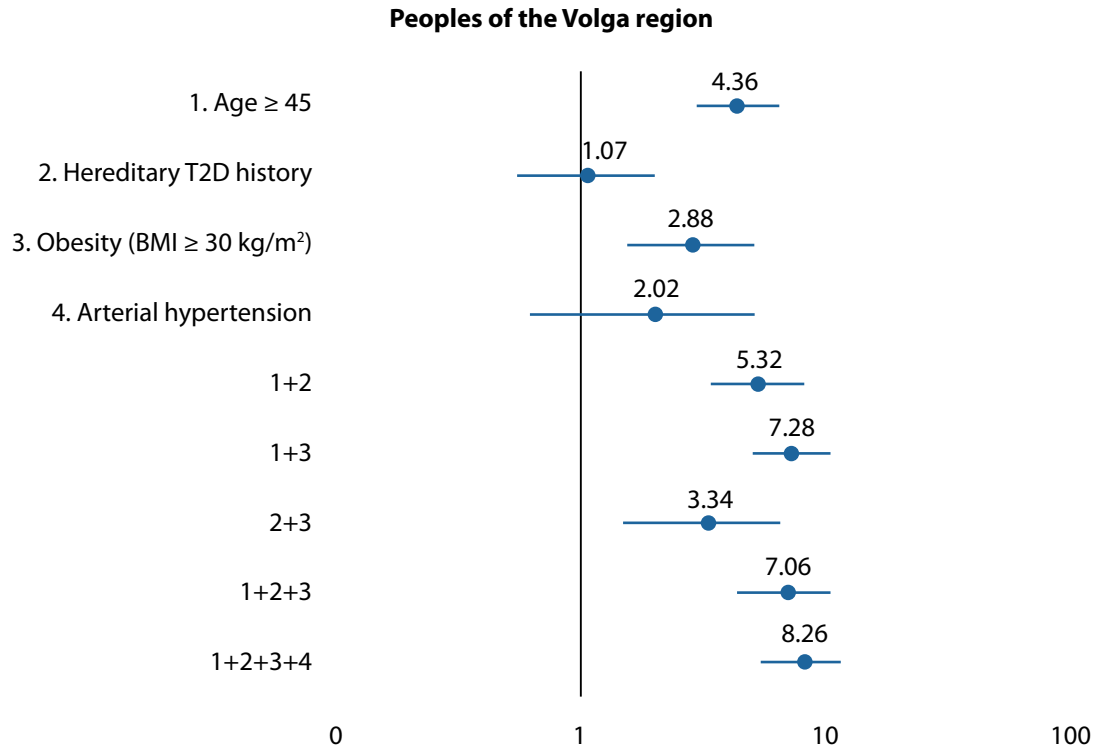

Figure 5. Relative risk of carbohydrate metabolism disorders among the "Peoples of the Volga region" group driven by T2D risk factors.

APPENDIX 4.
COMPARING THE PARAMETERS OF ETHNIC GROUPS RESIDING IN THEIR NATIVE LANDS AGAINST THOSE OF RUSSIANS RESIDING IN THE SAME REGIONS.

Table 1. Comparing the parameters of the subjects from the "Peoples of the Volga region" group residing in their native lands vs. those of Russians residing in the same regions

Metric	Peoples of the Volga region (all)		Russians (in the Volga region, all)		p, Mann-Whitney test
	N	Me [Q1; Q3]	N	Me [Q1; Q3]	
HbA1c (%)	969	5.5 [5.3; 5.8]	816	5.4 [5.2; 5.6]	<0.001
Waist-to-hip ratio_	969	0.87 [0.81; 0.93]	816	0.86 [0.79; 0.92]	<0.001
Waist-to-height ratio	969	0.53 [0.48; 0.59]	816	0.53 [0.47; 0.59]	0.16
Height (m)	969	1.65 [1.60; 1.73]	816	1.67 [1.61; 1.73]	0.10
Weight (kg)	969	71.0 [62.0; 82.0]	816	73.0 [63.0; 84.0]	0.026
Body Mass Index (kg/m^2)	969	26.0 [23.0; 29.0]	816	26.0 [23.0; 30.0]	0.26
Waist circumference (cm)	969	89.0 [79.0; 98.0]	816	89.0 [79.0; 98.0]	0.56
Hip circumference (cm)	969	101.0 [95.0; 107.0]	816	102.0 [97.0; 110.0]	0.002
Body Adiposity Index	969	29.08 [25.76; 33.32]	816	29.0 [25.6; 33.9]	0.55
Age at the time of survey (years)	969	44.0 [30.0; 56.0]	816	44.0 [30.0; 57.0]	0.56

Table 2. Comparing the parameters of the subjects from the "Peoples of Northern Caucasus" group residing in the Chechen Republic and Kabardino-Balkarian Republic vs. those of Russians residing in the Central Federal District

Metric	Peoples of Northern Caucasus (all)		Russians (residing in the Central Federal District, all)		p, Mann-Whitney test
	N	Me [Q1; Q3]	N	Me [Q1; Q3]	
HbA1c (%)	598	5.2 [5.0; 5.4]	5,043	5.4 [5.2; 5.7]	<0.001
Waist-to-hip ratio_	598	0.86 [0.78; 0.94]	5,043	0.86 [0.79; 0.92]	0.86
Waist-to-height ratio	598	0.53 [0.45; 0.60]	5,043	0.53 [0.47; 0.5966]	0.24
Height (m)	598	1.68 [1.61; 1.74]	5,043	1.68 [1.62; 1.75]	0.06
Weight (kg)	598	76.5 [66.0; 90.0]	5,043	77.0 [66.0; 88.0]	0.84
Body Mass Index (kg/m^2)	598	27.0 [23.0; 32.0]	5,043	27.0 [23.0; 31.0]	0.44
Waist circumference (cm)	598	90.0 [78.0; 100.0]	5,043	90.0 [80.0; 100.0]	0.13
Hip circumference (cm)	598	102.0 [95.0; 111.0]	5,043	104.0 [97.0; 111.0]	<0.001
Body Adiposity Index	598	28.33 [24.46; 34.37]	5,043	29.16 [25.3; 34.4]	0.023
Age at the time of survey (years)	598	39.0 [28.0; 52.0]	5,043	45.0 [32.0; 59.0]	<0.001

Table 3. Comparing the parameters of the subjects from the "Mongoloid population" group residing in their native lands (Republic of Sakha (Yakutia), Republic of Bashkortostan, Republic of Buryatia, Irkutsk Region, Republic of Kalmykia) vs. those of Russians residing in the same regions.

Metric	Mongoloid population (all)		Russians* (Northern Caucasus, all)		p, Mann-Whitney test
	N	Me [Q1; Q3]	N	Me [Q1; Q3]	
HbA1c (%)	490	5.4 [5.2; 5.7]	722	5.4 [5.1; 5.6]	<0.001
Waist-to-hip ratio_	490	0.88 [0.82; 0.93]	722	0.84 [0.78; 0.90]	<0.001
Waist-to-height ratio	490	0.55 [0.48; 0.61]	722	0.51 [0.45; 0.58]	<0.001
Height (m)	490	1.64 [1.57; 1.72]	722	1.67 [1.61; 1.74]	<0.001
Weight (kg)	490	71.5 [63.0; 83.0]	722	74.0 [63.0; 85.0]	0.054
Body Mass Index (kg/m^2)	490	27.0 [23.0; 30.0]	722	26.0 [23.0; 30.0]	0.159
Waist circumference (cm)	490	90.0 [81.0; 100.0]	722	87.0 [76.0; 97.0]	<0.001
Hip circumference (cm)	490	102.0 [96.0; 109.0]	722	103.0 [96.0; 109.0]	0.61
Body Adiposity Index	490	29.97 [26.47; 35.34]	722	29.02 [25.2; 33.4]	<0.001
Age at the time of survey (years)	490	42.0 [29.0; 54.0]	722	43.0[30.0; 57.0]	0.0645

*Parameters of Russian population residing in Republic of Sakha (Yakutia), Republic of Bashkortostan, Republic of Buryatia, Irkutsk Region, and Republic of Kalmykia.