

MORTALITY VARIABILITY IN GEORGIA IN 1994-2022

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Abstract: The paper presents the results of a statistical analysis of the variability of annual mortality per 1000 population (M) in Georgia and its regions from 1994 to 2022. The average value of M for Georgia in 1994-2022 is 12.6, the lowest mortality on average is observed in the Kvemo Kartli region (M = 9.4), the highest - in Racha-Lechkhumi and Kvemo Svaneti (M = 21.5). The range of variability in annual mortality is from 5.4 (Kvemo Kartli) to 31.1 (Racha-Lechkhumi and Kvemo Svaneti). It is shown, that the Covid-19 pandemic (2020-2021) has had a significant impact on the population mortality. In particular, during the period with the Covid-19 pandemic compared to the period without the pandemic (1994-2019, 2022), the average M value in Georgia increased from 12.4 to 14.9 (by 2.5 units). The smallest increase in M values was observed in Tbilisi (from 11.4 to 13.3, by 1.8 units), the largest – in Racha-Lechkhumi and Kvemo Svaneti (from 21.0 to 28.8, by 7.8 units). Data on the differences in average annual mortality in Georgia and its regions for different time intervals (including taking into account the impact of Covid-19 pandemic) are also presented.

Key words: Human health, mortality, environment.

Introduction

For many years, M. Nodia Institute of Geophysics, TSU together with medical organizations, has been conducting research into the influence of various natural and anthropogenic factors on the health of the population of Georgia [1,2]. Over the past 10 years, these studies have been successfully continued [3-10]. During the Covid-19 pandemic, a number of works were carried out on statistical analysis of various components of the pandemic, including ten-day, two-week and monthly interval forecasting of these components (infection cases, infection rate, death cases) [11-13]. In the post-Covid-19 period, studies of the influence of various bioclimatic indices on the spread of this infection have begun and will continue [14,15].

This work is part of these studies. Below are the results of a statistical analysis of the variability of population mortality in Georgia and its individual regions in 1994-2022. The role of the Covid-19 pandemic in the increase in mortality during its existence (2020-2021) is shown.

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 of National Statistics Office of Georgia [<https://www.geostat.ge/en>] on annual mortality to 1000 population (M) from 1994 to 2022 is used.

In the proposed work the analysis of data is carried out with the use of the standard statistical analysis methods.

The following designations will be used below: Mean – average values; Min – minimal values; Max - maximal values; St Dev - standard deviation; Cv – coefficient of variations ($Cv = 100 \cdot St\ Dev / Mean, \%$).

Differens between mean annual mortality in Georgia and its regions for different time intervals: $\Delta(I) = M(2007-2019) - M(1994-2006)$; $\Delta(II) = M(2020-2021) - M(1994-2022)$; $\Delta(III) = M(2020-2021) - M(1994-2006)$; $\Delta(IV) = M(2020-2021) - M(2007-2019)$; $\Delta(V) = M(2020) - M_Max(1994-2019, 2022)$; $\Delta(VI) = M(2021) - M_Max(1994-2019, 2022)$.

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 0.15.

Results and discussion

Results in Fig. 1 and Table 1, 2 are presented.

In Fig. 1 the time series of annual mortality in Georgia and its regions from 1994 to 2022 are presented.

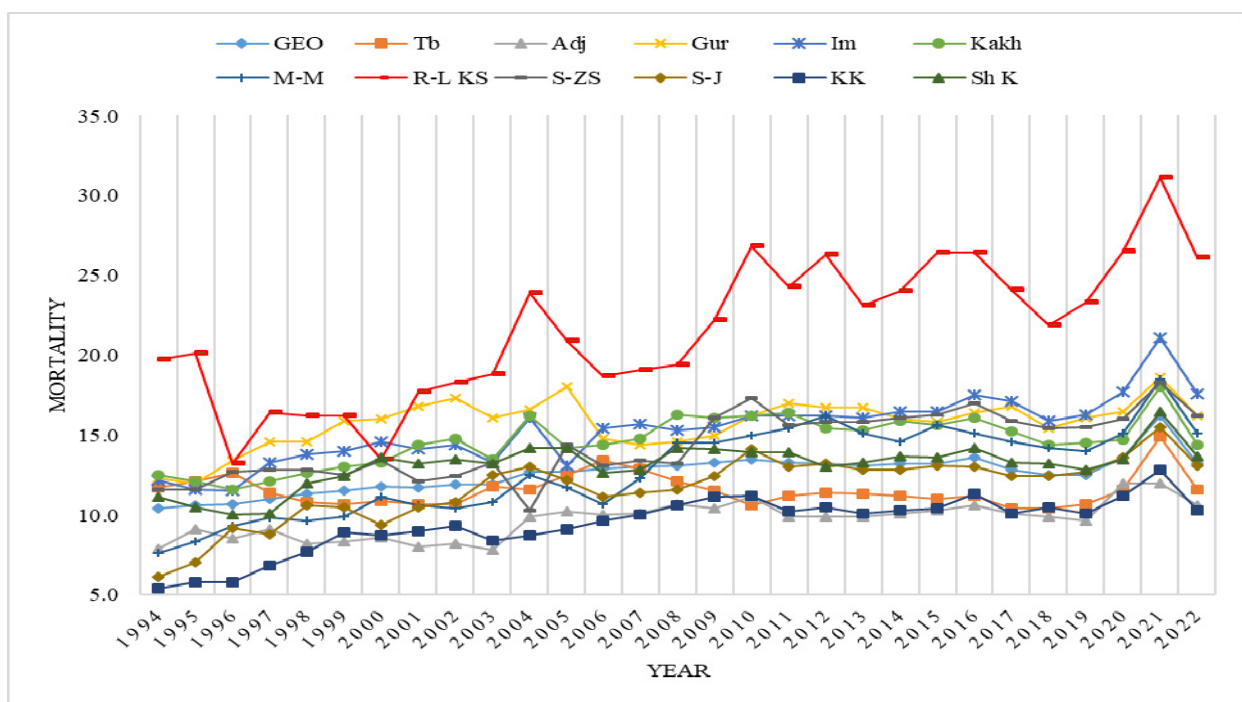


Fig. 1. Time series of annual mortality in Georgia and its regions from 1994 to 2022.

In Table 1 the statistical characteristics of annual mortality in Georgia and its regions for three periods of time are presented.

In particular, as follows from Fig. 1 and Table 1, average value of M for Georgia in 1994-2022 is 12.6, the lowest mortality on average is observed in the Kvemo Kartli region ($M = 9.4$), the highest – in Racha-Lechkhumi and Kvemo Svaneti ($M = 21.5$). The range of variability in annual mortality is from 5.4 (Kvemo Kartli) to 31.1 (Racha-Lechkhumi and Kvemo Svaneti).

The Covid-19 pandemic (2020-2021) has had a significant impact on the population mortality. In particular, during the period with the Covid-19 pandemic (2020-2021) compared to the period without the pandemic (1994-2019, 2022), the average M value in Georgia increased from 12.4 to 14.9 (by 2.5 units). The smallest increase in M values was observed in Tbilisi (from 11.4 to 13.3, by 1.8 units), the largest – in Racha-Lechkhumi and Kvemo Svaneti (from 21.0 to 28.8, by 7.8 units).

Table 1. Statistical characteristics of annual mortality in Georgia and its regions.

Period	1994-2022 (Full period)											
Region	GEO	Tb	Adj	Gur	Im	Kakh	M-M	R-L KS	S-ZS	S-J	KK	Sh K
Max	16.2	14.9	12.0	18.6	21.1	18.0	18.5	31.1	18.3	15.5	12.8	16.5
Min	10.4	10.4	7.8	12.0	11.5	11.6	7.6	13.2	10.3	6.1	5.4	10.0
Mean	12.6	11.5	9.7	15.8	15.3	14.6	12.8	21.5	14.4	11.7	9.4	13.1
St Dev	1.2	1.0	1.1	1.5	2.1	1.5	2.7	4.4	2.0	2.1	1.8	1.4
Cv,%	9.4	8.6	11.8	9.5	13.4	10.6	21.4	20.4	14.1	17.7	18.7	10.4
Period	1994-2019, 2022 (Period without Covid-19 pandemic)											
Max	13.6	13.4	11.1	18.0	17.6	16.4	16.2	26.8	17.3	14.1	11.3	14.2
Min	10.4	10.4	7.8	12.0	11.5	11.6	7.6	13.2	10.3	6.1	5.4	10.0
Mean	12.4	11.4	9.5	15.6	15.0	14.5	12.5	21.0	14.2	11.5	9.3	13.0
St Dev	1.0	0.8	1.0	1.4	1.7	1.5	2.6	4.0	1.9	2.0	1.7	1.2
Cv,%	7.8	6.8	10.3	9.2	11.4	10.1	20.5	19.1	13.6	17.1	18.0	9.5
Period	2020-2021 (Period with Covid-19 pandemic)											
Max	16.2	14.9	12.0	18.6	21.1	18.0	18.5	31.1	18.3	15.5	12.8	16.5
Min	13.6	11.6	12.0	16.5	17.7	14.7	15.1	26.5	16.0	13.6	11.2	13.5
Mean	14.9	13.3	12.0	17.6	19.4	16.4	16.8	28.8	17.2	14.6	12.0	15.0
St Dev	1.8	2.3	0.0	1.5	2.4	2.3	2.4	3.3	1.6	1.3	1.1	2.1
Cv,%	12.3	17.6	0.0	8.5	12.4	14.3	14.3	11.3	9.5	9.2	9.4	14.1

In Table 2 the differences between mean annual mortality in Georgia and its regions for different time intervals are presented

Table 2. Differences between mean annual mortality in Georgia and its regions for different time intervals.

Region	$\Delta(I)$	$\Delta(II)$	$\Delta(III)$	$\Delta(IV)$	$\Delta(V)$	$\Delta(VI)$
GEO	1.5	2.3	3.3	1.8	0	2.6
Tb	-0.4	1.7	1.6	2.0	-1.8	1.5
Adj	1.4	2.3	3.2	1.8	0.9	0.9
Gur	0.7	1.8	2.3	1.6	-1.5	0.6
Im	2.6	4.1	5.8	3.2	0.1	3.5
Kakh	2.1	1.7	2.9	0.8	-1.7	1.6
M-M	4.5	4.0	6.6	2.1	-1.1	2.3
R-L KS	5.7	7.3	10.8	5.2	-0.3	4.3
S-ZS	3.1	2.8	4.6	1.5	-1.3	1.0
S-J	2.6	2.9	4.4	1.9	-0.5	1.4
KK	2.6	2.6	4.1	1.5	-0.1	1.5
Sh K	1.2	1.9	2.6	1.5	-0.7	2.3

As follows from Table 2 the difference between mean annual mortality in the pre-Covid-19 period $\Delta(I)$ [$M(2007-2019) - M(1994-2006)$] change from -0.4 (Tbilisi, reduction in mortality) to 5.7 (Racha-Lechkhumi and Kvemo Svaneti, increase in mortality). In general, in Georgia the increase in the mean value of $\Delta(I)$ was 1.5.

Compared to the average mortality rate in 1994-2022, 1994-2006 and 2007-2019, in 2020-2021 the mortality rate increased both throughout Georgia and in its individual regions.

$\Delta(II) = 2.3$ (Georgia), range of change – from 1.7 (Tbilisi and Kakheti) to 7.3 (Racha-Lechkhumi and Kvemo Svaneti).

$\Delta(\text{III}) = 3.3$ (Georgia), range of change – from 1.6 (Tbilisi) to 10.8 (Racha-Lechkhumi and Kvemo Svaneti).

$\Delta(\text{IV}) = 1.8$ (Georgia), range of change – from 0.8 (Kakheti) to 5.2 (Racha-Lechkhumi and Kvemo Svaneti).

The mortality rate in 2020 compared to the maximum mortality rate in 1994-2019, 2022 in Georgia as a whole has not changed. It increased only in Imereti and Adjara (by 0.1 and 0.9, respectively). In other regions, a decrease in $\Delta(\text{V})$ values was observed from -0.1 (Kvemo Kartli) to -1.8 (Tbilisi).

Mortality in 2021 compared to the maximum mortality in 1994-2019, 2022 both in Georgia as a whole and in its individual regions has increased. For Georgia, the value $\Delta(\text{VI}) = 2.6$, for its regions the range of variability is from 0.6 (Guria) to 4.3 (Racha-Lechkhumi and Kvemo Svaneti).

Conclusion

In the future, taking into account the receipt of new data, it is planned to continue research into the influence of various natural and anthropogenic factors on the health of the population of Georgia. Particular attention will be paid to long-term forecasting of these effects on human health in connection with expected changes in these factors (for example, climate change).

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