

Spatial Patterns of Excess Mortality Related to 2010 Heatwave in European Russia

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2010 Heat Wave Excess Mortality in Cities and Regions of European Russia

Human-induced global warming has led to a substantial increase in heatwaves severity, which have a significant impact on population health including a rise in mortality and morbidity. The early years of the twenty-first century have seen numerous extreme heatwaves producing large societal impacts. For instance, the quasi-stationary anticyclone over western Russia together with resulted in a record-scale heatwave in summer of 2010. The current study aims to assess the excess mortality related to this extreme event and to explore its geographical patterns.

The current study deals with the urban and rural populations of 54 regions as well as 126 big cities (with over 100,000 inhabitants) of European (western) Russia. Micro-level mortality data and age- and sex-specific mid-year population were obtained from the Federal State Statistics Service (Rosstat) and Russian Fertility and Mortality Database. Excess mortality was calculated as the absolute difference between observed (O) and expected (E) ASDRs (and deaths) based on 2006-2009 empirical data. It was deliberately estimated for the period from 27 to 33 weeks of 2010 (05.07 – 22.08) – the period of a heatwave for the majority of locations.

Total number of excess deaths during the heatwave amounted to 57,700. At the regional level, the largest excess mortality increase was observed in the Middle Volga and Central Black Earth regions as well as in Moscow and Moscow *oblast*. Spatial association analysis revealed high excess mortality cluster extending from Voronezh and Kursk *oblasts* to Chuvashia and Mari El republics. Excess mortality also differed by the city size. SDR increase in cities with population exceeding 500,000 was in general much more significant. The highest excess occurred in Saratov, Lipetsk, Ryazan, Kamyshin (Volgograd *oblast*), etc.

The greatest mortality excess was observed in the area of blocking high extent, where temperature extremes were the highest. Moreover, the overwhelming majority of deaths was concentrated at 30-32 weeks, when most absolute temperature records were broken. Weekly

mortality fluctuations were more pronounced in larger cities, which may be partially attributed to “urban heat island” effects.

An attempt was also made to identify temporal effects. Lags between peak temperatures and mortality rates were not observable on the scope of weeks, therefore, it is required to consider daily death counts for further study of lag effects. Harvesting was found in numerous cities (Saratov, Tolyatti, Cheboksary, etc.) severely affected by heat wave, however, in the scope of several weeks compensatory mortality decrease was not reliable in most cities.