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SCALING UP NUTRITION—LEARNING AND EVALUATION (SUN LE)

A Literature Review of Childhood Stunting: Epidemiology and Determinants in Zambia and Sub-Saharan Africa

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Submitted by:
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Acronyms

GRZ	Government of the Republic of Zambia
MAM	Moderate Acute Malnutrition
NFNC	National Food and Nutrition Commission
SAM	Severe Acute Malnutrition
SSA	Sub-Saharan Africa
SUN	Scaling Up Nutrition
SUN LE	Scaling Up Nutrition Learning and Evaluation
SUN TA	Scaling Up Nutrition Technical Assistance
USAID	United States Agency for International Development
WASH	Water, Sanitation, and Hygiene

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1. Background

1.1 Introduction

Scaling Up Nutrition Learning and Evaluation (SUN LE) is implemented by Khulisa Management Services, Inc. (Khulisa), in partnership with the Government of the Republic of Zambia (GRZ), and in collaboration with its consortium partners, Indaba Agricultural Policy Research Institute, ICF, and the University of North Carolina at Chapel Hill.

SUN LE provides survey, research, evaluation, and dissemination services to the GRZ Scaling Up Nutrition (SUN) programme and the United States Agency for International Development (USAID)/Zambia Scaling Up Nutrition Technical Assistance (SUN TA) activity, which aims to reduce childhood stunting in Zambia. SUN LE emphasises the building of a learning culture and adaptive management that allows SUN 2.0 to more quickly achieve its goal (i.e., reduced child stunting) than it would without a learning culture.

SUN LE Objectives

Build a SUN 2.0 evidence base for programme and policy decisions through conducting high-quality:

1. Baseline, midline, and endline surveys
2. Focused studies
3. Biennial performance audits

Facilitate individual and organisational capacity to use data through:

4. Creating a culture of learning and adaptive

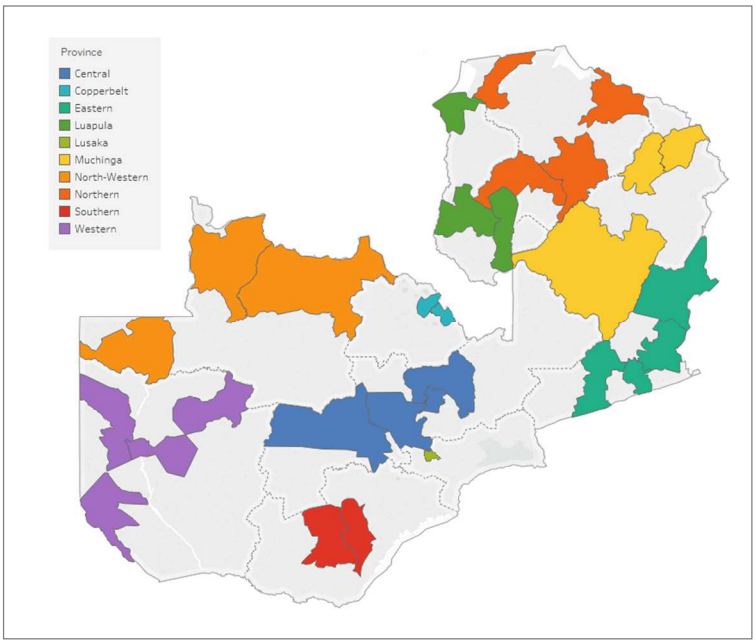
1.2 SUN LE Context

Zambia was one of the first African countries to join the SUN Movement, a global movement uniting governments, civil society, businesses, and citizens in a worldwide effort to end undernutrition.[1] SUN Zambia aims to improve child nutritional status by emphasising a decrease in Zambia's critically high rates of under-five stunting.

In 2019, the second phase of the SUN programme (known as SUN 2.0) will be implemented in 30 priority districts of the country, as shown in Figure 1, with support from various development partners (donors and civil society organizations).

[1] https://scalingupnutrition.org/sun-countries/zambia/

Figure 1. The 30 Priority Districts of SUN 2.0



The GRZ's SUN programme is coordinated by the National Food and Nutrition Commission (NFNC), a statutory body established by an act of parliament in 1967 to oversee nutrition activities in Zambia. NFNC coordinates and monitors the nutrition-specific and nutrition-sensitive efforts of seven line ministries (Table 1) and their overall contribution to the SUN programme. NFNC also coordinates the SUN 2.0 support from development partners.

USAID, one of the development partners supporting SUN 2.0, has committed support through two long-term projects—SUN TA and SUN LE—both of which work in close collaboration with the key line ministries and partners outlined in Table 1.

Table 1. Line Ministries and Agencies Involved in the SUN 2.0 Programme

1. Seven GRZ line ministries: • Ministry of Agriculture • Ministry of Health • Ministry of Community Development • Ministry of Fisheries and Livestock • Ministry of Local Government and Housing • Ministry of Water Development • Ministry of National Planning and Development 2. Other GRZ institutions and departments: • NFNC	3. Donor agencies: • USAID • European Union • Department for International Development • UNICEF 4. Civil society organizations for SUN

• University of Zambia, Department of Food Science and Nutrition • Central Statistics Office	

1.3 Literature Review

This literature review is SUN LE's first focused study. It was undertaken by ICF, a SUN LE consortium partner, with input from other consortium partners, namely Khulisa and the University of North Carolina at Chapel Hill. The objective of the literature review was to undertake a thorough search of studies on childhood stunting and its determinants, with a special focus on sub-Saharan Africa (SSA) and Zambia in particular. Findings from this literature review will inform SUN 2.0 planning, and gaps identified in the literature will contribute to the development of SUN LE's learning agenda.

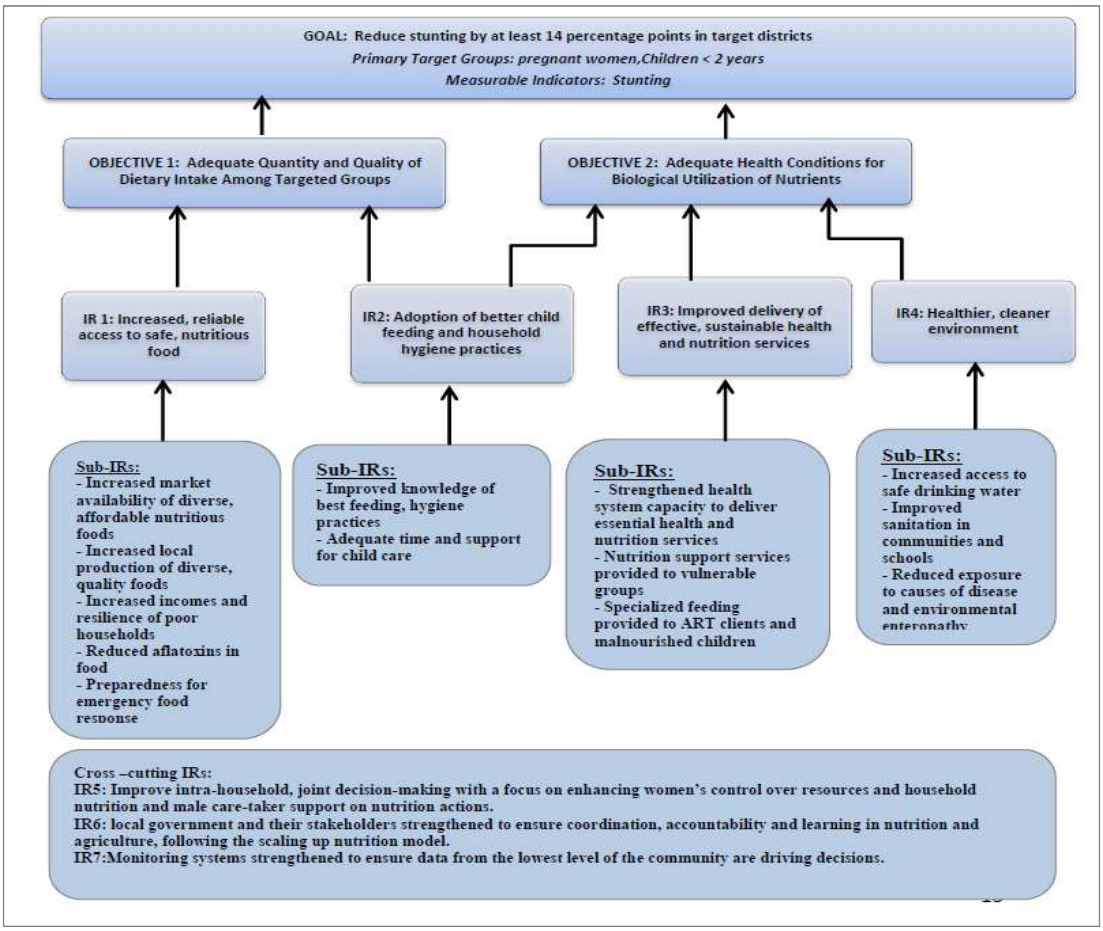
This report describes the methods used to conduct the literature review, including the guiding frameworks. The primary guiding framework, the UNICEF conceptual framework for the determinants of child undernutrition, was used to organise the review. The results presented begin with an overview of stunting in SSA and in Zambia, and the determinants of findings. The report then discusses findings around the causes, and gaps and recommendations organised around the three levels—immediate, underlying, and basic causes of undernutrition—of the UNICEF conceptual framework.

2. Methods

2.1 Guiding Frameworks

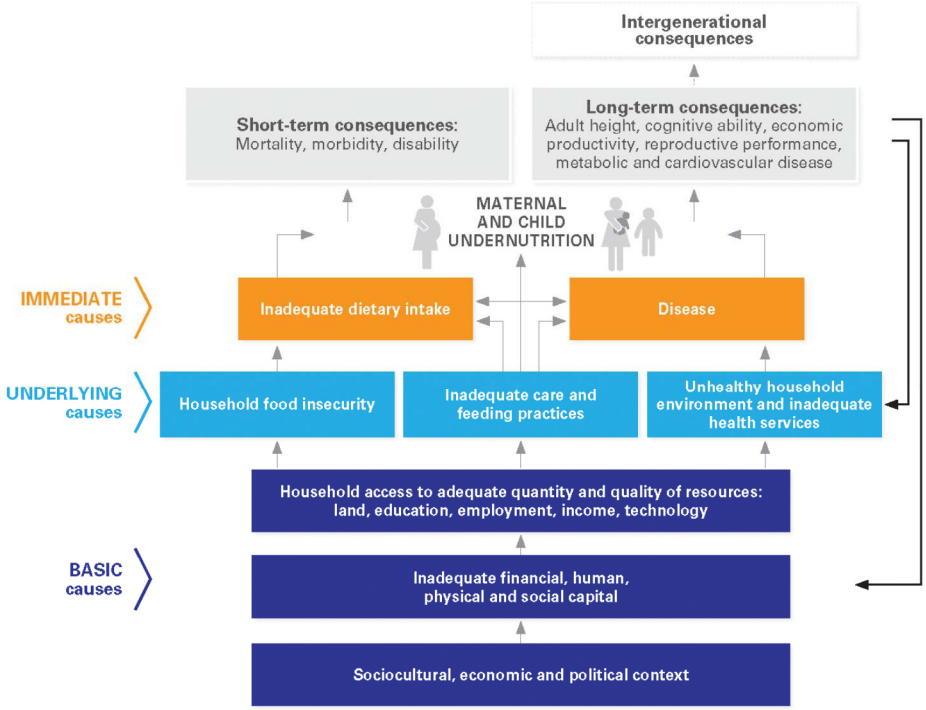
Multi-sectoral nutrition (nutrition-specific and nutrition-sensitive) interventions and actions are needed to address the multiple determinants of stunting. The USAID/Zambia results framework to reduce stunting (Figure 2) presents the expected change in stunting resulting from multi-sectoral nutrition interventions. There is little research, however, about how best to implement nutrition interventions, particularly across sectors (Menon 2014). Recent integrated nutrition intervention trials, including one in Zambia, have not had the desired impact on stunting (Kumar et al. 2018, Humphrey et al 2018, Luby et al. 2018, Null et al. 2018).

Figure 2. USAID/Zambia Results Framework to Reduce Stunting



Nutrition interventions seek to address the immediate, underlying, and basic drivers of undernutrition (e.g., disease, poor sanitation, food insecurity, women's empowerment), as depicted in Figure 3, which shows the UNICEF conceptual framework for the determinants of child undernutrition (UNICEF, 2015).

Figure 3. UNICEF Conceptual Framework for the Determinants of Child Undernutrition



The black arrows show that the consequences of undernutrition can feed back to the underlying and basic causes of undernutrition, perpetuating the cycle of undernutrition, poverty and inequities.

Source: Adapted from UNICEF, 1990.

This literature review is organised around the components of the UNICEF framework and serves as a review of the global stunting literature, with a regional focus on SSA and a country-specific focus on Zambia, where SUN LE operates.

2.2 Search Strategy

The SUN LE team conducted a systematic literature search between 20 March and 10 April, 2019. The team identified key publications by querying PubMed, SCOPUS, Web of Science, Development Experience Clearinghouse, and Global Health search engines, focusing on publications from 2009 onward (with the exception of seminal studies and publications recommended by nutrition experts, which were not time-bound). The search focused on adolescent, pregnant, infant, and young child populations. Specific search terms were used across databases and search engines. The Annex details the results of the search by search terms.

Although Zambia was the primary geographic focus area, additional sources from SSA were included in cases in which Zambia-specific information was not available. In some cases, contextual information and other relevant information with a broader or global geographic focus were included.

In addition to the systematic approach, a snowball approach using the Lancet Maternal and Child Nutrition Series (2013) was employed. All of the contributions to the series (seven commentaries, four series papers, and two articles) were reviewed. Relevant citations from these publications were also reviewed.

The SUN LE team used Excel to arrange the articles and relevant findings by thematic areas and map them according to the UNICEF conceptual framework. Specifically, the Excel sheet was organised according to the following categories: title, author, year, relevant findings by thematic area, implementation challenges, gaps, and recommendations. Figure 4 illustrates the prominent themes that emerged.

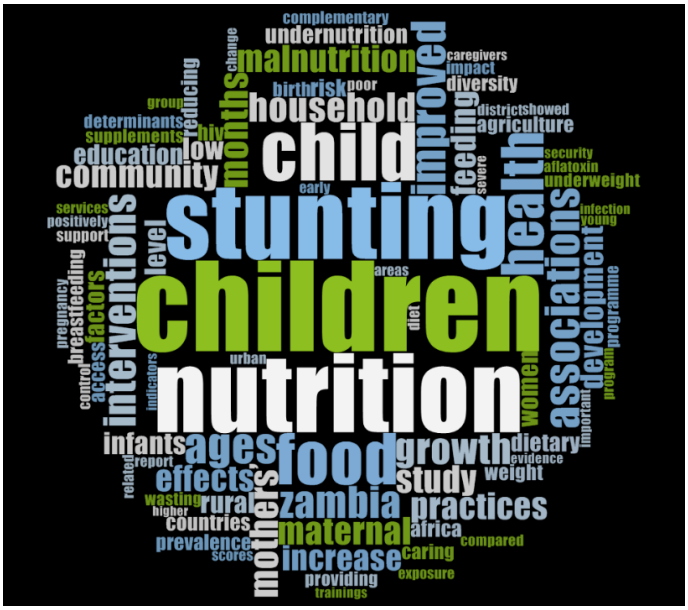


Figure 4. Word Cloud: Thematic Organization of Literature

2.3 Limitations

The following limitations are noteworthy:

- The search was restricted to publications in English.
- Although the literature is continuously being updated, the SUN LE search was limited to the publications available at the time of the search (i.e., publications released after 10 April 2019 are not included).
- The purpose of this review is to summarise literature about stunting determinants, which precludes a "deep dive" into any of the factors that interact to contribute to stunting.

3. Results

3.1 Stunting Background

Stunting (i.e., linear growth faltering) in early childhood is associated with increased risk of short-term morbidity and mortality, noncommunicable diseases later in life, and reduced learning capacity and productivity (Black et al. 2013). Stunting can begin in utero and continue through the first 2 years of life, and it peaks at 18–24 months of age (Prendergast and Humphrey 2014; Dewey and Huffman 2009; Victora et al. 2010). Multiple factors, including maternal nutrition status, infant and young child care and feeding practices, hygiene and sanitation, frequency of infections, and access to health care, are key proximal determinants of child growth and are influenced by the cultural, social, economic, political, and environmental context (Prendergast and Humphrey 2014; Stewart et al 2013, Black et al 2013).

3.2 Stunting in Zambia

Although rates of stunting in Zambia have decreased from a high of 52.5% in 2002 (CSO, Central Board of Health, ORC Macro 2003), they remain significantly high more than a decade and a half later, with 35% of children under 5 years of age stunted in 2018 (CSO, Ministry of Health, ICF 2019). This is a decrease from 40% in 2014 (CSO, Ministry of Health, ICF 2014) and shows a continuing positive, but slow, trend. The most recent Zambia Demographic and Health Survey report (CSO, Ministry of Health, ICF 2019) indicates that:

- Stunting prevalence is highest (46%) in children 18–23 months of age and lowest (7%) in children under 6 months of age.
- A greater proportion of boys (38%) are stunted than girls (31%).
- Stunting is higher in rural areas (36%) than in urban areas (32%).
- Northern Province has the highest proportion of stunted children (46%), and Southern and Western Provinces have the lowest (29%).
- Maternal education and wealth both have inverse relationships with stunting.
    - Only 15% of children whose mothers have more than a secondary education are stunted, compared with 38% of those whose mothers have no education.
    - Children in the wealthiest households are much less likely to be stunted (24%) than those in the poorest households (40%).
- More than a quarter (29%) of girls 15–19 years of age were pregnant or had given birth to their first child. By 19 years of age, 53% of adolescent girls had given birth or were pregnant with their first child, and the proportion of girls beginning childbearing during adolescence is increasing. This is important

because firstborn children of adolescent girls are 33% more likely to be stunted than children born to older mothers (Fink et al. 2014).

3.3 Stunting: Epidemiology and Determinants in Zambia and SSA

3.3.1 Stunting Epidemiology in SSA

Although stunting prevalence decreased minimally between 2000 and 2015 (Ricci et al., 2018), Africa was the only region with an increase in the number of stunted children during that time period (Black et al., 2013). Currently, Africa has 50 million stunted children, one-third of the world's total (UNICEF, 2017).

Figure 5. Determinants of Stunting in SSA

There is a spatial dimension to undernutrition; stunting varies by location within and between countries (Yourkavitch et al. 2018; Chagomoka et al. 2016), a situation also observed in Zambia (CSO, Ministry of Health and ICF, 2019). Although foetal growth restriction may account for 20% of stunting (Black et al. 2013), scaling up 10 key interventions could reduce stunting by 20% (Bhuttah et al. 2013). Those 10 interventions are as follows: periconceptional folic acid supplementation or fortification, maternal balanced energy protein supplementation, maternal calcium supplementation, multiple micronutrient supplementation in pregnancy, promotion of breastfeeding, appropriate complementary feeding, vitamin A supplementation in children 6–59 months of age, zinc supplementation in children 6–59 months of age, management of severe acute malnutrition (SAM), and management of moderate acute malnutrition (MAM).

3.3.2 Stunting Determinants in SSA

Table 2 lists findings from the literature review in terms of determinants of stunting in SSA, which are also depicted in Figure 5. These determinants are categorised under "immediate," "underlying," and "basic" causes of child undernutrition as identified in the UNICEF conceptual framework.

Table 2. Findings from Literature Review Indicating Determinants of Stunting in SSA

Determinants	Citation
Immediate Causes	
Foetal growth restriction	Danaei et al., 2016
Diarrhoeal illness	Akombi et al., 2017; Asfaw et al., 2015
No deworming medication during pregnancy	Nshimyiryo et al., 2019
Underlying Causes	

Determinants	Citation
Food insecurity	Bukusuba et al., 2017; M'Kabi, et al, 2017
Age of introduction to complementary foods	Bukusuba et al., 2017
Pre-lacteal feeding	Asfaw et al., 2015
Unimproved sanitation, leading to risk factors for stunting	Danaei et al., 2016
Maternal characteristics: Preeclampsia through low birthweight, multiple births, low maternal height, age of mother (children born to adolescent girls)	Akombi et al., 2017; Amugsi, et. al., 2017; Browne et al., 2015; Fink et al., 2014; Gebremedhin, 2015; Nshimyiryo, et al., 2019;
Basic Causes	
Household wealth	Akombi et al., 2017; Bukusuba et al., 2017; Efevbera et al., 2017; Eshete et al., 2017; Nshimyiryo et al., 2019
Lack of caregiver knowledge about stunting	Bukusuba et al., 2017
Male children are more likely to be stunted[2]	Akombi et al., 2017; Asfaw et al., 2015; Bukusuba et al., 2017; Doctor and Nkhana-Salimu, 2017; Nshimyiryo et al., 2019
Age of child (more than 6 months)	Amugsi, et. al., 2017; Doctor and Nkhana-Salimu, 2017; Eshete et al., 2017; Nshimyiryo et al., 2019
Mother's and father's education level	Balogun and Yakumu, 2015; Efevbera et al., 2017; Eshete et al., 2017; Nshimyiryo et al., 2019
Early marriage	Efevbera et al., 2017

3.3.3 Stunting Determinants in Zambia

Zambia-specific determinants align with some of the factors identified in the global literature. Dumas et al. (2018) found that in Luangwa Valley, livestock ownership was not associated with children's consumption of animal products, dietary diversity, or stunting. Interestingly, however, dietary diversity improved with increasing the number of chickens (Dumas et al., 2018). This is possibly because households are more likely to consume chicken than other livestock; households typically view livestock as assets and thus keep them for sale or wealth rather than consumption. In their logistic regression model for the determinants of stunting, Marinda et al. (2018) found that children who did not consume fish were more likely to be stunted, and children in poor urban

[2] The pathways to stunting in boys are still not definitive, although immature immune system and infant and young child feeding practices specific to boys are being explored as possible explanations.

households who consumed small fish *(kapenta)* were less likely to be stunted. Other factors that the authors found associated with stunting for children 6–23 months include the following:

- Child's age: odds ratio: 0.858, confidence interval: 0.800–0.919, p-value: 0.000
- Body mass index for the mother: odds ratio: 1.057, confidence interval: 1.001–1.117, p-value: 0.046
- Access to treated water: odds ratio: 0.496, confidence interval: 0.300–0.820, p-value: 0.006

The findings linking dietary diversification with stunting were mixed. Mofya-Mukuka (2016) found that low diversification can lead to long-term negative consequences for the nutritional status of children. For extremely high diversification, however, farmers may have less efficient production strategies, yielding many different types of food products but in shorter supply, thus reducing the household's overall food security. High levels of diversification could improve the nutrition status of children over the short term by delivering a high amount of nutrients, but this may come at the cost of reducing the production efficiency of the households and thus increase the possibility of longer-term stunting (Mofya-Mukuka, 2016). Moderate increases in diversification of crops were more likely to be beneficial in improving long-term nutritional outcomes (Mofya-Mukuka, 2016). These findings highlight the need to consider the complexity of interventions as well as their intended and unintended outcomes.

Other studies have made the case for multiple interventions. Fink et al. (2017) found that home-based growth monitoring did not affect child development. Community-based growth monitoring, in addition to nutritional supplements, reduced child development scores (the intended positive outcome). Together, both interventions had larger positive effects among stunted children and improved parents' reports of child protein intake (Fink et al., 2017). In addition, the combined effect of multiple factors, including household income, maternal education, mother's participation in nutrition training, and child dietary diversity had a significant effect and an inverse relationship with stunting i.e., improvements in these factors led to a reduction in stunting. Another significant factor was food insecurity; as food insecurity increased, stunting also increased. (Mulenga et. al., 2017). Mweemba et al. (2016) examined whether levels of knowledge of undernutrition in children under 5 years of age among mothers and caregivers of children in Zambia were associated with other known determinants of undernutrition. They found that mothers and caregivers had an average knowledge of undernutrition, but this was not associated with socio-demographic determinants related to undernutrition.

Hangoma et al. (2017) explored the relationship between stunting determinants and health inequality and found that stunting increased as households became poorer. They

also found that the mother's height and weight, birth order, place of delivery, duration of breastfeeding, level of maternal education, and wealth appeared to affect stunting levels. Mzumara et al. (2018) also had similar findings, in which children of mothers with some formal education, with a higher wealth status, and who had received assistance from a health professional during childbirth had a lower prevalence of stunting. They also found lower rates of stunting among children who lived in urban areas, were exposed to improved drinking water sources, were delivered in a private mission hospital, and had been breastfed for a longer duration. Consistent with several other studies, stunting rates were also lower in children 6 months of age and younger than in older children. For children aged 6–23 months, stunting rates were higher for children between 13–23 months than for those between 6–12 months (Mzumara et al. 2018).

Hangoma et al. (2017) also determined that the community in which a child is raised could affect stunting rates. Communities with access to different resources, based on socioeconomic background, could have reduced rates of stunting.

The findings of this literature review are presented according to the immediate, underlying, and basic causes of stunting in the global literature as well as in SSA and Zambia-specific literature.

3.4 Immediate Causes

The UNICEF conceptual framework of the determinants of child undernutrition identifies inadequate dietary intake and disease as two immediate causes of maternal and child undernutrition. The immediate causes of undernutrition identified in this literature review include these two determinants.

3.4.1 Inadequate Dietary Intake

Nutrition-related services in the health system are central to addressing the immediate causes that lead to stunting. Women are critical to providing these services, but several factors inhibit their participation (Bezabih et al., 2018). These factors include heavy and competing workloads, food avoidance or taboos, limited husband support, lack of economic resources, lack of awareness, low educational level, poor dietary habits, increased expenditure for cultural and religious festivities, "dependency syndrome," limited physical access to health facilities, and poorly equipped health facilities (Bezabih et al., 2018). A focus on child health and nutrition rather than maternal health, poor coordination among nutrition-specific and nutrition-sensitive interventions, and limited sources of nutrition information were also identified as barriers limiting the uptake of nutrition services during pregnancy (Bezabih et al., 2018).

Even in the presence of good intentions, conflicting priorities and limited knowledge of positive child feeding practices limit the uptake of nutrition-related services (Ruel-Bergeron et al., 2018). Dietary intake, especially meat consumption, has also been

associated with improved growth, in which consistent meat intake by toddlers had a protective effect against stunting (Krebs et al., 2011).

3.4.2 Disease and Infection

Several studies have examined the co-association between diseases, in relation to stunting.

HIV: Examining the impact of the malnutrition-infection cycle on the immune system is especially important in areas with high HIV prevalence rates. Some malnutrition determinants related to HIV are highlighted as follows:

- In HIV-exposed but uninfected infants in Malawi, underweight and stunting substantially increased the odds of not achieving motor milestones at 12 and 18 months of age (Buonomo et al. 2015).
- HIV-exposed infants had poorer nutritional status than those not exposed (Chalashika et al. 2017; le Roux et al. 2019).
- HIV-exposed but uninfected infants had shorter breastfeeding duration (le Roux et al. 2019).
- HIV-infected children "do not respond as well as non-infected children to usual nutritional care" (Jesson and Leroy 2015, abstract).
- Women with low CD4 count and those not receiving antiretroviral therapy delivered lower-weight babies (Morden et. al., 2016).

Malaria: Although there is well-documented evidence on the relationship between stunting and HIV, there is mixed evidence for the effect of malaria on stunting (Das et al. 2018), and insufficient evidence to include malaria as a determinant of stunting (Jackson et al., 2017). One study, however, found that agronomic fortification is not cost-effective for addressing malnutrition if the malaria burden is modest (Berkhout et al. 2019). Increases in the soil densities of copper, manganese, and zinc reduce child mortality when incidence of malaria is modest but not when it increases (Berkhout et al. 2019). Malaria infection during pregnancy contributes to, or exacerbates, undernutrition and is believed to affect foetal growth (Unger et al. 2016).

Diarrhoea: Diarrhoea incidence is a well-known risk factor of stunting (Bukusuba, Kaaya, and Atukwases, 2017), and has a mutually reinforcing relationship with malnutrition: malnutrition increases the risk of diarrheal disease and diarrheal disease increases the risk of malnutrition (WHO 2017).

Post-partum depression: In Kenya, as part of a match case-controlled study- with malnutrition, children who were hospitalised were found to have mothers with a significant mental health burden, and post-partum depression was associated with reduced or non-exclusive breastfeeding and underweight infants (Haither et al., 2018). Post-partum depression was also higher among mothers of malnourished children

(Haither et al., 2018; Madeghe et al., 2016). The directionality of this relationship cannot be verified in terms of which factor came first, depression or malnutrition.

Preventing and treating infections and disease, and increasing awareness of care for children and women are critical, particularly in settings with persistent global acute malnutrition (Young and Marshak, 2017).

3.5 Underlying Causes

The UNICEF conceptual framework of the determinants of child undernutrition identifies household food insecurity, inadequate care and feeding practices, unhealthy household environments, and inadequate health services as underlying causes of child undernutrition. Although these underlying causes are less obvious and more indirect, they allow the immediate causes described in Section 3.4 to develop. This literature review identified several aspects of inadequate care and feeding practices, including the relationship between stunting and feeding practices and access to safe and nutritious foods. The review also identified unhealthy household environments due to aflatoxin exposure and unhygienic practices.

3.5.1 Inadequate Care and Feeding Practices

Several studies conducted in SSA examined supplementation and feeding practices for children under 2 years of age as they relate to children's nutritional status, including stunting. In Zambia, introduction to complementary foods prior to 6 months of age is common, along with sub-optimal complementary feeding practices (NFNC, 2017). Several studies have attempted to further understand supplementation and feeding practices in this region. Studies by Ashorn et al. (2015) and Callaghan-Gillespie et al. (2017) found that food supplementation of maternal diets alone was not associated with preventing stunting in utero or up to 6 months after birth (Ashorn et al., 2015; Callaghan-Gillespie et al., 2017). Ashorn et al. (2015) found that supplementing maternal diets during pregnancy and for 6 months postpartum, and supplementing infant diets after 6 months with nutrient supplements (SQ-LNS), did not promote child growth by 18 months of age in rural Malawi. However, providing SQ-LNS to children 6-18 months of age reduced stunting among children 18 months of age in Zimbabwe (Humphrey et al. 2019).

A few positive determinants were also identified. In Burundi, projects showed success in reducing stunting by providing conditional food rations during pregnancy and the first two years of life. Although rations varied, they generally included a fortified-blended food for the individual ration and vegetable oil, grains, and legumes for the family ration (FANTA, 2018). Further supplementation with nutrient supplements was also successful (FANTA, 2018). In Benin, researchers found that maternal food preparation behaviours (including refrigeration) can prevent child malnutrition, controlling for biological and socioeconomic factors (Nagahori et al., 2018). In Ethiopia, mother's place of residence in urban settlement and postnatal check-up were significantly associated

with timely initiation of complementary feeding (Ayana et al., 2017). It is also important to note that Amugsi et al. (2017) found that the relationship between dietary diversity and stunting could differ based on the degree of stunting, and dietary diversity interventions may have more impact on children at a higher risk of malnutrition.

3.5.1.1 Stunting and Feeding Practices

Several studies have examined the relationship between dietary intake, feeding practices, and stunting. The following factors were associated with stunting:

- Mothers who resided in an urban setting were more likely to have timely initiation of complementary feeding for children 6–23 months of age in Pawe District in northwest Ethiopia (Ayana et al., 2017).
- Significant improvement in children's mean weight, weight for height, and weight for age were found in the intervention group that received nutrition education and recipe demonstrations twice monthly for 6 months in Ethiopia based on knowledge, attitudes, and practices (KAP) scores at baseline, midline, and endline (Mulualem et al., 2016).
- Improved maternal food preparation behaviours, including food refrigeration, can help prevent child malnutrition (Nagahori et al., 2018)
- Practicing the recommended infant and young child feeding practices was positively associated with women's empowerment (Na et al., 2015).
- Most caregivers who reported inappropriate breastfeeding practices lacked knowledge of proper breastfeeding practices (Nankumbi and Muliira, 2015).
- Caregiver's lack of knowledge around complementary feeding resulted in early weaning from breastmilk and early introduction of solid foods (Nankumbi and Muliira, 2015).
- Influence of cultural practices was identified as a significant barrier to appropriate infant and young child feeding practices (Nankumbi and Muliira, 2015).
- Lack of time, due to the burden of other responsibilities, was a barrier to exclusive breastfeeding for mothers (Nankumbi and Muliira, 2015).

3.5.1.2 Access to Safe and Nutritious Food

Another underlying factor for undernutrition is having access to safe and nutritious food. Although there is mixed evidence about the relationship between dietary diversification and stunting (Mofya-Mukuka 2016), lack of access to a diverse diet negatively affects the nutritional status of children (Fungo et al., 2016, Govender et al., 2016). Studies have also noted that although staple foods are plentiful, they are also associated with higher proportions of stunting and wasting (Amaral et al., 2018). Specifically, diets that are high in staple foods, such as a maize-based diet, might also

be low in micronutrients or protein (Amaral et al., 2018). Studies have found that access to forest foods, traditional crops, and home gardens helped increase food security and access to nutritional foods (Fungo et al., 2016, Govender et al., 2016). In addition, micronutrient needs could be met with local foods when several nutrient-dense but rarely consumed foods were included in daily diets (Arimond et al., 2018).

Studies conducted in Zambia identified the following factors related to supplementation and feeding practices:

- Protein sources, such as fish, were associated with reduced stunting and may contribute to improved nutritional outcomes (Marinda et al., 2018).
- Limited intake of non-staple foods and low dietary diversity were identified as a determinants for malnutrition (Mulenga, 2018; SUN Movement, 2017).
- Women of reproductive age lack financial resources, receive inflexible complementary feeding advice, which often do not align with the sociocultural context, and have competing priorities that compromise the quality of their diets (Grech et al., 2018).
- Women's diets were high in staple and plant-based foods but lower in foods rich in micronutrients, especially iron and calcium (Grech et al., 2018).
- The maize economy is important and may negatively affect progress on diversifying diets and programmes to improve food availability and use (Acosta and Fanzo, 2012; NFNC, 2017).
- Small-scale egg production increased consumption of eggs but showed no impact on stunting, possibly due to short follow-up time (Dumas et al., 2018).

3.5.2 Unhealthy Household Environments

3.5.2.1 Aflatoxins

Several studies found mixed results when exploring the link between aflatoxins and stunting (Chen et al., 2018; Mupunga et al., 2017; Watson et al., 2018). Chen et al. (2018) found that low aflatoxin exposure at 24 months of age was not linked to growth restriction and had no association with stunting. Further, growth stunting associated with aflatoxins may be confounded by poverty (Mupunga, et al., 2017). Mupunga, Mnggawa, and Katere (2017) discussed the importance of peanuts as a source of good nutrition in SSA, but their high nutritive value makes them a conducive substrate for fungal growth and potential aflatoxin contamination. Exposure to aflatoxins was also linked to poor growth in children under 5, risk for low birth weight, and *kwashiorkor* (Mupunga, Mngqawa, and Katere, 2017). A study by Watson et al. (2018) also found associations between aflatoxins and poor growth, in which high levels of aflatoxin exposure may contribute to failures of trials targeting micronutrient deficiencies. Alamu et al. (2018) found similar results, in which consumption of foods highly contaminated with aflatoxins resulted in poor absorption of essential nutrients.

3.5.2.2 Hygiene Practices

Hygiene practices were also found to affect child growth. Limited access to safe water and sanitation and poor hygiene practices increase the risk of infections that then contribute to undernutrition (NFNC, 2017; SUN Movement, 2017). In a study by Cumming and Cairncross (2016), poor water, sanitation, and hygiene (WASH) conditions negatively affected child growth and development due to repeated exposure to enteric pathogens. The literature review also found some reports that highlighted interventions to improve hygiene practices. Continued sensitization on handwashing practices and implementation of handwashing facilities were shown to improve adherence to handwashing (World Vision, 2017). In Zambia, headmen's support of and advocacy for WASH practices (e.g., toilet construction) also resulted in a high acceptance among community members to adopt new behaviours for hygiene (World Vision, 2017).

3.6 Basic Causes

The UNICEF conceptual framework of the determinants of child undernutrition identifies three categories of basic causes: (1) household access to adequate quantity and quality of resources, including land, education, employment income and technology; (2) inadequate financial, human, physical, and social capital; and (3) sociocultural, economic, and political context. The literature review identified associations between agricultural and environmental context and social context and stunting in SSA.

3.6.1 Agricultural and Environmental Context

Agriculture training and education programmes for nutrition, health care, and child stimulation resulted in positive linear growth for children but did not improve stunting (Marquis, et. al., 2018). However, growth stunting associations may be confounded by poverty (Mupunga, et. al. 2017). Agricultural considerations are also associated with place of residence. Chakona et al. (2017) found that dietary diversity increased in wetlands, compared to drylands. In addition, high population density areas and areas with low micronutrient densities in soil harbour the greatest potential for using agricultural fortification as a way to combat malnutrition (Berkhout et al., 2019). For example, bio-fortified maize improved quality protein intake in young children (Gunaratna et al., 2019)

3.6.2 Social Context

The most robust predictors of reductions in child undernutrition worldwide are secondary education for girls, reductions in fertility, accumulation of household assets, and increased access to health care (Gillespie et al., 2012). High levels of poverty exacerbate the nutrition situation (NFNC, 2017).

There is mixed evidence on the association between economic growth and stunting; thus, economic growth as a policy will only be effective at reducing the prevalence of stunting when increases in national income are directed at improving the diets of

children, addressing gender inequalities and strengthening the status of women, improving sanitation, and reducing poverty and inequities (McGovern et al., 2017).

4. Gaps

When mapping findings from the literature review to the UNICEF conceptual framework of the determinants of child undernutrition, several gaps were identified that could benefit from further research to assess the effectiveness of certain interventions in improving stunting.

A key gap identified throughout this literature review is evidence of effective interventions to reduce stunting. Many papers focused on nutrition-specific interventions, but evidence of their effective implementation is lacking. Dewey and Adu-Afarwuah (2008) identified successful interventions that are noteworthy in a systematic literature review. These include the following:

- Good supplementation, along with education, is more effective than education alone in India and Bangladesh.
- Fortification strategies increased iron intake in Mexico and Ghana and vitamin A intake in Ecuador and Ghana.
- Key messages to promote the regular consumption of foods from animal sources impacted growth in China and Peru. This was achievable because the promoted foods were both available and affordable, which may not be the case in all settings.

This systematic review has found that interventions should be context-specific and that impact is dependent on initial prevalence of malnutrition, degree of household food insecurity, caloric density of traditional complementary foods, and local availability of micronutrient-rich foods. The review also notes that interventions focused on complementary feeding need to consider and address underlying conditions, such as poverty and poor sanitation, in order to be effective. Furthermore, programmes that include pretested educational messages about fortified foods and home fortification products delivered to the target population through multiple channels may also help reduce morbidity and affect behavioural development. The studies included in this review showed optimal growth for infants and young children with complementary foods high in micronutrient density, especially for infants 6-12 months of age (Dewey and Adu-Afarwuah, 2008).

4.1 Immediate Causes

Immediate causes of childhood stunting include inadequate dietary intake and disease. Evidence from this literature review shows that, in order to reduce stunting, programmes need to address diseases or infections that contribute to undernutrition, as well as improve dietary intake, particularly animal-source foods and micronutrient-rich complementary foods. Further research could better explain these relationships and test interventions to improve prevention and treatment of infections and disease.

4.2 Underlying Causes

There are also gaps in underlying causes of childhood stunting, such as how to implement effective behaviour change interventions related to complementary feeding. Another gap at this level is the identification of how to improve dietary practices in ways that will lead to improved household food security. In addition, at this level, there is a gap in addressing the prevalence, impact, and ways to reduce aflatoxins and enteric disease pathogens. Another related gap is the optimal level of integration and delivery of health services, including nutrition-specific and nutrition-sensitive interventions at the facility and community levels.

Research conducted by Cumming and Cairncross (2016) emphasised the importance of creating new or modified WASH strategies, beyond the traditional interventions, which would tackle exposure pathways during the first 1,000 days. Exploring this gap could help shed light on effective ways to improve unsanitary practices and water sources. However, recent cluster randomised trials in Zimbabwe and Kenya testing the efficacy of integrated WASH-nutrition interventions did not improve stunting in the WASH arms (Humphrey et al. 2019).

Other gaps include understanding the effect of drought on malnutrition (Bauer and Mburu, 2017), reducing microbial ingestion (Reid et al., 2018), and the relationship between aflatoxin exposure and undernutrition (Watson, et. al., 2017), all of which are underlying causes of malnutrition.

4.3 Basic Causes

This literature review reveals several gaps in basic causes of childhood stunting. Gillespie et al. (2012) discuss the potential of commercial sector involvement to direct more resources towards health and nutrition. The authors also discuss the factors needed to create an enabling environment to address undernutrition in high-burden countries. These factors are knowledge and evidence, politics and governance, and capacity and resources, which includes the potential of commercial sector involvement to direct more resources towards health and nutrition (Gillespie et al., 2012). These factors justify further investigation because they could result in additional political support and resources for nutrition interventions. There is also need to increase interventions targeting adolescents and preconception nutrition.

Another gap identified was in the Zambia Nutrition Advocacy Plan, 2017, regarding the implementation and enforcement of policies to improve nutrition and food standards. This relates to creating more nutritionally dense foods by ensuring that commercially produced foods are not only safe to eat, but are also fortified with supplemental nutrients that make them more nutritionally dense.

5. Recommendations

Levels of stunting could be reduced by 20% by scaling up 10 nutrition-specific interventions to 90% coverage (Bhutta et al., 2013). These interventions are periconceptional folic acid supplementation or fortification, maternal balanced energy and protein supplementation, maternal calcium supplementation, multiple micronutrient supplementation in pregnancy, promotion of breastfeeding, appropriate complementary feeding, vitamin A supplementation in children 6–59 months of age, and preventive zinc supplementation in children 6–59 months of age, management of SAM, and management of MAM.

It is also important to take nutrition-sensitive interventions into consideration. Immunization, WASH, and social safety net programmes appear to be the most commonly included interventions of an effective package (Hossain, 2017; Ruel, 2013; Vir, 2016). Interventions worked best when country, community, and programme context were taken into account in all aspects of implementation.

5.1 Immediate Causes

There is a need to address diseases that can contribute to undernutrition to reduce stunting. Gaps in how to implement effective behaviour change to improve dietary intake also need to be addressed. Visits from village or community health workers can help leverage the gains, or potential gains, from nutrition-specific and nutrition-sensitive interventions. For example, the small pilot study in preparation for the Sanitation Hygiene Infant Nutrition Efficacy (SHINE) trial in Zimbabwe found that visits from village health workers that included infant feeding counselling and providing small quantity lipid nutrient supplements (SQ-LNS) improved maternal knowledge on infant feeding in the short term and increased the percentage of infants meeting their daily consumption needs for energy, protein, calcium, zinc, folate, and iron (Desai et al., 2015).

5.2 Underlying Causes

It is important to determine the acceptability of nutrient-dense food supplementation with local foods. Gewa et al. (2014) found that nutrient-dense food supplementation was a feasible approach to reduce stunting by providing more macronutrients and micronutrients to diets. The implementation of this approach is recommended as it could address three other nutrition-specific interventions-folic acid, and micronutrient supplementation in pregnancy.

5.3 Basic Causes

A few studies have identified some promising approaches to address challenges associated with undernutrition in the short term and stunting in the long term. Regarding nutrition-sensitive interventions, the NFNC (2017) identified that women's

economic empowerment helped reduce stunting. Improving women's economic status could be facilitated through the following nutrition-sensitive interventions: improving education, increasing nutrition education and counselling, decreasing early marriage, decreasing domestic violence, and creating and improving social safety nets. Table 3 summarises some of these approaches.

Table 3. Potential Approaches to Undernutrition

Promising Approaches	Authors	Country/Region
Multi-faceted approach that includes investment in agriculture, poverty reduction, feeding initiatives, and a stable political environment	Gillespie et al., 2013	Global
Building the evidence base on how to scale up nutrition-specific and nutrition-sensitive interventions with quality and equity	Gillespie et al., 2013	Global
Economic empowerment of women	NFNC, 2017	Zambia
Specific targeting of mothers of children with MAM	Kajjura, Veldman and Kassier, 2019	Uganda
Using nutrient-dense local foods as supplements	Gewa et al., 2014	Kenya
Infant feeding interventions delivered by village health workers	Desai et al., 2015; Humphrey et al 2019	Zimbabwe

6. Key Learning Questions

In response to the gaps identified in the framework, we developed six questions to further learning on these topics. These questions can help guide further investigation into the gaps, which could open up other support options and intervention approaches that could potentially address other underlying causes of stunting in Zambia.

- Improving complementary feeding behaviour change: What is the best way to implement effective behaviour change interventions? What is the right combination of increasing knowledge and access to food, and changing feeding practices, considering women's time and household-level support?
- Improving nutrition: Which nutrition services can be integrated with other services at health facilities? Which nutrition services should be delivered in communities, and how? Have there been any innovations to influence behaviour change for better nutrition? What are the optimal infant and young child feeding delivery systems? What pathways have been created to improve the link between agriculture and nutrition programmes?
- Improving food security: What works in Zambia? What is the role of and how can traditional foods be used? How can agricultural practices be adjusted to improve food security? What is the role of programmes such as cash transfers, child grants and social protection?
- Understanding the effect of aflatoxins and enteric disease pathogens: What is the prevalence of aflatoxin exposure, as measured in both food supply and through biomarkers, and what role does it play in Zambia's stunting prevalence? What are the prevalence and impact of aflatoxins, and how can they be reduced? What are effective ways of reducing exposure to enteric disease pathogens?
- Improving the enabling environment: How can knowledge and evidence, politics and governance, and capacity and resources, including the commercial sector, contribute to improving children's nutrition status?

7. Conclusion

Throughout the literature review, programmatic recommendations surfaced that align with a holistic approach encompassing both nutrition-specific and nutrition-sensitive interventions to address stunting. As depicted in the USAID/Zambia results framework to reduce stunting, multi-sectoral approaches, inclusive of both nutrition-specific and nutrition-sensitive approaches, are needed to reduce stunting. However, several questions remain about how to address the drivers of undernutrition (e.g., poor sanitation, food insecurity, women's empowerment) and there is little research about how best to implement nutrition interventions, particularly across sectors (Menon, 2014). Recent trials, including an integrated agriculture and nutrition programme in Zambia and integrated WASH and nutrition trials in Kenya, Bangladesh, and Zimbabwe, have not had the desired impact on stunting (Kumar et al., 2018; Humphrey et al., 2018; Luby et al., 2018; Null et al., 2018). It is also important to understand the factors that cause malnutrition, specifically the basic, underlying and immediate causes. In keeping with this, we identified several holistic interventions that could potentially reduce stunting. Other points to consider when implementing a holistic approach include the following:

- Promoting the production and consumption of diverse and nutritious food (GIZ, 2017)
- Strengthening early warning systems and local response capacity related to agro outbreaks and crop failures (IAPRI, 2018)
- Shifting from interventions that focus on mothers, children, and infants, to those that reach families and improve living environments and nutrition (Danaei et al., 2016)
- Obtaining a better understanding of cross-cutting elements such as gender, livelihoods, and seasonality, or inter-linkages and pathways that show one underlying cause driving another (Young and Marshak, 2017)
- Planning for other possible co-morbidities that are associated with stunting, such as obesity (Vonaesch et al., 2017)
- Using social protection to address food insecurity and improve access to diverse foods (Bhutta et al., 2013)

There is widespread agreement that nutrition-specific interventions alone cannot address stunting (Bhutta et. al., 2013; Global Nutrition Report, 2017). Gillespie et al. (2012) recommended a multi-faceted approach that includes investments in agriculture, poverty reduction, and feeding initiatives, as well as a stable political environment. We are in agreement with the authors' recommendations of scaling up nutrition-specific and nutrition-sensitive interventions with quality and equity.

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Annex: List of Literature Review Search Terms

Words Searched	Plus	Results: PubMed	Results: DEC
Stunting	+ Zambia + Sub-Saharan Africa (SSA) + SSA + Nutrition + SSA + Epidemiology + SSA + Determinants + SSA + Multisectoral	427 results	42 results
Nutrition + Food + Access + (SSA: DEC search only)	+ Pregnant Women + Lactating Women + Children Under 2	100 results	376 results
Nutrition + Food + Stunting OR Undernutrition	+ SSA + Agriculture/Agricultural + Safe Handling + Storage + Cooking + Cooking Practices + Cooking Processes	183 results	54 results
Diet OR Dietary OR Dietary Diversity + SSA	+ Stunting OR Undernutrition	70 results	23 results
Feed OR Feeding OR Feeding Practices + Stunting OR Undernutrition + SSA	+ Breastfeeding OR Exclusive Breastfeeding + Complementary Feeding + Care + Practices	74 results	592 results
Hygiene + Stunting OR Undernutrition	+ Practices + Water OR Water and Sanitation OR Water and Hygiene OR Hygiene and Sanitation OR Water, Sanitation and Hygiene OR WASH	225 results	285 results

Words Searched	Plus	Results: PubMed	Results: DEC
Nutrition + Stunting OR Undernutrition	+ Health System + SSA (PubMed only) + Antenatal Care + SSA (PubMed only) + Infection OR Infection Screening + SSA (PubMed only) + Diagnosis + Treatment	366 results	554 results
[Environment OR Environmental] OR [House OR Household] + Stunting OR Undernutrition	+ SSA (PubMed only) + Unhealthy + Soil + Mycotoxins + Africa (PubMed only) + Weather + SSA (PubMed only) + Agriculture	291 results	429 results
Agriculture + Stunting OR Undernutrition	+ SSA (PubMed only) + Production OR Productivity + Access + Post-Harvest	102 results	468 results
HIV/AIDS + Stunting OR Undernutrition	+ Child Health OR [Child AND Stunting] + Child Growth	90 results	149 results
Health OR Healthcare + Stunting OR Undernutrition + (SSA: PubMed only)	+ Limited Access + Inadequate	24 results	219 results
Gender OR Ethnicity OR Wealth OR SES OR Poverty + (SSA: PubMed only)	+ Stunting OR Undernutrition	129 results	244 results
Social OR Economic OR Political + (SSA: PubMed only)	+ Maternal Undernutrition + Child Undernutrition	26 results	90 results