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# THE INFLUENCE OF SEISMOLOGICAL ACTIVITY ON MORTALITY FROM CARDIOVASCULAR PATHOLOGIES IN SHIRVAN REGION OF AZERBAIJAN

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The purpose of the study was to access the dependence of mortality from cardiovascular diseases on helioseismic indicators in the Shirvan region of Azerbaijan. To analyze the fatal outcomes of diseases in the Shirvan region, 99 case histories of patients who died in 2013 from various diseases were studied. The causes of deaths, distribution by sex and age, and a relationship between death accidents and the magnitude of earthquakes, the depth of the epicenter and seismological activity by months were established. Among both men and women, the largest percentage of patients died from a hypertensive crisis (47.5 % and 57.9 %, respectively). Deaths among the male population were in the range of magnetic field 49200.8T, and among the female – in the range of 49202.9T. Depending on the depth of earthquakes, the maximum number of deaths was at the process depth less than 10 km (10.1 %). Thus, the study of the seismological activity in different geographical areas makes it possible to assess environmental and emergency situations with a high probability and to provide for preventive measures.

**Key words:** acute coronary syndrome, cerebral stroke, hypertensive crisis, earthquake, magnitude

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# ВПЛИВ СЕЙСМОЛОГІЧНОЇ АКТИВНОСТІ У ШИРВАНСЬКОМУ РАЙОНІ АЗЕРБАЙДЖАНУ НА СМЕРТНІСТЬ ВІД КАРДІОВАСКУЛЯРНОЇ ПАТОЛОГІЇ

Метою дослідження було вивчити залежність смертності від серцево-судинних захворювань від геліосейсмічних показників у Ширванському районі Азербайджану. Для аналізу летальних наслідків хвороб у Ширванському районі вивчено 99 історій хвороби хворих, які померли у 2013 році від різних захворювань. Встановлено причини загибелі, розподіл за статтю та віком, а також зв'язок між смертельними випадками та магнітудою землетрусів, глибиною епіцентру та сейсмологічною активністю за місяцями. Як серед чоловіків, так і серед жінок найбільший відсоток хворих померли від гіпертонічного кризу (47,5 % та 57,9 % відповідно). Смерті серед чоловічого населення були у діапазоні напруженості магнітного поля 49200,8Тл, серед жіночого – у діапазоні 49202,9Тл. Залежно від глибини землетрусів, максимальна кількість померлих була за глибини процесу менше 10 км (10,1 %). Таким чином, вивчення сейсмологічної активності в різних географічних районах дозволяє з високою ймовірністю оцінювати екологічні та надзвичайні ситуації та передбачати превентивні заходи.

**Ключові слова:** гострий коронарний синдром, мозковий інсульт, гіпертонічний криз, землетрус, магнітуда.

Almost a third of the territory of Azerbaijan is located in a zone of high seismic activity (8–9 points), according to him, the southeastern slope of the Greater Caucasus (Shamakhi-Ismayilli), the middle and high-mountainous Caucasus, the entire Lesser Caucasus, the lowland-mountainous territory of the Nakhchivan Autonomous Republic, the Absheron-Gobustan territory – up to eight points, the rest of the territories cover seismic zones up to seven points. If we take into account the risk of earthquakes, then the Mountain-Shirvan economic region ranks first – 40 % of the 200 earthquakes recorded on the territory of the republic over the past 100 years occur in the Shamakhi region [1, 15].

Diseases of the circulatory system are the main cause of death and disability of the adult and working age population, which determines their significant medical, social and social-economic significance [8]. The influence of meteorological conditions on the intensity of the occurrence of diseases in the population is currently one of the actively studied problems of medical geography [9, 12]. Despite the numerous publications on this issue, there are currently few studies showing mathematical relationships between exacerbations of diseases of the cardiovascular system in the population of large cities under the influence of seismic and geophysical conditions [3, 5, 6].

As a result of the research, it was found that, based on a comparative analysis of the number of requests for medical help, on unfavorable meteorological days with an average annual number of requests per day, on unfavorable seismological days, the appealability of patients with cardiovascular diseases for medical care is 1.1–1.4 times higher than the annual average [4]. In practical medicine and geoecology, attention is increasingly drawn to the relationship between exacerbations of the course of diseases, deterioration in well-being and changes in meteorological and seismic conditions [10, 14]. However, the World Health Organization in the international classification of diseases does not single out an independent diagnosis of the geoseismic profile of the disease and does not consider such a condition as a medical problem.

Depending on the geographical location of the territory, there are climatic differences, for which it is necessary to clarify the list of regional risk factors that affect the occurrence and exacerbation of the course of diseases of the cardiovascular system. No such studies have been conducted in Azerbaijan, which underlines the significance of the work.

**The purpose** of the study was to access the dependence of mortality from cardiovascular diseases on helioseismic indicators in the Shirvan region of Azerbaijan.

**Materials and methods**. In 2013, seismological information was received from 35 telemetry stations, which included an overview of the seismic regime of the republic, the distribution of seismic waves, the dynamics of seismic processes, the intensity of the earthquake, the magnitude, etc. Also, at 9 geophysical and 5 geochemical stations, the strength of the geomagnetic field and the force of attraction were studied.

To analyze the fatal outcomes of diseases in the Shirvan region, 99 case histories of patients who died in 2013 from various diseases were studied. The causes of deaths, distribution by sex and age, and a relationship between death accidents and the magnitude of earthquakes, the depth of the epicenter and seismological activity by months were established. The obtained data were statistically processed using the Statistica 12.0 for Windows application package (Statsoft Inc., USA). The Kruskal-Wallis analysis of variance was used to compare three or more samples, the results were considered significant at $p<0.05$.

**Results of the study and their discussion**. 99 patient cases were examined, of which 61.6 % were men and 38.4 % were women. 56.9 % of men and 43.1 % of women died from a hypertensive crisis, 73.7 % of men and 26.3 % of women died from acute cerebrovascular accident, 66.7 % of men and 33.3 % of women died from acute coronary syndrome, from heart failure equally 50.0 % men and 50.0 % women.

When comparing the causes of death by gender, it was determined that among men, the most deaths were from a hypertensive crisis – 47.5 %, from acute coronary syndrome and acute disorders were the same – 23.0 % and from heart failure – 6.6 %. Among women, there were also more deaths from hypertensive crisis – 57.9 %, then from coronary syndrome – 18.4 %, from acute cerebrovascular accident 13.2 – % and from acute heart failure – 10.5 %.

Of these, 51.5 % died from a hypertensive crisis, 19.2 % from acute cerebrovascular accident, 21.2 % from acute coronary syndrome, and 8.1 % from acute heart failure.

Depending on the months of the year, a large percentage of deaths was in September 22.2 %, then in May 21.2 %, in October 15.2 %, January 14.1 %, April 10.1 %, August 9.1 %, December 6.1 %, November 2.0 %. With a gender difference, men had more deaths during earthquakes in January 92.9 %, April 70.0 %, August 56.7 %, September 68.2 %, October 60.0 %, November 100.0 %, and more women in May 61.9 % and December 83.3 %.

When distributing the causes of death by months of the year, it was determined that for all groups there were more deaths in January, from a hypertensive crisis 71.4 %, from acute cerebrovascular accident 14.3 %, from acute coronary syndrome and acute heart failure 7.1 %. In May: 38.1 % of death were from hypertensive crisis, 28.6 % from acute coronary syndrome, 19.0 % from acute heart failure and 14.3 % from acute disorders of cerebral circulation. In August: 44.4 % from acute coronary syndrome, 33.3 % from hypertensive crisis, 11.1 % from acute cerebrovascular accident and acute heart failure. In September: 40.9 % from hypertensive crisis, 27.3 % from acute coronary syndrome, 22.7 % from acute cerebrovascular accident and 9.1 % from acute heart failure. In October: 60.0 % from a hypertensive crisis, 26.7 % from acute cerebrovascular accident and 13.3 % from acute coronary syndrome. In November, from acute cerebrovascular accident and acute coronary syndrome equally (50.0 %), and in December, most of all (50.0 %) from hypertensive crisis, 33.3 % from acute cerebrovascular accident and 16.7 % from acute coronary syndrome.

Depending on age, more deaths on seismically active days were at the age of 70–79 years old (39.4 %), the other results were as following: 80–89 years old (20.2 %), 60–69 years old (17.2 %), 50–59 years old (16.2 %), 40–49 years old and 90–99 years old both 3 %, 30–39 years old 1.0 %.

In the age aspect, more deaths from hypertensive crisis were at the age of 70–79 years (33.3 %), at the age of 80–89 years – 23.5 % and at the age of 50–59 years – 19.6 %. From acute cerebrovascular accident: at the age of 70–79 years was 63.2 %, 60-69 years and 80–89 years – 15.8 %. From acute coronary syndrome: at the age of 70–79 years was 33.3 %, 80–89 years – 23.8 % and 60–69 years – 14.3 %. From acute heart failure: at the age of 50–59 years and 70–79 years – 37.5 % and 60–69 years 25.0 %.

In a comparative analysis of the age period from gender dependence, it was determined that among men there were more deaths at the age of 70–79 years (37.7 %), then at 50–59 years (19.7 %), 80–89 years (18.0 %), 60–69 (16.4 %), 40–49 years old (4.9 %), 30–39 years old and 90–99 years old (1.6 %). And among women, there were also more deaths at the age of 70–79 years (42.1 %), 80–89 years (23.7 %), 60–69 years (18.4 %), 50–59 years (10.5 %), 90–99 years (5.3 %).

In the days of earthquakes, 25.3 % of patients died, in the days of absence – 74.7 %.

At a seismic process depth of less than 10 km 10.1 %, with a depth of 11–20 km 7.1 %, 31–40 km and more than 40 km 3.0 %, 21–30 km 2.0 % of patients died.

In the study of mortality on the days of earthquakes, depending on the depth of the seismic process and gender indicators, it was determined that with a seismic process depth of less than 10 km, more than

60.0 % of men died, and 40.0 % of women, with a depth of 11–20 km, the same 50.0 %, at 31–40 km 66.7 % of women and 33.3 % of men died, at more than 40 km 100.0 % of women died.

The study of the causes of death at different depths of the seismic process showed that at a depth of less than 10 km, 80.0 % died from a hypertensive crisis and 20.0 % from acute coronary syndrome, at a depth of 11–20 km 42.9 % from acute cerebrovascular accident, from hypertensive crisis 28.6 %, 14.3 % from acute coronary syndrome and acute heart failure, at a depth of 21–30 km from acute heart failure and acute cerebrovascular accident, 50.0 % died, at a depth of 31–40 km from a hypertensive crisis 66.7 % and acute coronary syndrome 33.3 %, at a depth of more than 40 km from acute cerebrovascular accident 66.7 % and from hypertensive crisis 33.3 %.

In a comparative analysis of the age aspect and the depth of the seismic process we found out that at a depth of less than 10 km, more deaths were at the age of 50–59 years (40.0 %), 80–89 years (30.0 %) and 70–79 years (10.0 %). At a depth of 11–20 km – at the age of 70–79 years (71.4 %) and at the age of 50–59 years and 60–69 years (14.3 % each). At a depth of 21–30 km at the largest percentage was at the age of 50–59 years old and 60–69 years old, 50.0 % each. At 31–40 km – at the age of 70–79 years (66.7 %) and 90–99 years (33.3 %), at a depth of the seismic process of more than 40 km – at the age of 70–79 years (66.7 %) and 60–69 years (33.3 %) (Table 1).

Table 1

**The relationship between the depth of the seismic process, sex and cause of death**

| | | | Depth of the seismic process | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | None | <= 10 km | 11–20 km | 21–30 km | 31–40 km | > 40 km |
| Sex | Men | Abs | 46 | 6 | 4 | 1 | 1 | 3 |
| | | % | 62.2 % | 60.0 % | 57.1 % | 50.0 % | 33.3 % | 100.0 % |
| | Women | Abs | 28 | 4 | 3 | 1 | 2 | 0 |
| | | % | 37.8 % | 40.0 % | 42.9 % | 50.0 % | 66.7 % | 0.0 % |
| Causes of death | Hypertensive crisis | Abs | 38 | 8 | 2 | 0 | 2 | 1 |
| | | % | 51.4 % | 80.0 % | 28.6 % | 0.0 % | 66.7 % | 33.3 % |
| | Acute cerebrovascular accident | Abs | 13 | 0 | 3 | 1 | 0 | 2 |
| | | % | 17.6 % | 0.0 % | 42.9 % | 50.0 % | 0.0 % | 66.7 % |
| | Acute coronary syndrome | Abs | 17 | 2 | 1 | 0 | 1 | 0 |
| | | % | 23.0 % | 20.0 % | 14.3 % | 0.0 % | 33.3 % | 0.0 % |
| | Heart failure | Abs | 6 | 0 | 1 | 1 | 0 | 0 |
| | | % | 8.1 % | 0.0 % | 14.3 % | 50.0 % | 0.0 % | 0.0 % |
| Age | 0–9 | Abs | 0 | 0 | 0 | 0 | 0 | 0 |
| | | % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 10–19 | Abs | 0 | 0 | 0 | 0 | 0 | 0 |
| | | % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 20–29 | Abs | 0 | 0 | 0 | 0 | 0 | 0 |
| | | % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 30–39 | Abs | 1 | 0 | 0 | 0 | 0 | 0 |
| | | % | 1.4 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 40–49 | Abs | 3 | 0 | 0 | 0 | 0 | 0 |
| | | % | 4.1 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 50–59 | Abs | 10 | 4 | 1 | 1 | 0 | 0 |
| | | % | 13.5 % | 40.0 % | 14.3 % | 50.0 % | 0.0 % | 0.0 % |
| | 60–69 | Abs | 13 | 1 | 1 | 1 | 0 | 1 |
| | | % | 17.6 % | 10.0 % | 14.3 % | 50.0 % | 0.0 % | 33.3 % |
| | 70–79 | Abs | 29 | 1 | 5 | 0 | 2 | 2 |
| | | % | 39.2 % | 10.0 % | 71.4 % | 0.0 % | 66.7 % | 66.7 % |
| | 80–89 | Abs | 17 | 3 | 0 | 0 | 0 | 0 |
| | | % | 23.0 % | 30.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % |
| | 90–99 | Abs | 1 | 1 | 0 | 0 | 1 | 0 |
| | | % | 1.4 % | 10.0 % | 0.0 % | 0.0 % | 33.3 % | 0.0 % |

Among the patients who died at the magnitude of 1.1–2.0 ml, 55.0 % were men and 45.0 % were women. When studying the influence of magnitude on the causes of death during earthquakes, it was determined that at the magnitude of 1.1–2.0 ml 50.0 % died from a hypertensive crisis, from acute cerebrovascular accident – 20.0 %, from acute coronary syndrome – 20.0 % and from acute heart failure – 10.0 %. Further, at the magnitude of 2.1–3.0 ml: 60.0 % died from a hypertensive crisis and 40.0 % from acute cerebrovascular accident.

In a comparative analysis of the magnitude of earthquakes and the age of the patients, it turned out that deaths were at the magnitude of 1.1–2.0 ml at the age of 70–79 years – 40.0 %, 50–59 years – 25.0 %, 60–69 years and 80–89 years – 15.0 %. At the magnitude of 2.1–3.0 was at the age of 70–79 years – 40.0 %, 50–59 years and 60–69 years – 20.0 %.

When analyzing the state of the average value of the magnetic field in 2013, in was determined that the average standards were not exceeded, the results were in the range of 49141–49232 T. Deaths among the male population were in the range of 49200.8T, and among the female 49202.9T. Deaths from a hypertensive crisis corresponded to a magnitude of 49198.1 T, from acute cerebrovascular accident – corresponded to 49206.4 T, from acute coronary syndrome – 49206.3 T, and from acute heart failure – 49200.4 T.

Our study revealed exacerbation of CVD in patient, depending on characteristics of earthquakes in Shirvan region of Azerbaijan. The largest number of death was noted in our patients from hypertensive crisis. The different results we found in Aoki T, et al and Nakamura A, et al works. The authors revealed that the most common cause of in-hospital mortality which increased after the Great East Japan Earthquake (2011) was heart failure [2, 11].

The results we obtained showed that increase of death rate occurred in short time after earthquake. According to Huang K, et al, evaluation of 19,083 hospitalizations after the 2008 Sichuan earthquake revealed a significantly lower (27.81 %, $P<0.001$) number and cost (32.53 %, $P<0.001$) of hospitalizations of patients related to ischemic heart disease, in the 60 days after the earthquake, but in the 5 years after the earthquake, the age-adjusted annual incidence of hospitalization increased significantly ($P<0.001$) [7].

Some researchers, in addition to the relationships we studied, pointed to the influence of additional factors, in particular, the time of the earthquake. So, comparing the earthquake in Loma Prieta (1989), which occurred at 17:04, and another earthquake in Los Angeles (1994), which occurred at 4:31 am, the authors found an increase in the frequency of acute myocardial infarction (AMI) by 110 % in the second case. They believed that the reason for this is an additional stress factor. But in this study the dependence of CVD mortality on age, magnitude of earthquake and other important factors was not studied [3].

In our study we also evaluated impact of magnitude on death cases number, and according to our results maximum was in low magnitude (1.1–2.0 ml). But the population-based study (2010–2011) of Tanaka F. et al. suggests that the increase in AMI events after a major earthquake varies depending on the seismic scale of the initial shock and each aftershock. The authors revealed that incidence of AMI was positively correlated with the seismic scale of the earthquake ($r=0.75$, $P<0.01$) [13]. Our results were opposite, and we supposed that it might be related to effect of age, nosological features (the greatest percentage in our study was from heart failure 46.3 %)

## Conclusions

1. Among both men and women, the largest percentage of patients died from a hypertensive crisis (47.5 % and 57.9 %, respectively).

2. Deaths among the male population were in the range of magnetic field 49200.8T, and among the female – in the range of 49202.9T.

3. Depending on the depth of earthquakes, the maximum number of deaths was at the process depth less than 10 km (10.1 %)

Thus, the study of the seismological activity in different geographical areas makes it possible to assess environmental and emergency situations with a high probability and to provide for preventive measures.

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# RESEARCH ON THE RELATIONSHIP BETWEEN THE SEVERITY OF THE COURSE OF PSORIASIS AND METABOLIC SYNDROME AND THE LEVEL OF INDICATORS OF SYSTEMIC INFLAMMATION

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In patients with moderate psoriasis with concomitant metabolic syndrome, the indicators of general clinical and biochemical blood tests and carbohydrate and lipid metabolism were determined, and indicators of systemic inflammation were assessed by the level of susceptible C-reactive protein, ceruloplasmin, interleukin-6 and tumor necrosis factor-α. A laboratory study found that in patients with moderate psoriasis with concomitant metabolic syndrome, an important role is played by the systemic inflammatory process, which is accompanied by the development of insulin resistance, impaired lipid and nitrogen metabolism, and regulation of vascular tone. Furthermore, an increase in the intensity of systemic inflammation is accompanied by an increase in skin lesions, an increase in systolic blood pressure, and a violation of lipid and carbohydrate metabolism.

**Key words:** psoriasis, metabolic syndrome, systemic inflammation, dyslipidemia, insulin resistance

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# ДОСЛІДЖЕННЯ ЗАЛЕЖНОСТІ ТЯЖКОСТІ ПЕРЕБІГУ ПСОРІАЗУ ТА МЕТАБОЛІЧНОГО СИНДРОМУ ВІД РІВНЯ ПОКАЗНИКІВ СИСТЕМНОГО ЗАПАЛЕННЯ

У хворих на псоріаз середнього ступеня тяжкості з супутнім метаболічним синдромом визначали показники загальноклінічного та біохімічного аналізів крові та вуглеводно-ліпідного обміну, а також показники системного запалення – за рівнем чутливого С-реактивного білка, церулоплазміну, інтерлейкіну-6 та фактор некрозу пухлини-α. Лабораторним дослідженням встановлено, що у хворих на псоріаз середньої тяжкості з супутнім метаболічним синдромом важливу роль відіграє системний запальний процес, який супроводжується розвитком інсулінорезистентності, порушенням ліпідного та азотистого обміну, регуляції тонусу судин. Крім того, збільшення інтенсивності системного запалення супроводжується збільшенням ураження шкіри, підвищенням систолічного артеріального тиску, порушенням ліпідного та вуглеводного обміну.

**Ключові слова:** псоріаз, метаболічний синдром, системне запалення, дисліпідемія, інсулінорезистентність

*The study is a fragment of the research project "Development of improved methods of diagnosis and complex treatment of chronic dermatoses and infections, which are mainly sexually transmitted, taking into account the determination of additional factors significant in the pathogenesis of these diseases", state registration No. 0117U000272.*

Psoriasis is a common chronic dermatosis often combined with metabolic syndrome (MS). According to several authors, the prevalence of combined pathology in the population is from 30 % to 50 %, while the majority of psoriasis is from 2 % to 4 %, and MS is from 15 % to 24 % [10]. There is no doubt about common risk factors (RF), genetic, etiological, and pathogenetic mechanisms in developing these diseases [2, 8, 11]. In recent years, there has been an increase in the incidence of dermatosis combined with MS and the number of severe, atypical, disabling, resistant to therapy forms of the disease [10, 14]. The disease significantly worsens the quality of life. It reduces the work capacity and social activity of patients, which determines the medical and social significance of the problem.