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TWENTY WEEKS OF THE PANDEMIC OF CORONAVIRUS COVID-19 IN GEORGIA AND NEIGHBORING COUNTRIES (ARMENIA, AZERBAIJAN, TURKEY, RUSSIA). PRELIMINARY COMPARATIVE STATISTICAL DATA ANALYSIS.

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Summary: The preliminary results of a comparative statistical analysis of the weekly mean data associated with coronavirus COVID-19 infection of confirmed, recovered and fatal cases of the population in Georgia, Armenia, Azerbaijan, Turkey and Russia amid a global pandemic in the period from March 14 to July 31, 2020 are presented.

Key words: New Coronavirus COVID-19, statistical analysis.

Introduction

The new coronavirus (COVID-19) epidemic began in China at the end of 2019. The disease soon spread rapidly around the world and a pandemic was recognized as of 11 March 2020 [1].

Scientists and practioners of many countries of the world began to intensively study phenomenon unprecedented earlier (including Georgia and boundary with it countries - Armenia, Azerbaijan, Turkey, Russia [2-4]). In addition to doctors- epidemiologists, who had the main concern in the fight against the pandemic, scientists from a wide variety of specialties, including specialists in natural sciences, were actively involved in research on the spread of the new coronavirus COVID-19. At first the conducted works had descriptive nature. Then, in proportion to the accumulation of the new data, appeared the mathematical and statistical spatial-temporary models of the propagation of the new coronavirus [5-11].

This paper presents the preliminary results of a comparative statistical analysis of the mean weekly data associated with new coronavirus infection of confirmed, recovered and fatal cases in the population of the above-mentioned countries amid a global pandemic in the period from March 14 to July 31, 2020.

Study area, Material and Methods

The study area: World, Georgia, Armenia, Azerbaijan, Turkey and Russia.

Data of John Hopkins COVID-19 Time Series Historical Data (with US State and County data) [https: // www.soothsawyer.com/john-hopkins-time-series-data-with-us-state-and-county-city-detail-historical/] about confirmed, recovered and deaths**,** coronavirus-related cases, from March 14 to July 31, 2020 are used.

In table 1 numbers of weeks and the range of days with the data averaging are presented. The standard statistical methods of data analysis are used.

The following designations will be used below: Mean – average values; Min – minimal values; Max - maximal values; Range – Max-Min; St Dev - standard deviation; σ_m - standard error; Cv = 100·St Dev/Mean – coefficient of variation, %; R – coefficient of linear correlation; CR – cross correlations;

99%(+/-) - 99% confidence interval of average; α - the level of significance; Weekly mean value) – mean daily value in each week.

Table 1. Numbers of weeks and the range of days with the data averaging

N	Data	N	Data	N	Data	N	Data
1	14.03-20.03	**6**	18.04-24.04	**11**	23.05-29.05	**16**	27.06-03.07
2	21.03-27.03	**7**	25.04-01.05	**12**	30.05-05.06	**17**	04.07-10.07
3	28.03-03.04	**8**	02.05-08.05	**13**	06.06-12.06	**18**	11.07-17.07
4	04.04-10.04	**9**	09.05-15.05	**14**	13.06-19.06	**19**	18.07-24.07
5	11.04-17.04	**10**	16.05-22.05	**15**	20.06-26.06	**20**	25.07-31.07

The following rule of thumb for interpreting the size of a correlation coefficient is used [12]: $0 \leq R < 0.3$ - Negligible correlation, $0.3 \leq R < 0.5$ - Low correlation, $0.5 \leq R < 0.7$ - Moderate correlation, $0.7 \leq R < 0.9$ - High correlation, $0.9 \leq R \leq 1.0$ - Very high correlation. Note that the significance level of the correlation coefficient $R = 0.3$ is 0.2.

Results and Discussion

The results in the table 2-5 and fig. 1-6 are presented.

In table 2 data about statistical characteristics of weekly mean values of confirmed, recovered and deaths, coronavirus-related cases, from March 14 to July 31, 2020 in Georgia and neighboring countries (Armenia, Azerbaijan, Turkey, Russia) amid a global pandemic are presented.

In particular, analysis of this table reveals the following: confirmed new coronavirus-related cases. Over the entire observation period, the largest number of infected per 1 million populations was on average observed in Armenia (93.1, range of change 6.2-197.5), the smallest - in Georgia (2.2, range of change 0.7-5.2). In the world, these values are respectively 16.2, 2.4 and 33.3.

Table 2. Statistical characteristics of weekly mean values of confirmed, recovered and deaths, new coronavirus-related cases, from March 14 to July 31, 2020 in the study sites (per 1 million population)

Location	Parameters	Mean	Min	Max	Range	St Dev	σm	Cv (%)	99%(+/-)
World	**Confirmed**	16.2	2.4	33.3	31.0	8.7	2.0	54.1	5.2
	Recovered	9.5	0.3	23.8	23.5	7.2	1.7	75.7	4.3
	Deaths	0.6	0.1	1.0	0.8	0.2	0.0	29.6	0.1
Georgia	**Confirmed**	2.2	0.7	5.2	4.5	1.2	0.3	56.4	0.7
	Recovered	1.8	0.0	4.0	4.0	1.1	0.3	63.6	0.7
	Deaths	0.03	0.00	0.1	0.1	0.04	0.01	122.4	0.02
Armenia	**Confirmed**	93.1	6.2	197.5	191.4	72.4	16.6	77.7	42.8
	Recovered	70.0	0.0	187.5	187.5	73.2	16.8	104.5	43.3
	Deaths	1.8	0.0	4.4	4.4	1.5	0.4	86.9	0.9
Azerbaijan	**Confirmed**	22.7	0.4	55.4	55.0	19.9	4.6	87.9	11.8
	Recovered	18.4	0.0	61.6	61.6	20.4	4.7	110.7	12.0
	Deaths	0.3	0.0	0.8	0.8	0.3	0.1	94.9	0.2
Turkey	**Confirmed**	19.8	0.6	54.0	53.4	13.8	3.2	69.6	8.1
	Recovered	18.4	0.0	55.8	55.8	15.4	3.5	83.8	9.1
	Deaths	0.5	0.0	1.4	1.4	0.4	0.1	85.3	0.2
Russia	**Confirmed**	41.1	0.2	73.4	73.2	23.3	5.3	56.7	13.7
	Recovered	31.2	0.0	58.4	58.4	24.3	5.6	77.9	14.4
	Deaths	0.7	0.0	1.2	1.2	0.4	0.1	63.8	0.3

Recovered new coronavirus-related cases. The largest number of recovered per 1 million populations on average was also observed in Armenia (70.0, variation range 0.0-187.5), the smallest - in Georgia (1.8, variation range 0.0-4.0). In the world these values are respectively 9.5, 0.3 and 23.8.

Deaths, new coronavirus-related cases. The largest number of deaths per 1 million populations on average was observed in Armenia (1.8, change range 0.0-4.4), the smallest - in Georgia (0.03, change range 0.0-0.1). In the world these values are 0.6, 0.1 and 1.0 respectively.

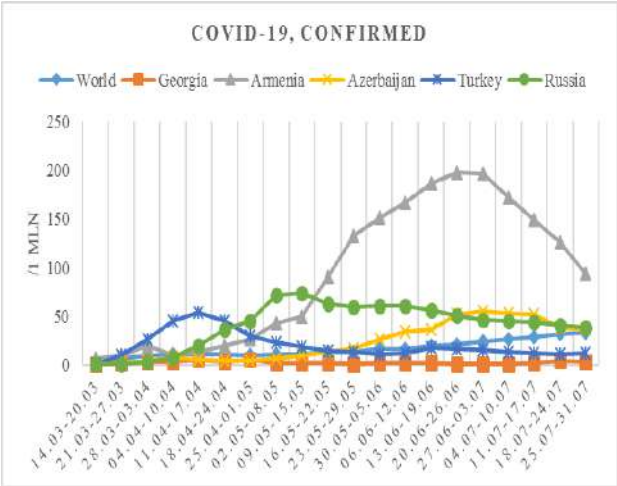

Fig. 1. Variability of weekly mean values of new coronavirus-related confirmed cases from March 14 to July 31, 2020 in the study sites.

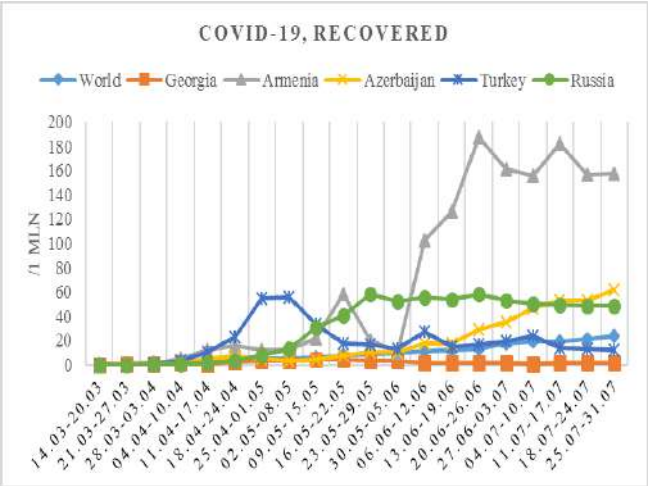

Fig. 2. Variability of weekly mean values of new coronavirus-related recovered cases from March 14 to July 31, 2020 in the study sites.

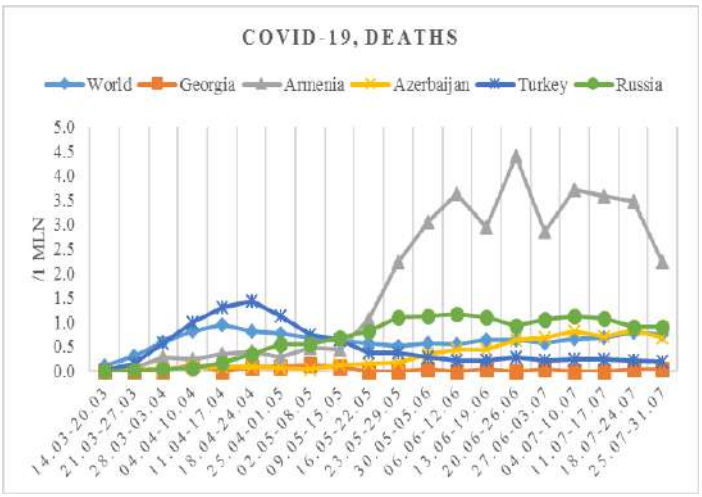

Fig. 3. Variability of weekly mean values of new coronavirus-related deaths cases from March 14 to July 31, 2020 in the study sites.

In fig. 1-3 provide data on the variability of new coronavirus-related weekly averages of confirmed, recovered, and deaths at the study sites. The curves of variability of these parameters have the following features.

COVID-19, confirmed (fig. 1).

World. Continuous growth of a non-linear nature.

Georgia. Small variability in time with periodic bursts.

Armenia. Unimodal distribution with right skewness. The peak falls on 15-16 weeks of the study period.

Azerbaijan. Relatively monotonic growth up to 14 weeks of the studied observation period. Peak at week 16 with further decline.

Turkey. Unimodal distribution with left asymmetry. Peak at week 5. Then - a more or less monotonous decline with a slight surge at 14 weeks.

Russia. A vaguely pronounced peak at 8-9 weeks of observation with a further more or less monotonous decrease.

COVID-19, recovered (fig. 2).

World. Continuous growth, close to linear.

Georgia. Unimodal distribution with a peak at 9 weeks.

Armenia. Bimodal distribution. Peaks at 15 and 18 weeks, a slight spike at 10 weeks.

Azerbaijan. Continuous growth is non-linear.

Turkey. Unimodal distribution with left asymmetry. Peak at 7-8 weeks. Weak bursts - at 13 and 17 weeks.

Russia. Non-linear growth up to 11 weeks, then a plateau with small fluctuations up to 15 weeks with a further slight decrease.

COVID-19, deaths (fig. 3).

World. Bimodal distribution with peaks at 5 and 19 weeks.

Georgia. Periodic bursts.

Armenia. In general, non-linear growth with a main peak at 13 weeks and secondary peaks at 11 and 15 weeks.

Azerbaijan. Non-linear growth with two peaks at 17 and 19 weeks.

Turkey. Unimodal distribution with left asymmetry. Peak at 6 weeks. Then there is a nonlinear decrease.

Russia. Non-linear growth up to 11 weeks, two peaks at 13 and 17 weeks with a further decrease.

Thus, as follows from Fig. 1-3, the temporal variations of the indicated parameters of new coronavirus infection COVID-19 in different investigated locations have their own characteristics and are not very similar to each other. This testifies to the isolation of the processes of its course. A similar feature is the time shift between confirmed cases of COVID-19 and cases of convalescence and death (Figure 1-3 and Figure 4-5). This shift is from one to several weeks and can be qualitatively estimated by comparing Fig. 1 with fig. 2,3 (see description above).

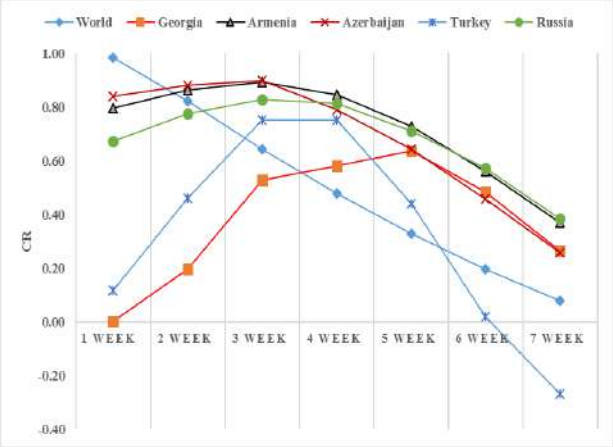

Fig. 4. Cross-correlations between Confirmed and Recovered COVID-19 cases in different study sites.

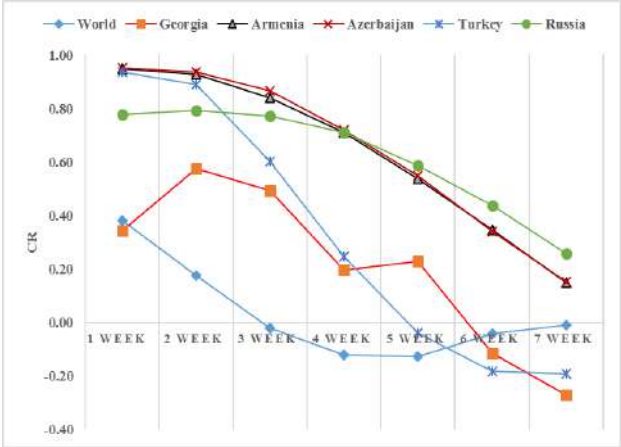

Fig. 5. Cross-correlations between Confirmed and Deaths COVID-19 cases in different study sites.

This shift is quantitatively estimated using Fig. 4 and 5, which show the cross-correlation function between confirmed COVID-19 cases with convalescence and death. The most likely time lags for recoveries and deaths relative to confirmed cases of COVID-19 are as follows:

World. COVID-19, recovered - 1 week, COVID-19, deaths - 1 week.

Georgia. COVID-19, recovered - 5 weeks, COVID-19, deaths - 2 week.

Armenia. COVID-19, recovered - 3 weeks, COVID-19, deaths – 1-2 weeks.

Azerbaijan. COVID-19, recovered -3 weeks, COVID-19, deaths – 1-2 week.

Turkey. COVID-19, recovered – 3-4 weeks, COVID-19, deaths - 1 week.

Russia. COVID-19, recovered – 3-4 weeks, COVID-19, deaths – 1-3 weeks.

Table 3 shows data on the correlations between the studied locations for confirmed cases of new coronavirus disease. From this table, in particular, it follows that the correlation relationship for the indicated disease between the world data and the data of the studied countries is as follows: Georgia - no correlation, Turkey - low negative correlation, Russia - low positive correlation, Armenia - moderate correlation, Azerbaijan - high correlation.

Table 3. Linear correlation between the study sites on the weekly mean values of confirmed new coronavirus-related cases from March 14 to July 31, 2020.

Location	COVID-19, CONFIRMED					
	World	**Georgia**	**Armenia**	**Azerbaijan**	**Turkey**	**Russia**
World	1	-0.10	0.69	0.86	-0.30	0.32
Georgia	-0.10	1	-0.49	-0.41	0.72	-0.19
Armenia	0.69	-0.49	1	0.91	-0.49	0.56
Azerbaijan	0.86	-0.41	0.91	1	-0.41	0.36
Turkey	-0.30	0.72	-0.49	-0.41	1	-0.22
Russia	0.32	-0.19	0.56	0.36	-0.22	1

Between these countries, this correlation coefficient varies from -0.19 (Georgia-Russia pair) to 0.91 (Armenia-Azerbaijan pair).

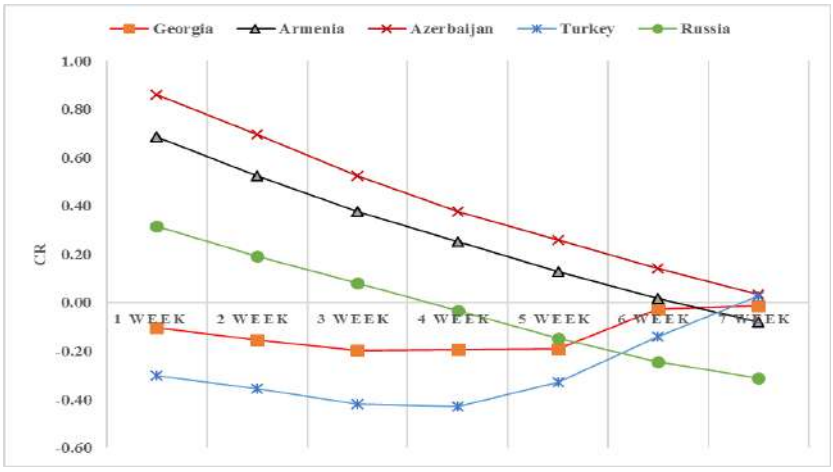

Fig. 6. Cross-correlations between Confirmed COVID-19 cases in World and another study sites.

The data in Table 3 are in good agreement with Fig. 6, which presents curves of cross-correlation functions between confirmed cases of COVID-19 in the world and the 5 studied countries. As follows from this figure, in Georgia and Turkey, the CR values are not subject to significant changes within the

insignificant and weak levels of correlation. In Armenia, Azerbaijan and Russia, the highest CR values are observed at the initial moment of observations (1 week), then - a monotonic decrease.

It should be noted, that these correlations do not characterize direct dependencies, since all countries introduced restrictions on border crossing and, as noted above, in the period under study were practically isolated systems. The degree of correlation is most likely of an indirect nature and indicates a similarity or difference in the trends in the development of new coronavirus infection in these countries.

Table 4. Coefficient of recovery (Recovered/Confirmed) and coefficient of mortality (Deaths/Confirmed) associated with COVID-19, %

Parameters	World	Georgia	Armenia	Azerbaijan	Turkey	Russia
1. Coefficient of Recovery_COVID-19	58.8	82.2	75.2	81.2	92.9	76.0
2. Coefficient of Mortality_COVID-19	3.9	1.5	1.9	1.4	2.5	1.7

Table 5. Coefficient of mortality (Total Deaths/Country Population, %) in 2013-2017 in the study sites (according to https://data.worldbank.org/topic/health)

Parameter	World	Georgia	Armenia	Azerbaijan	Turkey	Russia
3. Coefficient of Mortality General	0.77	1.32	0.97	0.58	0.58	1.30
2.Coefficient/3.Coefficient	5.06	1.15	1.96	2.4	4.3	1.3

Finally, table 4 presents data on the Coefficient of recovery (Recovered / Confirmed) and coefficient of mortality (Deaths / Confirmed) associated with COVID-19. As follows from this table, the highest value of the recovery rate on average was observed in Turkey (92.9%), the lowest in Armenia (75.2%). In the world, this value is 58.8%. The highest mortality rate on average was observed in Turkey (2.5%), the lowest in Azerbaijan (1.4%). In the world, this value is higher and amounts to 3.9% (table 4).

For comparison, table 5 shows the average for 2013-2017 data on the general mortality rate in the above countries and the world. As shown in tables 4 and 5, the death rate from the new coronavirus COVID-19 is higher than the crude death rate. Of the locations under consideration, this is especially observed in the world and Turkey (the excess is 5.06 and 4.3 times, respectively). The smallest excess is observed in Georgia (1.15 times) and Russia (1.3 times). In Armenia, the effect of mortality from the new coronavirus COVID-19 is almost two times higher than the average mortality rate, in Azerbaijan it is 2.4 times higher. This fact once again demonstrates the need to contain the widespread distribution of the new coronavirus pandemic COVID-19.

Conclusion

In the nearest future, it is planned to continue similar studies for Georgia and boundary countries, in particular, short-term statistical forecasting of new coronavirus infection COVID-19.

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