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VARIABILITY OF MORTALITY IN GEORGIA AND ITS REGIONS IN 1994-2024

[*,]Japaridze N., [**,***]Khazaradze K.,**
[****]Chkhitunidze M., [***]Revishvili A.

[*]Tbilisi State Medical University, Tbilisi, Georgia
[**]Ministry of Internally Displaced Persons from Occupied Territories, Labour, Health and Social Affair of Georgia, Tbilisi, Georgia
[***]Georgian State Teaching University of Physical Education and Sport, Tbilisi, Georgia
[****]Mikheil Nodia Institute of Geophysics of Ivane Javakhishvili Tbilisi State University, Tbilisi, Georgia
n.japaridze@tsmu.edu

Abstract: *The paper presents the results of statistical analysis of variability mortality rate (annual mortality per 1000 population) in the regions of Georgia in 1994-2024. It was shown that in Guria and Kakheti, in the post-COVID-19 period (2022-2024), compared to the pre-COVID-19 period (2017-2019), the mortality rate decreased by 1.0 and 1.1, respectively. In all other regions, this rate did not change significantly during these time periods. In 2024, compared to 2023, a slight increase in mortality was observed in all regions except Tbilisi (unchanged) and Racha-Lechkhumi Kvemo Svaneti. Correlations between regions of Georgia by the mortality rates were studied.*

Key words: *Human health, mortality, environment, statistical analysis.*

Introduction

M. Nodia Institute of Geophysics of TSU, together with various medical organizations, has been conducting a systematic analysis of various demographic indicators (birth rate, mortality, population growth) in Georgia, as well as their vulnerability to the impact of various natural and anthropogenic factors (astro-meteo-geophysical factors, air pollution, photochemical smog, radon, ozone, viral diseases, etc.) [1-8].

In particular, during the COVID-19 pandemic, a series of works were carried out on the statistical analysis of various components of the pandemic (infection cases, infection rate, deaths), including ten-day, two-week and monthly interval forecasting of these components [9,10].

Research on the influence of various bioclimatic indicators on the spread of this infection has been conducted [11-13]. It studied the impact of the COVID-19 pandemic on the demographic indicators of Georgia during and after the pandemic [14,15].

For example, paper [15] presents the results of statistical analysis of variability of birth (B), death (D) and population growth (PG) in Georgia in 1994-2023. The role of the COVID-19 pandemic in the deterioration of the demographic situation during its existence (2020-2021) and in the post-COVID-19 period (2022-2023) is shown. It was revealed that throughout the entire thirty-year period, Georgia had the worst demographic indicators in 2019-2023: B = 12.0, D = 13.4, PG = -1.4 (out of 1000 population).

This work is a continuation of previous studies, taking into account new data on the demographic situation in Georgia. The results of statistical analysis of variability of mortality in Georgia and its regions in 1994-2024 are presented below.

Study area, material and methods

Study area – Georgia and its regions: Georgia (GEO); Tbilisi (Tb); Adjara (Adj); Guria (Gur); Imereti (Im); Kakheti (Kakh); Mtskheta-Mtianeti (M-M); Racha-Lechkhumi and Kvemo Svaneti (R-L KS); Samegrelo-Zemo Svaneti (S-ZS); Samtskhe-Javakheti (S-J); Kvemo Kartli (KK); Shida Kartli (Sh K).

Data from the National Statistics Office of Georgia [https://www.geostat.ge/en] on annual mortality to 1000 population (M) from 1994 to 2024 is used. In the proposed work the analysis of data is carried out with the use of the standard statistical analysis methods [16].

The following designations will be used below: Mean – average values; Min – minimal values; Max – maximal values; St Dev – standard deviation; C_v – coefficient of variations (C_v = 100· St Dev/ Mean, %); R – coefficient of linear correlation. Difference between mean annual values of M was produced with the use of Student's criterion with the level of significance α not worse than 0.25.

Results and discussion

Results in Fig. 1 and Table 1 are presented.

In Fig. 1 the time series of population death rate in Georgia and its regions from 1994 to 2024, and in Table 1 the statistical characteristics of this parameter are presented.

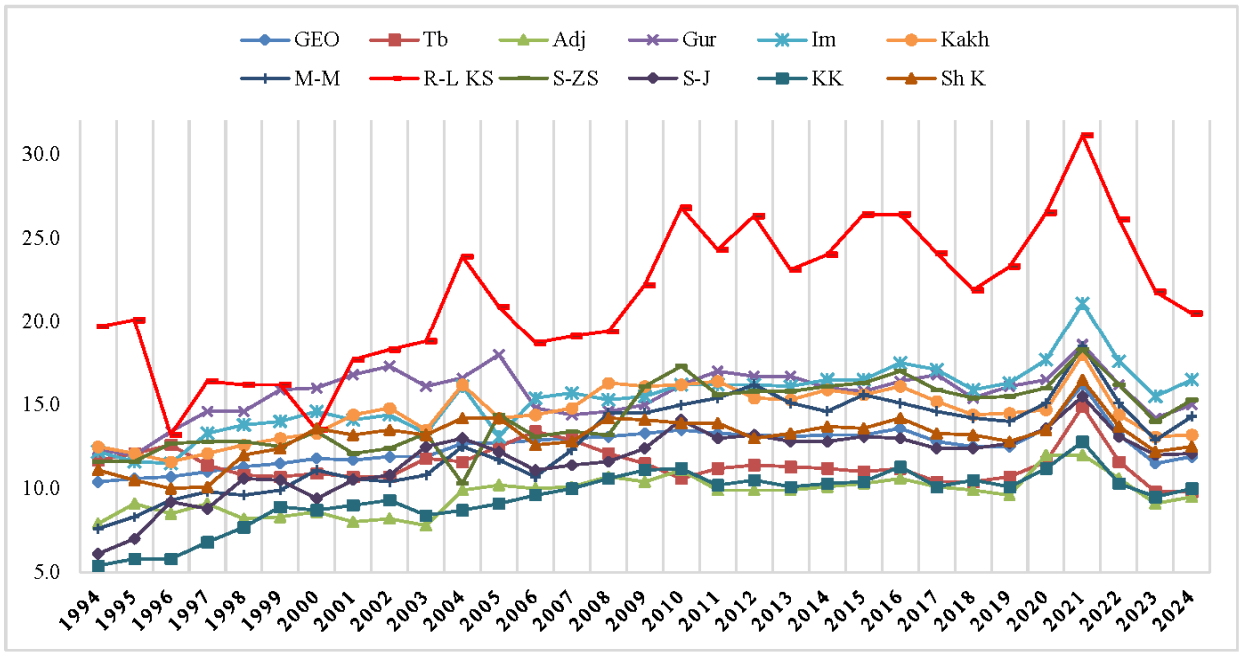

Fig. 1. Changeability of population death rates in regions of Georgia in 1994-2024.

In particular, as follows from Fig. 1 and Table 1, the values of M in different regions of Georgia in 1994-2024 change from 5.4 (Kvemo Kartli, 1994) to 31.1 (Racha-Lechkhumi and Kvemo Svaneti, 2021, COVID-19 period). The average values of M for these regions change from 9.5 to 21.5 respectively. The average value of M for Georgia is 12.5 and change from 10.4 (1994) to 16.2 (2021). In Tbilisi the average value of M is 11.4 and change from 9.8 (2023, 2024) to 14.9 (2021).

In Guria and Kakheti, in the post-COVID-19 period (2022-2024), compared to the pre-COVID-19 period (2017-2019), the mortality rate decreased by 1.0 and 1.1, respectively. In all other regions, this rate did not change significantly during these time periods. In 2024, compared to 2023, a slight increase in mortality was observed in all regions except Tbilisi (unchanged) and Racha-Lechkhumi Kvemo Svaneti.

The analysis of correlations between regions of Georgia in terms of mortality rates shows the following (Table 1).

Regions of Georgia. Values of R change from 0.01 (pair: Tb÷S-ZS, negligible correlation) to 0.90 (pair: KK÷M-M, very high correlation), average – 0.63 (moderate correlation).

Regions of Georgia without Tbilisi. Values of R change from 0.39 (pair: Adj÷Gur, low correlation) to 0.90 (pair: KK÷M-M, very high correlation), average – 0.74 (high correlation).

Table 1. Statistical characteristics of population death rates in regions of Georgia in 1994-2024 (R_{min} = 0.24, α = 0.2).

Variable	GEO	Tb	Adj	Gur	Im	Kakh	M-M	R-L KS	S-ZS	S-J	KK	Sh K
Max	16.2	14.9	12	18.6	21.1	18	18.5	31.1	18.3	15.5	12.8	16.5
Min	10.4	9.8	7.8	12	11.5	11.6	7.6	13.2	10.3	6.1	5.4	10
Mean	12.5	11.4	9.7	15.7	15.4	14.5	12.9	21.5	14.4	11.7	9.5	13.1
St Dev	1.2	1.1	1.1	1.5	2.0	1.5	2.7	4.3	2.0	2.0	1.7	1.3
Cv,%	9.3	9.2	11.5	9.4	13.0	10.6	20.7	19.8	13.7	17.1	18.1	10.2
	Correlation Matrix											
GEO	1	0.40	0.85	0.68	0.89	0.90	0.88	0.79	0.76	0.86	0.90	0.87
Tb	0.40	1	0.34	0.05	0.11	0.23	0.04	0.12	0.01	0.05	0.03	0.20
Adj	0.85	0.34	1	0.39	0.77	0.71	0.81	0.78	0.72	0.71	0.76	0.61
Gur	0.68	0.05	0.39	1	0.61	0.65	0.60	0.49	0.49	0.75	0.68	0.78
Im	0.89	0.11	0.77	0.61	1	0.78	0.90	0.80	0.76	0.83	0.89	0.76
Kakh	0.90	0.23	0.71	0.65	0.78	1	0.81	0.75	0.60	0.78	0.84	0.88
M-M	0.88	0.04	0.81	0.60	0.90	0.81	1	0.83	0.87	0.89	0.90	0.74
R-L KS	0.79	0.12	0.78	0.49	0.80	0.75	0.83	1	0.75	0.75	0.71	0.64
S-ZS	0.76	0.01	0.72	0.49	0.76	0.60	0.87	0.75	1	0.75	0.79	0.57
S-J	0.86	0.05	0.71	0.75	0.83	0.78	0.89	0.75	0.75	1	0.90	0.79
KK	0.90	0.03	0.76	0.68	0.89	0.84	0.90	0.71	0.79	0.90	1	0.84
Sh K	0.87	0.20	0.61	0.78	0.76	0.88	0.74	0.64	0.57	0.79	0.84	1

Georgia and regions of Georgia. Values of R change from 0.40 (pair: Tb÷Geo, low correlation) to 0.90 (pairs: Kakh÷Geo and KK÷Geo, very high correlation), average – 0.80 (high correlation).

Georgia and regions of Georgia without Tbilisi. Values of R change from 0.68 (pair: Gur÷Geo, moderate correlation) to 0.90 (pairs: Kakh÷Geo and KK÷Geo, very high correlation), average – 0.84 (high correlation).

Conclusion

A detailed statistical analysis of mortality variability in Georgia and its regions from 1994 to 2024 was conducted. Specifically, it was found that there is a complete lack of correlation in mortality rates between Tbilisi and the rest of Georgia's regions (except Adjara). The correlation coefficient for the Tbilisi ÷ Adjara pair is 0.34 (low correlation). Further research will analyze the reasons for this.

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References

1. Japaridze N., Khazaradze K. Changeability of Mortality in Georgia in Different Seasons and Periods of Year into 1993-2017. // Int. Sc. Conf. “Natural Disasters in Georgia: Monitoring, Prevention, Mitigation”. Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 205-208. http://www.dspace.gela.org.ge/bitstream/123456789/8672/1/48_Conf_NDG_2019.pdf
2. Khazaradze K.R., Chkhitunidze M.S., Japaridze N.D., Changeability of Annual Values of Mortality as Whole in Georgia and Kakheti Region from 1993 to 2018. // Int. Sc. Conf. „Modern Problems of Ecology“ Proceedings, ISSN 1512-1976, v. 7, Tbilisi-Telavi, Georgia, 26-28 September, 2020, pp. 360-363. http://dspace.gela.org.ge/handle/123456789/8837
3. Japaridze N., Khazaradze K., Studies in the Field of the Influence of Natural and Anthropogenic Environmental Factors on Human Health in Georgia: Current Status and Planned Works. // Int. Sc. Conf. “Natural Disasters in Georgia: Monitoring, Prevention, Mitigation”. Proc., ISBN 978-9941-13-899-7, Publish House of Iv. Javakhishvili Tbilisi State University, December 12-14, Tbilisi, 2019, pp. 201-204. http://109.205.44.60/bitstream/123456789/8671/1/47_Conf_NDG_2019.pdf
4. Japaridze N., Khazaradze K., Chkhitunidze M., Revishvili A. A Brief Overview of Research Conducted by M. Nodia Institute of Geophysics, TSU Together with Medical Organizations in the Field of “Health of the Population of Georgia and Environment” Over the Past 10 Years. // Int. Sc. Conf. "Geophysical Processes in the Earth and its

Envelopes", Proceedings, Publish House of Iv. Javakhishvili Tbilisi State University, November 16-17, Tbilisi, 2023, pp. 337-343. http://dspace.gela.org.ge/handle/123456789/10469

5. Amiranashvili A.G., Japaridze N.D., Khazaradze K.R., On the Connection of Monthly Mean of Some Simple Thermal Indices and Tourism Climate Index with the Mortality of the Population of Tbilisi City Apropos of Cardiovascular Diseases. // Journal of the Georgian Geophysical Society, ISSN: 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 21(1), Tbilisi, 2018, pp. 48 -62. http://www.jl.tsu.ge/index.php/GGS/article/view/2489
6. Amiranashvili A., Bliadze T., Chikhladze V., Photochemical smog in Tbilisi. // Monograph, Trans. of Mikheil Nodia institute of Geophysics, ISSN 1512-1135, vol. 63, Tb., 2012, p. 160. (in Georgian).
7. Amiranashvili A., Bakradze T., Ghlonti N., Khazaradze K., Japaridze N., Revishvili A., Influence of Variations of the Annual Intensity of Galactic Cosmic Rays on the Mortality of the Population of Georgia. Int. Sc. Conf. „Natural Disasters in the 21st Century: Monitoring, Prevention, Mitigation“. Proceedings, ISBN 978-9941-491-52-8, Tbilisi, Georgia, December 20-22, 2021. Publish House of Iv. Javakhishvili Tbilisi State University, Tbilisi, 2021, pp. 163 – 166.
8. Amiranashvili A.G., Revishvili A.A., Khazaradze K.R., Japaridze N.D., Connection of Holiday Climate Index with Public Health (on Example of Tbilisi and Kakheti Region, Georgia). Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN: 1512-1127, // Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 24 (1), 2021, pp. 63-76. DOI: https://doi.org/10.48614/ggs2420212884
9. Amiranashvili A.G., Khazaradze K.R., Japaridze N.D., The statistical analysis of daily data associated with different parameters of the New Coronavirus COVID-19 pandemic in Georgia and their monthly interval prediction from January 1, 2022 to March 31, 2022. 20 p. // Preprint from medRxiv, 21Apr 2022, medRxiv 2022.04.19.22274044; doi: https://doi.org/10.1101/2022.04.19.22274044
10. Amiranashvili A.G., Khazaradze K.R., Japaridze N.D., Comparative Analysis of Reported Deaths Cases Associated with the New Coronavirus COVID-19 Pandemic in the South Caucasus Countries (Armenia, Azerbaijan, Georgia) from March 2020 to May 2022. // medRxiv 2022.04.19.22274044; doi: https://doi.org/10.1101/2022.04.19.22274044
11. Amiranashvili A., Japaridze N., Kartvelishvili L., Khazaradze K., Revishvili A., Preliminary Results of a Study on the Impact of Some Simple Thermal Indices on the Spread of COVID-19 in Tbilisi. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973, p-ISSN*:* 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 25(2), 2022, pp. 59–68. DOI**:** https://doi.org/10.48614/ggs2520225961
12. Amiranashvili A., Bliadze T., Japaridze N., Khazaradze K., Revishvili A., Angstrom Fire Index as a Bioclimatic Indicator (Using the Example of the Impact on the Spread of Covid-19 in Tbilisi). // Int. Sc. Conf. "Geophysical Processes in the Earth and its Envelopes", Proceedings, Publish House of Iv. Javakhishvili Tbilisi State University, November 16-17, Tbilisi, 2023, pp. 328-331. http://openlibrary.ge/handle/123456789/10467
13. Amiranashvili A., Japaridze N., Kharchilava J., Khazaradze K., Revishvili A., Results of a Study on the Impact of Surface Ozone Concentration on the Spread of COVID-19 in Tbilisi. // Journal of the Georgian Geophysical Society, e-ISSN: 2667-9973*,* p-ISSN*:* 1512-1127, Physics of Solid Earth, Atmosphere, Ocean and Space Plasma, v. 26(2), 2023, pp. 57–64.
14. Japaridze N., Khazaradze K., Chkhitunidze M., Revishvili A. Mortality Variability in Georgia in 1994-2022. // Int. Sc. Conf. "Geophysical Processes in the Earth and its Envelopes", // Proceedings, Publish House of Iv. Javakhishvili Tbilisi State University, November 16-17, Tbilisi, 2023, pp. 332-336. http://openlibrary.ge/handle/123456789/10468
15. Japaridze N., Khazaradze K., Chkhitunidze M., Revishvili A., Variability of the Birth, Death and Population Growth Rates in Georgia in 1994-2023. // Int. Sc. Conf. “Complex Geophysical Monitoring in Georgia: History, Modern Problems, Promoting Sustainable Development of the Country”, Proceedings, ISBN 978-9941-36-272-9, Publish House of Iv. Javakhishvili Tbilisi State University, Tbilisi, Georgia, October 17-19, 2024, pp. 129 – 132. http://109.205.44.60/bitstream/123456789/10625/1/33_MM-180.pdf
16. Hinkle D. E., Wiersma W., Jurs S. G., Applied Statistics for the Behavioral Sciences. // Boston, MA, Houghton Mifflin Company, ISBN: 0618124055; 9780618124053, 2003, p. 756.