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IMPACTS OF WASH ON ACUTE MALNUTRITION

FROM AVAILABLE SCIENTIFIC EVIDENCE TO INFORMED ACTION

Systematic review by ACF France

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ACRONYMS

ACF: *Action Against Hunger*
AM: *Acute Malnutrition*
CRCT: *Cluster randomised controlled trial*
CMAM: *Community management of acute malnutrition*
EED: *Environmental enteric dysfunction*
HAZ: *Height-for-age Z-score*
ITN: *Insecticide-treated bed nets*
IYCF: *Infant and Young Child Feeding*
MAM: *Moderate Acute Malnutrition*
MUAC: *Mid-upper arm circumference*
NCHS: *National Center for Health Statistics*
PLW: *Pregnant and lactating women*
RCT: *Randomized controlled trial*
SAM: *Severe acute malnutrition*
SD: *Standard deviations*
ToC: *Theory of Change*
UNICEF: *United Nations Children's Fund*
WASH: *Water, sanitation, and hygiene*
WFP: *World Food Programme*
WHO: *World Health Organisation*
WHZ: *Weight-for-height Z-score*

PREFACE

A review of the current state of evidence on WASH for nutrition outcomes was commissioned by Action Against Hunger France as an essential preliminary step to develop a set of recommendations on how to support the use of wash activities for enhanced nutrition outcomes in humanitarian and development programmes. The evidence presented in this report was reviewed and summarized by Heather Strobaugh in May 2019.

The first edition of the report was circulated to a selected group of stakeholders invited to participate in the 'Research 4 Action' workshop aimed at facilitating the uptake of scientific evidence and move beyond research to inform action.

This version features an updated list of articles and is intended to be shared with the large public, including academic institutions, donors and humanitarian and development organizations in the WASH and nutrition sector.

SECTION 1: ASSESSING THE POTENTIAL IMPACT OF WASH ON ACUTE MALNUTRITION

1.1 INTRODUCTION

Prevalence surveys suggest that in 2019 there were almost 50 million children worldwide that suffer from acute malnutrition (AM), or wasting, of which 14.3 million were severely wasted* (1). The consequences of AM are life threatening: those with severe acute malnutrition (SAM) are ten times more likely to die and those with moderate acute malnutrition (MAM) are three times more likely to die than a child with WHZ > -1 SD (2). **Acute malnutrition is estimated to account for over one-third of child deaths** and 11% of the total global disease burden (2).

South Asia has the largest prevalence and number of children with wasting, followed by Africa and the Middle East (3). Worldwide numbers of children who suffer from wasting have only marginally decreased over the years, particularly when compared to progress made in reducing other malnutrition indicators, such as stunting. The global estimated number of children suffering from wasting was only reduced by 11% over the course of 21 years, between 1990 and 2011 (4).

The immediate causes of malnutrition are inadequate dietary intake and disease; however, the underlying causes can be multifactorial and complex, often driven by food insecurity, poor care practices, an unsanitary living environment, and/or poor access to healthcare.

Most responses to acute malnutrition are food specific, but more recently the nutrition community has also turned to nutrition-sensitive programming, which goes beyond the provision of food and counseling on nutrition and aims to address the underlying causes of malnutrition, including poor water, sanitation and hygiene (WASH).

Globally, **4.5 billion people do not have access to improved sanitation**, that is having sanitation facilities that hygienically separate human excreta from human contact and 2.3 billion people lack access to basic sanitation services (5). Even so, nearly 892 million people practice open defecation, having no sanitation facilities at all (5), leaving their living spaces contaminated with harmful pathogens that can lead to illness and malnutrition.

Furthermore, 2.1 million people do not have access to safe drinking water sources on premises and 844 million lack access to basic water services. **Many of the populations that live in unsanitary living conditions with unsafe drinking water are the same populations with high levels of AM.** Efforts have been made to better understand the causal links between poor WASH and malnutrition in order to increase the evidence-base for interventions that aim to improve the nutritional status of children. This report aims to summarize the state of the evidence regarding the links between WASH and AM.

1. 2020 Global Nutrition Report: Action on equity to end malnutrition. Bristol, UK: Development Initiatives.
2. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. The Lancet. 2008 Jan 19;371(9608):243–60.
3. Watkins K. A fair chance for every child. New York, NY: UNICEF; 2016. 172 p. (The state of the world's children).
4. Annan R, Webb P, Brown R. Management of moderate acute malnutrition (MAM): current knowledge and practice. CMAM Forum Technical Brief: September 2014. CMAM Forum, 2014.
5. World Health Organization (WHO), United Nations Children's Fund (UNICEF). Progress on household drinking water, sanitation and hygiene 2000-2017. Special focus on inequalities. New York; 2019. .

* In this statistic, acute malnutrition is defined as weight-for-height Z score (WHZ) < −2 standard deviations (SD), but the typical definition also includes children with a Mid-Upper Arm Circumference (MUAC) < 12.5 cm.

1.2 OBJECTIVES

The main objective of this report is to provide a user-friendly summary of available evidence linking WASH indicators and interventions to child AM. It will serve as the basis for further discussion by a selected panel of experts to generate programmatic recommendations at the Research 4 Action workshop held in November 2019 in Paris. To facilitate this process, the meeting will follow the steps below:

1 **'What we know' Presentation of the key findings on the effects of wash interventions on nutrition outcomes, as well as evidence gaps (including programme design and implementation).**

2 **Group discussion on ways of moving beyond research and transforrming evidence into concrete recommendations**

3 **'How can these recommendations be translated into action' Workshop participants brainstormed on ways of trans-lating recommendations into programme and policy action.**

1.3 DEFINITIONS

In this report, acute malnutrition, or AM, is inclusive of both SAM and MAM and defined as WHZ <-2 SD or MUAC < 12.5 cm and/or the presence of bilateral pitting edema. Because the available literature is limited on the associations between WASH and AM, we also include average child WHZ as a preliminary step to improving AM rates. For example, if an intervention or a certain risk factor is associated with an improvement in child WHZ, then it may be indicative of preventing cases of AM.

WASH indicators and interventions included in this report are defined as the following:

- **Biological water quality** – any indicator related to or intervention aimed to improve the microbiological quality of drinking water, including various water treatment methods and sources of water;
- **Water quantity or supply** – any indicator related to or intervention aimed to improve the amount of water available to a household or individual and providing continious access to water sources;
- **Sanitation and sanitary practices** – any indicator related to or intervention aimed to improve access to improved sanitary facilities (flush toilet, piped sewer system, septic tank, flush/pour flush to pit latrine, ventilated improved pit latrine, or pit latrine with slab) or promote the use of sanitation facilities and proper disposal of child feces;
- **Hygiene** – any indicator related to or intervention aimed to improve the adoption of or increased practice of handwashing with soap, safe storage of water, food, and utensils, and hygienic preparation of foods;
- **Environmental hygiene** – any indicator related to or intervention aimed to improve vector control (insecticide-treated bed nets, breeding areas for mosquitos) and reduce risk of contamination by the immediate environment (fecal contamination of living and playing space for children).

1.3 THEORY OF CHANGE

Theory of change is a dynamic, critical thinking process, it makes the initiative clear and transparent - it underpins strategic planning. It is developed in a participatory way over time, following a logical structure that is rigorous and specific, and that can meet a quality test by the stakeholders. The terminology is not important, it is about buying into the critical thinking. (6)

Understanding the causal pathways between WASH and child AM is important in order to develop appropriate interventions that target specific potential underlying WASH-related causes of child AM. These causal chains can then be linked together to create a theory of change (ToC), which consists of a full picture of the potential pathways leading to child malnutrition that guide where programs might intervene to change the trajectory of outcomes. A ToC is increasingly regarded as an essential tool in designing and appreciating the complex network of factors influencing program outcomes and impact. A ToC is as well essential to understand the important pathways and mediating factors that together underpin the success, or failure, of any program(6). Here, we discuss the theoretical causal links between WASH conditions and child malnutrition as presented in a 2013 Cochrane review by Dangour *et al.* (7) (Annex 3) that may serve as a starting point for the development of a WASH and nutrition program ToC.

The hypothesized causal pathways between poor WASH and child malnutrition consists namely of diarrhea, environmental enteric dysfunction, and helminth infections (worms). These three conditions are hypothesized to be caused by unsanitary living conditions, unsafe drinking-water, inadequate sanitation, and poor hygiene.

Diarrhea increases the loss of nutrients and water in the body leading to malnutrition, and conversely, malnutrition compromises a child's immune system leaving the child more susceptible to diarrheal diseases. The link between diarrheal diseases and undernutrition is described as cyclical in nature, recognizing that diarrhea and malnutrition can be exacerbated by one another. The relative contribution to which diarrhea directly causes acute malnutrition is unclear, leaving the degree to which WASH interventions impact acute malnutrition unknown. Nonetheless, WASH does have a role in itself to prevent diarrhea, which is an important cause of mortality (8). Giardia lamblia, Entamoeba histolytica, and Cryptosporidium spp. are some of the most common diarrhoeagenic intestinal protozoans and have been linked to undernutrition.

Helminth infections and malnutrition are often present the same geographic areas. Helminth infections can impair nutritional status by causing intestinal bleeding and competition for nutrients which leads to malabsorption. They can also reduce the ability to use protein and absorb fat by through vomiting, diarrhea and loss of appetite.

Environmental enteric dysfunction (EED) is a subclinical condition, caused by a continuous exposure to entero-pathogens producing a sustained stimulation of the immune response. It is caracterize by increased intestinal inflammation and damaged cells (villous atrophy, crypt hyperplasia, and increased permeability) that reduce nutrient absorption and impair barrier functions. Research is ongoing to better understand the biological interactions between EED and AM.

Other indirect causal pathways relate more to the ability of families to provide safe and clean-living environments, the time it takes to do so, and time it takes to adequately care for children in such environments. It also refers to a broader socio-economic environment, including affordability of water, available sanitation and hygiene services, education, and poverty.

6. Fenn B. Impacts of CASH on NUTRITION outcomes. Action Contre la Faim, World Food Programme; p. 24.
7. Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, et al. Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. Cochrane Database Syst Rev [Internet]. 2013 [cited 2019 Jul 8];(8). Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD009382.pub2/full
8. Cumming O, Cairncross S. Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. Matern Child Nutr. 2016 May;12 Suppl 1(Suppl Suppl 1):91–105.

SECTION 2: METHODOLOGY

The aim of this review was to **identify and evaluate the strength of the available evidence related to WASH and AM**. The review included a computerized search of PubMed between Jan 1, 2000 and May 13, 2019**. Relevant articles were obtained and included in this review if they met inclusion and exclusion criteria based on three main items—population, intervention, and outcome. This review included studies if they involved children under the age of 5 years old. Only studies that used definitions of acute malnutrition by anthropometric measurements based upon the National Center for Health Statistics (NCHS) child growth references, World Health Organization (WHO) child growth standards, and/or MUAC were included.

The included literature consisted of WASH interventions or interventions that contained at least one WASH-related component or indicator. Non-intervention studies were also included if studies collected data on WASH-related indicators and acute malnutrition. There were no parameters around location or whether the context was considered a humanitarian emergency or development setting. The main outcome of interest in this review was the impact of WASH interventions on the prevention and treatment of acute malnutrition as well as associations between WASH indicators and acute malnutrition. Only studies written in the english language and published in peer-review journals were included. In order to ensure a good quality of evidence, only the following designs were selected: individual and cluster - randomized controlled trials (RCT/cRCT)), quasi-experimental studies, case-control studies, and cohort studies.

We screened all publications identified in the search by reading the titles and abstracts to determine initial relevance. After removing duplications, a second screening process consisted of reading full texts of the remaining articles and those that met the inclusion/exclusion criteria were retained. A flowchart of the process of study selection is shown in Annex 1. Ultimately, **28 articles were included in the final analysis.** We evaluated the strengths and weaknesses of each research article independently to ensure that quality of evidence was considered when interpreting results.

This evaluation was based on the Cochrane GRADE approach (9).

First, we rated each article based on the quality of study design (trials or observational studies):

1) High-quality (++++): randomized controlled trial and cluster-randomized controlled trial;
2) **Moderate-quality (+++)**: quasi-experimental (non-randomized controlled trial) and controlled before and after intervention study;
3) Low-quality (++): controlled or uncontrolled prospective cohort and case-control study.

Subsequently, we adjusted the rating (either upward or downward) depending on factors such as potential biases or large effect.

Ultimately, we assessed the significance of available evidence (insufficient, low, moderate and strong) for each of the investigated indicators of the impact of WASH interventions on the prevention and treatment of acute malnutrition, **following the Evidence-based Practice Center (EPC) Grading Guidelines (10).**

9. Schünemann H, Brożek J, Guyatt G, Oxman A. GRADE Handbook for Grading Quality of Evidence and Strength of Recommendations [Internet]. 2013. Available from: https://gdt.gradepro.org/app/handbook/handbook.html
10. Berkman ND, Lohr KN, Ansari M, McDonagh M, Balk E, Whitlock E, et al. Grading the Strength of a Body of Evidence When Assessing Health Care Interventions for the Effective Health Care Program of the Agency for Healthcare Research and Quality: An Update. Methods Guide for Comparative Effectiveness Reviews. Rockville, MD: Agency for Healthcare Research and Quality; 2013 Nov p. 44.

** The following search terms were used: child*, infant*, "acute malnutrition", "acutely malnourished", "severe acute malnutrition", "severely malnourished", "severely wasted", "moderate acute malnutrition", "moderately malnourished", "moderately wasted", "wasted", "wasting", "outpatient therapeutic feeding", "outpatient therapeutic program", "stabilization center", "nutrition rehabilitation unit", "inpatient therapeutic feeding", "supplementary feeding", "community-based management of acute malnutrition", "CMAM", "weight-for-height", "weight for height", "mid-upper arm circumference", "MUAC", "kwashiorkor", "marasmus", "water", "sanitation", "sanitary", "hygiene", "hygienic", "WASH", handwash*, "soap", "community led total sanitation", "CLTS", "mosquito net*", "bed net*", "mosquito", "vector control", "insecticide treated bed net", "waste", "feces", "faeces", "toilet", "open defecation", "WiN Kit", "latrine", "chlorine", "chlorination", "aquatabs", "babywash", "potty", and "potties". Reference lists of articles were also screened for further relevant publications.

SECTION 3:
WHAT DOES THE EVIDENCE SAY?

3.1 DESCRIPTION OF THE SIGNIFICANCE OF THE BODY OF EVIDENCE

Much of the evidence in this report focuses on associations between WASH indicators and AM, and less on which interventions produce the greatest impact, due to the limited quantity of robust research documenting the impact of WASH interventions on child AM. **An initial review of the evidence in which only high-quality, robust study designs were included resulted in so few studies that additional study designs were later included to better encompass a larger portion of the current state of evidence.** Therefore, many of the studies produced results that are prone to bias as inherent in study designs that are less rigorous than double-blinded, randomized controlled trials.

The heterogeneity of WASH-related indicators and interventions makes results difficult to compare across studies. Furthermore, many of the intervention arms in WASH-related trials consist of a package of WASH-related services, making it impossible to attribute which effects were caused by which components of the intervention package. Reporting bias is also common as many WASH intervention trials have been conducted that include the collection of child anthropometric data, yet effects on AM are not reported (rather other nutrition-related indicators are reported, such as stunting or underweight). Also, many studies collect WASH-related indicators but only report on those that result in statistically significant associations with child nutrition outcomes, leaving out those that do not have statistically significant associations.

Tables 1 and 2 below describe the strength of the current evidence base (from insufficient to high) according to WASH approaches (either prevention or treatment) and WASH indicators with child AM outcomes. Short descriptions are provided to summarize the evidence and clarify if there is a positive or negative association.

Figure 1. Strength of evidence grades and definitions

GRADE	DEFINITION
High	**We are very confident that the estimate of effect lies close to the true effect for this outcome.** The body of evidence has few or no deficiencies. We believe that the findings are stable, i.e., another study would not change the conclusions.
Moderate	**We are moderately confident that the estimate of effect lies close to the true effect for this outcome.** The body of evidence has some deficiencies. We believe that the findings are likely to be stable, but some doubt remains.
Low	**We have limited confidence that the estimate of effect lies close to the true effect for this outcome.** The body of evidence has major or numerous deficiencies (or both). We believe that additional evidence is needed before concluding either that the findings are stable or that the estimate of effect is close to the true effect.
Insufficient	**We have no evidence, we are unable to estimate an effect, or we have no confidence in the estimate of effect for this outcome.** No evidence is available or the body of evidence has unacceptable deficiencies, precluding reaching a conclusion.

Source: Adapted from Agency for Healthcare Research and Quality. Grading the Strength of a Body of Evidence When Assessing Health Care Interventions for the Effective Health Care Program of the Agency for Healthcare Research and Quality: An Update. 2013.

TABLE 1: EVALUATION OF THE SIGNIFICANCE OF EVIDENCE ON APPROACHES FOR MANAGING ACUTE MALNUTRITION: PREVENTION AND TREATMENT

INDICATORS *(with reference to literature in annex)*	SIGNIFICANCE OF EVIDENCE	DESCRIPTION
Prevention 1- 8, 10-28	✓✓	Current evidence is mixed and weak. While several studies have been conducted to examine associations between WASH indicators and AM as well as the effect of WASH interventions on preventing AM, results are inconsistent, and the quality of studies is mostly low to moderate (2, 3, 4, 5, 6, 8, 11, 12, 14, 15, 16, 17,20, 26, 27). • Even among the few high-quality studies employed, most found no effect of WASH interventions on preventing AM (10, 14, 18, 21, 22, 24).
Treatment 1 , 9, 25	✓✓	Very few studies have examined the effect of WASH interventions on the treatment of AM. • In this review, two studies demonstrated that the provision of water treatment supplies in addition to SAM treatment improved SAM recovery outcomes (1, 8, 9). • The provision of WASH materials and services have not proven to impact the sustainability of recovery and thus prevent relapse (1, 22). • Further studies in various contexts are needed to confirm results of these first trials.

… INSUFFICIENT ✓ LOW ✓✓ MODERATE ✓✓✓ HIGH

TABLE 2 : EVALUATION OF THE SIGNIFICANCE OF EVIDENCE ON ASSOCIATIONS BETWEEN WASH INDICATORS AND ACUTE MALNUTRITION

INDICATORS *(with reference to literature in annex)*	SIGNIFICANCE OF EVIDENCE	DESCRIPTION
Drinking water access and availability		
Distance to water point < 30 minutes; Access to 15 liters/person/day; Fetching drinking water daily 4, 8, 20	⋯	• Few studies have examined the association between access to drinking water and AM. Those that have been done found no association between access to water and preventing AM (4, 8, 20). Studies were low-quality.
Water quality		
Water for drinking is treated 1, 2, 3, 7, 8, 9, 10 ,14, 18,20, 21, 26	✓✓ ✓✓	• Current evidence is mixed and weak. While 2 low- to moderate-quality studies found associations between water treatment and preventing SAM (2, 20), several other studies ranging in quality did not find any association with improving WHZ or preventing AM (1, 3, 7, 8, 10, 14, 18, 21, 26). • However, two high-quality studies demonstrated that provision of water treatment during SAM treatment at household level improved recovery outcomes among children (1, 9), but did nnot prevent relapse post-discharge (1).
Presence of E. Coli at point of use; Turbidity < 5 NTU; type of water source 8, 11, 12, 17, 19, 26	✓	• Studies have consistently demonstrated no association between measured water quality and preventing AM or improved WHZ (8, 11, 12, 17, 19, 26); however, all studies but one (26) were low-quality.
Safe water storage		
Water is correctly stored (clean and covered container) 1, 8, 18, 21, 26	✓	Majority of studies did not find any association between correctly stored water (1, 8, 18, 21) and prevention of AM, with the exception of one prospective cohort study (26). • Regarding treatment, the provision of a lidded container did have an effect on improving SAM recovery outcomes in one high-quality study; however, it was part of a package of other services and therefore, the positive effects cannot be attributed specifically to the provision of a lidded container (1).

⋯ INSUFFICIENT ✓ LOW ✓✓ MODERATE ✓✓✓ HIGH

INDICATORS *(with reference to literature in annex)*	SIGNIFICANCE OF EVIDENCE	DESCRIPTION
Handwashing		
Knowledge or practice of proper handwashing behaviors 3, 4, 8, 19, 26	✓	• Current evidence is mixed and weak. Some studies found **no association** between handwashing and the prevention of SAM (8, 19, 26), or the improvement of anthropometric measures in children (3), while one study did find an association with the prevention of SAM (4). Only one study was high-quality (26), the rest of the studies were low-quality.
Observation of soap at a handwashing station; Observation of soap use during a handwashing demonstration 7, 8, 16, 20, 26	✓	• Few studies have examined the association between use of soap and preventing AM. Those that have been done found **no association** between use of soap and preventing AM (7, 26) or SAM (8, 20) or improving WHZ (16). Body of evidence includes one high-quality study (26), one moderate-quality study (16), and three low-quality studies (7, 8, 20).
Provision of soap 1, 14, 16	✓	• Current evidence is mixed. Three studies (1, 14, 16), including several intervention-based studies, all found no association with the provision of soap and improved WHZ. Regarding treatment of SAM, the provision of soap did have an effect on improving SAM recovery outcomes in one high-quality study; however, it was part of a package of other services (including drinking water, a container with a fitted lid; chlorine tablets, a cup with a handle, and leaflet with hygiene messages) and therefore, the positive effects cannot be attributed specifically to the provision of soap alone (1).
Food hygiene		
Provision of a cup with handle for child to drink; monthly hygiene expenses 1, 7, 8	...	• Very little research has been conducted on the link between food hygiene and AM. One study (8) found **no association** between monthly hygiene expenses and prevention of SAM. Another (7) found no association with use of utensils and prevention of acute malnutrition. Regarding treatment of SAM, the provision of drinking cup intended for the child did have an effect on improving SAM recovery outcomes in one high-quality study; however, it was part of a package of other services and therefore, the positive effects cannot be attributed specifically to the provision of the cup (1)
Hygiene promotion and community mobilization activities		
Provision of individual and/or group hygiene sensitization sessions; provision of hygiene promotional material. 14 ,16, 18, 20, 23, 27, 28	✓	• The majority of studies, ranging from low to high-quality, do not show an effect of hygiene sensitization sessions and promotional material on improved WHZ (14, 16) or preventing AM (14, 18, 20). While three high-quality studies did demonstrate an effect of group hygiene sensitization sessions on improved WHZ (23, 27, 28), in two of these studies (27, 28), the sessions were in combination with the provision of food, whereby the effect on improved WHZ cannot be attributed specifically to the hygiene sessions alone.

... INSUFFICIENT ✓ LOW ✓✓ MODERATE ✓✓✓ HIGH

INDICATORS *(with reference to literature in annex)*	SIGNIFICANCE OF EVIDENCE	DESCRIPTION
Environmental hygiene and vector control		
Absence of animal and human feces around children playing/waiting areas; provision of safe chil play space 14	⋯	• One high-quality study showed that the provision of a safe play space for children (to minimize geophagia and ingestion of chicken feces) had **no effect** on preventing AM (14).
Provision of insecticide-treated bed net education 24, 25	⋯	• Two cRCTs demonstrated **no effect** of providing insecticide-treated bed nets on preventing AM (24, 25)
Access to sanitation		
Access to or presence of household latrine 4, 5, 7, 8, 20	⋯	• Current evidence is mixed and weak. Two studies (4, 8) found a positive association between access to a household latrine and preventing AM (4) and SAM (8), while other studies (5, 7, 20) found no association with preventing SAM (20) or improving WHZ (5). All studies were low-quality. One low-quality study found an association between the percent of community using a latrine and improved child WHZ (5), indicating the **importance of community-level sanitation over household-level sanitation.**
Presence of household hygienic toilets or "improved latrine" 2, 5, 6, 7, 12, 13, 14, 16, 18, 19, 21, 26	✓✓	• Studies have consistently shown no association between the presence of an improved latrine at the HH and preventing AM or improving WHZ (2, 5, 6, 7, 12, 13, 16, 18, 19, 21, 26). While four studies (14, 18, 21, 26) were high-quality, the remainder were low-quality.
Presence of potties for toddlers 18, 21	✓	• Very few studies exist that examine the effect of the presence of small potties for children on AM. Two large high-quality studies that involved providing small potties for children as part of a larger package of WASH services (provision of chlorine, water container with lid, messaging on use of latrine and disposal of child feces, latrine, messaging on handwashing, soap, handwashing stations, child potties, and food supplements), including the provision of small potteries for children, demonstrated no effect on preventing wasting (18, 21)
Absence of open defecation	⋯	• While there is a strong logic that a casual link exists between the absence of open defecation and child AM, no study that examined this association were found on this review.

⋯ INSUFFICIENT ✓ LOW ✓✓ MODERATE ✓✓✓ HIGH

INDICATORS *(with reference to literature in annex)*	SIGNIFICANCE OF EVIDENCE	DESCRIPTION
Sanitation practices		
Safe disposal of child feces 8, 12		• Very little evidence exists of the association between safe disposal of child feces and AM. In this review, two low-quality studies show mixed results regarding the association between safe disposal of child feces and preventing AM (8, 12).

INSUFFICIENT LOW MODERATE HIGH

3.2 KEY FINDINGS AND RECOMMENDATIONS

This report highlights evidence gaps on the impact of WASH interventions on acute malnutrition, and reaffirms the importance of context as a key critical factor of the effectiveness of an intervention.

The major findings of the evidence review are summarized in the below graphic:

TREATMENT

Very little research has been conducted on the effect of WASH interventions on the treatment of AM. While the provision of specially-formulated therapeutic and supplementary foods in outpatient therapeutic feeding programs and supplementary feeding programs are the standard of practice for treating acutely malnourished children, **evidence is building on the additional benefits of the provision of water treatment supplies and counseling for improved water quality.** A few small studies have demonstrated that improving the water quality at the household level has a moderate effect on improving AM outcomes. While additional trials are needed in a variety of contexts to confirm these initial findings, programs that are treating acutely malnourished children may consider the feasibility and cost of adding a water quality component to the current standard of care. Increasing adherence and continuing such behaviors after discharge may help to improve the sustainability of that recovery and reduce relapse; however, this is yet to be proven through research.

PREVENTION

While many low-quality studies have been conducted that indicate associations between WASH-related indicators and child AM, **very few high-quality intervention trials have been conducted that demonstrate significant impact on preventing malnutrition**. The results are inconsistent, and the quality of studies are varied. Therefore, given the current state of the evidence, a consistent conclusion of strong associations between household sanitation and AM have not been demonstrated. **The lack of evidence may or may not translate to an incorrect hypothesized causal chain between poor WASH and child AM**; but surely, enough high-quality studies have yet to be conducted to determine and prove which causal pathways are the most significant contributors to AM and which interventions are most effective in reducing such malnutrition.

It is important to consider that the WASH sector includes a wide variety of diverse interventions that aim to address distinct (albeit still related) issues.

Therefore, **extensive context analysis may be necessary** before designing a WASH intervention in order to best match the intervention with the specific needs of the target population and the environmental context.

As the aim of WASH interventions is to prevent the transmission of harmful pathogens from the environment to humans, it is important to understand that not all WASH interventions will disrupt the transmission of all pathogens. For example, certain water treatment methods do not kill all pathogenic organisms that may be present in drinking water. It may be useful to conduct environmental testing to determine what harmful pathogens are particularly present in the context of implementation and determine which interventions are best suited to stop transmission.

It also may be possible that environments are so contaminated that one or even the combination of a few interventions aimed at the individual or household level does not reduce the among of exposure to harmful pathogens enough to realize an impact on acute malnutrition. Because of this, many hypothesize that community-based interventions may show more promise than individual and household interventions. In many contexts throughout low- and middle-income countries, communal living is quite pervasive.

Therefore, in order to truly reduce the exposure to harmful pathogens, the environment both within and beyond the household must be sanitary.

3.3 CONCLUSION

In conclusion, the current state of the evidence regarding associations between WASH indicators and AM outcomes is very weak. Although hypothesized causal pathways are supported by strong logic, they have yet to be consistently proven through rigorous studies. Therefore, there is a great need for high-quality, rigorous intervention studies to be conducted in order to further prove or disprove the proposed links between WASH and AM. This evidence must be developed in order to guide decision-making regarding if and how WASH services are to be implemented with the aim of improving AM outcomes.

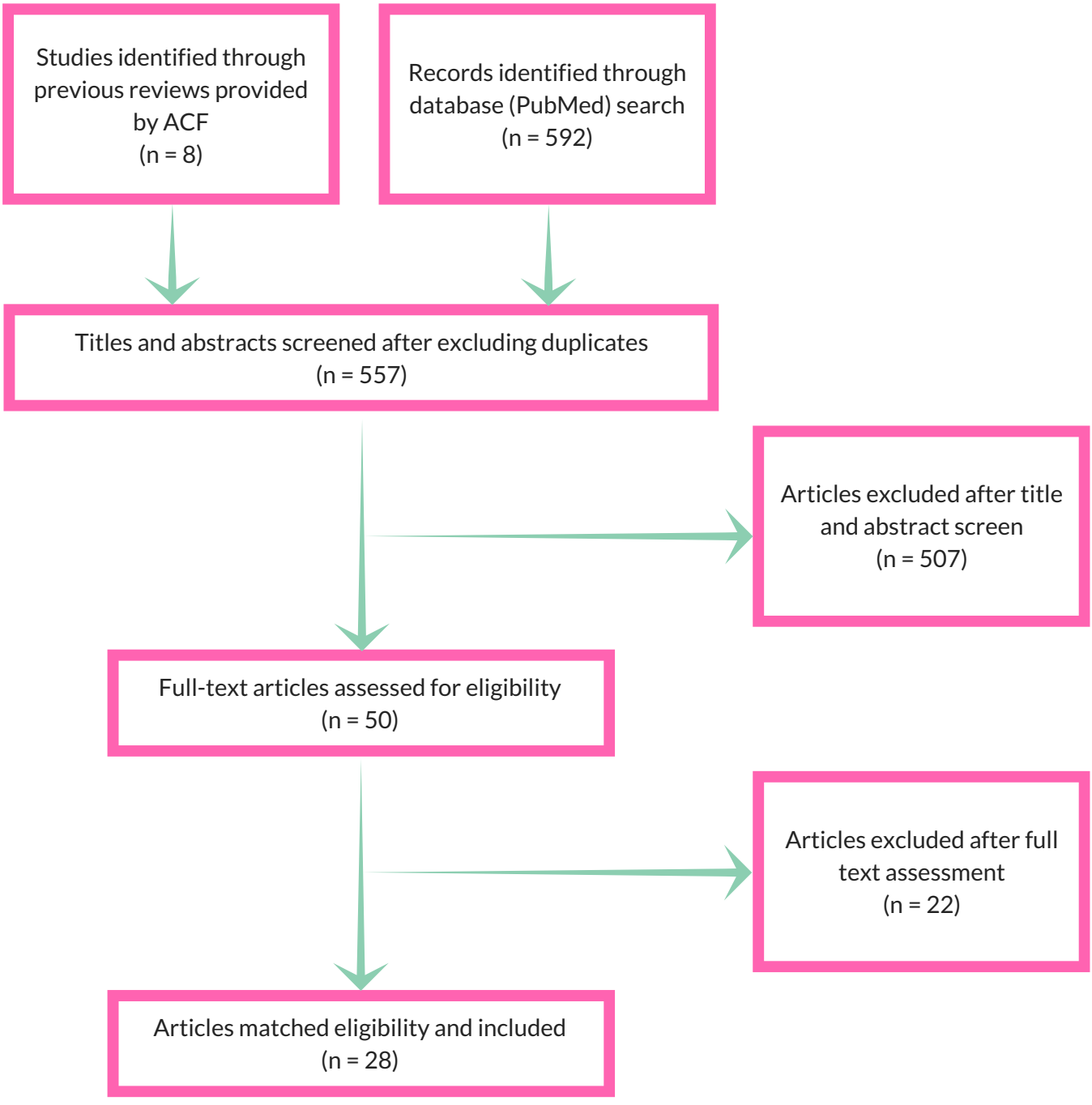
3.4 NEXT STEPS

A workshop was convened on November 22nd 2019 with a group of researchers, donor and health, nutrition and WASH technical advisors from various organizations (Action Against Hunger, Concern Worldwide, French Red Cross, ICRC, International Medical Corps, LSTHM, MSF France, Première Urgence Internationale, Save the children UK, Solidarités International, TUFTS, USAID, WASH and Global Nutrition Cluster, Welthungerhilfe) to translate the evidence on water quality into concrete, practical actions to reinforce WASH and nutrition integration.

With regard to the results of the review, integration discussions focused on ways of improving household water quality and systematically including it in the package of activities accompanying AM treatment. The R4ACT systematic review was presented followed by a presentation of the WASH'Nutrition strategy developed in 2012 and consolidated in 2017 by Action Against Hunger and seventeen organizations. A presentation of the CMAM protocol followed by a presentation of WASH activities related to water quality allowed nutrition and WASH advisors to have a good understanding of the activities developed by the other sector to ultimately facilitate the identification of potential areas to reinforce integration.

Participants were then divided into two working groups and asked to prioritize three key integrated activities at the health facility level and three at the community/household level with one linked indicator per activity. They were then asked to identify barriers/opportunities for the implementation of these activities as well as potential mitigation solutions. At the end of the day, a roadmap was defined and participating organizations selected the activities they committed themselves to implement in their own organization in the future.

ANNEX 1: EXISTING BODY OF EVIDENCE ON WASH AND NUTRITION



ANNEX 2: STUDIES INCLUDED IN THE SUMMARY OF EVIDENCE ON WASH AND ACUTE MALNUTRITION

Ref	First Author, Year, Country, Context	Outcomes	Prevention or Treatment	Study design	Study description	Association or Impact	Results	Significance of evidence*
1	Altmann *et al.*, 2018, Chad, rural	SAM (WHZ <-3)	Treatment and Prevention	cRCT**	cRCT including 1603 participants to assess the effectiveness of a household WASH package on the performance of an Outpatient Therapeutic feeding Program (OTP) for SAM.	Positive None	Intervention group associated with higher recovery rate of SAM, but no difference in relapse rates post-discharge. Improved WASH behaviors declined over time post discharge.	++++
2	Ambadekar& Zodpey, 2017, India, rural	SAM (WHZ <-3)	Prevention	case control	Cases were 737 children with SAM and controls were 737 children with WHZ > -2, matched by age, gender, location	Positive	Use of water purification method (purifier or filer straining) and use of latrine associated with not having SAM	+++
3	Arnold *et al.*, 2009, Guatemala, rural	SAM (WHZ <-3)	Prevention	quasi-experimental	Evaluation of the behavioural and health impacts of a pre-existing 3-year combined point-of-use water treatment and handwashing non-randomized intervention in 30 villages (15 intervention and 15 control) that included 600 households, and 929 children <5 years old.	None None	The intervention included the promotion of handwashing and the next water treatment methods: boiling, solar disinfection (SODIS) and chlorination with diluted bleach. No significant differences were observed in the anthropometric measures between children living in intervention and control villages.	++
4	Ayana, Hailemariam &Melke ,2015, Ethiopia, rural	wasting (MUAC < 12.5cm)	Prevention	case control	Non-matched, facility-based cases (113 wasted children) and control (226 non-wasted children)	Positive Positive None	Less frequent handwashing of mothers and the absence of a latrine are associated with higher risk of having SAM. The distance to water source has no effect on AM outcomes.	++
5	Buttenheim, 2008, Bangladesh, urban	mean WHZ	Prevention	quasi-experimental	Data taken from a program that build improved latrines in poor slums in Bangladesh, one-year follow-up . No randomization.	None None None Negative	1) no association between changes in latrine availability at HH level and WHZ 2) no association between change from unimproved to improved latrine at HH level and WHZ 3) no association between latrine per HH in community and WHZ 4) association between percentage of community using improved latrines and WHZ	++
6	Chisti *et al.*, 2007, Bangladesh	SAM (WHZ <-3)	Prevention	case control	Unmatched case-control study in which 6,881 under-five children, presented to facility with SAM were cases and controls were non-SAM	Positive	association between maternal use of 'unsanitary' toilet and child wasting	++
7	De Vita, 2019, Kenya, urban	SAM (WHZ <-3)	Prevention	case control	Secondary analysis of quantitative data collected from a cluster randomized trial that involved 1119 infants. It examined associations between WASH interventions and wasting.	None	association between maternal use of 'unsanitary' toilet and child wasting	++

*The strength of evidence derived from each study was evaluated based on the Cochrane GRADE approach (Schünemann et al., 2013). A detailed description of the approach is contained in Annex 4.
**Cluster randomised controlled trial

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Ref	First Author, Year, Country, Context	Outcomes	Prevention or Treatment	Study design	Study description	Association or Impact	Results	Significance of evidence
8	Dodos *et al.*, 2018, Chad, rural	SAM (WHZ <-3)	Prevention	case control	A matched case (SAM) control (non-SAM) study was conducted on 411 children and their caregivers. Controls were matched on place of residence and on age (± 3 months).	Positive	1) Less frequent hand washing after defecation and absence of toilet in the household are associated with SAM. 2) No other differences in WASH factors between cases and control were identified.	++
9	Doocy *et al.*, 2018, Pakistan, urban and rural	SAM (MUAC < 11.5cm)	Treatment	cRCT	901 participants where program sites were randomized to one of four intervention arms: (i) standard SAM treatment; (ii) SAM treatment plus flocculent/disinfectant water treatment; (iii) SAM treatment plus chlorine disinfectant; or (iv) SAM treatment plus ceramic water filter.	Positive	incorporating point-of-use water treatment in OTP improved recovery rates, length of stay and weight gain. No difference between different types of water treatment	++++
10	du Preez *et al.*, 2011, Kenya, urban and rural	Median WHZ	Prevention	RCT	555 children between 6 months and 5 years of age were included in an RCT to examine the effect of solar disinfection (SODIS) of drinking water on the incidence of diarrhoea, and anthropometric measurements	None	incorporating point-of-use water treatment in OTP improved recovery rates, length of stay and weight gain. No difference between different types of water treatment	++++
11	Fikree, Rahbar&Berendes, 2000, Pakistan, urban	wasting (WHZ < -2)	Prevention	prospective cohort	A 2-year birth cohort of 565 children with regularly interval anthropometric measurement and WASH indicators collected	None	no association between having piped water into a HH and wasting.	++
12	George *et al.*, 2016, Bangladesh, rural	wasting (WHZ <-2) mean WHZ	Prevention	prospective cohort	In a cohort of 216 children, unsafe child feces disposal was assessed using 5-hour structured observation by trained study personnel as well as caregiver reports; anthropometrics measured at baseline and at a 9-month follow-up	Positive	safe disposal of child feces is associated with higher WHZ; not modified by an improved sanitation option	++
13	Headey & Palloni, 2019, multi-country	wasting (WHZ < -2)	Prevention	Panel data secondary analysis	In a cSecondary data analysis of 442 subnational regions in 59 countries using Demographic Health Surveys to examine whether longer-term changes in water and sanitation at the subnational level predict improvements in child morbidity, mortality, and nutrition.	None	No association between increased sanitation coverage or increased improved water source with improved prevalence of wasting	++

++++ **High quality** We are very confident that the true effect lies close to that of the estimate of the effect

+++ **Moderate quality** We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

++ **Low quality** Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect

+ **Very low quality** We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

ANNEX 2 : STUDIES INCLUDED IN THE SUMMARY OF EVIDENCE ON WASH AND ACUTE MALNUTRITION

Ref	First Author, Year, Country, Context	Outcomes	Prevention or Treatment	Study design	Study description	Association or Impact	Results	Significance of evidence
14	Humphrey *et al*., 2019, Zimbabwe, rural	wasting (WHZ < -2) mean WHZ mean MUAC	Prevention	cRCT	5280 pregnant women enrolled in a 2 x 2 factorial trial, clusters were randomly assigned to standard of care, IYCF, WASH (construction of a ventilated improved pit latrine, provision of two handwashing stations, liquid soap, chlorine, and play space plus hygiene counseling, or IYCF plus WASH; final outcomes were measured when child was 18 months old	None	Household-level WASH intervention did not effect levels of acute malnutrition in children	++++
15	Iannotti, Zavaleta, Leon & Caufield 2009, Peru, urban	mean WHZ	Prevention	prospective cohort	232 infants were followed longitudinally from birth through 12 months of age from a prenatal zinc supplementation trial conducted in Lima, Peru, between 1995 - 1997.	None	no association between toilet type and water source with WHZ	++
16	Langford, Lunn&Brick 2011, Nepal, urban	mean WHZ	Prevention	quasi-experimental	88 infants 3 to 12 months old living in the eight slums were enrolled. In intervention areas, a small-scale community-based hand-washing program was implemented for six months; in control areas, mothers continued their normal practices	None	no association between participation in the handwashing intervention and child WHZ	+++
17	Lin *et al*., 2013, Bangladesh, rurall	wasting (WHZ <-2) mean WHZ	Prevention	case control	Government implemented national wide program to improve sanitary conditions of HHs. Study selected 119 HHs from clean and unsanitary conditions from both intervention and control groups. They followed-up with children 3 years after intervention started to determine impact on nutrition	None	no statistical difference in prevalence of wasting (WHZ - <2) or mean WHZ between living in a 'clean' vs. 'unsanitary' environment	++
18	Luby *et al*., 2018, Bangladesh, rural	wasting (WHZ <-2) mean WHZ	Prevention	cRCT	The WASH Benefits cluster-randomized trial enrolled pregnant women and evaluated outcomes at 1 and 2 years of follow-up of WASH intervention alone or combined with nutrition interventions. Geographically-adjacent clusters were block-randomized to active control (household visits to measure MUAC), passive control (data collection only), or compound-level interventions	None	WHZ was better among the groups receiving nutrition component only; no association between WHZ and WASH interventions. No difference in wasting across groups.	++++
19	Munirul Islam, 2018, Bangladesh, urban	SAM (WHZ <-3)	Prevention	prospective cohort	77 infants with SAM and 77 without SAM enrolled at 48 weeks of age and followed for 6 months	None	WASH indicators were not associated with SAM	++
20	Nabwera *et al*., 2018, Gambia, rural	SAM (WHZ <-3)	Prevention	case control	77 cases had WHZ < −3 on at least 1 occasion during infancy. 203 controls were those with a WHZ > −3 in the same interval, matched on age, gender, village size and distance from the clinic	Positive None None None None	SAM associated with water treatment; none with drinking water fetched daily, source of drinking water being > 30 min; toilet in compound; handwashing with soap	++

ANNEX 2: STUDIES INCLUDED IN THE SUMMARY OF EVIDENCE ON WASH AND ACUTE MALNUTRITION

Ref	First Author, Year, Country, Context	Outcomes	Prevention or Treatment	Study design	Study description	Association or Impact	Results	Significance of evidence
21	Null *et al*, 2018, Kenya, rural	wasting (WHZ < -2) mean WHZ	Prevention	cRCT	The WASH Benefits cluster-randomized trial enrolled 8246 pregnant women and evaluated outcomes at 1 and 2 years of follow-up. Geographically-adjacent clusters were block-randomized to active control (household visits to measure mid-upper-arm circumference), passive control (data collection only), or compound-level interventions	None	The study included interventions on : 1) water; 2) sanitation; 3) handwashing; 4) combined water, sanitation, and handwashing; 5) nutrition; and 6) combined water, sanitation, handwashing, and nutrition interventions. No statistical differences were found in wasting between control and intervention groups.	++++
22	Patil *et al*, 2014, India, rural	mean WHZ mean MUAC	Prevention	cRCT	A cRCT with randomization at the village level and equal allocation to the two treatment arms. The study population included villages from two neighboring districts whereby villages were randomized to receive the total sanitation campaign (TSC) program or serve as the control group. The study enrolled a random sample of 5,209 children <5 years old from 3,039 households that had at least one child <24 months at the beginning of the study.	None None	no association between participation in the total sanitation campaign (TSC) and child WHZ or MUAC	++++
23	Seetha *et al*., 2018, Malawi, rural	mean WHZ mean MUAC	Prevention	cRCT	The study adapted the 21 day Positive Deviance/Hearth model and 179 mothers were trained on the subjects of appropriate complementary feeding, WASH practices, and aflatoxin contamination in food.	Positive	Participation in the Pd hearth training associated with higher WHZ (day 7 and 21) and MUAC (day 21).	++++
24	Smithuis *et al*, 2013, Myanmar, rural	mean WHZ	Prevention	cRCT	cRCT to assess the efficacy of ITNs in preventing malaria and anemia in 8,175 children and their secondary effects on nutrition and development. The data were aggregated for each village to obtain cluster-level infection rates. Involved children under 10 yrs followed for 10 mos	None	no association between village-wide distribution of ITN and child WHZ	++++
25	Stobaugh *et al*, 2017, Malawi, rural	wasting (MUAC < 12.5cm)	Treatment and Prevention	cRCT	cRCT among children recovered from MAM to assess a package of health and nutrition interventions that consisted of a lipid nutrient supplement, deworming medication, zinc supplementation, a bed net, and malaria chemoprophylaxis.	None	no association between provision of ITN/chemoprophylaxis and prevalence of wasting	++++

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+++ **Moderate quality** We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

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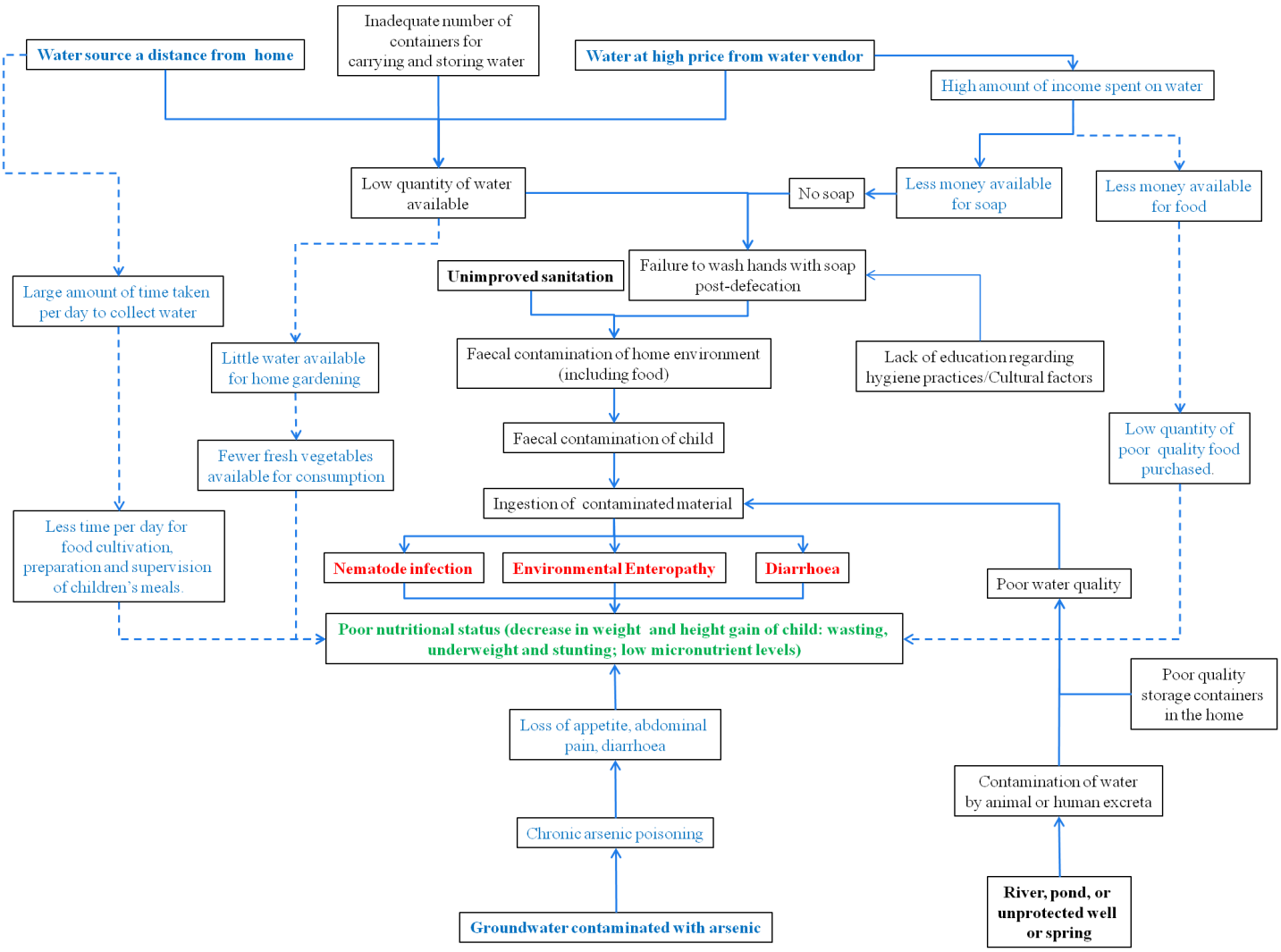
ANNEX 2: STUDIES INCLUDED IN THE SUMMARY OF EVIDENCE ON WASH AND ACUTE MALNUTRITION

Ref	First Author, Year, Country, Context	Outcomes	Prevention or Treatment	Study design	Study description	Association or Impact	Results	Significance of evidence
26	Stobaugh *et al*, 2018, Malawi, rural	wasting (MUAC < 12.5cm)	Prevention	prospective cohort (nested within cRCT)	Children were followed for 12 months after recovery from MAM and HH indicators were collected to assess HH-level risk factors of relapsing to MAM or SAM after initial recovery.	Positive None	1) Observed lids on water storage containers was associated with sustained recovery. 2) The next indicators were not associated with sustained recovery: cleanliness of caregivers' hands, cleanliness of child's hands, improved water source, treated drinking water, use soap for handwashing, knowledge of critical times for handwashing, frequency of bathing child, improved sanitation facility. (using soap and improved latrines were marginally significant).	++++
27	Tomedi *et al*., 2012, Kenya, rural	wasting (WHZ < -2) mean WHZ	Prevention	quasi-experimental	The intervention consisted of a monthly food ration for the child, a separate family ration, and group education on appropriate IYCF and hygiene. All children started with WHZ > -2. The intervention lasted 7mos.	Positive	Monthly family ration, child ration, and IYCF and hygiene counseling sessions were associated with improved WHZ and less wasting (0% v. 9% for intervention and control groups, respectively)	++++
28	Zhang, Shi, Shen, Wang & Wang, 2013, China, rural	mean WHZ	Prevention	cRCT	The intervention group received information on enhanced home-prepared recipes and food preparation and hygiene through group training, counselling and home visit by healthcare providers. Cohort began between 2-4 months old and ended at 18 mons old for child.	Positive	Educational intervention (including feeding practices and hygiene) to parents is associated with improved WHZ	++++

ANNEX 3: CAUSAL PATHWAYS BETWEEN WASH AND CHILD NUTRITION

Figure 1. Pathways for how poor water, sanitation and hygiene might impact child nutritional status, indirectly



Source: Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, Cavill S, Allen E, Uauy R. Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. Cochrane Database of Systematic Reviews 2013, 8. Art. No.: CD009382.

ANNEX 4: RATING THE QUALITY OF EVIDENCE: THE COCHRANE GRADE APPROACH

Figure 1. Significance of the four levels of evidence

QUALITY LEVEL	CURRENT DEFINITION	PREVIOUS DEFINITION
High	We are very confident that the true effect lies close to that of the estimate of the effect	Further research is very unlikely to change our confidence in the estimate of effect
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate
Very low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect	Any estimate of effect is very uncertain

Source: Adapted from Balshema H, Helfanda M, Schunemann HJ, Oxmand AD, Kunze R, Brozekc J, Vistd GE, Falck-Ytterf Y, MeerpohlgJ, Norrisi S, Guyatt GH. GRADE guidelines: 3. Rating the quality of evidence. J Clin Epidemiol 2011; 64: 401-406.

Figure 2. A summary of GRADE's approach to rating quality of evidence

STUDY DESIGN	INITIAL QUALITY OF A BODY OF EVIDENCE	LOWER IF	HIGHER IF	QQUALITY OF A BODY OF EVIDENCE
Randomized trials	**High**	**Risk of Bias** -1 Serious -2 Very serious **Inconsistency** -1 Serious -2 Very serious	**Large effect** +1 Large +2 Very large **Dose response** +1 Evidence of a gradient **All plausible residual confounding** +1 Would reduce a demonstrated effect +1 Would suggest a spurious effect if no effect was Observed	**High (++++)** **Moderate (+++)**
Observational studies	**Low**	**Indirectness** -1 Serious -2 Very serious **Imprecision** -1 Serious -2 Very serious **Publication bias** -1 Likely -2 Very likely		**Low (++)** **Very low (+)**

Source: Adapted fromBalshema H, Helfanda M, Schunemann HJ, Oxmand AD, Kunze R, Brozekc J, Vistd GE, Falck-Ytterf Y, MeerpohlgJ, Norrisi S, Guyatt GH. GRADE guidelines: 3. Rating the quality of evidence. J Clin Epidemiol 2011; 64: 401-406.