Effect of temperature on neonatal mortality: a timestratified case-crossover analysis using Demographic and Health Survey data from East Africa (2011-2022)



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Introduction



- Neonates have underdeveloped thermoregulatory systems
- Increased risk of morbidity & mortality from non-optimal temperatures
- In LMICs, relationship between non-optimal temperatures and neonatal mortality poorly understood
- Previous research focused on pooled analysis, despite different climate regions
- Neonatal mortality is time-dependent







Median Temperature across the study period

 To examine the impact of temperature on neonatal mortality across five East African countries using a time-stratified casecrossover design.





Methods



Outcome: neonatal mortality from the DHS datasets, 2011-2022

Outcome categorised into very early (0 days), early (1-6 days) and late (7-27 days)

Exposure: 2m air temperature from ERA5-Land reanalysis data

ERA5-Land hourly: global gridded dataset 0.1° x 0.1°(9km x 9km) horizontal & hourly temporal resolution

Study design: Time-stratified case-crossover design: controls for acute and long-term effects

Statistical analysis: with distributed lag non-linear models using linear and natural cubic splines

Examines complex, non-linear relationships between temperature & acute health outcomes; also accounts for time-invariant and lagged effects of environmental exposures on health outcomes





Neonatal mortality across the 5 East African countries





- Over 80% of all neonatal mortalities occur within the first week (very early and early)
- Over 50% of all neonatal mortalities in Rwanda are very early



15

0 -

10

15

Odds Ratio 10

Kenya

20 Daily mean temperature (°C)

Kenya

30

25

Results



HORIZONS

- Uganda displaying Jshaped relationship
- Tanzania and Rwanda suggest higher odds at higher temperatures; but imprecise
- Burundi and Kenya suggest higher odds of mortality at lower temperatures; but imprecise



Results cont'd



95th percentile (hot) vs the median: overall neonatal mortality



95th percentile (hot) vs the median: very early



5th percentile (cold) vs the median: overall neonatal mortality



5th percentile (hot) vs the median: very early





Results cont'd:



95th percentile (hot) vs median: early neonatal mortality



95th percentile (hot) vs median: late neonatal mortality



5th percentile (hot) vs median: early neonatal mortality



5th percentile (hot) vs median: late neonatal mortality





Results cont'd



95th percentile vs median

5th percentile vs median







Discussion



- Overall, hotter temperatures associated with a tendency towards increased mortality and colder temperatures with decreased mortality
- Effects strong for Uganda but imprecise for the rest of the countries
- In Uganda, increased temperature associated with increased odds of overall, very early and early neonatal mortality while low temp associated with decreased mortality in these groups
- In Burundi, effects delayed up to 2 days for 95th percentile vs median, with maximum mortality observed on day 3 (results not shown).

Discussion cont'd



- Between-country variable linear association between temperature and mortality observed
- The lagged effects show a nonlinear association for the effect of temperature on neonatal mortality.
- Thus, there may be some temperature-related effects that vary between countries or over time
- However, limitations with DHS data displacement and place of mortality not indicated



Conclusion



- Findings suggest that other factors may play a more significant role in neonatal mortality in these East African countries
- Further research in Uganda to understand policies, mechanisms and practices underlying the relationship between temperature & neonatal mortality
- Further research by different temperature regions
- ? Spatial Bayesian DLNM for small-area exposure-lagresponse





Thank you!