# THE EFFECT OF WEATHER FACTORS ON THE CERTAINABILITY OF THE RESIDENTS OF BISHKEK AND OSH ON HEART DISEASES

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The purpose of the work is to compare the effect of air temperature, atmospheric pressure, precipitation, abrupt weather changes on the number of ambulance calls to patients with cardiovascular diseases. Bishkek, Osh. Material and methods. The data of calls to the ambulance station of Bishkek, Osh were analyzed by disease classes in accordance with ICD-10 revision: A00-R99 – for all reasons; I00-I99 – diseases of the circulatory system. The study included more than 500 thousand ambulance calls. To assess the meteorological indicators, the archive data of the site http://www.gismeteo.ru/diary/5327 was used. Correlation analysis was performed using the SPSS program. The results indicate the existence of significant moderate and strong links to the circulation of patients with cardiac and cerebrovascular diseases with periods of prolonged heat, days with a sharp change in weather, days with an increase in atmospheric pressure after the invasion of the cold air front and precipitation. The need for seasonal prophylaxis of metapathic reactions with regard to weather changes is shown.

**Keywords: weather, morbidity, heart disease, meteopathic reactions, Fergana Valley, Chui Valley, correlation analysis**

Global climate change is not only warming. The absolute temperature increase over a hundred years was only 0.8 °C. This is not noticeable to humans. But such a change in temperature leads to powerful changes in air flow and sea currents. The weather is becoming very changeable. The number of abrupt weather changes.

It has long been a known fact that colds are growing, exacerbation of rheumatic diseases, respiratory diseases, and the urogenital system in cold and freezing temperatures. A 1-degree decrease in temperature in Europe accounts for a more substantial increase in morbidity and mortality than with a 1-degree increase in temperature [10]. However, in summer, when there is a strong heat in a certain risk group: post-infarction, post-stroke patients, hypertensive patients, elderly people, in general, develop meteopathic reactions [1, 3]. In this case, the temperature change does not occur by itself, but as a result of changes in atmospheric pressure, wind intrusions, which also leads to meteopathic reactions other than the listed patients in hypotension, asthmatics, and patients with COPD [6].

Identifying typical and individual human reactions to weather changes is not an end in itself; there are opportunities for seasonal and current weather prophylaxis of important non-communicable diseases, but it must be targeted, cost-effective [5, 7, 8].

Kyrgyzstan is a mountainous country with 4 climatic and geographical zones. Previously, studies were conducted on the impact of climate change on public health on the example of the Chui Valley and the city of Bishkek [2, 3].

The purpose of the work is to determine the influence of weather factors on the incidence of Bishkek and Osh residents over a twenty-year period.

## Materials and research methods

In assessing the incidence rates of the population, data from the Republican Medical Information Center of the Ministry of Health of the Kyrgyz Republic (RMIC of the Ministry of Health), calls to the Bishkek Emergency Medical Station of Osh for individual classes of diseases were used in accordance with ICD-10 revision: A00-R99 – from all causes; I00-I99 – diseases of the circulatory system. The study included more than 450 thousand ambulance calls.

The analysis was carried out by age categories, sex and classes of diseases. To assess the meteorological indicators, the archive data of Kyrgyzhydromet and the site http://www.gismeteo.ru/diary/5327 were used. The data were estimated in dynamics (daily, monthly and annual average). Correlation and regression analysis of medical and meteorological indicators was performed using the SPSS program (version 20.0.1).

## Research results and discussion

The cities of Bishkek and Osh are the largest cities of Kyrgyzstan. They are located approximately at the same height of 750-850 m above sea level. Bishkek is located in the Chuy valley, Osh – in the Fergana valley, both valleys are closed from the North, East and South by mountains, and open to the west. Bishkek is located at 43 °north latitude, and Osh – 41o. Social conditions in these cities are similar. There is a general system of organization of health care. That is, with a lot of consideration, they significantly differ in one climatic factor – air temperature. In Bishkek, the long-term winter air temperature is -5.0 °C, and the summer temperature is +24.4 °C. In Osh, respectively, -2.8 °C and +25.7 °C.

Correlation analysis showed that for the residents of Bishkek and Osh, there are significant links between air temperature, atmospheric pressure and precipitation, and morbidity and mortality from cardiovascular diseases (Fig. 1).

Moderate connections are common to all ages and any gender in general, but stronger connections are found for older women. It can be seen from the figure that there is a direct correlation of average power between the indices of appealability for emergency care of the population in the class of heart diseases in the age group of 65-74 years and data on atmospheric pressure and the amount of precipitation. In relation to temperature, an inverse relationship is established between the average force.

Here a paradox is revealed: on the one hand, the greatest number of calls is detected in July, on the other hand, with a temperature increase from -10 to +30 °C, as the correlation analysis shows, the frequency of calls in general decreases for all natural reasons. In our opinion, this is explained by the fact that the entire data set is processed for the whole year, when for 9 months the temperature rises from minus to comfortable or again decreases to minus. Whereas a hot daily temperature of + 30 °C and higher costs several days in June, more often in July, August, and sometimes in early September. These periods of heat and cause meteopathic reactions in infants, old people, meteo-labile patients.

We also identified days with hot temperatures and abrupt weather changes (fluctuations in average daily temperature by 5 or more degrees C compared with the previous day).

The results of the study show that with a slight increase in average annual, average monthly temperatures for the period studied, there are significant shifts in peak indicators of maximum daily temperature, which were not previously addressed (table 1).

The table shows that in Bishkek, there is a tendency for the number of hot days to increase by 36.7 %: from 46.3 per year in 1998-2001, with a certain decline – in 2002-2005, to 63.3 c year in the period -2011-2014, and 64.1 in the period 2015-2018.

For the city of Osh, for a sixteen-year period, there was a continuous increase in the rate of 45.1 %: from 52.6 to 77.2 days a year.

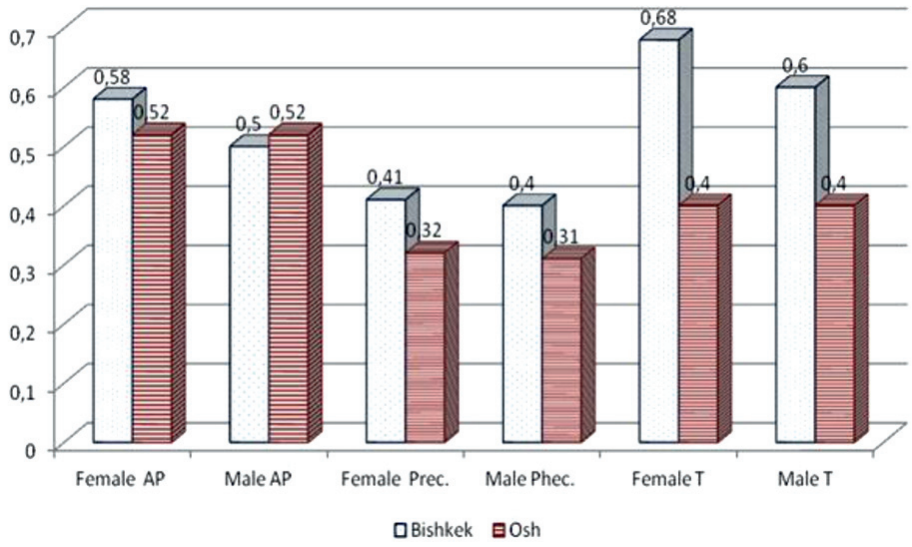


Fig. 1. Correlation coefficients between the population turnover rates of Bishkek and Osh for heart disease in old age (65-74 years) and data on atmospheric pressure, temperature and precipitation

**Table 1**

Number of hot days in the cities of Bishkek and Osh for the last 20 years (in four-year dynamics).

| City | 1998-2001 | 2002-2005 | 2006-2010 | 2011-2014 | 2015-2018 |
|---|---|---|---|---|---|
| Bishkek | 46,3 | 44,2 | 60 | 63,3 | 64,1 |
| Osh | 52,6 | 54,75 | 61,0 | 76,0 | 77,2 |

**Table 2**

Distribution of hot days per year by the cities of Bishkek and Osh in 2011-2018

| City | april | may | june | july | august | september | october |
|---|---|---|---|---|---|---|---|
| Bishkek | 0,25 | 2,0 | 12,25 | 21,0 | 20,25 | 6,5 | 1,0 |
| Osh | 0,75 | 5,75 | 13,25 | 23,75 | 23,75 | 8,0 | 0,25 |

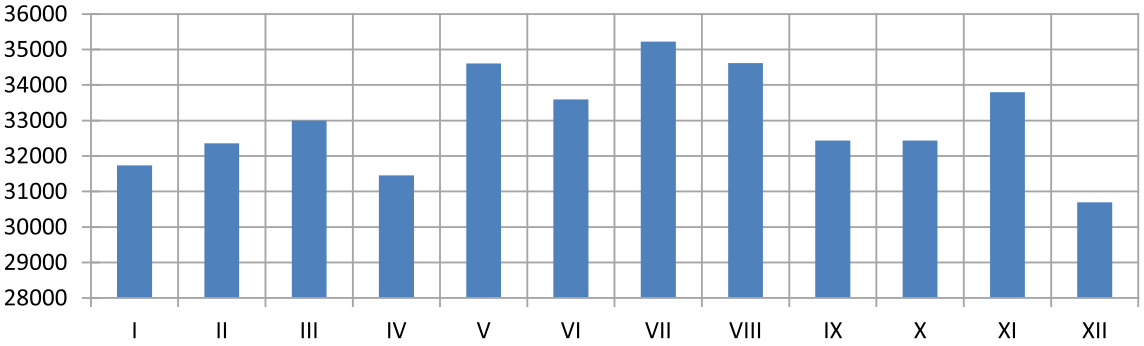


Fig. 2. Monthly structure of ambulance calls in the city of Bishkek in 2007-2014

**Table 3**

Monthly structure of ambulance calls in the city of Osh, in general, and about hypertension (H), including those that ended lethal before the ambulance arrived.

| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 6729 | 5024 | 6004 | 6303 | 6543 | 6374 | 6267 | 12441 | 5614 | 5205 | 5003 | 5457 |
| H | 1117 | 991 | 1112 | 1146 | 1027 | 819 | 669 | 1406 | 718 | 853 | 891 | 937 |
| Death before arrival | 63 | 50 | 41 | 46 | 56 | 44 | 32 | 81 | 32 | 36 | 45 | 48 |

N o t e : R o m a n numerals indicate the serial numbers of the months of the year.

Hot days are most frequent in July and August (Table 2), which must be taken into account when organizing seasonal weather prophylaxis.

It should be noted that the peak of ambulance calls in the city of Bishkek also falls on the month of July-August (Fig. 2). Also, a high number of calls occur in March and November, when the highest frequency of abrupt weather changes in the Chui Valley is observed.

Interestingly, the death rate from diseases of the cardiovascular system has increased over the past 10 years in Kyrgyzstan by 19.25%, including in the northern region by 22.6%, and in the southern region by 18.5%. In general, in the southern region, mortality from cardiovascular diseases is significantly lower (43.5 per 10 thousand people) than in the northern region (54.8 per 10 thousand people). With equal ethnic and social components, this suggests a certain role for climatic and geographical factors.

For example, 2014, when in the city of Osh, the temperature above +30 °C was kept 28 of the 31 days of August. It is interesting that the peak of ambulance calls in general and about hypertension also fell in August (Table 3).

Also, at the peak of the heat, death before the arrival of the ambulance was more than twice as high as during the other spring, summer and autumn months. Obviously, it is necessary to establish seasonal prophylaxis of cardiac and cerebral-vascular diseases during periods of prolonged heat.

Interestingly, in some other years, call peaks fell during the winter months. Therefore, meteorological prophylaxis should be targeted and associated with specific weather conditions in the current year, which is consistent with the data of other authors [4, 9].

**Table 4**

Number of days with a sharp change of weather in the cities of Bishkek and Osh for the last 20 years (in four-year dynamics)

| City | 1998-2001 | 2002-2005 | 2006-2010 | 2011-2014 | 2015-2018 |
|---|---|---|---|---|---|
| Bishkek | 93 | 90,75 | 92,7 | 91,25 | 94,3 |
| Osh | 44,3 | 36,6 | 38 | 46,7 | 54,2 |

**Table 5**

The number of days with a sharp change of weather in the cities of Bishkek and Osh 2011-2018

| City | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bishkek | 9 | 7,8 | 12,4 | 10,4 | 4,6 | 5,6 | 3,5 | 3,8 | 5,8 | 7,0 | 10,4 | 10,4 |
| Osh | 2 | 3,75 | 6,25 | 5,75 | 4,0 | 3,75 | 2,5 | 2,75 | 2,5 | 6 | 3,25 | 3,75 |

Note: Roman numerals indicate the serial numbers of the months of the year.

It is known that the adaptive capabilities of the body get off with a sharp change in the weather. In the Chui and Fergana valleys, warm weather with reduced atmospheric pressure and partial oxygen pressure faces an invasion from the West of cold air fronts. During the invasion of the cold wind, the atmospheric pressure quickly (in a few hours) increases, often with precipitation. We compared the number of abrupt weather changes in Bishkek and Osh (Table 4). It turns out that Osh is characterized by more stable weather. The number of abrupt weather changes in Osh is 51.1-59.7% less than in the city of Bishkek. However, their number in recent years has increased by 22.3% compared with 1998.

The most unstable years in the city of Bishkek were 1999 and 2002, the most quiet – in 2005. In 1999, there were 107 abrupt changes in the weather.

During the year, the most unstable weather in the city of Bishkek is characteristic for March, April and November (Table 5). During these months, it is necessary to conduct seasonal weather prophylaxis in meteo-dependent patients.

In the city of Osh, there are no months with a high number of days with abrupt changes in the weather, such as in Bishkek (10 or more). Residents easier to adapt to the current temperature. Seasonal weather prevention there will initially be less effective.

Correlation analysis revealed for the cities of Bishkek and Osh in the days of abrupt weather changes (according to the data of 2012-2018) an increase in mortality from cardiovascular and cerebrovascular diseases in general for the whole population (reliable positive moderate connections: r = + 54-62). In the group of persons over 75 years of age, the association of days with a sharp change of weather and mortality has reliable positive strengths r = +71.

Here we must take into account that Osh residents have long adapted to a higher temperature: clothing, food, housing, work and rest with them were initially more Asian than those of Bishkek residents, whose lifestyle is more European.

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