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B. Z. Belashev, **C. N. Kolomeichuk** (Petrozavodsk. Institute of Geology and Institute of Biology, Federal Research Centre, Karelian Research Centre, RAS)**. Experience in analysing calls for emergency medical service in Petrozavodsk for people with cardiovascular diseases.**

Cardiovascular diseases are one of the main reasons for human death in developed countries. There is a hypothesis about the relationship of pathologies of this type with magnetic storms and air pollution. The mechanisms of such influence are not yet well-understood and the results of relevant studies are often contradictory [1].

The goal of the present study is to construct a cardiovascular disease profile for residents of Petrozavodsk and to estimate the effect of magnetic storms and motor vehicles on the activation of cardiovascular disease pathology.

Petrozavodsk is located in an auroral latitude zone with frequent magnetic field variations. There is a heavy traffic on work-days at rush hours in the city. Motor vehicles, staying in jams, emit CO2, nitrogen and lead oxides and benzaperene into the atmosphere.

Data on magnetic variations, recorded by a GI MTS1 complex at Petrozavodsk Geophysical Observatory, PetrGU, the geomagnetic activity index, Kp, shown on-line at FIAN's Tesis web-site, the impersonificated database on emergency medical service calls at BSMP in Petrozavodsk from 1.08.2015 to 30.11.2016 and the archives of the Republican Clinical Hospital and the Emergency Medical Service Station in Petrozavodsk in 2009–2013, were used.

Call distribution was assessed using a MATLAB software package. The diseases diagnosed covered by our study are hypertension, stenocardia, chronical cardial ischemia, myocardial infarction, thromboembolism, myocardite, cardiomyopathy, insult and sudden cardial death according to the international diseases classification.

As a result of the data analysis essential hypertension (67%), stenocardia (8.2%) and chronical cardial ischemia (10.69%) make up over half of all calls for emergency medical service caused by cardiovascular diseases. Daily trends for individual emergency medical service calls show that seasonal factors affect the frequency of occurrence of essential hypertension, stenocardia and cardial ischemia. A period component of 28.4 days, similar to the Sun rotation period, was revealed in the time course spectrum for the number of emergency calls made by people diagnosed with hypertension. Most spectra display 3, 4 and 6 daily, weekly and half-weekly cycles. 3 and 6 daily cycles are associated with thyroid gland hormone activity and daily cycle 4 with glucorticocorticoid hormones that catalyze metabolic processes. Circumweekly cycles are considered either as common or as being invoked by people who do not wish to call for a doctor and stay in hospital on days-off.

A low values in the age histogram near the age of 73–75, and 85 for patients diagnosed with myocardial infarction is assumed to be due to a decline in population and birth rate during the early 1930 s hunger and the Great Patriotic War. Calls due to the above diagnoses are made at 10–11 a. m, and 2–3 p. m and 7 p. m. on work-days. They could be caused by the emission of CO2 by motor vehicles at rush hours 8–9 a.m., 1–2 p. m. and 6 p. m. and

a one-hour delay due to the development of the disease and calling for emergency medical service. There are no traffic peaks in the hourly distribution of the number of calls on days-off and on holidays.

Estimation of the correlation coefficient of mean values using the daily values of the geomagnetic activity index, Kp, and the number of emergency calls, caused by myocardial infarction, and checking its significance show that these values are not correlated. More detailed processing comprised the use of an algorithm to identify k-mean values of 5 clusters for the mean daily values of the geomagnetic activity index Kp, and the construction of the distribution of the number of emergency calls caused by myocardial infarction for each cluster with a shift relative to the time of events in the cluster. The number of calls, caused by myocardial infarction, for common geomagnetic indices is minimum and does not depend on time shift. Deviations from them increase the number of emergency calls. This fact accounts for the absence of a linear correlation. The maximum number of emergency calls is recorded one day after a magnetic storm. This conclusion is confirmed by the data of foreign authors.

The algorithms developed for analyzing calls for emergency medical service and relevant software were used to construct a cardiovascular disease profile for Petrozavodsk, to obtain disease spectra showing cyclicity and gender differences and to confirm the influence of geomagnetic activity and motor vehicle emissions on cardiovascular diseases. To make the results of our pilot study more reliable, an emergency call database, covering a longer period of time, is needed.

REFERENCES

1. *Chereshnev V. A.*, *Gamburtsev A. G.*, *Sigachyev A. V.*, *Verkhoturova L. F.*, *Gorbatenko E. V.*, *Gamburtseva N. G.* External Influences–Stresses–Morbidity. Moscow: Nauka, 2016, 168 p. (In Russian.)