The effect of climate and weather on postneonatal mortality, northern Sweden 1861–1950 (extended abstract)

Göran Broström and Tommy Bengtsson

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1 Background and motivation

Why does mortality increase at low temperatures? It depends on several things. On the one hand, many viruses multiply faster at lower temperatures when the humidity is low. Our defence against diseases weakens at low temperatures. Newborns are particularly vulnerable to low body temperature, hypothermia. Low temperatures also mean that we spend more time indoors and the longer the duration of exposure the higher the risk of infection. We may not heat the entire home but only a part, which was common in northern Sweden historically, which increases crowding and the dose of viruses received and the higher the dose and the longer the exposure, the higher fatality rate. This means that low temperatures increase the spread of airborne diseases both directly, through humidity, and indirectly, through crowding and longer exposure.

A first question is thus how outdoor temperature affects mortality, that is, whether it follows the expected relationship with high mortality during cold periods and low during the warm season. What form does the connection take? Do subsequent periods of low or high temperature have additional effects? How long does it take for deaths to occur, and does it differ with age? The fact that the risk of death after the first month of life generally decreases at the same rate as weight increases should mean that susceptibility to developing temperature-dependent diseases also decreases.

A second question is whether the relationship differs between socio-economic groups, either according to their nutritional status or their ability to heat their homes. Those who are more affluent should at least have the resources to cope with normally cold winters even if they do not have the resources to cope with extreme conditions. The question is where the line between the well-off and the others lies. For example, do the higher classes have sufficient resources to heat their homes even in very cold winters?

Two recent papers (Junkka et al., 2021; Karlsson et al., 2021)studied neonatal mortality and temperature variations in the same geographical area as we do during the years 1880-–1950. They found declining effects of low temperatures on neonatal mortality in Västerbotten 1880-–1929 to increase again until 1950. They also found a minor upswing in mortality during the warm season.

In the present study, the role of climate for *postneonatal* (mostly exogeneous) mortality, combining time series data on temperature and longitudinal individual level data, is studied. Of special interest is to find how the connection varies over subsets of the population, for instance social classes, rural/urban areas, and time periods.

2 Data

We have two sources of data which we combine into one data set suitable for our purpose. The first is demographic data obtained from the *Centre for Demographic and Ageing Research* (CEDAR,

https://cedar.umu.se), the second is daily temperature measurements obtained from the *Swedish Meteorological and Hydrological Institute* (SMHI, https://www.smhi.se).

Individual data with all births, surviving the neonatal period (28 days), between 1 January 1862 and 31 December 1950 in one coastal (Skellefteå) and two inland (Inland, Mountain) areas of Västerbotten in northern Sweden are included. The coastal region around Umeå is also included but data registration starts at 1 January 1895 there. The infants were followed until death or age one year, whichever came first.

The usual *static* characteristics were observed on each child aged 28 days, *birthdate*, *sex*, *Hisclass4*, *region*, etc.

Some basic statistics about postneonatal mortality are shown in figures. Mortality rates are calculated as *occurrence/exposure rates*.

From 1900 onwards, the four areas we study face a rapid decline in postneonatal mortality.

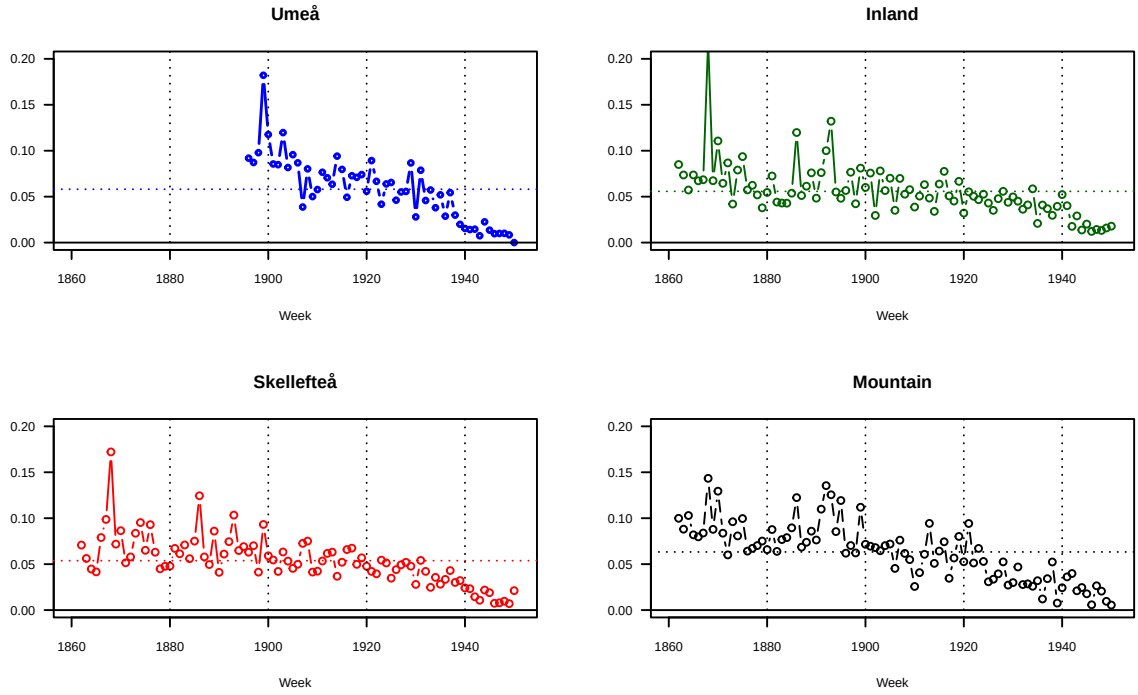

Figure 1: Crude postneonatal mortality by year and region, Västerbotten 1861–1950.

2.1 Temperature

Temperature data are collected from three weather stations, *Umeå*, *Bjuröklubb* (used with population data from Skellefteå coastal area), and *Stensele* (Inland and Mountain). All stations deliver daily temperature data covering our time period, usually three measures per day, morning, noon, and evening. The Umeå station is situated about 20 km from the coast, while the Bjuröklubb station is at the shore of the sea.

Weekly averages are calculated by week and year, and deviations from the averages of the weekly averages are used as time-varying *communal covariates*.

2.2 Temperature as communal covariates

The two data sets, mortality and weather, are combined into one by treating temperature data as a *communal*, time-varying covariate and incorporating it as such in the mortality data set.

3 Results

3.1 Pure effect of temperature on postneonatal mortality

The temperature variables are aggregated over lags 1-4 weeks (*temp1*) and over lags 5-8 weeks (*temp2*) Further, these averages are aggregated over five-degrees-lengths intervals centered at $0, \pm 5, \pm 10, \ldots \pm 20$. Cumulative hazards by by lagged temperatures are shown in Figure 2.

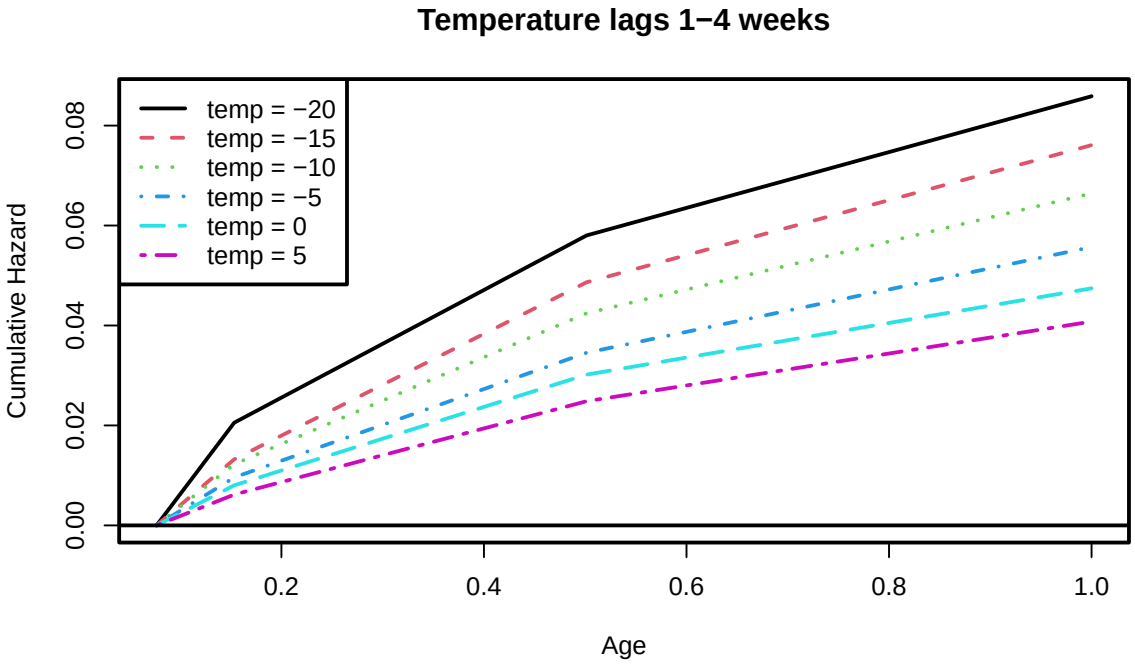

Figure 2: Cumulative hazards by lagged low temperatures, postneonatal mortality.

Besides the nice look, the property of *proportional hazards* seems to be well met, meaning that unfavourable temperatures strikes equally in all ages in the postneonatal period.

One reservation, though, climate variation over the first year of life makes a huge difference, see Figure 3. No proportional hazards there.

4 Conclusion

In this study, we study post-neonatal mortality in an effort to understand the role of resources to protect infants from both normal and extreme ambient temperatures in northern Sweden 1861–1950.

During the winter, the effects of temperature are much larger than during summer, and the summer effects are rather diffuse and small, and only short-term effects are visible.

The winter temperature effects on postneonatal mortality seem to be evenly spread in time, space, and social status. They are also more long-term, depending on temperatures five to eight weeks back in time.

To sum up, our hypothesis that the lower classes are worse off in meeting extreme cold weather could not be verified.

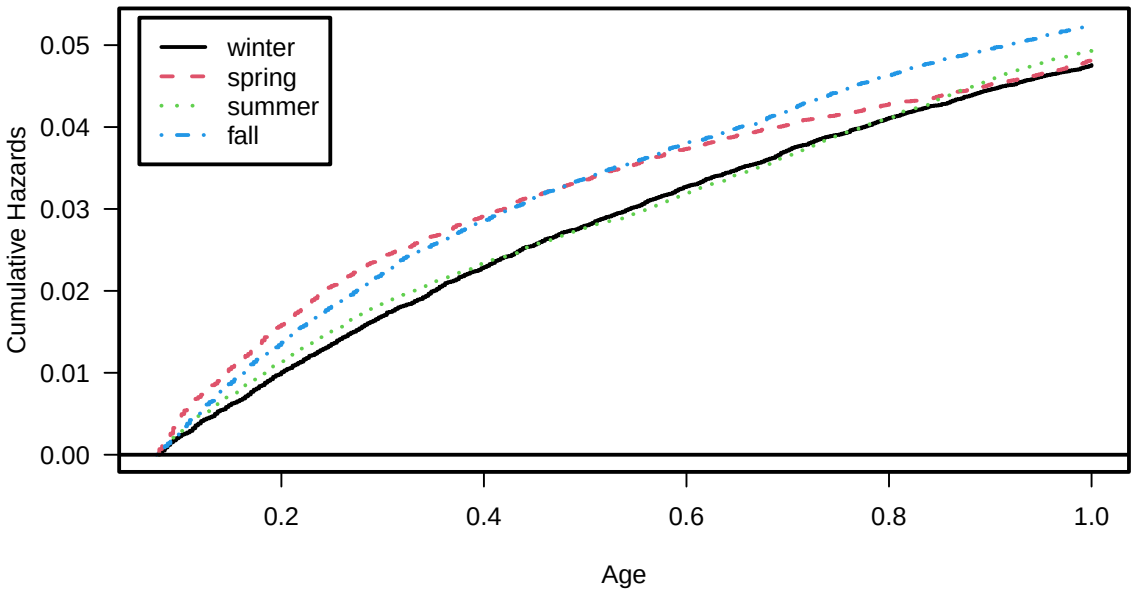

Figure 3: Cumulative hazards of postneonatal mortality by birth season.

References

Junkka, J., Karlsson, L., Lundevaller, E., and Schumann, B. (2021). Climate vulnerability of Swedish newborns: Gender differences and time trends of temperature-related neonatal mortality, 1880–1950. *Environmental Research*, 192. article id 110400.

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