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DETERMINANTS OF THE CYCLE OF CHILDHOOD UNDERNUTRITION AND INFECTIOUS DISEASE IN EASTERN AFRICA

MELINDA ANN JUDGE

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Childhood undernutrition and infectious disease are intricately linked in a cyclical relationship, with each being a risk factor and outcome of the other. Malnutrition can impair immune system responses, leaving children vulnerable to opportunistic infections, or infectious disease can result in reduced food intake, nutrient absorption and growth. Once started, the cycle can become self-exacerbating and may have dire consequences including death or life-long disability. The burden of childhood undernutrition and infectious disease disproportionately affects low- and middle-income countries, particularly in southeast Asia and Africa.

Despite significant reductions in child mortality in Tanzania during the Millennium Development Goals era, the proportion of deaths attributed to the common childhood infectious diseases of diarrhoea, pneumonia and malaria remains high, as does undernutrition. High-impact interventions to prevent malnutrition and infection are required in this low-income setting.

The aim of this thesis is to identify the key determinants of undernutrition and infectious disease in detail in Tanzania, and also more broadly in Eastern Africa, so that recommendations can be made for prioritising the most effective strategies to improve child health outcomes in this region.

Demographic and Health Survey (DHS) data, containing comprehensive and country-wide child and maternal health data alongside demographic information, are interrogated. The use of multiple imputation to handle missing data results in superior model efficiency and reduced bias. Binomial logistic regression modelling is used to identify determinants of stunting, underweight, wasting, diarrhoea, fever

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and acute respiratory infection (ARI) in Tanzanian children. Furthermore, these methods are applied to all DHS datasets available for Eastern Africa in the previous decade, to identify key determinants of diarrhoea in under-fives in Burundi, Comoros, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe.

Child-, maternal- and household-level characteristics associated with undernutrition and infectious disease are identified, and correlations interpreted in the context of available literature. In Tanzanian children, all three markers of undernutrition are strongly interrelated and correlated with child age and male gender as risk factors. Poverty and sanitation are more strongly correlated with chronic undernutrition, while recent infection and drinking water intake are more strongly associated with acute malnutrition. Therefore, the public health recommendations of targeted nutritional interventions for male offspring, improved drinking water quality for under-twos and improved sanitation combined with increased animal source foods for under-fives, would have the largest impacts on improving nutrition in Tanzanian children. For diarrhoea, fever and ARI in Tanzanian children, household availability of soap at the hand-washing station is the only variable that correlated with reduced risk of all three illnesses. A child recently drinking water, unsafe disposal of a child's stool and livestock ownership all increased the risk of diarrhoea. The typical ARI risk factors, involving household air pollution, are not strongly represented in the ARI model, but variables more commonly associated with diarrhoea (unimproved toilet facilities, water treatment methods and livestock ownership) and fever (iron supplementation) are significantly correlated with ARI risk. Likewise, child bednet use is not associated with fever risk, yet unsafe drinking water, unimproved toilet facilities and livestock ownership all correlate with increased risk of fever. These findings highlight the complex and interrelated nature of these infectious diseases; however, public health policy focusing on the promotion of hand-washing with soap would lead to the largest reductions in all three, for Tanzanian children.

Child age is the only consistent risk factor for diarrhoea in all the Eastern African countries studied. However, a number of variables are correlated with diarrhoea risk in multiple countries. This shows that despite commonalities between regional neighbours, country-specific investigations are required to determine the most effective intervention strategies to reduce diarrhoea in under-fives. Public health recommendations that are detailed include: improved promotion of WASH education to enable provision of clean drinking water (including water treatment and storage), improved toilet facilities and provision of soap or cleansing agents for handwashing; separation of livestock from areas where children play and sleep; promotion of early initiation of breastfeeding; targeted iron supplementation; sleeping under a bednet; and completion of full vaccination schedules.

This work has optimised methodology for the use of DHS data in the context of childhood undernutrition and infectious disease, describing risk factors and prevention factors, as well as recommending interventions that can most effectively improve child health outcomes in resource-limited Eastern Africa.

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MELINDA ANN JUDGE, School of Mathematics and Statistics,
University of Western Australia, Crawley, WA 6009, Australia
e-mail: melindaajudge@gmail.com

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