Study of the Impact of Social and Environmental Factors on the Spread of Coronavirus Infection in Russian Regions

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Abstract. The spread of the dangerous Covid-19 infection caused by the SARS-CoV-2 coronavirus since the end of 2019 has become a big challenge for both the world and Russian society. Thus, on January 30, 2020, the world health organization recognized the spread of a new infection as a public health emergency of international significance. On March 11, 2020, the same organization stated that the outbreak had become a pandemic. Currently, the role of social and environmental factors (which determine the spread of many environmentally-related diseases) in the spread of coronavirus infection in the population is not fully understood. The spread of Covid-19 infection in Russia can be divided into 3 stages. Stage 1 (31.01.2020-01.04.2020) - primary distribution. At this stage, the infection occurred mainly of Russian citizens visiting other countries. Stage 2 (1.04.2020-12.05.2020) - active distribution within the country. By the end of this stage, the maximum spread of infection is recorded. Stage 3 (12.05.2020-present) - gradual decline in the appearance of new cases of coronavirus infection. To assess the specific contribution of social and environmental conditions to the spread of coronavirus infection, data from the Federal information Fund for social and hygienic monitoring of the Federal center for hygiene and epidemiology of Rospotrebnadzor on indicators of financial security of citizens, quality of health care and sanitary conditions were analyzed. Studies have shown that at the first stages, a significant contribution to the spread of infection is made by the financial security of the population. The specific contribution of the quality of medical care, which is widely differentiated within the regions of Russia, affects only the third stage of the spread of coronavirus infection. Environmental and hygiene indicators make a weak contribution to the spread of Covid-19 at all three stages of the epidemic.

1. Introduction

The spread of various diseases is determined by many factors [1; 2; 3; 4; 5; 6]. These include the genetic characteristics of the population, the quality of medical care, and recently more and more attention is paid to the socio-ecological conditions of the territory, which, according to who, make more than 25% of the specific contribution to the integral value of morbidity. This figure is growing every year [7; 8; 9; 10; 11; 12; 13].

The theoretical basis for studying the contribution of social and environmental factors to the spread of morbidity in various classes of diseases is based on the works of many leading Russian and foreign scientists-hygienists [1; 2; 14; 15; 16].

The spread of the dangerous Covid-19 infection caused by the SARS-CoV-2 coronavirus since the end of 2019 has become a big challenge for both the world and Russian society. Thus, on January 30, 2020, the world health organization recognized the spread of a new infection as a public health emergency of international significance. On March 11, 2020, the same organization stated that the outbreak had become a pandemic [17; 18; 19; 20; 21].

At the same time, the role of social and environmental factors (which determine the spread of many environmentally-related diseases) in the spread of coronavirus infection in the population is not fully understood. The study of these mechanisms will optimize the prediction of the spread of infection, as well as the development of measures to contain epidemics in the regions of Russia.
The introduction of restrictive measures in a number of regions of Russia, necessary to contain the spread of coronavirus infection, has caused huge economic damage to small and medium-sized businesses and, as a result, the population working at these facilities. This fact makes it necessary to analyze the changed socio-economic situation in the regions of Russia.

On the territory of the Russian Federation, the first cases of coronavirus infection were detected on January 31, 2020.

2. Equipment and devices used in studies

The spread of Covid-19 infection in Russia can be divided into 3 stages.

Stage 1 – 31.01.2020-01.04.2020 – the primary distribution. At this stage, the infection occurred mainly of Russian citizens visiting other countries.

Stage 2 – 1.04.2020-12.05.2020 – active distribution within the country. By the end of this stage, the maximum spread of infection is recorded.

Stage 3-12.05.2020-present (1.07.2020) - gradual decline in the appearance of new cases of coronavirus infection.

At the first stage of the spread of coronavirus infection, the maximum values of infection were observed in the city of Moscow (1880 cases of infection). Also, the highest indicators were observed in the Moscow region, the city of Saint Petersburg, the Leningrad region, the Komi Republic, the Sverdlovsk region, the Republic of Buryatia, and the Krasnodar territory (table 1). In a number of regions (Kamchatka territory, Jewish Autonomous region, the Karachay-Cherkess Republic, Nenets Autonomous region, Altai Republic, Republic of Ingushetia, Republic of Karelia, Tuva, Yamal-Nenets Autonomous region) cases Covid-19 was absent.

Table 1 – Regions of Russia with the highest incidence of coronavirus infection at stage 1

| №  | Federal district            | Region                  | Number of cases |
|----|----------------------------|-------------------------|-----------------|
| 1  | Central Federal district   | city of Moscow          | 1880            |
| 2  | Central Federal district   | Moscow region,          | 134             |
| 3  | North-West Federal district| Saint Petersburg        | 125             |
| 4  | North-West Federal district| Republic of Komi        | 54              |
| 5  | Ural Federal district      | Sverdlovsk region       | 33              |
| 6  | Siberian Federal district  | Republic of Buryatia    | 25              |
| 7  | Southern Federal district  | Krasnodar region        | 23              |
| 8  | Siberian Federal district  | Krasnoyarsk region      | 20              |
| 9  | North-West Federal district| Leningrad region        | 20              |
| 10 | Ural Federal district      | Chelyabinsk region      | 20              |

At the second stage, the former "leaders" were added to the Nizhny Novgorod region, the Republic of Dagestan, the Murmansk region, and the Sverdlovsk region (table 2). At this stage, there are no regions where there are no cases of Covid-19 infection.

At the third stage, the Rostov region, Khanty-Mansi Autonomous Okrug, and Voronezh region were added to the number of regions "leading" in the incidence of coronavirus infection (table 3).

Maximum number of mortality rate from coronavirus infection observed in the Federal cities – Moscow and Saint-Petersburg and Moscow region, the Republic of Dagestan, Nizhny Novgorod region, Rostov region, Krasnoyarsk region, Tula region, Stavropol region, Sverdlovsk and Novosibirsk regions.

Comparing the number of cases of coronavirus infection in the regions of Russia with the population, it is possible to differentiate regions by the density of incidence (the number of cases per 1000 population). The highest incidence of coronavirus infection as of July 1, 2020 was recorded in the city of Moscow (17.4 cases per 1000 population), the Republic of Tuva (13.3 cases per 1000 population) and the Yamalo-Nenets Autonomous district (about 10 cases per 1000 population). Also, a high incidence of coronavirus infection is recorded in the Moscow region, the Karachay-Cherkess Republic, the Kamchatka territory, the Murmansk region, the Orel region, the Republic of Ingushetia and the Kaluga region. The incidence rates in these regions are 6-8 cases per 1000 population.
Table 2 – Regions of Russia with the highest incidence of coronavirus infection at stage 2

| № | Federal district          | Region                        | Number of cases | Number of deaths |
|---|---------------------------|-------------------------------|-----------------|-----------------|
| 1 | Central Federal district  | city of Moscow                | 121301          | 1179            |
| 2 | Central Federal district  | Moscow region, Saint Petersburg | 22700          | 219             |
| 3 | North-West Federal district | Nizhny Novgorod region      | 5087            | 32              |
| 4 | North Caucasus Federal district | Republic of Dagestan      | 2888            | 23              |
| 5 | North-West Federal district | Murmansk region            | 2428            | 5               |
| 6 | Ural Federal district     | Sverdlovsk region            | 2163            | 3               |
| 7 | Southern Federal district | Krasnodar region             | 2126            | 22              |
| 8 | Central Federal district  | Tula region                   | 1971            | 14              |
| 9 | Southern Federal district | Rostov region                | 1946            | 24              |

Table 3 – Regions of Russia with the highest incidence of coronavirus infection at stage 3

| № | Federal district          | Region                        | Absolute number of cases | Number of cases per 1000 population | Number of deaths |
|---|---------------------------|-------------------------------|--------------------------|-------------------------------------|-----------------|
| 1 | Central Federal district  | city of Moscow                | 220853                   | 17.4                                | 3761            |
| 2 | Siberian Federal district | Republic of Tuva              | 4361                     | 13.3                                | 3               |
| 3 | Ural Federal district     | Yamalo-Nenets Autonomous district | 5332 | 9.8 | 37 |
| 4 | Central Federal district  | Moscow region                 | 57269                    | 7.4                                 | 875             |
| 5 | North Caucasus Federal district | Karachay-Cherkess Republic | 3448 | 7.4 | 12 |
| 6 | North-Western Federal district | Murmansk region         | 5093                     | 6.9                                 | 13              |
| 7 | Far Eastern Federal district | Kamchatka territory         | 2145                     | 6.9                                 | 28              |
| 8 | Central Federal district  | Orel                          | 4480                     | 6.1                                 | 59              |
| 9 | Central Federal district  | Kaluga region                 | 5973                     | 6                                    | 44              |
| 10 | North Caucasus Federal district | Republic of Ingushetia | 3020 | 6 | 68 |

The lowest incidence of Covid-19 infection as of July 1 was established on the territory of the Republic of Crimea (0.4 cases per 1000 population), the city of Sevastopol (0.5 cases per 1000 population), and the Kemerovo region (0.6 cases per 1000 population). Also, a relatively low incidence of coronavirus infection was found in the Tyumen region, the Kurgan region, the Udmurt Republic, the Krasnodar territory, the Republic of Tatarstan, and the Chechen Republic. The incidence rates in these regions are 0.8-1.2 cases per 1000 population.

3. Results and Discussion

The conducted research allows us to state a significant differentiation of Russian regions in terms of the incidence of coronavirus infection in the population. Regions also differ in the rate of spread of the covid-19 virus-related disease at various stages. This fact determines the specific contribution of various factors in the spread of the Cabir-19 virus in the regions of Russia, including socio-ecological conditions.

To assess the specific contribution of social and environmental conditions to the spread of coronavirus infection, data from the Federal information Fund for social and hygienic monitoring of the
Federal center for hygiene and epidemiology of Rospotrebnadzor on indicators of financial security of citizens, quality of health care and sanitary conditions were analyzed.

An analysis of the financial security of citizens of Russian regions has shown that some of its factors may have an impact on the spread of coronavirus infection. Thus, at the 1st and 2nd stages of the spread of coronavirus infection, there are direct correlations of average strength with the volume of GDP per capita and the incidence of infection caused by the Covid-19 virus. At stage 3, the correlation coefficient for this indicator significantly weakens. In addition, at the first two stages, an inverse correlation was found between the average strength of the spread of coronavirus infection and the number of people with incomes below the subsistence minimum.

Assessment of the specific contribution of the quality of health care to the spread of coronavirus infection showed that these factors have an impact on the incidence of the population associated with the Covid-19 virus at the 3rd stage of the epidemic.

The study of the specific contribution of environmental and hygienic factors showed a small contribution of these factors to the spread of coronavirus infection at all three stages of the epidemic. Significant correlations were found between the incidence of the Covid-19 virus and the percentage of residential buildings without running water and sewerage.

4. Conclusion
Thus, the assessment of the specific contribution of social and environmental conditions to the spread of the Covid-19 virus in the regions of the Russian Federation showed that at the first stages, financial security of the population makes a significant contribution to the spread of infection. So, from the first days of the appearance of a new infection on the territory of Russia, the largest number of infected people was observed in the most prosperous regions in terms of financial support for citizens – the cities of Moscow and St. Petersburg, as well as the Moscow and Sverdlovsk regions and other regions. This fact can be explained by the fact that at the first stage of the spread of infection, most cases of infection were "imported", i.e. the infection of Russian citizens occurred mainly on the territory of other States. The higher the financial security of the population, the more mobile citizens are – they travel more often both to other countries and move more actively within the country, which contributed to the high infection of this group at the first stage of the spread of Covid-19.

The specific contribution of the quality of medical care, which is widely differentiated within the regions of Russia, affects only the third stage of the spread of coronavirus infection.

Environmental and hygiene indicators make a weak contribution to the spread of Covid-19 at all three stages of the epidemic.

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