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## A.S. Shastin, V.G. Panov, V.G. Gazimova, T.Yu. Obukhova DISEASES OF THE CIRCULATORY SYSTEM IN THE WORKING-AGE POPULATION OF THE REPUBLIC OF SAKHA (YAKUTIA) IN 2011–2023

Epidemiological characteristics and patterns of chronic non-communicable diseases in the working-age population (WAP) are often neglected nowadays. Disease rates in the WAP are not the object of statistical observation, which significantly complicates the conduct of targeted studies. Diseases of the circulatory system are the main cause of premature deaths, which determines the relevance of establishing their rates in the WAP, including the analysis of their changes and features during the spread of COVID-19 and in the early post-pandemic period.

**Materials and methods.** We calculated incidence and prevalence rates of circulatory system diseases (CSD) in the WAP of the Republic of Sakha (Yakutia) and analyzed their dynamics in 2011–2023. We also assessed the statistical significance of differences between the disease rates in Yakutia and the Russian Federation before, during and after the pandemic of the novel coronavirus disease. Direct ranking was used to determine the place of Yakutia among the constituent entities of the Russian Federation in terms of CSD rates.

**Results.** We established that during the study period, Yakutia belonged to a large group of Russian constituent entities with average CSD rates. We observed a statistical increase in the CSD prevalence in Yakutia in 2022–2023 and in the chronicity rate in 2020–2023. The high rate of increase in the latter indicates a more severe course of chronic CSDs during the COVID-19 pandemic and the early post-pandemic period in the WAP.

**Conclusions.** The study of trends and regional characteristics of morbidity of the working-age population is an important component of raising effectiveness of government measures taken to increase life expectancy and reduce mortality. The results of such studies should be taken into account when developing local programs of state guarantees for the provision of free medical care.

**Keywords:** working-age population, diseases of the circulatory system, incidence, prevalence, chronicity rate, COVID-19.

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**Introduction.** The current demographic and health situation in the Russian Federation and the Republic of Sakha (Yakutia) (hereinafter referred to

as Yakutia) is characterized by downward trends, especially a decrease in the size and proportion of the working-age population (WAP) and an increase in its mean age [4,8,9]. High mortality rates in this group of population both in the country and the republic have been registered for a long time [2,3,13,16]. The causes of WAP mortality and the factors affecting its rates are in the focus of attention of many specialists.

At the same time, despite this unfavorable background, epidemiological characteristics and patterns of chronic non-communicable diseases (CNCDs) in the WAP are often neglected. WAP morbidity is not the object of statistical observation, which significantly complicates the conduct of targeted studies.

Diseases of the circulatory system are the main cause of premature mortality, which determines the relevance of studying their rates in the WAP [6,10,13].

The **purpose** of the study was to analyze the dynamics of the circulatory system disease (CSD) rates in the working-age population of the Republic of Sakha (Yakutia) during the spread of the novel coronavirus disease and in the early post-pandemic period.

**Materials and Methods.** Using methods of descriptive and applied statistics, we conducted a retrospective study of the rates of circulatory system diseases based on the number of WAP seeking medical attention in Yakutia in 2011–2023. CSD incidence and prevalence rates in the WAP were calculated using data of statistical bulletins followed by estimation of the CSD chronicity rate. The study period was determined by the data available. To assess the statistical significance of differences in the CSD incidence, prevalence, and chronicity rates between the years 2020–2023 and the pre-pandemic period, we constructed confidence intervals (CI) for mean values ( $M$ ) of 2011–2019. The direct ranking method was used to determine the ranks of all constituent entities of the Russian Federation by the above rates from the highest to lowest. A quintile distribution of the regional rates was used for a comparative evaluation of morbidity. Given the nonlinearity of the dependence of the indicators on the study year, trends were assessed using quadratic regression.

Microsoft Excel and *Wolfram Research Mathematica* v.11.3 were used for statistical data analysis.

**Results.** Figures 1–3 show the dynamics of the circulatory disease incidence, prevalence and chronicity rates in the WAP of Yakutia.

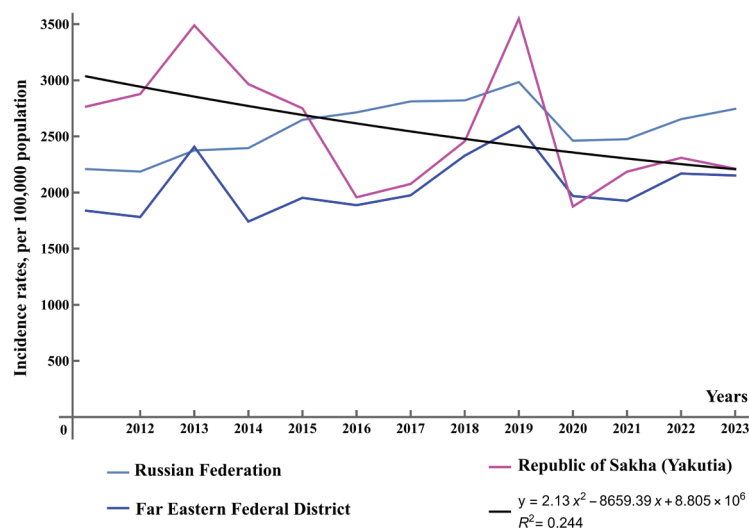


Fig. 1. Circulatory disease incidence rates in the working-age population in 2011–2023 (per 100,000 population).

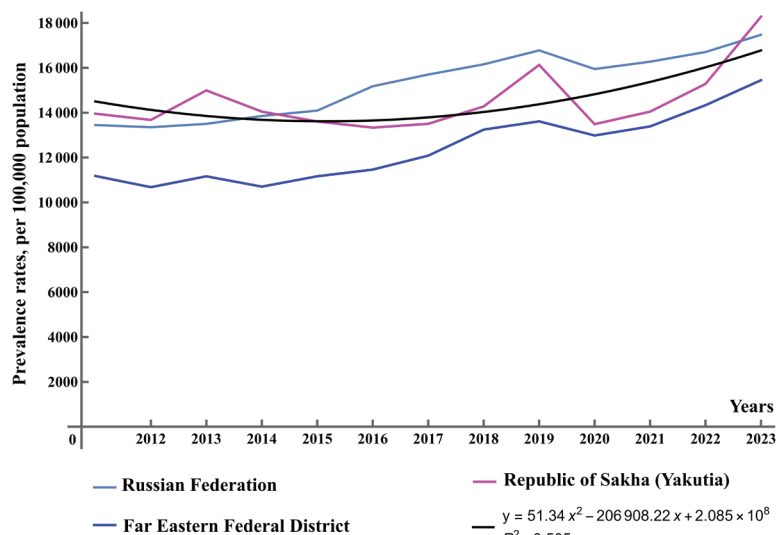


Fig. 2. Circulatory disease prevalence rates in the working-age population in 2011–2023 (per 100,000 population).

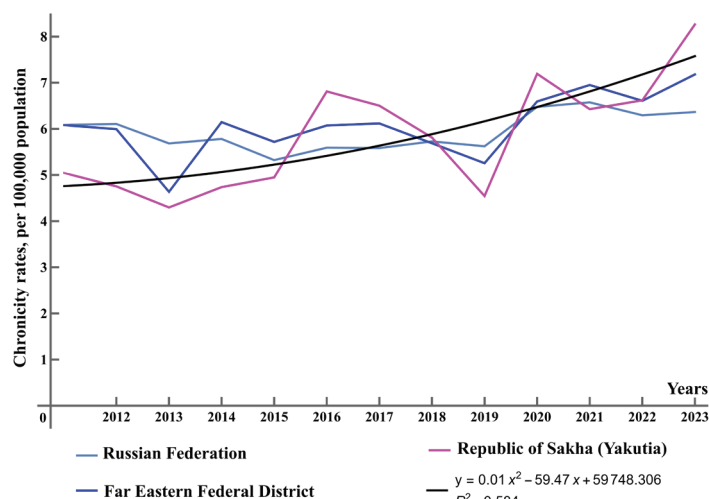


Fig. 3. Circulatory disease chronicity rates in the working-age population in 2011–2023 (per 100,000 population).

**Circulatory disease incidence and prevalence rates in the working-age population (per 100,000 population), chronicity and growth rates (%) compared to M.**

Territories	M <sub>2011-2019</sub>	2020	2021	2022	2023
Year (rate of increase, %)					
Russian Federation	2571.6 [2350.1;2793.1]	2462.0 (-4.3)	2475.2 (-3.7)	2653.7 (3.2)	2745.1 (6.7)
Far Eastern Federal District	2056.0 [1820.4;2291.5]	1968.9 (-4.2)	1926.1 (-6.3)	2169.1 (5.5)	2151.5 (4.6)
Republic of Sakha (Yakutia)	2765.3 [2343.1;3187.5]	1875.0 (-32.2)	2185.6 (-21.0)	2309.3 (-16.5)	2211.9 (-20.0)
Prevalence rates					
Russian Federation	14673.1 [13672.5;15673.8]	15945.6 (8.7)	16273.8 (10.9)	16705.5 (13.9)	17472.7 (19.1)
Far Eastern Federal District	11699.7 [10878.2;12521.1]	12983.3 (11.0)	13388.3 (14.4)	14334.6 (22.5)	15448.8 (32.0)
Republic of Sakha (Yakutia)	14169.5 [13488.2;14850.8]	13488.0 (-4.8)	14047.1 (-0.9)	15284.9 (7.9)	18279.9 (29.0)
Chronicity rates					
Russian Federation	5.72 [5.53;5.91]	6.48 (13.2)	6.57 (14.9)	6.30 (10.0)	6.37 (11.2)
Far Eastern Federal District	5.75 [5.36;6.14]	6.59 (14.8)	6.95 (21.0)	6.61 (15.0)	7.18 (25.0)
Republic of Sakha (Yakutia)	5.27 [4.59;5.96]	7.19 (36.4)	6.43 (21.9)	6.62 (25.5)	8.26 (56.7)

When described by quadratic regression, the dynamics of CSD incidence rates in Yakutia has an almost linear downward trend, however, due to the high variability of the indicators (i.e. variation coefficient of 21.2%), this model has a small coefficient of determination  $R^2 = 0.244$ .

In 2011–2019, Yakutia ranked 31<sup>st</sup> in terms of the mean CSD incidence rate in the fourth quintile of constituent entities of the Russian Federation with the above average level. In 2023, Yakutia moved to the second quintile (rank 63) with the below average level.

Experts also note a decrease in the CSD incidence rate in the general population of Yakutia in 2013–2016 [9].

When described by quadratic regression, the dynamics of CSD prevalence rates in Yakutia has a generally rising trend, which is determined, however, mainly by a noticeable increase in prevalence starting from 2016. In this case, the regression model has a much better quality described by  $R^2 = 0.505$ .

Changes in Yakutia ranks in terms of CSD prevalence were insignificant: 3<sup>rd</sup> quintile in the pre-pandemic period (rank 41, average level); rank 58 (below average) in 2020; rank 54 (below average) in 2021; rank 49 (average) in 2022, and rank 37 (average) in 2023.

When described by the same regression model, the dynamics of CSD chronicity rates in Yakutia has a noticeable upward trend with the coefficient of determination  $R^2 = 0.584$ .

In terms of the chronicity rates, more significant changes in the ranking of Yakutia were established ranging from rank 55 (below average) in 2011–2019 to rank 20 in 2023 (above average), with rank 31

(above average) in 2020; rank 53 (below average) in 2021, and rank 42 (average) in 2022.

In general, Yakutia belonged to a large group of subjects of the Russian Federation with relatively mean indicators in terms of the CSD prevalence in the WAP over the study period.

Table 1 demonstrates CSD rates in the WAP in 2020–2023 against those in the pre-pandemic period of 2011–2019.

**Table 1.** Circulatory disease incidence and prevalence rates in the working-age population (per 100,000 population), chronicity and growth rates (%) compared to M.

During the pandemic and in the early post-pandemic period, the CSD incidence rates in the WAP of Yakutia, in contrast to the Russian Federation and the Far Eastern Federal District, were significantly lower than those before the pandemic. Only in 2021, the CSD prevalence in Yakutia did not differ significantly from the rates registered in 2011–2019. In 2020–2023, chronicity rates in both the Russian Federation, the Far Eastern Federal District, and Yakutia were significantly higher than in the pre-pandemic period.

**Discussion.** Experts note a significant impact of COVID-19 on the cardiovascular system and highlight the need to study its consequences [7,12,15]. The decrease in the incidence rates of circulatory system diseases during the pandemic can be partly attributed to the lockdown, poorer access to health care, a lower volume of preventive measures, and self-protective behavior of patients [1,5,6,14]. The statistically significant decrease in the prevalence rate of circulatory system diseases in the Republic of

Sakha (Yakutia) established in 2020 is an atypical phenomenon in the Russian Federation as most regions of the country demonstrate rising trends [11]. At the same time, in 2023, the republican rate of increase in the prevalence already exceeded the Russian one.

We believe that the pronounced regional characteristics include high chronicity rates indicating a more severe course of chronic circulatory system diseases during the COVID-19 pandemic and the early post-pandemic period in the WAP of Yakutia and confirm the forecasts of experts about the long-term adverse effects of the novel coronavirus disease on the cardiovascular system [12,15].

**Conclusions.** The study of trends and regional characteristics of morbidity of the working-age population is an important component of increasing the effectiveness of government measures taken to increase life expectancy and reduce mortality. The results of such studies should be taken into account when developing local programs of state guarantees for the provision of free medical care.

*The authors declare no conflict of interest.*

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