COLUMBIA UNIVERSITY | MAILMAN SCHOOL of PUBLIC HEALTH

ENVIRONMENTAL HEALTH SCIENCES

Weather and climate change impacts on human mortality in Bangladesh

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Background and objectives

- Climate and temperature profoundly affect human health and mortality with an increase at the lower end of the temperature distribution, i.e. a cold effect as well as a particularly strong increase at the upper end of the temperature distribution, i.e. a heat effect
- The projected increase in temperatures due to climate change is likely to affect mortality with a substantial increase in heat-related mortality while the effect on cold-related mortality is unclear
- The projected consequences of demographic change, urbanization and increase in the burden of non-communicable diseases are likely to aggravate heat impacts
- Objectives of this study were (1) to analyze the relationship between temperature and mortality in Bangladesh for different subpopulations and (2) to project future heat-related mortality under climate change scenarios

Data and methods

- The relationship between daily mortality counts and temperature from 2003 to 2007 was analyzed using Generalized Additive models with segmented relationships adjusting for long-term and seasonal trend, day of the month and age
- Daily future temperature values were obtained from the NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP) dataset. This dataset is comprised of downscaled climate scenarios for the globe that are derived from the General Circulation Model (GCM) runs conducted under the Coupled Model Intercomparison Project Phase 5 (CMIP5)
- The derived dose-response functions were used to estimate the number of heat-related deaths occurring during the 1990s (1980-2005), the 2020s (2011-2040) and the 2050s (2041-2070):

$$ED_i = RR_i^{(T_i - T_{Threshold,i})} * Pop_i * CDR_i$$

with ED_i being the estimated heat-related excess deaths in group i, RR_i the relative risk above threshold temperature $T_{Threshold,i}$ in group i, Pop_i the population size and CDR_i the crude death rate in group i

Findings

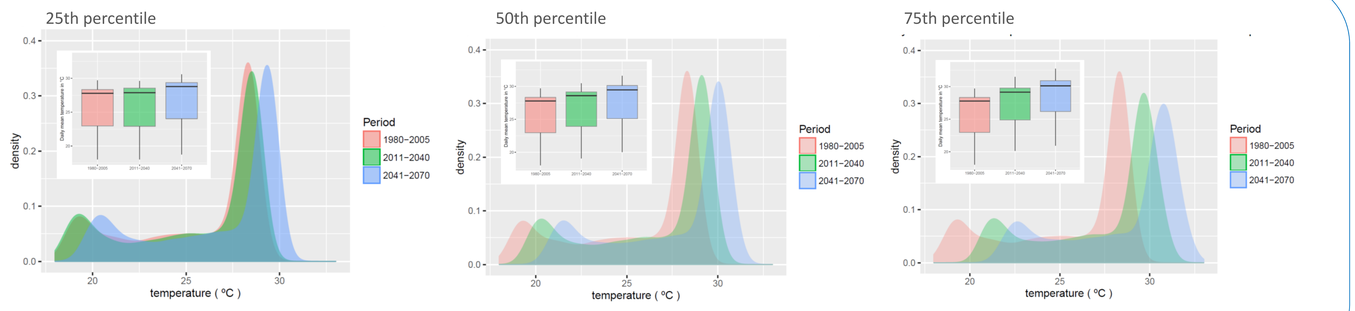

Figure 1: Probability density functions for daily mean temperatures derived from the NEX-GDDP multi-model data set for the 1990s (1980-2005), the 2020s (2011-2040) and the 2050s (2041-2070). Density functions on the left panel show the 25th percentile of the 21 model outputs, density functions on the middle panel show the median and density functions on the right panel show the 75th percentile

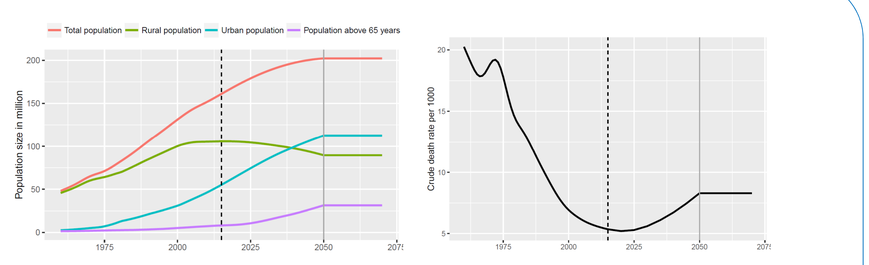

Figure 2: Past and future populations and crude death rates in Bangladesh (Source: United Nations)

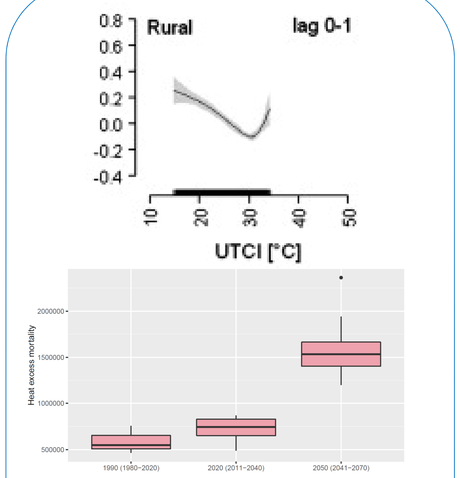

Figure 3: Dose-response functions for the relationship between equivalent temperature and mortality (upper panel) and projections of heat-related excess mortality for the 1990s, 2020s and the 2050s (lower panel)

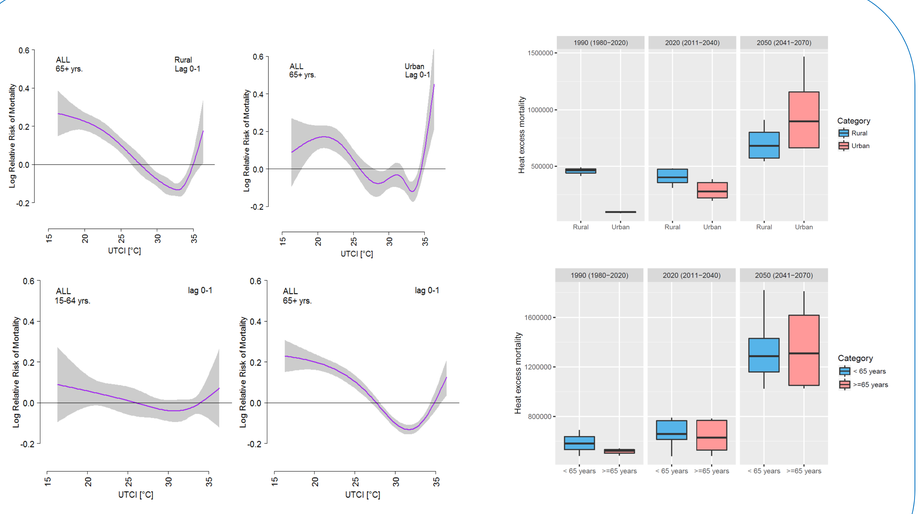

Figure 4: Dose-response functions for the relationship between equivalent temperature and mortality in urban and rural areas and in adults and the elderly (left panel) and projections of heat-related excess mortality for the 1990s, 2020s and the 2050s (right panel)

Conclusions

- Temperature affects human mortality with increasing levels at the upper and lower end of the distribution
- Temperature effects vary over different subpopulations with strongest effects observed in the elderly above the age of 65 years, in urban populations as well as in males and in areas with a high socio-economic status
- Climate projections show a persistent increase in mean and extreme temperatures in Bangladesh over all models
- With the projected increases in temperature as well as the increase in population and particularly vulnerable population such as urban populations and those above the age of 65 years heat-related excess mortality is projected to triple by the mid-century
- While only a small share of heat-related excess mortality occurs in the elderly above 65 years and in urban populations in the 1990s and 2020s these groups will strongly be affected in the 2050s

References

1. Burkart K., Khan M.M.H, Schneider A., Breitner S., Langner M., Krämer A., Endlicher W. The effect of season and meteorology on human mortality in tropical climates: a systematic review. Transaction of the Royal Society of Tropical Medicine and Hygiene, 2014, 108: 1–9
2. Burkart K., Khan M.H., Krämer A., Schneider A., Breitner S., Endlicher, W. An analysis of heat effects in different subpopulations of Bangladesh. International Journal of Biometeorology, 2014, 58:227–237