Child health and epidemiology with Bayesian geo-additive latent variable models

KHATAB, Khaled <http://orcid.org/0000-0002-8755-3964>

Child Health and Epidemiology with Bayesian Geo-Additive Latent Variable Models

KHALED KHATAB

SHEFFIELD HALLAM UNIVERSITY, UK.

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Outline

- Background about KK Work.
- African Research Network on Health (ARNH).
- Child health and Epidemiology Group.
- Analysis of Childhood Morbidity, Mortality and Malnutrition with Geo-Addtive Latent variable.
- Current relevant Projects.

Background

- Currently: Reader (Associate Professor) of Medical Statistics & Health Economic modelling at Sheffield Hallam University.
- Visiting Professor of statistics at Ohio University, USA.
- Academic Editor for PLOSONE Journal.
- Chairman of Child Health and Epidemiology Team.
- Coordinator of the African Research of Child health and Maternal Group.
- Main research interests are in Bayesian statistical methods and their application to epidemiology and health, in particular, addressing maternal and child health and a variety of health-related health inequalities both in the developing countries and command economies, using large scale household data. This includes Bayesian modelling and diseases mapping, statistical methods applied to epidemiology, survival analysis, longitudinal data analysis, meta-analysis, Bayesian spatial Analysis. Bayesian modelling and diseases mapping, statistical methods applied to epidemiology, survival analysis, longitudinal data analysis, meta-analysis, Bayesian spatial Analysis, and Health Economics .

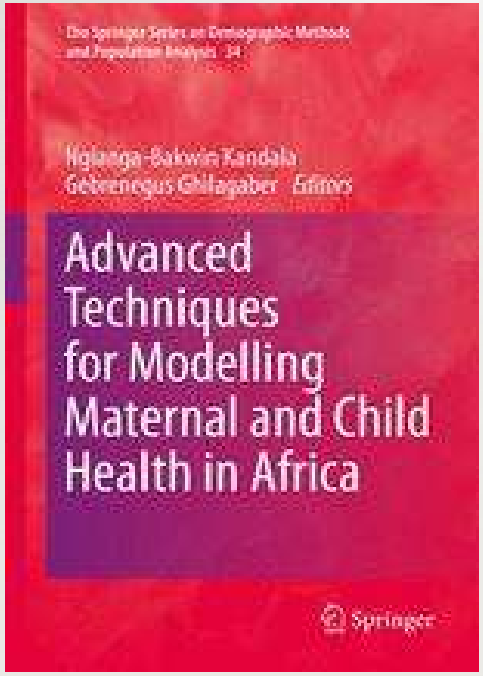
Scope of Research & Contributions.

- During these years, I developed an advanced statistical technique utilising highly sophisticated models to enable us to accommodate a large number of variables, such as categorical, metrical, binary, and spatial, as well as numerous types of outcome variables. I have developed and used the Markov Chain Mont Carlo (MCMC) package in R software and a C++ code compiler system to develop this model, which has since been used widely.
- The outputs have been published widely in high impact journals. The research focused on theoretical contributions and empirical applications of advanced statistical techniques including: Geo-additive Latent Variable Models which link individual measures with area variables to account for spatial correlation; multilevel models that address the issue of clustering within the family and household; multi-process models that account for interdependencies over life-course events and non-random utilisation of health services; flexible parametric alternatives to existing intensity models.
- These techniques are illustrated mainly through modelling in maternal and child health contexts, using data from different sources.

African Research Network on Health (ARNH)

- In 2009, I established the African Research Network on Health (ARNH), which includes eminent multidisciplinary experts and scholars from different institutes (such as Aachen University, Warwick University, Southampton University, Stockholm University, Northumbria University, and other African universities) and countries. The Network has a particular interest in public health issues in Africa.

Outputs :African Research Network on Health (ARNH)



1st.International Epidemiology workshop on Occupational and Public
Health (IEOPH)
May 21-22, 2010, Aachen
Abstracts of Talks and Posters
First workshop on
Epidemiology workshop on Occupational and Public Health
Joint organised by the Institute of occupational and Social Medicine-RWTH Aachen
University and The African Research Network on Health (ARNH)

Workshop Steering Committee

T.Kraus, K.Khatab, N.B.Kandala, G. Ghilagaber
Institute of occupational and Social Medicine-RWTH Aachen, Germany

Child Health and Epidemiology Group-Sheffield

- **Aim:**
- The overall goal of this research group is to develop and deploy new and improved evidence on the causes and determinants of neonatal and child morbidity and mortality, on intervention handling, and on the effectiveness of interventions to enlighten and impact the research priorities in this area nationally and internationally. This includes estimating specific distribution of the main causes of under-5 deaths, as well as maternal death and of the proportion of these deaths that can be prevented, and saving life by developing precise interventions, and enhancing modelling methodology along with the newly predications of efficacy and effectiveness of child survival intervention.

Child Health and Epidemiology Group-Sheffield

This group covers the following areas:

- Child Mortality and Morbidity.
- Child & Adolescent Mental Health.
- Maternal Mortality and Morbidity.
- Child labour and Environmental influence.
- Interventions & Evidence.

Analysis of Childhood Morbidity and Malnutrition with Geo-Additive Latent variable

Am. J. Trop. Med. Hyg., 81(1), 2009, pp. 116–128

Analysis of Childhood Morbidity with Geoadditive Probit and Latent Variable Model: A Case Study for Egypt

Khaled Khatab* and Ludwig Fahrmeir

Institute of Occupational and Social Medicine, Medical Faculty, RWTH Aachen University, Aachen, Germany; Department of Statistics, Ludwig-Maximilians-Munich University, Munich, Germany

Abstract. This work applies geoadditive latent variable models to analyze the impact of risk factors and the spatial effects on the latent, unobservable variable "health status" or "frailty" of a child less than 5 years of age using the 2003 Demographic and Health survey (DHS) data from Egypt. Childhood diseases are a major cause of death of children in the developing world. In developing countries a quarter of infant and childhood mortality is related to childhood disease, particularly to diarrhea. Our case study is based on the 2003 Demographic and Health Survey for Egypt (EDHS). It provided data on the prevalence and treatment of common childhood disease such as diarrhea, cough, and fever, which are seen as symptoms or indicators of children's health status, causing increased morbidity and mortality. These causes are often associated with a number of risk factors, including inadequate antenatal care, lack of or inadequate vaccination, and environmental factors that affected the health of the child in early years, various bio-demographic and socioeconomic variables. In this work, we investigate the impact of such factors on childhood disease with flexible geoadditive models. These models allow us to analyze usual linear effects of covariates, nonlinear effects of continuous covariates, and small-area regional effects within a unified, semi-parametric Bayesian framework for modeling and inference. As a first step, we use separate geoadditive probit models the binary target variables for diarrhea, cough, and fever using covariate information from the EDHS. Based on these results, we then apply recently developed geoadditive latent variable models where the three observable disease variables are taken as indicators for the latent individual variable "health status" or "frailty" of a child. This modeling approach allows us to study the common influence of risk factors on individual frailties of children, thereby automatically accounting for association between diseases as indicators for health status.

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Childhood Malnutrition in Egypt using Geoadditive Gaussian and Latent Variable Models

Khaled Khatab*

Institute of Occupational and Social Medicine, Medical School, Rheinisch-Westfälische Technische Hochschule Aachen (RWTH) University, Aachen, Germany

Abstract. Major progress has been made over the last 30 years in reducing the prevalence of malnutrition amongst children less than 5 years of age in developing countries. However, approximately 27% of children under the age of 5 in these countries are still malnourished. This work focuses on the childhood malnutrition in one of the biggest developing countries, Egypt. This study examined the association between bio-demographic and socioeconomic determinants and the malnutrition problem in children less than 5 years of age using the 2003 Demographic and Health survey data for Egypt. In the first step, we use separate geoadditive Gaussian models with the continuous response variables stunting (*height-for-age*), underweight (*weight-for-age*), and wasting (*weight-for-height*) as indicators of nutritional status in our case study. In a second step, based on the results of the first step, we apply the geoadditive Gaussian latent variable model for continuous indicators in which the 3 measurements of the malnutrition status of children are assumed as indicators for the latent variable "nutritional status".

Geoadditive Latent Variable Modelling of Child Morbidity and Malnutrition in Nigeria

Ludwig Fahrmeir and Khaled Khatab

Department of Statistics, University of Munich

SUMMARY

Investigating the impact of important risk factors and geographical location on child morbidity and malnutrition is of high relevance for developing countries. Previous research has usually carried out separate regression analyses for certain diseases or types of malnutrition, neglecting possible association between them. Based on data from the Nigeria Demographic and Health Survey of 2003, we apply recently developed geoadditive latent variable models, taking cough, fever and diarrhea as well as stunting and underweight as observable indicators for the latent variables morbidity and mortality. This allows to study the common impact of risk factors and geographical location on these latent variables, thereby taking account of association within a joint model. Our analysis identifies socio-economic and public health factors, nonlinear effects of age and other continuous covariates as well as spatial effects jointly influencing morbidity and malnutrition.

Key words: Developing countries, geoadditive regression, latent variable models, child morbidity and mortality.

- **Associations Between Nutritional Indicators Using Geoadditive Latent Variable Models with Application to Child Malnutrition in Nigeria**
- **Chapter · Source: InTech book: Current Topics in Tropical Medicine**

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Latent variable modelling of risk factors associated with childhood diseases: Case study for Nigeria

Khaled Khatab[1*], Ngianga-Bakwin Kandala[2]

[1]*Institute of Occupational and Social Medicine, Medical Faculty, RWTH Aachen University, Pawelsstr.30 D-52074 Aachen, Germany*
[2]*Health Sciences Research Institute, University of Warwick, Warwick Medical School, Warwick Evidence, Gibbet Hill, Coventry CV4 7AL, UK*

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ABSTRACT

Objective: To investigate the impact of various bio-demographic and socio-economic variables on joint childhood diseases in Nigeria with flexible geoadditive probit models. **Methods:** Geoadditive latent variable model (LVM) was applied where the three observable disease (diarrhea, cough, fever) variables were modelled as indicators for the latent individual variable "health status" or "frailty" of a child. This modelling approach allowed us to investigate the common influence of risk factors on individual frailties of children, thereby automatically accounting for association between diseases as indicators for health status. The LVM extended to analyze the impact of risk factors and the spatial effects on the unobservable variable "health status" of a child less than 5 years of age using the 2003 Demographic and Health Surveys (DHS) data for Nigeria. **Results:** The results suggest some strong underlying spatial patterns of the three ailments with a clear southeastern divide of childhood morbidities and this might be the results in the overlapping of the various risk factors. **Conclusions:** Comorbidity with conditions such as cough, diarrhoea and fever is common in Nigeria. However, little is known about common risk factors and geographical overlaps in these illnesses. The search for overlapping common risk factors and their spatial effects may improve our understanding of the etiology of diseases for efficient and cost-effective control and planning of the three ailments.

Chapter: **Bayesian Geoadditive Mixed Latent Variable Models with Applications to Child Health Problems in Egypt and Nigeria**

Khaled Khatab

[more]

Abstract: Childhood diseases and malnutrition are still a major cause of death of children in the developing world. This work focuses on investigating the impact of the important risk factors and geographical location on child morbidity and malnutrition in Egypt and Nigeria. Previous research has usually carried out separate regression analyses for certain diseases or types of malnutrition, neglecting possible association between them. Based on data from the Demographic and Health Survey of 2003, we apply recently developed geoadditive latent variable models, taking cough, fever and diarrhea as well as stunting and underweight as observable indicators for the latent variables morbidity and malnutrition. This allows studying the common impact of risk factors and geographical location on these latent variables, thereby taking account of association within a joint model. Our analysis identifies socio-economic and public health factors, nonlinear effects of age and other continuous covariates as well as spatial effects jointly influencing morbidity and malnutrition. Show less

Chapter · Jun 2014

PLOS | ONE

RESEARCH ARTICLE

Social and Demographic Factors Associated with Morbidities in Young Children in Egypt: A Bayesian Geo-Additive Semi-Parametric Multinomial Model

Khaled Khatab[1]*, Oyelola Adegboye[2], Taofeeq Ibn Mohammed[3]

1 Centre of Health and Social Care Research, Faculty of Health and Wellbeing, Sheffield Hallam University, Sheffield S10 2BP, United Kingdom, 2 Department of Mathematics, Statistics & Physics, College of Arts & Sciences, Qatar University, Doha 2713, Qatar, 3 Centre for Energy, Environment and Sustainability, University of Sheffield, Sheffield, S10 1FL, United Kingdom

* k.khatab@shu.ac.uk

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Data Availability Statement: All relevant data are within the paper and its Supporting Information files.

Abstract

Background

Globally, the burden of mortality in children, especially in poor developing countries, is alarming and has precipitated concern and calls for concerted efforts in combating such health problems. Examples of diseases that contribute to this burden of mortality include diarrhoea, cough, fever, and the overlap between these illnesses, causing childhood morbidity and mortality.

Methods

To gain insight into these health issues, we employed the 2008 Demographic and Health Survey Data of Egypt, which recorded details from 10,872 children under five. This data focused on the demographic and socio-economic characteristics of household members. We applied a Bayesian multinomial model to assess the area-specific spatial effects and risk factors of co-morbidity of fever, diarrhoea and cough for children under the age of five.

Results

The results showed that children under 20 months of age were more likely to have the three diseases (OR: 6.8; 95% CI: 4.6–10.2) than children between 20 and 40 months (OR: 2.14; 95% CI: 1.38–3.3). In multivariate Bayesian geo-additive models, the children of mothers who were over 20 years of age were more likely to have only cough (OR: 1.2; 95% CI: 0.9–1.5) and only fever (OR: 1.2; 95% CI: 0.91–1.51) compared with their counterparts. Spatial results showed that the North-eastern region of Egypt has a higher incidence than most of other regions.

PLOS | ONE

RESEARCH ARTICLE

Spatial modelling of contribution of individual level risk factors for mortality from Middle East respiratory syndrome coronavirus in the Arabian Peninsula

Oyelola A. Adegboye[1], Ezra Gayawan[2], Fahad Hanna[3]*

1 Department of Mathematics, Statistics and Physics, College of Arts and Sciences, Qatar University, 2713 Doha, Qatar, 2 Department of Statistics, Federal University of Technology, Akure, Nigeria, 3 Department of Public Health, College of Health Sciences, Qatar University, 2713 Doha, Qatar

* fhanna@qu.edu.qa

OPEN ACCESS

Citation: Adegboye OA, Gayawan E, Hanna F (2017) Spatial modelling of contribution of individual level risk factors for mortality from Middle East respiratory syndrome coronavirus in the Arabian Peninsula. PLoS ONE 12(7): e0181215. https://doi.org/10.1371/journal.pone.0181215

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Data Availability Statement: Data are made publicly available by Dr. Andrew Rambaut from http://epidemic.bio.ed.ac.uk/coronavirus_background.

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Competing interests: The authors have declared that no competing interests exist.

Abstract

Background

Middle East respiratory syndrome coronavirus is a contagious respiratory pathogen that is contracted via close contact with an infected subject. Transmission of the pathogen has occurred through animal-to-human contact at first followed by human-to-human contact within families and health care facilities.

Data and methods

This study is based on a retrospective analysis of the Middle East respiratory syndrome coronavirus outbreak in the Kingdom of Saudi Arabia between June 2012 and July 2015. A Geoadditive variable model for binary outcomes was applied to account for both individual level risk factors as well spatial variation via a fully Bayesian approach.

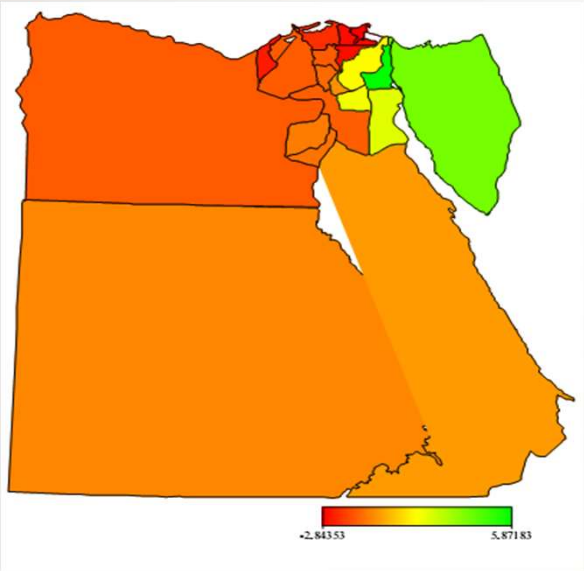
Results

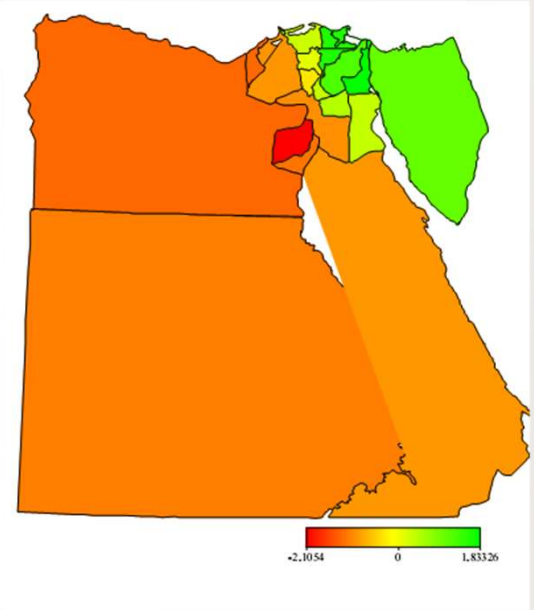
Out of 959 confirmed cases, 642 (67%) were males and 317 (33%) had died. Three hundred and sixty four (38%) cases occurred in Ar Riyad province, while 325 (34%) cases occurred in Makkah. Individuals with some comorbidity had a significantly higher likelihood of dying from MERS-CoV compared with those who did not suffer comorbidity [Odds ratio (OR) = 2.071; 95% confidence interval (CI): 1.307, 3.263]. Health-care workers were significantly less likely to die from the disease compared with non-health workers [OR = 0.372, 95% CI: 0.151, 0.827]. Patients who had fatal clinical experience and those with clinical and subclinical experiences were equally less likely to die from the disease compared with patients who did not have fatal clinical experience and those without clinical and subclinical experiences respectively. The odds of dying from the disease was found to increase as age increased beyond 25 years and was much higher for individuals with any underlying comorbidities.

Current Relevant Projects

Associate Risk Factors with Child Welfare including Child Labour and Violence against Child issues in Egypt using Bayesian Geospatial Modelling with Multiple Imputation.

A:less than 15hrs a week



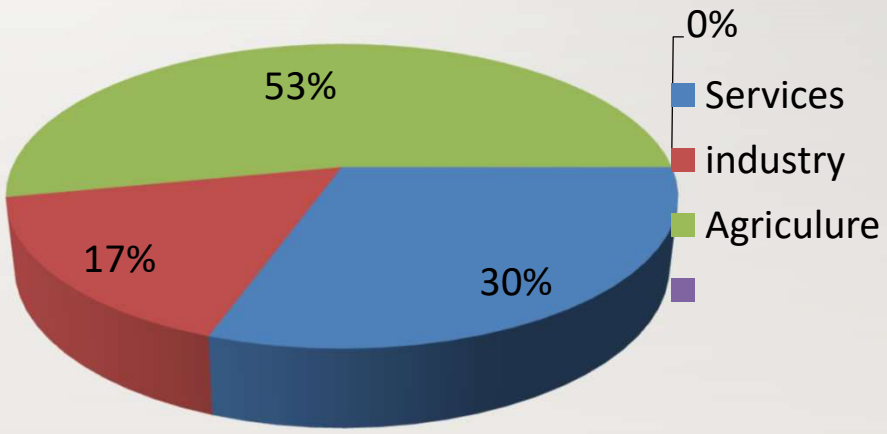


B. above 45 hours a week

Spatial effects of Hazordous Wage Work among Children in Egypt

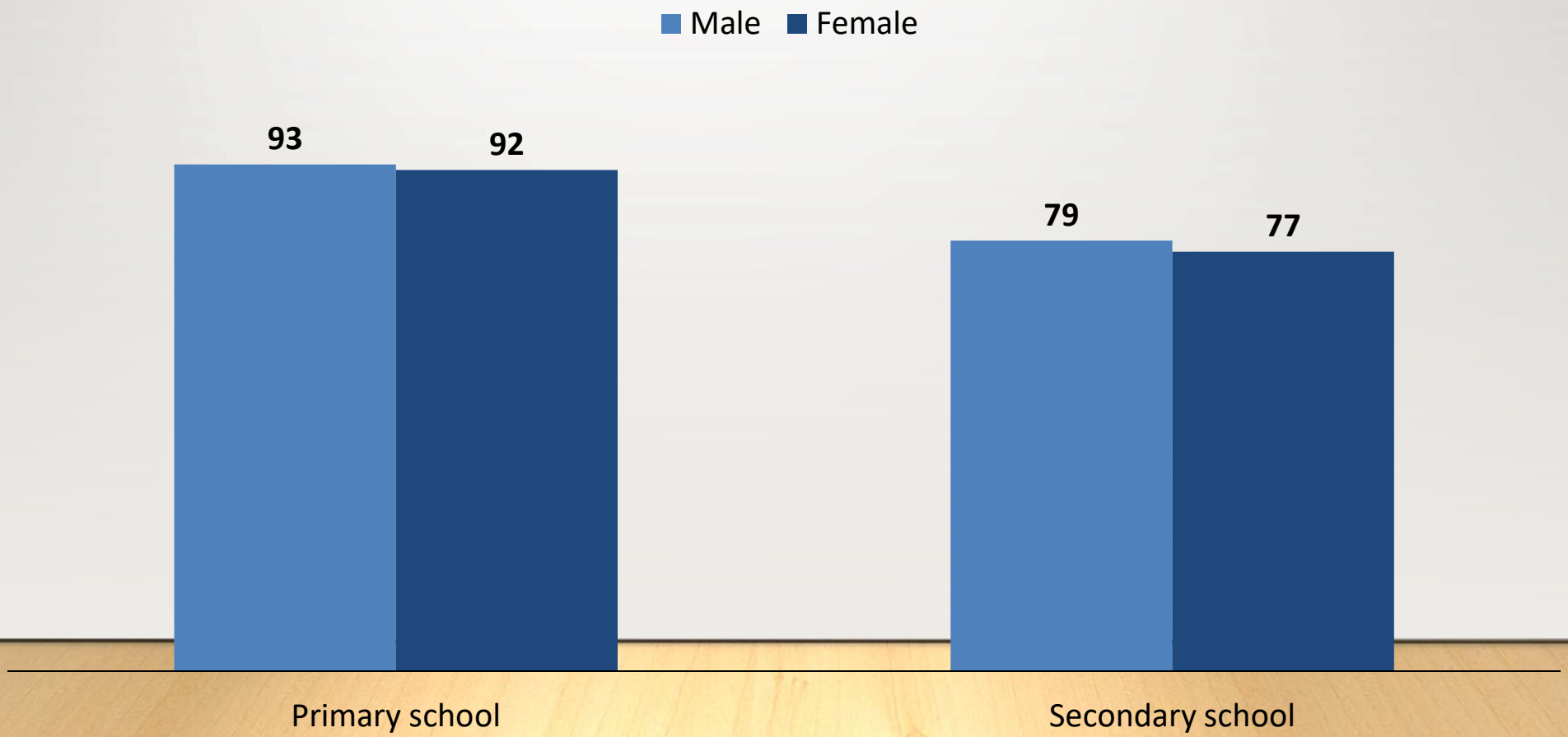
PREVALENCE AND SECTORAL DISTRIBUTION OF CHILD LABOUR

Working Children by sector, Ages 5-14



School Attendance

Percent of primary (6-11) and secondary (12-17) age children currently attending school



Violent Methods of Child Discipline

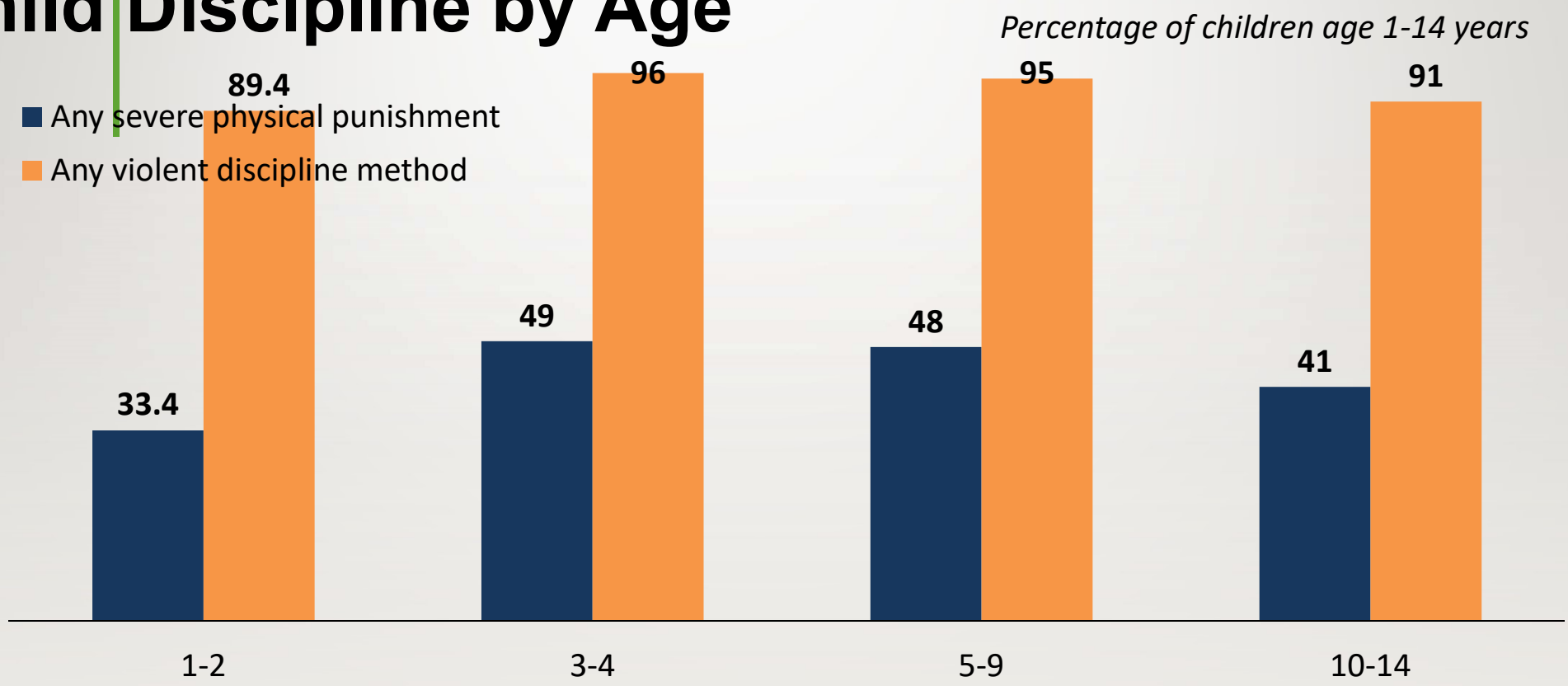
Many children were also disciplined with **violent** methods including:

- Psychological aggression – shouting, yelling, screaming (**88%**) and calling child dumb, lazy, or stupid (**63%**)

- Physical punishment – shaking (**46%**), hitting the child on the hand, arm, or leg (**55%**), spanking on the bottom with bare hand (**37%**), and hitting child with belt or other hard object (**23%**)

- Severe physical punishment – hitting or slapping child on face, head, or ears (**41%**) or beating the child over and over as hard as possible (**11%**)

Child Discipline by Age



Results

- An increase in household size increases the chance of a child engaged in child labour.
- When the father is missing from the household, girls are more engaged in child labour. However, When the mother is missing, both boys and girls tend to work more.
- Children in the age group of 11-15 are engaged more in house work while children above 15 are more engaged in hazard work.
- Lower and Upper Egypt are more affected by child labour.

Bayesian spatial analysis of relationship between early childhood mortality, non-malaria, and malaria in developing countries.

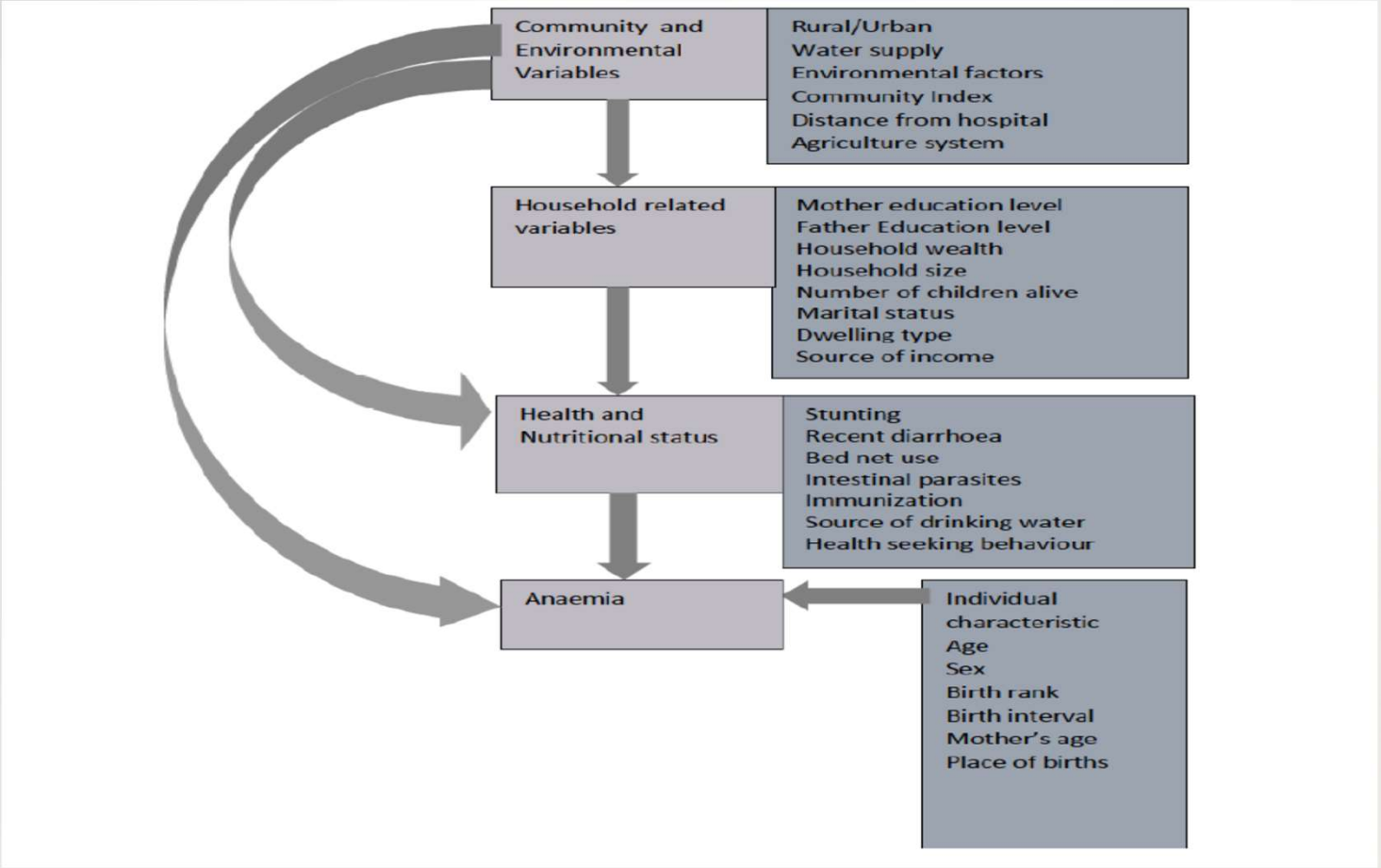
- **Objectives :**
- Determine the geospatial factors associated with malaria and non-malaria infection status among young Sub-Saharan children.
- To investigate the geospatial factors associated with Malaria & Mortality among young children.
- Investigate the impact of malaria and environmental factors on child mortality and non malaria infection, while at the same time taking into account cluster and strata (defined by demographic and socioeconomic group).
- The geostatistical analyses conducted to use model-based geo-statistics with Bayesian inference to explore the spatial variation and associated risk factors of malaria and non-malaria infection risk among children

Risk factors

- **1. Environmental factors :** Weather , Topography, Ecology, and spatial effects.
- 2. **Socio demographic factors**: Gender, Mother age , education, working status, wealth index, household size, birth interval, etc.
- **3: Non-Malaria diseases**: Fever, diarrhea, malnutrition status, HIV, TB, etc.
- 4. **Malaria**
- 5: **Child mortality.**

Equation to be discussed

- **Can LVM/joint model be applicable for Malaria & Non-Malaria outcome variables**



Teta et al, 2007

Risk of chronic poisoning among children (U 20) working within scrap market in Africa.

14/02/2018

- The aim of this project is to conduct a multicentre study in various regions of Africa mainly: southern Africa (South-Africa), West Africa (Ghana), central Africa (the DRC) and east Africa (Kenya) with the following research questions to be answered:
- Principal research question

❑ What is the nature and extent of chronic poisoning of workers with metals and other toxic substances such as polychlorinated biphenyls (PCBs) after processing waste from obsolete electrical and electronic products (e-waste) under the conditions of an unregulated informal industry?

- Secondary research questions

❑ What are the concentrations of pollutants in participants stratified by age, occupation, gender and other attributes?

❑ What are the general working conditions, basic techniques used and potential occupational hazards?

❑ What improvements can be made to current practices to limit exposure?

Thoughts & Collaborations!