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Climate Related Mortality Changes in Latvia, 1996–2008

Klimata ietekmes uz mirstību Latvijā 1996–2008

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Climate change is increasingly recognized as a threat to the survival of human beings because it could cause a serious increase in the occurrence of diseases, moreover, direct influences of climate extremes may also be of importance. To assess the direct impact of climatic events on human health, we have investigated mortality in Latvia from 1996 through 2008, analysing the data and their correlation to the climatic variables.

Key words: *climate change, Latvia, mortality, temperature, atmospheric pressure*

Introduction

Over the past decades there has been a renewed interest in the connection between climate and health, largely due to the potential impacts of climate change on health (Epstein 2002; Haines and Patz 2004; Patz and Kovats 2002). It is expected that climatic changes associated with global warming will have a serious impact on human beings (Kalkstein and Smoyer 1993). Among the potential direct risks that global warming presents to human health is the increase of heat-related deaths during intermittent hot weather, as predicted by WHO. An increase in mortality related to heat waves has been reported from various industrialized countries (Dessai 2002; Diaz *et al*. 2006). However, much remains unknown about the links between climate and a variety of health outcomes. This is of concern as climate change health impact assessments need to be based on plausible and well-established climate and health impact links, which could also be applied to health forecasting (Thomson *et al*. 2004).

The studies of the impacts of the so-called "heat waves" – periods when the temperature has reached extremely high values for a long lasting period – have been comparatively intensive (Diaz *et al*. 2006). Most of such studies have been carried

out in regions where the regular temperature is characterized by comparatively high temperatures, especially during summertime, but there are few studies where heat waves have had an identified impact in more temperate climatic conditions. Amongst the main climatic factors of concern, temperature and its variability, air pressure, and the amount of atmospheric precipitation can be considered. The changing human mortality can be influenced not only by positive temperature anomalies (heat waves), but also by negative anomalies, because extremely cold weather is a risk factor for acute complications of ischaemic heart disease (e.g., myocardial heart attack and cardiac arrhythmia). Year-to-year variations of the level of mortality may be partly determined by inter-annual variations in winter climate.

Considering this, the aim of the study is to analyse causations between climate indicators and mortality regionally – in Latvia.

Materials and Methods

Daily data on all-cause (total) mortality in the whole territory of Latvia and separately in seven cities – Rīga, Ventspils, Liepāja, Saldus, Dobele, Daugavpils and Alūksne – were obtained from the State Agency of Health Statistics and Medical Technologies over the period 1996–2008. All medical certificates of death were compiled by medical professionals (in the majority of cases by general practitioners, but also by specialists in pathology or in forensic medicine). Excess daily mortality or relative mortality was established by calculating deviations of the observed number of deaths from the expected number of deaths for each day of the examined period.

Daily climate data were provided by seven meteorological observation stations in Rīga, Ventspils, Liepāja, Saldus, Dobele, Daugavpils and Alūksne for the period under study. Variables included the maximum, the minimum and the average temperatures and atmospheric pressure recorded by the weather stations. For the analysis of climate related mortality changes in the capital city Rīga, the data from the Rīga-University meteorological observation station, which is located in the centre of the city, were used.

Results and Discussions

Overall mortality in Latvia is comparatively high, especially in comparison with the low mortality levels in the EU countries, probably this could be due to reasons related to the heritage of the socialistic regime and regime transformation processes in the society (excess of forcible deaths of young adults, high prevalence of unhealthy lifestyle in society, the low accessibility of medical services). However, meteorological processes also have a definite impact on human mortality, first to mention the impacts of atmospheric pressure (Fig. 1).

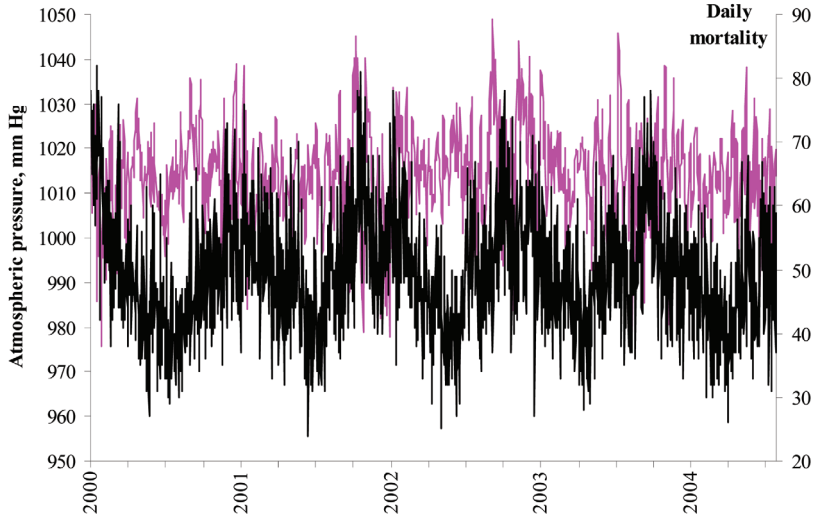

Fig. 1. **Daily mortality in absolute figures (—— overall in Latvia) and daily atmospheric pressure (— in Rīga).**

On the other hand, there is no significant correlation between atmospheric pressure and mortality (Fig. 2). It can also be found in literature (Ballaster *et al*. 2003; Jehn *et al*. 2002) that not so much the absolute value of atmospheric pressure, but just its changes, especially the type of dynamics in time, can be considered the most important determinant (risk factor) for mortality.

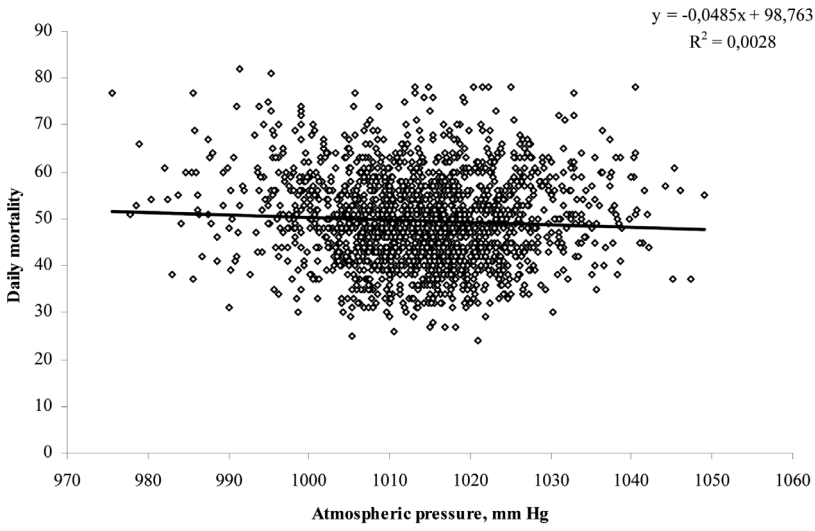

Fig. 2. **Correlation between daily mortality (in absolute figures) in Latvia and atmospheric pressure.**

The changes of air temperature can also be related to changes in human mortality (Fig. 3). In the conditions of climate change there has been an increase of the mean temperatures, which can induce considerable changes in the severity of extreme events. Such changes are likely to influence ecosystems and society severely, moreover, the impacts are larger when extreme weather conditions prevail over extended periods, for example, in the case of heat waves. The mean annual number of deaths caused by heat waves is much higher than that for any other extreme weather event (Kysely, 2002).

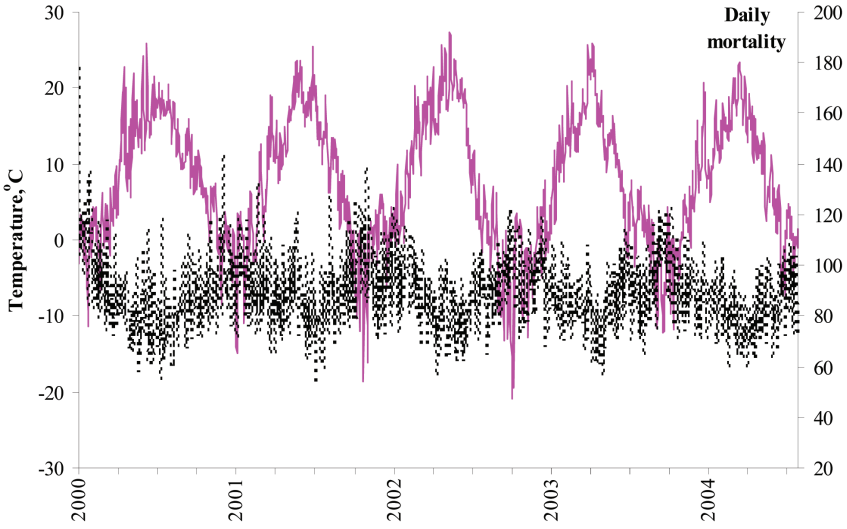

Fig. 3. **Daily mortality in absolute figures (── overall in Latvia) and the average daily temperature (── in Rīga)**

The correlation between the daily mean air temperature and mortality in Rīga (Fig. 4), in the same manner as in Latvia overall (Fig. 5), shows a negative tendency – increasing values of air temperature, induce a decrease in the relative mortality. Unless the correlation between average temperature and mortality is insignificant, the overall trend of their relation is evident, indicating an increased mortality in wintertime – as it has also been found in other countries of central and northern Europe (Lloyd 1991; Keatinge *et al*. 1997; Healy 2003; Mercer 2003). Considering that the period of observations for the study is comparatively short, possibly that is the reason why no stable general trends were observed. A tendency of such a character can be observed, because in the middle latitudes the mortality overall is greater during the wintertime, while people spend most of their time inside, where are subjected to the risk of infectious diseases. During summer the mortality is increased in the conditions of extremely hot, moist and calm weather, especially in the regions where hot weather is not common (Conti et al., 2005).

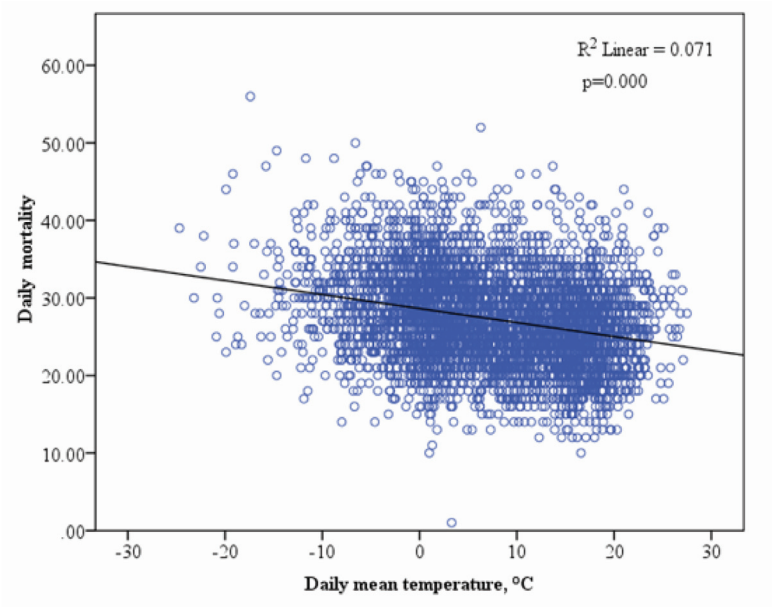

Fig. 4. **Relation between daily mortality in absolute figures and mean daily temperature in Riga for the period 1996–2008**

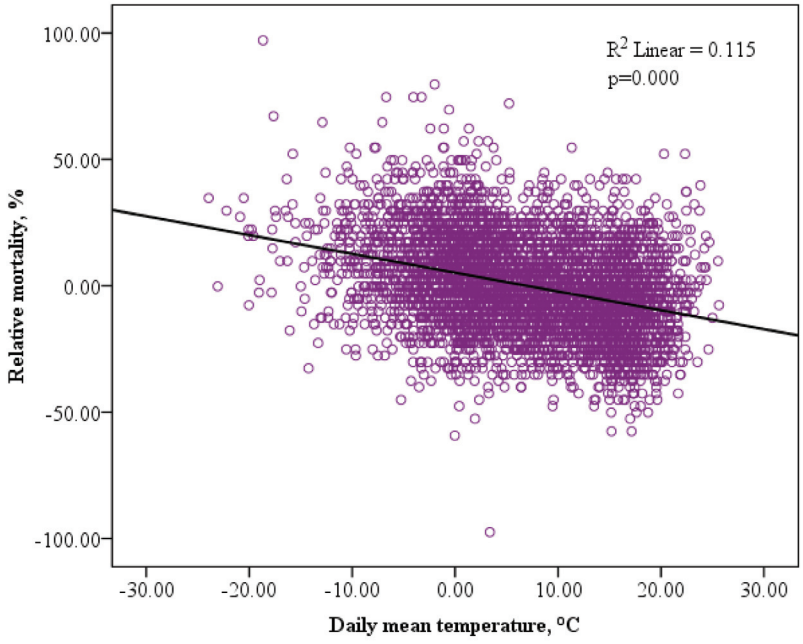

Fig. 5. **Relation between relative mortality (% above/below monthly mean) and mean daily temperature in Riga, Dobele, Alūksne, Saldus, Daugavpils, Ventspils and Liepāja for the period 1996–2008**

In Figure 6 one can see that relative mortality is inversely proportional to monthly mean temperatures – during months with a lower mean air temperature the relative mortality is exceeding the mean mortality of the period.

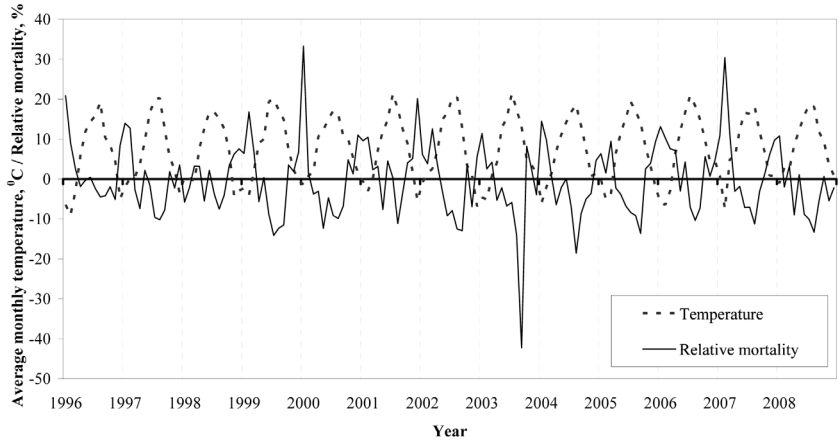

Fig. 6. **Consecutive data for average monthly temperature and relative mortality (% above/below 1996–2008 mean) in Riga for the period 1996–2008**

The relative mortality is dependent on the values of the air temperature and is subjected to changes caused by the annual cycle of air temperature, wherewith it is important to determine the character of the annual cycle of relative mortality. Figure 7 shows the trends of the relative mortality and its deviations from the monthly mean: the relative mortality is below the mean mortality of the period during the warmest months of the year. In general there is a well-expressed minimum of mortality during August and a maximum during the coldest months of the year – January, February and December. Such characteristics of the annual cycle of mortality have been observed also in the studies brought out elsewhere in Europe (Lerchl, 1998).

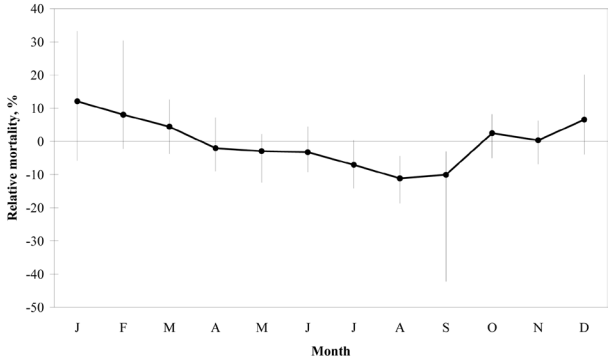

Fig. 7. **Trends of relative mortality (% above/below 1996–2008 mean) and its deviations from the monthly mean in Riga for the period 1996–2008**

As it can be seen in Figure 5, the increased incidence of mortality can be associated with the increasing temperature. Unless the temperature increases observed in the study period are far from the observed increases in the cases of warmer temperature, it is possible to identify increased mortality.

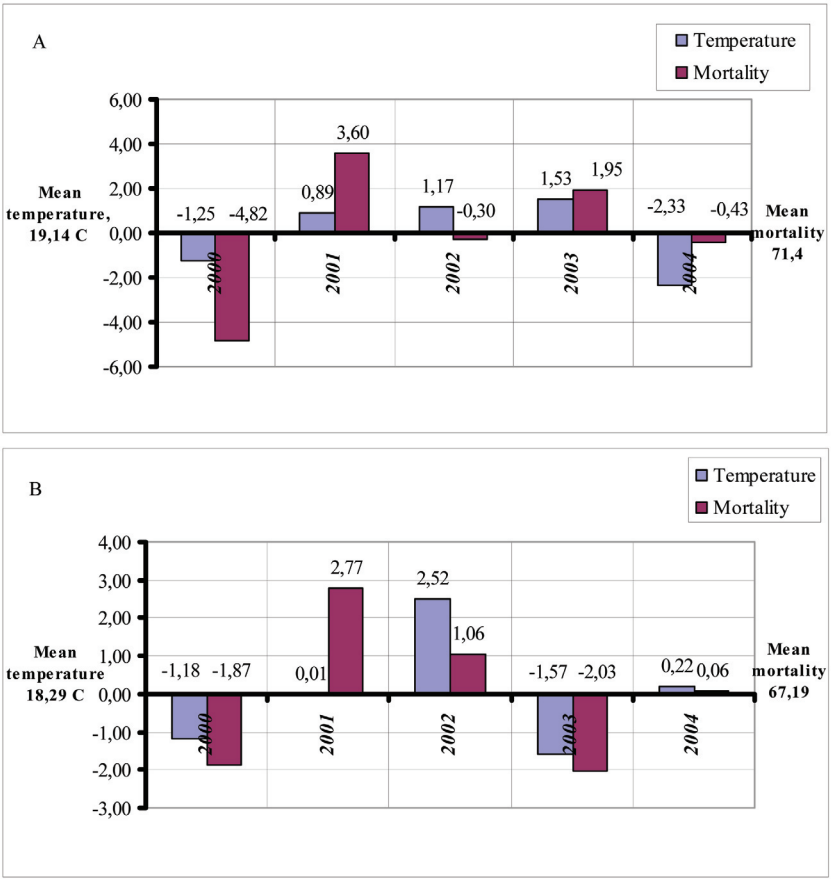

Fig. 8. **Changes of temperature and mortality in July (A) and August (B) with respect to the mean values of temperature (1960–1990) and mortality (2000–2004)**

Even though this study shows that in Latvia, in the same manner as in other countries of the world, mortality is higher during the cold seasons of the year, in particular cases extremely hot weather can also cause excess mortality during summer. However, such cases of extremely hot weather during the period of investigation have been too few to make unambiguous conclusions about their impact on the mortality. Though taking in concern the warming tendencies in Latvia and assuming that the increase in both summer and winter temperatures is going to continue, it is possible that in the future we are going to observe a decrease in mortality associated with extremely cold weather, but an increase in heat-related mortality.

Conclusions

Climatic factors can significantly influence human health conditions and, consequently, human mortality. Although the increased temperature events during summertime can be associated with increased mortality, it is much less important than the impacts on human health during the cold season of the year.

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