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Examining the relationship between WASH characteristics and malnutrition outcomes in Bihar, India in order to inform CARE-India study

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ABSTRACT

Intro: Undernutrition contributes to almost 45% of the mortality rate in children under five years of age. Stunting, wasting, and severe wasting, also classified as severe acute malnutrition (SAM), are three of the major nutritional outcomes, putting children at risk for poor development, morbidity, and mortality. In this study, the role of an unsafe environment is explored, specifically the role of water, sanitation, and hygiene (WASH), in relation to malnutrition outcomes in Bihar, India.

Methods: Secondary data analysis was conducted using the Fourth National Family and Health Survey data for Bihar (n=25110). Binary logistic regressions were conducted to examine the associations between WASH and child nutrition. For adjusted models, a WASH composite index was created that summed the key WASH variables. Qualitative cognitive interviews (n=23) were conducted to contextualize the WASH questionnaire for the Bihar context and inform the on-going CARE-India SAM study.

Results: The prevalence of malnutrition is significantly higher in Bihar than compared to the global average. 47.6% of children 0-59 months are stunted, 20.3% are wasted, and 6.7% are severely wasted (SAM). Age of the child, household wealth index, and the maternal education and literacy were significant predictors of SAM and wasting. For stunting, the scheduled caste/tribe status of the household was also significant. WASH was a significant predictor for all three nutritional outcomes during crude analyses, and adjusted models continued to show this association for stunting and wasting outcomes. Qualitative data analysis of cognitive interviews indicated that use and functionality of the water source, water quality and understanding of water security issues, and distrust were major themes.

Conclusion: The significant association of WASH with malnutrition, along with the high rates of malnutrition outcomes in the region, makes WASH a key target area for CARE-India to reduce malnutrition outcomes among children 0-59 months. Integration of the revised WASH tool into SAM study will likely better inform CARE-India on the state of water security in Bihar to improve programs targeted at malnutrition. Programs integrating education of proper nutrition and safer WASH practices will likely be the best approach to reducing the rates of malnutrition in Bihar.

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INTRODUCTION

Undernutrition is a significant determinant of maternal and child mortality in developing countries (Black, et.al., 2008). Those who survive are plagued with mental and developmental disabilities, which puts a strain on families socially and economically, and impedes subsequent generations' health as well. Specifically, undernutrition among mothers leads to intrauterine growth restriction and micronutrient deficiencies, contributing to low birth weight (<2500 g), stunting, and wasting among their children. These issues increase the risk of anemia, delayed cognitive development, and susceptibility to infectious diseases such as pneumonia and diarrheal diseases, creating a vicious cycle of generational undernutrition among mothers and children (Black, et.al., 2008). Severe acute malnutrition (SAM), which 17 million children currently suffer from globally (Bhadoria, et.al., 2017; UNICEF, et.al., 2017), puts children at higher risk for infections and mortality, and causes an inability to respond to and cope with environmental stressors (Briend, et.al., 1989). The first 1000 days, which includes pregnancy to 24 months, are the most severely impacted by SAM, and during this time, stunting and wasting can also have lasting effects on the child's adult life (Victora, et.al., 2008).

India has the largest number of malnourished children than any other region of the world, with numbers as high as 57 million (Bhadoria, et.al., 2017). Eight million of these children currently suffer from SAM and experience mortality rates as high as 20-30% (Kapil, 2009). In 2013, the United Nations International Child Emergency Fund (UNICEF) published a conceptual framework that outlined the underlying causes of child undernutrition (refer to Figure 1), which include household food insecurity, inadequate child care and feeding practices, and an unhealthy environment. Of these, the role of an unsafe environment, namely WASH, has consistently shown to have a significant impact on child nutritional status globally (WHO, 2015). An unsafe environment includes unsafe water, unsanitary conditions, and poor hygiene practices, which combine to contribute to an increase in illnesses among children, namely diarrhea and other gastrointestinal diseases. Repeated exposure to unsafe environmental conditions can lead to chronic gastrointestinal infection, which causes undernutrition by affecting nutrient absorption and perpetuating the cycle of illness and undernutrition (Chitty, 2014). Recent studies in rural India have also shown similar associations. In one specific study conducted in rural India, improved WASH conditions, such as hand

washing before cooking and after defecation, access to a safe, improved water source, and utilization of improved sanitation facilities, were associated with decreased stunting prevalence among children 1-23 months (Rah, 2015). Several evidence-based interventions, including hygiene interventions, have shown positive impacts on maternal and child undernutrition in all 36 developing countries they were implemented in (Bhutta, et.al., 2008).

One of the regions affected by malnutrition in India is the state of Bihar, where CARE-India is currently conducting a study to determine the prevalence and determinants of SAM among children 0-59 months. The specific etiology of SAM in Bihar remains unclear, including the role water, sanitation, and hygiene (WASH) practices. By using the survey data from the Fourth National Family and Health Survey (NFHS-IV), and qualitative data collected through water security cognitive interviews with CARE-India, this paper seeks to describe the nutritional status of children 0-59 months in Bihar, India, and propose recommendations targeted at improving these outcomes. Understanding the determinants of SAM, wasting, and stunting are crucial for Bihar. Considered one of the poorest states in India, Bihar suffers from low literacy and high poverty rates. Previous studies have shown that these factors, especially those of the mother, play a critical role in child nutritional status in rural areas in India. Other key factors included caste, gender, and program accessibility of the child and of the family. By conducting a similar analysis for Bihar, programmatic approaches can be targeted to specific, significant determinants of malnutrition.

Specific objectives of this study are to 1) describe the current child nutritional status and water, sanitation and hygiene situation within Bihar and SAM study districts using NFHS-IV data; 2) examine the association of WASH with child nutritional status; 3) contextualize existing WASH tools for the Bihar setting; and 4) propose program recommendations for CARE-India based on quantitative and qualitative findings.

LITERATURE REVIEW

THE STATE OF BIHAR, INDIA

Located in the northeastern corner of India, Bihar is diverse geographical state, comprised of 38 districts. Each of the districts is further broken up into blocks, which are made up of a group of villages and/or cities, and are fundamental at the rural level for implementation of governmental programs.

Bihar is in Eastern India and borders the country of Nepal to the north. Bihar experiences significant monsoon weather and a subtropical weather pattern that boasts hot summers and cool winters. The state is divided by the Ganges River, which makes it an immensely fertile agricultural region, with a majority of the population working in the agricultural industry (Ghatak and Roy, 2015). The most common language spoken is Hindi, with many varying regional dialects – these can even vary from village to village. Bihar also enjoys a diverse population and culture, including Hinduism, Islam, Christianity, and Sikhism.

Bihar has a population of 103,804,637 people, of which 18% are children under the age of six. Overall literacy in the state is 63.8%; males at 73.4% and women at 53.3% (Census of India, 2011). The population has been experiencing a rapid rate of growth, according to the 2011 Census, of 25.1% since 2001. However, despite an increase in literacy rates over the last two decades, the state remains classified as the most illiterate state in India due to a dearth of teachers and overcrowded classrooms. Bihar has also been classified as a backwards state by the government of India due to unmet parameters in areas like literacy, GDP, and poverty levels. Despite recent growth in the industrial sector, Bihar's GDP remains less than half of the national average, and more than 42% of the state's population is lives in poverty (Rasul and Sharma, 2014). Despite having rich agricultural lands, a growing industrial sector, and rising literacy rates for both men and women, Bihar remains an impoverished state.

WHAT IS MALNUTRITION?

According to the World Health Organization (WHO), malnutrition "refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients" (WHO, 2017). In lay terms, malnutrition is an imbalance in the necessary nutrients for adequate development and daily activities. However, malnutrition is an

umbrella term broken up into three main categories: under-nutrition, over-nutrition, and micronutrient-related malnutrition, which are further divided into sub-categories.

Over-nutrition is a category that is often over-looked when examining child malnutrition. Over-nutrition is a state where caloric intake (increased consumptions of energy dense foods) exceeds caloric expenditure (decreased physical activity). This results in a caloric surplus that leads to abnormal or excessive fat accumulation and the onset of non-communicable diseases such as obesity, diabetes, heart disease, hypertension, and stroke. As of 2017, 41 million children under 5 years of age are classified as overweight or obese globally.

Micronutrient-related undernutrition occurs when there is an inadequacy in the intake of micronutrients, namely vitamins and minerals. Micronutrients are essential to cellular functions, including enzyme and hormone production, including those related to growth and development. Deficiencies in proper micronutrients in diets have shown the most significant detrimental effects among pregnant women and children worldwide, particularly those in low-income countries. Vitamin A, zinc, folic acid, iron, and vitamin B-12, and vitamin D were defined as the key deficiencies that affected child growth and development (Black, et.al., 2008). Vitamin D deficiency during pregnancy was found to cause poor fetal skeletal growth, while folate and vitamin B-12 deficiencies have been shown to increase the risk of fetal neural deficits. Lack of zinc and vitamin A in child diets showed an increased susceptibility to infectious diseases in children, such as diarrhea, malaria, and pneumonia. Lastly, malnourished children have been shown to be deficient in iron and therefore, have a higher prevalence of anemia. The impact of childhood anemia can impact development and last well into adulthood in areas such as intellectual capacities, psychomotor skills, and cognition (Stanner, 2003, Perumal, et.al, 2018).

There are three sub-categories of undernutrition – underweight, wasting, and stunting. Each sub-category is measured by different indicators, and are not mutually exclusive. There are three main indicators used to determine undernutrition in children – height or length (depending on the age of the child, measured in centimeters), weight (measured in kilograms), and age (measured in months). These indicators are used to calculate growth percentiles and z-scores, which then determine how the child will be categorized. Underweight children have a low weight-for-age percentile – in order to be classified as underweight, the child's weight-for-age percentile z-score (WAZ) must be more than two standard deviations (SD) below the WHO Child Growth Standards reference median. Wasted

children use a different set of indicators – weight and height. In order to be considered wasted, a child's weight-for-height z-score (WHZ) must fall more than 2 SD below the reference median (Meshram, et.al., 2011). Similarly, children who have low height-for-age z-scores (HAZ), or z-scores that are more than two SD below the reference median, are classified as stunted, or chronically malnourished (Senbanjo, et.al., 2011; Mogeni, et.al., 2011). However, it is important to note that these three categories are not mutually exclusive – a child that is underweight can also be wasted, stunted, or both. Severe forms of undernutrition fall under a category known as severe acute malnutrition (SAM). Also defined as severe wasting, SAM is indicated by a WHZ that is more than or equal to three SD below the reference median (Mogeni, et.al., 2011). As recently as 2015, an estimated 13 million children suffer from SAM worldwide, and contributes to about 35% of the under-5 mortality rate (U5MR) (Asfaw, et.al., 2015), with current estimates from global organizations putting that number at 17 million.

Worldwide estimates indicate that over 227 million children suffer from undernutrition, and is still leading cause of death in women and children in developing countries, contributing to 45% of the U5MR globally, especially in low and middle income countries. India has the largest number of stunted children than any other region of the world, with rates as high as 51% among children under 5 years of age (Black, et.al., 2008). In addition, despite numerous policy changes and programs aimed at reducing these statistics, nationwide surveys conducted in 1998 and 2005 indicated that the number of children that were severely wasted increased by over 1 percent in 7 years (1-2 million children) (Bhadoria, et.al, 2017). The prevalence of severe stunting and severe underweight among children 0-5 years of age were 16% and 24% (Bhadoria, et.al, 2017). SAM, which is the most severe form of undernutrition, had a 7.9% prevalence in children under 5 in India, with mortality rates as high as 20-30% (Kapil, 2009; Bhadoria, et.al, 2017)).

Malnutrition has significant effects on mothers and children, and lasts well into adulthood. Maternal stunting puts the mother at increased risk intrauterine growth restriction (IUGR) (Black, et.al. 2008), which can affect the growth of the fetus and lead to neonatal complications. Short stature among women also puts them at an increased risk for caesarean births due to cephalopelvic disproportion to ensure safe delivery of the fetus. In countries where timely or economical access to healthcare is a challenge, this can pose a significant threat to both mother and child. Babies born to mothers with IUGR are also more likely to have a low birth weight, defined as less

than 2,500g. Small birth weight, in addition to the above factors, is also a significant factor in mortality, including stillbirths and deaths occurring within seven days of birth (Dewey and Khadija, 2011). These effects can last well into adulthood as well, contributing to small physiques and decreased intellectual and economic capacity. Children who are born with a small birthweight and grow up stunted in turn can have children with low birthweight, continuing the cycle (Dewey and Khadija, 2011).

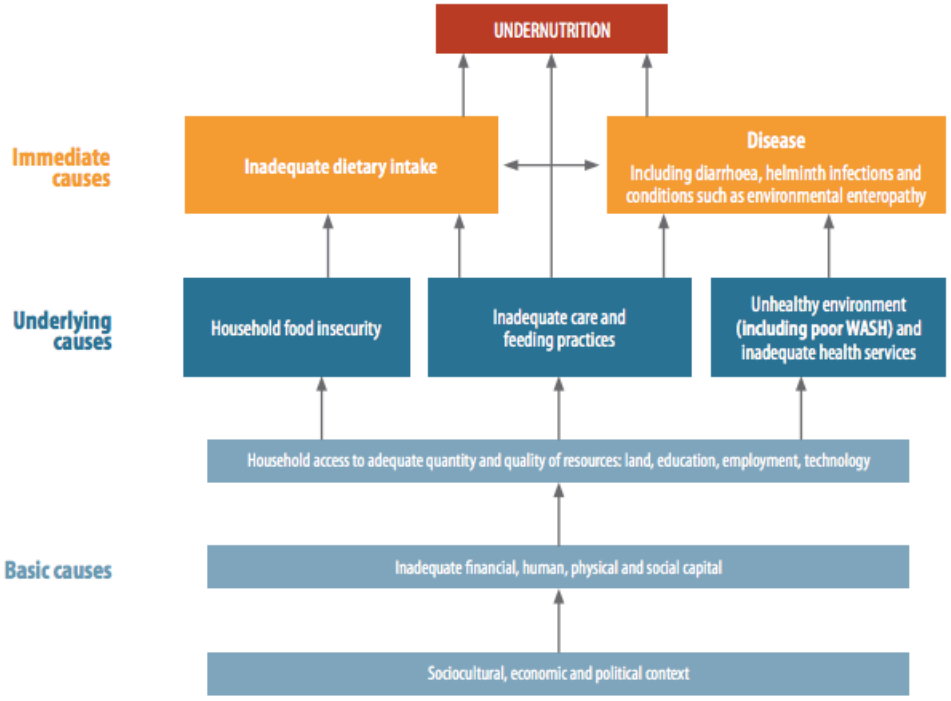
Exclusive breastfeeding (EBF) of the child until six months of age has shown remarkable reductions in incidence of infection, diarrheal diseases, and pneumonia among children, while also improving cognitive function later in life (Chanani, et.al., 2018). However, recent national studies have shown that the EBF rate in India is only about 69% for the first two months, with rates dropping as low as 20% by the child's fourth or fifth month (Patwari, et.al., 2015). Many mothers in rural areas supplement breastfeeding with diluted cow's milk, bottle feeding, or formula milk and this lack of EBF and inconsistent supplementary feeding can lead to an increased risk of growth failure among children 0-6 months. It is also important to note that in these low resource settings, the mother's health and her ability to be with her child in order to EBF is often compromised due to household and/or field work, and she is not able to adequately provide her infant with the necessary nutrients. Therefore, in order to adequately evaluate the effect of malnutrition, all children from 0 to 59 months were included in this study. All children under 5 years of age were chosen because they have been shown to be the most susceptible to malnutrition and malnutrition related deaths; according to the WHO, 45% of deaths occurring in children under 5 years of age is due to illnesses caused by malnutrition and SAM, such as diarrheal and respiratory diseases. Children in the poorest households in low- and middle-income countries have shown to have worse child death outcomes that their high-income counterparts. With households being unable to provide adequate nutritious food, malnutrition rates increase, weakening the child's immune system and making it susceptible to these illnesses.

ROLE OF WASH

UNICEF's conceptual framework for malnutrition, published in 2013, showcases the underlying causes of child undernutrition (Figure 1), (WHO, 2015) and has become the premiere framework when examining malnutrition and undernutrition indicators. One of the three underlying causes of undernutrition identified in this

framework is the child's environment. A healthy and proper environment for a child is classified as one that has access to safe water and improved sanitation facilities (Matariya, et.al., 2016). While factors such as maternal literacy and education level, age of the child, household wealth index, mother's nutritional status, and total number of children born to mother has been associated with undernutrition (Asfaw, et.al., 2015), the role of water and sanitation is just as important. In one study conducted in Gujarat, India among children 3-6 years of age, the mother's poor hygiene practices and inadequate sanitation facilities led to a significant increase in undernutrition among the children (Matariya, et.al., 2016).

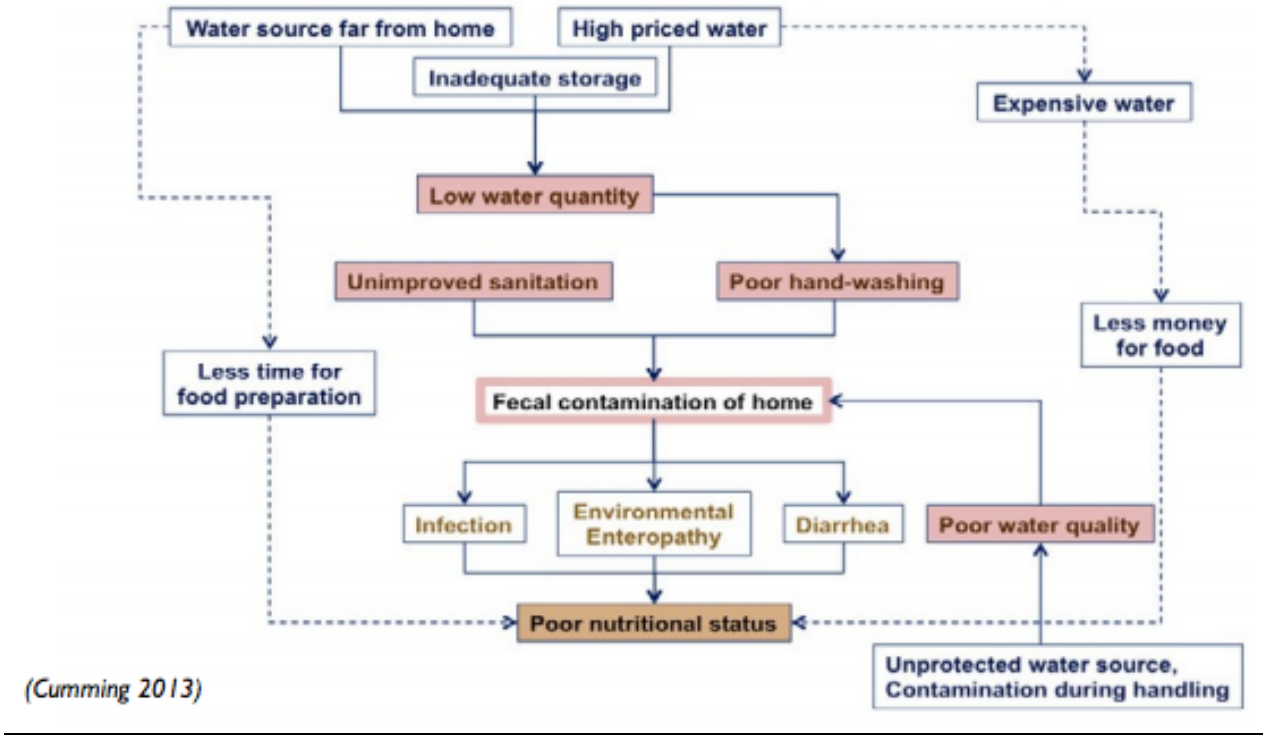
Figure 1: Conceptual framework on the causes of undernutrition (WHO, 2015)



During pregnancy and the child's first 1000 days, which includes the first two years of a child's life, adequate nutrition of the mother and baby is key to normal child development, including social and cognitive skills, productivity, and school achievement (Ngure, et.al., 2014). Inadequate WASH practices have become significant factors in global morbidity and mortality rates, causing millions of deaths annually. The pathway through which WASH affects undernutrition is by causing enteric disease, also termed environmental enteropathy (EE). Exposure to fecal and urinary matter, which is caused by poor sanitation (lack of improved sanitation facilities) and poor hygiene practices, leads to ingestion of contaminated water and food. This ingestion can cause EE, which produces inflammation in the gut mucosa, leading the malabsorption of nutrients at the cellular level (Ngure, et.al., 2014).

Repeated exposure to contaminated matter leads to chronic inflammation and anemia, furthering the cycle of undernutrition. In addition, poor WASH can also lead to helminth infections, such as intestinal worms and schistosomiasis, leading to decreased growth and reduced nutrient absorption in the intestines (US AID, 2015). This pathway is outlined in Figure 2, below. Provision of improved sanitation facilities, which separate human excreta from human or vector contact, and improved water sources has shown to be negatively associated with outcomes of undernutrition, including stunting, wasting, and severe wasting.

Figure 2: WASH pathway to undernutrition (Cumming, 2013)



WHY DO WE CARE?

India's malnourished children account for almost one-third of the world's malnourished children population, with an estimated five million deaths due to malnutrition in India alone (Bhadoria, et.al., 2017). In additional to maternal and household demographics playing a role in child nutritional outcomes, the role of WASH is an important area to understand in relation to Bihar, especially given recent data released by the Demographic and Health Survey (DHS) program. In addition, Bihar is a unique state in that despite rapid economic growth between 2001 and 2001, it is still classified as one of the most backwards states in India due to high poverty and low income

levels, and various socio-economic factors. Therefore, it is a key region that needs further research to best understand the specific determinants of malnutrition, specifically SAM, wasting, and stunting. By understanding the prevalence of malnutrition and identifying key indicators and determinants, it may be helpful for CARE-India's ongoing work in the area of malnutrition in the region to improve child and adult outcomes, leading to a healthier population that can contribute to the growth and improvement of the state.

METHODS

In order to achieve the objectives of this study, quantitative and qualitative data were utilized. To understand the state of child nutritional outcomes and WASH in Bihar, and the relationship between the two, data collected in the Fourth National Family and Health Survey were used for secondary data analysis. Contextualization of the WASH tools for Bihar was conducted through primary data collection and qualitative analysis. Methods are described in detail below.

1. NATIONAL FAMILY AND HEALTH SURVEY – IV (2014-2015)

The Fourth National Family and Health Survey (NFHS-IV) was designed to collect information on variables related to maternal and child health in India, including nutritional status of children 0-59 months and illnesses among that population. Key demographic, health, anthropometric, and biochemical measurements were taken in order to meet this objective. It was organized through the Ministry of Health and Social Welfare department, in conjunction with the International Institute for Population Sciences, Mumbai. Funding for the survey was through the United States Agency for International Development (US AID) and Ministry of Health and Family Welfare. The survey was conducted nation-wide from 2014-2015, and is the fourth iteration of the study since 1992 (IIPS and ICF, 2017).

Study Design

The NFHS-IV study was designed to be representative at the national, state, and district level for women, men, and children. In order to ensure adequate representativeness, NFHS-IV implemented a two-stage sampling procedure. Stage 1 of the sampling procedure was to stratify the sampling frame by geographic clusters. For this

survey, the sampling frame was the entire population of men, women, and children living in India and was constructed using the 2011 India census data, which also provides a listing of primary sampling units (PSUs). Prior to beginning the sampling procedure, the PSUs were stratified into homogenous sub-groups based on geographic location. After this was completed, stage 1 was implemented to select PSUs for inclusion in the survey. For this, the PSUs used were pre-established from the 2011 census data, with villages serving as the PSUs in rural regions and census enumeration blocks (CEBs) serving as PSUs in the urban areas. PSUs in both the rural and urban regions were selected for inclusion in the sample through probability proportional to size (PPS) sampling. PPS sampling is a method in which the probability of a sampling unit to be selected for a study is directly proportional to its size. This means that if the sampling unit, in this case, the PSU, has a larger population, it has a higher chance of being selected. The advantage of this method of sampling is that the sample is truly representative of the population.

Once the PSUs were selected through PPS, a complete listing of the households in each PSU was created (villages or CEBs). PSUs with 300 or more households were grouped into sub-segments of 100-150 households, and then two of these sub-segments from each PSU were sampled again through PPS to create "clusters" for the NFHS-4 survey. Once complete, 22 households were selected from each cluster through systematic sampling.

Questionnaire Design

To collect the health and demographic data, four surveys were utilized for men and women – household questionnaire, women's questionnaire, men's questionnaire, and biomarker questionnaire. The household questionnaire collected key information on water and sanitation indicators. The women's questionnaire collected key demographic information, including religion, caste, literacy, education, and wealth indices. The men's questionnaire collected similar information. Lastly, the biomarker questionnaire collected information on the nutritional and health status of children aged 0-59 months in each household, including anthropometric measurements (length/height, weight), age of child, and key illness variables.

Data Collection

Data collection was conducted between 2015 and 2016 by over 700 teams nationwide. Each team included a field supervisor, three female interviewers, one male interviewer, and two health investigators. The number of teams used in each state varied by the size and population of the state to ensure timely data collection.

Prior to beginning data collection, all field staff underwent a two-step extensive training, each occurring before each phase of the data collection process. Instruction manuals were also created for each role: the biomarker, supervisor, and interviewer roles. Because blood samples were to be taken during this survey, rigorous training and quality control measures were implemented amongst the biomarker sample collectors, who collected measurements for anemia levels and anthropometric measurements for length/height, and weight. These collectors underwent four phases of training, and only those who passed the selection and performance standards were selected to be part of the survey team.

Data were collected using Computer Assisted Personal Interviewing (CAPI) on mini-notebook computers. Data for both the questionnaires and biomarker samples were collected only after informed consent was obtained from each participant. Multiple key variables were measured related to maternal demographics, child nutrition, and child illnesses. Trends and periodic updates were provided to the government.

Data Cleaning

All data cleaning and data analysis procedures were conducted used the statistical software package SAS 9.2. Access to the NFHS-4 dataset was granted through the DHS Program. In order to gain access to this data, a request was placed within the DHS website outlining the objectives and goals of using the dataset. Once approved, the SAS datasets for the NFHS-IV survey were downloaded from the DHS site and saved onto a password-protected laptop. The datasets were re-coded by the DHS program into several different datasets – household, household member, women, children, men, and individual.

For this analysis, the DHS datasets utilized were the individual, household, and children's datasets. The children's dataset provided information on the ages, lengths/heights, and weights of children aged 0-59 months in the survey, from which key nutritional indicators would be calculated, and several key illness and WASH related variables. The household dataset provided a few more WASH indicators, while the individual dataset added an additional key demographic variable for the scheduled caste/tribe status of the household, which was not included in the other datasets.

Working datasets were created by restricting the full survey datasets to only the data that were collected form the Bihar for the key variables of interest. Other variables included in each dataset were the case identification

number, the PSU number, cluster number, stratum number, and weight for each observation, which were used to account for the complex survey design.

Data cleaning for the children's dataset was centered around the variables length/height, age, and weight. First, all missing values for age were examined. If the birthdate and the interview date of the child were present, the child's age in months was calculated using the century month code equation implemented by the DHS program and imputed into the dataset as a new variable. Any further missing values for age were excluded from the dataset. Then, length/height and weight variables were examined. Since DHS does not include decimals in the recoded datasets, new variables were created for length/height and weight that included the decimals. A similar procedure was conducted for the weight variable. The demographic variables underwent similar data cleaning procedures for the variable that showed the sample weight of each observation in order to add the decimals. However, there were no missing values for any of the variables, so none were excluded.

Another data subset was created for only the mothers by only including unique case identification numbers from the children's datasets. This ensured that the demographics created for the mothers did not have duplicate observations. This was then used to calculate demographics for the mother's age at first birth, mother's education and literacy level, and the number of living children each mother reported.

From the children's master subset for all of Bihar, and the mothers-only dataset, two more subsets were created that only included the 10 districts where the SAM study was taking place. Each of these SAM data subsets still had the same variables as the full Bihar data subsets.

Data Analysis

Analysis of the data occurred in several stages. The first stage was visualizing the demographic characteristics of the sample for all of Bihar, for all 10 SAM districts, and by individual SAM district to conduct univariate analyses. This was accomplished using SAS commands that considered the complex survey design of the dataset. The commands accounted for the sample weight, the cluster, and the stratum of each observation. It was important to account for the complex survey design by applying the sample weight, cluster, and stratum information in the analysis because PPS sampling was used in the study design. By doing so, issues of over- or under-sampling were accounted for.

Once the demographic information was completed, nutritional profiles were created for all of Bihar, all of the SAM study districts, and for each district within the SAM study. In order to create the nutritional profiles, anthro macro packages created by the World Health Organization (WHO) were used in SAS. These macros take into account three indicators for nutritional status, length/height, weight, and age, and generate information on the nutritional status of children using the WHO Growth Standards. The macros generate the following calculations: WAZ (used to determine underweight prevalence), HAZ (used to determine stunting prevalence), and WHZ (used to determine wasting and SAM prevalence), and calculate the prevalence of each nutritional status for the overall sample, by sex, age group (in months) and by district. They also generate datasets that include the z-scores for each nutritional status, in additional to excluding/flagging implausible values, and accounting for the complex survey design. For this analysis, only the tables for length/height for age and height-for age were used. The z-score cutoffs are outlined below:

A. HAZ: To calculate stunting, HAZ less than -2 SD from the reference median were included. Z-scores less than -6 or greater than 6 were flagged as implausible and removed when calculating prevalence.
B. WHZ:
    a. To calculate wasting, WHZ less than -2 SD from the reference median were included.
    b. To calculate SAM, WHZ less than or equal to -3 SD from the reference median were included
    c. Z-scores less than -5 or greater than 5 were flagged and implausible and removed when calculating prevalence.

Once univariate analysis was completed, bivariate analyses was done using simple binary logistic regression. In order to do this, the dataset generate by the macros were utilized to create three new dichotomous outcome variables, SAM, wasting, and stunting. Those observations that classified as each of these categories were classified as '1', while those that did not were classified as '0'. Each variable was then used with each of the predictors for bivariate analysis. By using the PROC SURVEYLOGISTIC command, sample weight, cluster, and stratum were taken into account for each regression analysis. Odds ratios were reported for bivariate analyses, including the 95% confidence intervals (CI). Odds ratio confidence intervals that included 1 were considered insignificant.

Following bivariate analysis, multivariate binary logistic regression analyses were conducted with demographic and WASH variables. However, because of the inter-relationship between WASH variables, a WASH index was first created. In order to do so, variables for water source, location of water source, toilet facilities, disposal of child feces, water availability for hand washing, hand hygiene practices, and water treatment were summed, with best practices scored highly, and worst practices scored as zero. The range of scores in the WASH index were 0-13, with zero the worst WASH score, and thirteen the best (Table 1). This WASH index was then used in multivariate binary logistic regression with all demographic variables, again accounting for the complex survey design, and results were reported in odds ratios with 95% confidence intervals. Reference categories are delineated with dashes. For all regression analyses, odds ratios were examined and deemed significant if the confidence intervals (CI) did not include 1.

Table 1: Scores for variables within the WASH index

VARIABLE	INDEX SCORE FOR EACH LEVEL
What is the source of drinking water for the household?	
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	2
Tube well or borehole	1
Other	0
Where is the water source located?	
In own dwelling	2
In own yard/plot	1
Elsewhere	0
Is anything done to make the water safer to drink?	
Yes	1
No	0
What type of toilet facility do you use?	
Flush to piped sewer system/septic tank/pit latrine	2
VIP/Pit latrine with and without slab	1
Openly defecate/other	0
Is there water available to wash your hands?	
Yes	1
No	0
Do you use anything with water to wash your hands?	
Soap/detergent	2
Ash, mud, sand	1
Nothing	0
What do you do to dispose your youngest child's stools?	
Used toilet/latrine	3
Put in drain/ditch/threw in garbage	2
Other	1
Left in the open/didn't dispose	0

2. CARE-INDIA STUDY

In 2016, CARE-India, in partnership with Emory University researchers, began a longitudinal study aimed at understanding the incidence and determinants of SAM in Bihar among children 0-59 months. The primary goal of the study was to collect data to inform the design and implementation of programs targeted at identifying and reducing the incidence of SAM in the region, and improving the nutritional status of both women and children in Bihar, India. The project is being conducted by CARE-India in Bihar, in conjunction with the Social Welfare and Health departments of the Government of Bihar.

Study Region

Due to the vast geographical area and population in Bihar, in order to evaluate the state of SAM, one district was chosen from each of the CARE program areas in Bihar, for a total of 10 districts. The districts are diverse in their geographical distribution to minimize variations in the data. From each district, three villages were purposively sampled according to the following criteria:

1) The population of each village should be between 1500 – 2000
2) The village must be served by at least 1 Anganwadi center (AWC)
3) The three selected villages will vary in terms of access to basic health care facilities, defined as good, average or poor access to basic health care

QUALITATIVE INTERVIEWS

Study Region

One area that was not explored in the initial iteration of the SAM study was understanding the role of WASH in SAM. During development of the initial study, the main focus was on understanding the nutritional and health aspects of SAM. With further research, WASH has shown to play an important role in malnutrition and malnutrition-related illnesses. Therefore, to better understand the role of WASH in SAM, two districts were purposively sampled from the 10 districts enrolled in the SAM study. Since monthly measurements were on-going when this project was starting, districts were chosen based on availability of field staff and access to field sites. Interviews were conducted at each of the three villages in each district. The first district chosen was Nalanda, where

the SAM field supervisor administered the survey in all three villages. The second district chosen was Banka, where a trained SAM study field facilitator administered the survey in all three villages. The sites are as follows:

1) Nalanda
    a. Hard-to-reach: Govindpur village (Sarmera block)
    b. Average: Nirya village (Karayparsurai block)
    c. Good: Tetariya village (Rajghir block)
2) Banka
    a. Hard to reach: Chihutuzor village (Chandan block)
    b. Average: Madhuban village (Fullidumar block)
    c. Good: Charmeli village (Banka block)

Study Population

As part of the SAM study, the WASH field work drew heavily from the same population as the SAM study. Since the WASH study was to be a supplemental survey built into the SAM study survey, all enrolled mothers in the SAM study were also eligible for participation in this study. Once in the field, mothers were purposively chosen based on the availability – able to talk freely, not engaged in housework/fieldwork – and willingness to participate.

Study Design

In order to better understand the role of WASH in SAM in Bihar, existing WASH tools were to be tested in Bihar to determine their functionality in Bihar, and to conduct formative research on this topic in the context of Bihar. Dr. Bethany Caruso, a post-doctoral fellow currently working at the Rollins School of Public Health (RSPH) at Emory University, has done tremendous work in Orissa examining maternal nutritional and breastfeeding practices. Based on her qualitative research in that region, and based on the water security tool published by Dr. Matthew Freeman and Dr. Craig Hadley, Dr. Caruso created an initial, 19-question module to be tested in Bihar to supplement the SAM study. This module was supplemented with additional questions, some of which were part of the existing SAM study questionnaire, to create a stand-alone WASH module for field testing. Once this version was finalized, the module was translated to Hindi by the CARE-India CML team in Bihar. Efforts were made to keep the translations simplistic and conversational to allow for optimal understanding in areas with varied dialects. A

similar process was taken with the consent forms, which informed the mothers that this study was purely an informational study designed to understand the state of water and sanitation in their household, and the sanitation module.

The interview guide was divided into three sections:

1) Demographic information: This module collected information on the participant's date of birth, age, educational level, marital status, religion, caste, people in the household, and current pregnancy status.
2) Water module: This module included 25 questions related to water access and security. Questions included topics such as water sources, water access, water quality, and barriers related to any of these issues.
3) Sanitation module: This module was a basic sanitation module aimed at understanding hygiene practices in the household.

For each of these modules, probes were added as needed to gain a deeper understanding of the responses and understand the mother's thought process regarding the questions.

Data Collection

Once the tool was finalized, 10-12 cognitive interviews were conducted in each district. Upon arrival in the study district, SAM study staff were trained on the purpose of cognitive interviews, the consent form and the WASH tool, and how to administer both. Trainings typically lasted between 2-3 hours, and continuing training was provided between interviews based on the participant feedback.

Three to four interviews were conducted in each village by the SAM study staff. Prior to each interview, the participating mother was introduced to the SAM study staff and the researcher, and verbal consent was obtained from the mothers. The consent form was given to the mothers, which contained contact information for the researcher. Once the mothers consented to the interview, they were also asked if they were comfortable being audio-recorded. Once consented, the interview began with initial questions on household demographics and characteristics. Then the WASH tool was tested to determine the mothers' understanding of each question, and their answers to the questions. Probes were added by the researcher as needed to gain a deeper understanding of an

issue presented in the answer to a question. Once completed, the audio files for the interviews were kept in a password-protected computer owned by the researcher, and backed up on an external, password-protected hard drive for use in further qualitative analysis. A summary of data collection is listed in Table 2.

Table 2: Qualitative data collection (n = 28)

Study Phase	District	Block	Village	# of interviews
Pre-Testing	Patna	Maner	Suarmarwa - Purbi	5
Data collection	Nalanda	Sarmera	Govindpur	2
		Karay-parsurai	Nirya	5
		Rajghir	Tetariya	5
	Banka	Chihutuzor	Chandan	3
		Madhuban	Fullidumar	4
		Charmeli	Banka	4
			TOTAL	28

Data Analysis

All transcription and translation of the qualitative work was done through the CARE-India CML team and the researcher. Once the interviews were transcribed and translated, the interviews and field notes taken by the researcher were read through and explored for major, recurrent themes. The major themes were also prominent codes throughout all the interviews and were stated by a majority of the participants. Main findings in the study pertained to: access to water sources, water quality and understanding of water security issues, and distrust. Responses were also analyzed for participants' understanding, and modified accordingly to ensure adequate data capture.

RESULTS

This section highlights the findings from secondary analysis of the NFHS-IV datasets, and the findings from the WASH qualitative cognitive interviews conducted through the support of CARE-India. District profiles for demographics, nutrition, WASH, and illness characteristics have been included in the appendices.

NFHS-IV

Univariate analyses of the NFHS-IV data for all of Bihar and for just the 10 CARE-India SAM study districts are shown in Tables 3 and 4. These tables indicate the frequencies and percentages for the categorical and dichotomous predictors, and mean and standard deviations of the continuous predictors. Among the basic demographics of the sample (Table 3), missing values were found only for the variable delineating the scheduled caste/tribe status of the participant.

Table 5 shows the prevalence of the various nutritional outcomes of children in Bihar, India and among the 10 SAM study districts, which were calculated using the WHO Growth Standards. Overall, 47.6% (95% CI: 47.0, 48.2) of children aged 0-59 months classified as 'stunted' in Bihar. Females had a slightly higher prevalence of stunting, 48.4% (95% CI: 47.5, 49.2) than males overall, 46.9% (95% CI: 46.1, 47.7). In addition, the prevalence of stunting increased as the child's age increased, which the highest prevalence of stunting among those children 48-59 months, and the lower prevalence among those children 0-5 months. These patterns differed when examining the outcomes for wasting and SAM among this demographic. Overall, 20.3% (95% CI: 19.9, 20.8) of children classified as 'wasted' in Bihar, while 6.7% (95% CI: 6.4, 6.9) classified as 'SAM'. The prevalence of wasting among females and males were roughly the same, with males showing a slightly higher prevalence. Males' wasting prevalence was 20.7% (95% CI: 20.0, 21.2), while females' was 19.9% (95% CI: 19.2, 20.6). This was also the case for SAM – males had a prevalence of 6.9% (95% CI: 6.5, 7.3), while females were at 6.4% (95% CI: 6.0, 6.9). In addition, the prevalence of wasting and SAM seems to decrease as the child becomes older – children 0-5 months have the highest prevalence of SAM and wasting, while children 48-59 months have the lowest prevalence. For both wasting and SAM categories, children aged 0-5 months had a significantly higher prevalence of each nutritional status than children in older age groups –30.9% (95% CI: 29.1, 32.8) of children in the 0-5 months age group were categorized as wasted, while 13.0% (95% CI: 11.6, 14.3) were categorized as having SAM.

Tables 6 and 7 show the odds ratios and confidence intervals (CI) generated as a result of bivariate simple logistic regression analyses among each of the predictors of interest, and the outcomes of interest, with significant bivariate results bolded and italicized within the table. Examining the crude bivariate results for stunting, the age of the child, education level of the mother, literacy level of the mother, mother's age at birth of first child, number of living children (for the mother), household wealth index, the scheduled caste/tribe status of the household, location of the household (rural or urban), water source, location of the water source, treatment of the water, hand hygiene practices, toilet facilities used, disposal of child feces, and the anemia level of the child are each significant predictors of stunting at each level of the variable. The odds of stunting were greatest among older children; children between 48-59 months were 4.65 (95% CI: 4.01, 5.39) times more likely to be stunted compared to children 0-5 months, while the odds of stunting among children 6-11 months was 1.48 times that of children 0-5 months.

Maternal education was an important determinant of stunting. Children born to mothers who had completed secondary education or higher had the lowest odds of stunting (0.30, 95% CI: 0.27 0.34) when compared to those with children whose mothers who had no education. The odds of stunting in children with moderate to severe anemia was 1.60 times the odds of stunting among children with no anemia. Mild anemia also increased the odds (1.28, 95% CI: 1.18, 1.39).

The WASH characteristics that were significantly associated with stunting included water availability to wash hands, treatment of water, hand hygiene practices, toilet facility used, and disposal of child feces. The odds of stunting when there was water available to wash hands was 0.69 times the odds when there was no such water available. Use of soap or detergent, ash, mud, or sand when washing hands was also associated with decreased odds of stunting when compared to using nothing except water. Treatment of water also showed a significant protective effect on the prevalence of stunting; the odds of stunting decreased by half when water was treated (by boiling, filtering, adding chemicals, etc.) compared to no treatment. Open defecation increased the odds of stunting 2 times than using a flush system toilet facility. Lastly, all methods of disposal of a child's feces increased the odds of stunting compared to using a toilet/latrine to dispose of the stools, with leaving the stools in the open having the highest odds of stunting (1.63, 95% CI: 1.47, 1.81).

For both wasting and SAM, age of the child, education level of the mother, literacy level of the mother, household wealth index, and toilet facilities were significant. The scheduled caste/tribe status of the household, location of the water source, water availability to wash hands, hand hygiene practices, disposal of child feces, anemia level, and recent diarrhea in child were significant for wasting, but not SAM.

In contrast to stunting, the odds of wasting decreased with child age. The odds of wasting were lower among children whose mothers had completed secondary education or higher (0.73, 95% CI: 0.61, 0.87) compared to mothers with no education at all. The same was seen in literacy; a significant protective effect on wasting was seen among children with mothers who were able to read full sentences having a compared to those mothers who were not literate. Interestingly, those households classified as belonging to a scheduled tribe had significantly increased odds of wasting compared to those households that didn't classify with any backwards class (1.34, 95% CI: 1.04, 1.73), but households that classified as scheduled caste or another backwards class did not show the same

effect. Of note, recent diarrhea in the child was significantly associated with wasting, increasing the odds of wasting by 1.23 times compared to children that didn't have recent diarrhea.

Similar to wasting, the odds of SAM decreased as the child's age increased; the odds of SAM among children 6-11 months were 0.69 (95% CI: 0.56, 0.84) times the odds of SAM among children 0-5 months, while the odds of SAM among children 48-59 months were 0.35 (95% CI: 0.28. 0.43) times the odds of SAM among children 0-5 months. Other than open defecation, none of the WASH and illness variable categories were significantly associated with SAM. Open defecation increased the odds of SAM 1.28 times the odds of using a flush system toilet.

Once bivariate analyses were completed, an indexed WASH variable was used in an adjusted regression analysis to determine whether any of these variables could be used as predictors of nutritional status. Crude models indicated that the WASH index was a significant predictor of nutritional status for all nutritional outcomes, SAM, wasting, and stunting. The odds of SAM, wasting and stunting decreased with every unit increase in the WASH index score (improvements in WASH), with stunting showing the highest impact from WASH (Table 8).

The fully-adjusted multivariate binary logistic model for stunting with WASH indicated that the WASH index, age of the child, education level of the mother, household wealth index, and scheduled caste/tribe status of the household were all significant predictors of stunting. For wasting, the WASH index, the age of the child, education level of the mother, literacy level of the mother, household wealth index, and type of residence were significant predictors in the model. SAM also had the same significant predictors as wasting, but the WASH index became insignificant in the fully adjusted model. Results for the crude and the fully adjusted multivariate binary logistic models can be seen in Table 8.

Table 3: Basic demographics of NFHS-IV sample (n = 25110)

VARIABLE	BIHAR		ALL CARE DISTRICTS	
Child characteristics	n	%	n	%
Sex				
Female	12008	48.0	3092	47.9
Male	13102	52.0	3393	52.1
Age				
0 – 5 months	2243	9.0	558	8.7
6 – 11 months	2865	11.2	695	10.6
12 – 23 months	5249	20.9	1396	21.5
24 – 35 months	4840	19.4	1291	20.1
36 – 47 months	5194	20.8	1332	20.4
48 – 59 months	4719	18.8	1213	18.6
Type of residence				
Urban	2633	10.5	584	8.8
Rural	22477	89.5	5901	91.2
Religion				
Hindu	20934	82.0	5202	81.8
Non-Hindu	4176	18.0	1283	18.2
Caste/Tribe				
Scheduled caste	5488	21.5	1389	22.8
Scheduled tribe	806	3.9	282	4.8
Other backward class	14978	59.7	3652	56.4
None	3730	14.9	1126	16.0
Wealth Index				
Lowest	13632	56.0	3648	57.4
Middle	6113	23.6	1578	23.9
High	5365	20.5	1259	18.7
TOTAL	**25110**	**100.0**	**6485**	**100.0**
Maternal characteristics				
Education level				
No education	8964	54.8	2429	57.0
Incomplete primary	1038	6.5	270	6.6
Completed primary/ Incomplete secondary	4670	28.0	1124	26.5
Completed secondary/Higher	1825	10.7	425	9.8
Literacy level				
Cannot read at all/Other	9567	58.2	2594	60.9
Can only read parts of sentence	974	6.1	240	5.9
Able to read complete sentence	5956	35.7	1414	33.2
Age at first birth				
15 – 17 years	2760	17.0	725	18.1
18 – 25 years	12665	76.3	3200	74.4
26 + years	1072	6.7	232	7.5
Number of living children				
1 – 3 children	12415	75.4	3135	73.9
4 + children	4082	24.6	1113	26.1
TOTAL	**16497**	**100.0**	**4248**	**100.0**

Table 4: Overall WASH and Illness characteristics of sample (n = 25110)

VARIABLE	BIHAR		CARE DISTRICTS	
	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	1110	4.7	271	4.1
Tube well or borehole	21952	87.6	5695	87.3
Other	2048	7.7	519	8.6
Where is the water source located?				
In own dwelling	13904	57.1	3439	53.9
In own yard/plot	6699	28.6	1696	26.7
Elsewhere	3681	14.3	1158	19.4
How long does it take to get to the water source, in minutes?	1.5	10.6	1.0	10.4
Is anything done to make the water safer to drink?				
Yes	1102	3.6	199	2.6
No	24167	96.4	6284	97.4
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	5990	23.4	1372	21.3
VIP/Pit latrine with and without slab	852	3.3	177	2.6
Openly defecate/other	18268	73.3	4936	76.1
Is there water available to wash your hands?				
Yes	21262	89.7	5355	86.7
No	2478	10.3	751	13.3
Do you use anything with water to wash your hands?				
Soap/detergent	6494	29.4	1687	27.3
Ash, mud, sand	12385	50.7	3280	51.7
Nothing	4461	20.0	1139	21.0
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	3148	12.8	750	12.2
Put in drain/ditch/threw in garbage	4187	15.3	1108	16.1
Left in the open/didn't dispose	16609	67.3	4358	67.9
Other	1035	4.6	227	4.0
Has your child had diarrhea recently?				
Yes	2431	10.6	620	10.3
No	22632	89.4	5852	89.7
Has your child with diarrhea had blood in stools?				
Yes	229	10.1	62	10.0
No	2201	89.9	558	90.0
Has your child had fever in the last two weeks?				
Yes	2962	12.4	739	12.4
No	22113	87.6	5737	87.6
Has your child had cough in the last two weeks?				
Yes	2392	10.4	614	10.5
No	22699	89.6	5865	89.5
Has your child had short, rapid breathing with cough?				
Yes	1164	49.4	270	46.7
No	1224	50.6	343	53.3
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	415	35.8	89	35.7
Nose only	543	49.0	145	54.8
Both	189	14.9	32	9.3
Anemia level of child				
Mild	6896	30.3	1774	30.4
Moderate - Severe	7293	33.2	2042	35.0
Not anemic	8160	36.5	1989	34.6
TOTAL	**25110**	**100.0**	**6485**	**100.0**

Table 5: Overall nutrition demographics of sample (n = 25110)

		STUNTING (HAZ < -2 SD)	WASTING (WHZ < -2 SD)	SAM (WHZ ≤ -3 SD)
REGION	**n**	**Prevalence (95% CI)**	**Prevalence (95% CI)**	**Prevalence (95% CI)**
Bihar				
Sex				
Female	14163	48.4 (47.5, 49.2)	20.0 (19.3, 20.7)	6.4 (6.0, 6.9)
Male	15153	46.9 (46.1, 47.7)	20.7 (20.0, 21.3)	6.9 (6.5, 7.3)
Age				
0 – 5 months	2468	18.5 (17.0, 20.1)	30.9 (29.1, 32.8)	13.0 (11.6, 14.3)
6 – 11 months	3234	28.6 (27.0, 30.2)	24.9 (23.4, 26.4)	8.4 (7.4, 9.3)
12 – 23 months	6117	52.0 (50.7, 53.2)	23.3 (22.2, 24.3)	7.6 (6.9, 8.3)
24 – 35 months	5692	53.7 (52.4, 55.0)	18.5 (17.5, 19.5)	5.4 (4.8, 6.0)
36 – 47 months	6188	55.1 (53.9, 56.4)	16.3 (15.4, 17.3)	4.9 (4.4, 5.5)
48 – 59 months	5617	52.2 (50.8, 53.5)	16.2 (15.2, 17.2)	5.1 (4.5, 5.6)
TOTAL	**29316**	**47.6 (47.0, 48.2)**	**20.3 (29.9, 20.8)**	**6.7 (6.4, 6.9)**
CARE Districts				
Sex				
Female	4166	49.2 (47.7, 50.7)	20.8 (19.6, 22.1)	7.4 (6.6, 8.2)
Male	4429	46.8 (45.3, 48.3)	20.7 (19.5, 21.9)	6.6 (5.8, 7.3)
Age				
0 – 5 months	696	18.4 (15.4, 21.3)	30.2 (26.7, 33.7)	15.0 (12.3, 17.7)
6 – 11 months	891	26.1 (23.2, 29.1)	25.9 (23.0, 28.8)	8.7 (6.8, 10.6)
12 – 23 months	1849	53.2 (50.9, 55.5)	24.2 (22.3, 26.2)	8.3 (7.0, 9.6)
24 – 35 months	1731	54.1 (51.7, 56.5)	17.9 (16.1, 19.8)	4.9 (3.9, 6.0)
36 – 47 months	1791	55.0 (52.7, 57.3)	16.9 (15.1, 18.6)	5.1 (4.1, 6.2)
48 – 59 months	1637	52.4 (50.0, 54.9)	17.2 (15.3, 19.0)	5.3 (4.2, 6.4)
TOTAL	**8595**	**48.0 (46.9, 49.0)**	**20.7 (19.9, 21.6)**	**7.0 (6.4, 7.5)**

Table 6: Unadjusted associations of demographic variables with nutrition status of children 0-59 months in Bihar, India using simple binary logistic regression (n = 25110)

Variables	SAM			STUNTING			WASTING		
	Odd's ratio	95% CI		Odd's ratio	95% CI		Odd's ratio	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Sex of child									
Female	0.92	0.82	1.04	1.05	0.99	1.12	0.96	0.89	1.03
Male	-	-	-	-	-	-	-	-	-
Age of child									
0 – 5 months	-	-	-	-	-	-	-	-	-
6 – 11 months	***0.68***	***0.56***	***0.84***	***1.68***	***1.42***	***1.98***	***0.78***	***0.64***	***0.88***
12 – 23 months	***0.58***	***0.48***	***0.70***	***4.38***	***3.76***	***5.12***	***0.69***	***0.59***	***0.78***
24 – 35 months	***0.43***	***0.35***	***0.52***	***4.65***	***3.96***	***5.45***	***0.53***	***0.46***	***0.61***
36 – 47 months	***0.35***	***0.28***	***0.43***	***5.05***	***4.31***	***5.90***	***0.44***	***0.38***	***0.51***
48 – 59 months	***0.35***	***0.28***	***0.43***	***4.55***	***3.91***	***5.30***	***0.43***	***0.37***	***0.50***
Education level (mother)									
No education	-	-	-	-	-	-	-	-	-
Incomplete primary	***0.56***	***0.44***	***0.73***	***0.86***	***0.76***	***0.98***	***0.76***	***0.64***	***0.91***
Comp. primary/ Incomp. secondary	***0.80***	***0.69***	***0.92***	***0.58***	***0.54***	***0.63***	***0.90***	***0.82***	***0.98***
Completed secondary/Higher	0.92	0.74	1.15	***0.30***	***0.27***	***0.34***	***0.78***	***0.68***	***0.90***
Literacy (mother)									
Cannot read at all/Other	-	-	-	-	-	-	-	-	-
Can only read parts of sentence	***0.72***	***0.55***	***0.96***	***0.83***	***0.73***	***0.95***	***0.83***	***0.70***	***0.98***
Able to read complete sentence	***0.82***	***0.72***	***0.94***	***0.48***	***0.45***	***0.52***	***0.84***	***0.77***	***0.91***
Age at 1st birth (mother)									
15 – 17 years	-	-	-	-	-	-	-	-	-
18 – 25 years	1.00	0.85	1.18	***0.87***	***0.79***	***0.96***	1.04	0.94	1.16
26 + years	1.01	0.79	1.30	***0.74***	***0.64***	***0.86***	0.98	0.82	1.17
Number of living children									
1 – 3 children	-	-	-	-	-	-	-	-	-
4 + children	1.00	0.88	1.14	***1.45***	***1.36***	***1.56***	1.01	0.92	1.10
Household wealth index									
Lowest	-	-	-	-	-	-	-	-	-
Middle	***0.78***	***0.68***	***0.12***	***0.73***	***0.68***	***0.78***	***0.79***	***0.71***	***0.86***
High	***0.81***	***0.67***	***0.97***	***0.38***	***0.34***	***0.41***	***0.78***	***0.69***	***0.88***
SC/ST									
Scheduled caste	1.22	0.97	1.54	***2.08***	***1.84***	***2.34***	***1.20***	***1.04***	***1.38***
Scheduled tribe	1.39	0.93	2.09	***1.65***	***1.35***	***2.02***	***1.41***	***1.12***	***1.79***
Other backward class	1.11	0.91	1.37	***1.53***	***1.37***	***1.70***	1.11	0.98	1.26
None	-	-	-	-	-	-	-	-	-
Place of residence									
Urban	-	-	-	-	-	-	-	-	-
Rural	0.82	0.65	1.03	***1.54***	***1.36***	***1.75***	0.96	0.82	1.12

Table 7: Unadjusted associations of WASH and illness variables with nutrition status of children 0-59 months in Bihar, India using simple binary logistic regression (n = 25110)

Variables	SAM			STUNTING			WASTING		
	Odd's ratio	95% CI		Odd's ratio	95% CI		Odd's ratio	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Water source									
Piped water	-	-	-	-	-	-	-	-	-
Tube well or borehole	0.73	0.53	1.00	***1.53***	***1.28***	***1.83***	0.92	0.75	1.13
Other	0.77	0.52	1.13	***1.35***	***1.09***	***1.66***	0.95	0.74	1.22
Location of water source									
In own dwelling	-	-	-	-	-	-	-	-	-
In own yard/plot	1.01	0.88	1.16	***1.24***	***1.15***	***1.34***	1.06	0.96	1.16
Elsewhere	1.18	0.99	1.40	***1.66***	***1.50***	***1.84***	***1.26***	***1.13***	***1.40***
Water treated									
Yes	1.04	0.72	1.50	***0.50***	***0.42***	***0.60***	1.04	0.83	1.31
No	-	-	-	-	-	-	-	-	-
Time to water source (minutes)	1.00	1.00	1.00	1.01	0.99	1.03	1.00	1.00	1.01
Water availability to wash hands									
Yes	0.88	0.73	1.06	***0.69***	***0.62***	***0.76***	***0.85***	***0.76***	***0.96***
No	-	-	-	-	-	-	-	-	-
Used while washing hands									
Soap/detergent	0.87	0.72	1.05	***0.57***	***0.52***	***0.63***	***0.79***	***0.70***	***0.89***
Ash, mud, sand	1.01	0.86	1.19	***0.89***	***0.82***	***0.97***	0.96	0.86	1.06
Nothing	-	-	-	-	-	-	-	-	-
Disposal of child feces									
Used toilet/latrine	-	-	-	-	-	-	-	-	-
Put in drain/ditch/threw in garbage	1.11	0.88	1.41	***1.47***	***1.30***	***1.67***	1.13	0.96	1.31
Left in the open/didn't dispose	1.07	0.87	1.31	***1.63***	***1.47***	***1.81***	***1.21***	***1.06***	***1.38***
Other	1.07	0.74	1.55	***1.60***	***1.34***	***1.90***	1.15	0.93	1.41
Toilet facility used									
Flush system	-	-	-	-	-	-	-	-	-
VIP/Pit latrine with and without slab	0.96	0.65	1.41	***1.49***	***1.25***	***1.78***	1.16	0.92	1.45
Openly defecate/other	***1.28***	***1.08***	***1.52***	***2.00***	***1.84***	***2.17***	***1.24***	***1.11***	***1.38***
Anemia level of child									
Mild	1.03	0.87	1.22	***1.28***	***1.18***	***1.39***	1.02	0.92	1.12
Moderate - Severe	1.12	0.95	1.33	***1.60***	***1.47***	***1.74***	***1.16***	***1.05***	***1.29***
Not anemic	-	-	-	-	-	-	-	-	-
Recent diarrhea									
Yes	1.11	0.93	1.34	0.92	0.82	1.02	***1.21***	***1.07***	***1.38***
No	-	-	-	-	-	-	-	-	-
Recent cough									
Yes	0.91	0.74	1.11	0.98	0.88	1.10	1.00	0.88	1.14
No	-	-	-	-	-	-	-	-	-
Recent fever									
Yes	0.96	0.80	1.15	1.01	0.91	1.12	1.07	0.95	1.20
No	-	-	-	-	-	-	-	-	-

Table 8 Adjusted associations of demographic variables and WASH index with nutrition status of children 0-59 months in Bihar, India using multivariate binary logistic regression (n = 251110)

Variables	SAM			STUNTING			WASTING		
	Odd's ratio	95% CI		Odd's ratio	95% CI		Odd's ratio	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
WASH Index* (crude)	***0.96***	***0.93***	***0.99***	***0.88***	***0.87***	***0.89***	***0.95***	***0.93***	***0.97***
WASH Index* (fully-adjusted)	0.98	0.94	1.01	***0.96***	***0.95***	***0.98***	***0.97***	***0.94***	***0.99***
Sex of child	0.91	0.81	1.03	1.03	0.96	1.10	0.96	0.89	1.04
Female									
Male	-	-	-	-	-	-	-	-	-
Age of child									
0 – 5 months	-	-	-	-	-	-	-	-	-
6 – 11 months	***0.72***	***0.57***	***0.90***	***1.65***	***1.37***	***1.98***	***0.77***	***0.65***	***0.91***
12 – 23 months	***0.59***	***0.48***	***0.72***	***4.58***	***3.86***	***5.44***	***0.72***	***0.63***	***0.84***
24 – 35 months	***0.43***	***0.35***	***0.54***	***4.95***	***4.16***	***5.89***	***0.55***	***0.47***	***0.64***
36 – 47 months	***0.36***	***0.28***	***0.45***	***5.18***	***4.34***	***6.17***	***0.47***	***0.40***	***0.54***
48 – 59 months	***0.36***	***0.29***	***0.45***	***4.52***	***3.83***	***5.34***	***0.44***	***0.38***	***0.51***
Education level (mother)									
No education	-	-	-	-	-	-	-	-	-
Incomplete primary	***0.68***	***0.51***	***0.91***	0.96	0.82	1.12	0.87	0.72	1.07
Comp. primary/ Incomp. secondary	1.17	0.84	1.63	***0.79***	***0.66***	***0.94***	**1.25**	**1.01**	**1.55**
Completed secondary/Higher	***1.52***	***1.02***	***2.25***	***0.54***	***0.42***	***0.67***	1.17	0.89	1.54
Literacy (mother)									
Cannot read at all/Other	-	-	-	-	-	-	-	-	-
Can only read parts of sentence	0.77	0.54	1.12	1.08	0.91	1.28	0.83	0.66	1.05
Able to read complete sentence	***0.67***	***0.48***	***0.95***	0.96	0.80	1.16	***0.76***	***0.61***	***0.94***
Age at 1st birth (mother)									
15 – 17 years	-	-	-	-	-	-	-	-	-
18 – 25 years	0.96	0.80	1.14	1.02	0.93	1.13	1.00	0.89	1.14
26 + years	0.90	0.68	1.18	0.85	0.72	1.01	0.95	0.79	1.16
Number of living children									
1 – 3 children	-	-	-	-	-	-	-	-	-
4 + children	1.03	0.88	1.20	1.07	0.98	1.16	1.04	0.94	1.15
Household wealth index									
Lowest	-	-	-	-	-	-	-	-	-
Middle	***0.83***	***0.70***	***0.99***	***0.85***	***0.78***	***0.93***	***0.80***	***0.72***	***0.90***
High	0.88	0.70	1.11	***0.60***	***0.53***	***0.68***	0.87	0.74	1.02
SC/ST									
Scheduled caste	1.26	0.98	1.62	***1.62***	***1.43***	***1.86***	1.06	0.91	1.24
Scheduled tribe	1.15	0.77	1.72	***1.29***	***1.04***	***1.60***	1.16	0.89	1.50
Other backward class	1.16	0.93	1.45	***1.33***	***1.19***	***1.49***	1.04	0.91	1.20
None	-	-	-	-	-	-	-	-	-
Place of residence									
Urban	-	-	-	-	-	-	-	-	-
Rural	***0.73***	***0.56***	***0.95***	1.05	0.91	1.22	***0.80***	***0.67***	***0.95***

* The WASH index included sums of the values of the following variables: water source, location of water source, water availability to wash hands, used while washing hands, toilet facility used, and disposal of child feces

QUALITATIVE INTERVIEWS WITH CARE-INDIA

Qualitative interviews were collected in conjunction with CARE-India as part of a summer internship with the organization in Bihar, India, to add a water security module to the on-going SAM study. All of the respondents

in the qualitative interviews were women enrolled in the SAM study. All women were mothers with children between 0-59 months of age, consented to participate in the study, and consented to be recorded. This section highlights the main findings from this study.

THEME #1: Access and functionality

Overall, access and functionality was a recurrent theme throughout the interviews. In Nalanda, the first village visited with the CARE team was Govindpur, which is classified as a hard-to-reach village. The interviewees in Govindpur initially stated that they collected water for their daily activities from the government hand pumps installed in the village. But as the interviews progressed and functionality was addressed, participants mentioned that they tended to get water from a nearby ditch. When probed further, participants stated that the hand pumps, which were supplied by the government, were usually broken or inaccessible. In addition, Govindpur is an area that is the furthest away from the Ganges River (which is used as a water source by many low-income and rural areas in Bihar), and is also the lowest lying in the region. Due to this, the village is prone to flooding, especially during the monsoon season, and many villagers end up having flooded homes. During this time, the hand pumps also become inaccessible as they would be underwater, so the women end up using water that collected in a nearby ditch for all of their household activities – drinking, cooking, and cleaning. Observation of the ditch showed the water to be muddy and brown in color. Upon further probing on whether anything was done to the water to make it safe to drink, participants stated that they did not do anything due to the heat (interviews were conducted in the summer) and the time it would take to do so. Participants in this village also stated that due to the scarcity of water in the region during the summer months, they tended to forego bathing, oftentimes for weeks, and limited water use to cooking and drinking.

Similar issues were found in the hard-to-reach village, Chihutuzor, in Banka. Most of the villagers there did not own their own hand pumps, instead relying on the two main government-supplied hand pumps that supplied an entire block of the village. These hand pumps were often far away from the home, necessitating the mothers to walk back and forth to the hand pumps multiple times a day to fetch water as needed.

Most participants in the average and good connectivity villages reporting having their own hand pumps, paid for by their own funds. Many of those hand pumps were within their own homes or right outside their home,

so accessing water was not a concern. However, women did state that water access became an issue when their hand pumps broke or didn't function properly. For example, one participant from Nirya, Nalanda, states this:

"When our hand pump breaks, we have to walk all the way to the [Ganges] river to do our [household] work."

For this particular participant, the walk to the river was about 5-10 minutes, so making the trek every time she needed to do a chore that needed water was an inconvenience compared to having a functional hand pump on her property. However, she stated that whenever the personal hand pump was malfunctioning, male family members were able to quickly repair it, usually within 1-3 days.

THEME #2: Water quality and understanding of water security issues

Water quality was another major theme throughout the two districts. In the water module, quality was assessed by asking participants about taste, color, and odor. In Govindpur, participants mentioned a strong, "iron" taste, a dirt smell, and a yellow color in the water they collected from the government hand pumps. However, these women also used water from the nearby drainage ditch, which had a distinctly muddy color to it. Women also admitted that their children and some men openly defecated in the ditch they collected water from. Despite this, and knowing that the water is not ideal and is not safe for consumption, participants also admitted to not knowing many ways to "make the water safe". They were aware that boiling water would make it safer for drinking, but stated that they only did it when children were sick. As one participant stated:

"My husband doesn't want to drink hot water, who would want to drink hot water when it is so hot? And also it takes so much time to boil."

Participants also stated that they didn't give their children different water or do anything extra to make the water safer for their children:

"If the water is okay to drink for us, why is it not okay for the children to drink? We all drink the same water, we don't do anything to it for the children."

These sentiments were also echoed by participants from the village Madhuban in Banka (average connectivity). Women there also reported a strong taste to their water, and noticed the water was turning their cooking utensils

and clothes a rust color, and their teeth black. One family even reported water testing of their household water, which found that the water was heavy in iron contamination.

One participant from the village Chihutuzor in Banka had a unique take on water quality. The participant was originally from a larger, urban town, and stated that she noticed a distinct taste and grit in the water she collected from the village hand pump versus the water she used to drink in her hometown. She specifically stated that there seemed to be small black particles in the water, and showed us such while she went to collect water for laundering.

Women from good and average connectivity villages were more knowledgeable about safe water practices. One participant from Tetariya, Nalanda (average connectivity) complained about finding insects and small dirt particles in the water she collected from personal and governmental hand pumps. She stated that in order to make the water safe, she strained the water through a scrap of cloth before drinking it herself or giving it to her children. This type of water safety measure was reiterated by other participants as well, if such measures were taken. In Charmeli, Banka (good connectivity), women also mentioned boiling the water, in addition to filtering it, during the monsoon season to ensure safety.

<u>THEME #3: Distrust</u>

Overall, there was a general theme of distrust among the participants of the study. Despite having interacted with CARE field staff in the past for the SAM study, there still seemed to be an initial wariness to participating and giving responses, despite repeated assurances that this was a research-based study that would not collect any identifying information. While in the village of Madhuban, Banka (average connectivity), two men in the village came up to myself and the female interviewer as we were walking around the village. Each man was quite forceful in his language, asking us *"Why are you here? What are you going to accomplish by doing this? People come and go but nothing ever happens."* In discussions with the interviewer and SAM study supervisor in Banka, they reiterated that there was a general mistrust of the government in most rural regions in Bihar. This sentiment was echoed in Nalanda as well by the male interviewer in Nalanda. He stated that in villages that had average or poor connectivity, there isn't much government interaction and engagement seen by the community members. Due to various factors, only a fraction of the money set aside by the federal government for programs targeting rural areas actual makes it to the

implementation stage of these programs. In addition, due to lack of education, poor economic standing, and lack of awareness of how to voice their problems, villagers are not motivated to fight for their communities. In Nalanda, the village of Govindpur was coded as a hard-to-reach village. In the researcher's travel there, getting to the heart of the village took almost two hours driving, with very bad and bumpy roads. Villagers must travel these roads in order to access even the most basic necessities like soap, but due to the long distances and household context (children/elderly to take care of, no mode of transportation), they often end up going without the necessities unless absolutely necessary.

While administering the sanitation module in Madhuban, Banka, one of the participants was very hesitant to answer questions regarding latrines and latrine use. When probed further, she had this to say:

"I worry that if I say anything bad, I won't get money [from the government] to make more latrines for the family."

Other participants expressed similar sentiments, stating they were hesitant to say anything, good or bad, that could impede their ability to receive aid from the government. There were also several instances where village members refused to participate or answer survey questions, worried that our study would be reported to the government and would results in negative consequences for them.

Sanitation Findings

Due to logistical constraints, the sanitation module was only tested in Banka. There were three main talking points prevalent in the interviews with regards to sanitation – disposal of child feces, use of latrines, and perception of latrines.

In all of the villages visited in Banka, all of the women indicated that when their youngest child defecated and didn't use the latrine, they tended to leave the feces in the open or threw the feces into a nearby ditch or garbage pile. Upon observation of several of the latrines in Banka, child stools were openly left in the latrine area, even right outside the door of the latrine. Upon further probing, proper disposal did not seem to be a priority to participants.

Another finding from the sanitation module highlighted mothers' perceptions of latrines use. All of the women asked stated that they felt latrines were safe. However, upon further probing, participants stated that the

feelings of "safety" was physical rather than health-related. Participants stated that they felt more comfortable defecating in a latrine rather than in the open due to the presence of men in the area. Using a latrine provided a sense of safety and privacy from men in the village. This was further highlighted when women were asked about open defecation in their villages. Many of the participants stated that men were more apt to openly defecate, especially while working in the fields. Since men's fields were often situated far from their homes or an available latrine, men tended to openly defecate in their fields in order to continue working immediately. However, it is also important to note that these responses were only given by women in the good and average connectivity villages in Banka. Participants from the hard-to-reach village did not have their own latrines and practiced open defecation. They stated that they traveled far in the mornings to ensure a private area for defecation, away from any potential men who could pass by. Again, however, despite not having their own latrines, the women reiterated that latrines provide a measure of safety and privacy from men.

MODIFICATIONS TO WASH TOOL

Based on the responses to interview questions, and the participants' own interpretations of the questions, several changes were made to the WASH tool to ensure flow and to keep participants engaged, while still collecting meaningful information. First, the sanitation form should be kept as is and used for further formative research on a sanitation module before finalization for inclusion in the SAM study. While the responses generated with the form were valuable, not enough interviews were performed to allow for a deeper understanding of participants' understanding of the sanitation-related questions. The sanitation form highlights several of the key WASH variables that were found to be associated with the three malnutrition outcomes in this analysis, including toilet facilities, hand hygiene practices, and disposal of child feces. It also includes questions on the functionality of the latrines, which were not asked in the NFHS-IV survey.

The bulk of changes should be implemented in the water security portion of the tool. There were several questions that elicited confusion, frustration, or fatigue in respondents and needed revision. Particularly, there were several questions that, due to the Hindi translation, ended up having very similar connotations and were difficult to

distinguish among participants and had to be merged. In addition, a few sub-questions were added to provide additional detail. The proposed changes, and the rationale for the changes, are outlined in Table 8, below:

Table 8: Proposed changes to water security tool

Q. No.	Original Question	Proposed Changes	Rationale for changes
C1.	What is the primary source of water for the following activities for members of your household throughout the year?	What is the main source of water for the following activities for members of your household throughout the year?	This translation to Hindi was a bit more conversational. Answer options will remain the same as they mirror pre-existing questions in the SAM study.
new		Where is it located? 3 = in own house 4 = in own yard/plot 5 = in fields 6 = elsewhere	I believe this would provide additional detail on the location of the water sources. Observational data regarding the water source could also be recorded.
C3.	In the past year, for how many months was this water source functional?	In the past year, how many days were you not able to get water from this source because it wasn't working properly?	Participants tended to measure this by number of times the source became non-functional, rather than months, since they were oftentimes able to fix it within a few days.
C4.	On the LAST DAY your household collected water, how many trips did you or another family member make to the water source?	Keep this question, but add the following options, make it closed-ended. a. collect once, store it in a large vessel for continued use throughout the day b. collect as needed by person and activity	Most of the participants stated that they collected water as needed and didn't count the number of trips they made. Therefore, instead of leaving this an open-ended question, I believe this should be made into a question with options to choose from.
C5.	In the past 30 days, how frequently did physical difficulties prevent you from getting the water from this source?	In the past 30 days, how frequently did someone else have to collect water for you because you were ill?	This question necessitated clarification among participants. Participants commonly mentioned that they weren't ill, or had to get water regardless of whether they were ill or not.
C7.	Do you think water from this source is safe for drinking?	In the past 30 days, did you observe the following your drinking water? 03 = Color 04 = Taste 05 = Smell 77 = Other, specify	This question seemed leading during the interview process. All respondents ended up saying yes to this question, even though later in other questions, they mentioned that the water tasted different or had an odor. The proposed change reduces interviewer bias.
C10.	In the past 30 days, did you worry that you would not have enough water for [activity]?	In the past 30 days, did you have enough water for [activity]? a. Drinking b. Cooking c. Bathing d. Washing utensils e. Cleaning the house f. Making chai/coffee g. Use of cattle/farming Code 1 = Yes, 2 = No	These three questions tended to generate amused or irritated reactions from the participants. Some participants stated that the questions seemed the exact same. Therefore, the proposed change merges these questions in order to reduce interviewee fatigue.
C10.a.	If YES, because there was not enough water or because it was too difficult to collect water, how frequently did you reduce the amount of water you used for [activity]?		
C11.	In the past 30 days, how frequently were you or anyone in your household not able to get water when needed for [activity]?		

C12.	Within the past 30 days, how frequently did you or anyone else in your household not collect water for [activity] when you wanted to because:	If no, why? 3 = water source is too far away 4 = too risky/dangerous 5 = Wait is too long at source 6 = Not enough water at source 7 = Water source inaccessible/non-functional	
C12.a.	Takes too long because too far away		
C12.b.	Too risky or dangerous		
C12.c.	Takes too long to wait at the source		
C12.d.	Not enough water at the source		
C13.	In the past 30 days, how frequently did you or anyone else in your household sleep very few hours because of water-related chores for [activity]?	OMIT this question	This question did not seem relevant at all - the participants laughed and said this was never the case. In other instances, participants mentioned that they needed to wake up early to tend to fields and cattle, but stated that they tended to go to bed earlier to compensate. This question didn't generate much useful data.
C15.c.	How frequently did you or anyone else in your household go a whole day without drinking water because there was not enough clean water?	OMIT this question	These two questions were thought to be very similar amongst participants and didn't generate useful information. Participants stated that water was always available and consumed, despite the quality of it, since it was necessary. They also seemed to be generating interviewee fatigue.
C15.d.	How frequently did you or anyone else in your household go to sleep thirsty because there was not enough clean water?	OMIT this question	
C19.	In the past 30 days, how frequently did you or anyone in your household feel upset about your drinking water situation?	In the past 30 days, how frequently did you or anyone in your household feel upset about your water situation?	These two questions should be merged into one. Upon asking each question, participants immediately mentioned that they had already answered it, or couldn't tell the difference between the two questions.
C25.	In the past 30 days, how frequently did you or anyone in your household feel upset about your water situation?		

Formatting is also an important change for this survey. Because of the nature of field work, the current format of the survey did not seem conducive to intuitive questioning by the interviewer – extra training was necessary to help the interviewer understand the tabular format of the survey and how to record responses. To make the survey more simple and easy to use, the water security module was transformed back into the original questionnaire format from the tabular format. In addition, the questions regarding water use for separate household activities were slightly altered to ask about household activities as a whole, rather than each individual activity as in the field, it was often difficult to get respondents to differentiate their responses for each household activity. The last formatting change were the coding options. Due to the nature of some of the open-ended questions, miscellaneous response categories (Refused to answer, Does not know, Other) were recoded to prevent confusion

in response with the open-ended questions. The original tool, and the new proposed tool, are included in appendices D and E, respectively.

DISCUSSION

The burden of malnutrition is very high in Bihar; The prevalence of stunting, wasting and severe wasting was 47.6%, , 20.3%, and 6.7%, respectively. The prevalence of stunting increased significantly with age, whereas the opposite was seen for wasting and SAM.

The results from the crude and fully-adjusted models showed that the child age, education level of the mother, household wealth index, scheduled caste/tribe status of the household, and WASH were significant predictors of stunting. Child age, mother's education and literacy level, household wealth index, and type of residence were significant predictors in the model for SAM and wasting, with WASH being an additional predictor only for wasting. Qualitative interviews also generated data on women's understanding of water security and sanitation issues, allowing for a preliminary understanding of water and sanitation concerns in the region, and providing data for contextualization of WASH tools for use in Bihar.

STUNTING

The prevalence of stunting in Bihar is 47.6% overall among children 0-59 months, with the odds increasing as the age of the child increases. Initial simple binary logistic regression analyses indicated significant associations between stunting and several key variables (Table 5). These findings are consistent with existing literature on malnutrition outcomes, which indicate that the mother's educational level, age of the child, and household wealth index were found to be significant factors contributing to stunting (Mohensi, et.al., 2017; Tariku, et.al., 2017). In addition, stunting has shown to be more prevalent in rural areas compared to urban areas, an association also found in the NFHS-IV data as well, where rural areas had increased odds of stunting compared to urban areas (OR = 1.54, 95% CI: 1.36, 1.75) (Tariku, et.al., 2017).

The data also showed that the odds of stunting were the lowest among the 0-5 month age group, and increased as the age of the child increased, a trend that is seen globally (de Onis and Branca, 2016). This is termed

growth faltering, in which the child is not meeting the optimal length and height standards for their age (Stewart, et.al., 2013). Literature has also shown that the rate of EBF in both rural and urban regions of India are sub-optimal, with inconsistent complementary feeding practices contributing to a drop in EBF rates after the 4-5 month and negatively impacting child health outcomes (Patwari, et.al., 2015; Tariku, et.al., 2017).

Several indicators for WASH were significantly associated with stunting in the crude bivariate analysis. Water located farther from the home, or water from un-piped sources were associated with an increased risk of stunting compared to water in the home and water from a piped source. However, the odds of stunting were drastically higher when examining sanitation variables, such as the toilet facility used and disposal of child feces. Open defecation doubled the odds of stunting compared to flush system toilet facilities, while leaving children's stools in the open resulted in 1.63 times the odds of stunting compared to disposal of child stools in a latrine. Interestingly however, results from analysis of stunting risk in children in Ethiopia, India, Peru, and Vietnam indicated that when controlling for factors such as child, household, and community-level variables, access to improved water (ex.: piped systems) were not significantly associated with stunting (Dearden, et.al., 2017). However, sanitation was significantly associated with stunting, both in the unadjusted and adjusted models in their study. Therefore, it is imperative that further work focused specifically on sanitation is needed, since the NFHS-IV data clearly suggests there is a significant association between WASH and stunting.

Multivariate binary logistic regression analysis of stunting indicated that household wealth index was one of the significant predictors for stunting. Analysis of previous DHS data from 46 countries showed that stunting prevalence was higher among those with a lower socio-economic status (SES) and lower wealth index (Wong, et.al., 2017). In the analysis of NFHS-IV data for Bihar, middle and high household wealth indices also had a similar significant protective effect on the odds of stunting, with those children in the highest wealth index having the least odds of stunting (OR = 0.60, 95% CI: 0.53, 0.68). This aligns with a majority of the literature, which indicates that poor SES and household wealth indices account for worse health outcomes among children 0-59 months compared to children in a higher wealth index (Endris, et.al., 2017), likely due to poor access to proper healthcare, nutritional food, and ability to access improved water and sanitation sources.

WASTING AND SAM

20.3% of children 0-59 months classify as wasted in Bihar. The prevalence of wasting is much higher among the 0-5 month age group, at 30.9%.. This clearly represents the need for an increased focus on this age group to combat the high incidence of wasting. Key demographic and WASH variables, such as household wealth index, availability of water to wash hands, location of water source, toilet facilities used, and disposal of child feces were all significant independent predictors of wasting, consistent with findings in other low-income regions, where WASH and household SES significantly affected weight-for-height z-scores in regression analyses, with the relationship between SES and wasting being indirectly affected by WASH practices (Raihan, et.al., 2017). Fully adjusted models of wasting also showed a significant association with WASH, affirming the role of WASH in the pathway for malnutrition. Household wealth index, education and literacy level of the mother, and age of the child were also found to be significant in the model for wasting. The odds of wasting were lower in households with a middle wealth index compared to the lowest wealth index (OR = 0.80, 95% CI = 0.72, 0.90). Interestingly, this was the only level of the household wealth index that was significant – there did not seem to be a significant difference between the lowest and highest wealth indexes in the fully adjusted model for wasting. Interesting trends were seen for both the education level and literacy level of the mother. Higher literacy levels amounted to lower odds of wasting, but only the mother's completion of primary schooling was a significant literacy predictor of wasting. However, while the predictor was significant, it showed an increase in odds of wasting at this level compared to mothers with no education, which is contrary to prior research in wasting.

This analysis found that the prevalence of SAM in Bihar was 6.7% (95% CI: 6.4, 6.9). Simple binary logistic regressions for predictors with SAM outcome indicated that again, the age of the child had a significant association with increased odds of SAM – children in the youngest age group, 0-5 months had highest odds of SAM compared to children in the oldest age groups. This is in alignment with previous NFHS-3 estimate trends seen in SAM in Northern India, where younger age was a significant predictor of SAM (Bhadoria, et.al., 2017). Other independent predictors of SAM included maternal education level, literacy level, household wealth index, and toilet facilities used, which align with recent findings on SAM in Pakistan, a neighboring country, where maternal education and household income were found to be significantly associated with SAM outcomes in children aged 6-59 months

(Sand, et.al., 2018). In fully adjusted models of SAM, household location, education and literacy levels of the mother, and household wealth index were significant predictors for SAM. Interestingly however, rural residences showed decreased odds of SAM compared to urban, (OR = 0.73, 95% CI: 0.56, 0.95), contrary to previous literature findings. For SAM, while WASH was a significant predictor during crude analyses, WASH became an insignificant predictor in the fully adjusted model.

While most of the literature states that wasting is strongly associated with maternal education and other demographic factors, not much work has been done examining the role of WASH as it specifically relates to wasting and SAM. While WASH has not shown to be a direct influencer on malnutrition, it may mediate the health outcomes associated with malnutrition, such as EE and respiratory illnesses due to compromised immune systems (WHO, 2015). In this analysis, several WASH variables were found to be associated with wasting and SAM in crude models, and WASH remained a significant predictor in multivariate analysis for wasting outcomes. Given that Bihar continues to experience a high burden of malnutrition, despite experiencing economic growth and increases in literacy and education levels among men and women that have been shown to reduce the risk of malnutrition outcomes, more research is necessary to understand the underlying issues surrounding malnutrition in the region.

Additionally, both SAM and wasting are measured by looking at WHZ, but they can also be calculated by measuring the child's mid-upper-arm circumference (MUAC), where a measurement of less than 115 cm classifies the child as severely wasted, and less than 125 cm as wasted. While WHZ and MUAC measurements have been used interchangeably to measure wasting and SAM, recent literature has shown that there is a discrepancy in classification of children's nutritional status when using WHZ compared to MUAC scores. Weight-for-height measurements have been shown to overestimate and underestimate SAM and wasting in those with long limbs and short limbs, respectively. There are several hypotheses that seek to explain these discrepancies, but no clear conclusion can be made on the use of MUAC vs. WHZ as a better predictor for wasting and SAM. Therefore, both should be used simultaneously to assess for wasting and SAM in future studies until further work can be done on the underlying factors that influence both MUAC and WHZ (Grellety and Golden, 2016).

QUALITATIVE INTERVIEWS

Through the course of the project with CARE-India, it was evident that water security and sanitation should be an immediate concern in the region, especially in the hard-to-reach villages. In a report published by the Chandragupt Institute of Management Patna (CIMP) in 2013, over 91% of rural households were reportedly supplied water by hand pump schemes (Das, 2013). Currently, the World Bank is working with the Ministry of Drinking Water Supply & Sanitation of India to implement a Rural Water Supply and Sanitation Program for Low Income States. The project goals were to improve water coverage within the state by supplying hand pumps, in addition to providing sanitation services. However, in a report released by the World Bank in September 2017, only 40% of the project was completed, and the overall progress toward the program objectives was deemed "Moderately Unsatisfactory" (World Bank, 2017). These numbers and programs also fail to take into account the number of damaged, inoperable hand pumps in the region, the quality of the water that is collected from the hand pumps, and the ability of villagers to rectify these issues. Therefore, it is imperative that rather than focusing on water access alone, such as access to a hand pump, data collection needs to focus on the quality of access. Many participants in the qualitative interviews reported that functionality of their hand pumps impacted their ability to access adequate water, especially if the hand pumps were underwater, dried out, and broken. Residents in poorer villages were unable to address problems with their hand pumps, and ended up using water from very unsafe sources, such as streams, lakes, and rivers that were often contaminated with feces due to open defecation.

In addition, in some areas, even with access to functional water sources, participants reported water quality issues. Many participants reported odd tastes, smells, and color to their water and their associated impacts. Namely, they reported instances where their water turned their utensils, clothes, and even teeth different colors. While many participants stated that boiling or filtering water were mechanisms that could help make the water "safe", this information does not take into account the inorganic contaminants of water in the region. Environmental studies in Bihar have indicated that there are widespread water quality issues in the region. One of the biggest factors affecting water quality is groundwater arsenic contamination. Biomarker sampling from villagers living in the Ganges plain area and the Patna district of Bihar showed blood level arsenic concentrations greater than 50 μg/L, which is five

times the WHO standard for arsenic concentration (10 μg/L) (Chakraborti, et.al., 2003; Chakraborti, et.al, 2016). Health effects from ingesting high levels of arsenic included skin lesions, neuropathy, adverse pregnancy outcomes, and malignancies (Chakraborti, et.al., 2016; Madhawi, et.al., 2017). Data collected from the Public Health Engineering Department (PHED) in Bihar also found issues of fluoride and iron contamination in water at levels higher than the recommended cut-offs. High levels of fluoride, which was found mainly along the southern border of Bihar, is a significant contributing factor in vitamin D deficiency, dental mottling, and severe skeletal deformities among children (Khandare, et.al., 2005). The participants who discussed odd qualities in their drinking or rough water use did not mention specific arsenic or fluoride contamination issues. Further education is needed to illuminate this issue to residents in Bihar, and to teach them ways on how to mitigate water quality issues that cannot be solved by boiling or filtering.

Due to logistical constraints, the sanitation form could only be applied in one of the two districts sampled in the qualitative study. Therefore, further formative research is necessary with the sanitation form to contextualize the tool for Bihar. However, it is important to note that open defecation is still widely practiced in the region of Banka, where the tool was applied. Even in households that reported having a functional latrines, many children and men still practiced open defecation. Mother stated that children often practiced open defecation "just because they're kids", while they reported that men did so due to work obligations. Because more rural men worked in fields that were located far from a latrine, it was more convenient for them to practice open defecation that return to the village to employ latrines for defecation. Most women however, did report using latrines if they were available to them, citing reasons of personal safety. While women did not extrapolate on the health benefits of using latrines, they intimated that their primary motivation for using latrines was physical safety. By having an enclosed space close to home for defecation, the women reported feeling safer from men compared to open defecation, in which they reported they would walk into secluded areas far from the village to avoid prying eyes, yet still worried about being seen by men and other villagers.

RECOMMENDATIONS

To analyze WASH in the context of Bihar and SAM, the detailed water security module (Appendix E), and the sanitation module should be included in the larger SAM study after conducting additional formative research to contextualize and pretesting. Since the SAM study was designed to be representative at the district level, whereas the NFHS-IV survey was designed to be representative at the national level, by implementing the WASH tool in the SAM study, we will be able to get a better grasp of the determinants of SAM, including WASH, in Bihar to better inform CARE policies and programs targeted at SAM. The module would address questions regarding water quality and security. Key questions include availability of water source by season, reasons for unavailability of water source in different seasons, and what is done for water collection when the water source is not available. In addition, environmental data should also be collected in order to test the water from water sources. Indicators for water quality, water source functionality, and water safety/hygiene practices can be correlated and modeled with SAM outcomes to determine whether WASH is a determinant of SAM. However, seasonality of water is also an issue. Many participants also mentioned that while they had not had water issues in the past 30 days, they have had issues in the past. It may be useful to implement this tool into the quarterly household survey to identify trends related to seasonality. Lastly, to supplement the WASH data, if given adequate logistical support and funding, whether internally through CARE-India or through a partnership agency, this work could also be paired with environmental sampling in the region to determine water quality as well. This work can also be correlated with incidence of SAM, wasting, and stunting to determine whether morbidity and mortality characteristics are significantly affected by water security and sanitation variables.

SIGNIFICANCE

Estimates from the joint UNICEF, WHO, and World Bank report on global malnutrition estimates indicate that the worldwide prevalence of malnutrition outcomes in children under 60 months of age are as follows: 22.9% (154.8 million) stunted, and 7.7% (41 million) are wasted, and about 2.5% (17 million) are suffering from SAM (UNICEF et.al., 2017). In comparison, the rates of these nutritional outcomes are much higher in Bihar in both this analysis and the NFHS-IV report published through the Government of India for Bihar. The high rates of

malnutrition outcomes in Bihar highlight the public health crisis occurring in the state and the need for further research to inform policies and programs surrounding malnutrition. However, it is not just enough to implement nutrition-based programs. Bihar's classification as a backwards state, low maternal literacy rates, and high poverty rates pose a threat to child nutrition outcomes, since these have shown to be determinants of stunting, wasting, and SAM, despite rapid economic growth in recent years and rising literacy levels. This is in contrast to malnutrition improvements seen in other low-income states in India like Gujarat, which has shown significant improvement in malnutrition rates with increased economic growth (Ruia, et.al., 2018).

While comparisons between NFHS-III data (conducted in 2005-2006) and NFHS-IV data indicate that prevalence of malnutrition is decreasing in the region, it is still significantly higher than the global rate. Therefore, in response to poor maternal and child health outcomes in Bihar and other rural areas of India, the Government of India implemented the National Rural Health Mission (NRHM) to combat this issue on multiple levels in 2005. Implemented among 18 of the weakest public health states in India, the program was designed to address a slew of insufficiencies within the health system in a multi-pronged approach utilizing community accountability, financial resources, monitoring of key indicators, managing the program through capacity building, and implementing innovative ideas to manage resources effectively. In order to address community accountability and "communitization", non-governmental organizations (NGOs), like CARE-India, play a critical role in the success of these missions. NGOs are utilized by the NRHM to collect information on disease programs, reproductive health, and maternal and child health (Nandan, 2010). Therefore, it becomes critical that organizations like CARE-India are collecting information that can fully inform programs and policies. Integrating the WASH tool into the current CARE-India study will allow CARE to fully inform the government on the determinants of malnutrition, including the role of WASH. As outlined in the conceptual framework in Figure 1, WASH is not a direct cause of malnutrition, but an underlying cause of EE which in turn leads to undernutrition. By examining WASH in the SAM study, the survey would allow for more accurate district profiles regarding malnutrition and WASH characteristics and draw more meaningful associations between the two variables at the district level.

In addition, because of the nature of the different malnutrition outcomes, interventions can be targeted at multiple stages of a child's life to reduce these outcomes. For instance, stunting is a result of chronic undernutrition.

As previously discussed, chronic undernutrition, left untreated, can lead to developmental problems in childhood that have lasting effects into adulthood, impacting the economic, educational, and social stability of the child, not to mention the onset of chronic illness, such as anemia. Wasting, on the other hand, results from inadequate undernutrition over a shorter time period, with severe stunting and severe wasting leading to increased risk of mortality among children (Caulfield, et.al., 2017). By collecting information on the determinants of malnutrition, including the role of WASH, CARE-India can propose multi-faceted programs that utilize not just nutrition-improvement based programs for the mother and child, but also water security education programs and improved hygiene and sanitation provisions.

LIMITATIONS

One of the most significant limitations of the CARE-India qualitative study was time. Due to the short time-span of the project, only two districts could be surveyed for formative research of WASH practices. In addition, because the field facilitators chosen to conduct the interviews had a limited number of hours per day to devote to data collection (due to other SAM study obligations and personal obligations), only a small number of interviews could be conducted daily. This was further compounded when data collection occurred in the average and poor connectivity villages in each district. Because travel to and from these village were arduous, it further narrowed the time frame available for data collection in each village.

In addition, logistical constraints, including illnesses and weather, impeded the researcher's to spend more time in the field conducting interviews. Due to illness, interviews in the districts of Munger and Kishanganj were not conducted as previously planned by the study team. If Munger had been added to the sample, data on women's empowerment could have been added to the analysis to enrich the findings and determine if there are any association with malnutrition outcomes. Kishanganj, which has a majority Muslim population in contrast to the other districts, would have added religious diversity and allowed us to determine the extent that religion influences nutritional outcomes. Lastly, while the researcher is fluent and conversational in Hindi, they lack writing and reading skills in Hindi. This proved a challenge during tool translation and survey administration, as the interviewers, despite the training, oftentimes failed to probe to the depth necessary. In addition, translation of the tool to Hindi was a

challenging process since connotations were very nuanced and it was difficult to communicate that to the translator. Multiple iterations of the translations were performed to ensure conversationality in the questions.

Another limitation of the qualitative study was the unwillingness of some participants to provide robust answers. While participants were willing to engage in the interview, extensive probing had to be utilized to gain an understanding of the participants' thought processes in answering the questions. While this tactic was fairly successful, several interviews in the district of Nalanda had to be terminated because of the participant's unwillingness to respond to any of the questions, despite extensive requests from both the interview team and the respondent's own family members. A likely reason for this is the inherent distrust of the government in rural regions in India. Despite numerous reassurances that this study was not associated with the government and would not impact any aid families were receiving, some women did not feel comfortable openly speaking about the concerns, which may have introduced some bias and data quality issues into the study.

Interviewer discrepancies may also be acting as a source of bias in this study and/or contributing to issues of data quality. In Nalanda, the interviewer was male and therefore, during interviews, the female participants seemed hesitant to answer questions in the presence of an outside male. Despite the interviewer being a SAM study supervisor who spent time in the village regularly, the women were still faltering in their responses to questions. Conversely, in Banka, a female interviewer was used. Interview responses were much more robust and easier to generate from participants, as they felt a sense of camaraderie with the interviewer. The interviews were much more conversational in Banka as well.

Lastly, a final limitation of the qualitative study is likely the representativeness of the sample. Due to the time and logistical constraints of this study, interviews could not be conducted in every SAM district, or in diverse geographic/demographic districts. Therefore, the sample in these interviews may not be representative of Bihar as a whole, or of all of the SAM study districts.

The quantitative portion of this analysis also had a few limitations. The data was collected at a national level by the DHS program and available for download by researchers on the DHS website. However, since the data was being collected in conjunction with the Government of India, there may have been implicit biases in the wording of questions. In addition, the survey was collected at one point in time. Issues of seasonality regarding illness and

WASH could not be addressed, and the variables could not be assessed for trends and changes over time. Lastly, WASH variables had missing observations (n < 2500), amounting to about 10% of the total number of observations. Some of the observations were coded as missing by the researchers due to non-response, but due to secondary data analysis, the reason for the majority of missing information could not be determined, whether it was due to imputation errors or non-response from participants.

CONCLUSION

In conclusion, WASH should be an aspect that should be more deeply explored within the context of the malnutrition, specifically in Bihar. Due to prior studies indicating the strong relationship between WASH characteristics and undernutrition in children, exploring this concept in Bihar will provide additional information to use for programmatic approaches to reducing the prevalence of in this region among children 0-59 months. Implementing the WASH tool will enhance the on-going SAM study in Bihar and provide additional variables that can be used to both explain malnutrition in the region, and allow for a multi-faceted approach to reducing adverse nutritional outcomes. The high rates of stunting, wasting, and SAM in Bihar, compared to the global and national prevalence, further deepens the case to examine malnutrition more deeply in the state, and develop targeted programs not just involving nutrition, but improved WASH practices as well.

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APPENDICES

APPENDIX A: DEMOGRAPHIC PROFILES OF 10 CARE-INDIA DISTRICTS IN BIHAR, INDIA

VARIABLE	BANKA		BHOJPUR		DARBHANGA		GAYA	
Child characteristics	n	%	n	%	n	%	n	%
Sex								
Female	287	44.6	293	45.9	326	49.3	385	47.5
Male	354	55.4	348	54.1	324	50.7	426	52.5
Age								
0 – 5 months	50	8.1	53	8.5	62	9.4	43	5.5
6 – 11 months	82	12.8	66	10.4	64	9.7	99	12.5
12 – 23 months	141	21.8	145	14.5	132	19.8	175	21.9
24 – 35 months	123	19.1	117	11.5	144	22.4	157	19.3
36 – 47 months	150	23.4	145	12.2	131	20.5	187	22.6
48 – 59 months	95	14.8	115	14.5	117	18.1	150	18.2
Type of residence								
Urban	22	2.8	90	15.6	50	5.7	94	10.9
Rural	619	97.2	551	84.4	600	94.3	717	89.1
Religion								
Hindu	581	89.7	589	91.8	493	77.2	761	94.5
Non-Hindu	60	10.3	52	8.2	157	22.8	50	5.5
Caste/Tribe								
Scheduled caste	101	15.5	124	18.3	178	26.9	290	35.7
Scheduled tribe	33	5.2	5	0.7	69	10.6	1	0.1
Other backward class	473	73.6	417	66.6	267	42.9	443	55.5
None	33	5.6	95	14.4	121	19.6	77	8.7
Wealth Index								
Lowest	398	63.7	232	35.8	382	60.9	437	55.1
Middle	160	24.0	193	30.8	153	23.6	173	21.4
High	83	12.4	216	33.4	115	15.6	201	23.5
TOTAL	**641**	**100.0**	**641**	**100.0**	**650**	**100.0**	**811**	**100.0**
Maternal characteristics								
Education level								
No education	245	58.6	195	47.3	256	61.7	289	54.6
Incomplete primary	18	4.1	25	6.0	19	4.7	19	3.6
Completed primary/ Incomplete secondary	114	26.6	143	33.5	104	24.4	150	28.2
Completed secondary/Higher	46	10.7	56	13.1	41	9.2	73	13.7
Literacy level								
Cannot read at all/Other	262	62.4	215	52.0	259	62.7	301	57.2
Can only read parts of sentence	24	5.6	15	3.5	21	5.1	30	5.7
Able to read complete sentence	137	32.0	189	44.5	140	32.2	200	37.2
Age at first birth								
15 – 17 years	56	13.5	51	12.1	103	24.7	119	22.0
18 – 25 years	341	80.4	325	77.0	287	68.0	385	72.7
26 + years	26	6.0	43	10.8	30	7.3	27	5.4
Number of living children								
1 – 3 children	327	76.6	317	76.1	304	71.9	418	78.7
4 + children	96	23.4	102	23.9	116	28.1	113	21.3
TOTAL	**423**	**100.0**	**419**	**100.0**	**420**	**100.0**	**531**	**100.0**

VARIABLE	KISHANGANJ		NALANDA		PASCHIM CHAMPARAN		SAHARSA	
Child characteristics	n	%	n	%	n	%	n	%
Sex	322	48.2	259	46.3	255	47.1	346	48.3
Female	351	51.8	296	53.7	289	52.9	375	51.7
Male								
Age								
0 – 5 months	74	11.1	38	6.6	68	12.2	56	7.8
6 – 11 months	72	10.7	53	9.5	47	8.9	91	12.6
12 – 23 months	134	20.1	116	20.8	114	21.1	146	20.1
24 – 35 months	132	19.4	113	20.2	111	20.9	152	20.9
36 – 47 months	127	18.8	134	24.5	111	20.3	121	16.9
48 – 59 months	134	19.9	101	18.3	93	16.6	155	21.5
Type of residence								
Urban	68	7.4	84	17.8	47	10.9	46	5.0
Rural	605	92.6	471	82.2	497	89.1	675	95.0
Religion								
Hindu	235	35.6	515	92.3	440	80.5	583	81.4
Non-Hindu	438	64.4	40	7.7	104	19.5	138	18.6
Caste/Tribe								
Scheduled caste	58	9.1	151	27.7	88	17.8	128	17.9
Scheduled tribe	45	6.8	10	1.7	49	10.0	3	0.4
Other backward class	238	35.9	350	62.8	330	65.8	448	62.8
None	323	48.3	44	7.8	32	6.4	142	18.9
Wealth Index								
Lowest	436	65.5	238	43.0	372	67.3	463	65.1
Middle	157	23.2	152	26.2	97	18.1	149	20.5
High	80	11.3	165	30.7	75	14.5	109	14.4
TOTAL	**673**	**100.0**	**555**	**100.0**	**544**	**100.0**	**721**	**100.0**
Maternal characteristics								
Education level								
No education	310	70.5	208	57.5	206	57.3	291	64.9
Incomplete primary	23	4.9	8	2.1	34	9.8	37	8.1
Completed primary/ Incomplete secondary	86	19.8	109	30.2	83	23.7	77	17.3
Completed secondary/Higher	24	4.9	37	10.2	31	9.2	47	9.8
Literacy level								
Cannot read at all/Other	325	73.9	218	60.1	219	61.0	313	69.7
Can only read parts of sentence	20	4.3	17	4.7	28	8.2	24	5.4
Able to read complete sentence	98	21.8	127	35.2	107	30.8	115	24.9
Age at first birth								
15 – 17 years	46	10.4	66	17.7	63	16.9	76	16.9
18 – 25 years	360	81.2	267	74.1	253	72.2	337	74.4
26 + years	37	8.4	29	8.1	38	10.9	39	8.9
Number of living children								
1 – 3 children	300	67.9	262	71.7	261	73.8	322	71.6
4 + children	143	32.1	100	28.3	93	26.2	130	28.4
TOTAL	**443**	**100.0**	**362**	**100.0**	**354**	**100.0**	**452**	**100.0**

VARIABLE	SITAMARHI		SIWAN	
Child characteristics	n	%	n	%
Sex	323	49.8	296	49.2
Female	324	50.2	306	50.8
Male				
Age				
0 – 5 months	52	8.0	62	10.4
6 – 11 months	66	10.3	55	9.4
12 – 23 months	158	24.0	135	22.5
24 – 35 months	122	19.1	120	19.9
36 – 47 months	110	17.1	116	19.0
48 – 59 months	139	21.4	114	18.9
Type of residence				
Urban	49	8.3	34	4.2
Rural	598	91.7	568	95.8
Religion				
Hindu	501	77.4	504	83.2
Non-Hindu	146	22.6	98	16.8
Caste/Tribe				
Scheduled caste	137	21.1	134	22.4
Scheduled tribe	23	3.5	44	7.3
Other backward class	381	59.4	305	52.5
None	101	16.0	107	17.8
Wealth Index				
Lowest	464	70.7	226	38.0
Middle	139	22.0	205	34.1
High	44	7.3	171	27.9
TOTAL	**647**	**100.0**	**602**	**100.0**
Maternal characteristics				
Education level				
No education	266	61.8	163	38.9
Incomplete primary	65	14.9	22	5.4
Completed primary/ Incomplete secondary	79	18.4	179	43.8
Completed secondary/Higher	21	4.9	49	11.8
Literacy level				
Cannot read at all/Other	312	72.2	170	40.5
Can only read parts of sentence	31	7.1	30	7.6
Able to read complete sentence	88	20.6	213	51.9
Age at first birth				
15 – 17 years	92	21.4	53	12.6
18 – 25 years	320	74.3	325	79.0
26 + years	19	4.3	35	8.4
Number of living children				
1 – 3 children	296	68.7	328	79.9
4 + children	135	31.3	85	20.1
TOTAL	**431**	**100.0**	**413**	**100.0**

APPENDIX B: NUTRITION PROFILES OF 10 CARE-INDIA DISTRICTS IN BIHAR, INDIA

		STUNTING (HAZ < -2 SD)	WASTING (WHZ < -2 SD)	SAM (WHZ ≤ -3 SD)
DISTRICT	**n**	**Prevalence (95% CI)**	**Prevalence (95% CI)**	**Prevalence (95% CI)**
Summary				
Bhojpur	652	42.5 (38.6, 46.3)	24.7 (21.3, 28.0)	11.9 (9.3, 14.4)
Saharsa	600	43.0 (39.0, 47.1)	24.4 (20.9, 27.9)	11.0 (8.4, 13.6)
Banka	590	50.3 (46.2, 54.4)	25.5 (21.9, 29.1)	9.1 (6.7, 11.5)
Kishanganj	517	48.1 (43.7, 52.5)	22.1 (18.4, 25.8)	8.8 (6.2, 11.3)
Gaya	1379	53.5 (50.9, 56.2)	25.6 (23.2, 27.9)	7.5 (6.0, 8.9)
Paschim Champaran	969	41.9 (38.8, 45.1)	20.8 (18.2, 23.4)	7.2 (5.6, 8.9)
Nalanda	666	52.7 (48.8, 56.6)	23.9 (20.6, 27.2)	6.5 (4.5, 8.4)
Siwan	796	36.7 (33.3, 40.1)	15.0 (12.5, 17.5)	4.6 (3.1, 6.1)
Darbhanga	1273	47.5 (44.7, 50.3)	16.3 (14.3, 18.4)	4.5 (3.3, 5.7)
Sitamarhi	1154	56.4 (53.5, 59.3)	14.8 (12.7, 16.9)	4.1 (2.9, 5.3)
Banka				
Sex				
Female	263	47.7 (41.4, 53.9)	25.0 (19.6, 30.5)	9.7 (6.0, 13.5)
Male	327	52.5 (46.9, 58.0)	25.9 (21.0, 30.8)	8.6 (5.4, 11.7)
Age				
0 – 5 months	41	28.8 (13.7, 43.9)	33.1 (17.4, 48.7)	16.7 (4.1, 29.4)
6 – 11 months	75	35.9 (24.5, 47.4)	26.1 (15.5, 36.7)	5.9 (0.0, 11.9)
12 – 23 months	129	51.7 (42.7, 60.7)	27.9 (19.7, 36.0)	12.6 (6.5, 18.7)
24 – 35 months	113	52.3 (42.6, 61.9)	27.9 (19.2, 36.7)	8.3 (2.8, 13.8)
36 – 47 months	140	58.3 (49.7, 66.8)	24.7 (17.2, 32.2)	7.4 (2.7, 12.1)
48 – 59 months	92	55.2 (44.5, 65.9)	16.7 (8.6, 24.9)	6.8 (1.2, 12.5)
Bhojpur				
Sex				
Female	303	47.1 (41.3, 52.9)	24.9 (19.9, 30.0)	10.4 (6.8, 14.0)
Male	349	38.5 (33.3, 43.7)	24.4 (19.8, 29.1)	13.1 (9.4, 16.8)
Age				
0 – 5 months	52	13.8 (3.5, 24.1)	12.6 (2.7, 22.6)	8.8 (0.2, 17.5)
6 – 11 months	65	20.3 (9.7, 30.8)	25.5 (14.1, 36.8)	13.7 (4.6, 22.8)
12 – 23 months	149	48.4 (40.1, 56.8)	25.7 (18.3, 33.0)	13.5 (7.7, 19.3)
24 – 35 months	118	42.6 (33.3, 52.0)	17.7 (10.4, 25.0)	7.8 (2.5, 13.1)
36 – 47 months	149	55.5 (47.2, 63.8)	30.0 (22.3, 37.7)	13.8 (7.9, 19.6)
48 – 59 months	119	43.3 (34.0, 52.7)	28.4 (19.9, 37.0)	11.8 (5.5, 18.0)
Darbhanga				
Sex				
Female	623	47.9 (43.9, 51.9)	19.4 (16.2, 22.6)	7.5 (5.4, 9.7)
Male	650	47.1 (43.2, 51.0)	13.4 (10.7, 16.1)	1.6 (0.6, 2.7)
Age				
0 – 5 months	112	15.7 (8.5, 22.9)	27.8 (19.1, 36.6)	19.0 (11.3, 26.7)
6 – 11 months	124	14.0 (7.5, 20.5)	23.7 (15.8, 31.6)	5.9 (1.3, 10.4)
12 – 23 months	247	49.2 (42.8, 55.7)	24.1 (18.6, 29.7)	7.2 (3.8, 10.6)
24 – 35 months	291	58.6 (52.8, 64.5)	10.7 (7.0, 14.4)	1.4 (0.0, 3.0)
36 – 47 months	268	53.8 (47.7, 60.0)	8.7 (5.2, 12.3)	0.0 (0.0, 0.2)
48 – 59 months	230	57.6 (51.0, 64.3)	14.4 (9.6, 19.1)	2.9 (0.5, 5.3)

		STUNTING (HAZ < -2 SD)	WASTING (WHZ < -2 SD)	SAM (WHZ ≤ -3 SD)
DISTRICT	**n**	**Prevalence (95% CI)**	**Prevalence (95% CI)**	**Prevalence (95% CI)**
Gaya				
Sex				
Female	665	57.3 (53.5, 61.2)	24.5 (21.2, 27.9)	6.5 (4.5, 8.4)
Male	713	50.0 (46.2, 53.7)	26.5 (23.2, 29.9)	8.4 (6.3, 10.5)
Age				
0 – 5 months	70	30.8 (19.2, 42.4)	34.3 (22.4, 46.2)	19.3 (9.3, 29.3)
6 – 11 months	170	30.9 (23.7, 38.2)	30.0 (22.8, 37.2)	9.8 (5.0, 14.6)
12 – 23 months	305	64.3 (58.7, 69.8)	31.9 (26.5, 37.3)	9.3 (5.9, 12.8)
24 – 35 months	266	62.6 (56.6, 68.6)	22.8 (17.6, 28.0)	3.6 (1.1, 6.0)
36 – 47 months	311	50.4 (44.7, 56.1)	20.0 (15.4, 24.6)	5.9 (3.2, 8.7)
48 – 59 months	258	56.3 (50.0, 62.5)	22.3 (17.1, 27.6)	6.4 (3.2, 9.6)
Kishanganj				
Sex				
Female	252	49.0 (42.6, 55.4)	22.0 (16.7, 27.3)	7.5 (4.1, 11.0)
Male	265	47.3 (41.1, 53.5)	22.2 (17.0, 27.4)	9.9 (6.1, 13.7)
Age				
0 – 5 months	52	18.2 (6.7, 29.6)	30.7 (17.2, 44.2)	7.9 (0.0, 16.1)
6 – 11 months	56	30.9 (17.9, 43.8)	22.4 (10.6, 34.2)	4.8 (0.0, 11.2)
12 – 23 months	105	61.3 (51.5, 71.1)	20.3 (12.1, 28.4)	6.2 (1.2, 11.3)
24 – 35 months	98	50.2 (39.8, 60.5)	21.5 (12.9, 30.1)	12.4 (5.4, 19.4)
36 – 47 months	100	55.2 (44.9, 65.5)	23.6 (14.7, 32.4)	12.2 (5.3, 19.2)
48 – 59 months	105	50.3 (40.2, 60.3)	18.7 (10.8, 26.6)	7.2 (1.8, 12.6)
Nalanda				
Sex				
Female	313	52.9 (47.2, 58.6)	25.3 (20.3, 30.3)	8.3 (5.1, 11.5)
Male	353	52.5 (47.2, 57.9)	22.6 (18.1, 27.1)	4.8 (2.4, 7.2)
Age				
0 – 5 months	42	11.1 (0.4, 21.8)	48.2 (31.9, 64.5)	13.2 (1.7, 24.6)
6 – 11 months	60	19.3 (8.5, 30.0)	30.7 (18.3, 43.2)	11.5 (2.6, 20.4)
12 – 23 months	140	61.3 (52.9, 69.7)	23.1 (15.8, 30.5)	3.9 (0.3, 7.5)
24 – 35 months	134	58.9 (50.2, 67.6)	24.0 (16.4, 31.6)	6.2 (1.7, 10.6)
36 – 47 months	164	64.9 (57.3, 72.5)	16.7 (10.7, 22.7)	3.4 (0.3, 6.5)
48 – 59 months	126	50.5 (41.4, 59.7)	22.4 (14.8, 30.1)	8.9 (3.5, 14.3)
Paschim Champaran				
Sex				
Female	466	44.0 (39.4, 48.6)	21.8 (17.9, 25.6)	8.4 (5.8, 11.0)
Male	502	40.0 (35.6, 44.4)	20.0 (16.4, 23.6)	6.2 (4.0, 8.4)
Age				
0 – 5 months	107	20.8 (12.6, 29.0)	35.3 (25.7, 44.8)	17.3 (9.7, 25.0)
6 – 11 months	82	27.9 (17.6, 38.2)	18.0 (9.1, 26.9)	2.3 (0.0, 6.2)
12 – 23 months	199	38.9 (31.9, 46.0)	24.9 (18.6, 31.1)	9.4 (5.1, 13.7)
24 – 35 months	208	41.9 (35.0, 48.9)	21.8 (15.9, 27.7)	6.8 (3.1, 10.5)
36 – 47 months	204	51.2 (44.1, 58.3)	17.5 (12.0, 22.9)	5.5 (2.1, 8.9)
48 – 59 months	169	54.4 (46.6, 62.2)	11.3 (6.2, 16.3)	3.3 (0.3, 6.3)

		STUNTING (HAZ < -2 SD)	WASTING (WHZ < -2 SD)	SAM (WHZ ≤ -3 SD)
DISTRICT	**n**	**Prevalence (95% CI)**	**Prevalence (95% CI)**	**Prevalence (95% CI)**
Saharsa				
Sex				
Female	299	40.7 (34.9, 46.4)	23.0 (18.1, 28.0)	9.6 (6.1, 13.1)
Male	301	45.4 (39.6, 51.1)	25.8 (20.7, 30.9)	12.4 (8.5, 16.3)
Age				
0 – 5 months	43	8.3 (0.0, 17.7)	43.4 (27.5, 59.4)	19.9 (6.8, 33.0)
6 – 11 months	73	22.2 (12.0, 32.4)	35.7 (24.0, 47.3)	16.1 (7.0, 25.2)
12 – 23 months	123	48.5 (39.3, 57.7)	24.4 (16.4, 32.4)	13.2 (6.8, 19.6)
24 – 35 months	120	49.9 (40.6, 59.3)	20.6 (12.9, 28.3)	9.7 (4.0, 15.4)
36 – 47 months	106	59.3 (49.5, 69.1)	19.9 (11.9, 28.0)	7.6 (2.1, 13.1)
48 – 59 months	135	41.5 (32.8, 50.2)	19.2 (12.2, 26.2)	7.3 (2.5, 12.0)
Sitamarhi				
Sex				
Female	578	59.3 (55.2, 63.4)	13.0 (10.2, 15.9)	4.7 (2.9, 6.5)
Male	576	53.5 (49.3, 57.6)	16.6 (13.4, 19.7)	3.4 (1.9, 5.0)
Age				
0 – 5 months	93	15.3 (7.5, 23.2)	26.3 (16.8, 35.7)	12.0 (4.9, 19.2)
6 – 11 months	113	36.6 (27.3, 46.0)	18.7 (11.1, 26.3)	6.0 (1.2, 10.9)
12 – 23 months	270	64.3 (58.4, 70.2)	20.2 (15.2, 25.2)	6.6 (3.5, 9.8)
24 – 35 months	227	64.0 (57.5, 70.5)	12.3 (7.8, 16.8)	2.4 (0.2, 4.7)
36 – 47 months	199	61.9 (54.9, 68.9)	8.9 (4.7, 13.2)	0.0 (0.0, 0.3)
48 – 59 months	252	60.7 (54.5, 67.0)	9.9 (6.0, 13.8)	2.2 (0.2, 4.2)
Siwan				
Sex				
Female	405	35.6 (30.8, 40.4)	15.5 (11.9, 19.2)	5.2 (2.9, 7.4)
Male	391	37.9 (33.0, 42.9)	14.5 (10.9, 18.1)	4.1 (2.0, 6.1)
Age				
0 – 5 months	84	18.5 (9.6, 27.5)	21.1 (11.7, 30.4)	12.1 (4.5, 19.7)
6 – 11 months	72	18.3 (8.6, 27.9)	29.4 (18.2, 40.6)	13.9 (5.2, 22.5)
12 – 23 months	182	36.1 (28.8, 43.3)	16.3 (10.6, 21.9)	3.2 (0.3, 6.0)
24 – 35 months	156	44.4 (36.3, 52.5)	9.8 (4.8, 14.7)	0.8 (0.0, 2.5)
36 – 47 months	150	45.2 (36.9, 53.5)	8.0 (3.3, 12.7)	3.8 (0.4, 7.2)
48 – 59 months	152	40.0 (31.9, 48.1)	15.6 (9.5, 21.7)	2.6 (0.0, 5.4)

APPENDIX C: WASH AND ILLNESS PROFILES OF 10 CARE-INDIA DISTRICTS IN BIHAR, INDIA

VARIABLE	BANKA		BHOJPUR	
Water characteristics	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	8	1.4	6	0.9
Tube well or borehole	539	84.3	611	95.6
Other	94	14.3	24	3.5
Where is the water source located?				
In own dwelling	216	33.4	475	75.1
In own yard/plot	182	28.9	105	16.0
Elsewhere	240	37.7	57	8.9
How long does it take to get to the water source, in minutes?	3.7	6.3	0.6	2.4
Is anything done to make the water safer to drink?				
Yes	16	2.4	11	1.8
No	625	97.6	630	98.2
Sanitation characteristics				
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	93	14.1	191	29.1
VIP/Pit latrine with and without slab	13	1.9	7	1.0
Openly defecate/other	535	84.0	443	69.8
Is there water available to wash your hands?				
Yes	500	79.8	21	3.2
No	123	20.2	620	96.8
Do you use anything with water to wash your hands?				
Soap/detergent	115	18.0	172	26.8
Ash, mud, sand	410	66.2	442	69.2
Nothing	98	15.8	27	4.0
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	70	10.8	67	10.4
Put in drain/ditch/threw in garbage	151	24.0	170	27.4
Other	4	0.7	5	0.8
Left in the open/didn't dispose	415	64.4	399	61.5
Illness Characteristics				
Has your child had diarrhea recently?				
Yes	49	7.6	72	12.4
No	592	92.4	569	87.6
Has your child with diarrhea had blood in stools?				
Yes	5	9.7	3	3.7
No	44	90.3	69	96.2
Has your child had fever in the last two weeks?				
Yes	68	10.7	70	12.2
No	573	89.3	571	87.8
Has your child had cough in the last two weeks?				
Yes	63	9.8	49	9.0
No	578	90.2	591	91.0
Has your child had short, rapid breathing with cough?				
Yes	31	48.5	13	24.5
No	32	51.5	36	75.5
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	10	31.8	7	55.0
Nose only	15	45.0	2	17.1
Both	6	23.2	4	28.0
Anemia level of child				
Moderate - Severe	256	43.3	209	36.3
Mild	153	26.1	201	34.4
Not anemic	176	30.6	175	29.23
TOTAL	**641**	**100.0**	**641**	**100.0**

VARIABLE	DARBHANGA		GAYA	
Water characteristics	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	12	1.6	6	0.9
Tube well or borehole	583	89.8	699	85.8
Other	55	8.6	106	13.3
Where is the water source located?				
In own dwelling	332	51.5	418	50.3
In own yard/plot	202	31.3	170	22.8
Elsewhere	105	17.2	215	26.8
How long does it take to get to the water source, in minutes?	1.6	6.1	2.7	8.5
Is anything done to make the water safer to drink?				
Yes	5	0.7	14	1.3
No	645	99.3	797	98.7
Sanitation characteristics				
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	145	21.9	184	20.9
VIP/Pit latrine with and without slab	45	5.7	13	1.5
Openly defecate/other	460	72.3	614	77.5
Is there water available to wash your hands?				
Yes	469	78.9	655	83.3
No	115	21.1	134	16.7
Do you use anything with water to wash your hands?				
Soap/detergent	170	27.5	220	26.8
Ash, mud, sand	215	37.5	293	37.1
Nothing	199	35.0	276	36.2
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	117	18.5	60	6.9
Put in drain/ditch/threw in garbage	62	8.6	127	15.1
Other	25	4.1	54	6.3
Left in the open/didn't dispose	429	68.8	570	71.8
Illness Characteristics				
Has your child had diarrhea recently?				
Yes	99	15.7	39	4.8
No	549	84.3	772	95.2
Has your child with diarrhea had blood in stools?				
Yes	10	11.8	2	5.5
No	89	88.2	37	94.5
Has your child had fever in the last two weeks?				
Yes	113	18.0	78	9.7
No	537	82.0	733	90.3
Has your child had cough in the last two weeks?				
Yes	109	18.2	64	7.7
No	540	81.8	747	92.3
Has your child had short, rapid breathing with cough?				
Yes	71	66.7	20	32.8
No	38	33.3	44	67.2
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	25	42.5	9	41.1
Nose only	42	55.0	6	36.1
Both	2	2.5	5	22.8
Anemia level of child				
Moderate - Severe	216	37.2	226	29.4
Mild	188	32.8	219	29.2
Not anemic	171	29.9	307	41.3
TOTAL	**650**	**100.0**	**811**	**100.0**

VARIABLE	KISHANGANJ		NALANDA	
Water characteristics	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	22	3.5	44	8.3
Tube well or borehole	624	92.4	457	81.2
Other	27	4.2	54	10.6
Where is the water source located?				
In own dwelling	363	55.0	291	55.6
In own yard/plot	240	37.4	112	21.0
Elsewhere	50	7.7	116	23.3
How long does it take to get to the water source, in minutes?	0.5	2.1	5.1	30.6
Is anything done to make the water safer to drink?				
Yes	17	2.2	13	2.4
No	656	97.8	542	97.6
Sanitation characteristics				
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	98	13.9	153	28.4
VIP/Pit latrine with and without slab	29	4.0	16	3.0
Openly defecate/other	546	82.1	386	68.6
Is there water available to wash your hands?				
Yes	600	93.0	464	90.1
No	44	7.0	49	9.9
Do you use anything with water to wash your hands?				
Soap/detergent	185	28.2	170	34.5
Ash, mud, sand	377	59.3	220	41.4
Nothing	82	12.4	123	24.1
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	55	7.9	67	12.2
Put in drain/ditch/threw in garbage	124	18.2	34	6.1
Other	28	4.3	39	7.5
Left in the open/didn't dispose	463	69.6	415	74.2
Illness Characteristics				
Has your child had diarrhea recently?				
Yes	49	6.9	35	6.5
No	624	93.1	519	93.5
Has your child with diarrhea had blood in stools?				
Yes	6	12.7	3	10.5
No	43	87.3	32	89.5
Has your child had fever in the last two weeks?				
Yes	50	7.0	46	8.2
No	623	93.0	508	91.8
Has your child had cough in the last two weeks?				
Yes	38	5.3	27	5.1
No	635	94.7	528	94.9
Has your child had short, rapid breathing with cough?				
Yes	13	36.9	15	54.9
No	25	63.1	12	45.1
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	8	60.7	3	17.9
Nose only	4	31.2	8	58.3
Both	1	8.1	4	23.8
Anemia level of child				
Moderate - Severe	191	32.0	135	26.4
Mild	200	34.0	169	33.4
Not anemic	199	34.0	212	40.2
TOTAL	**673**	**100.0**	**555**	**100.0**

VARIABLE	PASCHIM CHAMPARAN		SAHARSA	
Water characteristics	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	61	11.1	38	5.3
Tube well or borehole	449	81.5	656	91.2
Other	34	7.4	27	3.5
Where is the water source located?				
In own dwelling	275	54.8	389	54.4
In own yard/plot	164	31.9	243	35.0
Elsewhere	62	13.3	75	10.6
How long does it take to get to the water source, in minutes?	0.7	3.0	1.1	4.7
Is anything done to make the water safer to drink?				
Yes	16	3.0	64	8.1
No	526	97.0	657	91.9
Sanitation characteristics				
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	113	21.8	118	15.9
VIP/Pit latrine with and without slab	13	2.4	24	3.1
Openly defecate/other	418	75.8	579	81.0
Is there water available to wash your hands?				
Yes	427	86.9	591	87.7
No	61	13.1	82	12.3
Do you use anything with water to wash your hands?				
Soap/detergent	115	24.6	183	26.6
Ash, mud, sand	300	59.5	389	58.3
Nothing	73	15.9	101	15.1
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	85	16.7	64	8.5
Put in drain/ditch/threw in garbage	122	23.1	113	15.0
Other	35	6.3	3	0.4
Left in the open/didn't dispose	298	53.9	540	76.2
Illness Characteristics				
Has your child had diarrhea recently?				
Yes	52	10.0	61	8.5
No	491	90.0	660	91.5
Has your child with diarrhea had blood in stools?				
Yes	3	6.1	9	15.3
No	49	93.9	52	84.7
Has your child had fever in the last two weeks?				
Yes	70	12.9	62	8.5
No	473	87.1	659	91.5
Has your child had cough in the last two weeks?				
Yes	74	13.4	61	8.3
No	469	86.6	660	91.7
Has your child had short, rapid breathing with cough?				
Yes	30	40.7	20	31.8
No	44	59.3	40	68.2
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	9	27.8	2	10.2
Nose only	21	72.2	13	62.9
Both	-	-	4	21.6
Anemia level of child				
Moderate - Severe	155	34.5	230	35.1
Mild	126	28.1	216	32.9
Not anemic	170	37.4	209	32.1
TOTAL	**544**	**100.0**	**721**	**100.0**

VARIABLE	SITAMARHI		SIWAN	
Water characteristics	n/mean	% / SD	n/mean	% / SD
What is the source of drinking water for the household?				
Piped water - into dwelling/yard/plot, or public tap/standpipe/hand pump	8	1.2	66	10.4
Tube well or borehole	581	89.7	496	83.2
Other	58	9.1	40	6.4
Where is the water source located?				
In own dwelling	293	46.3	387	69.9
In own yard/plot	145	22.0	133	24.6
Elsewhere	206	31.7	32	5.5
How long does it take to get to the water source, in minutes?	2.7	7.0	0.4	2.5
Is anything done to make the water safer to drink?				
Yes	15	2.2	28	4.6
No	632	97.8	574	95.4
Sanitation characteristics				
What type of toilet facility do you use?				
Flush to piped sewer system/septic tank/pit latrine	125	19.9	152	24.7
VIP/Pit latrine with and without slab	8	1.3	9	1.5
Openly defecate/other	514	78.7	441	73.8
Is there water available to wash your hands?				
Yes	526	89.3	503	89.9
No	64	10.7	58	10.1
Do you use anything with water to wash your hands?				
Soap/detergent	145	24.5	212	37.5
Ash, mud, sand	343	58.5	291	52.4
Nothing	102	17.0	58	10.1
What do you do to dispose your youngest child's stools?				
Used toilet/latrine	60	9.5	105	17.5
Put in drain/ditch/threw in garbage	18	3.0	187	32.2
Other	10	1.7	24	4.0
Left in the open/didn't dispose	557	85.7	272	46.2
Illness Characteristics				
Has your child had diarrhea recently?				
Yes	90	14.3	74	12.6
No	551	85.7	525	87.4
Has your child with diarrhea had blood in stools?				
Yes	6	6.3	59	80.2
No	84	93.7	15	19.8
Has your child had fever in the last two weeks?				
Yes	99	15.3	83	14.0
No	543	84.7	517	86.0
Has your child had cough in the last two weeks?				
Yes	61	9.4	68	11.6
No	585	90.6	532	88.4
Has your child had short, rapid breathing with cough?				
Yes	26	42.6	31	45.3
No	35	57.4	37	54.7
Has the breathing been due to problems in the chest or a blocked/runny nose?				
Chest only	9	35.1	7	23.8
Nose only	15	61.0	19	60.9
Both	1	3.9	5	15.4
Anemia level of child				
Moderate - Severe	226	38.6	198	38.6
Mild	178	30.23	124	24.3
Not anemic	180	31.1	190	37.1
TOTAL	**647**	**100.0**	**602**	**100.0**

APPENDIX D: WASH TOOL USED FOR COGNITIVE INTERVIEWING IN BIHAR, INDIA

EMORY UNIVERSITY: CONSENT TO BE A RESEARCH SUBJECT

Title: Contextualization and validation of water security tool for Bihar, India

Principal Investigator: Madhumita Govindu

Study Overview

You are being asked to be part of a study to learn about the state of water in Bihar as part of a project with CARE-India. This form is designed to tell you everything you need to think about before you decide to agree to be in the study or not to be in the study. **It is entirely your choice. If you decide to take part, you can change your mind later on and withdraw from the research study. You can skip any questions that you do not wish to answer.** Before making your decision:

- Please carefully read this form or have it read to you
- Please ask questions about anything that is not clear

Procedures

You will be given a short interview. The interview will occur within your household or at another preferred place. Interviews will occur in Hindi or interviewee language preference, and will be recorded with your permission. Interviews are expected to last 1 hour. The survey will cover issues related to water. No names, addresses, phone numbers, or any other identifying information will be collected unless important to the study. The study staff will also be looking at water sources and sanitation facilities in and near the house. Photos will be taken with your permission.

Risks and Benefits

This study poses minimal risks to you. No identifying information is being collected that could compromise you socially, financially, or otherwise. There may be a risk of distress for you about the state of water in your house – you will be given resources on who to contact with your questions and concerns.

While the study has no direct benefits to participants, concerns related to water will be collected during the interviews. Data from the study will then be used by CARE to help develop programs to improve the state of water in Bihar.

Voluntary Participation and Withdrawal from the Study

You have the right to leave a study at any time without penalty. You may refuse to do any procedures you do not feel comfortable with, or answer any questions that you do not wish to answer.

Contact Information

Contact Madhumita Govindu at +91 9182161830:

- if you have any questions about this study or your part in it, or
- if you have questions, concerns or complaints about the research

Consent

Please write your name, and sign or place your fingerprint below if you agree to be in this study. By signing this consent form, you will not give up any of your legal rights. We will give you a copy of the signed consent, to keep.

_____

Name of Subject

_____ _____

Signature/Fingerprint of Subject Date Time

_____ _____

Signature of Person Conducting Informed Consent Discussion Date Time

शिर्षक : बिहार (भारत) में जल सुरक्षा एवं इसके सत्यापन के संदर्भ हेतु टूल

मुख्य जाँचकर्ता : मधुमिता गोविंदु

अध्ययन का अवलोकन

केयर इंडिया ,पटना की एक परियोजना के तहत बिहार में पानी की स्थिती को जानने के लिए आपसे इस अध्ययन में शामिल होने के लिए पूछा जा रहा है। पानी की जिस आवश्यकता के बारे में आप सोचते है उसी के अनुरूप यह फॉर्म तैयार किया गया है । इस अध्ययन में आप शामिल होने के लिए तैयार है या नहीं ,यह पूरी तरह आपके पसंद पर निर्भर है । यदि आप इस अध्ययन में भाग लेते है और बीच में किसी भी समय आप चाहे तो इस अध्ययन को छोड़ सकते है। यदि आप किसी प्रश्न का उत्तर नहीं देना चाहते है तो उस प्रश्न को छोड़ सकते है।

अपना निर्णय लेने से पहले :

- इस फॉर्म को अच्छे तरह से पढ़ ले या पढ़ा ले।
- कृप्या उन प्रश्नों के बारे में पूछे जो स्पष्ट नहीं है।

कार्यविधि

आपका एक संछिप्त साक्षात्कार होगा। साक्षात्कार आपके घर के अंदर या आपके पसंद के अनुसार होगा। साक्षात्कार लगभग एक घंटे का होगा। इस सर्वेक्षण में पानी से संबंधित मुद्दों को शामिल किया जायगा। कोई भी नाम ,पता ,फोन नम्बर या अन्य पहचान से संबंधित जानकारी नहीं ली जायगी जब तक की इस अध्ययन के लिए जरुरी नही हो। इस अध्ययन में शामिल व्यक्ति भी घर के अन्दर और आस-पास पानी के स्रोत एवं स्वच्छता सुबिधाओ को देखेंगे एवं आपके इजाजत से इसका फोटो लेंगे।

जोखिम एवं लाभ

इस अध्ययन में आपको कम जोखिम होगा। आपसे कोई भी पहचान वाली जानकारी नहीं लिया जा रहा है जिसके कारण आपको सामाजिक ,आर्थिक या अन्य रूप से समझौता करना पड़े। आपके घर में पानी की संकट को लेकर आपको जोखिम हो सकता है – आपके सवाल एवं पानी से संबंधित मामलों पर संसाधन दिया जायेगा जिससे आप संपर्क कर सके। इस अध्ययन में पानी से संबंधित समस्याओ पर प्रश्न पूछा जायगा एवं इसके लिए प्रतिभागि को किसी प्रकार का सीधे तौर पर कोई लाभ नहीं मिलेगा। इस अध्ययन से उपलब्ध आंकड़ो का उपयोग केयर द्वारा बिहार में पानी की समस्या में सुधार के लिए योजना को विकसित करने में होगा।

स्वैछिक भागीदारी एवं अध्ययन छोड़ना

आपको किसी भी समय बिना किसी दण्ड / जुर्माना के अध्ययन छोड़ने का पूरा अधिकार है। आप उन सवालो का जबाब जिसमे आपको सहज महसूस नहीं होता है ऐसे किसी भी प्रश्न या प्रक्रिया से इंकार कर सकते है।

जानकारी के लिए संपर्क : नाम - मधुमिता गोविंदु मोबाइल नंबर - +91 9182161830

- यदि इस अध्ययन से संबंधित या इसमें भागीदारी के बारे में कोई प्रश्न हो या ,
- यदि इस अनुसंधान से संबंधित कोई मामला या शिकायत के बारे में कोई प्रश्न हो।

सहमति

अगर आप इस अध्ययन में शामिल होने के लिए सहमत है तो कृप्या अपना नाम लिखे और उसके निचे अपना हस्ताक्षर या अंगूठे का निशान लगायें। आप इस सहमति फॉर्म पर हस्ताक्षर करके अपने किसी भी क़ानूनी अधिकार से वंचित नहीं होंगे। हम आपको आपके हस्ताक्षर वाला सहमती प्रपत्र की एक कॉपी भी रखने के लिए देंगे।

_____

उत्तरदाता का नाम

_____ _____

उत्तरदाता का हस्ताक्षर / अंगूठे का निशान दिनांक समय

_____ _____

जानकारी,सहमती एवं चर्चा करने वाले व्यक्ति का हस्ताक्षर दिनांक समय

जनसांख्यिकीय जानकारी का फॉर्म / FORM DEMOGRAPHIC INFORMATION

सेक्शन 'ए': *साक्षात्कार प्रारंभ करने के पहले भरें*) **SECTION A: *RA* -** *Fill out at the start of activity.*					
A1.	जिला: District	**A2.**	प्रखंड: Block	**A3.**	गाँव (आंगनवाड़ी केंद्र संख्या): Village (AWC no.)
A4.	प्रतिभागी का आई.डी.: _____ Participant ID#				
A5.	दिनांक (दिन/माह/वर्ष): __ __ / __ __ /__ __ __ __ Date (dd/mm/yyyy)				

सेक्शन 'बी': *"अब मैं आपके एवं आपके परिवार के बारे में कुछ जानकारी पूछूँगा।"* **SECTION B*: RA* - *"I WILL NOW ASK FOR SOME INFORMATION ABOUT YOU AND YOUR FAMILY."***			
B1.	जन्म की तिथि (दिन/माह/वर्ष) / Date of birth (dd/mm/yyyy): __ __ / __ __ /__ __ __ __		
B2.	उम्र / Age: _____		
B3.	शिक्षा / Education: ☐ 1. कुछ नहीं, अशिक्षित / None, Illiterate ☐ 2. शिक्षित/ थोडा बहुत पढ़ लिख सकते हैं परन्तु औपचारिक शिक्षा नहीं है / Literate but no formal education ☐ 3. शिक्षित पूर्ण वर्ष लिखें : _____ / Literate → NO. OF COMPLETED YEARS OF EDUCATION		
B4.	इस गाँव / समुदाय में कितने वर्षो से रह रहे हैं: _____ / # of years living in community	**B5.**	धर्म: _____ Religion
B6.	जाति: _____ Caste	**B7.**	क्या राशन कार्ड है / Has ration card: ☐ 1. हाँ / Yes ☐ 2. नहीं / No
B8.	वैवाहिक स्थिती (उपयुक्त एक को चिन्हित करें) / Marital Status (check one): ☐ 1. विवाहित → कितने वर्षों से विवाहित हैं: _____ / Married → **#** of years married → अगर विवाहित हैं तो क्या आप अपने पति के साथ रहते हैं? / **If Married,** do you live with your husband? ☐ a. हाँ, पति के साथ रहते हैं| / Yes, live with husband ☐ b. नहीं, पति घर से बाहर काम करते हैं| / No, husband works outside the home ☐ 2. तलाकशुदा → कितने वर्षों से तलाकशुदा है: _____ / Divorced → # of years divorced ☐ 3. अलग → कितने वर्षों से अलग रहते हैं: _____ / Separated → # of years separated ☐ 4. विधवा → कितने वर्षों से विधवा हैं: _____ / Widowed → # of years widowed		
B9.	आपके परिवार में 18 वर्ष से कम उम्र के कितने व्यक्ति हैं: _____ / # of people in the HH <18 yrs	**B10.**	आपके परिवार में 18 वर्ष से अधिक उम्र के कितने व्यक्ति हैं: _____ / # of people in the HH >18 yrs
B11.	आपके कुल कितने बच्चे हैं? _____ # of children	**B12.**	उम्र जब आपको पहला बच्चा हुआ : _____ Age when you had first child
B13.	वर्तमान के गर्भधारण की स्थिती / Present Pregnancy Status: ☐ 1. गर्भवती / Pregnant ☐ 2. गर्भवती नहीं / Not Pregnant →अगर गर्भवती हैं तो माह की संख्या: _____ / If Pregnant, Number of Months		

कोड / CODES					
01	हाँ / Yes	04	कभी-कभी / Sometimes	09	लागु नहीं / Not applicable
02	नहीं / No	05	हमेशा / Always		
03	कभी नहीं / Never	08	पता नहीं / Do not know		

प्रश्न QUESTION	पानी के श्रोत / WATER SOURCE																			
	03 = पाइप से पानी(आवास/यार्ड/प्लाट में) Piped water into dwelling/yard/plot/	04 = सार्वजनिक नल Public tap/standpost/ stand pipe	05 = ट्यूबेल /बोरवेल Tubewell/borehole	06 = सुरक्षित/ढका हुआ कुआँ Protected dug well	07 = असुरक्षित /खुला हुआ कुआँ Unprotected dug well	10 = सुरक्षित झरना Protected spring	11 = असुरक्षित झरना Unprotected spring	12 = संरक्षित वर्षा का पानी Rainwater collection	13 = पानी के छोटे विक्रेता/ छोटे टैंक की गाड़ियाँ / ड्रम Small water vendor/ Cart with small tank/ drum	14 = टैंकर /ट्रक Tanker-truck	15 = बोतल का पानी Bottled water	16 = बैग / पाउच का पानी Bagged/sachet water	17 = सतही पानी (तलाब/नदी/झील) Surface water (pond/river/lake)	18 = चापाकल /हैण्ड पंप(अपने घर या चारदीवारी के अन्दर) Hand pump (Personal)	19 = सार्वजनिक चापाकल / हैण्ड पंप Hand pump (Public)	20 = इंकार Refused	08 = पता नहीं Does not know	09 = लागू नहीं Not applicable	77 = अन्य , स्पस्ट करें Other, specify
"अब मैं आपसे घर के सामान्य कार्यो के लिए पानी कहाँ से लाते हैं के बारे में प्रश्न पूछूँगा" *RA: "I WILL NOW ASK YOU QUESTIONS REGARDING WHERE YOU GET WATER FOR SOME COMMON HOUSEHOLD ACTIVITES."*																			
C1. आप पुरे साल में इन चीजों के लिए जो पानी घर में इस्तेमाल करती हैं उसे आप आमतौर पर किस जगह से लाती हैं? What is the primary source of water for the following activities for members of your household throughout the year?																			
पीने / Drinking																			
खाना बनाने / Cooking																			
नहाने / Bathing																			
बर्तन धोने / Washing utensils																			
घर की सफाई / Cleaning the house																			
चाय/ कॉफ़ी बनाने / Making chai/coffee																			
कपड़े की सफाई / Washing clothes																			
मवेशियों के लिए / Use for cattle																			
खेती के लिए / Use for farming																			
निम्नलिखित प्रश्नों के लिए, सी *1* में प्रतिभागी द्वारा उल्लेखित प्रत्येक श्रोतों के लिए प्रश्न पूछें / *RA: For the following questions, ask the question for each of the sources mentioned by the participant in C1.*																			
C2. पानी के स्रोत पर जाने, पानी भरने एवं पानी लेकर वापस आने में आपको कितना समय लगता है? (इंतजार में लगा समय को जोड़कर) निर्देश:- समय को मिनट में दर्ज करें. (यदि जल का स्रोत घर/ कंपाउंड में ही है, तो मिनट में '00' दर्ज करें) How long (in minutes) does it take to go to the water source, get water and come back (including wait time)? RA: If water source is in household/ compound, record 00 minutes																			
C3. पिछले एक साल में, पानी के इस श्रोत से कितने दिन आपको पानी नहीं मिला क्योंकि श्रोत खराब था? In the past year, for how many days were you not able to get water from this source because it wasn't working?																			
C4. पिछले दिन जब आपके घर पानी लाया गया था तो पानी लाने वाले को कितनी बार पानी के श्रोत पर जाना पड़ा था? On the LAST DAY your household collected water, how many trips did you or another family member make to the water source?																			
C5. पिछले 30 दिनों में, कितनी बार आपके घर के किसी अन्य सदस्य को आपके लिए पानी लाना पड़ा क्योंकि आपकी तबियत ठीक नहीं थीं ? In the past 30 days, how frequently did someone else have you get wter for you because you were unwell?																			
C6. यदि पानी का श्रोत आपके घर या कंपाउंड में नहीं है, तो ज्यादातर पानी लाने के लिए कौन जाता है? If water is not in your compound or house, who usually goes to collect the water from each source for your household?																			
03 = उत्तरदाता / Respondent																			
04 = अन्य महिला (18 वर्ष से अधिक) / Another adult woman (>18 years)																			
05 = व्यस्क पुरूष / Adult male																			
06 = लड़की (18 वर्ष से कम) / Female child (<18 years)																			
07 = लड़का (18 वर्ष से कम) / Male child (<18 years)																			
77 = अन्य , स्पष्ट करें / Other, Specify																			

प्रश्न QUESTION		पानी के श्रोत / WATER SOURCE																		
		03 = पाइप से पानी(आवास/यार्ड/प्लाट में) Piped water into dwelling/yard/plot/	04 = सार्वजनिक नल Public tap/standpost/ stand pipe	05 = ट्यूबेल /बोरवेल Tubewell/borehole	06 = सुरक्षित/ढका हुआ कुआँ Protected dug well	07 = असुरक्षित /खुला हुआ कुआँ Unprotected dug well	10 = सुरक्षित झरना Protected spring	11 = असुरक्षित झरना Unprotected spring	12 = संरक्षित वर्षा का पानी Rainwater collection	13 = पानी के छोटे विक्रेता/ छोटे टैंक की गाड़ियाँ / ड्रम Small water vendor/ Cart with small tank/ drum	14 = टैंकर /ट्रक Tanker-truck	15 = बोतल का पानी Bottled water	16 = बैग / पाउच का पानी Bagged/sachet water	17 = सतही पानी (तलाब/नदी/झील) Surface water (pond/river/lake)	18 = चापाकल /हैण्ड पंप(अपने घर या चारदीवारी के अन्दर) Hand pump (Personal)	19 = सार्वजनिक चापाकल / हैण्ड पंप Hand pump (Public)	20 = इंकार Refused	08 = पता नहीं Does not know	09 = लागु नहीं Not applicable	77 = अन्य , स्पस्ट करें Other, specify
निम्नलिखित प्रश्नों के लिए, सी 1 में प्रतिभागी द्वारा उल्लेखित प्रत्येक श्रोतों के लिए प्रश्न पूछें। **RA:** *For the following questions, ask the question for each of the sources for DRINKING mentioned by the participant in C1.*																				
C7.	क्या आपको लगता है कि इस स्रोत से लाया गया पानी, पीने के लिए सुरक्षित है? Do you think water from this source is safe for drinking?																			
	अगर नहीं , तो आप ऐसा क्यों सोचते हैं? If NO, why do you feel the water is not safe?																			
	03 = रंग / Color																			
	04 = स्वाद / Taste																			
	05 = महक / Smell																			
	77 = अन्य ,स्पष्ट करें / Other, specify																			
C8.	क्या आप अपने पीने के पानी को साफ करने के लिए कुछ करते हैं? Do you do anything to treat your drinking water?																			
C8.a.	अगर हाँ तो क्या करते हैं ? (जो लागु हो उसे चिन्हित करें) IF YES, how is it treated? (Select all that apply)																			
	03 = उबालना / Boil																			
	04 = छानना / Filter																			
	05 = कोई रसायन मिलाना / Add chemical																			
	77 = अन्य ,स्पष्ट करें / Other, specify																			
C9.	क्या आपके बच्चों के पीने के पानी का श्रोत घर के बाकी सदस्यों से अलग है? Do your children get drinking water from another source than that for the rest of the household members?																			
C9a.	यदि हाँ तो किस श्रोत से लाते हैं? If YES, which source?																			
C9b.	यदि हा तो क्या आप अपने बच्चों के पीने के पानी को साफ करने के लिए कुछ करते हैं? If YES, do you treat your children's drinking water?																			
C9.b.1.	यदि हाँ तो क्या करते हैं? (जो लागु हो उसे चिन्हित करें) IF YES, how is it treated? (Select all that apply)																			
	03 = उबालना / Boil																			
	04 = छानना / Filter																			
	05 = कोई रसायन मिलाना / Add chemical																			
	77 = अन्य ,स्पष्ट करें / Other, specify																			

	प्रश्न QUESTION	गतिविधि / ACTIVITY पीने Drinking	खाना पकाने Cooking	नहाने Bathing	बर्तन धोने Washing utensils	घर की सफाई Cleaning the house	चाय या कॉफी बनाना Making chai/coffee	कपड़े की सफाई Washing clothes	मवेशियों के लिए Use for cattle	खेती के लिए Use for farming
"अब मैं आपसे 'घर के काम ' के लिए जो पानी आप इस्तेमाल करते हैं उसके बारे में कुछ सवाल पूछूँगा।" *RA: "I WILL NOW ASK YOU SOME QUESTIONS REGARDING YOUR VIEWS ON WATER FOR COMMON HOUSEHOLD ACTIVITIES."*										
प्रत्येक सूचीबद्ध गतिबिधियों के लिए निम्नलिखित प्रश्न पूछे। **RA:** *For the following questions, ask the question for each of the activities listed.*										
C10.	पिछले 30 दिनों में क्या आप कभी परेशान थीं क्योंकि _____(कार्य) के लिए पर्याप्त पानी नहीं था? In the past 30 days, did you worry that you would not have enough water for [activity]?									
C10.a.	यदि हाँ , क्योंकि पर्याप्त पानी नहीं था या पानी लाना /इकठ्ठा करना मुश्किल था, आपको कितनी बार _____(कार्य) के लिए पानी की मात्रा को कम करके इस्तेमाल करना पड़ा? If YES, because there was not enough water or because it was too difficult to collect water, how frequently did you reduce the amount of water you used for [activity]?									
C11.	पिछले 30 दिनों में, आप या आपके परिवार के किसी भी सदस्य को कितनी बार _____(कार्य) के लिए पानी की जरुरत होने पर भी पानी नहीं मिला? In the past 30 days, how frequently were you or anyone in your household not able to get water when needed for [activity]?									
C12.	पिछले 30 दिनों के भीतर आप या आपके परिवार के अन्य सदस्य ने कितनी बार इस कार्य के लिए पानी की जरुरत रहने के बावजुद पानी नहीं लाया क्योंकि : Within the past 30 days, how frequently did you or anyone else in your household not collect water for [activity] when you wanted to because:									
C12.a.	श्रोत बहुत दूर है इसलिए बहुत समय लगता है। / Takes too long because too far away									
C12.b.	बहुत जोखिम भरा या खतरनाक है। / Too risky or dangerous									
C12.c.	श्रोत पर काफी समय तक इतजार करना पड़ता है। / Takes too long to wait at the source									
C12.d	श्रोत काम नहीं कर रहा था या वहाँ तक पहुँचना संभव नहीं था / Source was not working / inaccessible.									
C12.e.	श्रोत पर पर्याप्त पानी नहीं है। / Not enough water at the source									
C13.	पिछले 30 दिनों में पानी से जुड़े काम के वजह से आप या आपके घर के कोई अन्य सदस्य कितनी बार बहुत कम समय के लिए ही सो पाए? In the past 30 days, how frequently did you or anyone else in your household sleep very few hours because of water-related chores for [activity]?									
C14.	पिछले 30 दिनों में क्या आपको लगता है कि आपको _____(कार्य) हेतु पानी के लिए दूसरों पर निर्भर होना पडा था ? In the past 30 days, did you feel that you had to depend on others for water for [activity]?									
C14.a.	यदि हाँ तो आप या आपके परिवार के अन्य सदस्य ने इस कार्य के लिए पानी कितनी बार गाँव के किसी दुसरे व्यक्ति से लिया ? If YES, how frequently did you or anyone else in your household take water for [activity] from someone else in your village?									
निम्नलिखित प्रश्न सिर्फ पीने का पानी के लिए ही पूछें। *RA: For the following questions, ask in regards to DRINKING only.*										
C15.	पिछले 30 दिनों में क्या आप या आपके परिवार के अन्य सदस्य को कभी बिना पसंद वाली जगह या गंदे श्रोत से पानी लेना पड़ा क्योंकि आप अपने पसंदीदा (मुख्य) श्रोत से पानी नहीं ले पाए थे? In the past 30 days, did you or any member of your household collect water from an undesirable or dirty source for because you could not collect from your preferred source?									
	यदि हाँ : If YES:									
C15.a.	आपने इस श्रोत से कितनी बार पानी लाया ? How frequently did you collect water from this source?									
C15.b.	क्या आपको ऐसा लगता है कि इस श्रोत से लिया गया पानी पीने के लिए सुरक्षित था ? Did you feel like water from this source was safe to drink?									
C16.	कितनी बार आप या आपके परिवार के अन्य सदस्य को पुरे दिन बिना पानी पिए रहना पडा क्योंकि आपके पास पीने का पर्याप्त साफ पानी नहीं था ? How frequently did you or anyone else in your household go a whole day without drinking water because there was not enough clean water?									
C17.	कितनी बार आप या आपके परिवार के अन्य सदस्य को प्यासा ही सोना पडा क्योंकि आपके घर में पीने का पर्याप्त साफ पानी नहीं था? How frequently did you or anyone else in your household go to sleep thirsty because there was not enough clean water?									
C18.	कितनी बार आप या आपके परिवार के अन्य सदस्य को ऐसा पानी पीना पड़ा जो आपको लगा कि वह पानी स्वास्थ्य के लिए सुरक्षित नहीं था ? How frequently did you or anyone in your household drink water that you thought might not be safe for health?									
C19.	पिछले 30 दिनों में आप या आपके परिवार के अन्य सदस्य को कितनी बार पीने का पानी की स्थिति को लेकर परेशानी हुई? In the past 30 days, how frequently did you or anyone in your household feel upset about your drinking water situation?									
निम्नलिखित प्रश्न सभी गतिविधियों के लिए एक साथ पूछें। *RA: For the following questions, ask for all activites together.*										
C20.	पिछले 30 दिनों में पानी के काम के वजह से आपको या आपके परिवार के अन्य सदस्य को कितनी बार बच्चों कि देखभाल में दिक्कत हुई? In the past 30 days, how frequently has the time spent getting water prevented you or anyone in your household from caring for children in the household?									
C21.	पिछले 30 दिनों में कितनी बार आपके घर में पानी कि समस्या के कारण आपस में झगड़ा हुआ ? In the past 30 days, how frequently did you or anyone in your household have problems with water that caused difficulties within your household?									
C22.	पिछले 30 दिनों में कितनी बार आपके परिवार के किसी सदस्य को पानी की समस्या के कारण पड़ोसी या अन्य व्यक्ति के साथ झगड़ा हुआ? In the past 30 days, how frequently did you or anyone in your household have problems with water that cause difficulties with neighbors or others in the community?									
C23.	पिछले 30 दिनों में कितनी बार आपने या आपके परिवार के अन्य सदस्य ने पानी इकठ्ठा करने के काम के वजह से घर का बाकी काम पूरा नहीं पाए? In the past 30 days, how frequently were you or anyone in your household unable to complete all of your work due to water collection?									
C24.	पिछले 30 दिनों में कितनी बार आप या आपके घर के अन्य सदस्य पानी इकठ्ठा करने के काम के वजह से शादी, पूजा या किसी अन्य उत्सव में शामिल नहीं हो पाए? In the past 30 days, how frequently did you or anyone in your household not participate in social events, like wedding or religious celebration, when you wanted to because you had too many water-related chores?									
C25.	पिछले 30 दिनों में आप या आपके परिवार के अन्य सदस्य को कितनी बार पानी की स्थिति को लेकर परेशानी हुई? In the past 30 days, how frequently did you or anyone in your household feel upset about your water situation?									

SANITATION FORM

RA: "Now I will ask some questions regarding your cleaning and bathroom habits."

Q. No.	Question	Options	Codes	SKIP
E1.	क्या अभी आपके घर में साबुन है? Do you have soap in your household right now?	हाँ / Yes नहीं / No पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....08 20	 → E2 → E2 → E2
E1.a.	यदि हाँ, तो क्या आपने आज या कल साबुन का इस्तेमाल किया है? If yes, have you used any soap today or yesterday?	हाँ / Yes नहीं / No पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....08 20	 → E2 → E2 → E2
E1.a.1.	यदि हाँ तो आपने किस लिए इसका इस्तेमाल किया था? निर्देश: - विकल्पों को ना पढ़े, उन सभी विकल्पों को चिन्हित करें जो लागू होते हैं If yes, what did you use it for? (do not read out options, choose all that apply)	कपड़ा धोने के लिए / Washing clothes बर्तन धोने के लिए / Washing cooking pots/dishes नहाने के लिए / Washing body बच्चों को नहलाने के लिए / Bathing my children बच्चों के हाथ धोने के लिए / Washing children's hands शौच के बाद हाथ धोने के लिए / Washing hands after defecating बच्चे के शौच को साफ़ करने के बाद अपना हाथ धोने के लिए / Washing hands after cleaning child बच्चों को खिलाने के पहले अपना हाथ धोने के लिए / Washing hands before feeding child खाना बनाने के पहले अपना हाथ धोने के लिए / Washing hands before preparing food खाना खाने के पहले अपना हाथ धोने के लिए / Washing hands before eating अन्य (स्पष्ट करें) / Other, Specify: _____	.....01 .....02 .....03 .....04 .....05 .....06 .....07 .....10 .....11 .....12 77	
E2.	पिछली बार जब आप शौच के लिए गए थे तो क्या आप खुले में गए थे, अपने घर के शौचालय में गये थे या किसी सामुदायिक शौचालय में गए थे? The last time you went to defecate, did you go in the open, in your own household latrine, or in a shared latrine?	खुले में / Open खुद के शौचालय में / Own Latrine सामुदायिक शौचालय / Shared Latrine पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....03 .....08 20	

E3.	क्या आपके घर में कोई शौचालय है ? (निर्देश : यदि उनका अपना शौचालय नहीं है लेकिन पिछले प्रश्न में उन्होंने बताया है की वह खुद का शौचालय का इस्तेमाल करते हैं तो एक बार फिर से पूछकर सुनिश्चित करें की वह शौच के लिए कहाँ जाती हैं) Does your household own a latrine? (Note: if they do not own their own latrine but indicated they went to defecate in their own latrine in the question above, ask the question about where they defecated again)	हाँ / Yes नहीं / No पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....08 20	 → E4 → E4 → E4
	यदि हाँ /If yes:			
E3.a.	क्या शोचालय ठीक से काम कर रहा है ? (निर्देश : यदि उनका अपना शौचालय ठीक से काम नहीं कर रहा है लेकिन पिछले प्रश्न में उन्होंने बताया है की वह खुद का शौचालय का इस्तेमाल करते हैं तो एक बार फिर से पूछकर सुनिश्चित करें की वह शौच के लिए कहाँ जाती हैं) Is the latrine functional? (Note: if they do not have a functional latrine but indicated they went to defecate in their own latrine in the question above, ask the question about where they defecated again)	हाँ / Yes नहीं / No पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....08 20	
E3.b.	आप के घर में किस तरह का शौचालय है? What type of latrine facility do you have?	फ्लश शौचालय ,सेप्टिक टैंक या पाइप युक्त सीवर / Pour Flush to pit, septic tank, or piped sewer system स्लैब सहित पिट शौचालय / Pit latrine with slab बिना स्लैब के पिट शौचालय / Pit latrine without slab/open pit or hole पता नहीं / Do not know इंकार / Refused अन्य (स्पष्ट करें) / Other, specify: _____	.....01 .....02 .....03 .....08 .....20 77	
E3.c.	कितने महीनों से आपके पास आपका अपना शौचालय है ? How long have you had a latrine? (If less than 1 year, write 1)	____ ____ years पता नहीं / Do not know इंकार / Refused	.....08 20	

E3.d.	क्या यह शौच के लिए उपयोग किया जाता है ? Is it currently being used for defecation?	हाँ / Yes नहीं / No पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....08 20	
E3.e.	शौचालय बनाने के लिए पैसे की मदद कहाँ से मिली थी ? What sources of funding were used to pay for its construction?	3 =सरकारी योजना से / government 4 = किसी एन.जी.ओ से / NGO 5 =खुद के पैसे से / Self-financed पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....03 .....08 20	
E4.	पिछली बार जब आपका छोटा बच्चा शौच किया था तो उस शौच को कहाँ फेंका था? The last time [the youngest child in your house] defecated, what was done to dispose of the feces?	शौचालय में / Put/rinsed into toilet or latrine मिटटी के अन्दर / Put/rinsed into drain or ditch नदी या तालाब में / Put/rinsed into stream or pond कूड़ा के पास / Thrown into garbage pile वही पर छोड़ दिया / Left in the open पता नहीं / Do not know इंकार / Refused अन्य ,स्पष्ट करें / Other, Specify: _____	.....01 .....02 .....03 .....04 .....05 .....08 .....20 77	
E5.	क्या आपको लगता है शौचालय स्वास्थ्य के लिए सुरक्षित होता है ? To what extent do you believe that latrines are hygienic?	बिलकुल नहीं / Not at all hygienic थोड़ा बहुत सुरक्षित / Somewhat hygienic बहुत सुरक्षित / Very hygienic पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....03 .....08 20	
E6.	आपके समुदाय के लोगों में खुले में शौच करने की आदत कितनी है ? How common is it for people in your community to defecate in the open?	बिलकुल नहीं / Not at all common थोड़ा बहुत / Somewhat common बहुत / Very common पता नहीं / Do not know इंकार / Refused	.....01 .....02 .....03 .....08 20	

निम्नलिखित प्रश्न के लिए, कृपया उत्तर अक्षरशःदर्ज करें / किसी भी बदलाव के बिना, जैसे कहा जाए वैसे नोट करें / ***RA - For the following questions, please record responses verbatim.***	
D1.	पीने के लिए एवं अन्य घरेलु कार्यों के लिए आप अलग-अलग जल श्रोतों का इस्तेमाल क्यों करती हैं? Why do you use different water sources for drinking vs. other activities?
D2.	अलग-अलग मौसम जैसे - बरसात, गर्मी एवं जाड़ा में आप अपने मुख्य श्रोत से घरेलु काम के लिए पानी कैसे ईकठ्ठा करते हैं? How is water collection from your preferred source for water for household activities different in the monsoon, summer, and winter?
D3.	जब आपके मुख्य श्रोत में पानी उपलब्ध नहीं होता है तो आप क्या करते हैं? What do you do when your preferred source for water is non-functional?

D4.	क्या पानी से सम्बंधित कोई और बात है जो आप मुझे बताना चाहती हैं? Are there any other issues you would like to discuss in relation to water or anything else we've talked about?

प्रतिभागी से पूछें की क्या उनके कोई सवाल हैं आपके लिए या क्या वोह पूछे गए सवालों के विषय में और कुछ जोड़ना चाहते हैं ?

आपकी भागीदारी के लिए धन्यबाद!!

RA: Ask if participant has any questions OR anything else to ADD. THANK PARTICIPANT.

APPENDIX E: REVISED WATER SECURITY MODULE

SECTION C: WATER SECURITY FORM

RA: Instructions are given in bold and italicized in this survey. Instructions in quotes are meant to be read out loud to the participant. Unless otherwise indicated, read out the response options to the participant. These are not to be read out loud to the participant; they are for your understanding of the survey. Only ask questions as they are written.

Q. No.	Question	Options	Codes	Skip
C1.	What is the main source of water for the following activities for members of your household throughout the year? a. Drinking b. Cooking c. Bathing d. Washing utensils e. Cleaning the house f. Making chai/coffee g. Use of cattle/farming ***(RA: Each activity will have a value. Do not read the options aloud to respondent.)***	Piped water into dwelling/yard/plot/ Public tap/standpost/ stand pipe Tubewell/borehole Protected dug well Unprotected dug well Protected spring Unprotected spring Rainwater collection Small water vendor/ Cart with small tank/drum Tanker-truck Bottled water Bagged/sachet water Surface water (pond/river/lake) Hand pump (Personal) Hand pump (Public) Refused to answer Does not know Not applicable Other, specify _____	03 04 05 06 07 08 09 10 11 12 12 14 15 16 17 666 888 999 777	
C.1.a.	Where is this water source located?	In own house In own yard/plot In fields Elsewhere Refused to answer Does not know	03 04 05 06 666 888	
C2.	How long does it take to go to the water source, get water, and come back (including wait time)? ***(RA: Record the answer in minutes)***	___ ___ minutes Refused to answer Does not know	 666 888	
C3.	In the past year, how many days were you not able to get water from this source because it wasn't working properly? ***(RA: Record the answer in days)***	___ ___ ___ days Refused to answer Does not know	 666 888	
C4.	On the last day you household collected water, how many trips did you or another family member make to the water source?	Water is collected and store it in a large vessel in household for use throughout the day Water is collected as needed by person and for activity	03 04	

		Other, please specify _____	777	
		Refused to answer	666	
		Does not know	888	

C5.	In the past 30 days, how frequently did someone else have to collect water for you because you were ill?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C6.	If water is not in your compound or house, who usually goes to collect the water from each source for your household?	Respondent Another adult woman (> 18 years) Adult male (> 18 years) Child (<18 years) Refused to answer Does not know	03 04 05 06 666 888	
C7.	In the past 30 days, did you observe any of the following your drinking water? a. Color b. Taste c. Smell ***(RA: Please ask participant to specify and record their answer)***	Yes No Specify _____ Specify _____ Specify _____ Refused to answer Does not know	01 02 666 888	
C8.	Do you do anything to your water prior to drinking it?	Yes, boil Yes, filter Yes, add chemicals Yes, other (please specify) No Refused to answer Does not know	03 04 05 777 666 888	
C9.	Do you children get drinking water from another source than that for the rest of the household members?	Yes No Refused to answer Does not know	01 02 666 888	→ C10
C9.a.	If YES, which source?	Piped water into dwelling/yard/plot/ Public tap/standpost/ stand pipe Tubewell/borehole Protected dug well Unprotected dug well Protected spring Unprotected spring Rainwater collection Small water vendor/ Cart with small tank/drum Tanker-truck Bottled water	03 04 05 06 07 10 11 12 13 14 15	

		Bagged/sachet water	16	
		Surface water (pond/river/lake)	17	
		Hand pump (Personal)	18	
		Hand pump (Public)	19	
		Refused to answer	666	
		Does not know	888	
		Not applicable	999	
		Other, specify _____	777	
C10.	Do you treat your children's drinking water?	Yes, boil	03	
		Yes, filter	04	
		Yes, add chemicals	05	
		Yes, other (please specify)	777	
		No		
		Refused to answer	666	
		Does not know	888	
C10.	In the past 30 days, did you have enough water for [activity]? a. Drinking b. Cooking c. Bathing d. Washing utensils e. Cleaning the house f. Making chai/coffee g. Use of cattle/farming	Yes	01	→ C11
		No	02	
		Refused to answer	666	
		Does not know	888	
C10.a.	If NO, why?	Water source is too far away	03	
		Too risky/dangerous	04	
		Wait is too long at source	05	
		Not enough water at source	06	
		Water source inaccessible/non-functional	07	
		Refused to answer	666	
		Does not know	888	
C11.	In the past 30 days, how often did you feel that you had to depend on others outside of your household for water for household activities?	Never	03	
		Sometimes	04	
		Always	05	
		Refused to answer	666	
		Does not know	888	
C12.	In the past 30 days, did you or any member of your household collect water from an undesirable or dirty source because you could not collect from your preferred source?	Yes	01	→ C13
		No	02	
		Refused to answer	666	
		Does not know	888	
C12.a.	How frequently did you collect water from this source? ***(RA: Record answer in number of days water was collected from here in the last 30 days.)***	___ ___ days		
		Refused to answer	666	
		Does not know	888	

C12.b.	Did you feel like water from this source was safe to drink?	Yes No Refused to answer Does not know	01 02 666 888	
C12.c.	How frequently did you or anyone in your household drink water that you thought might not be safe for health?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C13.	In the past 30 days, how frequently how frequently has the time spent getting water prevented you or anyone in your household from caring for children in the household?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C14.	In the past 30 days, how frequently did you or anyone in your household have problems with water that caused difficulties within your household or with your neighbors?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C15.	In the past 30 days, how frequently were you or anyone in your household unable to complete all of your work due to water collection?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C16.	In the past 30 days, how frequently did you or anyone in your household not participate in social events, like wedding or religious celebration, when you wanted to because you had too many water-related chores?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	
C17.	In the past 30 days, how frequently did you or anyone in your household feel upset about your water situation?	Never Sometimes Always Refused to answer Does not know	03 04 05 666 888	