Climate impacts on mortality in pre-industrial Sweden

T.T. Chen, R- Edvinsson, K. Modig, H.W. Linderholm, F. C Ljungqvist

Recommendation: To be published after some changes.

1.- Introduction

It includes an excellent review of the literature. I suggest to add some information from the public health point of view, including a description of the annual cycle of mortality rate whose maximum should coincide with the coldest months of the year. I found an article that claims that for cohorts born in 1800 the risk of dying during the winter season was almost twice that of dying during summer (Ledberg, 2020)

2.- Material and methods

I suggest to indicate the sizes of the three age groups: 0-14 years, 15-64 years, over 65 years.

It is not clear the purpose of including Fig. 1 showing the seasonal histograms of the Uppsala temperature record. As this information is not used later on in the analysis, I suggest to eliminate it.

In line 145 the study period is defined as 1750 – 1859. However in other parts of the text is mentioned as 1749 - 1859 (lines 6, 95, 111, 135, 138, 158, figure caption of Fig. 1)

It is a general consensus that in temperate climates mortality rate is highest during winter, let say from November to March. Then, as the data for mortality rate is only available on an annual basis, the causes for an anomalously high value of mortality for a certain year can be attributed to anomalously cold weather either at the beginning of the year (January – February), at the end of the year (November – December) or both at the beginning or at the end of the year. This difficulty for the interpretation of the results is not mentioned when presenting the available data.

3. Results

The correlation technique is generally used to test an hypothesis for a relationship between two variables. What it would be the hypothesis for a relationship between the mean regional temperature for a single month and the annual rate of mortality that are behind the correlations presented in Tables 1, 2, 3, 4, A1 and A2 ? Is it plausible to consider that mean temperature during a single month will have an impact on the annual rate of mortality ? This question if particularly valid for months at the end of the year, considering that to a large extent the mortality rate is determined by the deaths that occurred during the previous months.

I suggest to use a more precise language when extracting conclusions from correlations relatively low in magnitude, although statistically significant. For example, from correlations presented in Table 1 it is mentioned in line 190 “Colder winters and springs were associated with higher mortality and vice versa”. In fact, the correlations of the order of -0.3 explain only 9% of the mortality variance. A scatter diagram (which is not presented) would illustrate the weakness of the

link among the two variables. Later on in the text it is shown that the relatively low magnitude of the correlations derives from the fact that the relationship between temperature and mortality rate during winter and spring does not persist during the entire study period, due to geographical changes in its intensity (see Fig. 7).

I suggest to eliminate the discussion about the relationship between the rate of mortality and the PDSI index. Correlations presented in Table A2 are mostly not statistically significant and explain at most 4% of the variance of mortality. Furthermore, it is mentioned in line 151 – 152 that precipitation measurements can be considered unreliable prior to the late 19th century in Sweden. Regarding this, in the discussion section there is another example of a statement that overrates the results that were obtained. Line 307: "While our findings demonstrate the influence of a wet autumn on mortality in both western and eastern Sweden…". This statement is not supported by the results presented in Table A2, showing very low and mostly not statistically significant correlations between mortality and PDSI data for March, April and May. As in the case of temperature, it is possible that the positive correlations are stronger for certain periods, but this analysis was not performed.

4.- Discussion

There are several references to results showing the impact of winter and spring temperature on mortality (i.e. lines 255, 270, 282, 293). However, surprisingly, most of the correlations shown in Tables 1 – 4, A1 and A2 for December, January and February are not statistically significant. It is more correct to indicate that the results reveal some impact of low temperature on mortality during late winter and spring. Same objection is valid for statements in the Abstract and in the Conclusions.

5.- Conclusions

Lines 367 – 369: "… we found that the southern -most regions experienced the greatest impact of temperature on mortality during the same year. Conversely, central Sweden exhibited the strongest temperature effect on mortality in the following year"

Comment: In my opinion this conclusion does not summarize in an adequate way the results presented in Fig. 7. This figure shows significant geographical changes of these impacts during the study period. Thus, in the eastern – central part of the country anomalously low temperature during FMA tended to be associated with above average mortality rate in the period 1805-1859, but not in the period before. Do the author have and hypothesis for this ?. On the other hand, while during the period 1750 – 1804 relatively large mortality rate tended to prevail in the whole region the year following an anomalously cold FMA, this relationship was restricted to the central-eastern portion of the country afterward. Do the authors consider that improved food and nutrition security did not reach that part of the country during that period (1804 – 1859) ?

Lines 371 . 372: "Among adults, colder conditions in April had the most adverse effect on mortality both for the same year and the following year"

Comments: I question this statement referring to the impact of temperature during a single month, considering that Table 3 shows correlations similar in magnitude to that in April for the periods February – April, March – April and March April and May.

Reference

Ledberg, A., 2020. A large decrease in the magnitude of seasonal fluctuactions in mortality explains part of the increase in longevity in Sweden during the 20th century.