



## EFFECTS OF VARIATIONS OF THE MONTHLY MEAN AIR TEMPERATURE ON THE POPULATION HEALTH OF IMERETI REGION OF GEORGIA

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*Summary: It is found that the relationship between the average monthly air temperature in Kutaisi and such indices of the health of population as the total number of emergency medical calls, cases of hospitalizations and deaths has the form of a third power polynomial. In general, in the warm months there is a decrease of the total number of emergency medical calls, cases of hospitalizations and deaths. In the hot months, there is a worsening in these indicators of health, comparable to the cold months of the year (increase of the emergency medical calls, cases of hospitalizations and deaths).*

**Key words:** Air temperature, bioclimate, health of population.

### Introduction

The human's health is primarily affected by the lifestyle (50 – 55%), then – the environment (25 – 30%), and finally – heritage and medical care [1]. People's health largely depends on separate meteorological and geophysical elements, space weather parameters and its combinations: air temperature [1,2], humidity, wind speed, atmospheric pressure, solar activity (Wolf's number), the geomagnetic fields, solar radiation, the cosmic rays [3-6], light ions, aerosols, ozone, other air toxic admixtures and etc. [1,6-9].

The effects of the action of environmental factors on human health have different scales - from minute, hour, day, decade and month to the seasonal and annual [1,3,4,7,10]. One of the most important factors of this influence is the air temperature. The results of a study of the influence of the monthly average air temperature on human health in the conditions of Imereti are presented below.

Imereti offers a number of tourist opportunities including: cultural-educational and eco-tourism, religious and archaeological tours; and the use of 4X4 vehicles for adventure tours in Zekari and Sairme. Tourist Potential: horse-riding, water, fishing, photo-video and environmental tours; speleological tours in Tskaltubo and Katskhi; bird watching and botanical tours in the national parks of Imereti (Sataplia, Ajameti), ethnological, artistic and wine tours in the villages of Zemo Imereti, etc. Therefore, the study of the thermal regime as a bioclimatic factor is important for the development of the tourism industry in this region, as well as taking measures to protect the population under extreme temperature conditions.

### Study area, Material and Methods

The study area (fig. 1) is Imereti (<http://imereti.gov.ge/geo/static/101;http://dateandtime.info/ru/citycoordinates.php?id=611219>). Population of Imereti is 533906 (2014

year), number of ambulance teams – 40. Information about the appropriate municipal centers (population/number of ambulance teams/ height above sea level, meter) is given further: Kutaisi (147635/10/153), Baghdati (21582/2/215), Vani (24512/2/70), Zestafoni (57628/3/201), Terjola (35563/2/170), Samtredia (48562/3/23), Sachkhere (37775/3/484), Tkibuli (20839/3/565), Chiatura (39884/4/495), Tskaltubo (56883/3/142), Kharagauli (19473/3/555), Khoni (23570/2/118).



Fig. 1. Imereti region of Georgia (<http://geostat.ge/regions/#>)

As indices of the health of population the total number of emergency medical calls, cases of hospitalizations and deaths has used (<http://112.gov.ge/>). The data of the Hydro meteorological Service of Georgia about the monthly values of air temperature (T, °C) in Kutaisi are used. Period of investigations – 2013, 2105 and 2017. 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: Min – minimal values, Max - maximal values, Range - variational scope, St Dev- standard deviation, Cv – coefficient of variation, R<sup>2</sup> – coefficient of determination, R – coefficient of linear correlation, Ta - monthly average air temperature, Tmax - monthly average maximum air temperature, Tmin - monthly average minimum air temperature, Em. Calls - all emergency calls, Hosp. – hospitalization.

## Results and discussion

The results in the table and fig. 2-4 are presented.

Table

The statistical characteristics of air temperature and data of emergency medical for Imereti region of Georgia in 2013, 2015 and 2017

Variable	Ta, °C	Tmax, °C	Tmin, °C	Variable	Em. Calls	Hosp.	Dead
Max	27.0	33.3	22.3	Max	15959	4788	188
Min	4.9	8.9	2.0	Min	8196	2051	68
Range	22.1	24.4	20.3	Range	7763	2737	120
Average	15.7	21.0	12.1	Average	11580	3366	124
St Dev	6.9	7.4	6.4	St Dev	1441	715	30
Cv, %	43.7	35.4	53.0	Cv, %	12.4	21.3	24.1
Correlation Matrix				Correlation Matrix			
	Ta	Tmax	Tmin		Em. Calls	Hosp.	Dead
Ta	1	0.996	0.996	Em. Calls	1	0.83	0.72
Tmax	0.996	1	0.985	Hosp.	0.83	1	0.70
Tmin	0.996	0.985	1	Dead	0.72	0.70	1

As follows from table between  $T_a$ ,  $T_{max}$  and  $T_{min}$  high linear correlation is observed (practically linear functional dependence). Therefore, when analyzing data, it is possible to use either of these temperature parameters, in particular  $T_a$ . Values of  $R$  between Em. Calls, Hosp. and Dead are also high and vary from 0.70 to 0.83.

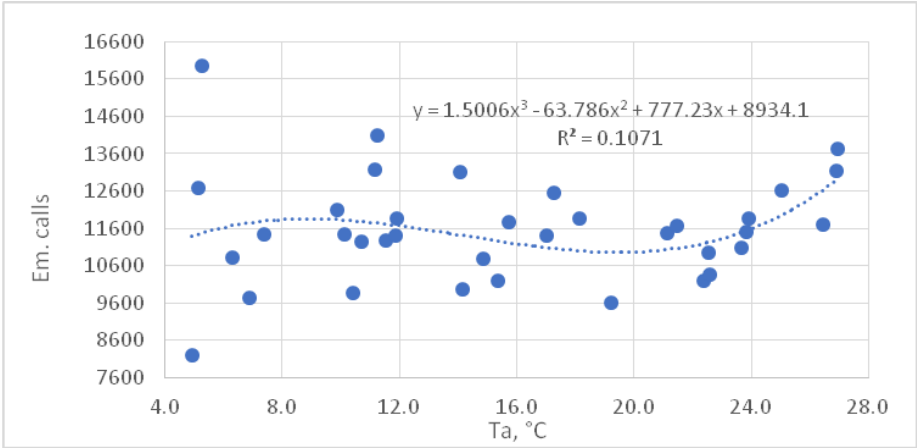


Fig. 2. The relationship between the number of ambulance calls in Imereti region and the monthly average air temperature in Kutaisi.

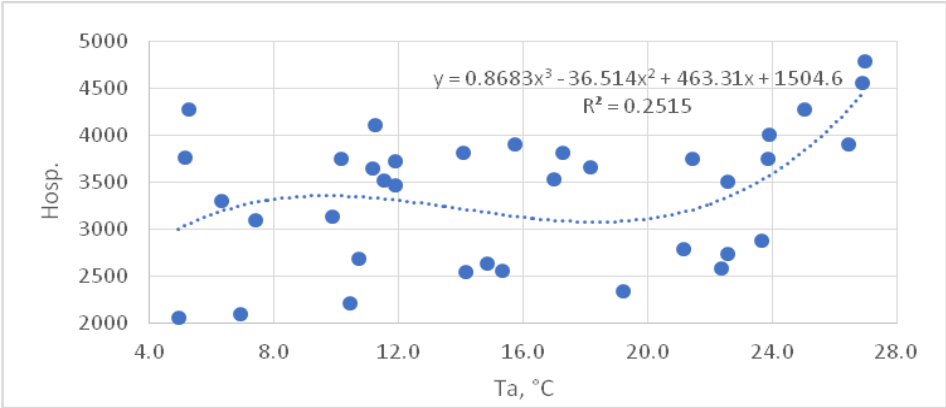


Fig. 3. The relationship between the cases of hospitalizations by ambulance in Imereti region and the monthly average air temperature in Kutaisi.

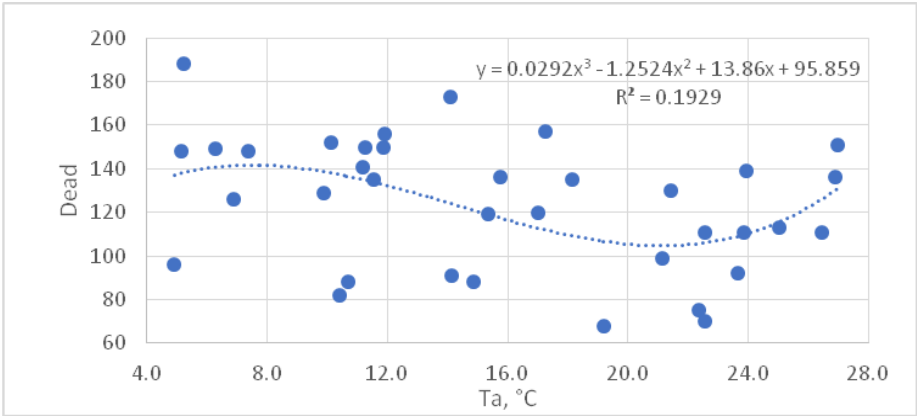


Fig. 4. The relationship between the cases of deaths fixed by ambulance in Imereti region and the monthly average air temperature in Kutaisi.

As follows from fig. 2-4 the relationship between the average monthly air temperature in Kutaisi and total number of emergency medical calls, cases of hospitalizations and deaths has the form of a third power polynomial (values of  $R^2$  respectively are 0.1071, 0.2515 and 0.1929, which indicates the significance of these connections not worse 0.05). As a whole, in the warm months there is a decrease of the total number of emergency medical calls, cases of hospitalizations and deaths. In the hot months, there is a worsening in these indicators of health, comparable to the cold months of the year (increase of the emergency medical calls, cases of hospitalizations and deaths).

## Conclusion

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

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