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# RELATIONS OF CERVICAL CANCER MORTALITY WITH THE POPULATION'S NUMBER AND DISTRIBUTION IN REPUBLICS, LOCATED IN SIBERIA (2007-2018)

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The statistical relationship analysis' results between the republics' annual values (2007-2018) of age-standardized mortality rates (ASMr) from cervical cancer (CC) and demographic indicators - the population's number and density, the population's distribution on a city-rural basis, are presented. The selected republics are Altai, Buryatia, Tuva, Khakassia and Sakha (Yakutia). A positive correlation us found between CC ASMr and the percentage of republics' rural settlements (Spearman correlation coefficient (r) = 0.7, p≤0.05). With the rest of the demographic data selected for the study, the correlation did not reach the required significance (r <0.7, p> 0.05).

**Keywords:** cervical cancer, mortality, Siberia, the Far East, Altai, Buryatia, Tuva, Khakassia, Sakha (Yakutia).

**Introduction.** Cervical cancer (CC) is the second most common type of cancer among women worldwide. More than 90% of deaths from cervical cancer occur in women living in low- and middle-income countries. This is believed to be due to women's inadequate access to screening and treatment services [3].

In the Russian Federation (RF), in the structure of cancer mortality (CM), CC is one of the three main causes of death for women at the highest social activity age (30-59 years) [4].

As well as throughout the world [3], Russian rates of CM, including CC mortality (CCM), have significant territorial variability [4]. The rates' heterogeneity and a high level of CM are characteristic including for residents of Siberia [8]. Researches devoted to a comparative analysis of cancer mortality in Siberia are few. Meanwhile, to do work like that make it possible to assess the contribution of various factors - demographic, geographical, social, racial, ethnic, genetic, etc. - on CM.

In our previous researches, we found disparities in CCM over the Siberia's national territories - the Republic of Altai (RA), Buryatia (RB), Tuva (RT), Khakassia (RKh), Sakha (Yakutia) (RS(Y)) from 2007 to 2017. For the majority of the peoples inhabiting these territories, the fact of genetic kinship has been established [10]. We have shown that the lowest values of annual CC age-standardized mortality rates (ASMr) were observed in RS(Y) [7, 12], the largest - in RB [12]. Differences in CC ASMr between RA, RT, and RKh did not reach a statistical significance [12].

This research goal was to establish a relationship (correlation) between the annual CC ASMr in the long-term (2007 – 2018) and the population's distribution data, namely, the population's number and density, the urban and rural population's number, the number of cities, urban-type and rural settlements in RA, RB, RT, RKh and RS(Y).

**Material and Methods.** The annual (2007 - 2018) CC ASMr in RA, RB, RT, RKh and RS(Y) were extracted from the annually published books of the Moscow Scientific Research Institute after P.A. Herzen - a branch of the Federal State Budgetary Institution Scientific Research Center for Radiology of the Russia's Ministry of Health, which present the cancer incidence and mortality data of the Russian territories' population [4].

The source of population distribution data in the RA, RB, RT, RKh and RS(Y) was the 2010 All-Russian Population Census (RPC) results, published in the Federal State Statistics Service collection [9].

The study included the following RPC data - the population's number and density, the urban and rural population's number (in absolute terms and as a percentage of the total population), the republics' urban and rural settlements numbers. Based on these data, we also calculated the rural settlements percentage (to the total settlements' number), the rural population's number per one rural settlement, and the urban population's number per one urban settlement (including the cities and urban-type settlements' number).

Since CC ASMr and demographic data did not have a normal distribution,

we applied ranking (from smaller to larger) to them. To identify correlations, the annual CC ACMr ranks' sum (2007-2018) of each republic individually was compared with the RPC's ranked data. To estimate the strength of the relationship Spearman correlation coefficient (r) was calculated using the formula for small sample sizes. Results r ≥0.7 at p <0.05 were considered as significant.

**Results and Discussion.** To calculate the CC ASMr (per 100 thousand of population) the world standard for the population's age distribution and the Russia's administrative territories average annual population for the corresponding year are used [4].

Having performed the annual (2007 – 2018) CC ASMr ranking in the bundle - RA, RB, RT, RKh, RS(Y), we found that the highest values of the ranks' sum, i.e. the largest CC ASMr were in RB, the smallest - in RS(Y) (Fig. 1). This is consistent with our previous researches [7, 12].

According to RPC, it can be seen that the population's number and density, the urban and rural population's number, the number of cities, urban-type settlements and rural settlements demonstrate a significant differences among republics (table 1).

The difference between the smallest population (RA) and the largest (RB) were 4.7 times. The population is most densely located in the RKh, where the population density is 28 times greater than in RS(Y). The proportion of the urban population that was most marked in RKh exceeds that of the minimum RA by 2.4 times. Accordingly, the republics' rural population's proportion indicators demonstrate the exact opposite.

The smallest number of cities, the absence of urban-type settlements, was typical for the RA, while the same indicators in the RS(Y) showed directly opposite results - the largest number of cities and urban-type settlements. The maximum number of rural settlements is noted in RB, the smallest - in the RT.

If we calculate the republic's rural and urban settlements numbers as a percentage of the total republic's settlements number, we get a similar picture - the maximum distribution of rural settlements (respectively, the minimum of urban) - in RA, the minimal of rural settlements (respectively, the maximum of urban) - in RS(Y) (Fig. 2).

After analyzing the relationship of CC ASMr with the population's number and density, the urban and rural population's number (in absolute values and as a percentage of the total population), the number of urban and rural settlements, and the rural settlement's percentage, it was revealed a significant positive correlation between the annual CC ASMr and the republic's rural settlements' percentage (r = 0.7, p≤0.05). The correlation of the annual CC ASMr with the rest of demographic data did not reach the required strength and probability (r> 0.7, p> 0.05). When calculating the number of rural population per one rural settlement, and the number of urban population per one urban settlement (including the number of cities and towns), the strength and probability r did not also reach the required values (table 2).

The obtained results of the relationship between the annual CC ASMRs with the rural settlement's percentages only, but neither with the rural population's distribution, either with the number of rural population per rural settlement, are somewhat ambiguous. An additional analysis of the relationship between CCM and other demographic data, including the number and ratio of male and female population in the republics, is needed. This is our goal in a future study. It is also possible that a lower quality of care in rural settlements compared to cities influences on CCM [1, 2, 5]. Probably the CC ASMr' transformation over time contributes to the values of r - CC ASMr are calculated on the state statistical reporting basis, in which, compared with the Cancer register,

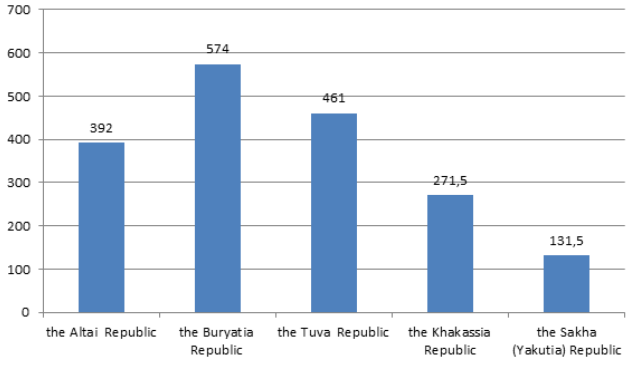


**Fig. 1.** The sum of CC ASMr annual values ranks in RA, RB, RT, Rkh, RS (Ya) from 2007 to 2018

Table 1

**The number and density of the population, the number of urban and rural population, the number of cities, urban-type settlements and rural settlements in RA, RB, RT, Rkh and RS(Ya) according to RPC**

| | TP | PD | UP | RP | UPp | RPp | UC | US | RS |
|---|---|---|---|---|---|---|---|---|---|
| the Altai Republic | 206.2 | 2.2 | 56.9 | 149.3 | 27.6 | 72.4 | 1 | 0 | 245 |
| the Buryatia Republic | 972 | 2.8 | 567.6 | 404.4 | 58.4 | 41.6 | 6 | 14 | 613 |
| the Tuva Republic | 307.9 | 1.8 | 163.4 | 144.5 | 53.1 | 46.9 | 5 | 1 | 144 |
| the Khakassia Republic | 532.4 | 8.6 | 358.2 | 174.2 | 67.3 | 32.7 | 5 | 8 | 264 |
| the Sakha (Yakutia) Republic | 958.5 | 0.3 | 614.5 | 344 | 64.1 | 35.9 | 13 | 42 | 586 |

Note. TP - total population (in thousands), PD - population density (people per 1 sq.m.), UP - urban population (in thousands), RP - rural population (in thousands), UPp - the urban population as a percentage of the total, RPp - rural population as a percentage of the total, UC - the number of cities, US - the number of urban settlements, RS - the number of rural settlements

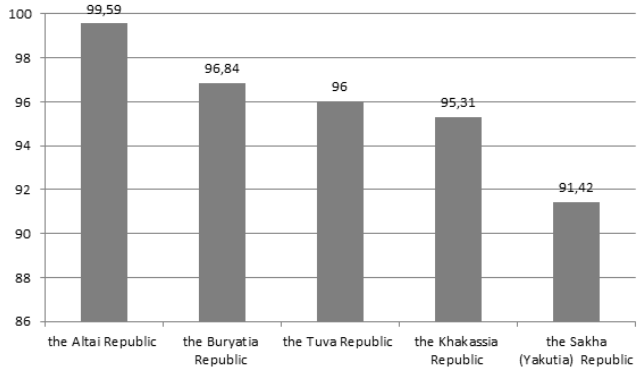


**Fig. 2.** The rural settlements' percentage of the Russia's constituent entity's settlements' total number in RA, RB, RT, RKh and RS(Ya) based on data from RPC 2010.

Table 2

**Spearman correlation coefficient (r) between the annual values of CC ASMr (2007-2018) and the number and density of the population, the number of urban and rural population, the number of cities, urban-type settlements and rural settlements in RA, RB, RT, Rkh and RS(Ya)**

| | TP | PD | UP | RP | RPp | UC | US | RS | RSp | RPdistr | UPdistr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **r** | 0.1 | 0.3 | -0.3 | 0 | 0.5 | -0.2 | -0.3 | 0 | 0.7* | 0.5 | 0.5 |

Note. *p<0.05, TP - total population, PD - population density, UP - urban population, RP - rural population, RPp - rural population as a percentage of the total, UC - the number of cities, US - the number of urban settlements, RS - the number of rural settlements, RSp - rural settlements' percentage of the total cities, urban-type settlements and rural settlement, RPdistr - the number of rural population per one rural settlement, UPdistr - the number of urban population per one urban settlement (including cities and urban-type settlements)

the mortality rate can be underestimated by up to 10% [6]. It is likely that the calculation features impact on CC ASMRs — into account the average annual populations of the administrative territories of Russia according to the state statistical reporting are taken for the corresponding year, but for demographic data are taken of 2010. At this point of view, the future All- Russian Population Census - 2020 is very relevant for new researches.

Nevertheless, our results on the association of CCM with the rural indicator are supported by researches conducted in Mexico [11], Australia [13], USA [14] and China [15], have shown higher CCM in the rural areas of these countries.

**Conclusion.** CCM in the 2007 to 2018 in the republics of the Russia, located in Siberia and inhabited by peoples having a close genetic portrait - RA, RB, RT, RKh, RS(Y), it is closely associated with the rural settlements' distribution. The relationship between CCM and the total number and density of the population, the number of urban and rural population and their ratio, the absolute number of cities, urban-type settlements and rural settlements, the number of rural population per one rural settlement and the number of urban population per one urban settlement (including the number of cities and towns) did not achieve the required significance.

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