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Understanding the role of household hygiene practices and foodborne disease risks in child stunting: a UKRI GCRF Action Against Stunting Hub protocol paper

Journal:	<i>BMJ Paediatrics Open</i>
Manuscript ID	bmjpo-2022-001695
Article Type:	Protocol
Date Submitted by the Author:	04-Oct-2022
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Keywords:	Epidemiology, Microbiology, Data Collection

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4 **Understanding the role of household hygiene practices and foodborne disease risks in child stunting:**
5 **a UKRI GCRF Action Against Stunting Hub protocol paper**
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43 Keywords: food safety, hygiene, water, sanitation, child stunting, protocol
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ABSTRACT

Introduction: Environmental hygiene and food safety are important determinants of child stunting. This research aims to explore the relationship between child stunting and household hygiene practices and behaviours, including the availability of water, sanitation and hygiene (WASH) facilities; the use of safe food and good quality drinking water (especially when used for complementary feeding); hygienic practices in food transport, storage and preparation; and the control of cross-contamination from animals, their produce and waste.

Methods and analysis: This study is part of a wider observational study which aims to investigate the interdisciplinary factors contributing to child stunting using a 'whole child' paradigm. The observational study recruits women during pregnancy in Hyderabad, India, Lombok, Indonesia and Kaffrine, Senegal, and dyads (i.e., 500 mother-infant pairs per country) are followed longitudinally up to 24 months after birth. Within the interdisciplinary niche, the study herein has developed tools to investigate the potential exposure pathways to environmental pathogen contamination of foods and water. Holistic WASH and food safety data collection tools have been developed to explore exposure pathways at the household-level, including: i) survey questionnaires; ii) spot-checks; iii) biological sampling of drinking water, food and domestic surfaces; and iv) direct observation. An integrated analytical approach will be used to triangulate the evidence in order to examine the relationships between child stunting, WASH and food safety behaviours.

Ethics and dissemination: Ethical approval of the study was granted by the ethics committee of the LSHTM, RVC, ILRI, ICMR, IIPHG, SEAMEO-RECFON, University of Cheikh Anta Diop. Findings of the study will be disseminated through publication in peer-reviewed journals, relevant international conferences, public engagement events, and policy-maker and stakeholder events.

SUMMARY BOX

- **What is known about the subject**
 - From the moment complementary feeding begins, the chances of exposure to food contamination and infectious disease increase exponentially
 - Adequate WASH and food safety practices can play a key role in reducing infectious disease transmission and child malnutrition.
 - The contribution of hygiene behaviours and food contamination in driving transmission of infections and childhood stunting requires further investigation.
- **What this study hopes to add**
 - Development, application and analysis of integrated WASH and food safety tools, towards a holistic understanding of how these practices and behaviours impact child stunting
 - Evidence towards a new typology of child stunting, with a focus on exposure pathways for pathogens, and to support programmes and policies to minimise stunting in childhood.

INTRODUCTION

The incidence and severity of stunting in childhood is closely linked to exposure to infection from food, drinking water and the wider environment¹. Infections associated with contaminated water or insufficient water, sanitation and hygiene (WASH) are responsible for an estimated 21% of the total global burden of diseases², contributing to the outbreak and chronicity of preventable infections such as diarrhoeal diseases and ARI (Acute Respiratory Infections), which are the two leading causes of death in children globally³. In addition, the World Health Organization (WHO) Foodborne Disease Burden Epidemiology Reference Group (FERG), estimated that approximately 40% of the global burden of foodborne diseases occurs in children under the age of five years⁴. A common cause of foodborne infections is the consumption of raw or undercooked meat, fish, seafood, eggs, fresh produce and dairy products contaminated by norovirus, *Campylobacter*, non-typhoidal *Salmonella* or pathogenic *E. coli*⁴. Food hygiene is a primary concern in the preparation of complementary foods - for example, bottles often cannot be adequately sterilised and perishable complementary foods are often left unrefrigerated or eaten using unclean utensils or with unwashed hands.

Disease transmission from faeces can be food- or water-borne (i.e., oral ingestion of contaminated food and water), water-washed or water-scarce (i.e., spread through inadequate hand and food hygiene) and water-based (i.e., transmitted by parasites that penetrate skin in water, such as schistosomiasis, or by walking barefoot on contaminated soil in the case of hookworm)⁵. For example, theory and evidence suggests that pathogens in foods are a main driver of infant faecal-oral disease⁶. Field studies have demonstrated high bacterial contamination from *E. Coli* or *Salmonella* in weaning foods^{7,8}. Of particular importance for the cleanliness of infant complementary foods are the quality of water, surfaces and utensils used to prepare and eat them⁹⁻¹¹ as well as the quality of the food ingredients procured.

Hence, the availability of WASH and food storage and preparation facilities is likely to determine exposure to infection. However, pathogen exposure can also arise when available facilities are used inadequately. For example, cultural norms and beliefs can restrict domestic food and hygiene practices – e.g., whether mothers are the principal decisionmakers about food preparation and hygiene in the household, or whether women are able to use the same toilet facilities as other household members¹².

However, while contamination of foods during cooking and feeding is common, the behavioural drivers have not been adequately explored. A recent systematic survey of 350 WASH evaluation projects in low and middle income countries (LMICs) found that around 15% of studies examined nutrition outcomes like stunting, and handwashing before food preparation, but only 5% reported on other food hygiene behaviours, such as whether food was stored appropriately and kitchen utensils were washed¹³. Whilst food safety and WASH are inter-linked, to date little attention has been paid to understanding the relationships and trade-offs between food safety, WASH and child stunting. The safety of livestock and fish derived foods is a particularly neglected area and there has been no systematic integration of these topics in food safety and WASH protocols⁹.

The UKRI GCRF Action Against Stunting Hub (AASH) explores child stunting from the Whole Child Approach. The aim of this study is to examine WASH and food safety elements, their convergence and contributions to child stunting at the household level. It evaluates WASH and food safety practices across households in three study sites with the objective to provide evidence on potential exposure to pathogens through contaminated environment, drinking water, and complementary food, and associated risk factors.

METHOD AND ANALYSIS

Conceptual Framework

The manner in which WASH and food safety at the household level lead to changes in infection and dietary intake, thereby affecting child stunting, is illustrated in Figure 1, adapted from the UNICEF’s (1990) conceptual framework on the causes of malnutrition¹⁴. Inadequate WASH practices and food safety can contribute to childhood stunting directly, by exposing infants to infection via complementary foods contaminated during preparation and storage, or through feeding with unclean utensils, including the hands of carers. The safety of foods can also be compromised before arrival at households, throughout the different steps and processes of the food value chain. Those food hazards can be intrinsic to the food produced (e.g., pathogens from animal diseases, heavy metal marine contamination), or extrinsic through processing and handling (e.g., inadequate hygienic practices, aflatoxin contamination during storage)¹⁵.

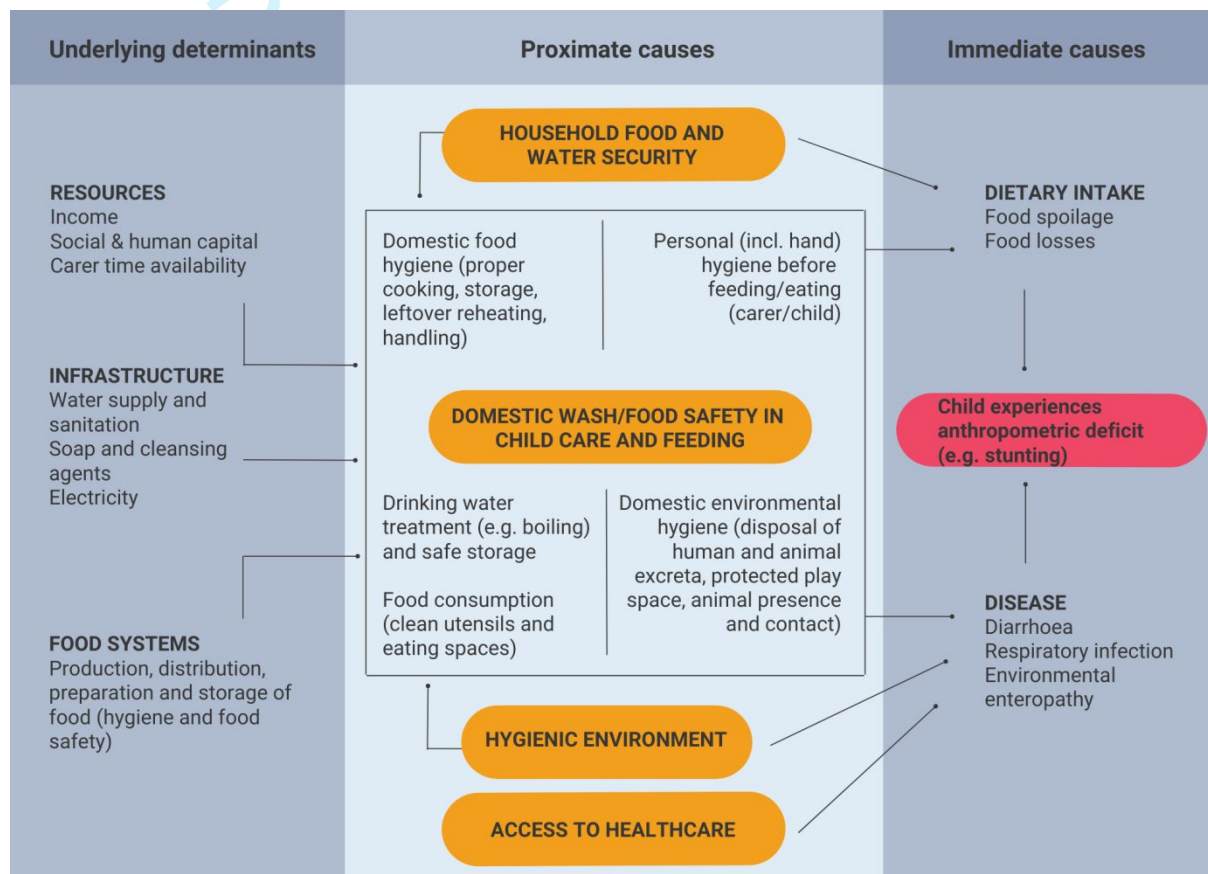


Figure 1: A conceptual framework showing the linkages of WASH and food safety with stunting at the household level

In theory, access to adequate WASH facilities enables appropriate drinking water, hygiene and food safety practices, contributing to reduction in transmission of food- and water-borne pathogens and improving nutrient uptake, and ultimately child growth and development¹⁵.

Drinking water may be contaminated at the point of supply, or through transport and storage^{10,11}. The availability of clean water is critical for optimal hygiene practices⁵, to address contamination by human and animal faeces¹⁶, and to prepare food hygienically. Sanitation facilities can enable safe faeces disposal, especially those of young children, which can be particularly pathogenic¹⁷. Faecal contamination can also come from the presence of domestic and wild animals or pests inside the household or in surrounding spaces¹⁸. It is expected that these sources of infection become more important as a child starts crawling and interacting with their environment. As such, understanding of

the determinants of food and hygiene practises in the household is key to improving infant health and nutrition¹⁹.

Along with direct exposure, there is also an indirect route from water supply and sanitation facilities to childhood malnutrition, which operates through the opportunity costs of resource use. The time carers have to observe, correct, and address unhygienic behaviour, and the scarcity of time in relation to competing activities that need to be done by carers in the home or workplace, may also be detrimental for children's nutritional outcomes²⁰. For example, it is typically women and older children, both of whom are more likely than others to be carers of young children, who spend time fetching water, engaging with animal fodder and collecting firewood. This may occur at the expense of adequate childcare and feeding, food preparation, education or rest²¹. When drinking water needs cannot be met affordably, households may need to purchase less food in order to afford enough water to drink. This kind of trade-off is clearly more prevalent for the poorest households, for whom malnutrition is also likely to be highest.

The WASH and food safety approaches, including their scope, evolution and methods are described in Table 1. Combining both WASH and food safety approaches provides an opportunity for more effective integration and learning of the two disciplines and their contributions to child growth and development. The two should converge when looking at household units with a central focus such as child stunting.

Table 1. Characteristics of Water, Sanitation and Hygiene (WASH) and Food Safety and Veterinary Public Health research

	Water, Sanitation and Hygiene (WASH)	Food Safety and Veterinary Public Health
Scope	To investigate deficiencies in water supply and quality, sanitation and hygiene to improve public health. Also, to evaluate the adequacy of hygiene standard to minimise food-borne diseases risks, and the role of water supply and sanitation access as enabling factors for improving child care, health and nutrition.	To pursue a comprehensive "farm to fork", "stable to table", "boat to throat" approach to prevent and minimise risks of food contamination at all stages of the food chain from production to human consumption and waste management.
Sector	Human-centred with a strong anchor in the public health sector.	Focus on animal source foods, zoonoses and their respective risks.

<p>Evolution</p>	<p>Historically, WASH research has focused on water-related disease transmission from human excreta (faecal-oral diseases). This has contributed to understanding the mechanisms of faecal-oral infection through water-borne, water-washed, and water-based routes. Early intervention studies focused on the provision of infrastructure, and information, education and communication (IEC).</p> <p>Current research focuses more on behaviour change communication using bottom-up approaches, and incorporating the “A (Animals)” into WASH more holistically.</p>	<p>Veterinary public health traditionally looked at all food chain stages to identify where risks (e.g., biological, chemical, and physical) can emerge and how to prevent or mitigate them. The initial focus was on microbiological aspects with a strong technical dimension.</p> <p>Veterinary public health now looks at human behaviour more widely, bringing in social science aspects and economics to understand better practices and the motivations behind them. There is a (slow) move towards systems thinking, and a lot of progress in quantitative microbiological and epidemiological studies, detection techniques, etc.</p>
<p>Research methods</p>	<ul style="list-style-type: none"> ▪ Interventions (e.g., randomised controlled trials) ▪ Cross-sectional, questionnaire- based surveys ▪ Longitudinal questionnaire-based surveys ▪ Spot checks ▪ Direct observation ▪ Biological sampling and testing ▪ Risk assessments ▪ Qualitative research on behaviour, practices and perceptions, including participatory approaches 	

Study Design

This is a longitudinal observational study where women are recruited during pregnancy and mother-infant pairs followed up to 24 months after birth. This protocol involves multiple approaches to assess WASH and food safety practices in households of women enrolled in the study, in Hyderabad, India, Lombok, Indonesia and Kaffrine, Senegal, at predefined timepoints (see AASH observational cohort description in Heffernan et al in this supplement).

Data collection

This WASH and food safety data collection protocol focuses on three areas: exposure pathways to wider environmental pathogens, foodborne hazards, and waterborne hazards. Four data collection tools for the household-level have been developed, namely: i) questionnaire-based interviews; ii) spot-checks; iii) biological sampling; and iv) direct observation. The interviews and spot-checks take place simultaneously during home visits at 9, 12 and 18 months after birth. Direct observation and biological sampling are conducted during a separate subsequent visit at each timepoint. The food safety component of the data collection focuses on nutrient-rich foods with the potential to alleviate stunting, particularly on animal source foods (ASFs). This is due to their important nutritional profile²², their documented potential to alleviate stunting²³⁻²⁶, and their high food safety risk profile. Selected ASFs will be considered at each country, according to their relevance.

Trained enumerators collect data using electronic tablets in all study households, as summarised in Table 2. Data collection tools developed in English are translated into local languages and backtranslated into English to check for accuracy, and piloted in the field.

Table 2. Summary of the integrated study methods and tools used to assess WASH and food safety at the household level

Tool	Description	Sample size	Timepoints
Questionnaire-based interview	<p>Mothers are asked about infant and young child feeding (IYCF) practices, household food expenditure, and the main household decision-makers and influencers of these activities. Physical activity questionnaires ask mothers about the times spent on work and housekeeping including collecting water, fodder and fuel. Furthermore, there are questions on water sources, water security, sanitation and handwashing. Other questions focus on the practices of acquisition, transport, storage, preparation of ASF, and the points of potential contamination in the household. Finally, other questions refer to the presence and behaviour of animals and potential transmission pathways associated with close proximity to animals, such as direct contact between animals and children or food.</p> <p>The hazards and risks prior to arrival of ASFs in the household are elucidated in a separate component, at the value chain level (see Cooper et al in this supplement).</p>	Whole cohort (500 households per country)	At 9, 12, and 18 months after birth
Spot-check	<p>Enumerators observe behavioural issues alongside the interview questionnaire. The data are recorded using a check list on the availability and type of sanitation facilities available at the households (e.g., the place for defecation and proximity), handwashing infrastructure (e.g., location, availability of water and soap), presence of animals (e.g., livestock, pests), food storage facilities and practices (e.g., functioning refrigerator), and food preparation (e.g., easy to clean equipment).</p>	Whole cohort (500 households per country)	At 9, 12, and 18 months after birth

Direct observation	Enumerators stay at the household for 3 hours around a feeding event, observing the mothers perform their daily activities and taking a passive approach to blend into the background in order to better observe hygiene related behaviours. Structured observation include activities related to water collection and storage, as well as personal, environmental and food hygiene (food preparation, storage, child feeding, handwashing, and animal contact). This data collection method is a gold standard for actual observation of behavioural practices.	Subsample (approximately one-third of full cohort in each country)	At 9, 12, and 18 months after birth
Biological sampling and testing	Enumerators collect samples of stored water, foods to be consumed by the children (as close to the feeding of the child as possible), and a swab of the main food preparation area at the households. Samples of hands rinse are optional. The samples are stored in a coolbox and transported to a specialised laboratory for analysis. The samples are processed in-country and tested for overall contamination and for selected pathogens (such as Salmonella, Shigella, E.coli, and Campylobacter for food and E.coli/faecal indicators for surfaces and water), using standard laboratory protocols (of conventional culture and PCR). Part of the samples collected are used for lab analysis and the remaining part stored under -20°C for future analysis and crosschecking.	Subsample (approximately one-third of full cohort in each country)	At 9, 12, and 18 months after birth

ASF: animal source foods; IYCF: Infant and young child feeding; PCR: Polymerase chain reaction

Data management and analysis

Data will be collected and analysed at each of the countries using tailored Standard Operating Procedures (SOPs). Data collected at the households and laboratories will be checked for accuracy and then transmitted to a central repository for analysis.

Descriptive, comparative and regression analyses will be used to investigate the impact of WASH and food safety on child stunting. Factors relating to WASH and food safety amenities and practices will be considered simultaneously as external risks or preventive factors influencing the incidence and severity of stunting, using multivariate statistical approaches. Data triangulation will also be used, firstly, to address biases in individual data collection tools. For example, known biases occur when measures are reported by participants, particularly by those people for whom illness becomes normalised after repeated bouts of infection²⁷. Observation of behaviours, through enumerator

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3 presence in the household at certain times of day, can help to mitigate reporting bias. However,
4 surveys and observation may also affect participant motivation, particularly when repeated over long
5 periods. Extensive collection of samples for laboratory testing can be done, but are expensive and
6 have their own weaknesses²⁸. Secondly, data triangulation through statistical modelling will be used
7 to the determine the relationship between WASH and food safety in each of the study contexts, and
8 to explore relevant questions such as whether they are complements or substitutes in child health
9 and nutrition. As such, a mix of approaches is being used in this study to address these potential
10 challenges.
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14 **Patient and Public Involvement statement**

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16 Study participants have not been involved in the general design of the study. However, the study was
17 designed in partnership with local research partners and stakeholders with experience in working at
18 each of the settings. Local enumerators helped finalise the data collection tools during training and
19 pilot testing.
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21 Extensive consultations will be organised with the local communities to understand the ethos of the
22 research including the involvement of participants and the implications of the research. Question and
23 answer sections will be held during the consultations to answer any questions and/or concerns raised.
24 Study participants and the public will be involved in the dissemination of the study's findings through
25 community discussion or engagement events.
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30 **DISCUSSION**

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32 Poor food safety and inadequate WASH, including getting in direct contact with animals, their produce
33 and/or their faeces, are thought to be important contributors to undernutrition. The potential
34 mechanisms include nutrient loss (e.g., during diarrhoeal episodes), energy used by the immune
35 system (e.g., in combating illnesses), and increased intestinal permeability and reduction in nutrients
36 absorption (e.g., enteropathy)²⁹. Other indirect pathways include scarcity of income and time with
37 which undertake childcare and feeding practices. Cumulatively over the first two years of life, these
38 factors can contribute to stunting expressed as linear growth faltering. However, the causes of infant
39 stunting are not exclusive to these factors, and therefore it is critical to cohesively consider the
40 multiple determinants involved. The UKRI GCRF AASH is using an interdisciplinary approach to
41 investigate this variety of factors causing stunting with the aim to identify solutions for the
42 amelioration of growth and development in early childhood at the 'whole-child' level. Within such an
43 interdisciplinary framework, this study design will generate comprehensive evidence on the
44 contribution of WASH, and food safety at the household level.
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48 Challenges to conducting integrated assessment in WASH and food safety in a multi-country study like
49 this are various, including identifying key ASFs and key hazards in a systematic way, or the analysis of
50 pathways linking hygiene, food and water safety, and sanitation data into the typologies of stunting.
51 For this purpose, we developed holistic data collection tools relevant to each study setting, to measure
52 risk factors for exposure to food- and water-borne disease. Multiple household-level interventions are
53 available in both WASH and food safety but, to date, their effectiveness has not been assessed
54 together, despite the similarity in the exposure mechanisms they are targeting. The effectiveness of
55 relevant interventions and technologies in addressing malnutrition depends on both their biological
56 efficacy, and the degree to which consumer behaviour adapts to accept and use the new approach, in
57 the environment where it is based³⁰. We draw on an approach and suggest data collection tools
58 through which these various underlying and proximate determinants of child growth may be analysed.
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3 Additionally, the value chains for ASF generally present important potential to improve availability,
4 accessibility, affordability and safety for the most nutritionally vulnerable population groups³¹. This
5 study will also provide information that will help to identify entry points in chains where upgrading
6 may be feasible and welcome by stakeholders (e.g., consumers, government, and businesses). Based
7 on secondary dietary and nutritional data, a systematic literature review of food safety hazards in ASF
8 value chains in each study setting and local experts' feedback, commodities of likely relevance are
9 eggs in all countries, milk in India and Senegal, and fish in Indonesia (see AASH food system protocol
10 description in Cooper et al in this supplement for value chain work).
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13 The data generated from the study will help pave the way for future interventions to to manage factors
14 associated with and prevent stunting.
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16 17 18 **ETHICS AND DISSEMINATION** 19

20 Ethical approval for the study was granted by the Institutional ethics committees of the London School
21 of Hygiene and Tropical Medicine (17915/RR/17513), the Social Science Research Ethical Review
22 Board at the Royal Veterinary College (URN SR2020-0198) and the International Livestock Research
23 Institute Institutional Research Ethics Committee (ILRI-IREC2020-33). In-country approvals were also
24 granted: the National Institute of Nutrition (ICMR), Ministry of Health and Family Welfare,
25 Government of India (CR/04/I/2021), the Health Research Ethics Committee, University of Indonesia
26 and Dr Cipto Mangunkusumo Hospital (KET-887/UN2.F1/ETIK/PPM.00.02/2019), and the Comité
27 National d'Ethique pour la Recherche en Santé, Senegal (Protocole SEN19/78).
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29 Findings of the study will be disseminated through publication in peer-reviewed journals, presented
30 at relevant international conferences, public engagement events, and policy-maker and stakeholder
31 events. Data generated from the study will be deposited on publicly available data repository.
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AUTHORS CONTRIBUTIONS

All authors were involved in the study design and the preparation of the study tools and protocols at different stages; BH, HW and PDS drafted the manuscript sections; all other authors critically reviewed the manuscript. PDS and HW share first authorship.

We want to thank Alessia Gasco for producing the conceptual framework and Claire Heffernan, Kaitlin Conway and Modou Jobarteh for careful editing of the manuscript.

FUNDING STATEMENT

This work was supported by the UKRI-GCRF Action Against Stunting Hub (Project ref. MR/S01313X/1). The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the funders.

COMPETING INTEREST STATEMENT

The authors declare no conflict of interest.

BMJ Paediatrics Open

Understanding the role of household hygiene practices and foodborne disease risks in child stunting: a UKRI GCRF Action Against Stunting Hub protocol paper

Journal:	<i>BMJ Paediatrics Open</i>
Manuscript ID	bmjpo-2022-001695.R1
Article Type:	Protocol
Date Submitted by the Author:	06-Nov-2022
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Keywords:	Epidemiology, Microbiology, Data Collection

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4 **Understanding the role of household hygiene practices and foodborne disease risks in child stunting:**
5 **a UKRI GCRF Action Against Stunting Hub protocol paper**
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43 Keywords: food safety, hygiene, water, sanitation, child stunting, protocol
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ABSTRACT

Introduction: Environmental hygiene and food safety are important determinants of child stunting. This research aims to explore the relationship between child stunting and household hygiene practices and behaviours, including the availability of water, sanitation and hygiene (WASH) facilities; the use of safe food and good quality drinking water (especially when used for complementary feeding); hygienic practices in food transport, storage and preparation; and the control of cross-contamination from animals, their produce and waste.

Methods and analysis: This study is part of a wider observational study which aims to investigate the interdisciplinary factors contributing to child stunting using a 'whole child' paradigm. The observational study recruits women during pregnancy in Hyderabad, India, Lombok, Indonesia and Kaffrine, Senegal, and dyads (i.e., 500 mother-infant pairs per country) are followed longitudinally up to 24 months after birth. Within the interdisciplinary niche, the study herein has developed tools to investigate the potential exposure pathways to environmental pathogen contamination of foods and water. Holistic WASH and food safety data collection tools have been developed to explore exposure pathways at the household-level, including: i) survey questionnaires; ii) spot-checks; iii) biological sampling of drinking water, food and domestic surfaces; and iv) direct observation. An integrated analytical approach will be used to triangulate the evidence in order to examine the relationships between child stunting, WASH and food safety behaviours.

Ethics and dissemination: Ethical approval of the study was granted by the ethics committee of the LSHTM, RVC, ILRI, ICMR, IIPHG, SEAMEO-RECFON, University of Cheikh Anta Diop. Findings of the study will be disseminated through publication in peer-reviewed journals, relevant international conferences, public engagement events, and policy-maker and stakeholder events.

SUMMARY BOX**● What is known about the subject**

- From the moment complementary feeding begins, the chances of exposure to food contamination and infectious disease increase exponentially
- Adequate WASH and food safety practices can play a key role in reducing infectious disease transmission and child malnutrition.
- The contribution of hygiene behaviours and food contamination in driving transmission of infections and childhood stunting requires further investigation.

● What this study hopes to add

- Development, application and analysis of integrated WASH and food safety tools, towards a holistic understanding of how these practices and behaviours impact child stunting
- Evidence towards a new typology of child stunting, with a focus on exposure pathways for pathogens, and to support programmes and policies to minimise stunting in childhood.

INTRODUCTION

The incidence and severity of stunting in childhood is closely linked to exposure to infection from food, drinking water and the wider environment¹. Infections associated with contaminated water or insufficient water, sanitation and hygiene (WASH) are responsible for an estimated 21% of the total global burden of diseases², contributing to the outbreak and chronicity of preventable infections such as diarrhoeal diseases and ARI (Acute Respiratory Infections), which are the two leading causes of death in children globally³. In addition, the World Health Organization (WHO) Foodborne Disease Burden Epidemiology Reference Group (FERG), estimated that approximately 40% of the global burden of foodborne diseases occurs in children under the age of five years⁴. A common cause of foodborne infections is the consumption of raw or undercooked meat, fish, seafood, eggs, fresh produce and dairy products contaminated by norovirus, *Campylobacter*, non-typhoidal *Salmonella* or pathogenic *E. coli*⁴. Food hygiene is a primary concern in the preparation of complementary foods - for example, bottles often cannot be adequately sterilised and perishable complementary foods are often left unrefrigerated or eaten using unclean utensils or with unwashed hands.

Disease transmission from faeces can be food- or water-borne (i.e., oral ingestion of contaminated food and water), water-washed or water-scarce (i.e., spread through inadequate hand and food hygiene) and water-based (i.e., transmitted by parasites that penetrate skin in water, such as schistosomiasis, or by walking barefoot on contaminated soil in the case of hookworm)⁵. For example, theory and evidence suggests that pathogens in foods are a main driver of infant faecal-oral disease⁶. Field studies have demonstrated high bacterial contamination from *E. Coli* or *Salmonella* in weaning foods^{7,8}. Of particular importance for the cleanliness of infant complementary foods are the quality of water, surfaces and utensils used to prepare and eat them⁹⁻¹¹ as well as the quality of the food ingredients procured.

Hence, the availability of WASH and food storage and preparation facilities is likely to determine exposure to infection. However, pathogen exposure can also arise when available facilities are used inadequately. For example, cultural norms and beliefs can restrict domestic food and hygiene practices – e.g., whether mothers are the principal decisionmakers about food preparation and hygiene in the household, or whether women are able to use the same toilet facilities as other household members¹².

However, while contamination of foods during cooking and feeding is common, the behavioural drivers have not been adequately explored. A recent systematic survey of 350 WASH evaluation projects in low and middle income countries (LMICs) found that around 15% of studies examined nutrition outcomes like stunting, and handwashing before food preparation, but only 5% reported on other food hygiene behaviours, such as whether food was stored appropriately and kitchen utensils were washed¹³. Whilst food safety and WASH are inter-linked, to date little attention has been paid to understanding the relationships and trade-offs between food safety, WASH and child stunting. The safety of livestock and fish derived foods is a particularly neglected area and there has been no systematic integration of these topics in food safety and WASH protocols⁹.

The UKRI GCRF Action Against Stunting Hub (AASH) explores child stunting from the Whole Child Approach. The aim of this study is to examine WASH and food safety elements, their convergence and contributions to child stunting at the household level. It evaluates WASH and food safety practices across households in three study sites with the objective to provide evidence on potential exposure to pathogens through contaminated environment, drinking water, and complementary food, and associated risk factors.

METHOD AND ANALYSIS

Conceptual Framework

The manner in which WASH and food safety at the household level lead to changes in infection and dietary intake, thereby affecting child stunting, is illustrated in Figure 1, adapted from the UNICEF’s (1990) conceptual framework on the causes of malnutrition¹⁴. Inadequate WASH practices and food safety can contribute to childhood stunting directly, by exposing infants to infection via complementary foods contaminated during preparation and storage, or through feeding with unclean utensils, including the hands of carers. The safety of foods can also be compromised before arrival at households, throughout the different steps and processes of the food value chain. Those food hazards can be intrinsic to the food produced (e.g., pathogens from animal diseases, heavy metal marine contamination), or extrinsic through processing and handling (e.g., inadequate hygienic practices, aflatoxin contamination during storage)¹⁵.

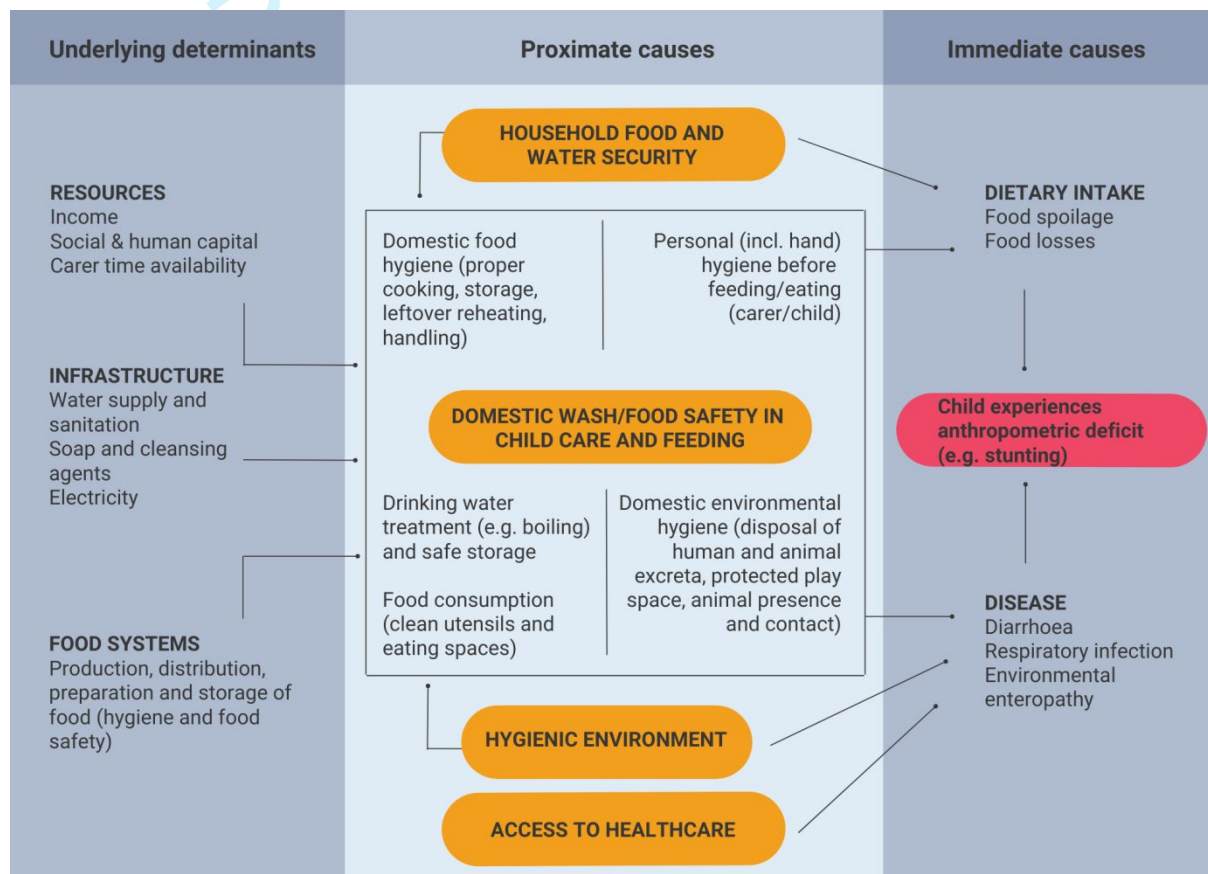


Figure 1: A conceptual framework showing the linkages of WASH and food safety with stunting at the household level

In theory, access to adequate WASH facilities enables appropriate drinking water, hygiene and food safety practices, contributing to reduction in transmission of food- and water-borne pathogens and improving nutrient uptake, and ultimately child growth and development¹⁵.

Drinking water may be contaminated at the point of supply, or through transport and storage^{10,11}. The availability of clean water is critical for optimal hygiene practices⁵, to address contamination by human and animal faeces¹⁶, and to prepare food hygienically. Sanitation facilities can enable safe faeces disposal, especially those of young children, which can be particularly pathogenic¹⁷. Faecal contamination can also come from the presence of domestic and wild animals or pests inside the household or in surrounding spaces¹⁸. It is expected that these sources of infection become more important as a child starts crawling and interacting with their environment. As such, understanding of

the determinants of food and hygiene practises in the household is key to improving infant health and nutrition¹⁹.

Along with direct exposure, there is also an indirect route from water supply and sanitation facilities to childhood malnutrition, which operates through the opportunity costs of resource use. The time carers have to observe, correct, and address unhygienic behaviour, and the scarcity of time in relation to competing activities that need to be done by carers in the home or workplace, may also be detrimental for children's nutritional outcomes²⁰. For example, it is typically women and older children, both of whom are more likely than others to be carers of young children, who spend time fetching water, engaging with animal fodder and collecting firewood. This may occur at the expense of adequate childcare and feeding, food preparation, education or rest²¹. When drinking water needs cannot be met affordably, households may need to purchase less food in order to afford enough water to drink. This kind of trade-off is clearly more prevalent for the poorest households, for whom malnutrition is also likely to be highest.

The WASH and food safety approaches, including their scope, evolution and methods are described in Table 1. Combining both WASH and food safety approaches provides an opportunity for more effective integration and learning of the two disciplines and their contributions to child growth and development. The two should converge when looking at household units with a central focus such as child stunting.

Table 1. Characteristics of Water, Sanitation and Hygiene (WASH) and Food Safety and Veterinary Public Health research

	Water, Sanitation and Hygiene (WASH)	Food Safety and Veterinary Public Health
Scope	To investigate deficiencies in water supply and quality, sanitation and hygiene to improve public health. Also, to evaluate the adequacy of hygiene standard to minimise food-borne diseases risks, and the role of water supply and sanitation access as enabling factors for improving child care, health and nutrition.	To pursue a comprehensive "farm to fork", "stable to table", "boat to throat" approach to prevent and minimise risks of food contamination at all stages of the food chain from production to human consumption and waste management.
Sector	Human-centred with a strong anchor in the public health sector.	Focus on animal source foods, zoonoses and their respective risks.

<p>Evolution</p>	<p>Historically, WASH research has focused on water-related disease transmission from human excreta (faecal-oral diseases). This has contributed to understanding the mechanisms of faecal-oral infection through water-borne, water-washed, and water-based routes. Early intervention studies focused on the provision of infrastructure, and information, education and communication (IEC).</p> <p>Current research focuses more on behaviour change communication using bottom-up approaches, and incorporating the “A (Animals)” into WASH more holistically.</p>	<p>Veterinary public health traditionally looked at all food chain stages to identify where risks (e.g., biological, chemical, and physical) can emerge and how to prevent or mitigate them. The initial focus was on microbiological aspects with a strong technical dimension.</p> <p>Veterinary public health now looks at human behaviour more widely, bringing in social science aspects and economics to understand better practices and the motivations behind them. There is a (slow) move towards systems thinking, and a lot of progress in quantitative microbiological and epidemiological studies, detection techniques, etc.</p>
<p>Research methods</p>	<ul style="list-style-type: none"> ▪ Interventions (e.g., randomised controlled trials) ▪ Cross-sectional, questionnaire- based surveys ▪ Longitudinal questionnaire-based surveys ▪ Spot checks ▪ Direct observation ▪ Biological sampling and testing ▪ Risk assessments ▪ Qualitative research on behaviour, practices and perceptions, including participatory approaches 	

Study Design

This is a longitudinal observational study where women are recruited during pregnancy and mother-infant pairs followed up to 24 months after birth. This protocol involves multiple approaches to assess WASH and food safety practices in households of women enrolled in the study, in Hyderabad, India, Lombok, Indonesia and Kaffrine, Senegal, at predefined timepoints (see AASH observational cohort description in Heffernan et al in this supplement).

Data collection

This WASH and food safety data collection protocol focuses on three areas: exposure pathways to wider environmental pathogens, foodborne hazards, and waterborne hazards. Four data collection tools for the household-level have been developed, namely: i) a module for WASH and food safety to be included to the cohort questionnaire-based interviews (see Appendix 1); ii) spot-checks (see Appendix 2); iii) biological sampling; and iv) direct observation (see Appendix 3). The interviews and spot-checks take place simultaneously during home visits at 9, 12 and 18 months after birth. Direct observation and biological sampling are conducted during a separate subsequent visit at each timepoint. The food safety component of the data collection focuses on nutrient-rich foods with the potential to alleviate stunting, particularly on animal source foods (ASFs). This is due to their important

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3 nutritional profile²², their documented potential to alleviate stunting²³⁻²⁶, and their high food safety
4 risk profile. Selected ASFs will be considered at each country, according to their relevance.
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6 Trained enumerators collect data using electronic tablets in all study households, as summarised in
7 Table 2. Data collection tools developed in English are translated into local languages and
8 backtranslated into English to check for accuracy, and piloted in the field.
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11 **Table 2.** Summary of the integrated study methods and tools used to assess WASH and food safety at
12 the household level
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Tool	Description	Sample size	Timepoints
Questionnaire-based interview	<p>Mothers are asked about infant and young child feeding (IYCF) practices, household food expenditure, and the main household decision-makers and influencers of these activities. Physical activity questionnaires ask mothers about the times spent on work and housekeeping including collecting water, fodder and fuel. Furthermore, there are questions on water sources, water security, sanitation and handwashing. Other questions focus on the practices of acquisition, transport, storage, preparation of ASF, and the points of potential contamination in the household. Finally, other questions refer to the presence and behaviour of animals and potential transmission pathways associated with close proximity to animals, such as direct contact between animals and children or food.</p> <p>The hazards and risks prior to arrival of ASFs in the household are elucidated in a separate component, at the value chain level (see Cooper et al in this supplement).</p>	Whole cohort (500 households per country)	At 9, 12, and 18 months after birth
Spot-check	Enumerators observe behavioural issues alongside the interview questionnaire. The data are recorded using a check list on the availability and type of sanitation facilities available at the households (e.g., the place for defecation and proximity), handwashing infrastructure (e.g., location, availability of water and soap), presence of animals (e.g., livestock, pests), food storage facilities and practices (e.g., functioning refrigerator), and food	Whole cohort (500 households per country)	At 9, 12, and 18 months after birth

	preparation (e.g., easy to clean equipment).		
Direct observation	Enumerators stay at the household for 3 hours around a feeding event, observing the mothers perform their daily activities and taking a passive approach to blend into the background in order to better observe hygiene related behaviours. Structured observation include activities related to water collection and storage, as well as personal, environmental and food hygiene (food preparation, storage, child feeding, handwashing, and animal contact). This data collection method is a gold standard for actual observation of behavioural practices.	Subsample (approximately one-third of full cohort in each country)	At 9, 12, and 18 months after birth
Biological sampling and testing	Enumerators collect samples of stored water, foods to be consumed by the children (as close to the feeding of the child as possible), and a swab of the main food preparation area at the households. Samples of hands rinse are optional. The samples are stored in a coolbox and transported to a specialised laboratory for analysis. The samples are processed in-country and tested for overall contamination and for selected pathogens (such as Salmonella, Shigella, E.coli, and Campylobacter for food and E.coli/faecal indicators for surfaces and water), using standard laboratory protocols (of conventional culture and PCR). Part of the samples collected are used for lab analysis and the remaining part stored under -20°C for future analysis and crosschecking.	Subsample (approximately one-third of full cohort in each country)	At 9, 12, and 18 months after birth

ASF: animal source foods; IYCF: Infant and young child feeding; PCR: Polymerase chain reaction

Data management and analysis

Data will be collected and analysed at each of the countries using tailored Standard Operating Procedures (SOPs). Data collected at the households and laboratories will be checked for accuracy and then transmitted to a central repository for analysis.

Descriptive, comparative and regression analyses will be used to investigate the impact of WASH and food safety on child stunting. Factors relating to WASH and food safety amenities and practices will be considered simultaneously as external risks or preventive factors influencing the incidence and severity of stunting, using multivariable statistical approaches. To relate the main exposure variables

(WASH and food safety factors) with the main outcome (stunting, measured as either z-scores or presence/absence), multivariable regression models will be developed. According to our causal framework presented in Figure 1, we will adjust this model by potential confounding factors (including age, sex, socioeconomic status and environmental hygiene levels), and we will avoid intermediate factors (e.g., infection rates). Subsequently, we will explore the potential role of the mediators in the causal framework using mediation analysis. Due to the existence of repeated measures conducted over three different timepoints for each child, we will account for this with a random effect term by individual in the regression model. The model will be a linear regression for stunting measured as a continuous variable, and a logistic (or ordered logistic) regression for stunting (moderate and severe) measured as a dichotomous variable. Due to the fact that in our 3 country settings the relevant association might differ, we will estimate the models separately in each country, and afterwards we will conduct individual participant data meta-analysis of the coefficients of interest across the countries. This strategy will allow for an optimal fit of the model in each country and at the same time we will be able to explore the heterogeneity of coefficients across countries and within sub-groups (by age, sex and socioeconomic characteristics).

Data triangulation will also be used, firstly, to address biases in individual data collection tools. For example, known biases occur when measures are reported by participants, particularly by those people for whom illness becomes normalised after repeated bouts of infection²⁷. Observation of behaviours, through enumerator presence in the household at certain times of day, can help to mitigate reporting bias. However, surveys and observation may also affect participant motivation, particularly when repeated over long periods. Extensive collection of samples for laboratory testing can be done, but have their own weaknesses²⁸. Secondly, data triangulation through statistical modelling will be used to determine the relationship between WASH and food safety in each of the study contexts, and to explore relevant questions such as whether they are complements or substitutes in child health and nutrition. As such, a mix of approaches is being used in this study to address these potential challenges.

Patient and Public Involvement statement

Study participants have not been involved in the general design of the study. However, the study was designed in partnership with local research partners and stakeholders with experience in working at each of the settings. Local enumerators helped finalise the data collection tools during training and pilot testing.

Extensive consultations will be organised with the local communities to understand the ethos of the research including the involvement of participants and the implications of the research. Question and answer sessions will be held during the consultations to answer any questions and/or concerns raised. Study participants and the public will be involved in the dissemination of the study's findings through community discussion or engagement events.

DISCUSSION

Poor food safety and inadequate WASH, including getting in direct contact with animals, their produce and/or their faeces, are thought to be important contributors to undernutrition. The potential mechanisms include nutrient loss (e.g., during diarrhoeal episodes), energy used by the immune system (e.g., in combating illnesses), and increased intestinal permeability and reduction in nutrients absorption (e.g., enteropathy)²⁹. Other indirect pathways include scarcity of income and time with which undertake childcare and feeding practices. Cumulatively over the first two years of life, these

factors can contribute to stunting expressed as linear growth faltering. However, the causes of infant stunting are not exclusive to these factors, and therefore it is critical to cohesively consider the multiple determinants involved. The UKRI GCRF AASH is using an interdisciplinary approach to investigate this variety of factors causing stunting with the aim to identify solutions for the amelioration of growth and development in early childhood at the 'whole-child' level. Within such an interdisciplinary framework, this study design will generate comprehensive evidence on the contribution of WASH, and food safety at the household level.

Challenges to conducting integrated assessment in WASH and food safety in a multi-country study like this are various, including identifying key ASFs and key hazards in a systematic way, or the analysis of pathways linking hygiene, food and water safety, and sanitation data into the typologies of stunting. For this purpose, we developed holistic data collection tools relevant to each study setting, to measure risk factors for exposure to food- and water-borne disease. Multiple household-level interventions are available in both WASH and food safety but, to date, their effectiveness has not been assessed together, despite the similarity in the exposure mechanisms they are targeting. The effectiveness of relevant interventions and technologies in addressing malnutrition depends on both their biological efficacy, and the degree to which consumer behaviour adapts to accept and use the new approach, in the environment where it is based³⁰. We draw on an approach and suggest data collection tools through which these various underlying and proximate determinants of child growth may be analysed.

Additionally, the value chains for ASF generally present important potential to improve availability, accessibility, affordability and safety for the most nutritionally vulnerable population groups³¹. This study will also provide information that will help to identify entry points in chains where upgrading may be feasible and welcome by stakeholders (e.g., consumers, government, and businesses). Based on secondary dietary and nutritional data, a systematic literature review of food safety hazards in ASF value chains in each study setting and local experts' feedback, commodities of likely relevance are eggs in all countries, milk in India and Senegal, and fish in Indonesia (see AASH food system protocol description in Cooper et al in this supplement for value chain work).

The data generated from the study will help pave the way for future interventions to manage factors associated with and prevent stunting.

ETHICS AND DISSEMINATION

Ethical approval for the study was granted by the Institutional ethics committees of the London School of Hygiene and Tropical Medicine (17915/RR/17513), the Social Science Research Ethical Review Board at the Royal Veterinary College (URN SR2020-0198) and the International Livestock Research Institute Institutional Research Ethics Committee (ILRI-IREC2020-33). In-country approvals were also granted: the National Institute of Nutrition (ICMR), Ministry of Health and Family Welfare, Government of India (CR/04/I/2021), the Health Research Ethics Committee, University of Indonesia and Dr Cipto Mangunkusumo Hospital (KET-887/UN2.F1/ETIK/PPM.00.02/2019), and the Comité National d'Ethique pour la Recherche en Santé, Senegal (Protocole SEN19/78).

Findings of the study will be disseminated through publication in peer-reviewed journals, presented at relevant international conferences, public engagement events, and policy-maker and stakeholder events. Data generated from the study will be deposited on publicly available data repository.

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AUTHORS CONTRIBUTIONS

All authors were involved in the study design and the preparation of the study tools and protocols at different stages; BH, HW and PDS drafted the manuscript sections; all other authors critically reviewed the manuscript. PDS and HW share first authorship.

We want to thank Alessia Gasco for producing the conceptual framework and Claire Heffernan, Kaitlin Conway and Modou Jobarteh for careful editing of the manuscript.

FUNDING STATEMENT

This work was supported by the UKRI-GCRF Action Against Stunting Hub (Project ref. MR/S01313X/1). The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the funders.

COMPETING INTEREST STATEMENT

The authors declare no conflict of interest.

APPENDIX 1: WASH AND FOOD SAFETY QUESTIONNAIRE

1	
2	
3	
4	
5	
6	# WATER SANITATION *(3 TIMES AT 3RD TRIMESTER, 3 & 24 MO)*
7	ws_1. What is the main source of drinking water for members of your household?
8	Piped water piped to dwelling
9	Piped water piped to compound yard or plot
10	Piped water piped to neighbor
11	Public tap / tapstand
12	Borehole or tubewell
13	Protected well
14	Unprotected well
15	Protected spring
16	Unprotected spring
17	Rainwater
18	Delivered watertanker or truck
19	Delivered watersmall cart with tank drum
20	Water kiosk
21	Packaged waterbottled water
22	Packaged watersachet water
23	Surface water
24	Other: specify
25	<i>ws_1_96x. Other: specify</i>
26	ws_2. What is the main source of water used by members of this household for other purposes, such as cooking and handwashing?
27	Piped water piped to dwelling
28	Piped water piped to compound yard or plot
29	Piped water piped to neighbor
30	Public tap / tapstand
31	Borehole or tubewell
32	Protected well
33	Unprotected well
34	Protected spring
35	Unprotected spring
36	Rainwater
37	Delivered watertanker or truck
38	Delivered watersmall cart with tank drum
39	Water kiosk
40	Packaged waterbottled water
41	Packaged watersachet water
42	Surface water
43	Other: specify
44	<i>ws_2_96x. Other: specify</i>
45	ws_3. Where is this water collected from?
46	In own dwelling
47	In own yard
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

1	
2	
3	Elsewhere
4	ws_4. How many minutes in total does it take you to go fetch water from this source and come back?
5	(Fill in X minutes)
6	
7	ws_5. Do you store drinking water in your home?
8	Yes
9	No
10	
11	ws_6. Where do you store your drinking water?
12	In a container with a lid/top on it
13	In an open container
14	Container on the roof
15	
16	ws_7. In the last 4 weeks/month, how frequently did you or anyone in your household worry you would not have enough water for all of your household needs?
17	Never (0 times)
18	Rarely (1-2 times)
19	Sometimes (3-10 times)
20	Often (11-20times)
21	Always (more than 20 times)
22	
23	ws_8. In the last 4 weeks/month, how frequently has your main water source been interrupted or limited (eg water pressure, less water than expected, river dried up)?
24	Never (0 times)
25	Rarely (1-2 times)
26	Sometimes (3-10 times)
27	Often (11-20times)
28	Always (more than 20 times)
29	
30	ws_9. In the last 4 weeks/month, how frequently has there not been enough water to wash clothes?
31	Never (0 times)
32	Rarely (1-2 times)
33	Sometimes (3-10 times)
34	Often (11-20times)
35	Always (more than 20 times)
36	
37	ws_10. In the last 4 weeks/month, how frequently have you or anyone in your household had to change schedules or plans due to problems with your water situation? Activities that may have been interrupted include caring for others, doing household chores, agricultural work, income-generating activities, sleeping, etc
38	Never (0 times)
39	Rarely (1-2 times)
40	Sometimes (3-10 times)
41	Often (11-20times)
42	Always (more than 20 times)
43	
44	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
45	Never (0 times)
46	Rarely (1-2 times)
47	Sometimes (3-10 times)
48	Often (11-20times)
49	Always (more than 20 times)
50	
51	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
52	Never (0 times)
53	Rarely (1-2 times)
54	Sometimes (3-10 times)
55	Often (11-20times)
56	
57	
58	
59	
60	

1	Always (more than 20 times)
2	
3	
4	ws_12. In the last 4 weeks/month, how frequently have you or anyone in your household had to go
5	without washing hands after dirty activities (eg, defecating or changing diapers, cleaning animal dung)
6	because of problems with water?
7	
8	Never (0 times)
9	Rarely (1-2 times)
10	Sometimes (3-10 times)
11	Often (11-20times)
12	
13	Always (more than 20 times)
14	ws_13. In the last 4 weeks/month, how frequently have you or anyone in your household had to go
15	without washing their body because of problems with water (eg, not enough water, dirty, unsafe)?
16	
17	Never (0 times)
18	Rarely (1-2 times)
19	Sometimes (3-10 times)
20	Often (11-20times)
21	
22	Always (more than 20 times)
23	ws_14. In the last 4 weeks/month, how frequently has there not been as much water to drink as you
24	would like for you or anyone in your household?
25	
26	Never (0 times)
27	Rarely (1-2 times)
28	Sometimes (3-10 times)
29	Often (11-20times)
30	
31	Always (more than 20 times)
32	ws_15. In the last 4 weeks/month, how frequently did you or anyone in your household feel angry
33	about your water situation?
34	
35	Never (0 times)
36	Rarely (1-2 times)
37	Sometimes (3-10 times)
38	Often (11-20times)
39	
40	Always (more than 20 times)
41	ws_16. In the last 4 weeks/month, how frequently have you or anyone in your household gone to
42	sleep thirsty because there wasn't any water to drink?
43	
44	Never (0 times)
45	Rarely (1-2 times)
46	Sometimes (3-10 times)
47	Often (11-20times)
48	
49	Always (more than 20 times)
50	ws_17. In the last 4 weeks/month, how frequently has there been no useable or drinkable water
51	whatsoever in your household?
52	
53	Never (0 times)
54	Rarely (1-2 times)
55	Sometimes (3-10 times)
56	Often (11-20times)
57	
58	Always (more than 20 times)
59	ws_18. In the last 4 weeks/month, how frequently have problems with water caused you or anyone in
60	your household to feel ashamed/excluded/stigmatized?

1	
2	
3	Never (0 times)
4	Rarely (1-2 times)
5	Sometimes (3-10 times)
6	Often (11-20times)
7	Always (more than 20 times)
8	
9	
10	ws_19. Is there a latrine or toilet that members of this household use regularly?
11	Yes
12	No
13	
14	ws_20. Where is this toilet facility located?
15	In own dwelling
16	In own yard or plot
17	Elsewhere
18	
19	ws_21. How many households other than your own share this facility?
20	Enter the enumerator Name
21	
22	
23	fh_1. Is there a designated place for handwashing in the household?
24	Yes
25	No
26	
27	fh_2. How often is soap available at this location?
28	Always
29	Sometimes
30	Never
31	
32	fh_3. What were all of the times when you washed your hands (Circle all that apply but do not prompt
33	After each response, ask "any other times?")
34	After defecating
35	After cleaning a child/wiping a child's bottom
36	After changing a babies nappy
37	Before preparing food
38	Before eating
39	Before feeding the child
40	After touching animals
41	After touching animal faeces
42	After handling raw animal source foods
43	After crop farming activities
44	Other
45	Cannot remember/does not know
46	<i>fh_3_96x. Specify other</i>
47	
48	FOOD STORAGE
49	
50	
51	fh_4. Do you store meat and meat products (except dried meat)?
52	Yes
53	No
54	
55	fh_4a. Where do you store raw meat (fresh/chilled/frozen)?
56	In a fridge
57	In a freezer
58	
59	Covered in a cool room (below 5 degrees Celsius)
60	

1	
2	
3	
4	Uncovered in a cool room (below 5 degrees Celsius)
5	Covered in a room at room temperature
6	Uncovered in a room at room temperature
7	Other, specify
8	
9	<i>fh_4a_96x. Other, specify</i>
10	fh_4b. How long do you store the meat and meat products?
11	less than 2 hours
12	2 hours to 5 hours
13	5 hours to 12 hours
14	12 hours
15	1-3 days
16	3-7 days
17	1 week
18	1 month
19	
20	
21	fh_4c. Where do you store processed meat (ready-to-cook and ready-to-eat)?
22	In a fridge
23	In a freezer
24	Covered in a cool room (below 5 degrees Celsius)
25	Uncovered in a cool room (below 5 degrees Celsius)
26	Covered in a room at room temperature
27	Uncovered in a room at room temperature
28	Other, specify
29	
30	<i>fh_4c_96x. Other, specify</i>
31	
32	fh_4d. How long do you store the meat and meat products?
33	less than 2 hours
34	2 hours to 5 hours
35	5 hours to 12 hours
36	12 hours
37	1-3 days
38	3-7 days
39	1 week
40	1 month
41	
42	
43	fh_5. Do you store milk and milk products (except milk powder, evaporated milk or condensed milk)?
44	Yes
45	No
46	
47	fh_5a. Where do you store liquid milk (including pasteurized and non-pasteurized)?
48	In a fridge
49	In a freezer
50	Covered in a cool room (below 5 degrees Celsius)
51	Uncovered in a cool room (below 5 degrees Celsius)
52	Covered in a room at room temperature
53	Uncovered in a room at room temperature
54	Other, specify
55	
56	<i>fh_5a_96x. Other, specify</i>
57	
58	
59	
60	

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4	fh_5b. Where do you store solid/semi solid dairy/milk products (e.g cheese, yoghurt, ghee, etc)?
5	In a fridge
6	In a freezer
7	Covered in a cool room (below 5 degrees Celsius)
8	Uncovered in a cool room (below 5 degrees Celsius)
9	
10	Covered in a room at room temperature
11	Uncovered in a room at room temperature
12	Other, specify
13	
14	<i>fh_5b_96x. Other, specify</i>
15	fh_6. Do you store raw or cooked vegetables and fruits?
16	Yes
17	No
18	
19	fh_6a. Where do you store raw vegetables?
20	In a fridge
21	In a freezer
22	
23	Covered in a cool room (below 5 degrees Celsius)
24	Uncovered in a cool room (below 5 degrees Celsius)
25	
26	Covered in a room at room temperature
27	Uncovered in a room at room temperature
28	Other, specify
29	
30	<i>fh_6a_96x. Other, specify</i>
31	fh_6b. Where do you store cooked vegetables and fruit?
32	In a fridge
33	In a freezer
34	
35	Covered in a cool room (below 5 degrees Celsius)
36	Uncovered in a cool room (below 5 degrees Celsius)
37	
38	Covered in a room at room temperature
39	Uncovered in a room at room temperature
40	Other, specify
41	
42	<i>fh_6b_96x. Other, specify</i>
43	fh_7. Do you store food that has been prepared for your child to give it to the child later?
44	Yes
45	No
46	fh_7a. How do you store food that has been prepared for your child?
47	Thermos
48	Jug
49	
50	Plate or bowl (covered)
51	Plate or bowl (uncovered)
52	
53	Cooking pot (covered)
54	Cooking pot (uncovered)
55	
56	Other container (covered)
57	Other container (uncovered)
58	Other, specify
59	
60	<i>fh_7a_96x. Other, specify</i>

1	
2	
3	
4	fh_7b. Where do you store this food?
5	In a fridge
6	In a freezer
7	In a cool room (below 5 degrees Celsius)
8	In a room at room temperature
9	Other, specify
10	
11	<i>fh_7b_96x. Other, specify</i>
12	
13	How long do you store this food?
14	less than 1 hour
15	1-2 hours
16	2 hours to 5 hours
17	5 hours to 12 hours
18	12 hours
19	1-3 days
20	3-7 days
21	Longer than a week
22	
23	Animals
24	
25	fh_8. Does your household keep any animals inside or outside the house you are looking after (i.e. not taken care of by others)?
26	
27	Yes
28	No
29	
30	fh_9. What type of animals?
31	Chickens
32	Ducks
33	Other birds
34	Dogs
35	Cats
36	Goats
37	Sheep
38	Pigs
39	Cows
40	Fish
41	Other animals, specify
42	
43	<i>fh_9_96x. Other: specify</i>
44	
45	fh_10. Which of these animals are in the patio, veranda or house any time of the day?
46	None
47	Chickens
48	Ducks
49	Other birds
50	Dogs
51	Cats
52	Goats
53	Sheeps
54	Pigs
55	Cows
56	
57	
58	
59	
60	

1	
2	
3	Other animals, specify
4	
5	<i>fh_10_96x. Other: specify</i>
6	fh_10a. Is the animal contained in some form of enclosure?
7	Yes
8	No
9	
10	fh_10b. Can the child be in contact with the animals or their faeces?
11	Yes
12	No
13	
14	fh_10c. Can the animal be in contact with food for the child?
15	Yes
16	No
17	
18	ASF1_1. What is the first priority ASF consumed by the child most recently? Select [ASF1]
19	Chicken
20	fish
21	beef
22	egg
23	squid
24	meat ball
25	beef soup
26	chicken soup
27	duck egg
28	fish egg
29	None
30	
31	
32	
33	ASF1_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
34	No packaging
35	Sealed package
36	Washable container (plastic, glass, steel), open
37	Washable container (plastic, glass, steel), closed
38	Plastic bag
39	Newspaper
40	Other paper
41	Aluminium foil
42	Other foil
43	Container made from natural materials
44	Other, specify
45	
46	<i>ASF1_2_96x. ASF_2_96x Other: specify</i>
47	
48	ASF1_3. Did you transport this [ASF] after you got it?
49	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a trader or neighbour, etc)
50	Yes
51	No
52	
53	ASF1_3a. How long did you transport the ASF for (to take it home)?
54	less than 5 minutes
55	5 min to 15 min
56	15 to 30 min
57	
58	
59	
60	

1	
2	
3	30 min to 1 hour
4	1hour to 2 hours
5	2 hours to 3 hours
6	3 hours
7	
8	ASF1_3b. How did you transport this [ASF] after you got it?
9	Chilled (e.g. on ice)
10	At ambient temperature
11	Kept warm (e.g. thermos or thermal food container)
12	Other, specify
13	<i>ASF1_3b_96x. Other, specify</i>
14	
15	ASF1_4. Did you store this [ASF] before preparation?
16	Yes
17	No
18	
19	ASF1_4a. Was this [ASF] covered when you stored it before preparation?
20	Yes
21	No
22	
23	ASF1_4b. Where did you store this [ASF] before preparation?
24	In a fridge
25	In a freezer
26	In a cool room (below 5 degrees Celsius)
27	In a room at room temperature
28	Other, specify
29	<i>ASF1_4b_96x. Specify, other</i>
30	
31	ASF1_4c. How long was this [ASF] stored before preparing?
32	minute
33	hour
34	day
35	total minutes
36	total hours
37	total day
38	
39	ASF1_5. Did you wash this [ASF] before preparation?
40	Yes
41	No
42	Not applicable
43	
44	ASF1_6. If yes, why did you wash this [ASF]? (multiple answers)
45	To remove visible dirt
46	To remove visible blood
47	To make it safer
48	Because it is a good practice
49	Other, specify
50	<i>ASF1_6_96x. Specify, other</i>
51	
52	ASF1_7. Did you chop or cut this [ASF] product before preparation?
53	Yes
54	No
55	
56	
57	
58	
59	
60	

1	
2	
3	Not applicable
4	ASF1_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
5	
6	Cutting board
7	Plate
8	Knife
9	Other, specify
10	
11	<i>ASF1_8_96x. Specify, other</i>
12	ASF1_9. How did you prepare this food for the child?
13	
14	Grilling
15	Baking
16	Frying
17	Boiling
18	Stewing
19	Simmering
20	Fermenting
21	Heating
22	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
23	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
24	Other, specify
25	
26	<i>ASF1_9_96x. Specify, other</i>
27	ASF1_10. For how long was this [ASF] cooked?
28	
29	1-5 min
30	5-15 min
31	15-30 min
32	30-60 min
33	More than 1 hour
34	ASF1_11. After preparation, was this [ASF] stored before giving it to the child?
35	
36	Yes
37	No
38	ASF1_12. After preparation, how long was this [ASF] stored before giving it to the child?
39	
40	1-5 min
41	5-15 min
42	15-30 min
43	30-60 min
44	More than 1 hour, less than 24h
45	More than 1 day, less than 2 days
46	More than 2 days
47	ASF1_13. How did you store this [ASF] that had been prepared for your child?
48	
49	Thermos
50	Jug
51	Plate or bowl (covered)
52	Plate or bowl (uncovered)
53	Cooking pot (covered)
54	
55	
56	
57	
58	
59	
60	

1	
2	
3	
4	Cooking pot (uncovered)
5	Other container (covered)
6	Other container (uncovered)
7	Other, specify
8	
9	<i>ASF1_13_96x. Specify, other</i>
10	ASF1_14. Where did you store this [ASF]?
11	In a fridge
12	In a freezer
13	In a cool room (below 5 degrees Celsius)
14	In a room at room temperature
15	Other, specify
16	
17	<i>ASF1_14_96x. Specify other</i>
18	
19	ASF2_1. What is the second priority ASF consumed by the child most recently? Select [ASF1]
20	Chicken
21	fish
22	beef
23	egg
24	squid
25	meat ball
26	beef soup
27	chicken soup
28	duck egg
29	fish egg
30	None
31	
32	ASF2_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
33	No packaging
34	Sealed package
35	Washable container (plastic, glass, steel), open
36	Washable container (plastic, glass, steel), closed
37	Plastic bag
38	Newspaper
39	Other paper
40	Aluminium foil
41	Other foil
42	Container made from natural materials
43	Other, specify
44	
45	<i>ASF_2_96x Other: specify</i>
46	
47	ASF2_3. Did you transport this [ASF] after you got it?
48	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a trader or neighbour, etc)
49	Yes
50	No
51	
52	ASF2_3a. How long did you transport the ASF for (to take it home)?
53	less than 5 minutes
54	5 min to 15 min
55	
56	
57	
58	
59	
60	

1	
2	
3	15 to 30 min
4	30 min to 1 hour
5	1hour to 2 hours
6	2 hours to 3 hours
7	3 hours
8	
9	
10	ASF2_3b. How did you transport this [ASF] after you got it?
11	Chilled (e.g. on ice)
12	At ambient temperature
13	Kept warm (e.g. thermos or thermal food container)
14	Other, specify
15	<i>ASF2_3b_96x. Other specify</i>
16	
17	ASF2_4. Did you store this [ASF] before preparation?
18	Yes
19	No
20	
21	ASF2_4a. Was this [ASF] covered when you stored it before preparation?
22	Yes
23	No
24	
25	ASF2_4b. Where did you store this [ASF] before preparation?
26	In a fridge
27	In a freezer
28	In a cool room (below 5 degrees Celsius)
29	In a room at room temperature
30	Other, specify
31	<i>ASF2_4b_96x. Specify, other</i>
32	
33	ASF2_4c. How long was this [ASF] stored before preparing?
34	minute
35	hour
36	day
37	total minutes
38	total hours
39	total day
40	
41	ASF2_5. Did you wash this [ASF] before preparation?
42	Yes
43	No
44	Not applicable
45	
46	ASF2_6. If yes, why did you wash this [ASF]? (multiple answers)
47	To remove visible dirt
48	To remove visible blood
49	To make it safer
50	Because it is a good practice
51	Other, specify
52	<i>ASF2_6_96x. Specify, other</i>
53	
54	ASF2_7. Did you chop or cut this [ASF] product before preparation?
55	Yes
56	
57	
58	
59	
60	

1	No
2	Not applicable
3	ASF2_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
4	Cutting board
5	Plate
6	Knife
7	Other, specify
8	<i>ASF2_8_96x. Specify, other</i>
9	ASF2_9. How did you prepare this food for the child?
10	Grilling
11	Baking
12	Frying
13	Boiling
14	Stewing
15	Simmering
16	Fermenting
17	Heating
18	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
19	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
20	Other, specify
21	<i>ASF2_9_96x. Specify, other</i>
22	ASF2_10. For how long was this [ASF] cooked?
23	1-5 min
24	5-15 min
25	15-30 min
26	30-60 min
27	More than 1 hour
28	ASF2_11. After preparation, was this [ASF] stored before giving it to the child?
29	Yes
30	No
31	ASF2_12. After preparation, how long was this [ASF] stored before giving it to the child?
32	1-5 min
33	5-15 min
34	15-30 min
35	30-60 min
36	More than 1 hour, less than 24h
37	More than 1 day, less than 2 days
38	More than 2 days
39	ASF2_13. How did you store this [ASF] that had been prepared for your child?
40	Thermos
41	Jug
42	Plate or bowl (covered)
43	Plate or bowl (uncovered)
44	
45	
46	
47	
48	
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1	
2	
3	Cooking pot (covered)
4	Cooking pot (uncovered)
5	Other container (covered)
6	Other container (uncovered)
7	Other, specify
8	<i>ASF2_13_96x. Specify, other</i>
9	
10	ASF2_14. Where did you store this [ASF]?
11	In a fridge
12	In a freezer
13	In a cool room (below 5 degrees Celsius)
14	In a room at room temperature
15	Other, specify
16	<i>ASF2_14_96x. Specify, other</i>
17	
18	ASF3_1. What is the third priority ASF consumed by the child most recently? Select [ASF1]
19	Chicken
20	fish
21	beef
22	egg
23	squid
24	meat ball
25	beef soup
26	chicken soup
27	duck egg
28	fish egg
29	None
30	ASF3_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
31	No packaging
32	Sealed package
33	Washable container (plastic, glass, steel), open
34	Washable container (plastic, glass, steel), closed
35	Plastic bag
36	Newspaper
37	Other paper
38	Aluminium foil
39	Other foil
40	Container made from natural materials
41	Other, specify
42	<i>ASF_2_96x Other: specify</i>
43	
44	ASF3_3. Did you transport this [ASF] after you got it?
45	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a trader or neighbour, etc)
46	Yes
47	No
48	ASF3_3a. How long did you transport the ASF for (to take it home)?
49	less than 5 minutes
50	
51	
52	
53	
54	
55	
56	
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1	
2	
3	5 min to 15 min
4	15 to 30 min
5	30 min to 1 hour
6	1hour to 2 hours
7	2 hours to 3 hours
8	3 hours
9	
10	
11	ASF3_3b. How did you transport this [ASF] after you got it?
12	Chilled (e.g. on ice)
13	At ambient temperature
14	Kept warm (e.g. thermos or thermal food container)
15	Other, specify
16	<i>ASF3_3b_96x. Other, specify</i>
17	
18	
19	ASF3_4. Did you store this [ASF] before preparation?
20	Yes
21	No
22	
23	ASF3_4a. Was this [ASF] covered when you stored it before preparation?
24	Yes
25	No
26	
27	ASF3_4b. Where did you store this [ASF] before preparation?
28	In a fridge
29	In a freezer
30	In a cool room (below 5 degrees Celsius)
31	In a room at room temperature
32	Other, specify
33	<i>ASF3_4b_96x. Specify, other</i>
34	
35	
36	ASF3_4c. How long was this [ASF] stored before preparing?
37	minutes
38	hour
39	day
40	total minutes
41	total hours
42	total day
43	
44	ASF3_5. Did you wash this [ASF] before preparation?
45	Yes
46	No
47	Not applicable
48	
49	ASF3_6. If yes, why did you wash this [ASF]? (multiple answers)
50	To remove visible dirt
51	To remove visible blood
52	To make it safer
53	Because it is a good practice
54	Other, specify
55	<i>ASF3_6_96x. Specify, other</i>
56	
57	
58	ASF3_7. Did you chop or cut this [ASF] product before preparation?
59	
60	

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2	
3	Yes
4	No
5	Not applicable
6	
7	ASF3_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
8	Cutting board
9	Plate
10	Knife
11	Other, specify
12	<i>ASF3_8_96x. Specify, other</i>
13	
14	ASF3_9. How did you prepare this food for the child?
15	Grilling
16	Baking
17	Frying
18	Boiling
19	Stewing
20	Simmering
21	Fermenting
22	Heating
23	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
24	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
25	Other, specify
26	<i>ASF3_9_96x. Specify, other</i>
27	
28	ASF3_10. For how long was this [ASF] cooked?
29	1-5 min
30	5-15 min
31	15-30 min
32	30-60 min
33	More than 1 hour
34	
35	ASF3_11. After preparation, was this [ASF] stored before giving it to the child?
36	Yes
37	No
38	
39	ASF3_12. After preparation, how long was this [ASF] stored before giving it to the child?
40	1-5 min
41	5-15 min
42	15-30 min
43	30-60 min
44	More than 1 hour, less than 24h
45	More than 1 day, less than 2 days
46	More than 2 days
47	
48	ASF3_13. How did you store this [ASF] that had been prepared for your child?
49	Thermos
50	Jug
51	Plate or bowl (covered)
52	
53	
54	
55	
56	
57	
58	
59	
60	

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3	
4	Plate or bowl (uncovered)
5	Cooking pot (covered)
6	Cooking pot (uncovered)
7	Other container (covered)
8	Other container (uncovered)
9	Other, specify
10	
11	<i>ASF3_13_96x. Specify, other</i>
12	
13	ASF3_14. Where did you store this [ASF]?
14	In a fridge
15	In a freezer
16	In a cool room (below 5 degrees Celsius)
17	In a room at room temperature
18	Other, specify
19	
20	<i>ASF3_14_96x. Other, specify</i>
21	
22	
23	
24	
25	
26	
27	
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APPENDIX 2: WASH AND FOOD SAFETY SPOT CHECK

WATER SANITATION (SPOT CHECK) *(3 TIMES AT 2ND TRIMESTER, 3 & 9MO)*
wash_1. What type of facility is the primary location for defecation?
Flush toilet to piped sewer system
Flush toilet to septic tank
Flush toilet to pit
Flush toilet to onsite, above ground, open pit
Pour flush toilet to piped sewer system
Pour flush toilet to septic tank
Pour flush toilet to pit
Pour flush toilet to onsite, above ground, open pit
Pit latrine with concrete slab (not pour flush)
Pit latrine without slab (not pour flush)
Bucket
Bag
Open defecation (no facilities)
Other:
Refused observation
<i>wash_1_96x. Specify, other</i>
wash_2. Approximately how many meters is the toilet from the entrance of the household
wash_3. For the following, please note if following indicators of functionality are present
wash_3_1. Is the pan working (not broken)
yes
no
wash_3_2. Are there leaves or rubbish blocking the pan?
yes
no
wash_3_3. Is there standing water in the pan?
yes
no
wash_3_4. Is there a cover over the pit?
yes
no
wash_3_5. Are there one or two pits?
One
Two
More
wash_3_6. Is there a cover on all the pits?
No
Partial (only to one pit)
Yes, to more than one pit
wash_3_7. Are there flies?
None

1	Some
2	
3	Many
4	
5	
6	wash_4. Can you please show me where members of this household most often wash their hands?
7	Fixed facility (sink/basin)... in dwelling
8	Fixed facility...in yard
9	Mobile object (bucket / jug)
10	No handwashing place in dwelling
11	Refused observation
12	
13	
14	wash_5. Is there water available at this location?
15	Yes
16	No
17	
18	wash_6. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
19	Yes
20	No
21	
22	wash_7. Is the dedicated location located near (within 5 steps) the primary cooking location?
23	Yes
24	No
25	
26	wash_8. Is the dedicated location located near (within 5 steps) the latrine/toilet
27	Yes
28	No
29	
30	wash_9. Are there animals located in or around the household? (select all)
31	No animals visible
32	In the cooking area (outside house)
33	In the cooking area (inside house)
34	In the food storing area (outside house)
35	In the food storing area (inside house)
36	In other areas of the house that are not cooking or food storing areas
37	
38	
39	wash_10. What type of animals (select all)
40	Chickens
41	Ducks
42	Other birds
43	Dog
44	Cat
45	Goat
46	Sheep
47	Pig
48	Cow
49	Wild animals
50	Rodents
51	Other animal
52	<i>wash_10_96x. Other, specify</i>
53	
54	wash_11. Are there animal feces located in or around the household? (select all)
55	No animal feces visible
56	In the cooking area (outside house)
57	
58	
59	
60	

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2	
3	In the cooking area (inside house)
4	In the food storing area (outside house)
5	In the food storing area (inside house)
6	In other areas of the house that are not cooking or food storing areas
7	
8	In the yard / courtyard
9	
10	
11	# FOOD SAFETY QUESTIONNAIRE *(1 TIME: AT 6 MO)*
12	HAND WASHING
13	spot_1. Can you please show me where members of this household most often wash their hands after using the toilets?
14	
15	Fixed facility (sink/basin)... in dwelling
16	Fixed facility....in yard
17	Mobile object (bucket / jug)
18	No handwashing place in dwelling
19	Refused observation
20	spot_2. Is there water available at this location?
21	Yes
22	No
23	spot_3. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
24	Yes
25	No
26	spot_4. Is the dedicated location located near (within 5 steps) the primary cooking location?
27	Yes
28	No
29	spot_5. Is the dedicated location located near (within 5 steps) the latrine/toilet
30	Yes
31	No
32	spot_6. Can you show me where members of this household most often wash their hands before eating or preparing food?
33	
34	Fixed facility (sink/basin)... in dwelling
35	Fixed facility....in yard
36	Mobile object (bucket / jug)
37	No handwashing place in dwelling
38	Refused observation
39	Same as after toilet
40	spot_7. Is there water available at this location?
41	Yes
42	No
43	spot_8. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
44	Yes
45	No
46	spot_9. Is the dedicated location located near (within 5 steps) the primary cooking location?
47	Yes
48	
49	
50	
51	
52	
53	
54	
55	
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1	No
2	
3	
4	spot_10. Is the dedicated location located near (within 5 steps) the latrine/toilet
5	Yes
6	No
7	
8	spot_11. Do you see animals in or around the household? (select all)
9	No animals visible
10	In the cooking area (outside house)
11	In the cooking area (inside house)
12	In the food storing area (outside house)
13	In the food storing area (inside house)
14	In other areas of the house that are not cooking or food storing areas
15	
16	spot_12. What type of animals (select all)
17	Chickens
18	Ducks
19	Other birds
20	Dog
21	Cat
22	Goat
23	Sheep
24	Pig
25	Cow
26	Wild animals
27	Rodents
28	Other animal
29	<i>spot_12_96x. Specify other</i>
30	spot_13. Is it possible for the child to be in contact with these animals (e.g. if they are unrestrained or the child can access an enclosure)?
31	Yes
32	No
33	
34	spot_14. Is it possible for these animals to be in contact with food (e.g. if animals are unrestrained)
35	Yes
36	No
37	
38	spot_15. Are there visible animal feces located in or around the household? (select all)
39	No animal feces visible
40	In the cooking area (outside house)
41	In the cooking are (inside house)
42	In the food storing area (outside house)
43	In the food storing area (inside house)
44	In other areas of the house that are not cooking or food storing areas
45	In the yard / courtyard
46	In the animal enclosure (e.g. chicken coop)
47	spot_16. Is it possible for the child to be in contact with these faeces (e.g. because they are in areas where the child is or the child can access an enclosure)?
48	Yes
49	No
50	
51	
52	
53	
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4	spot_17. Is it possible that food gets in contact with these faeces?
5	Yes
6	No
7	safe_1. Is there a functioning refrigerator?
8	Yes
9	No
10	
11	safe_2. Is there a functioning freezer?
12	Yes
13	No
14	
15	safe_3. Is there any visible, stored [ASF] not protected from the environment?
16	Yes
17	No
18	
19	safe_4. Is it [ASF] in contact with other food products?
20	Yes
21	No
22	
23	safe_5. Is the area where this [ASF] is kept protected from animals and flies?
24	Yes
25	No
26	
27	safe_6. Is there a kitchen area (a dedicated food preparation area)?
28	Yes
29	No
30	
31	safe_6a. Is the kitchen area free from pest animals (i.e. birds, flies, rats)
32	Yes
33	No
34	
35	safe_6b. Are there anti-pest measures in place in the kitchen area? e.g. nets, traps, insect killers
36	Yes
37	No
38	
39	safe_6c. Is the kitchen area free of visible dirt?
40	Yes
41	No
42	
43	safe_6d. Are cooking utensils clean?
44	Yes
45	No
46	
47	safe_6e. Is the kitchen area easy to clean (e.g. tiles)?
48	Yes
49	No
50	
51	safe_6f. Does the kitchen area have access to running water?
52	Yes
53	No
54	safe_6g. If there is no access to running water, is there stored water in the area where food is being prepared?
55	Yes, there is water in a container with a lid/top on it
56	Yes, there is water in an open container
57	No, there is no water
58	
59	
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3	safe_6h. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
4	Yes
5	No
6	
7	safe_7. Is there a food storage area?
8	Yes
9	No
10	
11	safe_7a. In the food storage area, is the storage equipment made of material that is easy to clean (e.g. metal, plastic)?
12	Yes
13	No
14	
15	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
16	Yes
17	No
18	
19	safe_7c. Are there anti-pest measures in place in the food storage area? e.g. nets, traps, insect killers
20	Yes
21	No
22	
23	safe_7d. Is the food storage area free of visible dirt?
24	Yes
25	No
26	
27	safe_7e. Is the food storage area easy to clean (e.g. tiles)?
28	Yes
29	No
30	
31	safe_8. Is there a facility to dispose of food waste?
32	No
33	In the cooking area (outside house)
34	In the cooking area (inside house)
35	In the food storing area (outside house)
36	In the food storing area (inside house)
37	Outside the house remove from cooking or food storing areas
38	Removed from the household
39	
40	safe_9. Are the knife and chopping board used to cut vegetables and fruits are clean?
41	Yes
42	No
43	
44	safe_10. Are the nails of the food handler trimmed?
45	Yes
46	No
47	
48	
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GCRF Action against stunting Hub

Household ID:	Mother ID:	Child ID:
Enumerator ID:	Supervisor ID:	
District:	Sub-county:	
Parish:	Village:	
Salter calibration ID:	Salter calibration weight:	
Date of record:	Day of the week <u>today</u> :	
Time ARRIVED: (24-hr)	Monday <input type="checkbox"/>	Friday <input type="checkbox"/>
Time DEPARTED: (24-hr)	Tuesday <input type="checkbox"/>	Saturday <input type="checkbox"/>
	Wednesday <input type="checkbox"/>	Sunday <input type="checkbox"/>
	Thursday <input type="checkbox"/>	
<i>Complete at the end of the day</i>		
<p>Describe the location of the observations: Where in the home the observation was completed – where the observer sat, what the conditions were when you did the observation (weather, lighting, heat) how busy the home was, etc.</p>		
<p>Describe who the main caretaker of the child was:</p> <p>Mother <input type="checkbox"/></p> <p>Sibling <input type="checkbox"/></p> <p>Grandmother <input type="checkbox"/></p> <p>Aunt <input type="checkbox"/></p> <p>Caretaker <input type="checkbox"/></p> <p>Other, specify <input type="checkbox"/> _____</p>		
<p>Please note if caretaker changes during observation: Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>Mother <input type="checkbox"/></p> <p>Sibling <input type="checkbox"/></p> <p>Grandmother <input type="checkbox"/></p> <p>Aunt <input type="checkbox"/></p> <p>Caretaker <input type="checkbox"/></p> <p>Other, specify <input type="checkbox"/> _____</p>		

Direct observation

Household ID: _____

	Yes (tick)	Date: dd/mm/yy
Checked by supervisor: (code)		
Checked by co-ordinator: (code)		
Data entry completed: (code)		

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
1. Child Activities																	
1.1 Sleeping																	
1.2 Caretaker change																	
1.3 Child being cared for by other children																	
2. Child feces																	
2.1 Child nappy or diaper is changed																	
2.2 Child defecates on floor																	
2.3 Child defecates in potty																	
2.4 Child feces disposed in toilet																	
2.5 Child feces disposed in bush / ditch																	
3. Food preparation																	
3.1 Fruit or vegetable washed																	
3.2 Food preparation surface rinsed (specify surface type)																	
3.3 Food preparation surface washed (specify surface type)																	
3.4 Utensils rinsed																	
3.5 Utensils washed																	
3.6 Plates / bowls/ cups rinsed																	
3.7 Plates / bowls/cups washed																	
3.8 Child bottle rinsed																	
3.9 Child bottle cleaned																	
4. Food cooking																	
	Specify from section 3																

Direct observation

Household ID: _____

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
	Specify type in comments																
4.1 Food fried (ASF / Fruit Veg / Other)																	
4.2 Food dried (ASF / Fruit Veg / other)																	
4.3 Food roasted (ASF / Fruit Veg / other)																	
4.4 Food heated in pot, no boiled (ASF/ Fruit Veg / other)																	
4.5 Food boiled (ASF / Fruit Veg/ other)																	
4.6 Food steamed (ASF / Fruit Veg / Other)																	
4.7 Food arrives processed (ASF / Fruit Veg / Other)																	
4.8 Food added raw / uncooked to dish (ASF / Fruit Veg / Other)																	
5. Food handling	Specify from section 4																
5.1 Cooked food served immediately to child																	
5.2 Cooked food left at room temp / open																	
5.3 Cooked food placed in cabinet / cupboard																	
5.4 Cooked food placed in fridge																	
5.5 Cooked food covered (loosely)																	
5.6 Cooked food covered (sealed)																	
6. Child feeding	Specify from section 4																
6.1 Child breastfed																	
6.2 Child given food that was stored																	
6.3 Child given milk																	
6.4 Child given water																	
6.5 Flies on food given to child																	
6.6 Child fed by caregivers hand																	
6.6 Child eating using child's hand																	
6.7 Child fed/eating using utensils (e.g. spoon)																	
7. Floor contact	Specify from section 4																
7.1 Child hand contact with floor																	
7.2 Child hand contact with dirt																	

Direct observation

Household ID: _____

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
7.3 Child eats dirt / soil																	
7.4 Child places objects from the floor in their mouths																	
7.5 Child places hands that have been in contact with the floor in mouth																	
8. Animal contact																	Write down the animal (chickens, ducks, other birds, goats, sheep, pigs, cow, dog, cat, other/specify)
8.1 Caretaker hand contact with animals																	
8.2 Caretaker hand contact with animal feces																	
8.3 Child hand contact with animals																	
8.4 Child hand contact with animal feces																	
9. Toilet use																	
9.1 Primary caretaker uses toilet																	
9.2 Primary caretaker goes for open defecation																	
10. Domestic cleaning																	
10.1 Caretakers washes clothes																	
10.2 Caretaker / other household member sweeps																	
10.3 Caretaker / other household members cleans floors (with disinfectant / soap)																	
10.3 Caretakers handles garbage																	
11. Handwashing / Facewashing																	
11.1 Caretaker rinses hands – water only																	
11.2 Caretaker washes hands – soap used																	
11.3 Child's hands rinsed – water only																	
11.4 Child's hands washed – soap used																	
11.5 Child's face wiped or rinses																	
11.6 Child's face cleaned																	
11.7 Caretaker bathes																	
11.8 Child bathed																	

Direct observation

Household ID: _____

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Confidential: For Review Only

Direct observation

Household ID: _____

Data log Table. Food Sample

HH ID: _____

Timepoint: 9 month/ 12 month/ 18 month

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Collection period: During feeding ☑	Directly after feeding ☑	Before feeding ☑
Food:		
Total sample weight		
Ingredients:		
Preparation method:		
Notes:		

Direct observation

Household ID: _____

Data log Table. Water Sample

HH ID: _____

Timepoint: 9 month/ 12 month/ 18 month

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Has the water been treated with chlorine/aquatabs or is from the municipal system?

Yes (collect water in a small 100 mL whirlpak bag with sodium thiosulfate tablets + collect further water in a 50mL centrifuge tube)No (collect water in a large 250 mL whirlpak bag)

Notes:

Direct observation

Household ID: _____

Data log Table. Surface Sample

Timepoint: 9 month/ 12 month/ 18 month

HH ID: _____

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Where is the child's food prepared [the surface where foods and utensils are placed during preparation and/or where foods cut up or otherwise processed in any way]?

Notes:

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BMJ Paediatrics Open

Understanding the role of household hygiene practices and foodborne disease risks in child stunting: a UKRI GCRF Action Against Stunting Hub protocol paper

Journal:	<i>BMJ Paediatrics Open</i>
Manuscript ID	bmjpo-2022-001695.R2
Article Type:	Protocol
Date Submitted by the Author:	17-Feb-2023
Complete List of Authors:	Dominguez-Salas, Paula; University of Greenwich; International Livestock Research Institute (ILRI) Waddington, Hugh Sharma; London School of Hygiene and Tropical Medicine, Department of Disease Control Grace, Delia; University of Greenwich; International Livestock Research Institute (ILRI) Bosire, Caroline; International Livestock Research Institute (ILRI) Moodley, Arshnee; International Livestock Research Institute (ILRI) Kulkarni, Bharati; National Institute of Nutrition Dasi, Teena; National Institute of Nutrition B, Santosh Kumar; National Institute of Nutrition, Clinical Division Kumar, Ramachandrapa Naveen; National Institute of Nutrition Fahmida, Umi; Southeast Asian Ministry of Education Organisation Regional Centre for Food and Nutrition (SEAMEO RECFON) Htet, Min Kyaw; Southeast Asian Ministry of Education Organisation Regional Centre for Food and Nutrition (SEAMEO RECFON) Sudibya, Arienta R.P.; Southeast Asian Ministry of Education Organisation Regional Centre for Food and Nutrition (SEAMEO RECFON) Faye, Babacar; Université Cheikh Anta Diop (UCAD) Tine, Roger ; University of Cheikh Anta DIOP, Department of Parasitology-Mycology Heffernan, Claire; University of London, Department of Pathobiology and Population Sciences; London International Development Centre Saxena, Deepak ; Public Health Foundation of India Dreibelbis, Robert; London School of Hygiene and Tropical Medicine, Department of Disease Control Häsler, Barbara N; Royal Veterinary College (RVC), Department of Pathobiology and Population Sciences
Keywords:	Epidemiology, Microbiology, Data Collection, Growth

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4 **Understanding the role of household hygiene practices and foodborne disease risks in child stunting:**
5 **a UKRI GCRF Action Against Stunting Hub protocol paper**
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49 Keywords: food safety, hygiene, water, sanitation, child stunting, protocol
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ABSTRACT

Introduction: Environmental hygiene and food safety are important determinants of child stunting. This research aims to explore the relationship between child stunting and household hygiene practices and behaviours, including the availability of water, sanitation and hygiene (WASH) facilities; the use of safe food and good quality drinking water (especially when used for complementary feeding); hygienic practices in food transport, storage and preparation; and the control of cross-contamination from animals, their produce and waste.

Methods and analysis: This study is part of a wider observational study which aims to investigate the interdisciplinary factors contributing to child stunting using a 'whole child' paradigm. The observational study recruits women during pregnancy in Hyderabad, India, Lombok, Indonesia and Kaffrine, Senegal, and dyads (i.e., 500 mother-infant pairs per country) are followed longitudinally up to 24 months after birth. Within the interdisciplinary niche, the study herein has developed tools to investigate the potential exposure pathways to environmental pathogen contamination of foods and water. Holistic WASH and food safety data collection tools have been developed to explore exposure pathways at the household-level, including: i) survey questionnaires; ii) spot-checks; iii) biological sampling of drinking water, food and domestic surfaces; and iv) direct observation. An integrated analytical approach will be used to triangulate the evidence in order to examine the relationships between child stunting, WASH and food safety behaviours.

Ethics and dissemination: Ethical approval of the study was granted by the ethics committee of the LSHTM, RVC, ILRI, ICMR, IIPHG, SEAMEO-RECFON, University of Cheikh Anta Diop. Findings of the study will be disseminated through publication in peer-reviewed journals, relevant international conferences, public engagement events, and policy-maker and stakeholder events.

SUMMARY BOX

- **What is already known on this topic**
 - From the moment complementary feeding begins, the chances of exposure to food contamination and infectious disease increase exponentially
 - Adequate WASH and food safety practices can play a key role in reducing infectious disease transmission and child malnutrition.
 - The contribution of hygiene behaviours and food contamination in driving transmission of infections and childhood stunting requires further investigation.
- **What this study adds**
 - Development, application and analysis of integrated WASH and food safety tools, towards a holistic understanding of how these practices and behaviours impact child stunting
 - Evidence towards a new typology of child stunting, with a focus on exposure pathways for pathogens, and to support programmes and policies to minimise stunting in childhood.
- **How this study might affect research, practice or policy**
 - Understanding of the role of home hygiene and food safety related practices in childhood stunting with a view to identify solutions.
 - New and more integrated approaches in research and practice that bring together WASH and food safety considerations at the household level to investigate exposure to pathogens.
 - Evidence on complementarities between food hygiene and WASH in order to help design suitable interventions to combat stunting.

INTRODUCTION

The incidence and severity of stunting in childhood is closely linked to exposure to infection from food, drinking water and the wider environment.[1] Infections associated with contaminated water or insufficient water, sanitation and hygiene (WASH) are responsible for an estimated 21% of the total global burden of diseases,[2] contributing to the outbreak and chronicity of preventable infections such as diarrhoeal diseases and ARI (Acute Respiratory Infections), which are the two leading causes of death in children globally.[3] However, three recent randomised controlled trials (RCTs) have assessed the impacts of WASH combination interventions on nutrition in Bangladesh,[4] Kenya[5] and Zimbabwe.[6] The studies were not able to detect any effects on child linear growth, and only in Bangladesh was diarrhoea reduced.[7] Cumming, et al. have challenged the efficacy of the WASH interventions in addressing common causes of faeco-oral disease in low-income contexts, such as cryptosporidium.[8] More generally, the interventions did not increase the quantity of water supply available to practice domestic hygiene.

In addition, the World Health Organization (WHO) Foodborne Disease Burden Epidemiology Reference Group (FERG), estimated that approximately 40% of the global burden of foodborne diseases occurs in children under the age of five years.[9] A common cause of foodborne infections is the consumption of raw or undercooked meat, fish, seafood, eggs, fresh produce and dairy products contaminated by norovirus, *Campylobacter*, non-typhoidal *Salmonella* or pathogenic *E. coli*. [9] Food hygiene is a primary concern in the preparation of complementary foods - for example, bottles often cannot be adequately sterilised and perishable complementary foods are often left unrefrigerated or eaten using unclean utensils or with unwashed hands.

Disease transmission from faeces can be food- or water-borne (i.e., oral ingestion of contaminated food and water), water-washed or water-scarce (i.e., spread through inadequate hand and food hygiene) and water-based (i.e., transmitted by parasites that penetrate skin in water, such as schistosomiasis, or by walking barefoot on contaminated soil in the case of hookworm).[10] For example, theory and evidence suggests that pathogens in foods are a main driver of infant faecal-oral disease.[11] Field studies have demonstrated high bacterial contamination from *E. Coli* or *Salmonella* in weaning foods.[12, 13] Of particular importance for the cleanliness of infant complementary foods are the quality of water, surfaces and utensils used to prepare and eat them[14-16] as well as the quality of the food ingredients procured.

Hence, the availability of WASH and food storage and preparation facilities is likely to determine exposure to infection. Nonetheless, pathogen exposure can also arise when available facilities are used inadequately. For example, cultural norms and beliefs can restrict domestic food and hygiene practices – e.g., whether mothers are the principal decisionmakers about food preparation and hygiene in the household, or whether women are able to use the same toilet facilities as other household members.[17] However, while contamination of foods during cooking and feeding is common, the behavioural drivers have not been adequately explored. A recent systematic survey of 350 WASH evaluation projects in low and middle income countries (LMICs) found that around 15% of studies examined nutrition outcomes like stunting, and handwashing before food preparation, but only 5% reported on other food hygiene behaviours, such as whether food was stored appropriately and kitchen utensils were washed.[18]

Whilst food safety and WASH are inter-linked, to date little attention has been paid to understanding the relationships and trade-offs between food safety, WASH and child stunting. The safety of livestock and fish derived foods is a particularly neglected area and there has been no systematic integration of these topics in food safety and WASH protocols.[14] The UKRI GCRF Action Against Stunting Hub (AASH) explores child stunting from the Whole Child Approach, that is, considering different aspects of child development, including biology considerations, the home environment, the educational

environment, and the food system, that can contribute to thriving childhood. The aim of this study is to examine WASH and food safety elements, their convergence and contributions to child stunting at the household level. It evaluates WASH and food safety practices across households in three study sites with the objective to provide evidence on potential exposure to pathogens through contaminated environment, drinking water, and complementary food, and associated risk factors.

METHODS AND ANALYSIS

Conceptual Framework

The manner in which WASH and food safety at the household level can potentially lead to changes in infection and dietary intake, thereby affecting child stunting, is illustrated in Figure 1, adapted from the UNICEF's (1990) conceptual framework on the causes of malnutrition.[19] Inadequate WASH practices and food safety can contribute to childhood stunting directly, by exposing infants to infection via complementary foods contaminated during preparation and storage, or through feeding with unclean utensils, including the hands of carers. The safety of foods can also be compromised before arrival at households, throughout the different steps and processes of the food value chain. Those food hazards can be intrinsic to the food produced (e.g., pathogens from animal diseases, heavy metal marine contamination), or extrinsic through processing and handling (e.g., inadequate hygienic practices, aflatoxin contamination during storage).[20] Mechanisms include nutrient loss (e.g., during diarrhoeal episodes), energy used by the immune system (e.g., in combating illnesses), and increased intestinal permeability and reduction in nutrients absorption (e.g., enteropathy).[21]

Figure 1: A conceptual framework showing the linkages of WASH and food safety with stunting at the household level

In theory, access to adequate WASH facilities enables appropriate drinking water, hygiene and food safety practices, contributing to reduction in transmission of food- and water-borne pathogens and improving nutrient uptake, and ultimately child growth and development.[20] Drinking water may be contaminated at the point of supply, or through transport and storage.[15, 16] The availability of clean water is critical for optimal hygiene practices[10], to address contamination by human and animal faeces,[22] and to prepare food hygienically. Sanitation facilities can enable safe faeces disposal, especially those of young children, which can be particularly pathogenic.[23] Faecal contamination can also come from the presence of domestic and wild animals or pests inside the household or in surrounding spaces.[24] It is expected that these sources of infection become more important as a child starts crawling and interacting with their environment. As such, understanding of the determinants of food and hygiene practises in the household is key to improving infant health and nutrition.[25]

Along with direct exposure, there is also an indirect route from water supply and sanitation facilities to childhood malnutrition, which operates through the opportunity costs of resource use. The time carers have to observe, correct, and address unhygienic behaviour, and the scarcity of time in relation to competing activities that need to be done by carers in the home or workplace, may also be detrimental for children's nutritional outcomes.[26] For example, it is typically women and older children, both of whom are more likely than others to be carers of young children, who spend time fetching water, engaging with animal fodder and collecting firewood. This may occur at the expense of adequate childcare and feeding, food preparation, education or rest.[27] When drinking water

needs cannot be met affordably, households may need to purchase less food in order to afford enough water to drink. This kind of trade-off is clearly more prevalent for the poorest households, for whom malnutrition is also likely to be highest.

The WASH and food safety approaches, including their scope, evolution and methods are described in Table 1. Combining both WASH and food safety approaches provides an opportunity for more effective integration and learning of the two disciplines and their contributions to child growth and development. The two should converge when looking at household units with a central focus such as child stunting.

Table 1. Characteristics of Water, Sanitation and Hygiene (WASH) and Food Safety and Veterinary Public Health research

	Water, Sanitation and Hygiene (WASH)	Food Safety and Veterinary Public Health
Scope	To investigate deficiencies in water supply and quality, sanitation and hygiene to improve public health. Also, to evaluate the adequacy of hygiene standard to minimise food-borne diseases risks, and the role of water supply and sanitation access as enabling factors for improving child care, health and nutrition.	To pursue a comprehensive “farm to fork”, “stable to table”, “boat to throat” approach to prevent and minimise risks of food contamination at all stages of the food chain from production to human consumption and waste management.
Sector	Human-centred with a strong anchor in the public health sector.	Focus on animal source foods, zoonoses and their respective risks.
Evolution	Historically, WASH research has focused on water-related disease transmission from human excreta (faecal-oral diseases). This has contributed to understanding the mechanisms of faecal-oral infection through water-borne, water-washed, and water-based routes. Early intervention studies focused on the provision of infrastructure, and information, education and communication (IEC). Current research focuses more on behaviour change communication using bottom-up approaches, and incorporating the “A (Animals)” into WASH more holistically.[24]	Veterinary public health traditionally looked at all food chain stages to identify where risks (e.g., biological, chemical, and physical) can emerge and how to prevent or mitigate them. The initial focus was on microbiological aspects with a strong technical dimension. Veterinary public health now looks at human behaviour more widely, bringing in social science aspects and economics to understand better practices and the motivations behind them. There is a (slow) move towards systems thinking, and a lot of progress in quantitative microbiological and epidemiological studies, detection techniques, etc.

Research methods	<ul style="list-style-type: none"> ▪ Interventions (e.g., randomised controlled trials) ▪ Cross-sectional, questionnaire- based surveys ▪ Longitudinal questionnaire-based surveys ▪ Spot checks ▪ Direct observation ▪ Biological sampling and testing ▪ Risk assessments ▪ Qualitative research on behaviour, practices and perceptions, including participatory approaches
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Study Design

This is a multicountry longitudinal observational study where women are recruited during pregnancy in Senegal, Indonesia and India and mother-infant pairs are followed up to 24 months after birth. Average stunting prevalences in these three countries selected are medium (17.9% in Senegal) to very high (30.8% in Indonesia and 37.4% in India).[28] This protocol involves multiple approaches to assess WASH and food safety practices in urban or rural households of women enrolled in the study, in Hyderabad city, India, East Lombok, Indonesia and Kaffrine, Senegal, at predefined timepoints (see AASH observational cohort description in Heffernan et al in this supplement, including further details on the study setting, sampling process, participant schedule, data collection and quality control, data management, etc).

Data Collection

This WASH and food safety data collection protocol focuses on three areas: exposure pathways to wider environmental pathogens, foodborne hazards, and waterborne hazards. Four data collection tools for the household-level have been developed, namely: i) a module for WASH and food safety to be included to the cohort questionnaire-based interviews (see Appendix 1); ii) spot-checks (see Appendix 2); iii) biological sampling; and iv) direct observation (see Appendix 3). The interviews and spot-checks take place simultaneously during home visits at 9, 12 and 18 months after birth. Data will be collected throughout the different seasons. Direct observation and biological sampling are conducted during a separate subsequent visit at each timepoint, in a subsample of the cohort. No additional inclusion or exclusion criteria were considered in the selection. Food and water samples are kept to a minimum for the analysis required, namely half filling a 50ml Falcon tube with food served to the child, and the measure of the container in which the child is normally given drinking water, respectively.

The food safety component of the data collection focuses on nutrient-rich foods with the potential to alleviate stunting, particularly on animal source foods (ASFs). This is due to their important nutritional profile,[29] their documented potential to alleviate stunting,[30-33] and their high food safety risk profile. Selected ASFs will be considered at each country, according to their relevance.

Trained enumerators collect data using electronic tablets in all study households, as summarised in Table 2. The direct observation tool is recorded on paper and enumerator positioning and previous rapport creation are used as ways to minimise bias. Privacy is maintained by stopping the direct observation on the respondent's request. Data collection tools developed in English are translated into local languages and backtranslated into English to check for accuracy, and piloted in the field.

Table 2. Summary of the integrated study methods and tools used to assess WASH and food safety at the household level

Tool	Description	Sample size
Questionnaire-based interview	<p>Mothers are asked about infant and young child feeding (IYCF) practices, household food expenditure, and the main household decision-makers and influencers of these activities. Physical activity questionnaires ask mothers about the times spent on work and housekeeping including collecting water, fodder and fuel. Furthermore, there are questions on water sources, water security, sanitation and handwashing. Other questions focus on the practices of acquisition, transport, storage, preparation of ASF, and the points of potential contamination in the household. Finally, other questions refer to the presence and behaviour of animals and potential transmission pathways associated with close proximity to animals, such as direct contact between animals and children or food.</p> <p>The hazards and risks prior to arrival of ASFs in the household are elucidated in a separate component, at the value chain level (see Cooper et al in this supplement).</p>	Whole cohort (500 households per country)
Spot-check	Enumerators observe behavioural issues alongside the interview questionnaire. The data are recorded using a check list on the availability and type of sanitation facilities available at the households (e.g., the place for defecation and proximity), handwashing infrastructure (e.g., location, availability of water and soap), presence of animals (e.g., livestock, pests), food storage facilities and practices (e.g., functioning refrigerator), and food preparation (e.g., easy to clean equipment).	Whole cohort (500 households per country)
Direct observation	Enumerators stay at the household for 3 hours around a feeding event, observing the mothers perform their daily activities and taking a passive approach to blend into the background in order to better observe hygiene related behaviours. Structured observation include activities related to water collection and storage, as well as personal, environmental and food hygiene (food preparation, storage, child feeding, handwashing, and animal contact). This data collection method is a gold standard for actual observation of behavioural practices.	Subsample (approximately one-third of full cohort in each country)
Biological sampling and testing	<p>Enumerators collect samples of stored water, foods to be consumed by the children (as close to the feeding of the child as possible), and a swab of the main food preparation area at the households. Samples of hands rinse are optional.</p> <p>The samples are stored in a coolbox and transported to a specialised laboratory for analysis. The samples are processed</p>	Subsample (approximately one-third of full cohort in each country)

	in-country and tested for overall contamination and for selected pathogens (such as Salmonella, Shigella, E.coli, and Campylobacter for food and E.coli/faecal indicators for surfaces and water), using standard laboratory protocols (of conventional culture and PCR). Part of the samples collected are used for lab analysis and the remaining part stored under -20°C for future analysis and crosschecking.	
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ASF: animal source foods; IYCF: Infant and young child feeding; PCR: Polymerase chain reaction

Data Management and Analysis

Data are collected at the households in CommCare and checked for accuracy before being transmitted to a central repository and can be downloaded in Excel for analysis. Samples are analysed at laboratories in each of the countries using tailored Standard Operating Procedures (SOPs).

Descriptive, comparative and regression analyses will be used to investigate the impact of WASH and food safety on child stunting. Factors relating to WASH and food safety amenities and practices will be considered simultaneously as external risks or preventive factors influencing the incidence and severity of stunting, using multivariable statistical approaches. To relate the main exposure variables (WASH and food safety factors) with the main outcome (stunting, measured as either z-scores or presence/absence), multivariable regressions models will be developed. According to our causal framework presented in Figure 1, we will adjust this model for potential confounding factors. Some of these confounding factors will be fairly stable (e.g. sex, maternal literacy, household facilities, socioeconomic status, etc.) and others will be time-varying (e.g. age, breastfeeding, environmental hygiene levels, etc.). We will avoid intermediate factors (e.g., infection rates). Subsequently, we will explore the potential role of the mediators in the causal framework using mediation analysis. Due to the existence of repeated measures conducted over three different timepoints for each child, we will account for this with a random effect term by individual in the regression model. The model will be a linear regression for stunting measured as a continuous variable, and a logistic (or ordered logistic) regression for stunting (moderate and severe) measured as a dichotomous variable. Due to the fact that in our 3 country settings the relevant association might differ, we will estimate the models separately in each country, and afterwards we will conduct individual participant data meta-analysis of the coefficients of interest across the countries. This strategy will allow for an optimal fit of the model in each country and at the same time we will be able to explore the heterogeneity of coefficients across countries and within sub-groups (by age, sex and socioeconomic characteristics).

Data triangulation will also be used, firstly, to address biases in individual data collection tools. For example, known biases occur when measures are reported by participants, particularly by those people for whom illness becomes normalised after repeated bouts of infection.[34] Observation of behaviours, through enumerator presence in the household at certain times of day, can help to mitigate reporting bias. However, surveys and observation may also affect participant motivation, particularly when repeated over long periods. Extensive collection of samples for laboratory testing can be done, but have their own weaknesses.[35] Secondly, data triangulation through statistical modelling will be used to determine the relationship between WASH and food safety in each of the study contexts, and to explore relevant questions such as whether they are complements or substitutes in child health and nutrition. As such, a mix of approaches is being used in this study to address these potential challenges.

Patient and Public Involvement Statement

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3 Study participants have not been involved in the general design of the study. However, the study was
4 designed in partnership with local research partners and stakeholders with experience in working at
5 each of the settings. Local enumerators helped finalise the data collection tools during training and
6 pilot testing.
7

8 Extensive consultations will be organised with the local communities to understand the ethos of the
9 research including the involvement of participants and the implications of the research. Question and
10 answer sessions will be held during the consultations to answer any questions and/or concerns raised.
11 Study participants and the public will be involved in the dissemination of the study's findings through
12 community discussion or engagement events.
13

14 15 16 17 **DISCUSSION** 18

19
20 Poor food safety and inadequate WASH, including getting in direct contact with animals, their produce
21 and/or their faeces, are considered as important contributors to undernutrition. Cumulatively over
22 the first two years of life, these factors can determine linear growth faltering. However, the causes of
23 infant stunting are not exclusive to these factors, and therefore it is critical to cohesively consider the
24 myriad of determinants involved. The UKRI GCRF AASH is using an interdisciplinary approach to
25 investigate this variety of factors causing stunting with the aim to identify solutions for the
26 amelioration of growth and development in early childhood at the 'whole-child' level. Within such an
27 interdisciplinary framework, this study design will generate comprehensive evidence on the
28 contribution of WASH, and food safety at the household level.
29

30
31 Challenges to conducting integrated assessment in WASH and food safety in a multi-country study like
32 this are various, including identifying key ASFs and key hazards in a systematic way, or the analysis of
33 pathways linking hygiene, food and water safety, and sanitation data into the typologies of stunting.
34 For this purpose, we developed holistic data collection tools relevant to each study setting, to measure
35 risk factors for exposure to food- and water-borne disease. Multiple household-level interventions are
36 available in both WASH and food safety but, to date, their effectiveness has not been assessed
37 together, despite the similarity in the exposure mechanisms they are targeting. The effectiveness of
38 relevant interventions and technologies in addressing malnutrition depends on both their biological
39 efficacy, and the degree to which consumers adapt to and use the new approach to their contexts.[8]
40 We propose an approach and suggest data collection tools through which these various underlying
41 and proximate determinants of child growth may be analysed.
42

43
44 The data generated from the study will help pave the way for future interventions to manage factors
45 associated with and aimed at preventing stunting. At the individual level (immediate causes),
46 inadequate practices and knowledge gaps identified will help tailor education and social behaviour
47 change communication interventions. These are aimed at improving intake while reducing disease
48 risks. At the household level (proximate causes) the findings can inform the implementation of more
49 efficient WASH interventions, that ensure healthy environments and better personal hygiene.
50 Ultimately, it can inform advocacy efforts to improve infrastructures and services at the community,
51 regional or even national level (underlying causes).
52

53
54 ASF value chains generally present important potential to improve availability, accessibility,
55 affordability and safety for the most nutritionally vulnerable population groups.[36] This study can
56 provide information on mechanisms through which value chains are linked to stunting. The study also
57 offers information that will help to identify entry points in chains where upgrading may be feasible
58 and agreeable among stakeholders (e.g., consumers, government, and businesses). Based on
59 secondary dietary and nutritional data, a systematic literature review of food safety hazards in ASF
60

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2
3 value chains in each study setting and local experts' feedback, commodities of likely relevance are
4 eggs in all countries, milk in India and Senegal, and fish in Indonesia (see AASH food system protocol
5 description in Cooper et al in this supplement for value chain work).
6

7 All in all, the described data, combined with data from other workstreams related to epigenetics,
8 microbiome, gut health and nutrition, education, etc. also described in this supplement, this work
9 aims to providing with a powerful piece of evidence for improving the child environment with a 'Whole
10 child' approach.
11

12 13 14 15 **ETHICS AND DISSEMINATION**

16
17 Ethical approval for the study was granted by the Institutional ethics committees of the London School
18 of Hygiene and Tropical Medicine (17915/RR/17513), the Social Science Research Ethical Review
19 Board at the Royal Veterinary College (URN SR2020-0198) and the International Livestock Research
20 Institute Institutional Research Ethics Committee (ILRI-IREC2020-33). In-country approvals were also
21 granted: the National Institute of Nutrition (ICMR), Ministry of Health and Family Welfare,
22 Government of India (CR/04/I/2021), the Health Research Ethics Committee, University of Indonesia
23 and Dr Cipto Mangunkusumo Hospital (KET-887/UN2.F1/ETIK/PPM.00.02/2019), and the Comité
24 National d'Ethique pour la Recherche en Santé, Senegal (Protocole SEN19/78). Mothers and relevant
25 family members are explained to all the procedures and processes prior to acceptance, then informed
26 consent is obtained. All data and samples are anonymised with a unique identification number.
27 Withdrawal from the study is allowed at any stage.
28

29 Findings of the study will be disseminated through publication in peer-reviewed journals, presented
30 at relevant international conferences, public engagement events, and policy-maker and stakeholder
31 events. Data generated from the study will be deposited in a publicly available data repository.
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AUTHORS CONTRIBUTIONS

All authors were involved in the study design and the preparation of the study tools and protocols at different stages; BH, HW and PDS drafted the manuscript sections; all other authors critically reviewed the manuscript. PDS and HW share first authorship.

We want to thank Alessia Gasco for producing the conceptual framework, David Prieto-Merino for his advice on statistics, and Kaitlin Conway and Modou Jobarteh for careful editing of the manuscript.

FUNDING STATEMENT

This work was supported by the UKRI-GCRF Action Against Stunting Hub (Project ref. MR/S01313X/1). The views expressed in this manuscript are those of the authors and do not necessarily represent the views of the funders.

COMPETING INTEREST STATEMENT

The authors declare no conflict of interest.

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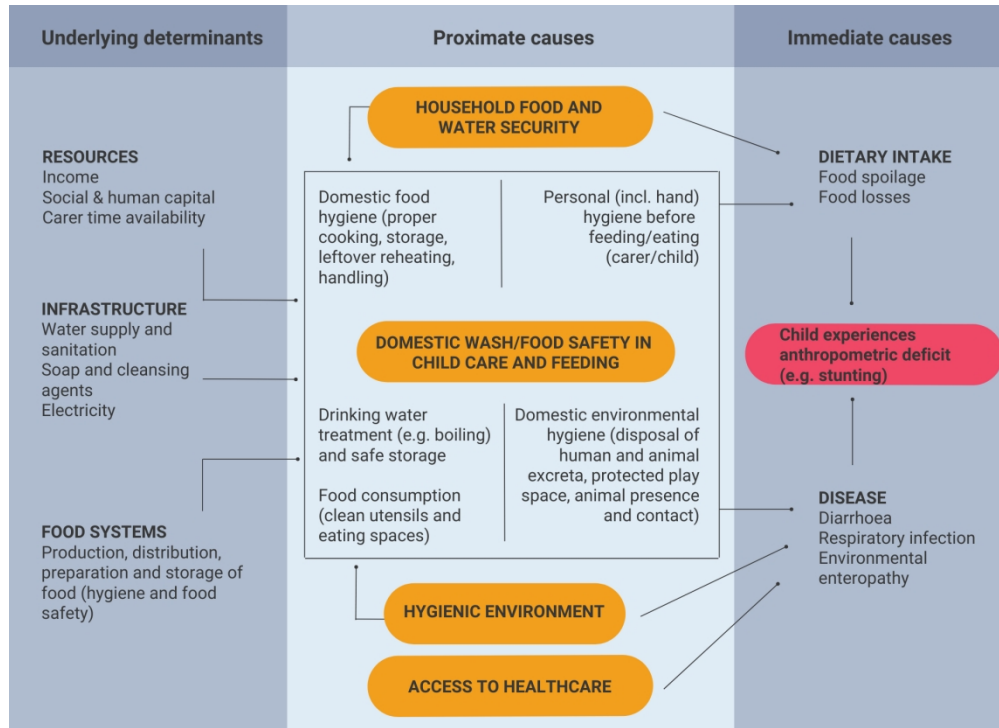


Figure 1: A conceptual framework showing the linkages of WASH and food safety with stunting at the household level

736x533mm (69 x 69 DPI)

APPENDIX 1: WASH AND FOOD SAFETY QUESTIONNAIRE

This questionnaire is administered by trained enumerators to mothers at 3 different time points, to elicit information about food safety and water and sanitation and hygiene practices at home, particularly in relation to infant and young child feeding. Data are collected in tablets on CommCare.

WATER SANITATION *(3 TIMES AT 3RD TRIMESTER, 3 & 24 MO)*
ws_1. What is the main source of drinking water for members of your household?
Piped water piped to dwelling
Piped water piped to compound yard or plot
Piped water piped to neighbor
Public tap / tapstand
Borehole or tubewell
Protected well
Unprotected well
Protected spring
Unprotected spring
Rainwater
Delivered watertanker or truck
Delivered watersmall cart with tank drum
Water kiosk
Packaged waterbottled water
Packaged watersachet water
Surface water
Other: specify
<i>ws_1_96x. Other: specify</i>
ws_2. What is the main source of water used by members of this household for other purposes, such as cooking and handwashing?
Piped water piped to dwelling
Piped water piped to compound yard or plot
Piped water piped to neighbor
Public tap / tapstand
Borehole or tubewell
Protected well
Unprotected well
Protected spring
Unprotected spring
Rainwater
Delivered watertanker or truck
Delivered watersmall cart with tank drum
Water kiosk
Packaged waterbottled water
Packaged watersachet water
Surface water
Other: specify
<i>ws_2_96x. Other: specify</i>
ws_3. Where is this water collected from?
In own dwelling

1	In own yard
2	Elsewhere
3	ws_4. How many minutes in total does it take you to go fetch water from this source and come back?
4	(Fill in X minutes)
5	ws_5. Do you store drinking water in your home?
6	Yes
7	No
8	ws_6. Where do you store your drinking water?
9	In a container with a lid/top on it
10	In an open container
11	Container on the roof
12	ws_7. In the last 4 weeks/month, how frequently did you or anyone in your household worry you would not have enough water for all of your household needs?
13	Never (0 times)
14	Rarely (1-2 times)
15	Sometimes (3-10 times)
16	Often (11-20times)
17	Always (more than 20 times)
18	ws_8. In the last 4 weeks/month, how frequently has your main water source been interrupted or limited (eg water pressure, less water than expected, river dried up)?
19	Never (0 times)
20	Rarely (1-2 times)
21	Sometimes (3-10 times)
22	Often (11-20times)
23	Always (more than 20 times)
24	ws_9. In the last 4 weeks/month, how frequently has there not been enough water to wash clothes?
25	Never (0 times)
26	Rarely (1-2 times)
27	Sometimes (3-10 times)
28	Often (11-20times)
29	Always (more than 20 times)
30	ws_10. In the last 4 weeks/month, how frequently have you or anyone in your household had to change schedules or plans due to problems with your water situation? Activities that may have been interrupted include caring for others, doing household chores, agricultural work, income-generating activities, sleeping, etc
31	Never (0 times)
32	Rarely (1-2 times)
33	Sometimes (3-10 times)
34	Often (11-20times)
35	Always (more than 20 times)
36	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
37	Never (0 times)
38	Rarely (1-2 times)
39	Sometimes (3-10 times)
40	Often (11-20times)
41	Always (more than 20 times)
42	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
43	Never (0 times)
44	Rarely (1-2 times)
45	Sometimes (3-10 times)
46	Often (11-20times)
47	Always (more than 20 times)
48	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
49	Never (0 times)
50	Rarely (1-2 times)
51	Sometimes (3-10 times)
52	Often (11-20times)
53	Always (more than 20 times)
54	ws_11. In the last 4 weeks/month, how frequently have you or anyone in your household had to change what was being eaten because there were problems with water (eg, for washing foods, cooking, etc)?
55	Never (0 times)
56	Rarely (1-2 times)
57	Sometimes (3-10 times)
58	Often (11-20times)
59	Always (more than 20 times)
60	

1	ws_12. In the last 4 weeks/month, how frequently have you or anyone in your household had to go
2	without washing hands after dirty activities (eg, defecating or changing diapers, cleaning animal dung)
3	because of problems with water?
4	Never (0 times)
5	Rarely (1-2 times)
6	Sometimes (3-10 times)
7	Often (11-20times)
8	Always (more than 20 times)
9	
10	ws_13. In the last 4 weeks/month, how frequently have you or anyone in your household had to go
11	without washing their body because of problems with water (eg, not enough water, dirty, unsafe)?
12	Never (0 times)
13	Rarely (1-2 times)
14	Sometimes (3-10 times)
15	Often (11-20times)
16	Always (more than 20 times)
17	
18	ws_14. In the last 4 weeks/month, how frequently has there not been as much water to drink as you
19	would like for you or anyone in your household?
20	Never (0 times)
21	Rarely (1-2 times)
22	Sometimes (3-10 times)
23	Often (11-20times)
24	Always (more than 20 times)
25	
26	ws_15. In the last 4 weeks/month, how frequently did you or anyone in your household feel angry
27	about your water situation?
28	Never (0 times)
29	Rarely (1-2 times)
30	Sometimes (3-10 times)
31	Often (11-20times)
32	Always (more than 20 times)
33	
34	ws_16. In the last 4 weeks/month, how frequently have you or anyone in your household gone to
35	sleep thirsty because there wasn't any water to drink?
36	Never (0 times)
37	Rarely (1-2 times)
38	Sometimes (3-10 times)
39	Often (11-20times)
40	Always (more than 20 times)
41	
42	ws_17. In the last 4 weeks/month, how frequently has there been no useable or drinkable water
43	whatsoever in your household?
44	Never (0 times)
45	Rarely (1-2 times)
46	Sometimes (3-10 times)
47	Often (11-20times)
48	Always (more than 20 times)
49	
50	ws_18. In the last 4 weeks/month, how frequently have problems with water caused you or anyone in
51	your household to feel ashamed/excluded/stigmatized?
52	Never (0 times)
53	Rarely (1-2 times)
54	Sometimes (3-10 times)
55	Often (11-20times)
56	
57	
58	
59	
60	

1	Always (more than 20 times)
2	ws_19. Is there a latrine or toilet that members of this household use regularly?
3	Yes
4	No
5	ws_20. Where is this toilet facility located?
6	In own dwelling
7	In own yard or plot
8	Elsewhere
9	ws_21. How many households other than your own share this facility?
10	Enter the enumerator Name
11	
12	
13	
14	fh_1. Is there a designated place for handwashing in the household?
15	Yes
16	No
17	fh_2. How often is soap available at this location?
18	Always
19	Sometimes
20	Never
21	fh_3. What were all of the times when you washed your hands (Circle all that apply but do not prompt After each response, ask "any other times?")
22	After defecating
23	After cleaning a child/wiping a child's bottom
24	After changing a babies nappy
25	Before preparing food
26	Before eating
27	Before feeding the child
28	After touching animals
29	After touching animal faeces
30	After handling raw animal source foods
31	After crop farming activities
32	Other
33	Cannot remember/does not know
34	<i>fh_3_96x. Specify other</i>
35	FOOD STORAGE
36	fh_4. Do you store meat and meat products (except dried meat)?
37	Yes
38	No
39	fh_4a. Where do you store raw meat (fresh/chilled/frozen)?
40	In a fridge
41	In a freezer
42	Covered in a cool room (below 5 degrees Celsius)
43	Uncovered in a cool room (below 5 degrees Celsius)
44	Covered in a room at room temperature
45	Uncovered in a room at room temperature
46	Other, specify
47	<i>fh_4a_96x. Other, specify</i>
48	fh_4b. How long do you store the meat and meat products?
49	less than 2 hours
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

1	2 hours to 5 hours
2	5 hours to 12 hours
3	12 hours
4	1-3 days
5	3-7 days
6	1 week
7	1 month
8	
9	fh_4c. Where do you store processed meat (ready-to-cook and ready-to-eat)?
10	In a fridge
11	In a freezer
12	Covered in a cool room (below 5 degrees Celsius)
13	Uncovered in a cool room (below 5 degrees Celsius)
14	Covered in a room at room temperature
15	Uncovered in a room at room temperature
16	Other, specify
17	<i>fh_4c_96x. Other, specify</i>
18	fh_4d. How long do you store the meat and meat products?
19	less than 2 hours
20	2 hours to 5 hours
21	5 hours to 12 hours
22	12 hours
23	1-3 days
24	3-7 days
25	1 week
26	1 month
27	
28	fh_5. Do you store milk and milk products (except milk powder, evaporated milk or condensed milk)?
29	Yes
30	No
31	
32	fh_5a. Where do you store liquid milk (including pasteurized and non-pasteurized)?
33	In a fridge
34	In a freezer
35	Covered in a cool room (below 5 degrees Celsius)
36	Uncovered in a cool room (below 5 degrees Celsius)
37	Covered in a room at room temperature
38	Uncovered in a room at room temperature
39	Other, specify
40	<i>fh_5a_96x. Other, specify</i>
41	fh_5b. Where do you store solid/semi solid dairy/milk products (e.g cheese, yoghurt, ghee, etc)?
42	In a fridge
43	In a freezer
44	Covered in a cool room (below 5 degrees Celsius)
45	Uncovered in a cool room (below 5 degrees Celsius)
46	Covered in a room at room temperature
47	Uncovered in a room at room temperature
48	Other, specify
49	<i>fh_5b_96x. Other, specify</i>
50	fh_6. Do you store raw or cooked vegetables and fruits?

1	Yes
2	No
3	fh_6a. Where do you store raw vegetables?
4	In a fridge
5	In a freezer
6	Covered in a cool room (below 5 degrees Celsius)
7	Uncovered in a cool room (below 5 degrees Celsius)
8	Covered in a room at room temperature
9	Uncovered in a room at room temperature
10	Other, specify
11	<i>fh_6a_96x. Other, specify</i>
12	fh_6b. Where do you store cooked vegetables and fruit?
13	In a fridge
14	In a freezer
15	Covered in a cool room (below 5 degrees Celsius)
16	Uncovered in a cool room (below 5 degrees Celsius)
17	Covered in a room at room temperature
18	Uncovered in a room at room temperature
19	Other, specify
20	<i>fh_6b_96x. Other, specify</i>
21	fh_7. Do you store food that has been prepared for your child to give it to the child later?
22	Yes
23	No
24	fh_7a. How do you store food that has been prepared for your child?
25	Thermos
26	Jug
27	Plate or bowl (covered)
28	Plate or bowl (uncovered)
29	Cooking pot (covered)
30	Cooking pot (uncovered)
31	Other container (covered)
32	Other container (uncovered)
33	Other, specify
34	<i>fh_7a_96x. Other, specify</i>
35	fh_7b. Where do you store this food?
36	In a fridge
37	In a freezer
38	In a cool room (below 5 degrees Celsius)
39	In a room at room temperature
40	Other, specify
41	<i>fh_7b_96x. Other, specify</i>
42	How long do you store this food?
43	less than 1 hour
44	1-2 hours
45	2 hours to 5 hours
46	5 hours to 12 hours
47	12 hours

1	1-3 days
2	3-7 days
3	Longer than a week
4	Animals
5	fh_8. Does your household keep any animals inside or outside the house you are looking after (i.e. not
6	taken care of by others)?
7	
8	Yes
9	No
10	fh_9. What type of animals?
11	
12	Chickens
13	Ducks
14	Other birds
15	
16	Dogs
17	Cats
18	Goats
19	Sheep
20	
21	Pigs
22	Cows
23	
24	Fish
25	Other animals, specify
26	<i>fh_9_96x. Other: specify</i>
27	fh_10. Which of these animals are in the patio, veranda or house any time of the day?
28	
29	None
30	Chickens
31	Ducks
32	Other birds
33	
34	Dogs
35	Cats
36	Goats
37	Sheeps
38	
39	Pigs
40	Cows
41	
42	Other animals, specify
43	<i>fh_10_96x. Other: specify</i>
44	fh_10a. Is the animal contained in some form of enclosure?
45	Yes
46	No
47	
48	fh_10b. Can the child be in contact with the animals or their faeces?
49	Yes
50	No
51	
52	fh_10c. Can the animal be in contact with food for the child?
53	Yes
54	No
55	
56	ASF1_1. What is the first priority ASF consumed by the child most recently? Select [ASF1]
57	Chicken
58	fish
59	beef
60	egg

1	squid
2	meat ball
3	beef soup
4	chicken soup
5	duck egg
6	fish egg
7	fish egg
8	None
9	
10	ASF1_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
11	No packaging
12	Sealed package
13	Washable container (plastic, glass, steel), open
14	Washable container (plastic, glass, steel), closed
15	Plastic bag
16	Newspaper
17	Other paper
18	Aluminium foil
19	Other foil
20	Container made from natural materials
21	Other, specify
22	
23	<i>ASF1_2_96x. ASF_2_96x Other: specify</i>
24	
25	ASF1_3. Did you transport this [ASF] after you got it?
26	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a trader or neighbour, etc)
27	
28	Yes
29	No
30	
31	ASF1_3a. How long did you transport the ASF for (to take it home)?
32	less than 5 minutes
33	5 min to 15 min
34	15 to 30 min
35	30 min to 1 hour
36	1hour to 2 hours
37	2 hours to 3 hours
38	3 hours
39	
40	ASF1_3b. How did you transport this [ASF] after you got it?
41	Chilled (e.g. on ice)
42	At ambient temperature
43	Kept warm (e.g. thermos or thermal food container)
44	Other, specify
45	
46	<i>ASF1_3b_96x. Other, specify</i>
47	
48	ASF1_4. Did you store this [ASF] before preparation?
49	Yes
50	No
51	
52	ASF1_4a. Was this [ASF] covered when you stored it before preparation?
53	Yes
54	No
55	
56	ASF1_4b. Where did you store this [ASF] before preparation?
57	In a fridge
58	In a freezer
59	
60	

1	In a cool room (below 5 degrees Celsius)
2	In a room at room temperature
3	Other, specify
4	<i>ASF1_4b_96x. Specify, other</i>
5	ASF1_4c. How long was this [ASF] stored before preparing?
6	minute
7	hour
8	day
9	total minutes
10	total hours
11	total day
12	ASF1_5. Did you wash this [ASF] before preparation?
13	Yes
14	No
15	Not applicable
16	ASF1_6. If yes, why did you wash this [ASF]? (multiple answers)
17	To remove visible dirt
18	To remove visible blood
19	To make it safer
20	Because it is a good practice
21	Other, specify
22	<i>ASF1_6_96x. Specify, other</i>
23	ASF1_7. Did you chop or cut this [ASF] product before preparation?
24	Yes
25	No
26	Not applicable
27	ASF1_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
28	Cutting board
29	Plate
30	Knife
31	Other, specify
32	<i>ASF1_8_96x. Specify, other</i>
33	ASF1_9. How did you prepare this food for the child?
34	Grilling
35	Baking
36	Frying
37	Boiling
38	Stewing
39	Simmering
40	Fermenting
41	Heating
42	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
43	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
44	Other, specify
45	<i>ASF1_9_96x. Specify, other</i>
46	ASF1_10. For how long was this [ASF] cooked?
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	

1	1-5 min
2	5-15 min
3	15-30 min
4	30-60 min
5	More than 1 hour
6	
7	ASF1_11. After preparation, was this [ASF] stored before giving it to the child?
8	Yes
9	No
10	
11	ASF1_12. After preparation, how long was this [ASF] stored before giving it to the child?
12	1-5 min
13	5-15 min
14	15-30 min
15	30-60 min
16	More than 1 hour, less than 24h
17	More than 1 day, less than 2 days
18	More than 2 days
19	
20	
21	ASF1_13. How did you store this [ASF] that had been prepared for your child?
22	Thermos
23	Jug
24	Plate or bowl (covered)
25	Plate or bowl (uncovered)
26	Cooking pot (covered)
27	Cooking pot (uncovered)
28	Other container (covered)
29	Other container (uncovered)
30	Other, specify
31	
32	<i>ASF1_13_96x. Specify, other</i>
33	
34	ASF1_14. Where did you store this [ASF]?
35	In a fridge
36	In a freezer
37	In a cool room (below 5 degrees Celsius)
38	In a room at room temperature
39	Other, specify
40	
41	<i>ASF1_14_96x. Specify other</i>
42	
43	ASF2_1. What is the second priority ASF consumed by the child most recently? Select [ASF1]
44	Chicken
45	fish
46	beef
47	egg
48	squid
49	meat ball
50	beef soup
51	chicken soup
52	duck egg
53	fish egg
54	None
55	
56	ASF2_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
57	
58	
59	
60	

1	No packaging
2	Sealed package
3	Washable container (plastic, glass, steel), open
4	Washable container (plastic, glass, steel), closed
5	Plastic bag
6	Newspaper
7	Other paper
8	Aluminium foil
9	Other foil
10	Container made from natural materials
11	Other, specify
12	ASF_2_96x Other: specify
13	ASF2_3. Did you transport this [ASF] after you got it?
14	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a trader or neighbour, etc)
15	Yes
16	No
17	ASF2_3a. How long did you transport the ASF for (to take it home)?
18	less than 5 minutes
19	5 min to 15 min
20	15 to 30 min
21	30 min to 1 hour
22	1hour to 2 hours
23	2 hours to 3 hours
24	3 hours
25	ASF2_3b. How did you transport this [ASF] after you got it?
26	Chilled (e.g. on ice)
27	At ambient temperature
28	Kept warm (e.g. thermos or thermal food container)
29	Other, specify
30	ASF2_3b_96x. Other specify
31	ASF2_4. Did you store this [ASF] before preparation?
32	Yes
33	No
34	ASF2_4a. Was this [ASF] covered when you stored it before preparation?
35	Yes
36	No
37	ASF2_4b. Where did you store this [ASF] before preparation?
38	In a fridge
39	In a freezer
40	In a cool room (below 5 degrees Celsius)
41	In a room at room temperature
42	Other, specify
43	ASF2_4b_96x. Specify, other
44	ASF2_4c. How long was this [ASF] stored before preparing?
45	minute
46	hour
47	day

1	total minutes
2	total hours
3	total day
4	ASF2_5. Did you wash this [ASF] before preparation?
5	Yes
6	No
7	Not applicable
8	ASF2_6. If yes, why did you wash this [ASF]? (multiple answers)
9	To remove visible dirt
10	To remove visible blood
11	To make it safer
12	Because it is a good practice
13	Other, specify
14	ASF2_6_96x. Specify, other
15	ASF2_7. Did you chop or cut this [ASF] product before preparation?
16	Yes
17	No
18	Not applicable
19	ASF2_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
20	Cutting board
21	Plate
22	Knife
23	Other, specify
24	ASF2_8_96x. Specify, other
25	ASF2_9. How did you prepare this food for the child?
26	Grilling
27	Baking
28	Frying
29	Boiling
30	Stewing
31	Simmering
32	Fermenting
33	Heating
34	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
35	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
36	Other, specify
37	ASF2_9_96x. Specify, other
38	ASF2_10. For how long was this [ASF] cooked?
39	1-5 min
40	5-15 min
41	15-30 min
42	30-60 min
43	More than 1 hour
44	ASF2_11. After preparation, was this [ASF] stored before giving it to the child?
45	Yes
46	No

1	ASF2_12. After preparation, how long was this [ASF] stored before giving it to the child?
2	1-5 min
3	5-15 min
4	15-30 min
5	30-60 min
6	More than 1 hour, less than 24h
7	More than 1 day, less than 2 days
8	More than 2 days
9	
10	ASF2_13. How did you store this [ASF] that had been prepared for your child?
11	Thermos
12	Jug
13	Plate or bowl (covered)
14	Plate or bowl (uncovered)
15	Cooking pot (covered)
16	Cooking pot (uncovered)
17	Other container (covered)
18	Other container (uncovered)
19	Other, specify
20	<i>ASF2_13_96x. Specify, other</i>
21	ASF2_14. Where did you store this [ASF]?
22	In a fridge
23	In a freezer
24	In a cool room (below 5 degrees Celsius)
25	In a room at room temperature
26	Other, specify
27	<i>ASF2_14_96x. Specify, other</i>
28	ASF3_1. What is the third priority ASF consumed by the child most recently? Select [ASF1]
29	Chicken
30	fish
31	beef
32	egg
33	squid
34	meat ball
35	beef soup
36	chicken soup
37	duck egg
38	fish egg
39	None
40	ASF3_2. How was this [ASF] packaged when you got it from the source? (select all that apply)
41	No packaging
42	Sealed package
43	Washable container (plastic, glass, steel), open
44	Washable container (plastic, glass, steel), closed
45	Plastic bag
46	Newspaper
47	Other paper
48	Aluminium foil
49	
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1	Other foil
2	Container made from natural materials
3	Other, specify
4	<i>ASF_2_96x Other: specify</i>
5	ASF3_3. Did you transport this [ASF] after you got it?
6	No transport means that they either produced it themselves or the ASF was brought to them (e.g. by a
7	trader or neighbour, etc)
8	
9	Yes
10	No
11	
12	ASF3_3a. How long did you transport the ASF for (to take it home)?
13	less than 5 minutes
14	5 min to 15 min
15	15 to 30 min
16	30 min to 1 hour
17	1hour to 2 hours
18	2 hours to 3 hours
19	3 hours
20	
21	
22	ASF3_3b. How did you transport this [ASF] after you got it?
23	Chilled (e.g. on ice)
24	At ambient temperature
25	Kept warm (e.g. thermos or thermal food container)
26	Other, specify
27	<i>ASF3_3b_96x. Other, specify</i>
28	
29	
30	ASF3_4. Did you store this [ASF] before preparation?
31	Yes
32	No
33	
34	ASF3_4a. Was this [ASF] covered when you stored it before preparation?
35	Yes
36	No
37	
38	ASF3_4b. Where did you store this [ASF] before preparation?
39	In a fridge
40	In a freezer
41	In a cool room (below 5 degrees Celsius)
42	In a room at room temperature
43	Other, specify
44	<i>ASF3_4b_96x. Specify, other</i>
45	
46	ASF3_4c. How long was this [ASF] stored before preparing?
47	minutes
48	hour
49	day
50	
51	total minutes
52	total hours
53	total day
54	
55	ASF3_5. Did you wash this [ASF] before preparation?
56	Yes
57	No
58	Not applicable
59	
60	ASF3_6. If yes, why did you wash this [ASF]? (multiple answers)

1	To remove visible dirt
2	To remove visible blood
3	To make it safer
4	Because it is a good practice
5	Other, specify
6	<i>ASF3_6_96x. Specify, other</i>
7	ASF3_7. Did you chop or cut this [ASF] product before preparation?
8	Yes
9	No
10	Not applicable
11	ASF3_8. If yes, which tool(s) did you use to chop or cut this [ASF]? (multiple answers)
12	Cutting board
13	Plate
14	Knife
15	Other, specify
16	<i>ASF3_8_96x. Specify, other</i>
17	ASF3_9. How did you prepare this food for the child?
18	Grilling
19	Baking
20	Frying
21	Boiling
22	Stewing
23	Simmering
24	Fermenting
25	Heating
26	Mixed in with other ingredients without cooking the ASF (e.g. mixing yoghurt with fruit or adding dried fish to salad)
27	Made smaller portion (e.g. cutting in pieces or butting in a bowl), but did not cook or mix with other ingredients
28	Other, specify
29	<i>ASF3_9_96x. Specify, other</i>
30	ASF3_10. For how long was this [ASF] cooked?
31	1-5 min
32	5-15 min
33	15-30 min
34	30-60 min
35	More than 1 hour
36	ASF3_11. After preparation, was this [ASF] stored before giving it to the child?
37	Yes
38	No
39	ASF3_12. After preparation, how long was this [ASF] stored before giving it to the child?
40	1-5 min
41	5-15 min
42	15-30 min
43	30-60 min
44	More than 1 hour, less than 24h
45	More than 1 day, less than 2 days
46	More than 2 days

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48
49
50
51
52
53
54
55
56
57
58
59
60

ASF3_13. How did you store this [ASF] that had been prepared for your child?
Thermos
Jug
Plate or bowl (covered)
Plate or bowl (uncovered)
Cooking pot (covered)
Cooking pot (uncovered)
Other container (covered)
Other container (uncovered)
Other, specify
<i>ASF3_13_96x. Specify, other</i>
ASF3_14. Where did you store this [ASF]?
In a fridge
In a freezer
In a cool room (below 5 degrees Celsius)
In a room at room temperature
Other, specify
<i>ASF3_14_96x. Other, specify</i>

APPENDIX 2: WASH AND FOOD SAFETY SPOT CHECK

This checklist is filled by trained enumerators in the households at 3 different time points, to observe and record information about behaviours and facilities in relation to food safety and water and sanitation and hygiene practices at home. Data are collected in tablets on CommCare.

WATER SANITATION (SPOT CHECK) *(3 TIMES AT 2ND TRIMESTER, 3 & 9MO)*
wash_1. What type of facility is the primary location for defecation?
Flush toilet to piped sewer system
Flush toilet to septic tank
Flush toilet to pit
Flush toilet to onsite, above ground, open pit
Pour flush toilet to piped sewer system
Pour flush toilet to septic tank
Pour flush toilet to pit
Pour flush toilet to onsite, above ground, open pit
Pit latrine with concrete slab (not pour flush)
Pit latrine without slab (not pour flush)
Bucket
Bag
Open defecation (no facilities)
Other:
Refused observation
<i>wash_1_96x. Specify, other</i>
wash_2. Approximately how many meters is the toilet from the entrance of the household
wash_3. For the following, please note if following indicators of functionality are present
wash_3_1. Is the pan working (not broken)
yes
no
wash_3_2. Are there leaves or rubbish blocking the pan?
yes
no
wash_3_3. Is there standing water in the pan?
yes
no
wash_3_4. Is there a cover over the pit?
yes
no
wash_3_5. Are there one or two pits?
One
Two
More
wash_3_6. Is there a cover on all the pits?
No
Partial (only to one pit)
Yes, to more than one pit
wash_3_7. Are there flies?

1	None
2	Some
3	Many
4	wash_4. Can you please show me where members of this household most often wash their hands?
5	Fixed facility (sink/basin)... in dwelling
6	Fixed facility....in yard
7	Mobile object (bucket / jug)
8	No handwashing place in dwelling
9	Refused observation
10	wash_5. Is there water available at this location?
11	Yes
12	No
13	wash_6. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
14	Yes
15	No
16	wash_7. Is the dedicated location located near (within 5 steps) the primary cooking location?
17	Yes
18	No
19	wash_8. Is the dedicated location located near (within 5 steps) the latrine/toilet
20	Yes
21	No
22	wash_9. Are there animals located in or around the household? (select all)
23	No animals visible
24	In the cooking area (outside house)
25	In the cooking area (inside house)
26	In the food storing area (outside house)
27	In the food storing area (inside house)
28	In other areas of the house that are not cooking or food storing areas
29	wash_10. What type of animals (select all)
30	Chickens
31	Ducks
32	Other birds
33	Dog
34	Cat
35	Goat
36	Sheep
37	Pig
38	Cow
39	Wild animals
40	Rodents
41	Other animal
42	<i>wash_10_96x. Other, specify</i>
43	wash_11. Are there animal feces located in or around the household? (select all)
44	No animal feces visible
45	In the cooking area (outside house)
46	In the cooking area (inside house)
47	In the food storing area (outside house)

1	In the food storing area (inside house)
2	In other areas of the house that are not cooking or food storing areas
3	In the yard / courtyard
4	
5	
6	# FOOD SAFETY QUESTIONNAIRE *(1 TIME: AT 6 MO)*
7	HAND WASHING
8	spot_1. Can you please show me where members of this household most often wash their hands after using the toilets?
9	
10	Fixed facility (sink/basin)... in dwelling
11	Fixed facility....in yard
12	Mobile object (bucket / jug)
13	No handwashing place in dwelling
14	Refused observation
15	
16	spot_2. Is there water available at this location?
17	
18	Yes
19	No
20	
21	spot_3. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
22	
23	Yes
24	No
25	
26	spot_4. Is the dedicated location located near (within 5 steps) the primary cooking location?
27	
28	Yes
29	No
30	
31	spot_5. Is the dedicated location located near (within 5 steps) the latrine/toilet
32	
33	Yes
34	No
35	
36	spot_6. Can you show me where members of this household most often wash their hands before eating or preparing food?
37	
38	Fixed facility (sink/basin)... in dwelling
39	Fixed facility....in yard
40	Mobile object (bucket / jug)
41	No handwashing place in dwelling
42	Refused observation
43	Same as after toilet
44	
45	spot_7. Is there water available at this location?
46	
47	Yes
48	No
49	
50	spot_8. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
51	
52	Yes
53	No
54	
55	spot_9. Is the dedicated location located near (within 5 steps) the primary cooking location?
56	
57	Yes
58	No
59	
60	spot_11. Do you see animals in or around the household? (select all)

1	No animals visible
2	In the cooking area (outside house)
3	In the cooking area (inside house)
4	In the food storing area (outside house)
5	In the food storing area (inside house)
6	In other areas of the house that are not cooking or food storing areas
7	spot_12. What type of animals (select all)
8	Chickens
9	Ducks
10	Other birds
11	Dogs
12	Cats
13	Goats
14	Sheep
15	Pigs
16	Cows
17	Wild animals
18	Rodents
19	Other animal
20	<i>spot_12_96x. Specify other</i>
21	spot_13. Is it possible for the child to be in contact with these animals (e.g. if they are unrestrained or the child can access an enclosure)?
22	Yes
23	No
24	spot_14. Is it possible for these animals to be in contact with food (e.g. if animals are unrestrained)
25	Yes
26	No
27	spot_15. Are there visible animal feces located in or around the household? (select all)
28	No animal feces visible
29	In the cooking area (outside house)
30	In the cooking area (inside house)
31	In the food storing area (outside house)
32	In the food storing area (inside house)
33	In other areas of the house that are not cooking or food storing areas
34	In the yard / courtyard
35	In the animal enclosure (e.g. chicken coop)
36	spot_16. Is it possible for the child to be in contact with these faeces (e.g. because they are in areas where the child is or the child can access an enclosure)?
37	Yes
38	No
39	spot_17. Is it possible that food gets in contact with these faeces?
40	Yes
41	No
42	safe_1. Is there a functioning refrigerator?
43	Yes
44	No
45	safe_2. Is there a functioning freezer?
46	Yes

1	No
2	safe_3. Is there any visible, stored [ASF] not protected from the environment?
3	Yes
4	No
5	safe_4. Is it [ASF] in contact with other food products?
6	Yes
7	No
8	safe_5. Is the area where this [ASF] is kept protected from animals and flies?
9	Yes
10	No
11	safe_6. Is there a kitchen area (a dedicated food preparation area)?
12	Yes
13	No
14	safe_6a. Is the kitchen area free from pest animals (i.e. birds, flies, rats)
15	Yes
16	No
17	safe_6b. Are there anti-pest measures in place in the kitchen area? e.g. nets, traps, insect killers
18	Yes
19	No
20	safe_6c. Is the kitchen area free of visible dirt?
21	Yes
22	No
23	safe_6d. Are cooking utensils clean?
24	Yes
25	No
26	safe_6e. Is the kitchen area easy to clean (e.g. tiles)?
27	Yes
28	No
29	safe_6f. Does the kitchen area have access to running water?
30	Yes
31	No
32	safe_6g. If there is no access to running water, is there stored water in the area where food is being prepared?
33	Yes, there is water in a container with a lid/top on it
34	Yes, there is water in an open container
35	No, there is no water
36	safe_6h. Is soap available at this location? (Soap includes bar soap, liquid soap, powder detergent, and soapy water but does not include ash, soil, sand or other handwashing agents)
37	Yes
38	No
39	safe_7. Is there a food storage area?
40	Yes
41	No
42	safe_7a. In the food storage area, is the storage equipment made of material that is easy to clean (e.g. metal, plastic)?
43	Yes
44	No
45	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
46	Yes
47	No
48	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
49	Yes
50	No
51	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
52	Yes
53	No
54	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
55	Yes
56	No
57	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)
58	Yes
59	No
60	safe_7b. Is the food storage area free from pest animals (i.e. birds, flies, rats)

1	Yes
2	No
3	safe_7c. Are there anti-pest measures in place in the food storage area? e.g. nets, traps, insect killers
4	Yes
5	No
6	No
7	safe_7d. Is the food storage area free of visible dirt?
8	Yes
9	No
10	No
11	safe_7e. Is the food storage area easy to clean (e.g. tiles)?
12	Yes
13	No
14	No
15	safe_8. Is there a facility to dispose of food waste?
16	No
17	In the cooking area (outside house)
18	In the cooking area (inside house)
19	In the cooking area (inside house)
20	In the food storing area (outside house)
21	In the food storing area (inside house)
22	In the food storing area (inside house)
23	Outside the house remove from cooking or food storing areas
24	Removed from the household
25	safe_9. Are the knife and chopping board used to cut vegetables and fruits are clean?
26	Yes
27	No
28	No
29	safe_10. Are the nails of the food handler trimmed?
30	Yes
31	No
32	No
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APPENDIX 3: WASH AND FOOD SAFETY DIRECT OBSERVATION TOOL

This direct observation tool is filled by trained enumerators in the households at 3 different time points, to observe and record information about behaviours related to food safety and water and sanitation and hygiene practices at home, particularly in relation to infant and young child feeding. Food, drinking water and surface samples are subsequently collected for microbiological testing. Data are collected on paper.

GCRF Action against stunting Hub

Household ID:	Mother ID:	Child ID:
Enumerator ID:		Supervisor ID:
District:		Sub-county:
Parish:		Village:
Salter calibration ID:		Salter calibration weight:
Date of record:	Day of the week <u>today</u>:	
Time ARRIVED: (24-hr)	Monday <input type="checkbox"/>	Friday <input type="checkbox"/>
Time DEPARTED: (24-hr)	Tuesday <input type="checkbox"/>	Saturday <input type="checkbox"/>
	Wednesday <input type="checkbox"/>	Sunday <input type="checkbox"/>
	Thursday <input type="checkbox"/>	
<i>Complete at the end of the day</i>		
<p>Describe the location of the observations: Where in the home the observation was completed – where the observer sat, what the conditions were when you did the observation (weather, lighting, heat) how busy the home was, etc.</p>		
<p>Describe who the main caretaker of the child was:</p> <p>Mother <input type="checkbox"/></p> <p>Sibling <input type="checkbox"/></p> <p>Grandmother <input type="checkbox"/></p> <p>Aunt <input type="checkbox"/></p> <p>Caretaker <input type="checkbox"/></p> <p>Other, specify <input type="checkbox"/> _____</p>		
<p>Please note if caretaker changes during observation: Yes <input type="checkbox"/> No <input type="checkbox"/> Mother <input type="checkbox"/></p> <p>Sibling <input type="checkbox"/></p> <p>Grandmother <input type="checkbox"/></p> <p>Aunt <input type="checkbox"/></p> <p>Caretaker <input type="checkbox"/></p> <p>Other, specify <input type="checkbox"/> _____</p>		

Direct observation

Household ID: _____

	Yes (tick)	Date: dd/mm/yy
Checked by supervisor: (code)		
Checked by co-ordinator: (code)		
Data entry completed: (code)		

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
1. Child Activities																	
1.1 Sleeping																	
1.2 Caretaker change																	
1.3 Child being cared for by other children																	
2. Child feces																	
2.1 Child nappy or diaper is changed																	
2.2 Child defecates on floor																	
2.3 Child defecates in potty																	
2.4 Child feces disposed in toilet																	
2.5 Child feces disposed in bush / ditch																	
3. Food preparation																	
3.1 Fruit or vegetable washed																	
3.2 Food preparation surface rinsed (specify surface type)																	
3.3 Food preparation surface washed (specify surface type)																	
3.4 Utensils rinsed																	
3.5 Utensils washed																	
3.6 Plates / bowls/ cups rinsed																	
3.7 Plates / bowls/cups washed																	
3.8 Child bottle rinsed																	
3.9 Child bottle cleaned																	
4. Food cooking																	
	Specify from section 3																

Direct observation

Household ID: _____

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
Specify type in comments																	
4.1 Food fried (ASF / Fruit Veg / Other)																	
4.2 Food dried (ASF / Fruit Veg / other)																	
4.3 Food roasted (ASF / Fruit Veg / other)																	
4.4 Food heated in pot, no boiled (ASF/ Fruit Veg / other)																	
4.5 Food boiled (ASF / Fruit Veg/ other)																	
4.6 Food steamed (ASF / Fruit Veg / Other)																	
4.7 Food arrives processed (ASF / Fruit Veg / Other)																	
4.8 Food added raw / uncooked to dish (ASF / Fruit Veg / Other)																	
5. Food handling																	
Specify from section 4																	
5.1 Cooked food served immediately to child																	
5.2 Cooked food left at room temp / open																	
5.3 Cooked food placed in cabinet / cupboard																	
5.4 Cooked food placed in fridge																	
5.5 Cooked food covered (loosely)																	
5.6 Cooked food covered (sealed)																	
6. Child feeding																	
Specify from section 4																	
6.1 Child breastfed																	
6.2 Child given food that was stored																	
6.3 Child given milk																	
6.4 Child given water																	
6.5 Flies on food given to child																	
6.6 Child fed by caregivers hand																	
6.6 Child eating using child's hand																	
6.7 Child fed/eating using utensils (e.g. spoon)																	
7. Floor contact																	

Direct observation

Household ID: _____

Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
7.1 Child hand contact with floor																	
7.2 Child hand contact with dirt																	
7.3 Child eats dirt / soil																	
7.4 Child places objects from the floor in their mouths																	
7.5 Child places hands that have been in contact with the floor in mouth																	
8. Animal contact																Write down the animal (chickens, ducks, other birds, goats, sheep, pigs, cow, dog, cat, other/specify)	
8.1 Caretaker hand contact with animals																	
8.2 Caretaker hand contact with animal feces																	
8.3 Child hand contact with animals																	
8.4 Child hand contact with animal feces																	
9. Toilet use																	
9.1 Primary caretaker uses toilet																	
9.2 Primary caretaker goes for open defecation																	
10. Domestic cleaning																	
10.1 Caretakers washes clothes																	
10.2 Caretaker / other household member sweeps																	
10.3 Caretaker / other household members cleans floors (with disinfectant / soap)																	
10.3 Caretakers handles garbage																	
11. Handwashing / Facewashing																	
11.1 Caretaker rinses hands – water only																	
11.2 Caretaker washes hands – soap used																	
11.3 Child's hands rinsed – water only																	
11.4 Child's hands washed – soap used																	
11.5 Child's face wiped or rinses																	
11.6 Child's face cleaned																	
11.7 Caretaker bathes																	

Direct observation

Household ID: _____

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Activity	:00				:00				:00				:00				Pilot notes
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	
	00	15	30	45	00	15	30	45	00	15	30	45	00	15	30	45	
11.8 Child bathed																	

Confidential: For Review Only

Direct observation

Household ID: _____

Data log Table. Food Sample

HH ID: _____

Timepoint: 9 month/ 12 month/ 18 month

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Collection period: During feeding <input type="checkbox"/>		Directly after feeding <input type="checkbox"/>	Before feeding <input type="checkbox"/>
Food:			
Total sample weight			
Ingredients:			
Preparation method:			
Notes:			

Direct observation

Household ID: _____

Data log Table. Water Sample

HH ID: _____

Timepoint: 9 month/ 12 month/ 18 month

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Has the water been treated with chlorine/aquatabs or is from the municipal system?

Yes (collect water in a small 100 mL whirlpak bag with sodium thiosulfate tablets + collect further water in a 50mL centrifuge tube)No (collect water in a large 250 mL whirlpak bag)

Notes:

Direct observation

Household ID: _____

Data log Table. Surface Sample

Timepoint: 9 month/ 12 month/ 18 month

HH ID: _____

Date (DD/MMM/YY): _____

Collection time (24 hour clock, HH:MM): --- _____

Where is the child's food prepared [the surface where foods and utensils are placed during preparation and/or where foods cut up or otherwise processed in any way]?

Notes: