CHANGEABILITY OF ANNUAL VALUES OF MORTALITY AS WHOLE IN GEORGIA AND KAKHETI REGION FROM 1993 TO 2018

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Summary: The results of the study of the variability of annual mortality in general in Georgia and its Kakheti region from 1993 to 2018 are presented. The variability of both total mortality and mortality in urban and rural areas is considered. In particular, the mortality trend is as follows: total mortality is a third order polynomial both in general in Georgia and in the Kakheti region; mortality in urban areas - a ninth order polynomial for Georgia and a tenth order polynomial for Kakheti; mortality in rural areas is an eighth order polynomial in Georgia as a whole and in the Kakheti region. In 2006-2018 in comparison with 1993-2005, with the exception of rural areas of Kakheti, the following mortality growth was observed: total mortality - by 13.5 and 16.8% as a whole in Georgia and in Kakheti, respectively; mortality in urban areas - by 5.4% in Georgia; in rural areas - by 25.1 and 22.3% as a whole in Georgia and in Kakheti, respectively.

Key words: Health of population, mortality, trend.

Introduction
It is known that the human's health is primarily affected by the lifestyle (50 – 55%), then – the environment (25 – 30%), and finally – heritage and medical care [1].
The effects of the action of environmental factors (separate meteorological and geophysical elements, space weather parameters and its combinations: air temperature, humidity, wind speed, atmospheric pressure, solar activity, the geomagnetic fields, solar radiation, the cosmic rays, light ions, aerosols, ozone, other air toxic admixtures and etc.) on human health have different scales - from minute, hour, day, decade and month to the seasonal and annual [1-10].
Therefore, to identify the links between people's health and these factors, it is necessary to conduct a preliminary selection and analysis of data characterizing the health of the population (emergency calls, hospitalization, morbidity for various reasons, mortality, etc.). It is especially important to analyze the long-term series of these data (identifying trends, random components, etc.). After that, we can begin to carry out a comparison of two or more time series characterizing of peoples health and external factors affecting on them.
Similar studies were carried out by us earlier [1,4-6,9,10]. This work is a continuation of them. The results of analysis of the variability of mortality in general in Georgia and its Kakheti region from 1993 to 2018 are present below (total mortality per 1000 population, as well as mortality in urban and rural conditions).

Study area, Material and Methods
Study area – Georgia and its Kakheti region. The work uses data from the National Statistics Office of Georgia [https://www.geostat.ge/ka] on mortality in the period from 1993 to 2018.
In the proposed work as in [4] the analysis of data is carried out with the use of the standard statistical analysis methods of random events and methods of mathematical statistics for the non accidental time-series of observations.

The following designations will be used below: Min – minimal values, Max - maximal values, Range - variational scope, St Dev - standard deviation, R^2 – coefficient of determination, K_{DW} – Durbin-Watson Statistic, α - the level of significance, Real - measured data, Calc – calculated values. The curve of trend is equation of the regression of the connection of the investigated parameter with the time at the significant value of the coefficient of determination and such values of K_{DW}, with which the residual values are accidental. Comparison of two average values was carried out using Student's criterion t.

Results and discussion

The results in the table 1,2 and fig. 1-3 are presented.

Table 1. Statistical characteristics of annual values of mortality on 1000 population as whole in Georgia and Kakheti region from 1993 to 2018.

Variable	Total		Urban		Rural	
	Georgia	Kakheti	Georgia	Kakheti	Georgia	Kakheti
Min	10.2	11.3	10.3	10.7	10.1	11.4Стьюдента
Max	13.6	16.4	14.6	28.4	15.2	16.7
Mean	12.31	14.41	12.20	17.10	12.47	13.59
St Dev	1.01	1.55	1.36	5.09	1.85	1.84
Range	3.40	5.10	4.30	17.70	5.10	5.30
II. Mean (2006-2018)	13.09	15.52	12.52	17.41	13.86	14.95
I. Mean (1993-2005)	11.53	13.28	11.88	16.80	11.08	12.23
Differ. (II-I)	1.55	2.24	0.64	0.60	2.78	2.72
100·(II/I-1), %	13.5	16.8	5.4	3.6	25.1	22.3
α(t)	<0.001	<0.001	0.25	No sign	<0.001	<0.001
Trend	3th Ord.	3th Ord.	9th Ord.	10th Ord.	8th Ord.	8th Ord. Pol.
R² (α<0.001)	0.97	0.85	0.95	0.82	0.92	0.89
K_DW (α<0.05)	1.92	2.26	2.36	2.33	2.26	2.29

As follows from table 1 from 1993 to 2018 mortality per 1000 population varies within the following limits: total mortality - 10.2 ÷ 13.6 (average 12.31) in general in Georgia, and 11.3 ÷ 16.4 (average 14.41) in the Kakheti region; mortality in urban areas - 10.3 ÷ 14.6 (average 12.2) in general in Georgia, and 10.7 ÷ 28.4 (average 17.1) in the Kakheti region; mortality in rural areas is 10.1 ÷ 15.2 (average 12.47) in general in Georgia, and 11.4 ÷ 16.7 (average 13.59) in the Kakheti region.
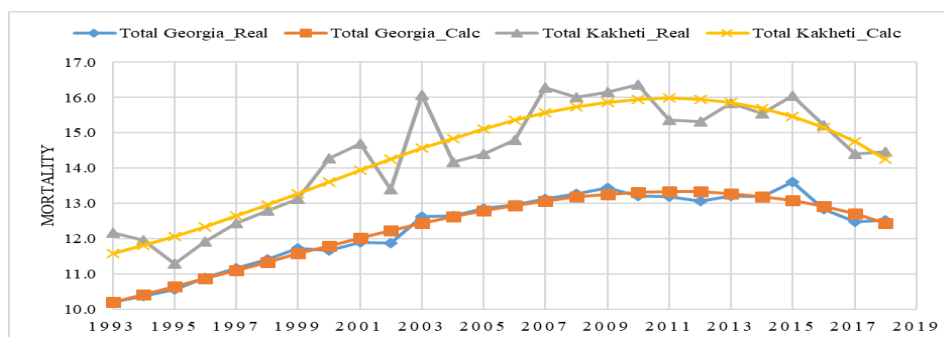

Fig. 1. Mortality trend per 1000 population as a whole in Georgia and in Kakheti region from 1993 to 2018.

The mortality trend is as follows: total mortality is a third order polynomial both in general in Georgia and in the Kakheti region; mortality in urban areas - a ninth order polynomial for Georgia and a tenth order

polynomial for Kakheti; mortality in rural areas is an eighth order polynomial in Georgia as a whole and in the Kakheti region.
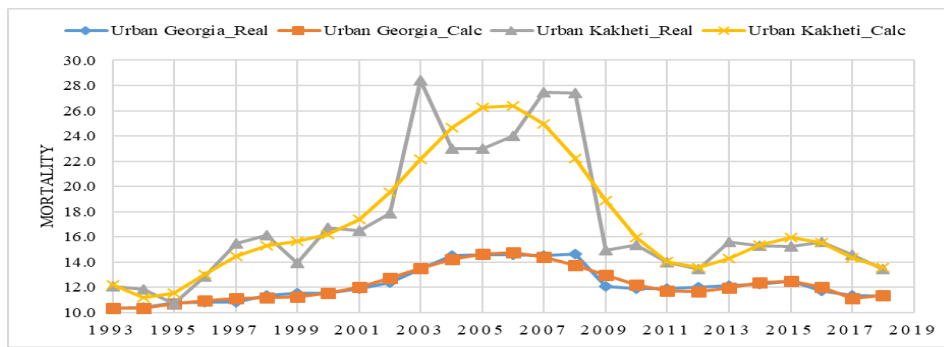

Fig. 2. Mortality trend per 1000 population as a whole in Georgia and in Kakheti region for urban areas from 1993 to 2018.

In 2006-2018 in comparison with 1993-2005, with the exception of rural areas of Kakheti, the following mortality growth was observed: total mortality - by 13.5 and 16.8% as a whole in Georgia and in Kakheti, respectively; mortality in urban areas - by 5.4% in Georgia; in rural areas - by 25.1 and 22.3% as a whole in Georgia and in Kakheti, respectively (table 1, Fig. 1-3).
As follows from fig. 1 as a whole in Georgia and in Kakheti until 2007-2010 there is an increase in total mortality, then some stabilization and decrease in recent years.
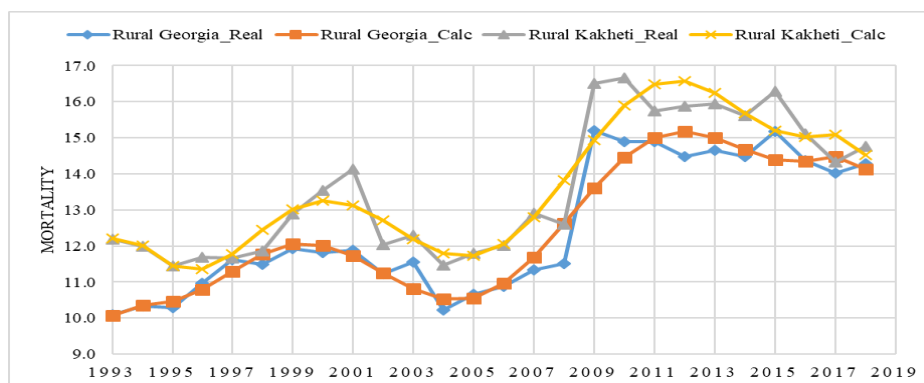

Fig. 3. Mortality trend per 1000 population as a whole in Georgia and in Kakheti region for rural areas from 1993 to 2018

Table 2. Difference between mean mortality on 1000 population in Kakheti region and as whole in Georgia for three periods of time.

Difference	Total	Urban	Rural
1993-2018	2.10	4.90	1.12
α	<0.001	<0.001	0.05
1993-2005	1.75	4.92	1.15
α	<0.001	<0.001	<0.001
2006-2018	2.44	4.88	1.09
α	<0.001	<0.002	0.07

In urban areas as a whole in Georgia, mortality growth was observed until 2005-2006, then a decrease, some stabilization and again decrease in 2017-2018. In Kakheti, the variability of mortality in urban areas is

complex - two peaks in 2003 and 2007-2008. Since 2009 mortality has sharply decreased (fig. 2). In rural areas, the variability of mortality in Georgia as a whole and in the Kakheti region has a similar wave-like appearance with two growing extremes (Fig. 3).

As follows from table 2, mortality in Kakheti is higher than in Georgia as a whole. Thus, over the entire observation period, the total mortality per 1000 population in Kakheti is 2.1 cases higher than in Georgia in general, by 4.9 in urban areas, and 1.12 cases in rural areas. Moreover, in 2006-2018 in comparison with 1993-2005 the difference in total mortality in Kakheti and in general in Georgia grew (2.44 and 1.75 cases, respectively), for urban areas this difference is insignificant, in rural areas this difference decreased (1.09 and 1.15 cases, respectively).

Conclusion

In the future, similar studies are planned for other regions of Georgia.

Acknowledgement

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