Reviewer's report

Title: On the effects of heat-intensity and heat-duration in time series models of temperature-related mortality

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Reviewer: Daniela D'Ippoliti

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The Authors address the issue of which is the most appropriate methodological approach to interpret and estimate the extra heat wave effects, as additional excess mortality related to duration and intensity, beyond the effects captured with models of overall temperature-related mortality. The authors argue that additional risks are related to cumulative heat stress and susceptible factors in vulnerable populations.

Several recent studies have tackled this topic, but the question still remains not definitively clarified even if it is very important in terms of public health impact and measures.

The authors state that more flexible parameterizations of temperature-mortality association (e.g. distributed lag non-linear models) are not completely suitable to assess the relationship between heat waves and mortality, because these models estimate the delayed lag effects of temperatures for different days but are not able to estimate the cumulative heat effects of prolonged periods being consecutive days assumed to be independent.

The authors propose a different approach where the additional heat wave effect is measured by an indicator variable for duration included in the DLNL Models that can be interpreted as interactions between different lags of temperature and consequently as effect-modification of cumulative heat stress.

The aim of the study is important, well-posed and clearly argued in the background, however the sections of methods and results should be reviewed in depth doing a substantial work.

In the Methods section they have to clearly explain, using formulas, how the indicator variable for duration is constructed, why it represents an interaction term between different lags of temperature and why its coefficient can be interpreted as effect-modification of cumulative heat periods.

The Results section is very difficult to read. For those who are not familiar with this type of analysis is extremely arduous to compare and interpret models results, especially when they have to be derived from figures.

As major issue, the most significant limitation is that the main results refer to an application of the models 2 and 3 on a single heat wave with a duration of 5 days and this is no guarantee that results can be generalized to any lasting heat
waves.

To state that Models 2 and 3 are the best considering only the AIC values is an oversimplification, and make an exercise in estimation for a single heat wave lasting 5 days doesn’t give no strength to the conclusions of the Authors.

In addition, because the authors believe that the issue of distinguishing between the effect of temperature and heat waves is especially important in relation to groups of susceptible population, it may be very important to verify whether the same results are obtained in a subset of population identified as susceptible (e.g. elderly or children).

Further, in table 2 are reported only the estimates of the added effects relating to heat wave duration (models 2 and 3), while for a correct comparison it is also important to know the effect estimates of temperature obtained with the model without the variable for heat wave (model 1). This is especially important to evaluate just the effect-modification that the authors want to highlight with models 2 and 3. The effect-modification can also be supported with a specific test.

In conclusion, as the results are presented, they are not strong enough to convince that models proposed are preferable to those with more complex parameterizations and therefore they don’t fully meet the objectives of the study.

As minor issue, it may be useful a table that describes the dataset used, especially in terms of the study population (all ages? ..) and, more importantly, temperature distribution and number of heat wave days. Finally, also in the Abstract aims, background and methods are very confused.

As results of all these considerations, the present paper can be reconsidered for publication only after a depth review that fully embraces all the issues highlighted.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I declare to have no competing interests