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Space–time mapping of wasting among children under the age of five years in Somalia from 2007 to 2010

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ABSTRACT

Objective: To determine the sub-national seasonal prevalence and trends in wasting from 2007 to 2010 among children aged 6–59 months in Somalia using remote sensing and household survey data from nutritional surveys.
Methods: Bayesian hierarchical space–time model was implemented using a stochastic partial differential equation (SPDE) approach in integrated nested Laplace approximations (INLA) to produce risk maps of wasting at 1 × 1 km^2 spatial resolution and predict to seasons in each year of study from 2007 to 2010.
Results: The prevalence of wasting was generally at critical levels throughout the country, with most of the areas remaining in the upper classes of critical and very critical levels. There was minimal variation in wasting from year-to-year, but a well-defined seasonal variation was observed. The mean difference of the prevalence of wasting between the dry and wet season ranges from 0% to 5%. The risks of wasting in the South Central zone were highest in the Gedo (37%) and Bay (32%) regions. In North East zone the risk was highest in Nugaal (25%) and in the North West zone the risk was high in Awdal and Woqooyi Galbeed regions with 23%.

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Conclusion: There was a clear seasonal variation in wasting with minimal year-to-year variability from 2007 to 2010 in Somalia. The prevalence was high during the long dry season, which affects the prevalence in the preceding long rainy season. Understanding the seasonal fluctuations of wasting in different locations and at different times is important to inform timely interventions.

1. Introduction

Wasting, defined as low weight-for-height, is a strong indicator of mortality among children under the age of five years (Mason et al., 2010). Wasting is thought to develop as a result of acute food shortage and/or disease (Vesel et al., 2010) and is used to assess individuals for supplementary and therapeutic feeding, and to assess emergency humanitarian needs in regions vulnerable to drought, displacement and related causes of food insecurity (Chotard et al., 2010).

Globally, approximately 52 million (8%) children under-five years of age were wasted in 2010, a 11% decrease from an estimated 58 million in 1990 (Chotard et al., 2010). About 70% of the world's wasted children live in Asia where approximately 1 in 6 children (16%) is moderately or severely wasted. In sub-Saharan Africa, 1 in 10 children under the age of five (9%) were wasted in 2010, a prevalence that has barely changed since 1990 (10%) (UNICEF et al., 2013).

A number of risk factors including seasonal food insecurity and environmental conditions have previously been associated with wasting (Engebretsen et al., 2008, Rice et al., 2000, Black et al., 2008, Bhutta et al., 2008, Kinyoki et al., 2015). Wasting is thought to develop over a short period and is reversible with short term intervention (Bhutta et al., 2008). Wasting typically varies seasonally due to variations in climate, disease and food availability (Khara and Dolan, 2014). This leads to potential variation of wasting between populations in normal conditions as well as under drought (Chotard et al., 2010). In Gambia, the prevalence of wasting fluctuated between 4% and 10% between seasons (Tomkins et al., 1986) while in Ethiopia, seasonality did not have a significant effect on wasting in children (Branca et al., 1993).

Thus, the prevalence of wasting determined through nutrition surveys is often highly variable and needs to be interpreted in relation to both emergency factors, climatic anomalies and seasonality which may also vary subnationally, to help with planning timely interventions. This information is useful both for assessing the severity of malnutrition at one time and for predicting early how far malnutrition rates are likely to rise with the onset of drought and resulting food insecurity (Chotard et al., 2010). This paper seeks to understand the dynamics of wasting and the role of seasonality among children aged 6–59 months in Somalia using space–time geo-statistical models from 2007 to 2010.

2. Methods

2.1. Data

The data used for this study were obtained from surveys undertaken by the Food Security and Nutrition Unit (FSNAU) in Somalia from 2007 to 2010. Within this period, FSNAU, in partnership with United Nations Children's Fund (UNICEF), conducted bi-annual seasonal nutrition assessment surveys using Standardized Methodology for Survey in Relief and Transition (SMART) methods, indicators and tools for data collection (Chotard et al., 2010; WHO et al., 2010; FAO/FSNAU-Somalia, 2011). Detailed description of the survey methods are provided elsewhere (Smith, 2006).

Using a multi-stage cluster sampling method across all districts, over 100,000 children were interviewed in approximately 1,100 unique clusters. We undertook a detailed search to establish a set of spatial coordinates for each cluster, which were verified using Google Earth (Google, Seattle, USA) to visually inspect whether the coordinates matched evidence of human settlement. Those settlements for which no reliable sources of coordinates were obtained were excluded from the analysis.

Five environmental covariates associated with vector-borne diseases (Gething et al., 2011) and food security (Grace et al., 2012) were examined for modeling. These were rainfall, enhanced vegetation index (EVI), mean temperature, distance to water, and urbanization. Rainfall and mean temperature were derived from the monthly average grid surfaces obtained from WorldClim database (WorldClim). The EVI values were derived from the MODerate-resolution Imaging Spectroradiometer (MODIS) sensor imagery (Scharlemann et al., 2008) for period 2000–2010 while the urbanization information was obtained from Global Rural Urban Mapping Project (GRUMP) (Balk et al., 2005). All the environmental covariates were extracted from 1×1 km^2 spatial resolution grids to data points. Rainfall, temperature and EVI were summarized to compute seasonal averages using the four main rainy seasons in Somalia.

The data were aggregated at cluster level with the corresponding geographical covariates, year and season of survey. Each record represented a cluster and consisted of the number of children wasted and total children examined together with a list of geographical covariates and the corresponding year and season of survey.