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THE LONG-TERM EFFECTS OF MOTHER'S DISPLACEMENT DURING WAR ON CHILDHOOD DIARRHEA, STUNTING, AND VACCINATION IN POST-CONFLICT LIBERIA

By

Bradi Barrett

A thesis

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Bradi Barrett find it satisfactory and recommend that it be accepted.

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RE: regarding study number IRB-FY2017-46: Determinants and prevalence of child diarrhea in post-conflict Liberia: An epidemiological analysis

Ms. Barrett:

I agree that this study qualifies as exempt from review under the following guideline: Category 4: Collection or study of existing data. This letter is your approval, please, keep this document in a safe place.

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Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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List of Abbreviations

AFC	Audit and Finance Committee
BCG	bacille Calmette-Guerin vaccine (Tuberculosis)
CRED	Centre for Research on the Epidemiology of Disasters
DHS	Demographic and Health Survey
DPT	Diphtheria-Pertussis-Tetanus vaccine
ICRC	International Committee of the Red Cross
IDMC	The Internal Displacement Monitoring Centre
IRB	Institutional Review Board
NGO	Non-governmental organization
ORS	Oral Rehydration Solutions
SD	Standard Deviation
UNHCR	United Nations High Commissioner for Refugees
UNICEF	The United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Abstract

Background: Liberia continues to rebuild after the more than decade long war, however it remains burdened with high rates of poverty, infectious disease, and child malnutrition. Little research has been done to determine if a mother's displacement due to conflict may perpetuate poor health for her children (both born and unborn) in the long-term.

Methods: Using the DHS 2006-2007 data, our objective was to describe diarrhea, stunting, and vaccination rates in children under five according to the type of displacement their mother experienced, and to describe the association between displacement and each child health outcome.

Results: Most Liberian mothers with children under-five in 2006-2007 (90.32%) were displaced during the war to live in the bush (29.70%), in the home of friends/family (24.42%), outside of Liberia (24.00%), or in a camp (11.74%). Compared to mothers that remained home during the war, mothers living in the bush during the war were nearly two times more likely (OR=1.85, 95%CI 1.28-2.69) to have children with diarrhea, and were less likely to have children who were fully vaccinated (OR=0.59, 95%CI 0.44-0.80). However, after controlling for other factors, living in the bush was not significantly related to child health outcomes. Compared to remaining home, other displacement categories were not associated with poor child health.

Conclusion: While displacement was common during conflict in Liberia, long-term risk of child health outcomes post-conflict was not associated with different types of displacement. Further research on whether different exposure related to displacement during conflict affects long-term child health outcomes is warranted.

Chapter I: Introduction

As Liberia continues the rebuilding process after the more than decade long, damaging civil war from 1991-2003, it remains burdened with high rates of poverty, infectious disease, and child malnutrition. Efforts to rebuild infrastructure, health systems, and other social services in Liberia are still far below pre-war levels (UNICEF, 2013; Kruk et al., 2010). Given the extent to which war has impacted health in Liberia, it is important to determine factors of current poor child health outcomes that may have been impacted by war-related conflict.

Aside from direct mortality and injury due to violence, displacement of individuals from their homes during large-scale armed conflicts have both immediate and long-term impacts on the health of individuals and communities. It is estimated that approximately 500,000-600,000, or one-third of Liberia's population, was displaced during the war (IDMC, 2013). At the community level, displacement during conflict contributes to the disruptions in basic services that include electricity, water, infrastructure, and health care that may poorly affect health during and long after the period of conflict (Kruk et al., 2010). At the individual level, stress, trauma, disruptions of social networks, and increases in exposure to disease-causing agents due to displacement during conflict impacts individual biological processes that may result in long-term or irreversible negative health. Furthermore, evidence is growing of historical trauma, or the intergenerational transfer of negative health effects, both psychological and biological, being passed to children as a result of violence to a parent. Negative health effects of displacement during war may be particularly evident in vulnerable

segments of society, including infants and toddlers (Devakumar, Birch, Osrin, Sondorp, & Wells, 2014).

War has impacted child health in various ways. Research has shown that conflicts in countries have impacted immunization rates in children (Senessie, Gage, & von Elm, 2007), and the mental health of the children involved in the war (Betancour, McBain, Newnham, & Brennan, 2013). Following the conclusion of the war, only 10% of the population was estimated to have access to basic healthcare in Liberia (National Government of Liberia, 2004), which reduces the ability to get care for child malnutrition and diarrhea, as well as the ability to receive life-saving vaccines.

The objective of this research is to look at the effects that conflict has on child health indicators, particularly the impact that different forms of displacement may have on child health. The objectives of this study are: 1) to determine and compare the prevalence of diarrhea, stunting, and vaccination rates among children under five among different displacement groups in Liberia, and 2) to determine the association between displacement groups and diarrhea, stunting, and vaccination. Due to the disruption caused by displacement during conflict, we hypothesize that displacement from home during conflict will be associated with poor child health outcomes years after the end of the conflict. Diarrhea, stunting, and vaccination represent acute, chronic, and health-care specific measures affecting children's health, which allows us to assess the extent of the impact of displacement during conflict on child health post-conflict.

Determining the association between displacement due to conflict and difference in child health outcomes years after the displacement in Liberia may inform future research or interventions aiming to reduce under-five child mortality and morbidity in

post-conflict settings. Benefits or risks of specific types of displacement (e.g. in camps, or wilderness, versus staying home) may inform strategies addressing displacement during conflict that may have a long-term impact on child health.

Chapter II: Literature Review

Child health outcomes

While the civil war in Liberia ended in 2003, Liberia infant and under-five mortality rates still remain among the five highest in the world, with more than 15 percent of children dying before they reach their first birthday (UNICEF, 2013). Malnutrition and diarrhea are among the leading causes of mortality and morbidity, with nearly 40 percent of children under the age of five suffering from stunting. Forty percent of the population does not have access to safe drinking water and 75 percent of the population does not have access to adequate sanitation (UNICEF, 2013). While there have been some improvements in recent years, child health outcomes have notably lagged behind improvements to maternal health care (Kentoffio et al, 2016). Preventable diseases remain among the leading causes of death of children in Liberia.

While social and economic factors play a major roll in child health outcomes, the specific determinants may vary between countries (Fuller et al, 2014), indicating that future studies may need to approach looking at child health outcomes from the specific context and conditions of the particular country being evaluated. Previous research has indicated the importance of considering local and regional context rather than at the national or multi-national level (Emina & Kandala, 2012).

Diarrhea Diarrhea is the second leading cause of death of children worldwide, responsible for about one in five deaths among children each year, or 1.5 million deaths total. The global child death toll from diarrhea is more than AIDS, malaria and measles combined (WHO & UNICEF, 2009). While diarrhea mortality and morbidity rates for children under-five has been steadily declining worldwide since the 1980s (Boschi-Pinto,

Lanata, Mendoza, & Habte, 2006), the burden of diarrhea in the Sub-Saharan Africa countries is still high. In Liberia the under-five child mortality rates rank in the five highest in the world (UNICEF, 2013), accounting for 17% of the deaths for children under the age of five in the country (World Health Organization: Africa, 2008).

Numerous studies show the individual, interpersonal, and environmental factors that lead to diarrhea morbidity and mortality in children under five (Diouf, Tabatabai, Rudolph, & Marx, 2014; Fuller, Clasen, Heijnen, & Eisenberg, 2014; Mihrete, Alemie, & Teferra, 2014;Yilgwan & Okolo, 2012). Diarrhea prevalence is typically associated with poverty and unhygienic conditions (Emina & Kandala, 2012), where sanitation facilities, clean water, health behavior, and access or distance to health care facilities and treatment are involved.

Stunting Between 2007 and 2013 rates of chronic and acute undernutrition have decreased in Liberia, yet nearly one-third of children under five remain stunted. This decline could be due to an increase in breastfeeding between 2007 and 2013; however, poor dietary deficiency and diarrheal disease contribute to the suboptimal nutritional outcomes (USAID, 2014). Micronutrient deficiencies are still highly prevalent (USAID, 2014). Two of the main causes of stunting include inadequate nutrition to support growth and development of infants and young children and frequent infections during early life (Frongillo, 1999). Stunting usually reflects the persistent cumulative effects of poor nutrition and other deficits that can often span across several generations, as maternal undernutrition can result in a low birth weight. It is recognized that the process of becoming stunted usually starts in utero, although children may not have signs of stunting until they are 2-3 years of age (Dewey & Begum, 2011). A review of stunting in low-

income countries found that many families and health care workers do not recognize stunting and, therefore, is not always viewed as a public health issue (Dewey & Begum, 2011).

Vaccination rates Childhood vaccinations continue to be one of the most cost-effective public health interventions (Makamba, 2011). Vaccinations can reduce the mortality and morbidity related to preventable infectious diseases. In post-conflict settings, where health systems have been destroyed, it is critical to have strong immunization programs. Because of the collapse of health systems and infrastructure, vaccinations are essential to manage outbreaks of preventable infectious diseases such as measles and polio. Studies done in Southern Sudan found that unvaccinated children infected by a disease that a vaccine may have prevented will most likely die due to the lack of healthcare services; therefore, stronger immunizations programs are the best method to improve the survival of post-conflict children (Makamba, 2011).

Research has indicated that one of the largest consequences of conflict-related migration is the impact on preventative immunizations for children (Avogo & Aganjanian, 2010). Populations who are forcibly displaced, which include both refugees and internally displaced populations, have unique challenges that often interfere with immunization services and can also prevent access to the recommended vaccinations. This disruption can increase the susceptibility to vaccine-preventable disease (Lam, Diaz, Kahindo Maina, & Brennan, 2016). Studies have shown that the dynamic movement and unique characteristics of displaced populations require specific vaccination strategies and should be part of eradication and elimination strategies prior to the beginning of conflicts or emergency situations (Lam et al., 2016; Minetti et al., 2013).

Impacts of war on child health

Displacement The number of people forcibly displaced worldwide has been increasing, reaching an all time high in 2014 with 59.3 million people displaced. One in every 122 people is a refugee, seeking asylum, or internally displaced in the world (UNHCR, 2015). During the Liberian civil war, it is estimated that 500,000 to 600,000 people were displaced, which made up approximately one third of the entire country population (IDMC, 2013). Armed conflict often leads to displacement of individuals and communities, which can lead to living with relatives/friends, temporary settlements, and camps or subsistence in unincorporated wilderness areas (the bush). This can lead to inadequate safe water and sanitation, and increase exposure to disease vectors. These populations may also be more vulnerable to infection and disease due to high levels of malnutrition, low-vaccine coverage, and long-term stress (Gayer, Legros, Formenty, & Connolly, 2007). A study found that during conflict in Sierra Leone there was a dramatic increase in the population of major urban communities that resulted in camps and squatter settlements with poor sanitization. Overcrowding and poor sanitation habits contaminated the drinking water supplies through improper disposal of feces (Kallon, 2008). Because feces-oral transmission of pathogens is the most common cause of diarrhea disease, this dramatically increased the risk of exposure. Similarly, many displaced Liberian's fled to Monrovia, the nations capital, during the war, putting strain on urban services (Shilue & Fagen, 2014).

Emergency settings, like war and conflict, often interfere with routine services and can prevent access to recommended vaccination, and this disruption of services increases the number of susceptible individuals creating a population that is at high risk

for vaccine-preventable disease (Lam et al., 2016). It has been indicated that internally displaced populations likely suffer the worst health impacts from conflict. They and their children are almost twice as likely as refugees to die from conflict-related causes, such as disease and starvation. They also tend to have the highest rates of acute malnutrition and are half as likely as refugees to be immunized against the measles (CRED, 2013).

Health System As suggested by Joshi (2015) in his study on child mortality and armed conflict, armed conflict is both a development and a public health issue. War can have major implications on the country as a whole and the entire health system. Armed conflict in developing countries has an even larger impact, as many developing countries still struggle to develop a health care system and provide adequate health and resources to its citizens without the difficulties and consequences of war. In post-conflict setting, populations may have high rates of morbidity and mortality due to the breakdown of the health systems, the failure of existing disease control programs, and destroyed infrastructure (Gayer et al., 2007).

Countries that experience large-scale armed conflict see both immediate and long-term effects particularly on population health. Low-income countries seem to be impacted the most by armed conflict. In their research on the availability of health services in post-conflict Liberia, Kruk et al. (2010) found that armed conflict disrupts the delivery of basic services, including electricity, water, and health care, and causes looting and physical destruction of facilities. The manpower needed to sustain a health care system was also not available as most of the doctors, nurses, and other health care workers fled the country, leaving only 30 physicians to care for a population of 3 million in Liberia (Kruk et al., 2010). At the end of the war, it was estimated that only about ten

percent of the population had access to healthcare (National Transitional Government of Liberia, 2004).

Newbrander, Waldman, & Shepherd-Banigan (2011) proposed an extensive and comprehensive list of characteristics of a post-conflict system that are related to health and are negatively effected by conflict including: insufficient coordination, oversight and monitoring of health services, lack of equity in who receives the available health services, lack of mechanisms for developing, establishing and implementing nation health policies, non-operational health information systems, inadequate management capacity, inability to provide health services to a large proportion of the population, ineffective or nonexistent referral systems, lack of infrastructure for delivery health services, and nonexistence or inadequate capacity-building systems. Each of these must be addressed and improved upon in the rebuilding stage after conflict.

Infrastructure In addition to the destruction of the health care system, the collapse of infrastructure can have major implications on the overall health of a country. Destroyed roadways and family homes create a more difficult situation when trying to address problems like diarrheal disease, growth stunting, and vaccinations. Destruction of family homes forced members to build makeshift camps and settlements, which do not provide an environment for safe hygiene practices important to reducing diarrhea rates because of overcrowding and unimproved sanitation facilities or open defecation (Zakaria, Garci, Hooijman, & Brdjanovic, 2015). Overcrowding and an unsafe environment can also lead to the spread of disease. Additionally, without access to health care facilities either via destroyed roadways or facilities, children are not able to get the care they need for diarrhea treatment such as ORS, zinc, or antibiotics, as well as care for

nutritional deficiencies. Prior to the war, there were 293 operating public health facilities and 242 of those were determined to be non-functional after the war because of destruction and looting (Senessie et. al., 2007). Without access to health care facilities, it is also difficult to get the required vaccinations. Those trying to administer vaccinations after conflict have found that the roads have not fully recovered and cannot be reached by car (WHO & UNICEF, 2012), making it difficult for mobile vaccination clinics to get to the areas where it is needed.

There also has been an association found between the distance to the nearest health facility with decreased odds of seeking heath care for most child health indicators (Kenny et. al., 2015). Distance also appeared to play a role in the type of health care provider mother's sought, in which mother's whose children had diarrheal symptoms were less likely to seek formal health care treatment and more likely to utilize traditional providers due to distance (Kenny et. al., 2015). This study had similar findings to those done in other areas of Liberia. In northern Liberia, Kruk et al. (2011) found an association between travel time and utilization of facility-based interventions, and Gartland, Taryor, Norma, & Vermund (2012) found a significant barrier to facility based delivery to be transport difficulties in north-central Liberia.

International support While most developing countries see a large amount of international support, it can be fragmented and poorly coordinated making it more difficult to rebuild and distribute resources after war. Countries with weaken governance due to war is reflected in ineffective management, support systems, supply systems, and misdistribution of resources. Similarly, problems may be worsened when international support is given to and directed by people who have little understanding of local context

(McPake et al., 2015). This indicates that while international support is necessary for survival in countries like Liberia, the heavy reliance on outside support can create problems of their own with the distribution of services and the country inabilities to control where resources are going, risking an imbalance of resources due to NGO special interests and other problems that may arise.

Additionally, during the war aid was fragmented, which has the potential to lead to further problems in the future. Organizations including UNICEF, ICRC, Oxfam, and AFC implemented community-based projects to prevent cholera outbreaks in Liberia after the war. These projects were beneficial for social unity; however, they did very little to increase the coverage or quality of municipal services to those that needed it the most (Pinera & Reed, 2009). Research done to look at these projects concluded that large scale rehabilitation projects have the potential to contribute to the development of water utility, essential in decreasing diarrhea rates, which can ensure the durability of the service, but is unlikely to cover the poor, rundown neighborhoods, the ones in most need of clean water, in the foreseeable future (Pinera & Reed, 2009). On the other hand community-based projects target the poor neighborhoods and rely on locally maintained systems. These projects, however, cannot guarantee quality and long-term sustainability. Unfortunately, these two types of projects seem to focus more on the skill or capability of the agencies involved rather than the needs of the community (Pinera & Reed, 2009). The evaluations done on these projects provide context as to why it can be so difficult for outside sources to provide services that target the groups that need the most help, while also building quality systems for long-term sustainability. These types of systems are essential when trying to target child health issues.

Intergenerational effects of war

It has been suggested that consequences due to conflict can propagate many effects across generations where the impacts of conflict that directly affect the mother can indirectly affect the child, even if they were not born during conflict. These harms to health may be long lasting throughout an individual's lifetime, but the effects may continue through intergenerational biological mechanisms (Devakumar et. al., 2014). As indicated previously, conflict can cause a breakdown of infrastructure, schooling, and resources, while it can also cause mass population displacement and a culture of violence. These effects can impact the mother's health including increasing disease, causing mental health problems, injury from direct violence, and nutritional deficiencies (Devakumar et. al., 2014).

It has been suggested that malnourished mothers may pass the stress to their children, in which their poor nutritional status may affect subsequent generations (Dewey & Begum, 2011). Mothers who are malnourished risk birthing a child with a low birth weight that can lead to stunting. Mother's who have poor prenatal nutrition and care, which can be a result of conflict due to poor living conditions and inadequate health care, have an increased risk of their children having nutritional deficiencies and an increased risk of infection (Dewey & Begum, 2011).

Typical health behavior and knowledge on health behavior also seems to make an impact on the mortality and morbidity of young children. Mother's who are educated on proper hygiene techniques and food preparation see a lower prevalence of diarrhea in their children regardless of their socioeconomic status and living conditions (Emina & Kandala, 2012). Multiple recent studies in Sub-Saharan countries have shown that the

risk for diarrhea is higher in children whose mothers are uneducated (Kahabuka, Kvale, Moland, & Hinderaker, 2011; Mihrete et al., 2014; Yilgwan & Okolo, 2012), indicating the need for improved education for women. Studies in Brazil (Sastry & Burgard, 2008) have shown that for every year of education a women receives, the probability of her child developing diarrhea decreases by eight percent. Children born to educated women are less likely to suffer from malnutrition and studies in various setting have shown that maternal education has been associated with nutrition outcomes (Abuya, Ciera, & Kimani-Murage, 2012; Buor, 2003; Wamani, Tylleskar, Astrom, Tumwine, & Peterson, 2004). Conflict can have a direct impact on mother's education, as displaced families may disrupt schooling. This may have a generational effect as education can be related to future child health outcomes.

Chapter III: Methods

Study Design This study is an observational cross-sectional epidemiological study using secondary data from the Demographic and Health Survey (DHS) in Liberia using child, mother, and household characteristics. The DHS is a household survey where geographical areas were randomly selected from all 15 counties; therefore the data is a nationally representative sample of children in Liberia.

Setting Data from the DHS was taken from the children's recode dataset for children under five years old. The DHS was conducted between December 2006 and April 2007. Specific details on how data was collected have been published elsewhere (see DHS Methodology). Histories of illness and health indicators for children under the age of five were gathered by surveying the mother or caretaker. The dataset contains one record for every child under five of the interviewed women and contains information related to the child's pregnancy, postnatal care, immunizations, and health, and also includes the data on the mother for each of the children.

Outcome measures The three health outcome measures for children under five used in this study are acute diarrhea, stunting and full adherence to the recommended vaccination schedule.

Diarrhea is defined by the standard DHS as "increased frequency of depositions and/or low consistency of feces." According to DHS, the terms used for diarrhea during the survey should encompass the expressions used for all forms of diarrhea including blood stools, watery stools, etc., as well as the mother/caretaker's definition and "local terms." The survey asks the mothers if their child has had a running stomach any time during the last two weeks. The measurement is determined based on the mother's answer

(0=no; 1=yes) of the presence of diarrhea from the child at any time during the two weeks preceding the survey interview.

The 2007 DHS calculated the nutritional status of children based on the standards published by the World Health Organization (WHO) in 2006. According to the Liberia DHS, stunting is defined as children that are short for their age and chronically malnourished. This is determined using the height-for-age Z-score. Children with Z-scores that are minus two standard deviations (-2 SD) or lower were considered stunted. The proctors of the survey took the height measurements with the child either standing or lying down.

According to guidelines developed by WHO (2006), children are considered fully vaccinated when they have received BCG, three doses of both DPT and polio and a measles vaccination by the age of 12 months. Vaccinations were determined first by documentation on the child's vaccination care, and if not available, through the mother's report. Using information from the individual vaccination questions in the survey the full vaccination variable was created. We created a binary (Yes/No) full vaccination variable. Because doses of each vaccine are different, the age of child was taken in to account when determining whether they were fully vaccinated for their age. The measles vaccine is not given until the child has reached 9 months of age. For the purposes of our analysis, due to the possible difficulty of getting to a health care facility, we extended the timeframe to 12 months. Children over 12 months are required to have the measles vaccination, along with the others, in order to be fully vaccinated, but children under 12 months are not required to have the measles vaccination. Children between the ages of 3 months and 12 months who had received the BCG vaccine, three doses of DPT, and two

doses of polio were considered fully vaccinated (1=yes). Children older than 12 months were considered fully vaccinated (1=yes) if they had received the BCG, three doses of both DPT and polio, and the measles vaccination. Children under 12 months that were missing one or more of the BCG, three doses of DPT and two doses of the polio vaccine were not considered fully vaccinated. Children older than 12 months were not considered fully vaccinated if they were missing one or more of the BCG, three doses of DPT and polio, and the measles vaccination (0=no).

Independent variables The key independent variable of this study is the displacement during the civil war period in Liberia. The displacement variable was created using multiple variables in the dataset in the DHS survey specific to Liberia about where the respondent lived during the war. The variables in the dataset were created by the answer to the question "Where did you live during the war?" We combined these variables to create one categorical displacement variable that consists of the categories of Liberians that stated: they did not leave home (1), those that stayed with relatives or friends in Liberia (2), those who went to a camp (3), those who lived in the bush (4), those who lived outside of Liberia (5) and those who stated they went elsewhere (6).

Sociodemographic variables (urban/rural location, geographic region, wealth index, mothers education, and age of both mother and child) and health care specific variables (recent visit to healthcare facility, distance to health facility) were assessed for all three health outcome measures. Models for diarrhea included toilet facility type, water source, stool disposal, awareness of oral rehydration salts, and whether drugs taken for intestinal parasites were recently used. Models for stunting included when breastfeeding was started after birth, exclusivity of breastfeeding, and whether the first Vitamin A dose

was received. The variables were taken from different sections of the DHS study and represent individual (children's data), interpersonal (mother's data), and social and environmental (household data) data.

Data sources/measurements The outcome measures eligibility varied, which reduced the sample size for each dependent variable. The diarrhea outcome measure included only those who answered a question regarding whether or not the child had diarrhea in the last two weeks from when the survey was conducted. Those that did not know or declined to answer were dropped. For stunting, the children had to be present in order to record their height during data collection.

Study size The survey sample size in total included 5,799 children. Because of the differing eligibility of the outcomes measures, the sample size varied between variables (see Figure 1).

Quantitative variables The continuous height-for-age variable data was the children's height-for-age Z-score ranging between -5.99 and 5.74 standard deviations. This variable was used to create a categorical stunting variable in which children with a Z-score of -2 standard deviations and lower were considered stunted and chronically malnourished, and those with a Z-score of -1.99 standard deviations or larger were considered not stunted. This was determined based on the WHO determination of Z-scores and stunting (2006).

Statistical methods The statistical analyses was performed using STATA version IC. The data was weighted to account for complex sampling strategy using variable weights provided by DHS. Differences between with and without diarrhea, child stunting, and full vaccinations were calculated using chi-square tests for categorical variables and

t-tests for continuous variables using the alpha of <0.05. The odds ratios and confidence intervals were obtained using logistic regression to determine the association between each independent variable and having diarrhea, stunted growth and being fully vaccinated. Confounding was controlled3 by doing a multivariate logistic regression, and each analysis was modeled doing a backward stepwise method with an entry point of 0.1 and an exit point of 0.05. Collinearity between covariates was determined by assessing tolerance values less than 0.1. Problems with collinearity were not detected. Only those with complete data for all variables in the model were included in the final model. Those with missing data were dropped (see Figure 1).

Ethical considerations Permission for this study was obtained by an Institutional Review Board. The Idaho State University IRB considered this research exempt.

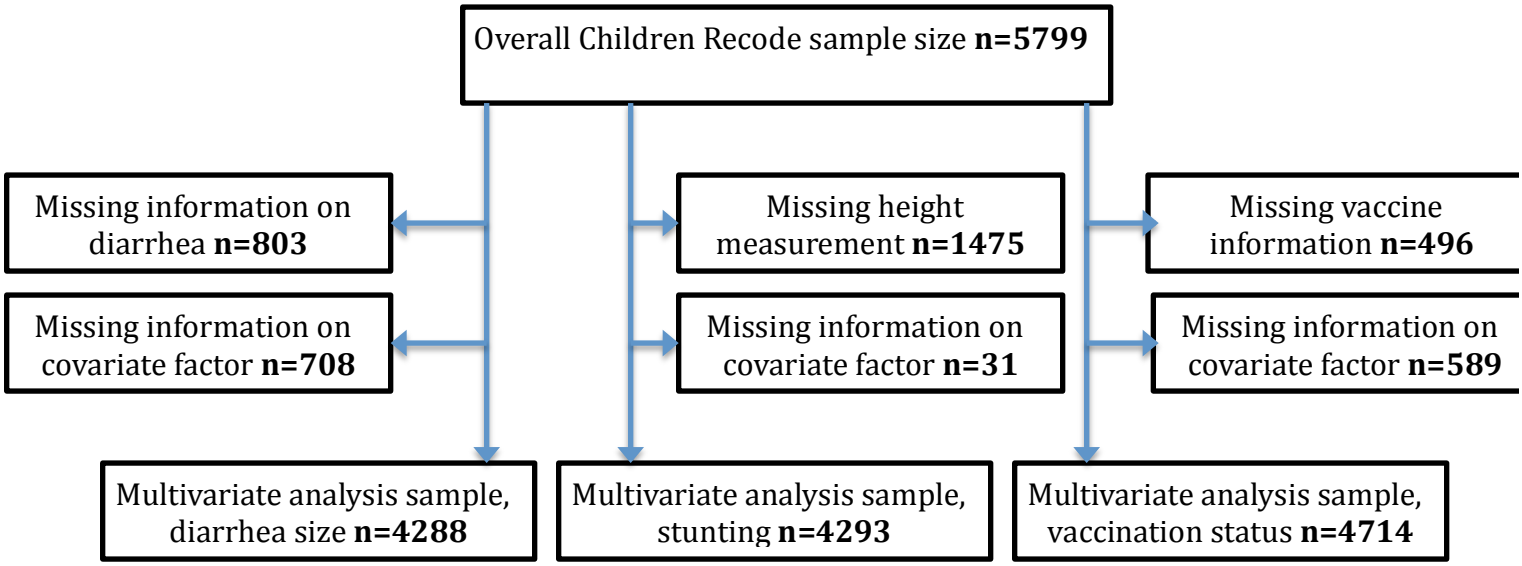

Figure 1: Sample size for three child health outcomes: diarrhea, stunting, and vaccination status.

Chapter IV: Results

Overall prevalence of displacement categories

The overall prevalence of mothers that did not leave home during the war was 9.68% (95% CI 8.94%-10.5%). The overall prevalence of mothers displaced during the war that lived with family or friends was 24.42% (95% CI 23.3%-25.5%), lived in a camp was 11.74% (95% CI 10.93%-12.60%), lived in the bush was 29.70% (95% CI 28.54%-30.90%), lived outside of Liberia during the war was 24.00% (95% CI 22.92%-25.13%), and went elsewhere during the war was 0.45% (95% CI 0.31%-0.66%).

Prevalence and correlates of diarrhea

The overall prevalence of diarrhea was 21.45% (95% CI 20.3%-22.6%) among children under five years of age in the two weeks preceding the survey. Respondents who indicated their child had had diarrhea within the last two weeks were more likely to be living in the bush during the war (see Table 1). Respondents who had children that had experienced diarrhea in the last two weeks were also more likely to have been from the South Eastern B region of Liberia, to have put or rinsed their child's stool in a drain or a ditch, had used ORS, and had taken drugs for intestinal parasites within the last 6 months. Whether or not they had visited a health care facility in the last 12 month, their urban/rural location, wealth index, distance to a health care facility, the mother's age, type of toilet facility and water source did not significantly differ between those who responded that their child had experienced diarrhea in the last two weeks and those that did not.

Respondents who lived in the bush during the civil war were almost two times more likely (OR = 1.85, 95% CI 1.28-2.69) to have children who experienced diarrhea in

the two weeks preceding the survey than the respondents who did not leave their home during the civil war (see Table 2). Respondents living in the South Eastern B region of Liberia were over two times more likely (OR=2.20, 95% CI 1.61-3.01) to have children with diarrhea than those that lived in Monrovia. Mother's who indicated they disposed of their child's stools in a drain or ditch were over 1.5 timed more likely (OR=1.63, 95% CI 1.20-2.20) to have a child who had experienced diarrhea than the mother's who said they disposed of their child's stool in a toilet or latrine. Children who had used drugs for intestinal parasites in the last 6 months were also over 1.5 times more likely (OR=1.64, 95% CI 1.37-1.97) to have experienced diarrhea than those that had not taken the drugs.

In the multivariate final model, factors that were independently associated with diarrhea were source of water, stool disposal, region, receiving an anti-parasite drug in the last 6 months and child's age. Displacement was not significant in the final model. After adjusting for factors in the final model, respondents living in the South Eastern B region of Liberia were over 2.5 times more likely (OR=2.62, 95% CI 1.77-3.86) to have children with diarrhea than those in Monrovia (see Table 2). For every month the child increases in age, they were nearly two times more likely (OR=1.71, 95% CI 1.41-2.08) to have had diarrhea in the last two weeks preceding the survey. Those with children that had diarrhea were also two times more likely (OR=1.92, 95% CI 1.02-3.64) if they got their water from a tube compared to those whose water source was piped and about 1.5 times (OR=1.44, 95% CI 1.04-2.01) more likely to have diarrhea if the child's stools were disposed of in a drain or a ditch compared to those who dispose of their child's stool in a toilet or latrine. Mother's with children who had diarrhea were also more likely

(OR=1.71, 95% CI 1.41-2.08) to have had a child receive anti-parasitic drugs in the last 6 months than those who did not.

Prevalence and correlates of stunting

The overall prevalence of children surveyed who were considered stunted was 38.2% (95% CI 36.8%-39.7%). Respondents who had children that were stunting were more likely to have lived in the bush during the civil war (see Table 1). They were also more likely to be living in rural locations, be living in the South Eastern B region of Liberia, come from the poorest or poorer wealth index, and have no education or primary education only. Their children were also more likely to be stunted if they did not breast feed exclusively for the first 3 days after birth, if the child was not given their first dose of vitamin A, and if they indicated that it was a big problem to get to health care facility. The time in which the mother started breastfeeding after birth and mother's age did not significantly differ between children who were considered stunted and those that were not.

Children living in rural locations were nearly two times more likely (OR=1.75, 95% CI 1.46-2.05) to be stunted compared to those living in urban location (see Table 2). Children living in the South Eastern B region of Liberia were also two times more likely (OR=1.94, 95% CI 1.45-2.59) to be stunted compared to children living in Monrovia. Families in the richest wealth index category were about half as likely (OR=0.43, 95% CI 0.33-0.57) to have stunted children compared to those in the poorest wealth index. Those who had visited a health facility within the last 12 months were also less likely (OR=0.63, 95% CI 0.52-0.76) to have stunted children compared to those who had not visited a health facility. Children who had received their first dose of vitamin A were 25

percent less likely (OR=0.75, 95% CI 0.60-0.93) to be stunted than those who had not received their first dose.

In the multivariate final model, factors that were independently associated with stunting were wealth index, child's age, and mother's age. Displacement was not significant in the final model. After adjusting for factors in the final model, mothers with the poorest or poorer wealth index were over 50 percent more likely to have stunted children than those in the richest wealth index (OR=0.46, 95% CI 0.34-0.62) (see Table 2).

Prevalence and correlates of vaccination rates

The overall prevalence of children that were considered not fully vaccinated was 30.7% (95% CI 29.5%-32.0%). Respondents whose children were not fully vaccinated were most likely to have lived in the bush during the civil war (see Table 1). Respondents living in rural locations, living in the South Eastern B region, coming from the poorest wealth index, having no education, and who indicated that distance to health care facility was a big problem were more likely to have not fully vaccinated children. The mother's age did not significantly differ between fully vaccinated children and those who were not fully vaccinated.

Children whose family lived in the bush during the war were about half as likely (OR=0.59, 95% CI 0.44-0.80) to be fully vaccinated as those who stayed in their home during the war (see Table 2). Children living in rural locations were about 60 percent less likely (OR=0.38, 95% CI 0.30-0.48) to be fully vaccinated compared to those living in urban locations and children living in the South Eastern B region of Liberia were nearly 90 percent less likely (OR=0.12, 95% CI 0.08-0.18) to be fully vaccinated than children

living in Monrovia. Families in the richest wealth index were five times more likely (OR=5.06, 95% CI 3.33-7.76) to have vaccinated children compared to families in the poorest wealth index. Mother's who completed secondary education or higher were over two times more likely (OR=2.20, 95% CI 1.70-2.86) to have fully vaccinated children than mother's who did not have any education.

In the multivariate final model, factors that were independently associated with full vaccination were wealth index, place of residence, region, visited a health care facility in the last 12 months, and child's age. Displacement was not significant in the final model. After adjusting for factors in the final model, mother's living in rural places of residence were 30 percent less likely (OR=0.67, 95% CI 0.45-1.00) to have children who were fully vaccinated compared to those living in urban areas (see Table 2). Those living in the South Eastern B region of Liberia were 80 percent less likely (OR=0.20, 95% CI 0.18-0.50) to have children who were fully vaccinated compared to those living in Monrovia. Those with the richest wealth index were over three times more likely (OR=3.22, 95% CI 1.92-5.41) to have fully vaccinated children than those in the poorest wealth index. Also, those who had visited a health care facility in the last 12 months were about two times more likely (OR=1.93, 95% CI 1.51-2.47) to have fully vaccinated children than those that had not.

Table 1: Health outcomes among Liberian children under the age of five by mother's displacement, demographic and socioeconomic correlates, 2007.

	Diarrhea			Stunting			Fully vaccinated		
	Yes	No	p-value	Yes	No	p-value	Yes	No	p-value
Displacement			<0.001			<0.001			<0.001
Did not leave home	89 (16.15)	412 (83.85)		151 (36.33)	272 (63.67)		147 (32.62)	372 (67.38)	
Stayed with relatives or friends in Liberia	247 (20.11)	954 (79.89)		332 (32.21)	689 (67.79)		511 (42.08)	778 (57.92)	
Went to a camp	79 (14.98)	519 (85.02)		203 (38.68)	326 (61.32)		223 (36.88)	402 (63.12)	
Lived in the bush	388 (26.31)	1069 (73.69)		545 (42.03)	732 (57.97)		337 (22.24)	1214 (77.76)	
Lived outside Liberia	257 (19.12)	923 (80.88)		399 (38.83)	621 (61.17)		392 (35.96)	863 (64.04)	
Went elsewhere	9 (39.58)	16 (60.42)		8 (44.20)	15 (55.80)		11 (36.43)	14 (63.57)	
Location			0.532			<0.001			<0.001
Urban	382 (19.80)	1358 (80.20)		443 (29.08)	1032 (70.92)		798 (48.56)	1053 (51.44)	
Rural	690 (21.20)	2566 (78.80)		1209 (41.47)	1640 (58.53)		832 (26.42)	2620 (73.58)	
Region			<0.001			<0.001			<0.001
Monrovia	140 (16.40)	707 (83.60)		198 (29.16)	509 (70.84)		464 (51.96)	428 (48.04)	
North Western	62 (10.01)	579 (89.98)		229 (37.69)	342 (62.31)		248 (38.40)	423 (61.60)	
South Central	190 (21.98)	602 (78.02)		236 (34.86)	464 (65.14)		264 (28.57)	580 (71.43)	
South Eastern A	141 (19.26)	582 (80.74)		247 (39.92)	371 (60.08)		161 (18.88)	619 (81.12)	
South Eastern B	295 (30.12)	656 (69.88)		376 (44.42)	454 (55.58)		147 (11.50)	881 (88.50)	
North Central	244 (23.84)	798 (76.16)		366 (41.93)	532 (58.07)		346 (30.30)	742 (69.70)	
Wealth Index			0.207			<0.001			<0.001
Poorest	239 (20.22)	982 (79.78)		473 (43.38)	596 (56.62)		226 (18.12)	1071 (81.88)	
Poorer	249 (20.10)	947 (79.90)		456 (42.95)	594 (57.05)		327 (27.39)	938 (72.61)	
Middle	245 (22.30)	802 (77.70)		346 (38.27)	556 (61.73)		353 (33.38)	766 (66.62)	
Richer	221 (21.14)	759 (78.86)		271 (32.29)	575 (67.61)		416 (44.32)	628 (55.68)	
Richest	118 (19.82)	434 (80.18)		106 (24.87)	351 (75.13)		308 (52.95)	270 (47.05)	
Mothers Education			0.007			<0.001			<0.001
No Education	471 (20.34)	1918 (79.66)		862 (39.98)	1254 (60.02)		673 (29.43)	1868 (70.57)	
Primary	434 (21.75)	1395 (78.25)		611 (39.04)	957 (60.96)		577 (31.55)	1363 (68.45)	
Secondary or higher	166 (19.86)	608 (80.14)		178 (28.01)	458 (71.99)		379 (47.90)	438 (52.10)	
Visited a health facility in the last 12 months			0.128			<0.001			<0.001
No	304 (21.49)	1200 (78.51)		572 (45.33)	718 (54.67)		296 (20.79)	1297 (79.21)	
Yes	765 (20.69)	2689 (79.31)		1059 (34.27)	1940 (65.73)		1321 (38.22)	2347 (61.78)	
Getting medical help: Distance to health facility			0.752			<0.001			<0.001
Big Problem	619 (20.80)	2243 (79.20)		1035 (41.08)	1453 (58.92)		671 (23.60)	2373 (76.40)	
Not a big problem	450 (20.74)	1667 (79.26)		612 (33.56)	1207 (66.44)		954 (45.83)	1286 (54.17)	
Age of Child (months)			0.020			<0.001			0.005
Weighted Mean	26.61	28.41		33.58	25.15		29.28	27.45	
Age of Mother (years)			0.493			0.512			0.946
Weighted Mean	28.98	29.27		29.51	29.34		29.16	29.18	
Toilet Facility			0.127			-			-
Flush Toilet	70 (21.03)	270 (78.97)		-	-		-	-	
Pit Latrine, improved	72 (23.38)	224 (76.62)		-	-		-	-	
Pit Latrine with slab	78 (17.97)	342 (82.03)		-	-		-	-	

Pit Latrine without slab/Open pit	154 (26.18)	468 (73.82)		-	-		-	-
No Facility/bush/field	595 (19.78)	2268 (80.22)		-	-		-	-
Other	86 (76.89)	303 (76.89)		-	-		-	-
Water Source			0.295			-		-
Piped water	44 (17.15)	205 (82.85)		-	-		-	-
Tube well water	36 (28.09)	97 (71.91)		-	-		-	-
Protected well	574 (20.78)	2086 (79.22)		-	-		-	-
Unprotected well	128 (24.99)	411 (75.01)		-	-		-	-
Protected spring	16 (14.42)	77 (85.58)		-	-		-	-
Unprotected spring	69 (15.47)	290 (84.53)		-	-		-	-
River/dam/lake/ponds/stream/ canal	171 (20.48)	640 (79.52)		-	-		-	-
Other	20 (21.03)	75 (78.97)		-	-		-	-
Stool Disposal			0.003			-		-
Used or put in toilet/latrine	223 (17.00)	930 (83.00)		-	-		-	-
Put/rinsed into drain or ditch	182 (24.98)	574 (75.02)		-	-		-	-
Throw into garbage	262 (22.37)	891 (77.63)		-	-		-	-
Buried	112 (20.40)	476 (79.60)		-	-		-	-
Left in the open/not disposed of	164 (17.83)	472 (82.17)		-	-		-	-
Other	43 (20.92)	200 (79.08)		-	-		-	-
Heard of oral rehydration (ORS)			<0.001			-		-
Never heard of ORS	55 (18.12)	246 (81.88)		-	-		-	-
Used ORS	590 (77.63)	169 (77.63)		-	-		-	-
Heard of ORS	401 (10.39)	3336 (89.61)		-	-		-	-
Drugs taken for intestinal parasites in last 6 months			<0.001			-		-
No	485 (17.29)	2227 (82.71)		-	-		-	-
Yes	582 (25.57)	1637 (74.43)		-	-		-	-
Starting Breastfeeding After Birth			-			0.444		-
1 hour or less	-	-		1173 (39.06)	1855 (60.94)		-	-
2-10 hours	-	-		199 (34.75)	355 (65.25)		-	-
11 hours or longer	-	-		227 (34.48)	373 (65.52)		-	-
Exclusively breastfed for first 3 days			-			0.002		-
Yes	-	-		757 (31.94)	1570 (68.06)		-	-
No	-	-		279 (37.69)	438 (62.31)		-	-
Received Vitamin A Dose 1			-			0.008		-
No	-	-		405 (43.16)	558 (56.84)		-	-
Yes	-	-		1174 (36.19)	1971 (63.81)		-	-

Table 2: Bivariate logistic regression of child health oucomes and mother's displacement, demographic and socioeconomic correlates, and multivariate analysis of child health outcomes and mother's displacement, demographic and socioeconomic correlates, Liberia, 2007.

	Diarrhea		Stunting		Fully vaccinated	
	OR (CI)	Adjusted OR (CI)	OR (CI)	Adjusted OR (CI)	OR (CI)	Adjusted OR (CI)
Displacement (Ref. Did not leave home)						
Stayed with relatives or friends in Liberia	1.31 (0.93-1.84)	1.18 (0.83-1.70)	0.83 (0.62-1.12)	0.83 (0.60-1.14)	1.50 (1.14-1.98)	1.29 (0.96-1.73)
Went to a camp	0.91 (0.59-1.43)	1.14 (0.64-2.03)	1.11 (0.83-1.48)	0.96 (0.71-1.30)	1.21 (0.82-1.77)	1.19 (0.79-1.81)
Lived in the bush	1.85 (1.28-2.69)	1.34 (0.91-1.98)	1.27 (0.96-1.69)	1.13 (0.85-1.51)	0.59 (0.44-0.80)	0.75 (0.53-1.05)
Lived outside Liberia	1.23 (0.83-1.82)	0.98 (0.62-1.56)	1.11 (0.84-1.48)	1.03 (0.76-1.39)	1.16 (0.82-1.63)	1.27 (0.88-1.82)
Went elsewhere	3.40 (1.13-10.19)	7.27 (1.28-41.11)	1.39 (0.30-6.51)	1.16 (0.26-5.23)	1.18 (0.38-3.69)	1.30 (0.48-3.52)
Location (ref. Urban)						
Rural	1.09 (0.87-1.36)	-	1.75 (1.46-2.05)	-	0.38 (0.30-0.48)	0.67 (0.45-1.00)
Region (Ref. Monrovia)						
North Western	0.57 (0.37-0.86)	0.68 (0.39-1.18)	1.47 (1.00-2.17)	-	0.58 (0.37-0.90)	1.34 (0.78-2.30)
South Central	1.44 (1.01-2.05)	1.53 (1.06-2.23)	1.30 (1.00-1.69)	-	0.37 (0.28-0.49)	0.78 (0.52-1.18)
South Eastern A	1.22 (0.85-1.73)	1.57 (1.01-2.46)	1.61 (1.26-2.07)	-	0.22 (0.15-0.30)	0.51 (0.32-0.83)
South Eastern B	2.20 (1.61-3.01)	2.62 (1.77-3.86)	1.94 (1.45-2.59)	-	0.12 (0.08-0.18)	0.20 (0.18-0.50)
North Central	1.60 (1.18-2.16)	1.93 (1.37-2.71)	1.75 (1.40-2.19)	-	0.40 (0.29-0.56)	0.98 (0.63-1.52)
Wealth Index (Ref. Poorest)						
Poorer	0.99 (0.77-1.28)	-	0.98 (0.80-1.21)	0.98 (0.79-1.22)	1.70 (1.19-2.44)	1.66 (1.17-2.37)
Middle	1.12 (0.82-1.56)	-	0.81 (0.65-1.01)	0.85 (0.68-1.07)	2.26 (1.61-3.17)	2.01 (1.41-2.87)
Richer	1.06 (0.78-1.43)	-	0.62 (0.49-0.79)	0.65 (0.51-0.84)	3.60 (2.51-5.14)	2.48 (1.62-3.79)
Richest	0.98 (0.71-1.33)	-	0.43 (0.33-0.57)	0.46 (0.34-0.62)	5.09 (3.33-7.76)	3.22 (1.92-5.41)
Mothers Education (Ref. No Education)						
Primary	1.09 (0.92-1.29)	-	0.96 (0.80-1.16)	-	1.11 (0.88)-1.36)	-
Secondary or higher	0.97 (0.75-1.26)	-	0.58 (0.45-0.75)	-	2.20 (1.70-2.86)	-
Visited a health facility in the last 12 months (Ref. No)						
Yes	0.95 (0.75-1.21)	-	0.63 (0.52-0.76)	-	0.42 (0.34-.53)	1.93 (1.51-2.47)
Distance to health facility (Ref. Big Problem)						
Not a big problem	1.00 (0.79-1.25)	-	0.72 (0.60-0.87)	-	0.37 (0.29-0.46)	-
Age of child in months	0.99 (0.99-1.00)	1.71 (1.41-2.08)	1.03 (1.03-1.03)	1.03 (1.03-1.04)	1.01 (1.00-1.01)	1.01 (1.01-1.02)
Age of mother in years	0.99 (0.98-1.01)	-	1.00 (0.99-1.01)	0.99 (0.98-0.99)	1.00 (0.99-1.01)	-
Toilet Facility (Ref. Flush toilet)						
Pit latrine, improved	1.15 (0.67-1.97)	-	-	-	-	-
Pit latrine with slab	0.82 (0.53-1.26)	-	-	-	-	-
Pit latrine without slab/open pit	1.33 (0.83-2.12)	-	-	-	-	-
No facility/bush/field	0.93 (0.65-1.32)	-	-	-	-	-
Other	1.13 (0.70-1.81)	-	-	-	-	-
Water Source (Ref. Piped water)						
Tube well water	1.89 (1.01-3.52)	1.92 (1.02-3.64)	-	-	-	-
Protected well	1.27 (0.84-1.92)	1.20 (0.74-1.94)	-	-	-	-
Unprotected well	1.61 (1.00-2.59)	1.24 (0.71-2.16)	-	-	-	-
Protected spring	0.81 (0.37-1.77)	0.75 (0.36-1.58)	-	-	-	-
Unprotected spring	0.88 (0.53-1.49)	0.73 (0.42-1.29)	-	-	-	-
River/dam/lake/ponds/canal	1.24 (0.72-2.16)	1.02 (0.54-1.92)	-	-	-	-

Other	1.29 (0.75-2.20)	1.12 (0.59-2.12)	-	-	-	-
Stool Disposal (Ref. Used or put in toilet/latrine)						
Put/rinsed into drain or ditch	1.63 (1.20-2.20)	1.44 (1.04-2.01)	-	-	-	-
Throw into garbage	1.41 (1.09-1.82)	1.13 (0.86-1.50)	-	-	-	-
Buried	1.25 (0.78-2.00)	1.15 (0.71-1.87)	-	-	-	-
Left in the open/not disposed of	1.34 (0.92-1.88)	1.05 (0.70-1.56)	-	-	-	-
Other	1.06 (0.69-1.62)	1.20 (0.77-1.86)	-	-	-	-
Heard of oral rehydration (ORS) (Ref. Never heard of ORS)						
Used ORS	15.68 (10.62-23.15)	-	-	-	-	-
Heard of ORS	0.52 (0.36-0.77)	-	-	-	-	-
Drugs given to child for intestinal parasites in last 6 months (Ref. No)						
Yes	1.64 (1.37-1.97)	1.71 (1.41-2.08)	-	-	-	-
Starting Breastfeeding After Birth (Ref. 1 hour or less)						
2-10 hours	-	-	0.83 (0.64-1.06)	-	-	-
11 hours or longer	-	-	0.82 (0.65-1.03)	-	-	-
Exclusively breastfed for first 3 days (Ref. Yes)						
No	-	-	0.77 (0.62-0.97)	-	-	-
Child received Vitamin A Dose 1 (Ref. No)						
Yes	-	-	0.75 (0.60-0.93)	-	-	-

Chapter V: Discussion

Among displacement groups measured, respondents who indicated they lived in the bush during the war had the highest rates of children with diarrhea, highest rates of stunted children and the lowest rates of fully vaccinated children. Diarrhea and rates of full vaccination had significant association in the bivariate models, though they were not significant in the multivariate modeling. Thus, the association between displacement and the two child health outcomes, diarrhea and vaccination, may partially be explained by covariates in our model, such as income, and urban/rural status. The health outcomes for children of mother's who said they lived in camps during the war did not differ significantly from those who said they lived at home, and even had higher full vaccination rates and a lower prevalence of diarrhea than those who did not migrate during the war. Respondents that indicated they lived with relatives or friends during the war also had lower rates of diarrhea and stunting and they had the highest rates of full vaccination and lowest rates of stunting out of all the displacement categories including those that stayed in their homes during the war. Additionally, those that left Liberia during the war had lower rates of diarrhea and stunting compared to those living in the bush, and they had full vaccination rates comparable to those that were living in camps during the war. These finding may indicate that long lasting effects of children's health could improve if displaced people are able to get into camps or elsewhere, in order to eliminate or reduce exposure to bush living as this seems to have the largest association with the long-term negative impacts on child health outcomes

We found that most of the women with children in Liberia were directly impacted by the war, as the majority of the population was displaced. It was estimated that

500,000-600,000, or one-third of the country, was displaced during the war (IDMC, 2013); however, the survey indicated that nearly 90% of the respondents were displaced from there homes. This is likely because the IDMC's definition of displacement was different from ours. A small minority of mother's surveyed indicated that they stayed in their home during the war, with most displaced, and nearly one-third of mother's stated they lived in the bush during the war. Since the impact of war affected so many within Liberia, it is unclear whether there was much protection from violence and trauma afforded to those women that remained home. Thus, the differences in risk for long-lasting effects for children of those displaced may be difficult to detect within Liberia given limited information on displacement. Yet, there was some evidence of increased risk for those displaced to live in the bush.

Differences in child health outcomes also varied greatly depending on the region and urban/rural status. Those living in rural areas, and in the South Eastern B region of Liberia in particular, had much poorer health outcomes, compared to those in urban areas and compared to other regions. The rates of diarrhea and stunting were the highest, and the number of children under five that were fully vaccinated was significantly lower in South Eastern B compared to the other regions throughout Liberia. This could potentially be explained by the impacts that the war had on the South Eastern region, as it has been indicated that this area possibly was impacted the most by the war, since the county of Grand Kru, one of the three counties making up the South Eastern B region of Liberia, has been cut off from the rest of the country. The main bridge, Nu River, was destroyed during the war cutting of the main town and two-thirds of the county from the rest of Liberia (IRIN, 2005). Additionally, the majority of those living in the counties that makes

up the South Eastern B region of Liberia are part of the poorest and poorer wealth indexes.

There were also additional associations that could be an indirect impact from the consequences of conflict and displacement such as mother's education, and distance and ability to reach a health facility as these were independently associated with child health outcomes in this study. As mentioned previously, mother's education could be disrupted by conflict and displacement and, because of the destruction brought on by the war in Liberia, the ability to find a functioning health care facility could be difficult. Child health outcomes can have various direct and indirect causes, but more research should be done to further look at the long-term impact that displacement can have on children both in the present and in the future. As more research is being done on the intergenerational effects of conflict, more analysis should be done to take a closer look at risk associated with different types of displacement and the possible long-term health disparities that can occur with displacement.

Limitations This study has important limitations that should be noted when assessing our findings. First, the information available in the DHS does not allow us to know the timeline for when, and how long, the mothers were displaced. Without this information we are unable to determine direct versus indirect exposure to displacement among the children in our study since there may have been some children in our study that were displaced or in the womb with their mothers at the time of displacement. This may have resulted in an overestimation of the indirect effects of displacement on children's health. Second, the DHS did not include a measure of violence experienced during the war. Thus we are unable to control for the relationship between displacement,

child health and direct personal violence experienced. Lastly, the cross-sectional nature of this study only allows for exploration of associations and does not allow for longitudinal prediction, follow-up, or statements on causation.

Recommendations This study had a robust amount of variables for assessing the effects of displacement and child health risks, indicating the long lasting effects on children's health. This study shows that there may be potential benefit in focusing efforts to move internally displaced populations into camps or elsewhere, such as with family and friends, and out of the bush during times of conflict in order to decrease the direct and indirect impact that the consequences of conflict have on child health.

Conclusions This study looked at the impacts that displacement from conflict had on child health outcomes. Most mothers reported living somewhere other than home during the war, with almost one-third living in the bush. Rates of diarrhea, stunting and incomplete vaccination were highest in those that lived in the bush during the civil war. Displacement was positively associated with diarrhea, and incomplete vaccination rates during the bivariate analysis, though not significant in the multivariate models. The prevalence of diarrhea, stunting, and full vaccination for those that indicated they lived in a camp, lived with friends/relatives, or lived outside of Liberia during the war is comparable to those that stayed at home. The results of this study could be used to drive further research on displacement groups during conflict and how the type of displacement and the conditions in which the mother and/or child are living in during conflict may affect both immediate and long-term child health outcomes.

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