Geospatial Modelling of the Effect of Malaria on Height of Children 0-5 in Africa

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Introduction

- Many children in low- and middle-income countries (LMICs) are stunted (i.e they have height-for-age (HFA) z-score < -2.
- Stunting affects mental development of children and increase death risk.
- Malaria affects many in LMIC
- Relationship between malaria stunting is unclear.

Objectives

1. Investigate effect of malaria on height.
2. Estimate fraction of stunting attributable to malaria.
3. Estimate height difference associated with malaria.

Results 1

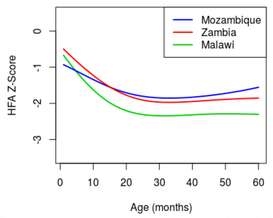

Figure 1: Age trend in HFA.

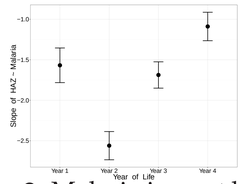

Figure 2: Malaria impact by age.

- HFA fall-off occurs in first two years of life
- More episodes of malaria is negatively associated with height.
- Malaria episode in second year of life has strongest impact on height.

Results 2

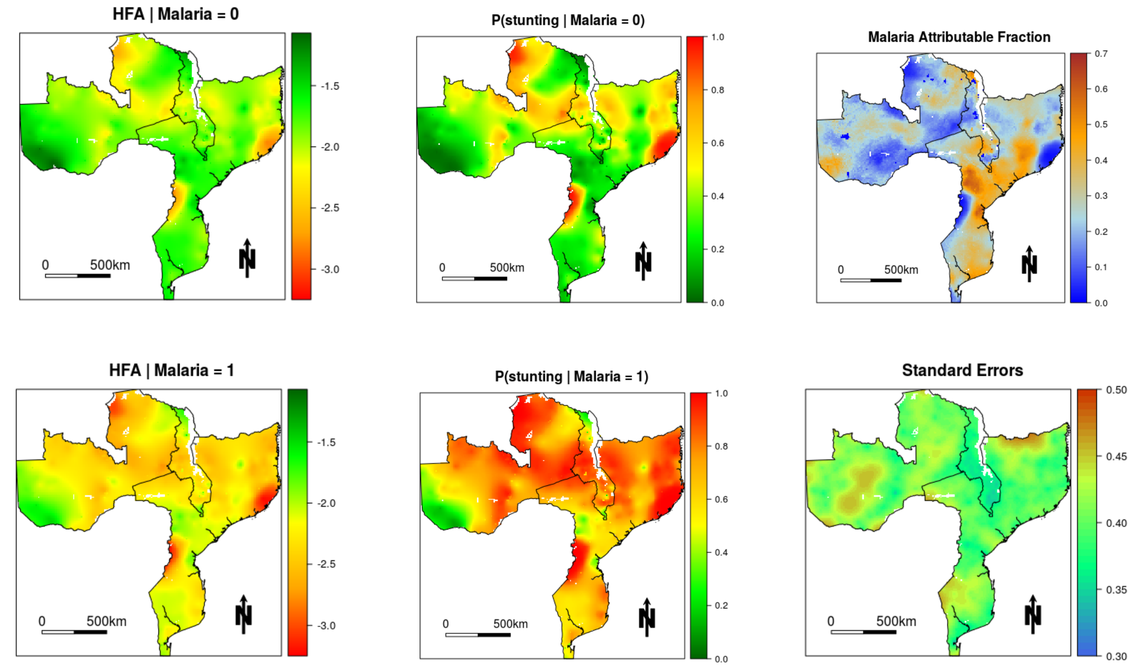

Figure 3: Predicted surfaces of mean HFA, probability of stunting and malaria attributable fraction.

Methods

- Geostatistical data from Malawi, Zambia and Mozambique we obtained from multiple sources.
- Linear predictors of HFA were malaria, mother's education level, Mother's wealth, country of residence, urban/rural, gender and age.
- The following geostatistical model was used for data analysis:

$$Z_{ij} = \alpha + \underbrace{d(x_i)^T\beta + U_i + S(x_i)}_{\text{spatial effects}} + \underbrace{e_{ij}^T\gamma + V_{ij}}_{\text{individual effects}} + \underbrace{\delta M_j(x_i, t)}_{\text{malaria effect}}.$$

Conclusion

- By the age of 5 years, there would be height difference as large as 6cm associated with difference in levels of malaria exposure.
- Having accounted for all known factors associated with height, malaria has little impact on height.
- Depending on location, malaria attributable fraction can be as large as 70%.

Discussion

- Malaria data are outputs of a model, but they have been used as if they were observed data.
- Effect of malaria on height may have been underestimated by removing age trend in height-for-age.
- We postulate that the fall-off in HFA during first 24 months of life in LMICs is due to malaria.

Future Research

- To use SITAR to correct for possible spurious height-for-age in very early life [1].
- To investigate fall-off in HFA during first two years of life.
- Longitudinal study of association between height and malaria.
- Extension of analysis to all of Africa.

References

[1] Tim J Cole, Malcolm DC Donaldson, and Yoav Ben-Shlomo. SITAR – a useful instrument for growth curve analysis. *International journal of epidemiology*, page dyq115, 2010.

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