

Applying a Global Nutrition Conceptual Framework to Analyze Potential Determinants of
Influence on Child Nutrition Among Children Participating in Nutrition Assistance Programs:
Insights from Burkina Faso, Sierra Leone, and the United States

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Abstract: Child malnutrition remains a persistent global challenge. Nutrition assistance, including supplementary nutritious foods or monetary benefit transfers, can help fill gaps in children’s diets to address malnutrition and prevent nutritional decline. Leveraging the global UNICEF Conceptual Framework for Child Nutrition (2020), this research explores how potential underlying determinants—such as child feeding practices, dietary diversity, WASH (water, sanitation, and hygiene) conditions, and home environments—and enabling determinants, such as economic barriers, may influence child nutrition in Sierra Leone, Burkina Faso, and the United States. Despite the established need for multisectoral approaches, traditional nutrition assistance programs often focus narrowly on food supplementation or temporary monetary support, without fully recognizing other important underlying and enabling systemic barriers that perpetuate child malnutrition. In Sierra Leone and Burkina Faso, poor WASH practices, unsanitary home environments, and limited dietary quality were contributors to wasting and stunting. In the United States, the Pandemic Electronic Benefit Transfer (P-EBT) program helped facilitate food access during the COVID-19 pandemic, but may have lacked complementary components, such as social behavior change communication, to help improve child diets. Across all three low-income contexts, economic constraints limited access to nutritious foods, underscoring the need to address enabling determinants, like household poverty. This research highlights the importance of integrated, multidimensional interventions as highlighted with the UNICEF Framework to address child malnutrition effectively in diverse settings. Recommendations include incorporating SBC to improve WASH practices, dietary diversity, and caregiving behaviors, alongside systemic efforts to address economic barriers. By targeting immediate, underlying, and enabling determinants, future nutrition assistance programs can

achieve sustainable improvements in child health and development. Future research should consider prioritizing the evaluation of integrated, context-specific nutrition assistance interventions that help to more holistically address the determinants of child malnutrition across distinct settings.

Background and Significance of Research:

Highlighting the importance of good nutrition during childhood

Good nutrition during the early childhood years, when growth and development are accelerating, is vital for lifelong health and well-being (Bhutta et al., 2013). Deficiencies during this critical window can result in impaired physical and cognitive development, increased morbidity, and long-term health consequences (Bhutta et al., 2013; Victora et al., 2021; Keats et al., 2021; Webb et al., 2018).

In under-resourced settings, particularly those impacted by factors such as poverty, conflict, displacement, or other crises, children are particularly vulnerable to malnutrition (Visser et al., 2018; Casey et al., 2001; UNICEF, 2023). These conditions disrupt children's access to adequate and nutritious foods, healthcare, and safe living environments, which increases the risk of malnutrition and other negative health outcomes (Visser et al., 2018; Casey et al., 2001). The global burden of child malnutrition remains a pressing issue, with 193 million children currently experiencing stunting and/or wasting, despite significant efforts to improve child health and nutrition outcomes worldwide (UNICEF, 2022, UNICEF 2023).

To further address these challenges, diverse nutrition assistance programs— which provide supplementary nutritious foods (SNF), cash, or other monetary transfers, often paired with nutrition social and behavior change (SBC) communication—aim to fill dietary gaps by temporarily increasing children's access to nutritious foods, thereby helping to prevent child nutrition from worsening, treat acute malnutrition, or prevent severe nutritional decline (Lenters et al., 2013; De Pee et al., 2015; Webb et al., 2014). Over the past few decades, advances in these nutrition assistance programs have improved the quality and effectiveness of interventions, successfully addressing acute malnutrition among children aged 6-59 months old across diverse

and challenging contexts globally (Das et al., 2020; Cliffer et al., 2020; Griswold et al., 2021). To address these persistent challenges, conceptual frameworks such as the global UNICEF Conceptual Framework for Child Nutrition (UNICEF, 2020) provide critical insights into understanding and addressing the determinants of child nutrition.

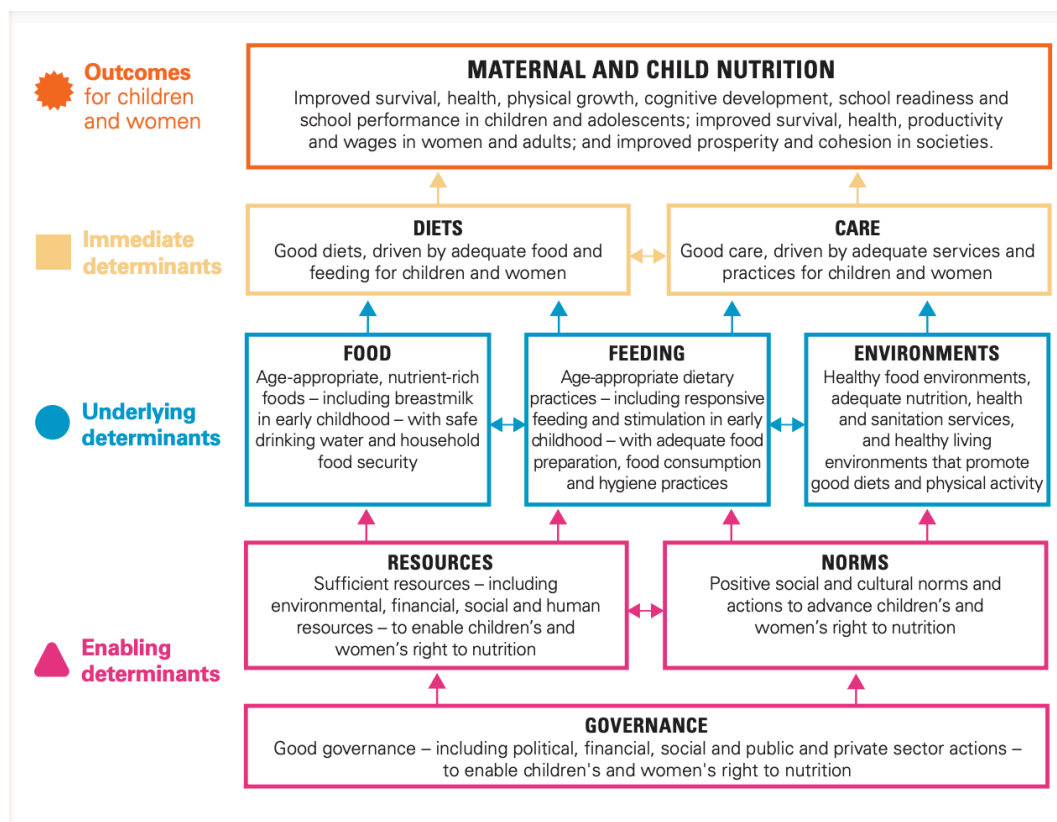
The UNICEF Framework for Child Nutrition and Health

While nutrition assistance programs primarily focus on addressing children's immediate needs for safe and nutritious food, achieving optimal nutrition requires a comprehensive, multifaceted approach. Undernutrition, including child wasting and stunting, remains unacceptably high worldwide, affecting over 45 million and 148 million children each year, respectively (WHO, 2023). Micronutrient deficiencies, often referred to as hidden hunger, impact one in two children under five years old globally (Stevens, Addo, et al., 2022). Moreover, the rising global prevalence of childhood overweight, affecting 37 million children, further complicates the nutritional landscape (WHO, 2023). This complex child nutrition situation underscores the urgent need for multidimensional solutions to improve child health outcomes (WHO, 2023; Stevens, Addo, et al., 2024).

The global UNICEF Conceptual Framework for Child Nutrition ('UNICEF Framework,' Figure 1) highlights the multifaceted determinants of child nutrition, organized into three levels: immediate, underlying, and enabling factors (UNICEF, 2020). Immediate determinants include dietary intake and caregiving practices that directly affect a child's nutritional status. Underlying determinants involve household and community-level factors, such as access to nutritious and safe foods, household food security, access to safe WASH infrastructure, and age-appropriate infant and young child feeding (IYCF) practices, and the child's environment (e.g. home environment or otherwise). Enabling factors address broader systemic influences, including

socioeconomic conditions (e.g. poverty), household access to resources, healthcare, and governance policies, which can either facilitate or hinder progress toward achieving optimal child nutrition (UNICEF, 2020; Bhutta et al., 2013; Jeffery et al., 2020; Li et al., 2020). These determinants interact in complex ways, amplifying their collective impact and highlighting the need for integrated nutrition assistance intervention strategies that consider the nutritional needs of children and broader enabling context.

Figure 1. UNICEF Conceptual Framework for Child Nutrition (2020).



The UNICEF Framework emphasizes the interconnectedness of these determinants, illustrating their combined influence on child health and nutrition outcomes. The Framework has been updated several times since it was first published in 1990 (UNICEF, 1990) based on advances in the literature, to the current version, which includes placing increased importance on the complex underlying and enabling determinants for child nutrition (UNICEF, 2020). Serving

as a conceptual guide, the Framework helps inform programmatic and policy actions by helping to identify areas where nutrition assistance interventions can have the greatest impact. While the Framework does not determine causal relationships, it provides a structured approach to understanding the complexities of child nutrition, supporting targeted actions such as improving access to nutritious foods, enhancing caregiver knowledge and practices, and strengthening social safety nets to help mitigate economic constraints.

This dissertation research applies the UNICEF Framework to investigate how immediate, underlying, and enabling determinants of child nutrition—such as IYCF practices, child diets, household economic resources, and home environments—may affect diet and nutritional outcomes like child wasting and stunting, and child diets in the United States. This research spans three diverse settings, each with its own nutrition challenges: the low-income community and protracted crises settings of Burkina Faso and Sierra Leone in West Africa, and the low-income community settings in the U.S. states of Massachusetts and California. By exploring these varied contexts, this research also underscores the flexibility and utility of the UNICEF Framework in addressing distinct child nutrition and health challenges. Moreover, leveraging the Framework for this research enables the identification of key entry points for future, targeted interventions that meet the unique nutritional needs of children within these and other similar settings.

Aligned with the principles outlined UNICEF Framework, age-appropriate, evidence-based IYCF practices are critical to promoting optimal child health and nutrition globally (Bhutta et al., 2013). These practices include early initiation of breastfeeding, exclusive breastfeeding for six months, continued breastfeeding for up to two years or beyond, and introducing safe, nutritious, and age-appropriate complementary foods beginning when children turn six months old (Bhutta

et al., 2013). Ensuring appropriate feeding frequency, dietary diversity, and safe food preparation, along with providing micronutrient supplementation where necessary, further supports optimal child growth (Bhutta et al., 2013).

However, adopting these practices often requires caregivers to have access to adequate resources, including sufficient funds, food, WASH infrastructure and facilities, in addition to knowledge and self-efficacy to implement the practices (Bhutta et al., 2013). However, many caregivers participating in nutrition assistance programs, including malnutrition prevention and treatment programs, already face significant resource constraints, increasing children's risk of malnutrition (Dipasquale et al., 2020; Webb et al., 2014; Wegner et al., 2015). These constraints are particularly evident in regions experiencing systemic poverty or conflict, where access to education, healthcare, and clean water are often limited (Dipasquale et al., 2020; Webb et al., 2014; Wegner et al., 2015, UNICEF, 2020).

Child Malnutrition as a Public Health Concern

Child malnutrition remains a critical global health and development issue, impacting one in three children worldwide and manifesting as a triple burden: undernutrition, hidden hunger, and child overweight (UNICEF, 2020; UNICEF, 2023). This multidimensional challenge aligns closely with the global UNICEF Framework's focus on the interconnected determinants of child nutrition and health, emphasizing the need for comprehensive, context-specific solutions (UNICEF, 2020).

Undernutrition encompasses moderate acute malnutrition (MAM), severe acute malnutrition (SAM), stunting, and micronutrient deficiencies, which primarily affects children under five years old. SAM, the most critical form of undernutrition, is characterized by very low weight-for-height (below -3 standard deviations of the median WHO growth standards), visible severe

wasting, and/or the presence of nutritional edema in children aged 6–59 months. SAM significantly heightens risks of morbidity and mortality due to weakened immune systems and increased susceptibility to infections such as diarrhea, pneumonia, and malaria (WHO, 1996; Lenters, Wazny, & Bhutta, 2016). Addressing SAM typically requires therapeutic feeding using ready-to-use therapeutic foods (RUTF) and medical management of co-occurring conditions (Lenters, Wazny, & Bhutta, 2016).

MAM, a less severe but still concerning condition (with lower, but still elevated, mortality risk compared to SAM), is defined by a weight-for-height z-score between -2 and -3 standard deviations or a mid-upper arm circumference (MUAC) of 11.5–12.5 cm in children aged 6–59 months (WHO, 1996). Although less immediately life-threatening than SAM, MAM requires timely intervention to prevent progression to SAM and mitigate risks of growth failure and future developmental delays (WHO, 1996). Supplementary feeding nutrition programs and ongoing monitoring are critical for effectively managing MAM (Lenters, Wazny, & Bhutta, 2016).

Stunting, indicative of chronic child malnutrition, is marked by a height-for-age z-score below -2 standard deviations from the median WHO growth standards in children under five years old (WHO, 1996). Stunting reflects long-term nutritional deficits, often beginning in utero due to maternal malnutrition, inadequate dietary intake, and/or frequent infections during the first 1,000 days of life, which begins in utero and then continues until the child is two years old. The stunting condition has far-reaching implications, including impaired physical growth, reduced cognitive development, and diminished economic productivity later in life (Victora et al., 2021). Despite global progress, stunting remains widespread today, affecting 148 million children globally, particularly in low-income countries and conflict-affected regions (UNICEF, 2023).

Another form of undernutrition, known as hidden hunger, representing deficiencies in essential micronutrients such as iron, iodine, folate, vitamin A, and zinc, impairs child growth, cognitive development, and immune function (WHO, 2023). These micronutrient deficiencies contribute to morbidities such as anemia, blindness, and developmental delays, with nearly one in two children under five globally suffering from hidden hunger (UNICEF, 2020; WHO, 2023). Micronutrient deficiencies often coexist with other forms of malnutrition, including wasting and stunting, compounding their impacts on child health (Stevens, Addo, et al., 2024).

Child overweight and obesity have emerged as growing public health concerns, with nearly 40 million children under five years old affected globally (UNICEF, 2020; WHO, 2023). Overnutrition is of particular concern in countries like the United States, where nearly one in five American children are experiencing severe overweight, known as obesity, with a body mass index (BMI) at or above the 95th percentile for age and sex (Stierman, B., Afful, J., Carroll, M. D., et al., 2021). This trend, driven by globalization, dietary transitions, and socioeconomic shifts, exacerbates the coexistence of undernutrition, hidden hunger, and overnutrition within communities and even within the same households. Such a triple burden creates unique challenges for policymakers and healthcare systems, necessitating integrated approaches to address all three forms of malnutrition simultaneously.

As such, the triple burden of child malnutrition—undernutrition, hidden hunger, and child overweight or obesity—creates a complex landscape where immediate nutritional needs are intertwined with systemic and contextual determinants. By leveraging the UNICEF Framework, this dissertation research seeks to identify and address these multidimensional challenges through recommending improved application of targeted and evidence-based interventions. This

approach emphasizes the need for holistic solutions that tackle the interconnected drivers of child malnutrition while tailoring strategies to the unique needs of diverse populations and settings.

Malnutrition Mitigation and Prevention Programs

As noted above, in many resource-limited contexts, malnutrition prevention programs often provide limited-time supplementary nutritious foods, food vouchers, or monetary transfers to prevent or mitigate children's nutritional decline (Black et al., 2013). Two primary types of nutrition interventions are used. Nutrition-specific interventions address immediate causes of malnutrition, such as inadequate dietary intake, through breastfeeding promotion, provision of supplementary nutritious foods (SNFs), and micronutrient supplementation, as well as health systems strengthening interventions to facilitate ensuring that children receive the health care they need (Black et al., 2013). Nutrition-sensitive interventions target broader underlying and enabling determinants, integrating actions into other sectors such as agriculture, women's empowerment, WASH (water, sanitation, and hygiene) programs, and behavior change and other educational initiatives (Black et al., 2013). Many programs to address child stunting and child overweight are nutrition-sensitive, whereas many programs to address child wasting and micronutrient deficiencies are nutrition-specific, but there are benefits for leveraging both nutrition-specific and nutrition-sensitive approaches in diverse nutrition assistance programs to ensure their comprehensiveness to prevent and address child malnutrition, including both wasting, micronutrient deficiencies, and stunting, in diverse contexts (Black et al, 2013, WHO, 2017). Expanding these complementary and integrated nutrition-sensitive and nutrition-specific programs to address the immediate, underlying, and enabling determinants of malnutrition, as aligned to the UNICEF Framework (UNICEF, 2020), is critical for sustainable, long-term

improvements in child health and nutrition, effectively addressing and combatting the triple burden of child malnutrition (WHO, 2017).

Food Assistance Programs and Transfer Modalities

To help address child malnutrition effectively, understanding the advantages and challenges of various nutrition assistance approaches is important. The existing literature highlights the benefits of various types of nutrition assistance programs and transfer modalities, depending on the malnutrition context and program goals (Gentilini, 2016, Manley et al, 2020). In a review of global nutrition assistance programs, authors noted that monetary transfer programs were potentially more cost-effective than food transfers alone due to the additional costs associated with logistics, such as storing, transporting, and delivering supplementary foods to affected communities (Gentilini, 2016, Manley et al, 2020). However, monetary or ‘cash’ transfer programs often require technological investments and training of program implementers upfront to ensure proper distribution and monitoring (Gentilini, 2016; Hoddinott, 2020). Additionally, Gentilini and others have noted that nutritious food transfer programs impose time costs on participants, who must travel to distribution sites and prepare supplementary foods according to recommendations (Gentilini, 2016; Griswold et al., 2021; Cliffer et al., 2021).

Monetary transfer programs aim to temporarily increase household purchasing power in contexts where local food and broader markets are functioning, enabling families to purchase items they desire and need, while stimulating the local economy (WFP, 2020; de Groot et al., 2017; Aker, 2014, Manley et al, 2020). However, despite the benefits, another potential limitation to monetary transfers is that they can impose unintended costs on recipients due to travel time required to distant markets and the cost of transportation of bulk foods to their homes in low-income or conflict contexts where markets are not well integrated (Manley et al., 2020).

Recent systematic reviews by Manley et al. (2020) and Manley, Alderman, & Gentilini (2022) found that monetary transfer programs supporting households with young children in low-income countries can help promote improved child nutrition, through facilitating improved linear growth, reducing stunting and wasting, and enhancing dietary diversity when cash or other monetary transfers are used to purchase nutritious foods and increase consumption of animal-source foods. However, the broader effects of cash transfer programs on nutrition outcomes vary, depending on program design, objectives, implementation strategies, and local market context (Manley et al., 2020, Manley, Alderman & Gentilini, 2022).

Enhancing the Impact of Monetary Transfers

While monetary transfers aim to provide critical financial support, enhancing their impact on child diets and nutrition requires strategic integration with complementary interventions. Social and behavior change communication (SBC) has emerged as a key factor in enhancing the impact of cash transfer programs (Gentilini, 2016). Incorporating well-targeted SBC alongside monetary transfers has been shown to help improve dietary diversity and child linear growth while reducing diarrhea incidence (de Groot et al., 2017). These findings emphasize the importance of combining monetary interventions with SBC and other educational strategies to address broader determinants of child malnutrition.

Monetary transfers, including other similarly valued modalities like food vouchers or coupons for nutritious foods—such as electronic benefits for nutritious food purchases provided to caregivers—have been shown to improve the dietary intake and nutritional status of young children in various developmental, emergency, and challenging contexts including in Somalia, Bangladesh, and Niger (de Groot et al., 2017; Grijalva-Eternod et al., 2018; Hoddinott et al., 2020). Conversely, in-kind nutritious food transfers are beneficial when local food markets are

not functioning efficiently or effectively, where households need immediate food resources, or where nutrition programs aim to increase consumption of specific foods (Grijalva-Eternod et al., 2018). Provision of in-kind food transfers have demonstrated improved caloric intake and intake of specific nutritious foods in such contexts (Manley, Alderman, & Gentilini, 2022, Gentilini, 2016; Hoddinott, 2020).

In recent years, some nutrition practitioners have increasingly advocated for monetary transfers, complemented by tailored SBC, over other in-kind food transfers in both humanitarian and development contexts (Gentilini, 2022). Though food assistance remains very valuable, particularly in contexts where markets are functional and nutritious foods are available, monetary transfers may provide participants with greater freedom of choice and can also help stimulate local food markets (Manley, Alderman, & Gentilini, 2022; Gentilini, 2016; WFP, 2020).

Supplemental Nutrition Assistance in the United States

Drawing on lessons learned from global contexts, the U.S. experience with the Supplemental Nutrition Assistance Program (SNAP) offers strong and valuable insights into the implementation of large-scale, monetary-based nutrition assistance programs in resource-limited contexts. Formerly known as Food Stamps, SNAP has been a cornerstone of U.S. food assistance policy since the mid-20th century, offering monthly monetary benefits to low-income families through electronic benefit transfer (EBT) cards, which function like debit cards (USDA, 2018). These EBT benefits are restricted to only approved food and beverage purchases but do not necessarily emphasize nutritional quality of food items, focusing instead on basic eligibility criteria for food items allowable for purchase with benefits (USDA, 2018). SNAP eligible foods include a wide variety of fruits, vegetables, meats, dairy, breads, cereals, processed snack foods, and other seeds/plants for food production (USDA, 2018). However, SNAP benefits cannot be

used for purchase of alcohol, tobacco, vitamins, neither prepared nor hot foods, nonfood items (e.g. pet supplies or kitchen products), nor live animals (USDA, 2018). Despite these limitations on purchases, SNAP has effectively addressed reducing childhood hunger and has increased food access for millions of American families, playing a vital role in reducing food insecurity, particularly during times of crisis and economic hardship (USDA, 2020; CBPP, 2018).

While SNAP has been successful in increasing food access for millions of low-income Americans, its focus on food access rather than nutritious diet quality has sparked some debates. The SNAP program's capacity to improve overall dietary quality and health outcomes remains limited, with various studies highlighting both its successes and gaps. For instance, Rivera, Maulding, and Eicher-Miller (2019) found that SNAP-Ed programs positively influenced food security among participants, further enhancing the program's health impact.

However, the evidence on SNAP EBT benefits influence on diet quality and participating children's weight outcomes is somewhat mixed. Studies such as those led by Katare, Binkley, and Chen (2021) and Hudak, Racine, and Schulkind (2021) report limited improvements in diet quality and nutrition outcomes among SNAP participants. Further, a recent review found that some studies suggested that SNAP benefit participation helps male children maintain a healthier weight status, while other research highlighted an increased risk of overweight or obesity for participating girls, particularly those who are long-term participants or already overweight before beginning participation in the program (Hudak, Racine, & Schulkind, 2019). These differences underscore the complexity of SNAP's influence on health and nutrition outcomes, and they highlight those other barriers, such as limited access to affordable nutritious foods, or limited availability of incentives for healthier food purchases, and insufficient SBC or educational

support to promote nutrition behavior change among participants may hinder SNAP's ability to enhance diets and nutrition most effectively.

Another key factor in understanding SNAP's effectiveness is the distinction between when benefits are inframarginal and extramarginal, which illustrates how SNAP impacts households differently based on their existing food spending patterns (Hoynes & Schanzenbach, 2009). For many households, SNAP benefits are inframarginal, meaning that they supplement existing food budgets without requiring changes in food consumption (Hoynes & Schanzenbach, 2009). These households already spend more on food purchases than the value of their SNAP allocations, so the benefits may effectively free up cash for other essential household or other expenses (Hoynes & Schanzenbach, 2009). This contributes to overall financial flexibility but does not necessarily result in improved diets (Hudak, Racine, & Schulkind, 2019).

In contrast, for households with very low existing food expenditures, who represent the minority of SNAP beneficiaries, SNAP benefits can be extramarginal, necessitating that SNAP participants have to adjust their consumption habits by increasing their food expenditures to fully be able to utilize the benefits provided (Hoynes & Schanzenbach, 2009). These adjustments to the benefits may lead to increased caloric intake or changes in dietary patterns, depending on the foods purchased (Hoynes & Schanzenbach, 2009). However, without complementary interventions, such as nutrition education on promoting healthy food choices or incentives for nutritious purchases, the potential for improving diet quality via SNAP benefits in extramarginal households remains limited.

This distinction between inframarginal and extramarginal use of SNAP benefits highlights the varied ways in which SNAP participation may influence food security and dietary choices among participants. It also underscores the importance of tailoring SNAP

interventions—such as through leveraging other incentives to facilitate purchase and consumption of nutritious foods or educational support—to address the specific dietary needs of different beneficiary groups.

To address the broader gaps in diet quality, complementary interventions such as monetary incentives for healthier purchases and targeted nutrition education have shown some promise. For example, Verghese, Raber, and Sharma (2019) demonstrated that combining the incentives for healthy food purchases together with tailored SBC strategies improved dietary diversity and increased fruit and vegetable consumption among participants. As such, future food assistance policies and programs could consider focus on integrating these approaches to help maximize SNAP's potential health and nutrition impact on participating families. By addressing the diverse sub-populations of participants and incorporating complementary nutrition interventions, SNAP can more effectively improve both food security and dietary quality among participating American households (Verghese, Raber, & Sharma, 2019).

COVID-19 Pandemic Impacts on US Food Assistance

Beginning in 2020, the four-year global COVID-19 pandemic demonstrated vulnerabilities in global food systems, including some specific impacts on U.S. nutrition assistance programs. While SNAP has long helped address food insecurity in the U.S., the COVID-19 pandemic exposed potentially vulnerabilities in distribution systems, influencing decisions to adopt adaptive measures. Early in 2020, the COVID-19 pandemic began to disrupt lives globally, resulting in nearly 7 million deaths globally, and significantly affecting the economic and social well-being of families and children worldwide (Mathieu et al., 2020). In the United States, many low-income American families with children faced heightened challenges as

pandemic-related unemployment and underemployment further contributed to exacerbated food insecurity and child hunger (Feeding America, 2022; Parekh et al., 2021; Wolfson & Leung, 2022). However, school closures and pandemic-imposed quarantines also contributed to increased sedentary behavior among children (Wang & Gago, 2024). This unintended consequence of school-closures may have elevated the risk of weight gain among American children in a context already marked by high rates of childhood obesity, as one in five American children are already affected by overweight or obesity (Wang & Gago, 2024). Additionally, food prices surged to their highest levels in nearly a decade, further limiting access to affordable, nutritious foods for millions of families (FAO, 2021).

To address the challenges posed by pandemic-related school closures, the U.S. Government expanded SNAP nutrition assistance and introduced Pandemic-EBT (P-EBT), a temporary, pandemic-specific program designed to help mitigate food insecurity among children who lost access to school meals due to school closures (USDA FNS, 2020). Distributed via EBT cards, P-EBT benefits could be used to purchase SNAP-eligible foods, including online—a critical adaptation during the pandemic (CA CDSS, 2020; MA DTA, 2020). In states like California and Massachusetts, children eligible for free or reduced-price lunch programs or attending Community Eligibility Provision schools qualified for P-EBT benefits during 2020 and 2021 (CA CDSS, 2020; MA DTA, 2020). P-EBT provided critical support, helping to protect children’s food access, reduce food insecurity, and avoid hunger for millions of American children (Bauer & Curran, 2020).

The experience of the rapid implementation of P-EBT during the COVID-19 pandemic can be reviewed and contextualized using the global UNICEF Conceptual Framework for Child Nutrition (UNICEF, 2020). By temporarily increasing low-income household monetary

resources for food, an underlying determinant of malnutrition, P-EBT helped sustain families' access to nutritious foods during the COVID-19 pandemic (USDA FNS, 2018; USDA FNS, 2020; UNICEF, 2020). Recently published studies helped underscore P-EBT's rapid deployment and potential effectiveness in alleviating food insecurity in the US for low-income families during the COVID-19 pandemic. For example, research in Houston highlighted how P-EBT benefits temporarily enhanced families' purchasing power for food and flexibility, while findings from New York City emphasized the importance of accessible nutrition assistance programs that included clear communications for participants during school closures (Fern et al., 2023; Cadenhead et al., 2022). These findings underscore the need for well-designed and managed nutrition assistance programs that help address potential structural and logistical, as well as behavioral barriers to improving food security and dietary outcomes for participants.

Despite the widespread implementation of P-EBT during the COVID-19 pandemic, limited evidence exists on how low-income families used these benefits for food purchases and whether the program may have influenced nutritious food purchasing behaviors or participating children's diets. To address this gap, we conducted a qualitative study exploring the experiences of parents whose school-aged children (pre-K–12) received P-EBT benefits in Boston, Massachusetts, and Fresno, California. Through in-depth interviews, the study examines how families used P-EBT benefits, including food purchasing patterns, preferences, and reported changes in children's diets during the pandemic compared with pre-pandemic habits.

By applying the global UNICEF Framework as a conceptual framework for analysis, this research helps highlights how nutrition assistance programs in high-income countries, like the United States, times of crisis, like the COVID-19 pandemic, can help address the underlying determinants of child malnutrition, particularly in a context where child overweight is a concern.

The pandemic exposed vulnerabilities in global food systems, emphasizing the importance of adaptive strategies to tackle emerging challenges. Our findings provide practical insights from participants into the effects of programs like P-EBT on household food security, food shopping behaviors, and child diets during public health crises. These insights aim to inform the development of more effective and efficient child nutrition assistance programs, ensuring they are designed to best support child nutrition and well-being during future public health emergencies.

Malnutrition Treatment Programs

Transitioning from broader malnutrition mitigation and pandemic-specific nutrition assistance programs, this section highlights the role of food-based interventions in treating acute malnutrition in complex contexts in low- and middle-income countries. For children experiencing acute malnutrition, treatment programs focus on providing supplementary nutritious foods (SNFs) to address moderate acute malnutrition (MAM) and severe acute malnutrition (SAM) and prevent further health deterioration. These programs aim to support children in under-resourced communities affected by poor diets, recurrent illnesses, and inadequate caregiving practices (Stobaugh et al., 2018; Ruel-Brockdorf et al., 2017; Flax et al., 2010).

The Food Aid Quality Review (FAQR) Study (2009–2020), led by Tufts University, aimed to improve nutritious food assistance by generating evidence-based recommendations to enhance cost-effectiveness and develop nutritionally appropriate food aid formulations for emergency settings (Ignowski et al., 2021). The FAQR field trials conducted in Malawi, Sierra Leone, and Burkina Faso addressed the nutritional needs of food assistance beneficiaries in resource-limited settings, focusing on regions affected by emergencies, conflict, climate shocks,

and economic instability (Ignowski et al., 2021; Koroma et al., 2015; Cliffer et al., 2021; Griswold et al., 2021).

The first two studies in this dissertation draw from a subset of FAQR research in Sierra Leone (2014–2016) and Burkina Faso (2014–2016). The Sierra Leone study evaluated the effectiveness of SNFs in treating MAM in children aged 6–59 months, while the Burkina Faso study assessed SNFs for preventing wasting and stunting in children aged 6–24 months. Findings from Burkina Faso revealed that none of the four tested SNFs significantly outperformed the standard of care (CSB+ with fortified vegetable oil) in preventing child stunting or wasting. However, cost analyses demonstrated that CSB+/oil was the most cost-effective option when factoring in caregiver time (Cliffer et al., 2021). In Sierra Leone, all of the tested SNFs achieved comparable MAM recovery rates, with over 60% of children recovering within 12 weeks (Griswold et al., 2021). However, sustained recovery one-month post-treatment was lowest among children receiving ready-to-use supplementary foods (Griswold et al., 2021).

These findings emphasize the opportunity to further explore additional factors or determinants influencing children's recovery from malnutrition and highlight the importance of considering addressing the underlying causes of malnutrition through comprehensive interventions beyond just food supplementation (Cliffer et al., 2021; Griswold et al., 2021). Both studies underscored the multifactorial nature of child stunting, noting that supplementary foods alone cannot effectively address the many complex socio-environmental factors contributing to chronic malnutrition (Cliffer et al., 2021).

Significance of Research

This dissertation leverages the UNICEF Framework to analyze immediate determinants, such as child diets, and underlying factors like feeding practices, food availability, and children's home environments, as well as enabling determinants, including household economic resources, and their influence on child nutrition in various contexts. By applying this comprehensive analytical approach across three distinct and low-income settings, including two in West Africa and two states in the United States, this research highlights the Framework's adaptability in addressing the multifaceted drivers of malnutrition and offers a comparative perspective on similarities and differences across contexts. Addressing the triple burden of malnutrition—undernutrition, hidden hunger, and overweight and obesity—requires consideration for addressing a complex set of immediate, underlying, and enabling determinants of child nutrition.

This research also provides practical and actionable insights to addressing the various determinants of child malnutrition, which contribute to supporting the design of sustainable, multifaceted, and context-specific nutrition assistance programs tailored to the unique needs of children in resource-constrained environments. These three studies help contribute to global efforts to addressing child malnutrition by offering strategies to help strengthen nutrition assistance programs, informing both policymakers and practitioners. Ultimately, this dissertation research aims to contribute to enhancing child health and nutrition outcomes by promoting multisectoral, context-specific nutrition assistance interventions.

Research Methods Overview

Overview Research Aims

The overarching aim of this dissertation research is to expand the evidence base on how distinct contextual household factors and behavioral practices—particularly those linked to the UNICEF Framework’s (2020) intermediate, underlying, and enabling determinants of child nutrition—may influence various child nutrition outcomes across diverse settings.

In the final section, we provide recommendations on addressing these determinants through targeted and context-specific improvements to diverse nutrition assistance programs. The research is structured around three specific aims:

Aim 1: Determinants of MAM Recovery and Progression to SAM in Sierra Leone

The first aim of this research sought to identify determinants that may have contributed to children’s ability to recover from moderate acute malnutrition (MAM) or deteriorate to severe acute malnutrition (SAM) in Sierra Leone, using qualitative information from in-home observation (IHO) data. Using qualitative content analysis on the IHO data, the study aimed to assess whether IHO captured behaviors that may have been missed by traditional survey methods and caregiver interviews, adding more depth, nuance, and additional details of observed practices to existing quantitative findings from the FAQR study.

Aim 2: Factors Influencing Stunting in Burkina Faso

for the goal of the second aim was to explore potential socioeconomic, WASH, and IYCF-C behaviors that could have influenced whether children aged 6-23 months became stunted at the end of the study in Burkina Faso over the 18-month study period. This analysis used IHO data to

assess which immediate (e.g., child diets and care) and underlying (e.g., household socioeconomic resources) determinants from the UNICEF Framework were associated with the child nutrition outcome of interest, children being stunted at endline of the study. Further we complemented the qualitative analysis on the IHO data with a quantitative analysis using data from the household surveys and child anthropometric data, which involved a logistic regression to assess whether any immediate (i.e., if child consumed animal-sourced protein during the observation period, whether child was breastfed) and underlying (mother's age and education level, household wealth quintile) determinants of child nutrition were associated with increased odds of the child being stunted at the end of the study.

Aim 3: Impact of Pandemic-Electronic Benefit Transfer (P-EBT) in the United States

The third aim was to examine the use of Pandemic-Electronic Benefit Transfer (P-EBT) benefits by parents of school-aged children in Fresno, CA, and Boston, MA, during the COVID-19 pandemic in 2020. This research investigated how P-EBT nutrition assistance may have influenced food shopping behaviors, typical purchases, and whether parents perceived any dietary changes among their children due to P-EBT during the crisis of the COVID-19 pandemic.

Study Overview

Together, these three studies aim to identify household, socioeconomic, and behavioral factors that enable or hinder an environment conducive to child nutrition, particularly in challenging contexts, as framed by leveraging the UNICEF Framework (UNICEF, 2020). The findings contribute to a broader understanding of how to create conditions that enable children to survive and thrive.

This dissertation presents findings from three separate studies, each using qualitative and/or quantitative methods to explore how various determinants associated with the UNICEF Framework may influence child nutrition outcomes in three different contexts in Burkina Faso, Sierra Leone, and the United States. Below, the methods are organized into qualitative methods and quantitative methods, with descriptions for how the methods were used in each study.

Overview of Food Aid Quality Review Study

The first two studies draw from a subset of data from the Food Aid Quality Review Study (FAQR) (2009–2020) led by Tufts University, aimed at improving food assistance by generating evidence-based recommendations to enhance cost-effectiveness and develop nutritionally appropriate food aid formulations (Ignowski et al, 2021). The FAQR efforts focused on addressing the nutritional needs of food assistance beneficiaries in distinct, resource-limited settings, with field trials conducted in Malawi, Sierra Leone, and Burkina Faso (Ignowski et al, 2021).

Four food products were tested: Corn Soy Blend Plus (CSB+) with Fortified Vegetable Oil (FVO), Corn Soy Whey Blend (CSWB) with added Whey Protein Concentrate and FVO, Super Cereal Plus (SC+) with integrated oil, and a lipid-based Ready-to-Use Supplementary Food (RUSF). Each ration provided approximately 500 kcal per daily serving. The field studies assessed these products' relative effectiveness and cost-effectiveness in two contexts: preventing stunting and wasting in children aged 6 to 24 months in Burkina Faso and treating Moderate Acute Malnutrition (MAM) in Sierra Leone.

The MAM and stunting prevention study in Burkina Faso (July 2014–December 2016) evaluated the four foods within a blanket supplementary feeding program. Children received one of the rations monthly for 18 months, with three additional months of post-program monitoring (Cliffer, 2021). The study found no significant differences among the foods in preventing child stunting, wasting, or linear growth faltering. However, CSB+ with FVO, the current standard, emerged as the most cost-effective option, even when considering caregiver time (Cliffer, 2021).

In Sierra Leone, the MAM treatment study (April 2017–November 2018) focused on evaluating the four foods for their effectiveness in achieving recovery from MAM, defined as reaching a mid-upper arm circumference (MUAC) of 12.5 cm or more within 12 weeks (Griswold et al., 2021). The study found that all four foods performed similarly well in achieving children’s MAM recovery, but sustained recovery one-month post-treatment was lowest for children receiving RUSF and comparable among Fortified Blended Foods (FBFs) (Griswold et al., 2021). The cost analysis revealed no significant differences in cost per enrolled child or cost per child recovered from both program and caregiver perspectives (Griswold et al., 2021).

Qualitative Research Methods

The following section describes the specific qualitative methods that were used in the qualitative analyses for each of the three study aims.

In-Home Observations

Direct observations are a qualitative method used to gain insights into behaviors in distinct, natural settings where typical behaviors take place (Patton, 2004). In-home observations ('IHO'), a specific type of direct observation, take place within participants' homes, allowing trained enumerators to spend extended periods observing real-time practices, typically over the course of several days of observation (Patton, 2004; Ruel and Arimond, 2003). IHOs have been effectively used in various public health studies to capture caregiver practices related to infant and child feeding and care, child eating and play behaviors, and other household dynamics in unique, natural settings (Ruel and Arimond, 2003; Ruel-Bergeron et al., 2019; Salasibew et al., 2019). The IHO method provides a unique opportunity to document the complexity of daily routines, social engagements, typical practices, and contextual factors that influence nutrition outcomes (Ruel & Arimond, 2003).

IHO data collection methods applied in field settings require specific training for enumerators on the method of direct observations and data collection tools, which are adapted to a particular context based on the behaviors of interest for a particular research or development project (Patton, 2004; Ruel and Arimond, 2003). As was the case in the field studies in Sierra Leone and Burkina Faso, the IHO methodology typically includes an IHO checklist, a detailed checklist that includes a list of behaviors of interest defined a priori by the research team, in addition to space to record who practiced the behavior and at what time (Patton, 2004; Ruel and Arimond, 2003). In addition to the IHO checklist, IHOs are often accompanied by detailed notes taken by the enumerators to record details related to certain behaviors and any additional observations of interest (Patton, 2004).

Although direct observations, including IHOs, are somewhat more resource-intensive than surveys or interviews (Ruel & Arimond, 2003), they often yield richer, context-specific insights,

which are essential for understanding behaviors in diverse environments (Patton, 2004). IHOs are not as commonly used in nutrition research nor programmatic settings due to the cost associated with their implementation (i.e., time required to conduct observations, training of enumerators, etc.) when compared to other methods like surveys which may require less time and resources, but they remain a valuable method for obtaining detailed insights into typical practices that respondents might not be aware of, which therefore they may not report in a survey (Ruel and Arimond, 2003).

Role of Enumerators

Enumerators play an important role in IHO data collection, as they are the observers who record behaviors and other activities ongoing in the household. The enumerators in the FAQR studies were local women recruited from villages near the study sites. All enumerators were female, spoke the local languages, including English in Sierra Leone and Moore and French in Burkina Faso, and had completed at least secondary-level education. All local enumerators underwent one week of training conducted by the FAQR field team in each country, which covered various aspects of data collection, including obtaining informed consent, maintaining professionalism during in-home observations, managing logistics, and using digital tablets for data entry. The training also emphasized non-disruptive observation techniques to avoid reactivity by participants and the importance of accurately documenting caregiving practices, household conditions, and infant feeding behaviors. The local enumerators conducted observations for 12-hour periods, from 6 a.m. to 6 p.m., over two to five consecutive days. Their local knowledge and ability to communicate effectively with participants were crucial in ensuring the accuracy and reliability of the data collected during the multi-day IHO.

Aim 1: FAQR MAM Treatment Study in Sierra Leone

In Sierra Leone, IHOs were conducted to evaluate caregiver behaviors, feeding practices, and SNF preparation. Observers recorded detailed field notes during 12-hour periods across two to five consecutive days for each household. Enumerators conducted IHOs in the semi-urban district of Pujehun, observing 255 children enrolled in the study. Each observation period lasted from 6 a.m. to 6 p.m., and enumerators documented caregiver-child interactions, SNF preparation and feeding practices, household chores, and caregiving behaviors. The duration of observations varied from two to five days depending on household availability, as some households could not be observed for the full duration due to external commitments (e.g., market visits or family farming).

The enumerators used a detailed observation checklist tool to record behaviors of interest, including preparation and consumption of the study food, child feeding and care practices by caregivers, and other topics of interest including WASH behaviors and sanitary conditions within the home. The enumerator took handwritten notes, which they later digitally transcribed, which detailed not only feeding practices but also child-caregiver interactions, home cleanliness, and other household activities. Enumerators focused on capturing the broader social environment, including who was involved in caregiving, how food was shared within the family, and any other factors potentially influencing child nutrition.

Aim 2: FAQR MAM and Stunting Prevention in Burkina Faso

In Burkina Faso, IHOs were conducted to assess caregiver preparation and child consumption of the FAQR-provided four SNFs. Observers were trained on the IHO method and

data collection instruments and spent three to five consecutive days in 176 beneficiary households, conducting 12-hour observations from 6 a.m. to 6 p.m. each day. While the observations were planned for five days, the caregivers had chores or needed to leave their homes to work or attend errands, which resulted in IHO that were about three days long per household, on average.

Using a detailed IHO checklist, the enumerators recorded caregiver-child interactions, food preparation techniques, feeding practices, and overall household conditions and cleanliness using digital tablets provided by the FAQR research team. The checklist tool facilitated documentation of SNF preparation methods by caregivers, hygiene practices, child feeding and care, and broader household routines. During each observation day, enumerators captured additional detailed qualitative notes that they transcribed in the tablet notes tool on household dynamics, including the cleanliness of the environment, the presence of animals, and water, sanitation, and hygiene (WASH) practices, diverse caregiver involvement in child rearing, and child feeding and care practices. The checklist tool was complemented by detailed open-ended notes recorded by the enumerators regarding specific activities ongoing in the households.

Key Areas of Observation in IHOs

Table 1 describes the types of infant and young child feeding and care (IYCF-C) practices, behaviors, and household conditions that were of interest by the research team and observed during the IHO conducted in Sierra Leone and Burkina Faso.

Table 1. Behaviors and Practices of Interest

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child

	Whether caregiver fed child or if child self-fed
	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child
	Water source for the household (stream, pump, etc.)

Analysis of IHO Data

A qualitative method, qualitative content analysis (Hsieh & Shannon, 2005) was performed on IHO checklists and the detailed enumerator field notes collected during IHOs. This

analysis involved reading through the notes, thematically coding, analyzing, and interpreting the household environment and caregiver behaviors. A preliminary codebook was developed based on an initial review of the IHO notes and then applied to a random sample of 10% of the transcripts, followed by modifications to ensure alignment with the data. The finalized codebook was used to analyze all the transcripts, focusing on themes related to infant and young child feeding and care (IYCF-C) practices, as well as other household behaviors. In addition, summary counts were carried out on the checklist to ascertain frequencies of observations for certain behaviors of interest. NVivo V12 and V14 software (QSR International) facilitated data management, coding, and analysis.

The coder was the lead researcher (AS), a public health practitioner with expertise in qualitative methods, who reviewed all the data multiple times to assign codes and carry out the analysis.

Observation Checklist/Survey vs. IHO Notes

The tools used by enumerators in IHO data collection include the IHO Checklist and detailed IHO notes also taken by the enumerators. The IHO Checklist is a structured, pre-designed tool that documents specific behaviors, recording details such as who performed each action, the timing, and aspects related to feeding practices, hygiene, and household routines (Patton, 2004; Ruel & Arimond, 2003). In addition, enumerators gather qualitative observations through detailed notes, capturing information about environmental cleanliness, animal presence, WASH (water, sanitation, and hygiene) practices, and social interactions within the household (Patton, 2004).

The observation checklist and detailed IHO notes were similar, as they covered the same general topics of interest. The observation checklist was a structured checklist tool used to systematically record key variables related to observations of behaviors of interest including child diets and nutrition, caregiver care giving and feeding practices, and general household conditions. This instrument provided consistent data for quantitative analysis by capturing specifics such as feeding frequency, SNF preparation, caregiver demographics, and general household conditions. These standardized checklists ensured data comparability across households.

By contrast, the IHO notes were recorded by enumerators in addition to the checklist and provided highly detailed, qualitative insights into caregiving practices related to feeding and care of the beneficiary children, activities ongoing by caregivers in the household (e.g. cleaning, cooking, running an errand/leaving the house) details on the specific observed activities of the beneficiary children (e.g. foods consumed, cleanliness of eating environment, play, behaviors related to sanitation and WASH), and details on the broader household environment (e.g. WASH practices, presence of animals in the home environment, etc.). Enumerators recorded these descriptive observations, which were not otherwise covered by the structured IHO checklist. The IHO notes allowed enumerators to capture nuances such as caregiver responsiveness, child preferences, and broader household dynamics that influenced child nutrition outcomes. This flexibility allowed for richer, context-specific data that provided depth beyond what structured surveys could achieve.

Aim 3: Study Assessing P-EBT Use During COVID-19 in the United States

Existing studies have used qualitative methods, such as in-depth interviews, to explore retail shopper preferences, motivations, and reported child feeding practices (Pitt et al., 2017; Vasileiou et al., 2018). For this research, a qualitative methods approach was chosen to complement prior quantitative studies on dollar stores shopping related to food access (Bustillos et al., 2009; Caspi et al., 2017) and to delve into the use of P-EBT in the specific context of a broader study on dollar store shopping during the first year of the COVID-19 pandemic (Schmall et al, in preparation).

In-depth interviews were conducted via Zoom with parents of school-aged children who received Pandemic-Electronic Benefit Transfer (P-EBT) assistance during the pandemic. The interviews focused on food shopping habits at dollar stores, potential dietary changes among children, and how families used the P-EBT benefits. Participants were recruited through flyers at dollar stores and local businesses around the dollar stores and community referrals in Boston, MA, and Fresno, CA. Each session lasted 60–90 minutes and was audio-recorded for transcription. Qualitative analysis, using NVivo, identified challenges families faced in accessing nutritious foods during the pandemic.

Ethical Considerations

All studies adhered to ethical standards, with approvals from Institutional Review Boards (IRBs) and informed consent obtained from all participants in each country. The FAQR studies in Burkina Faso and Sierra Leone received IRB approval from Tufts University and the respective Ministries of Health. Participants were assured of confidentiality, and data were anonymized. They were informed of their right to withdraw from the study at any time without repercussions.

Quantitative Research Methods

The following section describes the quantitative methods that were used in the quantitative analyses for the second study aim.

Specific Aim 2:

For the quantitative analysis, multiple logistic regression was conducted on household survey data to identify socioeconomic, demographic, and dietary factors associated with child stunting among 23-month-old children in the program in Burkina Faso. The analysis focused on households of beneficiary children who completed the IHO (n=176) and narrowed to those with complete data on outcome and explanatory variables (n=141). Descriptive statistics were used to assess data quality and model fit. The covariates included maternal age, maternal education, household wealth quintile, breastfeeding status, and animal-sourced protein consumption within the observation period. The model aimed to help predict the odds of child stunting as a binary outcome, with regression diagnostics confirming the model's fit. The study protocol was approved by the Tufts University Institutional Review Board (IRB) and Burkina Faso's Ministry of Health ethics board, ensuring ethical standards were met for the study.

Literature Review by Specific Aim

Specific Aim 1: Literature Review

In-home observations offer insights into child feeding and care practices that may influence children's ability to recover from acute malnutrition: A Case Study from Sierra Leone

Humanitarian nutrition programs designed to address moderate acute malnutrition (MAM), or wasting, in children have been successful in supporting recovery and preventing severe illness and mortality among participating children (Wegner et al., 2015, Arkparibo et al., 2017, Kennedy et al., 2015, Gluning et al., 2021, Chichon et al., 2023). Out-patient, community-based MAM treatment programs that provide supplementary specialized nutritious foods (SNFs) have helped millions of children recover from acute malnutrition across diverse African contexts (Das et al., 2020, Lenters, L.M., Wazny, K., Webb, P. et al., 2013, Gluning et al., 2021, Chichon et al., 2023).

However, the effectiveness of these MAM treatment programs is influenced by several components, including the quality of the program implementation and adherence to the recommended use and consumption of SNFs for beneficiary children (Langlois et al., 2021, Arkapribo et al., 2017, Ruel-Brockdorf et al., 2017, Gluning et al., 2015, Stobaugh et al., 2019, Beggs, Brubacher, & Little, 2024). Further, while the SNF products temporarily enhance children's access to essential nutrients, other household factors and practices can either support or hinder a child's full recovery from acute malnutrition (Stobaugh et al., 2018, Ickes et al., 2022, UNICEF, 2020, Oti and Allen, 2020, Rabaji et al., 2022).

The SNFs aim to cover nutrient gaps in children's typical diets temporarily, but the MAM treatment programs address only one underlying determinant of child nutrition, provision of

nutritious foods, as highlighted in the UNICEF Conceptual Framework for Child Nutrition and Health ('UNICEF Framework,' UNICEF, 2020). Per the UNICEF Framework, other underlying and enabling determinants, such as household resources and the home environment, access to social and health services, and child feeding, and care practices may also play a critical role in children's overall nutrition and health (UNICEF, 2020).

Available evidence suggests that the impact of the underlying and enabling determinants on MAM recovery among participating children likely varies by context. These systemic challenges, such as household food insecurity, low economic status, poor overall child health, inadequate diet quality, and suboptimal IYCF and care, and hygiene practices may hinder a child's full recovery from acute malnutrition, even when they are enrolled in MAM treatment programs, as the MAM program's provision of the SNFs addresses immediate dietary needs but does not necessarily address the broader determinants of the child's nutrition and health outcomes (Cliffer et al., 2021; Langlois et al., 2020; Ruel-Brockdorf et al., 2017; Stobaugh et al., 2018; Bergmeier et al., 2015; Rabaji et al., 2022; Black, Lutter, & Trude, 2020).

In many low-resource settings in Sub-Saharan Africa, suboptimal infant and young child feeding and care (IYCF-C) practices, compounded by inadequate water, sanitation, and hygiene (WASH) and food safety measures, along with low dietary diversity, are common within low-resource families, which contribute to risk of malnutrition among children (Fagbamigbe, Kandala, & Uthman, 2021; Otit & Allan, 2021, Nassur et al., 2022). Often due to poverty, these underlying determinants of child nutrition outlined by the UNICEF Framework, are already suboptimal for children who eventually develop acute malnutrition (Young, 2020; UNICEF, 2020). Moreover, children enrolled in MAM treatment programs frequently live in low-resource environments, where historically poor diets and other unfavorable conditions of poverty further

exacerbate risk and prevalence of acute malnutrition outcomes (Young, 2020; Rajabi et al., 2022; Nassur et al., 2022, Beggs, Brubacher, & Little, 2024). There is also some evidence regarding certain behavioral and environmental factors, including child feeding and care practices and WASH practices by caregivers during MAM treatment, which may influence the children's ability to recover fully from malnutrition while under MAM treatment and care (Stobaugh et al., 2018; Ruel-Brockdorf et al., 2017; Flax et al., 2010, Gagnon-Dufresner et al, 2021).

In Sierra Leone, and West Africa more broadly, MAM rates among children remain high (UNICEF, 2023). As part of broader research into improving global nutrition assistance programs, the Food Aid Quality Review (FAQR) (2009-2020) study in Sierra Leone assessed the cost-effectiveness of four supplementary foods on treatment of MAM among children 6-59 months old. The four foods tested were: Corn Soy Blend Plus (CSB+) delivered with Fortified Vegetable Oil, Corn Soy Whey Blend (CSWB) with added Whey Protein Concentrate delivered with Fortified Vegetable Oil, Super Cereal Plus (SC+) which integrated oil into the SNF product, and a lipid-based Ready-to-Use Supplementary Food (RUSF), provided to beneficiaries for use in isocaloric 500 calorie quantities (Ignowski et al, 2021). The FAQR study found that all four SNFs resulted in similar MAM recovery rates (at just over 60%), and all were similarly cost-effective at achieving children's recovery from MAM in Sierra Leone (Griswold et al, 2021). However, overall, about 19% of enrolled children deteriorated to severe acute malnutrition (SAM) while in the MAM treatment program, while nearly 10% did not respond to treatment (Griswold et al, 2021). The authors speculated that other factors, including adherence to MAM treatment recommendations and intended use of the study foods, children's at-home environmental conditions, caregivers' IYCF-C practices, and child illness may have also

contributed to children's recovery from MAM during the MAM treatment program (Griswold et al, 2021).

Then, to further explore if any potential reported household or behavioral factors may have contributed to MAM recovery rates, the household survey data were analyzed using secondary regression analyses by the FAQR study team. The results from the secondary regression analysis suggested that higher MUAC at enrollment for MAM treatment, enrollment during the rainy season in Sierra Leone, presence of a grandmother (a female aged 65 or older) in the home, and the beneficiary child's illness with diarrhea in the two weeks prior to MAM treatment enrollment were each associated with the children's recovery from MAM by the end of the program (Griswold et al., 2021). The research team found that children who did not recover from MAM, or those whose MAM deteriorated into SAM, experienced more acute illness during their participation in the MAM treatment program or were first transferred from the SAM treatment program to participate in the MAM treatment program (Griswold et al., 2021). Considering the finding that the beneficiary children who reported acute illness in the two weeks prior to enrollment in the MAM treatment program were more likely to graduate from the MAM treatment program and recover from acute malnutrition, the study authors speculated that their acute illness in fact caused the children to develop MAM, so participating in the MAM treatment program while recovering from the acute illness aided in their recovery from acute malnutrition overall and facilitated their graduation from the MAM treatment program (Griswold et al., 2021). However, the authors still noted that 'little attention has been paid' to the socioeconomic, household-level, and behavioral factors and practices that may influence children's response to treatment for acute malnutrition and called for further targeted research on the topic (Griswold et al., 2021).

Despite decades of research on implementation of MAM treatment programs in distinct contexts, gaps remain regarding which of the household factors and IYCF-C practices of children's caregivers while children are enrolled in the MAM treatment program might influence children's physiological response to the SNFs provided in MAM treatment and ability to recover from MAM within the program (Beggs, Brubacher, & Little, 2024, Griswold et al, 2021). Better understanding of these context-specific household and behavioral factors and practices may help inform future MAM treatment program implementation as well as targeted MAM treatment and prevention behavior change messaging in the future, but more in-depth, detailed, and nuanced information is needed from participating households.

While in-home observation (IHO) data are commonly used in anthropological studies, its application in nutrition and health programmatic settings remains rare due to the potential additional time, training on the IHO method, and resources required for its collection (Ahmad, Zaman, & Pervez, 2022). IHO data, which captures detailed observations of actual behaviors rather than relying on self-reported information, offers a valuable lens into context-specific environmental and behavioral factors that may influence a child's ability to recover from MAM during treatment programs. These insights can better inform the design of MAM treatment programs, moving beyond the provision of nutritious foods through SNFs to also address broader environmental, behavioral, and systemic components. This approach aligns with the UNICEF Framework, emphasizing the importance of potentially addressing the underlying and enabling factors that affect a child's recovery from acute malnutrition in resource-limited and challenging settings.

In this study, we analyze IHO data collected as part of the FAQR study conducted in Sierra Leone. IHO data were gathered using a structured observation checklist, with enumerators

encouraged to supplement these observations with detailed, open-ended notes documenting their own insights. This dual approach to data collection provides a unique and rich source of programmatic information, offering perspectives that structured instruments alone might otherwise miss. Unlike traditional self-reported surveys, IHO notes capture nuanced details of observed behaviors and practices, revealing dynamics that might otherwise remain undocumented in research. Moreover, the IHO notes go beyond structured observation checklists, providing deeper insights into how various household-level actions—such as child feeding practices, caregiving behaviors, and the home environment— may have shaped children’s recovery from MAM. By integrating these detailed observations with structured data, this analysis offers a more comprehensive understanding of the factors influencing MAM recovery in Sierra Leone and similar contexts, offering detailed information on behaviors or conditions of concern to design more context-specific and effective MAM treatment programs.

Specific Aim 2: Literature Review

In-Home Observations from a Malnutrition Prevention Program Help Outline

Complex Factors Contributing to Child Stunting in Burkina Faso

Global Perspectives on Child Stunting

One of the most detrimental forms of child malnutrition is stunting, which affects 148 million children globally (Bhutta et al, 2013, UNICEF, 2023). Stunting is a form of extreme linear growth failure that occurs between conception and the child's second birthday (Prendergast, 2014). The clinical timeline for stunting highlights the importance of adequate maternal nutrition during pregnancy, as fetal growth faltering begins during the gestational development period (Prendergast, 2014). Linear growth faltering commonly accelerates during the child's weaning period, after exclusive breastfeeding ends and when complementary foods, often of poor nutrient quality, are first introduced (Das et al 2020, Cliffer et al, 2022, UNICEF, 2023).

Global economic and social advancements have significantly contributed to a decline in stunting rates since the mid-2000s, when nearly 50 countries reported very high stunting prevalence (UNICEF, 2023, Das et al 2020). Today, 95% of stunted children are concentrated in 28 countries, nearly all of which are in Africa and Asia (UNICEF, 2023). However, regional differences remain stark, particularly in West Africa, where the complex interplay of socio-economic, environmental, and security challenges impede further progress in reducing child stunting (UNICEF, 2023; Bhutta et al., 2020).

Child stunting has lifelong implications, including impaired cognitive development, increased susceptibility to chronic diseases, and compromised gut function compared to non-stunted children (Prendergast, 2014; Bain et al., 2013). Furthermore, stunted children are more likely to attain lower educational outcomes and experience intergenerational poverty,

perpetuating cycles of malnutrition within families and communities (Bhutta et al., 2020; De Onis & Branca, 2016; UNICEF, 2023).

Existing literature underscores the multifaceted nature of child stunting, highlighting a variety of contributing factors (Das et al., 2020). Frequent illness, diarrheal disease, poor water sanitation and hygiene (WASH), unsanitary home environments, suboptimal dietary quality, and inadequate childcare practices are consistently associated with stunting in children under two years old (Prendergast et al., 2014; Black et al., 2013; Danaei et al., 2016; Akombi et al., 2017). Additionally, suboptimal breastfeeding practices and the early introduction of inappropriate complementary foods can exacerbate growth faltering and increase the risk of stunting (Pickering et al., 2019; Argaw et al., 2019; Keusch et al., 2013). The relative importance of these factors varies by context, underscoring the need for localized and tailored interventions to address stunting effectively (Prendergast et al., 2014; Zaharia et al., 2021; Bhutta et al., 2020).

Despite widespread implementation of stunting prevention and treatment programs, their impact has often been insufficient, especially in very resource-limited settings (Argaw et al., 2019; Bhutta et al., 2020; Keats et al., 2021). This gap emphasizes the necessity of understanding contextual factors that hinder program success and the need for adapting better-tailored interventions to address child stunting in distinct and challenging environments (Argaw et al., 2019; Bhutta et al., 2020).

Applying the UNICEF Framework to Understand Child Stunting

The UNICEF Conceptual Framework for Child Nutrition provides a comprehensive approach to analyzing the complex and interconnected factors that contribute to child stunting (UNICEF, 2020). Leveraging the global UNICEF Framework, child stunting is associated with challenges across various determinants: immediate determinants such as inadequate child diets and

suboptimal caregiving practices, underlying factors like poor household food security, sanitation, and limited access to health services, and enabling factors such as low socioeconomic status of their family and poor household resource availability (UNICEF, 2020; Pickering et al., 2019; Argaw et al., 2019; Keusch et al., 2013). This systemic perspective reinforces the need to address vulnerabilities beyond access only to nutritious food alone, necessitating holistic and integrated nutrition assistance solutions (UNICEF, 2020, Bhutta et al., 2020).

Recent reductions in child stunting in various contexts have been linked to systemic interventions that go beyond improving only food access or poverty alleviation (Bhutta et al., 2020). Advances across health, food, and economic systems have increased the availability and accessibility of diverse and nutritious foods in local markets, enhanced WASH practices, and driven investments in critical infrastructure such as roads and piped water (Keats et al., 2021; Ruel & Alderman, 2013; De Onis & Branca, 2016). Additionally, maternal and child health programs, community nutrition education initiatives, and targeted nutritional interventions have played important roles in supporting reducing stunting prevalence (Bhutta et al., 2020; Danaei et al., 2016; Pickering et al., 2019; Argaw et al., 2019). These multi-sectoral approaches highlight the importance of addressing broader determinants such as poor dietary diversity, inadequate childcare practices, poor socioeconomic status of households, and environmental factors like poor sanitation and limited access to clean water (Prendergast et al., 2014; Keusch et al., 2013).

Child Stunting in West Africa: Regional Challenges and Determinants

In West Africa in particular, child stunting remains a significant public health issue, with an average prevalence of over 30% among children under two years old (UNICEF, 2023). Over the past decade, stunting rates have decreased by more than 10%, attributed to social and economic progress such as investments in community development, infrastructure, improved health

services, and greater availability of diverse foods in markets (GNR, 2022; UNICEF, 2023).

However, challenges persist, as stunting rates remain alarmingly high in rural and conflict-affected areas, with rates exceeding 50% in some regions of Burkina Faso (Picbogoum et al., 2023).

The persistence of stunting in West Africa reflects the interplay of immediate, underlying, and enabling determinants outlined by the global UNICEF Framework. These contributing determinants include inadequate child diets, poor feeding and care practices, household food insecurity, low educational attainment of parents, poor household sanitation, and limited access to quality health services (UNICEF, 2020; Bhutta et al., 2020, Sawadogo et al., 2022). Political instability and conflict exacerbate these issues, jeopardizing any development or nutrition gains and heightening the risk of undernutrition among vulnerable populations (Sawadogo et al., 2022; UNICEF, 2023).

A recent scoping review highlighted potential key risk factors for chronic child malnutrition across West Africa, such as low household income, poor dietary quality, child vulnerability to illness, and low maternal education (Sawadogo et al., 2022). In Burkina Faso, these challenges are compounded by inadequate water and sanitation practices and limited household resources, which exacerbate stunting rates (Picbogoum et al., 2023). Despite these insights, much of the existing data relies on cross-sectional studies, underscoring the need for longitudinal and qualitative research to uncover the nuanced, context-specific determinants of stunting in this region (Sawadogo et al., 2022; Bhutta et al., 2020).

Insights from the FAQR Study in Burkina Faso and Directions for Future Research

The Food Aid Quality Review (FAQR) provides a recent example of efforts to identify the most effective and cost-effective supplement for use in food-based interventions in resource-

limited settings. From 2014 to 2016, the FAQR program conducted an 18-month longitudinal study in Burkina Faso’s Sanmatenga Province to evaluate the cost-effectiveness of four supplementary specialized nutritious foods (SNFs) in preventing stunting and wasting among children aged 6–23 months.

Despite the provision of these SNFs, the study found that none of the products effectively prevented linear growth failure, with 23% of participating children becoming stunted by the end of the intervention (Cliffer et al., 2021). These findings underscore the limitations of food supplementation alone in addressing stunting, particularly in settings where broader determinants—such as caregiving behaviors, household conditions, and environmental factors—remain unaddressed.

While the FAQR research assessed some behavioral factors influencing SNF consumption, it did not fully investigate broader contextual factors, such as child feeding practices, caregiving behaviors, and household environments. These unexamined factors may have significantly contributed to the persistence of stunting among participating children (Cliffer et al., 2021). This gap highlights the importance of further research to understand the interplay of behavioral, environmental, and systemic factors necessary to effectively combat child stunting in similar contexts.

Research Significance

By analyzing the FAQR data through the lens of the UNICEF Conceptual Framework for Child Nutrition, this study seeks to enhance the evidence base for more holistic, multi-dimensional approaches to addressing child stunting. Incorporating detailed in-home observations (IHO) of caregiving and feeding behaviors, alongside household survey data, will

provide a comprehensive understanding of the specific factors and determinants influencing child stunting in Burkina Faso. The findings from this research aim to inform and refine targeted interventions, contributing to the reduction of child stunting not only in Burkina Faso but also in other similar resource-limited settings.

Leveraging the UNICEF Framework and building on prior analyses of FAQR data, this mixed-methods secondary analysis explores potential socioeconomic and behavioral factors that may have contributed to children becoming stunted over the study period. While other analyses have assessed wasting outcomes (Cliffer et al., 2021), this study focuses specifically on stunting as an outcome. Based on a review of the existing literature, we hypothesize that non-stunted children are more likely to have lived in households with cleaner home compound environments, had older and more educated mothers/primary caregivers, consumed more diverse and nutritious diets, and will have been practicing breastfeeding compared to their stunted counterparts. By examining both immediate and broader determinants of stunting, through incorporating detailed in-home observations (IHO) of observed behaviors together with information from household surveys, this research aims to provide critical insights for designing future interventions to reduce and prevent child stunting in complex, resource-limited settings like Burkina Faso.

Specific Aim 3: Literature Review

Use of Pandemic-EBT during the COVID-19 pandemic in 2020: insights from Boston and Fresno parents

While the two previous aims focus on understanding behaviors and environmental conditions that influence child nutrition in geographic and sociocultural contexts very different than the United States, much can be learned about the behavioral factors that influence child nutrition among families participating in American nutrition assistance programs. In this aim, we explore parent use of P-EBT benefits and perceptions of how child diets in the United States were impacted by the COVID-19 pandemic, specifically among low-income families receiving nutritional food assistance.

Beginning in 2020, the COVID-19 pandemic disrupted lives globally, resulting in nearly 7 million deaths and significantly affecting the economic and social well-being of families and children worldwide (Mathieu et al., 2020). In the United States, low-income families with children faced heightened challenges, as pandemic-related unemployment and underemployment contributed to exacerbated food insecurity and risk of child hunger (Feeding America, 2022; Parekh et al., 2021; Wolfson & Leung, 2022). Additionally, food prices had surged to their highest levels in nearly a decade, further limiting access to affordable, nutritious foods for millions of families (FAO, 2021).

To address these challenges, the U.S. government expanded the Supplemental Nutrition Assistance Program (SNAP) and introduced Pandemic-EBT (P-EBT), a temporary food assistance program designed to prevent and mitigate food insecurity among children from low-income families who lost access to school meals during pandemic-related school closures (USDA FNS, 2020). Distributed via electronic benefit transfer (EBT) cards, the funds provided

via P-EBT benefits could be used to purchase SNAP-eligible foods, including online—a significant adaptation during the pandemic (CA CDSS, 2020; MA DTA, 2020, FNS, 2020). In states like California and Massachusetts, children from low-income communities who were eligible for free or reduced-price lunch programs or attending Community Eligibility Provision schools qualified for P-EBT benefits during 2020 and 2021 (CA CDSS, 2020; MA DTA, 2020). P-EBT aimed to protect food access, mitigate food insecurity, and prevent hunger for millions of children (Bauer & Curran, 2020).

The challenges faced by low-income families during the pandemic can be partially contextualized using the UNICEF Conceptual Framework for Child Nutrition (UNICEF, 2020). The UNICEF Framework identifies various immediate determinants of child hunger and malnutrition, such as inadequate dietary intake, alongside underlying determinants, including lack of household resources, high food prices, and limited access to social and health services. By temporarily increasing household funds, programs like SNAP’s temporary P-EBT program aimed to address these underlying determinants to enable low-income families to sustain access to nutritious foods during the height of the pandemic (USDA FNS, 2018; USDA FNS, 2020; UNICEF, 2020).

Early studies examining P-EBT’s implementation during the pandemic highlight its potential to alleviate food insecurity and prevent hunger among participating low-income, American families. For example, researchers in Houston found that cash assistance through P-EBT enhanced families’ purchasing power and as well flexibility for food purchases, helping to mitigate acute food insecurity for participating children (Fern et al., 2023). In contrast, in-kind food distributions may have created logistical barriers and failed to meet families’ specific needs (Fern et al., 2023). Similarly, findings from New York City emphasized the importance of

accessible food assistance programs that were well communicated to participants, like P-EBT, to facilitate effective participation and reduce risk of food insecurity for children during school closures (Cadenhead et al., 2022). These insights underscore the need and opportunity to further address underlying, structural determinants in designing effective nutrition and food assistance programs in the United States.

Despite the rapid and widespread implementation of P-EBT during the COVID-19 pandemic, evidence remains limited on how low-income, American families used the P-EBT benefits and whether the program influenced food purchasing behaviors or children's diets, particularly in the context within the United States, where one in five children are already overweight or obese. This qualitative study, which is a sub-sample of a Tufts University study examining use of dollar stores for food access, examines the experiences of parents whose school-aged children (pre-K–12) received P-EBT benefits in the Boston, Massachusetts, and Fresno, California metropolitan areas. Through in-depth interviews, the study investigates how families used P-EBT benefits, including their food purchasing patterns, preferences, and any reported changes in children's diets during the pandemic compared with pre-pandemic habits.

By applying the global UNICEF Conceptual Framework for Child Nutrition as a conceptual framework, an aim of this research is to learn from P-EBT's application in the United States and potentially further highlight how emergency food and nutrition assistance programs can help address the underlying determinants of child malnutrition. The findings from this work aim to provide actionable insights into the effects of programs like P-EBT on food security, shopping behaviors, and child nutrition during public health crises in the United States and other similar contexts. Such analyses, like this one, can help contribute to the development of stronger and more effective American food and nutrition assistance programs.

Specific Aim 1- Full Paper

In-Home Observations May Offer Insights into Child Feeding and Care Practices that May Help Explain Children’s Ability to Recover from Acute Malnutrition: A Case Study from Sierra Leone

Humanitarian nutrition programs designed to address moderate acute malnutrition (MAM), or wasting, in children have been successful in supporting recovery and preventing severe illness and mortality (Wegner et al., 2015, Arkparibo et al., 2017, Kennedy et al., 2015, Gluning et al., 2021, Chichon et al., 2023). Out-patient, community-based MAM treatment programs that provide supplementary specialized nutritious foods (SNFs) have helped millions of children recover from acute malnutrition across distinct African contexts (Das et al., 2020, Lenters, L.M., Wazny, K., Webb, P. et al., 2013, Gluning et al., 2021, Chichon et al., 2023).

However, the effectiveness of these MAM treatment programs is influenced by several components, including the quality of the program implementation and adherence to the recommended use and consumption of SNFs for beneficiary children (Langlois et al., 2021, Arkparibo et al., 2017, Ruel-Brockdorf et al., 2017, Gluning et al., 2015, Stobaugh et al., 2019, Beggs, Brubacher, & Little, 2024). Further, while the SNF products temporarily enhance children's access to essential nutrients, other household factors and practices can either support or hinder a child's full recovery from acute malnutrition (Stobaugh et al., 2018, Ickes et al., 2022, UNICEF, 2020, Oti and Allen, 2020, Rabaji et al., 2022).

The SNFs aim to cover nutrient gaps in children’s typical diets temporarily, but the MAM treatment programs address only one underlying determinant of child nutrition, provision of nutritious foods, as highlighted in the UNICEF Conceptual Framework for Child Nutrition and

Health ('UNICEF Framework,' UNICEF, 2020). Per the global UNICEF Framework, other underlying and enabling determinants, such as household resources and the home environment, access to social and health services, and child feeding, and care practices may also play an important role in children's overall nutrition and health (UNICEF, 2020).

Available evidence suggests that the impact of the underlying and enabling determinants on MAM recovery among participating children varies by context. These systemic challenges, such as household food insecurity, low economic status, poor overall child health, inadequate diet quality, and suboptimal infant and young child feeding (IYCF), care, and hygiene practices often hinder a child's full recovery from acute malnutrition, even when they are enrolled in MAM treatment programs, as the MAM program's provision of the SNFs addresses immediate dietary needs but does not necessarily address the broader determinants of the child's nutrition and health outcomes (Cliffer et al., 2021; Langlois et al., 2020; Ruel-Brockdorf et al., 2017; Stobaugh et al., 2018; Bergmeier et al., 2015; Rabaji et al., 2022; Black, Lutter, & Trude, 2020).

In many low-resource settings in Sub-Saharan Africa, suboptimal infant and young child feeding and care (IYCF-C) practices, compounded by inadequate water, sanitation, and hygiene (WASH) and food safety measures, along with low dietary diversity, are common within low-resource families, which may also contribute to risk of malnutrition among young children (Fagbamigbe, Kandala, & Uthman, 2021; Otit & Allan, 2021, Nassur et al., 2022). Often due to poverty, these underlying determinants of child nutrition outlined by the UNICEF Framework, are often already suboptimal for children who eventually develop acute malnutrition (Young, 2020; UNICEF, 2020). Moreover, children enrolled in MAM treatment programs frequently live in low-resource environments, where historically poor diets and other unfavorable conditions of poverty and other challenges further exacerbate risk and prevalence of acute malnutrition

outcomes (Young, 2020; Rajabi et al., 2022; Nassur et al., 2022, Beggs, Brubacher, & Little, 2024). There is also some evidence regarding certain behavioral and environmental factors, including child feeding and care practices and WASH practices by caregivers during MAM treatment, which may also influence the children's ability to recover fully from malnutrition while under MAM treatment and care (Stobaugh et al., 2018; Ruel-Brockdorf et al., 2017; Flax et al., 2010, Gagnon-Dufresner et al, 2021).

In Sierra Leone, and West Africa more broadly, MAM rates among children remain high (UNICEF, 2023). As part of broader research into improving global nutrition and food assistance programs, the Tufts University-led Food Aid Quality Review (FAQR) (2009-2020) study in Sierra Leone assessed the cost-effectiveness of four supplementary foods on treatment of MAM among children 6-59 months old. The four foods that were tested included: Corn Soy Blend Plus (CSB+) delivered with Fortified Vegetable Oil, Corn Soy Whey Blend (CSWB) with added Whey Protein Concentrate delivered with Fortified Vegetable Oil, Super Cereal Plus (SC+) which integrated oil into the SNF product, and a lipid-based Ready-to-Use Supplementary Food (RUSF), provided to beneficiaries for use in isocaloric 500 calorie quantities (Ignowski et al, 2021). The overall FAQR study found that all four of the study foods resulted in similar MAM recovery rates (at just over 60% of children). The study found that all four foods were similarly cost-effective at achieving children's recovery from MAM in Sierra Leone (Griswold et al, 2021). However, overall, about 19% of enrolled children deteriorated to severe acute malnutrition (SAM) while in the MAM treatment program, while nearly 10% did not respond to treatment (Griswold et al, 2021). The authors speculated that other factors, including adherence to MAM treatment recommendations and intended use of the study foods, children's at-home environmental conditions, caregivers' IYCF-C practices, and child illness may have also

contributed to children's recovery from MAM during the MAM treatment program (Griswold et al, 2021).

Then, to further explore if any reported household or behavioral factors may have contributed to MAM recovery rates in Sierra Leone, the household survey data were analyzed using secondary regression analyses by the FAQR study team. The results from the secondary regression analysis suggested that higher MUAC at enrollment for MAM treatment, enrollment during the rainy season in Sierra Leone, presence of a grandmother (a female aged 65 or older) in the home, and the beneficiary child's illness with diarrhea in the two weeks prior to MAM treatment enrollment were each also associated with the children's recovery from MAM (Griswold et al., 2021). The research team found that children who did not recover from MAM, or those whose MAM deteriorated into SAM, experienced more acute illness during their participation in the MAM treatment program or were first transferred from the SAM treatment program to participate in the MAM treatment program (Griswold et al., 2021). Considering the finding that the beneficiary children who reported acute illness in the two weeks prior to enrollment in the MAM treatment program were more likely to graduate from the MAM treatment program and recover from acute malnutrition by the study end, the study authors speculated that their acute illness in fact caused them to develop MAM, so participating in the MAM treatment program while recovering from the acute illness aided in their recovery from acute malnutrition overall and facilitated their graduation from the MAM treatment program (Griswold et al., 2021). However, the authors still noted that 'little attention has been paid' to the socioeconomic, household-level, and behavioral factors and practices that may further influence children's response to treatment for acute malnutrition and called for further targeted research on the topic (Griswold et al., 2021).

Despite decades of research on implementation of MAM treatment programs, there are certain gaps that remain regarding which of the specific household components and IYCF-C practices of children's caregivers while children are enrolled in the MAM treatment program might influence children's physiological response to the SNFs provided in MAM treatment and ability to recover from MAM while enrolled in a treatment program (Beggs, Brubacher, & Little, 2024, Griswold et al, 2021). Better understanding of these diverse household and behavioral factors and practices may help inform future MAM treatment program implementation as well as targeted MAM treatment and prevention behavior change messaging in the future, but more in-depth, detailed, and nuanced information is needed from participating households.

While in-home observation (IHO) data are commonly used in anthropological studies, its application in nutrition and health programmatic settings remains rare due to the perceived significant time, training, and resources required for its collection (Ahmad, Zaman, & Pervez, 2022). However, IHO data, which captures detailed observations of actual behaviors rather than relying on self-reported information, offers a valuable lens into context-specific environmental and behavioral factors that may influence a child's ability to recover from MAM during treatment programs. These insights can better inform the design of MAM treatment programs, moving beyond the provision of nutritious foods through SNFs to also consider addressing broader environmental, behavioral, and systemic components. This approach aligns with the UNICEF Framework, emphasizing the importance of considering addressing the underlying and enabling factors that affect a child's recovery from acute malnutrition in resource-limited and challenging settings.

In this study, we analyze IHO data collected as part of the FAQR study conducted in Sierra Leone. IHO data were gathered using a structured observation checklist, with local enumerators

encouraged to supplement these observations with detailed, open-ended notes documenting their own insights. This dual approach to data collection provides a unique and rich source of programmatic information, offering perspectives that structured instruments alone might otherwise miss. Unlike traditional self-reported surveys, IHO notes capture nuanced details of observed behaviors and practices, revealing dynamics that might otherwise remain undocumented or forgotten during self-reported surveys. Moreover, the IHO notes go beyond structured observation checklists, providing deeper insights into how various household-level actions—such as child feeding practices, caregiving behaviors, and the home environment—may have shaped children’s recovery from MAM. By integrating these detailed observations with structured data, this analysis offers a more comprehensive understanding of the factors influencing MAM recovery in Sierra Leone and similar contexts, offering detailed information on behaviors or conditions of concern to design more context-specific and effective MAM treatment programs.

Research Methods

The present study uses qualitative content analysis (Hsieh & Shannon, 2005) to code, analyze, theme, and interpret caregiver IYCF-C behaviors derived from the IHO data collected as part of a subset of participants in the Griswold et al. 2021 study. As noted, the main FAQR study in Sierra Leone was based on providing 500 kcal of one of four SNF per child per day for 12 weeks to 2691 children aged 6–59 months old experiencing MAM in the semi-urban district of Pujehun, Sierra Leone between 2014 and 2016 to determine SNF cost-effectiveness. At the beginning of the study, the beneficiary children’s caregivers participated in a household demographic interview. Subsequently, every two weeks throughout the study, the caregivers

brought their children to the local health clinic to have their height, weight, and MUAC measured, and receive a ration of the SNF. Children graduated from the program when they reached an average MUAC of ≥ 12.5 cm over two consecutive measurements. Those who regressed to SAM during the study were referred for appropriate SAM treatment, while children who relapsed to MAM were reenrolled in the treatment program for additional support, but not in the FAQR study. More detailed methods for the FAQR study in Sierra Leone can be reviewed in the original paper, linked [here \(Griswold et al., 2021\)](#).

The present analysis includes observations from a subset of 255 children in Sierra Leone from the wider study population of the MAM treatment program who, in addition to receiving the SNF distribution and having completed a household demographic interview, the household also participated in the IHOs, and either recovered from MAM or developed SAM. As the FAQR study team aimed to assess factors and practices that may have contributed to children's recovery from MAM or development of SAM, we excluded children who died during the study period and children who did not recover from MAM during the MAM treatment program but did not regress to SAM either.

Overview of the IHO Data Collection Method

As noted, two- to five-day IHOs were conducted at the homes of each of the participating 255 children, to assess caregiver preparation and child consumption of the four SNFs provided, in addition to recording caregivers' IYCF-C practices and other typical household activities, including: child caregiving and feeding, household chores including cooking and cleaning, home visits by family members or friends.

The FAQR Sierra Leone field team trained local enumerators on IHO data collection methods. Enumerators, who were females between twenty and forty years old, with secondary-level education, recruited from nearby villages, were instructed to record household activities with a focus on SNF preparation, child feeding, and care of beneficiary children. The IHO training lasted five days and covered obtaining informed consent, maintaining professionalism during observations, logistics of setting up in-home observations, conducting household surveys, and performing non-disruptive IHO.

Home observations took place at the child's family home compound for 12 hours, from 6 am to 6pm. Enumerators recorded household activities using IHO survey checklist forms, which categorized certain activities, as well as detailed, hand-written notes.

IHOs were planned for five consecutive days, but actual observation days ranged from two to five days. Children in this data set had observations for an average of over three observation days. If the observation did not take place, it was most often because the children's mother (primary caregiver) was not home or the family had errands to run (e.g. going to the market, going to the family farming plot), which required them to leave the family compound without the local enumerator.

IHO checklist data and detailed, open-ended notes were collected using paper forms and digitally transcribed after the fact. The IHO structured checklist included topics such as breastfeeding and complementary feeding practices by the caregivers, as well as water, sanitation, and hygiene (WASH) practices. Data from the hundreds of pages of IHO qualitative notes transcripts recorded by enumerators included other caregiving behaviors by the caregivers and characteristics of the child's home environment (Griswold et al., 2021). Table 1 describes the types of infant and young child feeding and care (IYCF-C) practices, behaviors, and

household conditions that were of interest for this research and were observed during the IHO and household surveys.

Table 1. IYCF Practices, Behaviors & Household Conditions of Interest for the IHO

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child
	Whether caregiver fed child or if child self-fed
	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child

	Water source for the household (stream, pump, etc.)
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Summary qualitative content analysis was carried out on the detailed field notes taken by enumerators during the IHOs. The qualitative content analysis involved reading through, thematically coding, analyzing, and interpreting the household environment and caregiver behaviors (described in Table 2) related to IYCF-C and other behavioral and household factors described in the notes by the enumerators. NVivo V12 and V14 qualitative software (QSR International) was used for data management and to aid in coding and analysis.

The coder was the lead researcher (AS), a public health practitioner with expertise in qualitative methods, who reviewed all the data multiple times to assign codes and carry out the analysis.

Results

In Sierra Leone, among the 255 children in the sub-population for the study, 207 children graduated from the program, and they recovered from MAM, and 48 children's malnutrition worsened, and they deteriorated to develop SAM (Table 2). Regarding beneficiary child gender, 149 were female (58%) and 106 (42%) were male. Of the 207 children who recovered from MAM, 91 were male and 116 were female. Of the 48 children who regressed to SAM, 33 were female and 15 were male. Regarding distribution of child age, of the 255 children, 147 children were 6-12 months old; 85 children were 13-24 months old, and 20 children were 25-36 months old, and 3 children did not have age data available at the time of interview.

Table 2. Characteristics of MAM Treatment Program Participants

	Female	Male	Totals
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Recovered from MAM	116 (56%)	91 (44%)	207
Regressed to SAM	33 (69%)	15 (31%)	48
Totals	149 (58%)	106 (42%)	255

The following themes and categories emerged after an in-depth review of the IHO data across the 255 children included in the analysis.

Primary and Secondary Caregivers

The mother of the beneficiary child was their primary caregiver over 85% of the time, and typical caregiving activities included preparing the child's meals, feeding the child, bathing, changing, and dressing the child, playing with the child, and taking the child to medical appointments. Secondary caregivers include the beneficiary child's paternal grandmother, who was the most frequently observed secondary caregiver, in addition to the children's father, aunts, and other female neighbors who also helped with childcare. Fathers were involved in childcare, play, and feeding, but less often than the child's mother or paternal grandmother. Siblings, specifically the elder siblings of the beneficiary child, were not heavily involved in the feeding and care of their younger siblings. The elder sisters of the beneficiary child provided some limited care of their younger siblings, including occasionally supporting their mothers with feeding, bathing, and playing with the younger sibling (the beneficiary child). In very few households, the elder sister watched the beneficiary child throughout the entire day while the caregiver was away from the home engaging in income-generating activities, typically farming. Elder female siblings also frequently helped the primary caregiver with household chores, including cooking and cleaning for the family. The beneficiary child's older brothers were

occasionally observed to play with the children or hold the child when the mother was occupied, but they were not very involved in caregiving of their younger siblings.

Table 3 provides an additional overview of the primary and secondary caregivers of the children observed in the data. As noted, the primary caregiver was overwhelmingly the children's mother, who was observed in the data to provide care (e.g., feeding, holding, bathing, playing with, dressing, etc.) over 25,000 individual observed instances. The next most observed caregiver of the children was their paternal grandmother, who was observed nearly 3,000 times. Other caregivers were the children's father, their aunties, and few observations of the children's elder siblings.

Table 3. Caregivers Individually Observed Caring for Children

Caregiver	Times Caregiver Observed
Mother	25,791
Grandmother	2,661
Father	1,116
Aunties / Other females (e.g., neighbor)	1,060
Child's siblings	
Sister	1,287
Brother	792

These illustrative quotes highlight the typical caregiving practices by primary (the child's mother) and secondary (child's grandmother and a female neighbor) caregivers in supporting childcare. Overall, primary and secondary caregivers engage in the same type of caregiving activities but the primary caregivers care for the children much more frequently.

Mother (Primary Caregiver)

Quote 1: “The mother (Jilloh Musa) is preparing the evening meal. The younger siblings, Umaru Tarawally and Hawa Tawei, are assisting her in the kitchen while processing the potato leaves. The caregiver carries the beneficiary child, Musa Tarawally, on her back.”

Grandmother (Secondary Caregiver)

Quote 2: “Mother took the beneficiary child from the ground, gave the child to her grandmother (Hawa Kamara), and she (mother) left the house to the stream to launder the beneficiary child’s clothes.”

Female Neighbor (Secondary Caregiver)

Quote 3: “Neighbor called Kema feeds Foday (beneficiary child) with rice and soup. She feeds him with a tablespoon. Eating environment was washed and swept by Kema. She gave him fish to eat, and Foday drank water in an unwashed cup.”

Foods Consumed by Beneficiary Children

Based on the IHO analysis, the beneficiary children typically consumed a grain-based diet, which was supplemented with small amounts of animal-sourced proteins and vegetables. Sweets and fruits were occasionally provided to children as snacks. Apart from the study SNFs, beneficiary children would typically consume foods out of the ‘family pot,’ meaning they were served and consumed a small portion of food from the family meal, rather than a meal prepared separately for them. All children consumed grain-based foods at each meal, while other food groups, including various animal proteins, fruit, and vegetables, were consumed less frequently,

typically twice or less per day in small quantities. Children typically consumed two to three meals per day, in addition to regularly breastfeeding, and consumed occasional snacks.

The most consumed foods observed across the IHO data across all 255 children included the study porridge, rice, cassava root, sweet cakes, groundnuts, various types of soup, including potato leaves or peanut sauce soup. Less commonly consumed foods that were observed in the IHO included coconut, potatoes, eggs, fish, corn, sweet biscuits, beans, bananas, pineapple, mango, palm fruits, oranges, among others. The following table (Table 4) describes number of times various foods were observed to be consumed by the children. The observations were targeted to observe the study food and record other foods as they were consumed by the children. The detailed IHO notes contained observations of other foods that children ate during the 12-hour observations by the enumerator. As outlined in Table 4, the most common foods other than the porridges that children ate were starches and tubers including rice, cassava root, and sweet breads. Table 3 outlines the number of observations of children eating, which includes both the same child eating foods at different times and unique observations of eating among diverse children in the study.

Table 4. Foods Consumed by Children During Home Observation Period

Food	Times Observed
Study food porridge	14,724
Non SNF porridge (local porridge)	154
Rice	6,889
Cassava root	1,115
Sweets (i.e., biscuit, cake, sweet bread, donut, other sweets)	1,416

Water	1,787
Other green vegetables (e.g., local greens)	1,894
Soup	898
Fish (in stew, grilled, fried)	583
Potato sauce	591
Groundnut sauce	497
Sugar-sweetened beverages (i.e., soda or juice)	444
Other Fruit (e.g., mango, pineapple, orange)	671
Milk	297
Fresh coconut	198
Cooked corn	199
Cooked okra	185
Boiled beans	156
Cucumber	139
Cooked Egg	204
Raw onion	147
Other meat (e.g., beef, chicken, goat in stew, fried, or grilled)	79

Children were offered beverages to drink after meals, which included water and often sugar-sweetened beverages, including soda, which was provided to children over 400 times.

Children two years old and younger were often breastfed when they woke in the morning and periodically throughout the day, which was observed in over half of all observation notes. Mothers nursed the child when they cried, awoke from a nap, or after a meal.

Although not common, there were several observations of children who refused breastmilk and other foods throughout an entire day due to illness. Overall, breastfeeding and consumption of other foods by the beneficiary children was poor during illness, as children regularly refused food and breastfeeding due to illness.

Child Feeding Practices

Children two years old or older were provided food to eat independently, with the goal being that they try to feed themselves; if they could not, they were fed by their primary caregivers. Children who could feed themselves, typically children younger than two years old, ate their meals on the ground or floor (observed 1,638 times) or the veranda (1,606 times), sometimes on a cloth mat in the household (86 times), or on a household bench (429 times), and small children under two years old, were typically held in the arms of a caregiver while being fed.

These illustrative quotes describe typical child feeding practices observed, and in addition, they highlight the WASH practices by caregivers and the potential risks associated with children mouthing unsanitary items during mealtimes. The quotes provide insights into the everyday scenarios of child feeding, the involvement of family members in feeding, and the cleanliness of the feeding environment, which may have influenced a child's recovery from MAM:

Quote 1: “She [the beneficiary child] is eating the pineapple all by herself while she is still sitting on the mud floor in the veranda at the household. While the beneficiary child was eating the pineapple, she was also playing on the hearth.”

and

Quote 2: “While the beneficiary child is playing, a kid (Aunty Tenneh’s child) came to the market hut with some cooked beans in a small green rubber plate. She then feeds the beans (cooked black eye beans with oil) to the beneficiary child. The beneficiary child and the kid, older than ten years, consumed all the beans provided, about less than half of the [serving in the] small green rubber bowl.”

and

Quote 3: “Haja Nessie (mother) gave the beneficiary child rice and okra sauce in a small blue rubber bowl; any heating of the food was not observed. The food was believed to be leftovers. The beneficiary child fed herself using her right bare hand. Hand washing was not observed. She was sitting on the ground in their kitchen, and there was no leftover from the meal.”

These quotes highlight typical child feeding and handwashing practices by caregivers, as well as the risk of children mouthing unsanitary items during mealtimes, among other aspects of the children’s home activities. The quotes demonstrate the autonomy of some of the beneficiary children during feeding, the communal approach to childcare due to the multiple caregivers involved in child feeding and care, and the potential pathways to children’s fecal-oral contamination due to unhygienic feeding and play practices. Poor food hygiene practices, potential food safety concerns due to poor preparation and storage of the study foods, and the

described living conditions also reflect important aspects within household that could have influenced children's recovery from MAM.

Beneficiary Children's Consumption of Study Food

Overall, children consumed the SNF, also known as the "study food," without issue. Most often, children consumed the entire portion of the study food (SNF porridge) that was offered to them by their caregivers. The SNF was often prepared in a cup or bowl, and the caregiver fed the child, or the child fed themselves, depending on their age. However, the study food was frequently shared if there were any leftovers of the portion originally offered to the child by the caregiver. The leftovers would be most often shared with the siblings of the beneficiary child, while there were just a few observations of the primary caregiver consuming the leftover study food herself.

If the SNF was totally refused by the child, it was most often due to illness. There were a few instances of refusal of child consumption of the SC+ food, which has been documented by the FAQR team to have had a bitter aftertaste in comparison to the other SNF (Langlois et al, 2020).

When preparing the SNFs for the beneficiary child, over two-thirds of the time, the mother would prepare the full SNF recommended serving for the day in the morning and feed it to the beneficiary child throughout the day in smaller portions, which were often not covered nor reheated before serving to the child. This food storage practice may have presented a food safety risk for children.

The following quotes describe the children's typical consumption of the study food. Quote 1 describes the sharing of the study food with the siblings after the beneficiary child finishes eating:

Quote 1: “The leftover from this consumption was given to Momoh Kallon (elder brother of the beneficiary child) and shared to other children above five years of age. The utensils were washed after feeding and put in a bowl with cover.”

and

The second quote describes how the caregiver provides the child with leftover SNF, without reheating it:

Quote 2: “The beneficiary child is eating the CSWB pap. Marie Sesay (caregiver) feeds the child the uncovered leftover pap from the previous serving (morning); she was feeding the child with a teaspoon. The child (Matailor) ate some of the pap, and there was left over from this serving. Marie Sesay (caregiver) gave some water she brought from the room to the child and the child was drinking directly from the cup in the veranda at the household.”

and

Quote 3 describes how the child consumed a partial serving of the SNF, but all of the portion that was offered to the child by the mother, with the leftovers then being stored by the caregiver for later consumption:

Quote 3: “The beneficiary child eats half of the pap in the cup (baby feeding) but consumed all the pap [that was] offered [to the child by the mother]; was more than half of a blue baby feeding cup. The leftover was placed in a covered rubber cup in the kitchen.”

Children’s Home Environment

The beneficiary children lived in their family household compounds which were single-family dwellings, with small homes located within walking distance of their neighbors, often extended family members, and the family farm, where caregivers often spent a significant

portion of their day. Presence of domestic or farm animals was not frequently reported, with just a few mentions of their presence around children. Most family compounds did not have their own water source, so the caregivers or their elder children often had to walk to draw water from the stream or community pump daily and store it in a pot, which was usually uncovered, at the home compound. Overall, the home compounds were tidied and swept daily in the mornings by the mother of the beneficiary child.

Beneficiary children were most frequently placed on the dirt or patio cement floor to play either alone or with their siblings while their caregivers carried out other household activities. Though the observations did not provide the exact lengths of time that children played on the dirt or patio floors, this practice was frequent and occurred multiple times per day. As is common among toddler children, beneficiary children were frequently observed to place unsanitary items, such as toys, dirt or debris, other household items, or food that they dropped on the floor into their mouths, and their hands were never washed by caregivers before or afterward.

The following quotes depict the typical home environment for children, highlighting the home conditions, play environment, and the WASH practices of their caregivers. These practices reveal the conditions in which beneficiary children were exposed to potential environmental health risks, stemming from limited environmental cleanliness, suboptimal waste disposal and handwashing by caregivers, and their frequent mouthing of unhygienic items. The beneficiary children's exposure to unsanitary conditions, particularly when children played with and mouthed objects that have been in contact with the ground, may have led to risk of illness.

Additionally, quote 1 describes the typical daily cleaning of the home compound and unclean water source for the family:

Quote 1: “Mummy Tejan (mother of the beneficiary child) woke up, swept the compound with a long broom and prepared [it] with a long broom and prepared the fire using charcoal, matches and plastic in a medium size coal pot...She [mother] went into the kitchen, took a broom and she started sweeping the entire compound, together with Tenneh Kpaka (aunty to the beneficiary child). They gathered dirt and threw it away. She went into the kitchen and built fire using wood, plastic and matches. She took a medium size locally made aluminum pot that was half filled with water she fetched from the river.”

and:

Quote 2 describes the typical practice of leaving children unsupervised to play alone on the floor of the home compound, and their tendency to mouth unhygienic household objects:

Quote 2: “Theresa (mother) brought out Iye (beneficiary child) and put her out the floor to sit and give her a bunch of keys, Iye (beneficiary child) rub the keys on the ground and put it into her mouth for 2 minutes and took it out by herself.”

Overall WASH Practices by Children’s Caregivers

There are a few WASH practices of interest that were observed, including handwashing, bathing of children, and toileting children. Handwashing among caregivers was generally not practiced at critical times such as before or after eating or feeding or after toileting the child. There were few observations of caregivers rinsing their hands with water, usually without soap, and this practice was carried out during dishwashing before cooking. There were very few observations of caregivers rinsing their hands and those of their children without soap before eating. Overall, caregivers bathed children daily in the morning with soap, mostly local ‘African black soap.’ There was little reporting of disposal of child feces, but there were a few mentions

of the child being rinsed with water after toileting. The households received their water from the local community pump or stream, which was not treated, and then stored the water in a container in the household. The storage containers of water at the home compounds varied, with both covered and uncovered sources which were all used for cooking, bathing, and drinking, posing a risk of unsafe water consumption because the water was not treated before use.

These two illustrative quotes demonstrate the typical hygiene and sanitation behaviors that were observed, with the first quote demonstrating a typical bathing practice for beneficiary children with a local soap, and the second quote describing a typical bathing practice as well, but without soap:

Quote 1: “Hawa Massaquoi [grandmother to the beneficiary child] bathed the beneficiary child with hot water that she poured into the same medium green and black rubber bucket, and it was two calabash of the same hot water and two and half calabash of unheated water that was in the big blue and pink rubber bucket. And she poured in into the same hot/heated water, and she took it at the back of the same kitchen to bath the beneficiary child. She used soda soap and water to bathe her. Finished at around 18:00 and she took her inside the same veranda room to dress her”

and

Quote 2: “Foday (beneficiary child) had a stool, his Aunty Mariama uses pump water to clean him and washed him using water only (no soap). She then puts on him clean clothes.”

Comparison between Children who Recovered from MAM and Those Who Failed to SAM

This sub-analysis compares the dietary intake, patterns of illness, and feeding practices between children who recovered from MAM and those who progressed to SAM. As outlined in

Table 5, more females than males experienced SAM, with 68% of SAM cases occurring in female children, with SAM being more common in younger children. However, we did not observe differences in practices or behaviors that might explain why more girls developed SAM than boys. There were more girls than boys enrolled in the FAQR MAM treatment program in Sierra Leone to begin with, with 58% of the study cohort being female (Griswold et al, 2021). The table below shows the age and gender breakdown of children who experienced SAM, noting that 32 children who developed SAM were between 7 and 12 months of age. Specifically, among children under 12 months old who developed SAM, 68% were female and 32% were male, while among children over 12 months who developed SAM, 67% were female and 33% were male.

Table 5. Gender and Age Summary Among Children Who Developed SAM

Age	Sex		Total Children Who Developed SAM
	Female	Male	
≤ 12 months	22 (68%)	10 (32%)	32 (100%)
≥ 12 months	10 (67%)	5 (33%)	15 (100%)
Totals	32 (68%)	15 (32%)	47 (100%)

There were several notable differences between children who progressed to SAM and those who recovered from MAM.

The most observed foods consumed by all children were starches, including rice, local porridge, cassava, potato, bread, and cakes. Consumption of animal source proteins was very rarely observed among children who progressed to SAM in comparison to children who recovered from MAM. Children who progressed to SAM consumed predominantly starches with

little to no animal protein or other nutrient-dense foods. Via analysis of the IHO data, overall, children who recovered from MAM were observed to have consumed more food and somewhat more diverse types of foods than the children who progressed to SAM. This was determined by counting the frequencies of foods observed to be consumed across both groups of children.

Although the children with SAM may have had reduced appetites due to illness, their overall food intake was less frequent and less varied than that of children who recovered from MAM. Among the children who progressed to SAM, there were several instances of children being fed the study food only once or twice a day, without additional foods or snacks, though occasional breastfeeding was observed, in comparison to children who recovered from MAM who consumed the SNFs multiple times per day in addition to other foods or snacks.

Three children with SAM were acutely ill and did not consume any food on at least one day of observation. Further, several children who developed SAM and had received the SC+ SNF were observed to consume little or none of the supplementary food provided during the observation period, though the reasons for this remain unclear.

Moreover, children who developed SAM were sicker than children who recovered from MAM, as the children who developed SAM experienced more frequent and prolonged illnesses during treatment. Additionally, illness was more prevalent among girls. However, we did not find major differences among feeding practices or other behaviors that might help explain why more female children were ill than male children. On average, children with SAM experienced more days of illness during treatment compared to those who recovered from MAM, reinforcing findings from previous FAQR analyses (Griswold et al., 2021). They were observed to suffer from symptoms such as cough, fever, gastrointestinal issues, diarrhea, and vomiting for more days than children who recovered from MAM. These children were treated with a combination

of medicines, including syrups and pills, as well as traditional remedies. Sick children were often given warm water and herbal tea made from local herbs, boiled by their caregivers in the mornings. This practice is supported by literature, which highlights it as a cultural tradition in Sierra Leone, where children are typically given these herbs to cleanse their stomachs before eating or to prevent or treat illness (MacDonald, Aubel, Aidam, Webb-Girard, 2020).

Discussion

Data from these IHOs confirm and complement findings from analyses previously carried out by the FAQR research team in Sierra Leone. The observation data from the IHO notes and checklists add depth to the quantitative findings from the MAM treatment program, revealing previously unknown details about factors influencing children's recovery from MAM. These details include trends in the consumption of study food by beneficiary children, as well as insights into suboptimal IYCF-C practices, hygiene behaviors by caregivers, and environmental conditions within children's home settings.

Specifically, we observed that beneficiary children typically consumed all the SNF study food provided to them by caregivers, which aligns with previous findings of good acceptability and consumption of the study food by beneficiary children (Griswold et al, 2021). Moreover, occasional sharing of leftover portions with siblings occurred but was not widespread, confirming findings by Griswold et al. (2021). However, additional behavioral and environmental factors emerged that were not evident in prior FAQR analyses. These included suboptimal WASH practices, such as infrequent handwashing at critical times and limited soap usage, frequent mouthing of unsanitary items by children, unsupervised play in unhygienic home compounds, and limited dietary diversity outside of the provided study food. These factors could

negatively impact children's recovery by exposing them to pathogens and causing extended nutrient deficiencies.

In addition, while the mother was by far the primary caregiver for the beneficiary children, their grandmother was the second most involved caregiver, often feeding, bathing, and caring for the beneficiary children, in support of the children's mother. This complements previous findings by the FAQR study team that children who were more likely to recover from the MAM treatment program had an elder female (65+ years old) present in the home (Griswold et al., 2021). Other researchers have noted the cultural importance and influence of grandmothers as part of child caregiving and feeding in Sierra Leone and advocated for their further engagement in child health and nutrition programs, in addition to the children's mothers, to promote improved child nutrition outcomes (MacDonald, Aubel, Aidam, Webb-Girard, 2020). As the grandmothers were regularly involved with beneficiary child feeding and care, including feeding children the study food, future MAM treatment programs in Sierra Leone and similar contexts may consider the intentional engagement of both mothers and grandmothers, two important caregivers, in programming and behavior change counselling activities to promote the children's graduation from the MAM program and sustained recovery from acute malnutrition.

As was described in previously reported findings by the FAQR team (Griswold et al, 2021), we observed that the MAM study food was occasionally shared. However, the serving of the study food was first offered to the beneficiary child to consume, and then any leftovers of what the portion that the child did not eat were primarily offered to the children's siblings, and very occasionally consumed by the caregiver. As some sharing of the study food does occur, MAM programs should continue the current, common practice of providing extra portions of the SNFs (Cichon et al, 2023).

The observation data also revealed specific caregiving practices and detailed feeding behaviors of children that were not previously captured in the self-reported FAQR household surveys. These included the fact that children who recovered from MAM consumed somewhat more diverse foods, including fruits, vegetables, and animal proteins, and ate more frequently throughout the day compared to children who progressed to SAM. However, overall, all children's diets predominantly consisted of starchy foods, with overall limited consumption of more nutrient-dense options.

Apart from the study food, there were 9,773 recorded observations of starchy, nutrient-limited foods consumed by children, compared to only 6,242 observations of nutritious foods, such as fruits, prepared vegetables, or animal-sourced proteins. This finding aligns with the parent study by Griswold et al. (2021), which reported severe food insecurity in over 60% of participating households, indicating that these children and their families lacked regular access to nutritious foods. Children enrolled in MAM treatment programs often come from resource-limited households, where their diets fail to meet key nutritional needs, leaving them vulnerable to malnutrition and its associated risks. These risks may be exacerbated if families experience additional shocks, such as reduced food access or a child becoming acutely ill, potentially leading to acute wasting (WHO, 2020).

Poor dietary intake and household food insecurity are well-documented risk factors for acute malnutrition and wasting among children, both of which we observed in this study (Bhutta et al., 2008; WHO, 2020; WHO, 2023; Black et al., 2013). Future MAM treatment programs should consider adoption of more integrated approaches, combining provision of SNF with behavior change communication, to enhance children's access to nutritious foods and improve child diet quality at home. This aligns with recent WHO guidelines on the management of acute

malnutrition, which recommend that in areas of high risk of shocks or conflict or high food insecurity, all children aged 6–23 months should receive supplementary food as a preventive measure against acute malnutrition, which should be paired with efforts to ensure adequate home diets for the entire family and incorporate infant and young child feeding (IYCF) counseling (WHO, 2023).

The home observations provided detailed insights into the frequency and nature of illness among children, particularly highlighting potential gender differences. Girls were observed to be ill more frequently during the MAM treatment period and experienced higher rates of SAM compared to boys. However, in the parent study by Griswold et al. (2021), girls comprised 58% of the MAM treatment program study population, so we would have expected the illness among children to match this distribution generally. This finding underscores a need for further investigation into potential gender-specific differences in the development of MAM in similar contexts.

Additionally, children who progressed from MAM to SAM were observed to be sicker than those who recovered, consistent with earlier analyses by the FAQR team and other studies (Griswold et al., 2021; Kerac et al., 2014; McDonald et al., 2013). These children experienced more days of illness and were frequently given various medicines, including traditional medicinal syrups, herbal teas, and over-the-counter remedies. Moreover, several children who progressed from MAM to SAM children were observed to consume little or none of the supplementary food provided, which may have been due to low appetite due to illness and may have contributed to higher rates of SAM among sick children. Given the significant impact of illness on children's recovery from malnutrition, future MAM programs should prioritize facilitating access to timely and appropriate healthcare services to address illnesses and prevent

the worsening of malnutrition from MAM to SAM, which is aligned with current MAM management guidelines (Padhani et al, 2023).

Additionally, the observation data documented a cultural practice in Sierra Leone of giving children warm water and herbal tea in the morning, which has been traditionally used for morning cleansing of the stomach or treating illness (MacDonald, Aubel, Aidam, & Webb-Girard, 2020). This practice observed in the IHO but not captured in the FAQR survey, could affect children's nutritional intake and overall health. For example, if herbal teas were consumed in quantities sufficient to fill the child's stomach, they might temporarily satiate the child, preventing adequate consumption of nutrient-dense foods. Alternatively, if the teas were prepared with unclean water or herbs, they might contribute to gastrointestinal distress, further compromising the child's health.

Understanding such cultural practices is important for tailored design of future behavior change communication (SBC) interventions that align with community traditions and beliefs. Future research should consider examining the frequency and context in which herbal remedies are used to help treat illnesses in Sierra Leone and similar settings. This could inform recommendations for parents or healthcare providers on whether and how traditional remedies and cultural practices could potentially be safely incorporated into care, while addressing potential risks to child health and nutrition outcomes.

Handwashing before or after meals was observed to be very uncommon, and when it did occur, soap was rarely used. Such poor WASH practices have been documented by other studies implementing MAM programs and are known to place children at increased risk of illness (WHO, 2023). Additionally, toddlers were frequently observed playing alone on dirt or concrete floors while caregivers were engaged in other activities. These children often placed unhygienic

items in their mouths, which, coupled with the lack of handwashing, increased their risk of fecal-oral transmission of pathogens. This exposure heightens the risk of infection and illness, potentially interfering with their recovery from MAM. Further, food safety practices, including treatment of water before drinking and safe storage and reheating of prepared foods were suboptimal. These practices may have also increased risk of child exposure to pathogens and potential illness.

Future MAM programs should consider incorporating additional SBC messaging to promote safer practices, such as encouraging the use of mats for children's play and ensuring caregiver supervision to reduce pathogen exposure. This approach has been applied in other contexts to prevent child illness and malnutrition and promoted by others for use in diverse contexts (Reid et al., 2018; Budge et al., 2021; Rosenbaum et al., 2021). Additionally, recent WHO guidelines on the management of acute malnutrition emphasize the critical importance of adopting improved WASH practices to prevent illness and support recovery among children with MAM, a finding which our results confirm (WHO, 2023).

However, implementing recommendations to improve WASH in regions like Pujehun, Sierra Leone, poses significant challenges. The region experiences high levels of poverty and inadequate WASH infrastructure (DHS, 2019). Only 66% of the population has access to an improved water source within a 30-minute walk, while 30% still practice open defecation, and water scarcity remains a widespread issue across the district's communities (DHS, 2019). Similar to the challenges associated with improving dietary intake, these potential structural barriers may impede caregivers' ability to adopt and sustain improved WASH practices.

Moreover, this study employed innovative methods through IHOs, which are rarely utilized in nutrition assistance programs. These observations provided unique and detailed

insights into the daily behaviors of beneficiary children and their caregivers, recorded over twelve-hour periods across multiple consecutive days. The IHOs captured critical nuances related to child feeding and caregiving routines, WASH practices, and child play and activities—insights that were not reflected in self-reported household surveys, including those in the study by Griswold and colleagues (2021).

These findings underscore the need and opportunity for holistic nutrition assistance programs that address not only the provision of SNFs to improve immediate food availability but also the broader household environment and behavioral factors influencing children's recovery from malnutrition. Future, tailored behavior change messaging should focus on integrating SNF consumption with nutritious home-prepared foods, encouraging consistent handwashing practices with soap, improving food safety and handling, maintaining clean, supervised play spaces for young children, and ensuring prompt referral to healthcare services when children fall ill. By addressing these interconnected factors, future MAM treatment programs can help significantly enhance their effectiveness in promoting recovery from acute malnutrition.

However, as noted, the provision of supplementary food addresses only one component—an underlying determinant—of the UNICEF Conceptual Framework for Child Nutrition (Black et al., 2020). By temporarily increasing the availability of nutrient-dense food in the household, SNFs supplement the children's diet during the MAM program. Yet, if a child's typical diet does not improve during and after program participation, they remain at risk of relapse into acute malnutrition.

Further compounding these challenges, children were regularly observed mouthing unhygienic items, while WASH practices remained inadequate, and food and water were often unsafely stored. These factors, identified as underlying determinants in the UNICEF Framework,

contribute to an environment that may perpetuate the risk of malnutrition. In such conditions, even a minor shock to the household's economic stability or a child falling ill can potentially increase the child's risk of wasting. Moreover, these risk factors extend beyond wasting to include micronutrient deficiencies and child stunting, highlighting the multifaceted and interconnected nature of malnutrition. Therefore, future research and MAM treatment programs should aim to more holistically tackle child wasting, as it is critical to break down the silos in MAM research and program implementation, given the well-documented multisectoral factors contributing to child malnutrition, including wasting, stunting, and micronutrient deficiencies (WHO, 2023).

The recent WHO Guidelines on management of acute malnutrition (2023) note that in high-risk areas characterized by poverty and food insecurity, MAM treatment programs should consider providing additional food or resources to low-income families to support children's recovery from acute malnutrition. While the available evidence on effective interventions to prevent relapse to MAM among children following treatment is limited, some studies suggest that providing additional food to families of affected children post MAM treatment can help reduce the likelihood of children falling ill again with acute malnutrition (Bliznashka, Rattigan, Sudfeld, & Isanaka, 2023). Further, in agreement with the Global Action Plan (GAP) to address child wasting, practitioners should consider further investments in broader health, social and economic systems as an investment in improving nutrition (WHO GAP, 2020). These investments may not only help improve child nutrition but also serve as protective factors against the recurrence of malnutrition, supporting children's overall healthy growth and development (WHO GAP, 2020). While our study did not examine this factor, we observed that families had low access to and limited consumption of nutritious foods, so it would be helpful for future

research to consider examining the impact of provision of additional nutritious foods to children and their families' post-treatment as a protective measure against future child malnutrition.

Recognizing that traditional MAM treatment programs alone cannot and are not designed to address all the determinants of child malnutrition aligned with the UNICEF Framework, intentional integration with other nutrition and social assistance programs is important to more holistically addressing child wasting. These complementary programs, implemented by governments, practitioners, or development actors, can help enhance families' access to essential resources such as food, financial aid, clean water, and other healthcare services. By fostering these synergies, future interventions can help more effectively tackle the multifaceted drivers of malnutrition, helping to ensure both immediate recovery and long-term well-being for children.

Limitations

This study had some limitations. While the local enumerators were trained to record observed behaviors objectively, some notes inevitably reflect somewhat subjective interpretations, which may introduce potential biases from the enumerators into the data. Nevertheless, a notable strength of the IHO data lies in the FAQR research team's analysis of the reactivity of behaviors, concluding that caregiver behavior exhibited minimal reactivity to being observed (Griswold et al, 2019). This limited reactivity suggests that the behaviors recorded are likely representative of typical practices. However, it is also possible that some of the suboptimal behaviors observed, including poor WASH practices and limited child dietary variation and intake, might have been more pronounced in the absence of enumerators, presenting a potential underestimation of certain practices.

Additionally, the qualitative analysis of complementary foods did not include quantitative data on child diet quality or specific amounts of food consumed. This limitation restricts the ability to draw more detailed conclusions regarding children's dietary intake. Despite these constraints, the in-home observations provided valuable insights into caregiving behaviors and cultural practices, including typical caregivers, limited handwashing and overall poor WASH behaviors, child mouthing of unsanitary items, and observed consumption of certain foods, related to child feeding and care that traditional surveys often miss.

Future programs could build on this approach by leveraging in-home observations to inform the design of context-specific MAM treatment programs and related behavior change counselling materials. These materials could help more effectively promote the adoption of improved practices, addressing both caregiving behaviors and environmental factors influencing child nutrition and recovery.

Conclusion

We observed that socioeconomic and behavioral factors, such as household poverty, child feeding practices, diet quality, and WASH behaviors by caregivers, had important influences on children's recovery from MAM treatment in Sierra Leone. As aligned with the UNICEF Framework, these factors help underscore the need and opportunity for holistic and context-specific nutrition assistance interventions that address not only the provision of supplementary nutritious foods but also consider the broader determinants of child nutrition in various, distinct contexts. A deeper understanding of these factors in distinct settings, like the research conducted in this study, can guide the design of more effective and efficient MAM treatment program

strategies, including tailored behavior change messaging and strengthened support for caregivers and health care providers. Conducting home observations with affected households provided important insights for designing future, targeted interventions aimed at improving dietary diversity, enhancing WASH practices, and also considering addressing systemic challenges related to poverty and food insecurity. By leveraging these tailored and integrated approaches, future MAM treatment programs can more effectively support sustainable recovery and help contribute to reducing the global burden of acute child malnutrition.

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Specific Aim 2- Full Paper

In-Home Observations from a Malnutrition Prevention Program May Help Identify Factors Contributing to Child Stunting in Burkina Faso

Global Perspectives on Child Stunting

One of the most detrimental forms of child malnutrition is child stunting, which affects 148 million children globally (Bhutta et al, 2013, UNICEF, 2023). Stunting is a form of extreme linear growth failure that occurs between conception and the child's second birthday (Prendergast, 2014). The clinical timeline for stunting highlights the importance of adequate maternal nutrition during pregnancy, as fetal growth faltering begins during the gestational development period (Prendergast, 2014). Linear growth faltering commonly accelerates during the child's weaning period, after exclusive breastfeeding ends and when complementary foods, often of poor nutrient quality, are first introduced (Das et al 2020, Cliffer et al, 2022, UNICEF, 2023).

Global economic and social advancements have significantly contributed to a decline in stunting rates since the mid-2000s, when nearly 50 countries reported very high stunting prevalence (UNICEF, 2023, Das et al 2020). Today, 95% of stunted children are concentrated in 28 countries, nearly all of which are in Africa and Asia (UNICEF, 2023). However, regional differences remain stark, particularly in West Africa, where the complex interplay of socio-economic, environmental, and security challenges continue to impede further progress in reducing child stunting (UNICEF, 2023; Bhutta et al., 2020).

Child stunting has lifelong implications, including impaired cognitive development, increased susceptibility to chronic diseases, and compromised gut function compared to non-

stunted children (Prendergast, 2014; Bain et al., 2013). Furthermore, stunted children are more likely to attain lower educational outcomes and often experience intergenerational poverty, perpetuating cycles of malnutrition within families and communities (Bhutta et al., 2020; De Onis & Branca, 2016; UNICEF, 2023).

Existing literature underscores the multifaceted nature of child stunting, highlighting a variety of contributing factors (Das et al., 2020). Frequent illness, diarrheal disease, poor water sanitation and hygiene (WASH), unsanitary home environments, suboptimal dietary quality, and inadequate childcare practices are consistently associated with stunting in children under two years old (Prendergast et al., 2014; Black et al., 2013; Danaei et al., 2016; Akombi et al., 2017). Additionally, suboptimal breastfeeding practices and the early introduction of inappropriate complementary foods can exacerbate growth faltering and increase the risk of stunting (Pickering et al., 2019; Argaw et al., 2019; Keusch et al., 2013). The relative importance of these factors varies by context, underscoring the need and opportunity for localized and tailored interventions to address stunting effectively (Prendergast et al., 2014; Zaharia et al., 2021; Bhutta et al., 2020).

Despite widespread implementation of stunting prevention and treatment programs, their impact has often been insufficient and of limited success, especially in very resource-limited settings (Argaw et al., 2019; Bhutta et al., 2020; Keats et al., 2021). This gap emphasizes the necessity of understanding the other contextual factors that may hinder program success and the need for adapting better-tailored interventions to address child stunting distinct and challenging global environments (Argaw et al., 2019; Bhutta et al., 2020).

Applying the UNICEF Framework to Understand Child Stunting

The UNICEF Conceptual Framework for Child Nutrition provides a comprehensive approach to analyzing the complex, context specific, and interconnected factors that contribute to child stunting (UNICEF, 2020). Leveraging the Framework, one can infer that child stunting arises from challenges across various determinants: immediate determinants such as inadequate child diets and suboptimal caregiving practices, underlying factors like poor household food security, sanitation, and limited access to health services, and enabling factors such as low socioeconomic status of their family and poor household resource availability (UNICEF, 2020; Pickering et al., 2019; Argaw et al., 2019; Keusch et al., 2013). This wholistic and systemic perspective reinforces the need to address factors beyond access to nutritious food alone, necessitating more holistic and integrated nutrition assistance solutions (UNICEF, 2020, Bhutta et al., 2020).

Recent reductions in child stunting in differing, global contexts have been linked to more wholistic and systemic interventions that go beyond improving food access or poverty alleviation (Bhutta et al., 2020). Advances across health, food, and economic systems have increased the availability and accessibility of diverse and nutritious foods in local markets, enhanced WASH practices, and driven investments in critical infrastructure such as roads and piped water (Keats et al., 2021; Ruel & Alderman, 2013; De Onis & Branca, 2016). Additionally, maternal and child health programs, community nutrition education initiatives, and targeted nutritional interventions have played important, contextually specific roles in supporting reducing stunting prevalence (Bhutta et al., 2020; Danaei et al., 2016; Pickering et al., 2019; Argaw et al., 2019). These multi-sectoral approaches highlight the importance of addressing broader determinants such as poor dietary diversity, inadequate childcare practices, poor socioeconomic status of households, and environmental factors like poor sanitation and limited access to clean water (Prendergast et al., 2014; Keusch et al., 2013).

Child Stunting in West Africa: Regional Challenges and Determinants

In West Africa in particular, child stunting remains a significant public health issue, with an average prevalence of over 30% among children under two years old (UNICEF, 2023). Over the past decade, stunting rates have decreased by more than 10%, which may be attributed to social and economic progress such as investments in community development, infrastructure, improved health services, and greater availability of diverse foods in markets (GNR, 2022; UNICEF, 2023). However, challenges persist, as stunting rates remain alarmingly high in rural and conflict-affected areas, with rates exceeding 50% in some regions of Burkina Faso (Picbogoum et al., 2023).

The persistence of stunting in West Africa reflects the interplay of immediate, underlying, and enabling determinants outlined by the UNICEF Framework. These include inadequate child diets, poor feeding and care practices, household food insecurity, low educational attainment of parents, poor household sanitation, and limited access to quality health services (UNICEF, 2020; Bhutta et al., 2020, Sawadogo et al., 2022). Further, instability and conflict may further exacerbate these issues, jeopardizing any development or nutrition gains and heightening the risk of undernutrition among low-income populations (Sawadogo et al., 2022; UNICEF, 2023).

A recent scoping review highlighted key risk factors for chronic child malnutrition across West Africa, such as low household income, poor dietary quality, child vulnerability to illness, and low maternal education (Sawadogo et al., 2022). In Burkina Faso, these challenges are compounded by inadequate water and sanitation practices, limited water and sanitation resources, and limited household resources, which exacerbate stunting rates (Picbogoum et al., 2023). Despite these insights, much of the existing data relies on cross-sectional studies,

underscoring the need for longitudinal and qualitative research to uncover the nuanced, context-specific determinants of stunting in this region (Sawadogo et al., 2022; Bhutta et al., 2020).

Insights from the FAQR Study in Burkina Faso and Directions for Future Research

The Food Aid Quality Review (FAQR), carried out by Tufts University, provides an example of identifying the most effective and cost-effective supplement for use in resource-limited settings. From 2014 to 2016, the FAQR program conducted an 18-month longitudinal study in Burkina Faso's Sanmatenga Province to evaluate the cost-effectiveness of four supplementary specialized nutritious foods (SNFs) in preventing stunting and wasting among children aged 6–23 months.

Despite the provision of the four SNFs, the study in Burkina Faso found that none of the products effectively prevented linear growth failure, with 23% of participating children becoming stunted by the end of the intervention (Cliffer et al., 2021). These research findings underscore the limitations of food supplementation alone as a solution to addressing stunting, particularly in settings where broader underlying and enabling determinants—such as caregiving behaviors, household conditions, and environmental factors—remain unaddressed.

While the FAQR research in Burkina Faso assessed some behavioral factors influencing SNF consumption, it did not fully investigate broader contextual factors, such as child feeding practices, caregiving behaviors, and household environments. These unexamined factors may have significantly contributed to the persistence of stunting among participating children (Cliffer et al., 2021). This gap highlights the importance of further research to understand the interplay of behavioral, environmental, and systemic factors necessary to effectively combat child stunting in similar contexts.

Research Significance

By analyzing the FAQR study data through the expanded view of the UNICEF Conceptual Framework for Child Nutrition, this mixed-methods study seeks to enhance the evidence base for more holistic, multi-dimensional approaches to addressing child stunting. This research aims to incorporate detailed in-home observations (IHO) related to caregiving and child feeding behaviors, alongside household survey data, will provide a comprehensive understanding of the specific factors and determinants influencing child stunting in Burkina Faso. The findings from this research aim to help inform and further refine targeted interventions, contributing to the reduction of child stunting not only in Burkina Faso but also in other similar resource-limited settings.

Through applying the UNICEF Framework and building on prior analyses of FAQR data, this mixed-methods secondary analysis explores potential socioeconomic and behavioral factors that may have contributed to children becoming stunted over the study period. While other analyses have assessed wasting outcomes (Cliffer et al., 2021), this study focuses specifically on stunting as a primary outcome. Based on a review of the existing literature, we hypothesize that non-stunted children are more likely to have lived in households with cleaner home compound environments, had older and more educated mothers/primary caregivers, consumed more diverse and nutritious diets, and will have been practicing breastfeeding compared to their stunted counterparts. By examining both immediate and broader determinants of stunting, this research aims to provide critical insights for designing future nutrition assistance interventions to reduce and prevent child stunting in complex, resource-limited settings like Burkina Faso.

Research Methods

Study Context

The data for our mixed-methods secondary analysis study is derived from the Food Aid Quality Review study in Burkina Faso, which is described more extensively elsewhere (Cliffer et al., 2020, Cliffer et al., 2021). Briefly, for background, this study was conducted in the northwest Sanmatenga province of Burkina Faso and was a geographically randomized trial that aimed to compare the cost-effectiveness of four specialized nutritious foods (SNFs) in preventing stunting and wasting among children aged 6-23 months.

The broader FAQR study was designed to assess the impact of four different SNFs: Corn-Soy Blend Plus (CSB+) with oil, Corn-Soy-Whey Blend (CSWB) with oil, SuperCereal Plus (SC+), and a Ready-to-Use Supplementary Food (RUSF). The FAQR program in Burkina Faso involved monthly distribution of supplementary rations and regular monitoring of children's growth using length-for-age z-score (LAZ) and weight-for-length z-score (WLZ) over approximately an 18-month study period. The food was distributed to the participants through their participation in the ACDI/VOCA-led Victory Against Malnutrition (ViM) program, a blanket supplementary feeding program designed to prevent undernutrition in high-risk areas by providing pregnant and lactating women (PLW) and children aged 6-24 months with a monthly ration of nutritious supplemental food. The ViM program also contained behavior change communication messaging via community-led outreach by local 'lead mothers,' which occurred monthly, described in more detail [here](#) (Cliffer et al., 2021).

Secondary Analysis & Methods

Our study data draw on information from the household surveys, as well as in-home observation (IHO) checklists and detailed IHO notes taken by in-home observers between

August 2014 and December 2016 during the FAQR longitudinal study in Burkina Faso. Using those data, we conducted an additional secondary analysis: a mixed-methods analysis to assess the association of various household and caregiver behavioral factors related to child feeding and care, including child feeding and care practices, water sanitation and hygiene practices, and household cleanliness, with the risk of children being stunted at the end of the study.

The mixed-methods design was chosen since it enabled us to provide a comprehensive understanding of the multifaceted qualitative and quantitatively measured components influencing child stunting in this context, guided by the conceptual insights of the UNICEF Framework for Child Nutrition (UNICEF, 2020).

Data Sources: Household Surveys and IHO Checklist and Notes

For this research, we drew on household surveys, including a household census and socioeconomic status details, which were conducted at baseline and during monthly follow-up visits, where children's anthropometric data were collected. In-home observations (IHOs) were used to assess caregiver preparation and child consumption of the four specialized nutritious foods (SNFs) provided as part of the overarching FAQR study. While caregiver behaviors are often assessed through self-reports, IHOs were specifically identified for this study as the direct observation method offers a more reliable assessment of these behaviors (Ruel & Arimond, 2003). Additionally, IHOs provided valuable context-rich information about the immediate, underlying, and enabling determinants, as per the UNICEF Framework, that could influence program effectiveness. These IHOs were conducted in 176 beneficiary households during October or November of either 2015 or 2016 by a team of five local enumerators.

The five, local enumerators were female, fluent in Moore and French, and had secondary-level education. They were recruited from local villages near the study area site. The FAQR field team conducted a one-week training program to equip the enumerators with essential skills for IHO data collection. The training covered obtaining informed consent from participants, maintaining professionalism during household observations, managing logistical challenges, completing household surveys, filling out IHO checklists, documenting detailed observational notes, and conducting direct observations in a non-disruptive manner. Enumerators were trained to record a wide range of activities occurring within the household, including caregiver preparation and beneficiary child consumption of the study food, broader child feeding and care practices, water, sanitation, and hygiene (WASH) practices, household chores, and overall cleanliness of the home and surrounding compound.

Burkinabe enumerators used digital tablets to document observed activities during 12-hour observation periods (6 a.m. to 6 p.m.) over three to five consecutive days. Data were recorded in French. While observations were initially planned for five days per household, logistical constraints, such as caregivers leaving their homes for chores, work, or errands, resulted in an average of three days of observations per household.

In Burkina Faso, the observations offered a comprehensive window into caregiver preparation and child consumption of the SNFs provided by FAQR. The IHO approach involved using a detailed IHO checklist developed by the FAQR research team prior to data collection and was used for enumerators to systematically record caregiver-child interactions, food preparation techniques, feeding practices, and overall household cleanliness and conditions. The observation checklist facilitated the documentation of behaviors of interest. The enumerators also captured additional qualitative data through open-ended notes that they entered into the tablet. These

observation notes provided rich details on household dynamics, including the cleanliness of the home environment, the presence of animals, water and sanitation practices, the involvement of diverse caregivers in child-rearing, and specific child feeding and care practices.

The combination of structured checklist data and open-ended qualitative notes enabled the enumerators to record detailed and routine child caregiving behaviors, household environments, and contextual factors, described in detail in Table 1, that may have influenced child nutrition and care.

Summary Qualitative Content Analysis

A qualitative approach, specifically, summary qualitative content analysis was carried out on the field notes taken by enumerators during the home observations (Hsieh & Shannon, 2005). The qualitative content analysis for this study involved the lead researcher reading through, thematically coding, analyzing, and interpreting the household environment and caregiver behaviors (described in Table 1) related to IYCF-C and other behavioral and household factors described in the notes by the enumerators. Further, a draft codebook was prepared based on a first review through of the IHO notes and was then applied to a wider random sample of 10% of IHO notes transcripts, which was followed up with modifications to the drafted codes to ensure they better aligned with the IHO data. The finalized codebook resulting from this process was subsequently employed to assess and interpret the entirety of the notes transcripts. NVivo V12 and V14 qualitative software (QSR International) was used for data management and to aid in coding and analysis. The coder was the lead researcher (AS), who reviewed all the data multiple times to assign codes and carry out the analysis.

Table 1. IYCF Practices, Behaviors & Household Conditions of Interest

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child
	Whether caregiver fed child or if child self-fed
	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child
	Water source for the household (stream, pump, etc.)

The summative content analysis was robust. Over 150 pages of detailed in-home observation (IHO) notes, digitally recorded by the enumerators, were analyzed using qualitative content analysis, in addition to an IHO survey collected during the home observations on a tablet, which included over 14,000 observation entries across the 141 IHO households. The analysis involved examining data from the 141 children across the four SNF groups (CSBP, CSWB, SC+, and RUSF) who had between three and four consecutive days of observations, with Table 2 providing an overview by SNF group among children with IHO data.

Table 2. Distribution of Children with IHO Data by SNF Group

SNF Group	Number of Children
CSBP	30
CSWB	39
SC+	34
RUSF	38
Total	141

Quantitative Data Analysis

We conducted a quantitative analysis of household survey data using multiple logistic regression to identify socioeconomic, demographic, and dietary factors potentially associated with child stunting at the end of the study among 23-month-old children enrolled in the program. Based on a literature review, we hypothesized that maternal education, older maternal age, higher household wealth, breastfeeding, and the consumption of animal-sourced proteins were associated with a reduced risk of child stunting by the end of the program.

The study sample was initially restricted to households of beneficiary children who participated in the IHO program (n=176). This sample was further narrowed to households with complete survey data for both the outcome variable (child stunting) and explanatory indicators of interest, resulting in a final analytic sample of 141 children. The primary outcome variable, child stunting, was measured as a binary variable at the end of the study, when participating children were 23 months old. Covariates included maternal age (continuous), maternal education (binary: any education vs. no education), household wealth quintile (categorical), breastfeeding status (binary: breastfed vs. not breastfed at the time of the survey), and the child's consumption of animal-sourced proteins during the observation period (binary). All covariates were selected based on their documented association with child stunting in the literature.

Descriptive statistics were calculated to assess the distribution and normality of continuous variables and to summarize binary and categorical indicators. Logistic regression was employed to examine associations between explanatory variables and child stunting. The model was designed as follows:

$$\ln[P(\text{Stunted}) / [1 - P(\text{Stunted})]] = \beta_0 + \beta_1 \text{maternal age} + \beta_2 \text{household wealth} + \beta_3 \text{breastfeeding status} + \beta_4 \text{consumed ASF} + \beta_5 \text{maternal education} + E$$

Regression diagnostics were performed to assess model fit, identify outliers, and detect influential observations. No significant data points were excluded based on these diagnostics. The final model provided a cross-sectional snapshot of associations, as longitudinal trends were not assessed. All analyses were conducted using Stata 17.

The quantitative analysis faced several limitations. First, some explanatory indicators, such as child consumption of animal-sourced foods, were constructed using observational data collected at different time points than the household surveys, potentially introducing temporal

misalignment. This misalignment may have impacted the reliability of the results by creating inconsistencies between data sources. For example, dietary practices observed over a single 24-hour period might not accurately reflect usual consumption patterns captured in survey responses. Future similar studies could potentially mitigate this issue by aligning data collection timeframes or incorporating repeated dietary measurements to improve accuracy. For instance, the indicator for animal-sourced food consumption was based on enumerator observations within a specific 24-hour period during the study, which may not align with dietary consumption at the time when the survey was conducted. Similarly, breastfeeding status was recorded only at the time of the baseline survey and did not capture changes by the study's end when children were 23 months old. These inconsistencies may have led to measurement error or misclassification of practices.

Further, other potential determinants associated with child stunting, such as the frequency and severity of illnesses (e.g., diarrhea, respiratory infections), micronutrient deficiencies (e.g., iron or zinc), and household sanitation practices (e.g., caregiver handwashing, child enteropathy due to mouthing of unsanitary items), were not systematically measured via the household survey or observations, nor included in the model. Additionally, the maternal education variable demonstrated low variability, as most women in the study had limited formal education. This led to its categorization as a binary variable, potentially reducing the model's explanatory power. Finally, the small sample size ($n=141$) may have limited the study's statistical power to detect significant associations.

All data from the FAQR study were reviewed and approved by the Tufts University Institutional Review Board (IRB) and the ethics board of the Ministry of Health in Burkina Faso. The study was registered on ClinicalTrials.gov under the identifier NCT02071563. Informed

consent was obtained from all participants before data collection, and all methods were carried out in accordance with relevant IRB guidelines and regulations.

To complement the quantitative findings, we conducted a qualitative content analysis of IHO survey responses and detailed observation notes taken by enumerators. NVivo software was used to organize and compare household environments and caregiver IYCF-C practices between households with stunted and non-stunted children. This approach provided additional context to the quantitative findings and helped identify patterns not captured in the regression analysis.

Mixed Methods Results

Qualitative Content Analysis of Observation Notes

The robust qualitative analysis over thousands of pages of IHO data revealed key themes related to typical child feeding practices, household environment, and caregiver behaviors in the local context. As such, the direct observations by local enumerators at the household level offer important insights into actual beneficiary child and caregiver behaviors, including more details on exact practices observed, which are typically provided only by self-reported data. The household-level direct observations provide more accurate and context-rich information that can significantly inform future child stunting interventions in similar settings.

Beneficiary Children's Primary and Secondary Caregivers

In most observations, mothers served as the primary caregivers, playing a central role in child-rearing activities. However, other adult women in the family, such as the children's paternal grandmothers and co-wives living within the family compound, also provided secondary support for childcare and feeding. However, the other women had less than one hundred

observations of caregiving, compared to over 1,000 for the children's mother. (See Table 3 for more details).

When mothers were occupied with errands or agricultural work, they often brought their children along or left them in the care of other female family members at the home compound. In addition to childcare and farm work, mothers were responsible for managing and cleaning the household compound. Co-wives, who shared the household as the wives of the same husband, worked together to complete household chores and took turns feeding, playing with, and caring for each other's children throughout the day.

While fathers were not the primary caregivers, they contributed to childcare by playing with the children or supervising them when the mother was busy with household tasks. Elder siblings, both female and male, were also observed engaging in play with their younger siblings, though they did not take on major caregiving responsibilities.

Table 3 highlights the frequency with which various caregivers participated in child feeding and care activities during the observation period, based on IHO notes.

Table 3. Frequency of Child Caregiving Activities by Various Caregivers

Child's Caregiver	Times observed caregiving
Mother of beneficiary child	1,101
Co-wives	88
Grand mother	35
Father	29
Elder siblings	33

In addition, **Table 4** presents the observed frequencies of common activities performed by the beneficiary children's mothers, their primary caregivers.

Table 4. Other Observed Activities by Mother in the Household

Activity Description	Number of times Observed
Preparing meals	1,651
Drawing water	857
Washing dishes	545
Holding child	301
Sweeping the home compound	290
Collecting firewood	232

The beneficiary children's mothers were observed carrying out most household chores, including preparing meals, drawing water from the local stream or well, washing dishes, collecting firewood, and cleaning the home compound. They were also regularly observed bathing the children and cleaning up after their defecation, by picking up the feces if the child defecated without clothes on or removing the soiled clothing, then usually just rinsing the child afterwards without soap.

To complement these observations, the following quotes from the enumerators' notes offer further insights into the caregiving practices in beneficiary households. The following quotes highlight the mother's role as the primary caregiver, while also noting the shared responsibilities among female family members, and the involvement of different caregivers in daily activities and childcare.

Quote 1: “After lunch, the caregiver returned to work in the field, leaving the beneficiary child with her sister. She worked there until the evening before coming home. The child stayed with the children in his court then with his grandmother until his mother has arrived.”

Quote 2: “The other wife served the couscous of CSB14 to the beneficiary child, and the other pregnant woman (wife) served her a yellow pea preparation with the couscous of CSB14.”

Quote 3: “Today the mother and her child were up very early. The child got up at the same time as his mother and begin to play with his elder siblings. The mother left them and went to sweep the courtyard. Then she did the dishes and lit a fire to heat the water. Then she went to fetch some water from the tub and came back to continue cooking. She bathed her children and went to serve the meal.”

Household Environment

The household compounds observed were generally multi-family, with roughly half of the caregivers in marriages involving multiple wives to the same husband. Each day, the wives would work together on domestic chores, such as cooking, and would spend significant time first, caring for their children and then, tending to family farming plots. Visitors to the family compounds were frequent and included extended family members, friends, and neighbors.

Observers recorded various aspects of the household environment. While they were trained by the FAQR team to collect objective notes, descriptions of cleanliness in the home compound and the overall household environment often included subjective and negative language. Terms like "unclean," "dirty," or "unhygienic" were used 115 times in the observation notes to describe the homes and household compounds. Household pets and farm animals—including dogs, goats, chickens, sheep, and pigs—were frequently seen in the same spaces as the

children. In some instances, farm animals were even found inside the homes, and domestic animals were commonly observed eating food off the same plates used by children, often without the plates being washed afterward.

Quote 1: “Animals eat in the same instruments used by humans. The dish is soap free. The child's bath was done with the decoction of the roots and leaves of plants. Animal and vegetable debris is located in the courtyard, making some corners of the courtyard dirty and releasing unpleasant odors.”

Fetching water from the community pump or local stream was a common task for caregivers, co-wives, and older children. However, access to sufficient water for household needs was often a challenge. Enumerators frequently observed garbage, animal waste, and plant debris around the household compound, including in areas where children played.

Quote 2: “The courtyard is not clean, with garbage, many dishes, pots, cups and dirty clothes, deposited here and there.”

Beneficiary children were active and mobile within the home compounds. They were often placed on the dirt floor to play, either alone or with siblings. Observers noted more than 50 instances where children were sitting alone in the dirt, eating, or playing with soiled items. It was common to see children mouthing toys and other household items. In a few cases, children were observed playing with or ingesting animal feces. These conditions potentially exposed the children to infections or other health risks.

Quote 3: “Very mobile and well awakened child. Child plays a lot in dirty places, eats soil, drinks dirty water. Most of the drinking water comes from the dam. The courtyard is comparable to a bin where domestic animals and people live. Hygiene barely exists.”

Overview of Observed WASH Practices

Evidence-based water, sanitation, and hygiene (WASH) practices, such as handwashing with soap at critical times (before eating, after using the toilet, after handling unsanitary items), treating drinking water, and safe water storage, were found to be inconsistently implemented among households. These gaps in hygiene practices can increase the risk of health issues, particularly for children, which is demonstrated by the following quote.

Quote 1: “Very mobile child and remains dirty all day. Child plays with earth, ash, and drinks dirty water. He plunges dirty objects in the jar containing the drinking water.”

Handwashing and General Hygiene Practices:

While caregivers regularly bathed their children with warm water, soap was rarely used during these activities. In the few instances where child feces disposal was noted, children were often rinsed with water without soap or wiped with a cloth after defecating, raising concerns about hygiene and the potential for spreading bacteria and illness.

The following quotes from the IHO notes, provided by enumerators, illustrate some of the WASH practices commonly observed in household compounds:

Quote 1: “The dishes are cleaned without soap; the hands of the mother and the hands of the child have not been washed neither before the kitchen or after the kitchen.”

Quote 2: “Mother’s hands are not washed before meals. Animals eat off of the same plates used by humans.”

Quote 3: “The other twin had diarrhea all day often; even defecated on the beneficiary child. The mother cleanses with a dirty tea towel and without washing hands, continues to breastfeed.”

Quote 4: “Today the mother and her child were up very early. The mother...lit a fire to heat the water. Then she went to fetch some water from the tub and came back to continue cooking. She bathed her children [with only water, no soap] ...”

Further, **Table 5** outlines specific WASH behaviors observed during household activities, using data from the detailed IHO surveys. While some regular hygiene practices, like bathing and cleaning children after defecation, were noted, soap use was infrequent, and handwashing practices, both for caregivers and children, were generally limited.

Table 5. Caregiver WASH Behaviors Observed

WASH behaviors	Times behavior was observed
Cleaning/rinsing the child’s defecation	645
Bathing child	459
Caregiver washing own hands or child hands before a meal	250
Caregiver not washing own hands or child hands before a meal	582

WASH Practices within the Home Compound

Enumerators also observed various conditions in household cooking areas. Dishes were often rinsed with water only, and in some cases, pans used for cooking were not always thoroughly cleaned before use. Cooking spaces sometimes contained dishes, garbage, and domestic animal feces. The close proximity of animals to areas where food was prepared and

consumed could pose a risk of fecal-oral contamination. These quotes demonstrate the aforementioned practices.

Quote 1: “Dishes are generally rinsed without soap. The kitchen instruments are laid out in the courtyard.”

Quote 2: “The kitchen is not clean, with different kinds of garbage. Remains of food are deposited on the wall, soiled dishes without covers and on the floor of the home.”

These observations provide insight into the daily hygiene practices within household compounds. The quotes emphasize the limited use of basic hygiene practices, such as handwashing with soap, and the presence of dirt, garbage, and animal waste in areas where children play and eat. These conditions may increase health risks for children, particularly through the potential contamination of food and water and the exposure to pathogens in their living environment.

Child Meals & Feeding

The primary caregiver, typically the child’s mother, prepared most of the beneficiary child’s meals over the hearth. However, other women in the household, such as co-wives and the children's paternal grandmother, occasionally took on this role. Generally, two meals were prepared each day—one in the morning and another in the evening—though there were instances where only one meal was made for the entire day. Leftovers from family meals or the study food were sometimes saved for later, but these leftovers were often stored uncovered in the kitchen and were not always reheated before being fed to the child, potentially increasing the risk of foodborne illness.

The children's diet was predominantly grain-based, with small additions of animal-sourced proteins and vegetables. Children typically ate from the family pot, consuming grain-based dishes multiple times a day from a portion prepared for the whole family. Meals were usually supplemented with breastfeeding and snacks, with children typically receiving two or more meals per day.

Commonly consumed dishes included the common Burkinabe dish of "fat rice" (oily rice with vegetables or meat), wheat couscous, beans mixed with rice, white bread, sweet cakes, soup, gumbo, cooked peanuts, dried fish, stewed beans, and various local sauces (e.g., baobab, jute, kapok). Other foods that were consumed, but less commonly observed included sorghum or corn porridge, cow milk or cow milk porridge, pasta, chicken, and locally made sweet drinks. Less commonly consumed foods included watermelon, chicken, fish, sweet biscuits, shea fruit, mango, corn, coffee or tea, grapes, wild fruits, African eggplant, beef, and organ meat. Children were often given snacks like fried sweet cakes (e.g., beignets), fruits, candies, and locally made sweet juices.

In a few instances, children were observed eating dirt or mud. After meals, they were typically offered water, which was fetched from a local community pump or stream by the caregiver or another family member. The water was stored in household containers such as buckets or large pots, which were inconsistently covered, raising concerns about potential contamination. **Table 6** highlights the variety of foods provided to children during the study period, that were observed to be provided to the children in the IHO notes.

Table 6. Variety of Foods Observed Being Provided to Children During the Study Period

Description	Observations from IHO
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Study food	615
Other Cereals (e.g. rice, millet)	1,733
Roots/tubers	42
Legumes (e.g. beans, peanuts)	525
Vegetables (e.g. greens, carrots, beans)	796
Milk	57
Eggs	8
Meat/fish	225
Other foods (e.g. biscuits, fruits, stews/sauce, snacks)	1,826

Breastfeeding Practices

Breastfeeding was a regular part of most children's daily routine and was often initiated when the child first woke up, cried, or after a meal. Drawing on the detailed IHO survey, there were nearly 3,000 observations of breastfeeding (2,960 observations) and 349 descriptions of breastfeeding practices within the enumerators' detailed observation notes. Mothers typically offered both breasts during breastfeeding sessions, although in some cases, children refused to nurse, particularly when they were ill. These quotes highlight the common practice of breastfeeding throughout the day.

Quote 1: "The mother breastfed her child, and afterward, the child ate the family meals."

Quote 2: "Typically when breastfeeding, it is done either lying down or standing by the mother to the child."

Quote 3: “The mother stands and holds the child aside and breastfeeds him. The child has a good appetite.”

Overall, breastfeeding played a central role in child nutrition, often complementing meals and snacks throughout the day.

Consumption of the Study Food

Beneficiary children generally consumed the SNFs provided by caregivers. If there were leftover portions, these were often shared among the child’s siblings, caregivers, and other wives in the compound. There were 163 recorded instances of sharing the study food, with the children’s siblings being the primary recipients of any shared food. Children typically ate on the ground, chairs, or benches within the home. When old enough, children fed themselves, but caregivers assisted younger children with feeding.

However, in over three dozen instances, the study food was not consumed by the beneficiary children. Reasons for non-consumption included illness or the child not wanting to eat the study food. Notably, the CSWB study food had the highest number of non-consumption observations. In the broader FAQR study in Burkina Faso, the researchers noted that the CSWB had a bitter taste, which could have influenced children’s avoidance of the food (Cliffer et al, 2021). Illness appeared to have a significant impact on both breastfeeding and the consumption of other foods.

The following quotes highlight some of the challenges in feeding the study food (CSB+) to children:

Quote 1: "The child eats alone; the dish is mixed with sand. Drinking water is dirty and muddy. The mother also ate the child's CSB+, along with the other children. The child preferred to eat family meals rather than the CSB+ couscous the mother prepared."

Quote 2: "The caregiver washed neither her hands nor the hands of the child. The mother served the CSB+ to her child and the child's cousin at the same time. Both children ate together but did not finish all the porridge. The mother gave the rest to the older children, who finished it. The child then breastfed a lot and ate mostly from the family meals."

These quotes suggest that the study food's effectiveness was sometimes limited by household practices, including sharing of the study food and food safety and sanitation practices, and food preferences. In both instances, the specialized food was either not fully consumed by the child or shared with other family members, reducing the intended nutritional benefit for the beneficiary child. The first quote also points to hygiene concerns and the child's preference for family meals over the study food, while the second highlights inadequate handwashing and the redistribution of leftover food to older children.

Additionally, the following quote provides insight into the impact of illness on food consumption. It describes a sick child avoiding the study food (CSWB) due to illness, despite showing signs of improved health later in the day:

Quote 3: "The child vomited three times after the mother administered paracetamol. He slept most of the day and woke up in the afternoon with less fever. Though his temperament improved, he did not consume CSWB all day."

Results of the Quantitative Analysis

To complement the qualitative findings from the IHO study, we conducted a multiple logistic regression analysis to identify factors associated with the risk of stunting among children by the end of the study period. The regression results, summarized in Table 7, indicate that most covariates, including maternal age, household wealth quintile, maternal education, and child consumption of animal-sourced foods within the previous 24 hours, did not significantly influence the odds of stunting. However, breastfeeding emerged as a statistically significant factor. Children who were breastfed during the study period had approximately 41% lower odds of experiencing stunting compared to those who were not breastfed (odds ratio = 0.41, $p = 0.049$). This suggests that breastfeeding had a protective effect against stunting among children in this study population. Nevertheless, the model's R-squared value was 0.065, indicating that the included variables collectively explained less than 7% of the variation in child stunting outcomes. This highlights the model's limited ability to predict stunting risk based on the available data.

Several factors may have likely contributed to the limited explanatory power of the regression model. First, the analysis was cross-sectional rather than longitudinal, offering only a snapshot of associations rather than capturing dynamic trends over time. This approach may have overlooked temporal changes in variables such as child feeding practices or illnesses that could influence stunting outcomes. Second, the indicator for animal-sourced food consumption was derived from enumerator observations during a specific 24-hour period rather than systematically collected dietary data. This mismatch in timing between the household surveys and observational data introduced potential temporal misalignment. Similarly, breastfeeding status was recorded during the baseline survey and did not account for whether the child was still being breastfed at 23 months of age, potentially misrepresenting its impact at the end of the study.

In addition, the regression model did not include several key determinants of child stunting that are well-documented in the literature. These include child health indicators, such as the frequency and severity of illnesses like diarrhea or respiratory infections, and nutritional deficiencies, including data on iron, zinc, or other micronutrient statuses. Household sanitation practices, such as caregiver handwashing at critical times or child enteropathy due to exposure to unsanitary conditions, were not systematically captured. Similarly, a lack of detailed information on dietary diversity and quality limited the ability to assess their influence on stunting. The binary categorization of maternal education due to limited variability in the data also reduced the model's explanatory power. With most mothers having no formal education, this lack of variation in the variable was unlikely to adequately capture the influence of maternal educational attainment on child stunting. Finally, the small sample size ($n = 141$) constrained the model's ability to detect statistically significant associations, especially for variables with limited variability.

To improve predictiveness of the model and better identify factors associated with stunting, future similar studies could consider prioritizing collecting longitudinal data to capture changes in socioeconomic, health, and dietary factors over time. Systematically measuring child health and dietary quality, including micronutrient deficiencies, frequency of illnesses, and dietary diversity indicators, would provide more robust data for analysis. Aligning data collection timeframes to reduce temporal inconsistencies between variables is also critical. Expanding the sample size could enhance statistical power and allow for the inclusion of additional covariates, particularly continuous variables, to capture more nuanced relationships. While the current model provided valuable insights into the protective role of breastfeeding,

addressing these limitations in future research could yield a more comprehensive understanding of the determinants of child stunting and inform targeted intervention strategies.

Table 7¹. Regression Output for Factors Associated with Child Stunting

Variable	Odds Ratio	Std. Err.	Z	P> z 	[95% Conf. Interval]
Age of mother	1.028175	0.037038	0.77	0.441	[0.9580854, 1.103392]
Wealth quintiles (1)	1.972913	1.516118	0.88	0.377	[0.43751, 8.896679]
Wealth quintiles (2)	1.742356	1.472316	0.66	0.511	[0.3325516, 9.12882]
Wealth quintiles (3)	1.001741	0.8471079	0.0	0.998	[0.1909631, 5.254867]
Wealth quintiles (4)	2.9257	2.288258	1.37	0.17	[0.6316624, 13.5511]
Breastfeeding	0.4087337	0.1853708	-1.97	0.049	[0.1680349, 0.9942171]
Consumption of animal source food in past 24-hrs	1.098564	0.5173955	0.2	0.842	[0.4364465, 2.765155]

¹ Regression diagnostics: R²: 0.0647

Maternal education	0.5403185	0.3318915	-1.0	0.316	[0.1621056, 1.80095]
Control	0.4535423	0.6780664	-0.53	0.597	[0.0242121, 8.495775]

Research Discussion

The findings from our study provide valuable insights into the potential factors contributing to risk of child stunting among 23-month-old children participating in the stunting and wasting prevention program in Burkina Faso. In summary, our quantitative analysis identified breastfeeding as a significant protective factor, while poor household WASH practices, grain-based diets with limited animal-sourced foods for children, and frequent exposure to unsanitary conditions emerged as notable risk factors observed through the qualitative evaluations that may have contributed to stunting among children participating in the study. These results complement and expand upon those from FAQR's previous research in Burkina Faso by exploring observed IYCF practices, caregiving practices, WASH practices, and information on the home environment, which was not previously analyzed in the other studies (Cliffer et al., 2021).

Overall, the in-home observations highlighted several caregiving and feeding practices and household conditions that may potentially contribute to the risk of child stunting within the study population of children. Children's diets were predominantly grain-based, with limited intake of animal-sourced proteins and vegetables, which was likely primarily due to the high levels of poverty experienced by their families, limiting their access to nutritious foods. The

limited nutrient-dense foods in their diets, compounded by the occasional refusal of the SNF due to illness or preference for family meals, may have reduced the FAQR program's intended nutritional benefits. Further, the low consumption of animal-sourced proteins may have further increased the risk of stunting over time, as has been documented by others in similar contexts (Das et al., 2020; Zaharia et al., 2021).

In this study, poor household WASH conditions, including water scarcity, unhygienic food storage, and inadequate handwashing by caregivers at critical times, may have increased children's exposure to environmental pathogens and may have elevated the risk of environmental enteropathy as well as child stunting, as these practices and their risk factors for child stunting have documented by others (Keusch et al., 2013; Pickering et al., 2019). Further, the frequent presence of domestic animals in children's living spaces was a concerning observation, as it may have further contributed to unsanitary conditions in the children's living and play environment. Additionally, children were frequently observed mouthing unsanitary items, such as dirt and household objects, which may have also heightened their risk of fecal-oral infections and illness (Keusch et al., 2013; Pickering et al., 2019).

The regression analysis supports the importance of potential protective factors against child stunting, such as breastfeeding. In this study, children who were breastfed had significantly lower odds of becoming stunted, which is consistent with existing literature and the determinants within the UNICEF Framework (Prendergast, 2014; Bhutta et al., 2020; UNICEF, 2020). However, the logistic regression model's limited predictive ability suggests that other unmeasured factors, such as exclusion of certain determinants, including detailed information related to child dietary intake and quality, patterns of child diarrheal or respiratory illness, household sanitation practices and child enteropathy due to unsanitary items in their

environment, and child micronutrient status, may have also contributed to stunting risk in this context. Future research could prioritize the robust and systematic measurement of potential risk factors for stunting, including child illness, micronutrient status, and dietary quality, employing a range of continuous and longitudinal variables rather than binary, cross-sectional ones to improve the quality of the analysis.

These findings align with several underlying determinants within the UNICEF Framework (UNICEF, 2020) and documented risk factors for child stunting identified by Black et al. (2013), including the importance of nutritious foods, age-appropriate, safe feeding practices, and a clean, safe and engaging environment, emphasizing the interplay between potential immediate and underlying determinants as influences on child nutrition and risk of child malnutrition. Moreover, while the supplementary nutritious foods provided in the stunting prevention program aimed to improve nutrient intake for children temporarily, they addressed only one component of the broader determinants identified in the UNICEF Framework (Black et al., 2020). However, without improvements to broader diet quality, hygiene practices, and the household environment, the children potentially remained vulnerable to malnutrition and stunting (UNICEF, 2020). In future similar programs, employing social behavior change (SBC) targeted behavior change interventions for caregivers could help address these risks.

Based on our findings, programs like the FAQR interventions in Burkina Faso could also consider integrating robust SBC activities alongside the distribution of the SNF to beneficiary children and their families, as well as considering links to programs that offered improvements to sanitation infrastructure within the household compound. This more integrated approach could help ensure that the program addresses not only the immediate nutritional needs but also

practices related to child feeding and care and WASH practices within the child's environment, which are important underlying determinants contributing to a child's risk of becoming stunted.

Our research highlights several key practices that could be promoted through SBC interventions in future stunting prevention programs. First, promoting continued breastfeeding alongside safe and nutritious complementary foods up to two years aligns with global recommendations and has been shown to reduce the risk of stunting (Victora et al., 2016; Bhutta et al., 2020). Improving household sanitation practices is equally important and includes measures such as keeping domestic animals away from living and cooking areas, preventing animals from consuming food from the same plates as people, maintaining overall household cleanliness, and encouraging regular handwashing with soap at critical times. These practices can substantially reduce infection risks and are particularly relevant in contexts like Burkina Faso, where the presence of animals near young children remains a potentially significant risk factor for fecal-oral illness (Curtis & Cairncross, 2003; Ngure et al., 2019).

Future stunting prevention programs could also encourage the use of play mats under caregiver supervision to prevent young children from ingesting unsanitary items, such as soil or household debris, which can also lead to illness. This strategy has been successfully applied in various sub-Saharan African contexts to prevent child illness and malnutrition (Gelli et al., 2023; Reid et al., 2018; Budge et al., 2021; Rosenbaum et al., 2021). Complementary efforts to establish designated clean play areas, away from domestic animals, can further reduce children's exposure to environmental contaminants, adding practical solutions to address observations of children playing unsupervised on unsanitary home floors or dirt compounds (Keusch et al., 2013; Budge et al., 2021; Rosenbaum et al., 2021).

Aligned with current best practices, and complementing observations from this study, efforts to increase dietary diversity should focus on promoting the consumption of locally available, nutrient-dense foods and educating caregivers on safe food handling practices (Victora et al., 2021). As aligned with the poor WASH practices and food safety practices we observed in our study, future SBC efforts could also include messaging around food safety to potentially reduce the risk of foodborne illnesses.

Leveraging caregiving dynamics within households could offer an opportunity to enhance future SBC interventions. Mothers, co-wives, and grandmothers often shared responsibilities in childrearing, presenting a multi-caregiver family structure in Burkina Faso that could be applied in future SBC activities within stunting prevention programs, such that mothers, grandmothers, and co-wives can participate in activities. Family-based approaches, with the specific inclusion of grandmothers, have demonstrated some success in improving child nutrition outcomes in other contexts (Ruel & Alderman, 2013). Engaging the key caregivers in the household in nutrition education can help foster a supportive environment for implementing best practices in child feeding, hygiene, and care, amplifying the impact of interventions (Victora et al., 2021).

Finally, while not explicitly measured, the observations underscored the significance of certain enabling determinants—such as household poverty, lack of WASH infrastructure within the household compounds, and environmental water scarcity—as important potential barriers to families' regular access to nutritious food, clean water, and WASH facilities (e.g., piped water, handwashing basins, or latrines). These challenges may have limited families' ability to adopt improved behaviors related to nutrition and hygiene for their children.

To prevent child stunting effectively, future nutrition assistance programs could consider adopting integrated, multipronged, and context-specific approaches. Such approaches could

combine the provision of SNFs together with targeted SBC interventions for priority behaviors, alongside broader support and links to complementary programs to help address enabling factors for malnutrition at the household level. This could involve coordination with complementary government or development projects in project areas to provide financial assistance to improve families' economic situations, construct latrines or piped water systems, install handwashing stations, or supply materials to confine animals away from living spaces.

Integrating supplementary nutritious foods with SBC interventions and support or linkages for other material resources to alleviate household poverty and improve infrastructure can potentially help address the multifaceted risks contributing to stunting, fostering sustainable improvements in child nutrition. Evidence from projects in Bangladesh and Peru highlights the potential success of such integrated, context-specific approaches to prevent child stunting (Hossain et al., 2017). In both countries, reductions in childhood stunting were achieved through varied, multi-sectoral approaches that combined nutrition-specific and nutrition-sensitive interventions. These interventions included nutrition education for caregivers, growth monitoring and immunization promotion at health clinics, water, sanitation, and hygiene (WASH) initiatives at the household level, and linking program participants to national social safety net programs (Hossain et al., 2017). These studies observed that strong local government commitment, community engagement, and context-specific program delivery were important factors in supporting the success of these interventions in moderately reducing child stunting (Hossain et al., 2017). However, further implementation science research is required to identify the most effective combinations of nutrition interventions tailored to specific contexts and risk factors to inform future nutrition assistance programs for reducing child stunting.

Limitations

This study has several limitations. Although the local enumerators received training by the FAQR team on how to record observed behaviors objectively, some notes reflected subjective opinions, particularly regarding the cleanliness of home compounds and the presence of animals in spaces occupied by children. This subjectivity could have influenced how the local enumerator data were captured overall, potentially affecting which behaviors were emphasized in the observations. Additionally, the IHO analysis was not carried out at the individual child level due to insufficient unique data across multiple days for each child. As a result, a summary content analysis was conducted across all children for the various practices, behaviors, and environmental conditions of interest. Previous FAQR research reported minimal reactivity among caregivers due to the presence of enumerators, owing to the high-quality observations conducted by local enumerators from neighboring communities (Griswold, 2020). While a lack of reactivity would suggest that observations were accurate, there was likely still some participant reactivity to the presence of enumerators in the homes. This could imply that certain negative behaviors and practices observed might have been even more pronounced in the absence of the enumerators.

In addition to limitations in the qualitative analysis, the quantitative analysis also included some challenges. The logistic regression model had limited predictive power, with an R-squared value indicating that less than 7% of the variation in child stunting outcomes was explained by the included variables. Key determinants of stunting, such as child illness patterns, micronutrient deficiencies, and household sanitation practices, were not systematically measured or included in the analysis. Furthermore, some covariates, such as maternal education, were categorized as binary variables due to limited variability in the dataset, which may have reduced

the explanatory power of the model. Additionally, the cross-sectional design of the analysis provided only a snapshot of associations, rather than capturing dynamic, longitudinal trends that may have influenced risk of stunting over time. Some variables were also collected at differing time points, which introduced temporal misalignment. For instance, breastfeeding status and household wealth were recorded at baseline, while observations of dietary intake, such as the consumption of animal-sourced foods, were collected during later stages of the study. This misalignment may have weakened the ability to detect associations between these factors and stunting outcomes.

Conclusions and Recommendations

In Burkina Faso, we observed that while SNFs temporarily increase the availability of nutrient-dense foods in households and play a critical role in supplementing children's diets during nutrition assistance programs, their long-term impact may be more limited. If a child's typical diet, WASH infrastructure, caregiver practices, and household environment do not improve during or after the stunting prevent program participation, these children may remain at risk of long-term malnutrition, including risk of acute malnutrition or progression to stunting. This underscores the need and opportunity for more holistic nutrition interventions that address immediate nutritional gaps while improving overall household food security and the broader home environment. In resource-constrained contexts, even minor shocks to household economic stability or a child's health can potentially undermine efforts to improve nutrition outcomes. These findings highlight the need and opportunity for integrated strategies that address stunting, micronutrient deficiencies, and acute malnutrition holistically. Breaking down silos in research

and implementation is critical to tackling the multifaceted nature of child malnutrition (WHO, 2023).

Building on evidence from this and other studies (Bhutta et al., 2013; De Onis & Branca, 2016; UNICEF, 2023), policymakers, researchers, and practitioners can work together to develop more context-specific, holistic strategies that address the various and context-specific drivers of child stunting. By fostering synergy among nutrition programs, WASH interventions, and other community assistance initiatives, future nutrition assistance programs can help create more collaborative and supportive environments that help reduce stunting risks and promote overall child well-being. These integrated, systems-based approaches can help pave the way for significant and lasting improvements in child nutrition, health, and development outcomes in various global settings (UNICEF, 2023; Bhutta et al., 2020; GNR, 2022; Ruel et al., 2013; De Onis & Branca, 2016; Prendergast et al., 2014).

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Specific Aim 3- Full Paper

Helping Maintain Child Diets During COVID-19: Qualitative Insights from Parents’

Use of Pandemic-EBT in Boston and Fresno

Beginning in 2020, the COVID-19 pandemic disrupted lives globally, resulting in nearly 7 million deaths, and significantly affecting the economic and social well-being of families and children worldwide (Mathieu et al., 2020). In the United States, low-income families with children faced heightened challenges, as pandemic-related unemployment and underemployment contributed to exacerbating food insecurity and child hunger (Feeding America, 2022; Parekh et al., 2021; Wolfson & Leung, 2022). Additionally, food prices surged to their highest levels in nearly a decade, further limiting access to affordable, nutritious foods for millions of families (FAO, 2021).

To address these challenges, the U.S. government expanded the Supplemental Nutrition Assistance Program (SNAP) and introduced Pandemic-EBT (P-EBT), a temporary food assistance program designed to mitigate food insecurity among children from low-income families who lost access to school meals during pandemic-related closures (USDA FNS, 2020). Distributed via electronic benefit transfer (EBT) cards, the funds provided via P-EBT benefits could be used to purchase SNAP-eligible foods, including online—a significant adaptation during the pandemic (CA CDSS, 2020; MA DTA, 2020, FNS, 2020). In states like California and Massachusetts, children from low-income communities who were eligible for free or reduced-price lunch programs or attending Community Eligibility Provision schools qualified for the temporary P-EBT benefits during 2020 and 2021 (CA CDSS, 2020; MA DTA, 2020). P-EBT aimed to protect food access, mitigate food insecurity, and prevent hunger for millions of children from low-income American families (Bauer & Curran, 2020).

The challenges faced by low-income American families during the pandemic can be partially contextualized leveraging the global UNICEF Framework for Child Nutrition as a conceptual framework (UNICEF, 2020). The UNICEF Framework identifies immediate determinants of child hunger and malnutrition, such as inadequate dietary intake, alongside underlying determinants, including lack of household resources, high food prices, and limited access to social and health services. By temporarily and rapidly helping increase household funds for food, programs like SNAP's P-EBT aimed to address these underlying determinants to help enable low-income American families to sustain access to nutritious foods during the height of the pandemic (USDA FNS, 2018; USDA FNS, 2020; UNICEF, 2020).

Early studies examining P-EBT's implementation during the pandemic highlight its potential to alleviate food insecurity and help prevent child hunger. For example, researchers in Houston found that cash assistance through P-EBT enhanced participating families' purchasing power and flexibility for food purchases, helping to potentially mitigate food insecurity. In contrast, in-kind food distributions may have created logistical barriers and failed to meet families' specific needs, as foods provided may not have been families preferred foods or lacked fresh options (Fern et al., 2023). Similarly, findings from New York City emphasized the importance of accessible and well-communicated food assistance programs like P-EBT to ensure effective participation and help reduce food insecurity during school closures (Cadenhead et al., 2022). These insights underscore that potential underlying, structural determinants may be further considered for designing more effective, efficient, and tailored nutrition and food assistance programs.

Despite the widespread implementation of P-EBT during the COVID-19 pandemic, evidence remains limited on how low-income American families used the benefits and whether the P-EBT program influenced food purchasing behaviors or participating children's diets, particularly in a

context like the United States, where child overweight or obesity affects one in five children. This qualitative study, which is a sub-sample of a Tufts University study examining use of dollar stores for food access, examines the experiences of parents whose school-aged children (pre-K–12) received P-EBT benefits in the Boston, Massachusetts, and Fresno, California metropolitan areas. Through in-depth interviews, the study investigates how families used P-EBT benefits, including their food purchasing patterns, preferences, and any reported changes in children's diets during the pandemic compared with pre-pandemic habits.

By applying the UNICEF Conceptual Framework for Child Nutrition, as a guiding conceptual framework, an aim of this research is to highlight how emergency nutrition assistance programs can help address the underlying determinants of child malnutrition. The findings from this work aim to provide actionable insights into the effects of programs like P-EBT on food security, shopping behaviors, and child diets and nutrition during public health crises in the United States or other similar contexts. Such analyses, like this one, can help contribute to the development of stronger and more effective American food assistance programs.

Research Methods

This study is a sub-analysis of participants from the broader Tufts University 2020 Dollar Stores Study which aimed to assess dollar store use for food purchases during the COVID-19 pandemic (Schmall et al., in preparation). Existing research has used qualitative methods, including in-depth interviews, to explore retail shopper preferences, motivations, and feeding practices (Pitt et al., 2017; Vasileiou et al., 2018). For this research, we adopted a qualitative framework to complement previous quantitative studies on dollar store food access (Bustillos et al., 2009; Caspi et al., 2017).

The primary goal of the broader Dollar Stores Study was to understand participants' preferences and shopping experiences within the unique context of dollar store shopping during the first year of the COVID-19 pandemic in the broader Fresno, California and Boston, Massachusetts areas. This sub-analysis specifically focuses on the cohort of dollar store shoppers with school-aged children (pre-K–12) who also received P-EBT food assistance. It aims to investigate how these shoppers utilized their benefits for food purchases, including the types of foods purchased, shopping preferences, and frequency of purchases at various retail outlets. Additionally, it examines parent-reported changes in their children's diets during the COVID-19 pandemic in 2020, and if receiving P-EBT benefits had any influence on their children's diets, compared with their typical diets prior to the pandemic (before March 2020).

Study Setting and Recruitment

For the Tufts University Dollar Stores study, we recruited participants who met the following eligibility criteria, based on the goals of the larger study: were ≥ 18 years old, lived in the greater Boston, MA or Fresno, CA metropolitan areas, spoke English or Spanish as their primary language, and reported shopping at a dollar store at least once during the past month during recruitment period in 2020 (Schmall et al., in preparation).

For this sub-study, we further limited the sample to participants who participated in the interview who also had a school-aged child (pre-K to grade 12) and who had also received SNAP or WIC and P-EBT in 2020. Participants were recruited via flyers in English and Spanish posted at dollar stores (i.e., Dollar General, Family Dollar, Dollar Tree, 99 Cents Store in California), local businesses, referrals from other study participants, and via digital flyers in local Facebook groups catering to discount store shoppers. Potential participants completed an online screener and, if eligible, were contacted for a virtual interview.

Data were collected from August to December 2020 by Tufts University undergraduate and graduate students trained on in-depth interviews and notetaking. Using a semi-structured interview guide, one research assistant asked questions, and the other took detailed notes during the interview. The interviews took about 30 minutes to complete and covered various topics including use of dollar stores during the pandemic; use of food assistance (WIC, SNAP) to buy food at grocery stores, discount stores, and other allowable food retailers, food shopping frequency, items frequently purchased, and any changes in food shopping during the pandemic; use of P-EBT food assistance; and any perceived changes child diets. With the consent of the participants, the interview was audio-recorded to produce a complete transcript.

Interviews were conducted virtually using the Tufts University account Zoom videoconferencing application. Verbal consent was reobtained from the participants at the start of the interview. The interview was conducted in English or Spanish, depending on the participant's preference. All study participants who completed the interview were sent a \$30 gift card for a local dollar store or a similar online retailer. This sub-study included a sub-sample of participants (n=32 out of N=55) from the broader study, meaning study participants who had a school-aged child (pre-K to grade 12) and who had also received SNAP or WIC and P-EBT in 2020.

Ethical approval was provided by the Tufts University Social, Behavioral & Educational Research Institutional Review Board (STUDY0000077).

Data Analysis

We applied qualitative content analysis using Nvivo12 software to aid in data management. Our analytical approach was deductive (Hsieh and Shannon, 2005), as we used a semi-structured interview guide to prepare a preliminary codebook, then applied it to a random

sample of transcripts and updated the codebook based on review of the data. The final codebook was applied to the full set of transcripts.

Interrater reliability was established on a random sample of ten coded transcripts (five in English, five in Spanish) between the lead coder (AS) and other research assistants, and at least 80% agreement was reached on all codes. The English and Spanish codebooks were used to analyze and interpret the data from both cities, depending on the language of the interview.

Results

Thirty-two low-income parents (n=17 in Boston, n=15 in Fresno) who received the P-EBT food assistance on behalf of their children participated in the study. Most participants were women (n=30 women, n= 2 men) and spoke English as their primary language (n=22 English speakers, n=10 Spanish speakers). The follow sections summarize the findings from the qualitative content analysis across various emergent themes.

Financial Difficulties and Importance of Pandemic-EBT Food Assistance for Low-Income Families During the COVID-19 Pandemic

All parents in the Boston and Fresno areas reported significant pandemic-related financial difficulties, such as job loss or reduced hours at their place of work, which strained their family budgets, including their ability to afford food. Due to financial constraints and to reduce their risk of contracting COVID-19, families decreased meals eaten outside the home and parents increased at-home meal preparation for the household. This led to increased time spent cooking at home for parents and higher than typical grocery store expenses to cover the cost of additional food.

Parents described the P-EBT assistance as providing them with additional resources to spend on food, helping them manage the increased grocery expenses, and helping to prevent cuts to their food budgets that would have otherwise occurred due to financial constraints they experienced. Parents also described the P-EBT assistance as helping them to continue purchasing the foods that their children were accustomed to. They noted that without P-EBT they would have substituted the preferred foods with more affordable alternatives to further save on grocery expenses. While shoppers primarily used their P-EBT benefits at grocery stores, they occasionally used them at discount or dollar stores.

P-EBT: Supporting Families During Financial Hardships of the Pandemic

The P-EBT program played a critical role in helping families access food during the financial constraints brought about by the COVID-19 pandemic. The following quotes illustrate how P-EBT benefits helped alleviate the burden of rising food costs and increased grocery expenses, especially as families prepared more meals at home due to school closures.

One parent described how P-EBT assistance provided relief during a period of significant financial hardship. This highlights the immediate impact of P-EBT in helping maintain healthy food access during times of job loss and economic uncertainty.

Quote 1 “I am very happy with this. It’s [P-EBT] helped a lot. Times are really hard. My husband recently lost his job...When I heard the news that they would help the kids with it [P-EBT] ... I’m very glad because food is so expensive.”

Another parent expressed gratitude for how P-EBT helped cover their food budget during the summer months, while also allowing for small treats for their children. This quote demonstrates

how P-EBT not only supported their basic needs for food access but also helped maintain a sense of normalcy and joy for low-income families under stress.

Quote 2: “We got the P-EBT over the summer, which was amazing. We used that over the two months to get stocked up on food, and that definitely helped us a lot. I told the kids to pick something they liked that I would otherwise say no to. Maybe a different cereal or something since we had a little extra money. Just to give them a little something fun. I don’t remember exactly when we got it [P-EBT], but they said it was to cover the summer months when the kids were home from school.”

Preventing Reductions to Family Food Budgets

Another parent reflected on how P-EBT access helped to prevent their family from having to make difficult choices about cutting grocery spending. By enabling parents to purchase familiar foods, P-EBT benefits helped alleviate both financial and emotional stress during the pandemic:

Quote 3: “My oldest uses P-EBT, which they based on last year’s school year...P-EBT works just like the SNAP benefits. It has been loaded once, with like \$175. It has helped...and has been very beneficial for us since I cook [both] breakfast and lunch for them now. It helped us a good amount because there were times when I was thinking we would have to cut some things short [grocery spending].”

These accounts underscore the critical role of P-EBT in maintaining access to a variety of foods for families, providing much-needed relief during a time of uncertainty and increased financial strain caused by economic challenges and job loss imposed by the COVID-19 pandemic. By helping families maintain access to adequate and familiar foods, the P-EBT

benefits program helped reduce the pressures of food access during the pandemic on low-income households.

Home-Cooked Meals During the Pandemic: Increased Parental Effort, Higher Child Satisfaction

With American schools moving online due to pandemic-imposed closures and children staying at home during the pandemic, parents took on the additional responsibility of preparing more home-cooked meals for their children since they were not able to eat breakfast and lunch at school. Many parents reported spending significantly more time cooking, and their efforts were often met with satisfaction as children expressed a preference for the taste and quality of the homemade meals over the foods typically provided at schools.

Some parents observed that their children consumed more food at home overall, and that their children enjoyed higher-quality, more nutritious meals during the pandemic. The increase in daily meal preparation brought an additional workload for the parents, but several parents took pride in their children's satisfaction with the meals they prepared at home. For some parents, this experience inspired a greater focus on selecting nutritious and high-quality ingredients, as one parent explained:

Quote 4: "Three of my children received P-EBT. I have five younger ones in elementary school, I don't know what happened or why it didn't come to the other two. It [P-EBT] helped us out a lot, it really did. It helped us out a lot financially. I was able to buy better, more nutritious foods, more high-quality foods. I look at the labels and see which one has more vitamins, more nutrition, more protein, and stuff like that so they can get that boost of vitamins more than before. But those products cost a lot more... I wish I could continue to buy them every time."

This one parent’s sentiment reflects how P-EBT allowed families to purchase nutritious foods during the pandemic, enhancing children’s diets in ways that might not have been possible otherwise. The quote also underscores how P-EBT empowered parents to make intentional, health-conscious food choices—decisions that might have otherwise been out of reach without P-EBT’s financial support due to the high cost of nutritious foods.

Limited Use of To-Go Lunches and Community Support Programs

A few parents in Boston and Fresno reported using the “to-go lunches” offered by school districts during the pandemic that were available for parents to pick-up at the schools. Many parents said that the pickup process was inconvenient and time-consuming, particularly amidst their already busy schedules during the pandemic. While a small number of parents in Boston reported using these lunches to offset grocery costs, most preferred to prepare meals at home, often using groceries purchased with P-EBT benefits.

In addition to P-EBT, some families in the Boston area benefited from a local nonprofit organization’s community food donation program. This community nutrition initiative aimed to increase access to fresh and nutritious foods in resource-limited communities, helping to provide some relief to families experiencing financial hardships.

One parent described their use of both P-EBT and a community food program to offset their grocery costs, enabling them to source healthy foods from various distributors:

Quote 5: “I got it [P-EBT] for the month of September (2020), but I haven’t gotten it for October yet. It was helpful. I used it to buy our normal groceries like fruits and vegetables and meats. Some lunch foods and breakfast foods. I also get the lunch from the school. They give out milk and things like that, so I am not buying milk anymore. And Revere has been giving out free

fruits and vegetables. So, there's a lot of stuff that the kids are getting, so that's one thing that is good. I still have to buy some fruits and vegetables. It [the community food program] changes every week, but it always has cucumbers, onions, and apples. Sometimes items will change. One time there was a pineapple. They will also do zucchinis or potatoes sometimes. I still end up having to buy stuff because either I need more foods, or I need a different item."

And another parent noted the availability of various community food distribution programs:

"Yeah, we get it [P-EBT]. We also get so many vegetables here in Revere, two to three times a week they give out a bag of fresh fruit and vegetables. Whatever I can't use I drop off at the church. Drive up, they throw the stuff in your trunk...In Revere, in Chelsea- every corner has boxes of food for free. I saw the other day there's a Salvation Army in Chelsea giving out free diapers, free wipes, it's an interesting situation."

The pandemic-induced shift to home-cooked meals not only increased parents' workload but also created different opportunities for families to try and prioritize healthier and more nutritious diets. Food assistance programs like P-EBT benefits helped to empower families in California and Massachusetts to purchase nutritious foods and protect their family food budgets despite the rising cost of foods, while community food donations provided additional support, especially in these under-resourced areas. These combined efforts played an important role in mitigating the financial and logistical challenges faced by families during the pandemic.

Spanish-Speakers Reported Worse Financial Challenges

The primarily Spanish-speaking parents in Fresno and Boston who participated in the study reported experiencing more severe financial challenges during the pandemic compared to their English-speaking counterparts. Higher reported rates of job loss and reduced work hours may

have made it more difficult for these families to meet their basic needs. As a result, P-EBT benefits were particularly helping for supporting some Spanish-speaking families to access food during the pandemic.

One primarily Spanish-speaking parent shared how P-EBT served as an important support mechanism during their financial struggles (translated from Spanish):

Quote 1: “Oh yes, yes, yes, they gave us P-EBT. The truth is it [P-EBT] has helped us so much because we aren’t working right now. They gave us 200 or so dollars, and it helped us so much. Our children have received the P-EBT benefits 3 times. We used it to buy fruits, rice, vegetables to make soups...and actually, it [P-EBT] is how we are able to feed our family right now.”

We found that for some primarily Spanish-speaking families, P-EBT became a primary contributing source of their family food budget. Parents who experienced job loss during the pandemic reported relying more on the P-EBT program for food, supplementing it with free meals from other community aid programs and food pantries. However, some families had to make further adjustments, such as substituting expensive proteins like meat with more affordable options like beans, due to rising food costs and limited budgets.

One parent explained how P-EBT allowed their family to focus on purchasing only essential foods:

Quote 2: “We have received P-EBT two times. It has helped us out quite a bit. We use it to buy our most necessary foods, like chicken to braise. Now we only buy necessities, not extras. It [P-EBT] is very good, I like it because they are providing it every month. With \$100 extra, it helps us out.”

And another parent expressed their gratitude for P-EBT and shared how it helped them manage costs during the difficult time posed by the COVID-19 pandemic:

Quote 3: “I am thankful for the P-EBT. We have received it once. We have experienced higher costs during the pandemic, and it [P-EBT] has been a big help for us. I still have a bit left. We try to shop the best we can, to make things last. We are really trying to keep our costs down because we have less income. We try to balance expenses, so things are not as difficult. I have also learned how to cook more meals at home. The other lunch (provided by the school) was not the best option for my children.”

P-EBT’s Universality of Benefits

Several parents emphasized the importance of the universality of the P-EBT benefits for the broader community of low-income families, particularly for families who may have been otherwise ineligible for other assistance programs.

One parent explained the significance of P-EBT in bridging this gap:

Quote 1: “[P-EBT] has been an excellent support to our family. More than anything [the pandemic] has been difficult for our families because we may not have access to all of the government support programs, or the benefits that they provided to others. It [P-EBT] has really helped to be able to purchase foods for our children.”

The experiences of Spanish-speaking families, coupled with these quotes, highlight the important role that P-EBT benefits played in mitigating food insecurity. For many families, P-EBT benefits became an important source to maintain their food budget, enabling them to continue to purchase nutritious foods for their children that may have otherwise been out of reach.

Furthermore, P-EBT helped to address gaps in food access for families who may not have had access to other assistance programs, as the program was tied to children's enrollment in school in a low-income neighborhood. This universality of benefits highlighted the program's importance in supporting low-income communities' access nutritious foods during a time of hardship.

Savvy Shopping and Food Sourcing Resourcefulness

Consistent with other research (Schmall et al., in preparation), parents whose children received P-EBT food assistance engaged in resourceful, 'savvy shopping' by shopping around at different food retailers to find the best prices for specific items and extend their family food budget. These families frequently shopped at multiple retailers to find the best prices, prioritizing affordability and planning purchases around the timing of their P-EBT or SNAP benefit deposits. Many parents reported conducting a large grocery shopping trip at the beginning of the month, when their benefits were deposited, to take advantage of bulk deals, and supplementing as needed with smaller purchases from local corner or discount stores.

One parent described their detailed approach to finding the best deals using P-EBT benefits:

Quote 1: "When I go to the grocery store at the beginning of month, I make sure it [purchases using benefits] will last 'til the end [of the month]. If it doesn't last, then that's when I go shopping towards the end of the month. I jump around stores a lot. The first week of the month I'll go grocery shopping at FoodsCo [local grocery store]. I'll see what else I need around the house, then I'll run to Dollar Tree, if I can't find it there, I'll go to the 99 Cent Store. If I can't find what I need there, I'll go to Family Dollar or Dollar General, if I can't find it there, I'll go to a bigger store like Walmart."

This ‘savvy shopping’ approach highlights not only resourcefulness but also the significant effort parents invested in managing their limited food budgets during the COVID-19 pandemic to ensure access to food for their families. Discount retailers played an important role in supplementing family food needs, by offering affordable staple foods at discounted prices that helped families stretch their P-EBT benefits further. While effective, this ‘savvy shopping’ process may have added stress and logistical challenges, as parents juggled their time between caregiving and navigating multiple trips to food retail stores to meet their families’ food needs.

Perceptions about Changes in Children’s Diets & Virtual Schooling

While this research did not quantify children’s diets before or during the pandemic, parents shared perceptions about how their children’s diets may have changed during the pandemic. Parents reported that their children were eating most meals and snacks at home, as their children’s schools closed in-person learning and shifted to virtual learning during the pandemic in 2020. Overall, parents described increased food consumption and more snacking at home by their children, which led to higher family grocery expenses, and a mix of challenges and opportunities in managing their children’s eating habits during the COVID-19 pandemic in 2020.

Parents reported that their children, who previously would have consumed breakfast, lunch, and snacks provided by their schools, now ate all their meals and snacks at home. Virtual schooling gave children more flexibility and immediate access to food and snacks, leading to more frequent snacking throughout the day. One parent reflected on her perceptions on how this shift affected her child’s eating habits and their shared routines:

Quote 1: “Since she’s [daughter] home more, she’s obviously consuming more [food]. But it is nice to have the opportunity to have breakfast together, or she’ll have a break and if I’m sitting

with my coffee or something she'll come sit with me and discuss her schooling for the day. So, we have a lot more contact, which is great...but she has immediate access to food obviously. It's not like in school, where you can't hit up a vending machine or a cafeteria whenever you want to [between classes]. But here [at home] you can either take the laptop with you and get a snack or turn the volume up and run and grab a snack and not miss the online schooling. In fact, the teachers are encouraging the little cherubs, 'Why don't you take a break and grab a snack right now,' and I'm like, 'Sure, you pay the bills and provide them with those snacks!'"

This parent's observation captured both the benefits and challenges of having children at home. While she appreciated the increased family interaction over meals, she noted the financial strain and difficulty in regulating her children's frequent snacking, driven by virtual learning's flexibility and teachers encouraging snack breaks.

Increased Food Costs and More Grocery Shopping

Most parents reported spending significantly more on groceries for their families during the pandemic. With children eating nearly all of their meals and snacks at home, family food supplies were consumed more quickly, requiring more frequent shopping trips and higher spending for food. One parent described the financial impact:

Quote 2: "I feel like I'm shopping more and more because everything goes so fast. They [the children] have eaten the food so fast! I feel like I'm buying more than ever before. I think it's because everyone's home."

This highlights how the shift away from school-provided meals placed a financial burden on families, requiring them to cover the cost of additional meals and snacks, which P-EBT benefits helped them cover.

Concerns About Snacking and Nutritional Choices

Their children's increased access to snacks at home throughout the day raised concerns among some parents about the potential for unhealthy eating habits and weight gain. This was an important finding, particularly because one in five children in the US experience overweight and obesity (Wang & Gago, 2024). To address this, parents reported making deliberate efforts to purchase healthier snack options, often leveraging financial support like P-EBT benefits to help her afford more nutritious alternatives for her child to snack on at home. One parent shared her proactive approach:

Quote 3: "Oh, it [P-EBT] has been so, so – it was wonderful because that extra money, we could buy more food...I bought more snacks for [her daughter] because when she is at home, she is eating more! More snacks for her. I bought granola bars, fruit juice, mozzarella cheese – the stick ones – and applesauce. I'm trying to get better snacks for her because a lot of kids now are gaining weight at home."

This parent's response highlights the importance of financial assistance like P-EBT in helping to enable families to maintain a balance between meeting increased food demands and also the opportunity to incorporate complementary behavior change communication promoting healthier eating habits.

Positive Opportunities for Family Bonding

Despite the challenges, some parents saw the increased time spent at home as an opportunity for family bonding, particularly over shared family meals. Breakfasts and snack breaks became moments to connect with their children, discuss the day's events, and strengthen relationships.

These positive experiences provided a silver lining to the otherwise demanding adjustments of virtual schooling.

One parent described how the time at home gave families more quality time together, including over meals:

"Since she's [daughter] home more, she's obviously consuming more [food]. But it is nice to have the opportunity to have breakfast together, or she'll have a break and if I'm sitting with my coffee or something she'll come sit with me and discuss her schooling for the day. So, we have a lot more contact, which is great..."

Parents observed that the shift to virtual schooling during the pandemic notably influenced their children's eating habits, leading to increased food consumption and frequent snacking at home compared to pre-pandemic routines. This shift placed both financial and logistical pressures on families, as they had to shop more often, spend more on groceries, and adapt to managing their children's unstructured eating patterns.

Despite the challenges, parents also recognized the unique opportunities for family bonding and connection caused by pandemic-imposed virtual schooling, particularly through shared mealtimes. Parents reflected that the little moments such as enjoying breakfast together or discussing the day during snack breaks became valuable opportunities to strengthen family relationships amidst the other disruptions caused by the pandemic.

Overall Discussion

Our research, among the few studies exploring the beneficiary family's experience with P-EBT during the COVID-19 pandemic, highlights the program's important role in helping low-income families in Boston, MA, and Fresno, CA meet their food needs, stretch their family food

budgets, and maintain their children's usual and preferred diets in 2020. Parents in this study reported that the additional financial resources provided by P-EBT benefits helped enable them to continue purchasing foods their children were accustomed to eating, thereby preventing significant reductions in food quality or the substitution of preferred items with cheaper alternatives. This was particularly important as children consumed more meals and snacks at home due to the transition to virtual schooling, which significantly increased grocery expenses for families.

We found that P-EBT benefits helped families navigate the financial strain of the pandemic, particularly the challenges of preparing most meals and snacks at home. Further, they practiced 'savvy shopping,' as a way to stretch their food budget further, which has been mentioned by others in recent research (California Association of Food Banks, 2021).

The program's support was especially critical during a time when children lost access to school-provided meals, including breakfast, lunch, and snacks when schooling shifted to virtual sessions. This shift to home-cooked and eaten meals not only increased family grocery expenses but also required parents to manage their children's unstructured eating patterns, underscoring the value of P-EBT in helping to address these challenges. Our findings align with recent quantitative research and provide parent accounts demonstrating that the rapidly deployed and widely implemented P-EBT program helped families stretch their budgets and meet increased food demands during the COVID-19 pandemic (Fern et al., 2023; California Association of Food Banks, 2021).

Parents in both cities emphasized how P-EBT benefits supported their ability to purchase essential food resources for their families in a time of economic difficulty. All parents in this study reported experiencing economic difficulties, including job loss, reduced work hours, and

increased food expenses. While we did not find any significant differences in how parents in Boston and Fresno used P-EBT, the primarily Spanish-speaking families reported facing more severe economic hardships, such as higher rates of job loss and reduced access to other forms of support. We also found that for many Spanish-speaking families, parents felt that P-EBT filled important gaps by helping enable them to purchase nutritious foods for their children despite these challenges. In this study in California and Massachusetts, we found that the P-EBT program's design, which tied benefits to children's school enrollment in a low-income community, ensured a universality of benefits that is not common in other food and nutrition assistance programs.

Further, the shift to home-prepared meals during the pandemic presented both challenges and opportunities for families receiving P-EBT. Parents described difficulties managing their children's increased food consumption and frequent snacking compared to pre-pandemic routines when structured school meal programs helped regulate children's eating patterns. These changes raised concerns among some parents about unhealthy eating habits and potential weight gain, especially given the high rates of childhood obesity in the U.S. and increased sedentary behavior during the pandemic (Wang & Gago, 2024). Further, California and Massachusetts have high rates of overweight and obesity among children, at one in three children and one in four children being overweight and obese in each state, respectively (CDPH, 2023, Massachusetts Department of Public Health, 2023). Parents concerns with increased snacking and overall food consumption were warranted, given the high rates of overweight and obesity and increased sedentary behavior among children during the pandemic. However, the pandemic-imposed reliance on home-cooked meals may have also created an opportunity for parents to

exercise greater control over their children's nutritional intake and elect which ingredients to prepare meals with.

Despite the concerns about overeating, several parents highlighted their use of P-EBT benefits to purchase nutritious meals and healthier snack options, such as granola bars, fruit juice, mozzarella sticks, and applesauce for their children. This is particularly noteworthy because, like SNAP, P-EBT benefits did not require participants to prioritize nutritious foods and operated under the same eligibility limitations as SNAP. Interestingly, by leveraging P-EBT benefits, some families were able to purchase and prepare healthier snacks and meals, addressing challenges associated with increased food consumption among their children while promoting balanced diets. This suggests that P-EBT may have offered a unique opportunity to enhance children's dietary intake and nutrition during a time of financial strain and public health crisis.

Previous research has highlighted the generally limited impact of SNAP participation on improving child diet quality (Katare, Binkley, & Chen, 2021; Hudak, Racine, & Schulkind, 2021). Within this current analysis, the observed focus on parents' healthier food purchases with P-EBT raises important questions about whether the program may have influenced dietary behaviors differently than SNAP. This underscores the need for future research to evaluate the impact of P-EBT on participants' overall diet quality and nutrition outcomes, particularly against the backdrop of heightened concerns about childhood obesity and sedentary behavior during the pandemic (Wang & Gago, 2024).

Considering the wider application of this research, the UNICEF Framework for Child Nutrition emphasizes addressing immediate determinants of child nutrition, such as dietary intake; underlying determinants, such as child feeding practices and food availability; and enabling determinants, such as household resources and food prices (UNICEF, 2023). Within

this framework, P-EBT helped to directly address a critical enabling determinant by providing families with financial resources to purchase food during the pandemic's economic challenges, particularly amid rising food prices. By doing so, P-EBT may have played an important role in mitigating potential negative impacts on children's dietary intake during a period of widespread financial hardship, enabling families to maintain typical diets and prevent substitutions with cheaper, less nutritious foods.

Our findings also align with prior qualitative research highlighting P-EBT's facilitated usability and convenience, which parents preferred over other methods of food assistance, such as to-go meals provided by schools (Cadenhead et al., 2022). In addition, parents in this study indicated that without P-EBT, they would have faced significant reductions in food budgets already strained by job losses and elevated food costs. By temporarily alleviating financial strain, P-EBT helped to ensure that participating low-income families could meet their children's food needs during the early stages of the pandemic in 2020.

In summary, P-EBT proved to be an important nutrition assistance intervention, helping low-income American families meet heightened food demands during the financial strain of the COVID-19 pandemic. By providing tailored financial relief and allowing flexibility in food choices, the program effectively mitigated some of the economic challenges posed by the crisis. Its design enabled families to maintain children's typical diets, reducing the likelihood of substitutions with less nutritious options, and adapt to the increased grocery expenses associated with home-cooked meals during virtual schooling. These findings underscore the need for continued research to evaluate P-EBT's long-term dietary impacts and to inform future food and nutrition assistance programs.

P-EBT was implemented rapidly and widely to help address the risk of food insecurity among low-income families during the pandemic. To prepare for future crises and align with the UNICEF Framework for Child Nutrition, policymakers and practitioners should consider the swift deployment of programs like P-EBT to help meet immediate nutritional needs efficiently and efficiently. Unlike other U.S. food assistance programs, P-EBT extended eligibility to all children in participating districts, demonstrating a universality of benefits

Beyond addressing immediate needs, helping to maintain access to nutrition assistance programs during crises can help reduce food insecurity, mitigate child malnutrition, and support family food access and resilience. These findings align with recent research emphasizing the importance of consistent access to nutritious foods for children during and after public health emergencies (Poole, Fleischacker, & Bleich, 2021).

Study Limitations

This study has some limitations. First, because it is based on a specific sub-sample of participants (n=32) from the broader Tufts University Dollar Stores Study, the generalizability of the findings may be limited. By focusing exclusively on dollar store shoppers with school-aged children who received P-EBT in 2020, the study may not fully capture the experiences of families with different shopping habits or access to other retail outlets. Additionally, the recruitment strategy, which included flyers at dollar stores and online discount-shopping communities in the Boston and Fresno metropolitan areas, may have introduced selection bias by attracting participants already engaged in discount shopping. These limitations suggest that future large-scale research is needed to provide a more comprehensive understanding of how P-EBT was used by families across diverse contexts. Despite these challenges, the study employs a

robust qualitative methodology, featuring in-depth interviews and detailed data collection. By including participants from two geographically and culturally diverse locations—California and Boston—and capturing the perspectives of both English- and Spanish-speaking communities, the research provides valuable insights into the experiences of an underexplored population during a critical period of public health and economic uncertainty. However, our research was only conducted in two American cities, which also limits the generalizability of our research given the expansive and distinct population across the United States.

Conclusions

Our research suggests that P-EBT was an important intervention in helping to address food insecurity during the COVID-19 pandemic in the United States, helping provide low-income families with the financial flexibility to maintain their children's dietary needs and prevent nutritional compromises during a time of economic strain. By enabling families to purchase healthier foods and adapt to increased food demands associated with home-cooked meals, P-EBT demonstrated its value in mitigating the challenges posed by school closures and rising food costs. These findings highlight the importance of integrating programs like P-EBT into comprehensive nutrition assistance frameworks that address immediate needs while also supporting low-income families to access to nutritious food and other support during crisis periods.

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Overall Discussion and Implications for Future Research

This dissertation explores the multifaceted determinants of child nutrition across three distinct contexts—Sierra Leone, Burkina Faso, and the United States—drawing on insights from three nutrition assistance programs. Guided by the UNICEF Conceptual Framework for Child Nutrition (2020), these findings highlight the interplay of immediate, underlying, and enabling factors in shaping child nutritional outcomes in varying and challenging environments. By examining these determinants, the research identifies shared and context-specific challenges families face in promoting child nutrition, whether in protracted crises like those in West Africa or during a pandemic in a country like the United States.

This research focused on the underlying and enabling determinants of child nutrition, including child feeding practices, WASH infrastructure, home cleanliness, and household economic resources, though the influence of these determinants on child nutrition outcomes varied across contexts. However, traditional nutrition assistance programs—whether aimed at addressing MAM or child stunting in West Africa, or food insecurity, like P-EBT in the United States—often adopt a one-dimensional approach, focusing on either providing nutritious foods or financial resources, while not considering other critical factors as strongly.

In the context of the triple burden of malnutrition, where globally, undernutrition, hidden hunger and overweight and obesity among children are of public health concern, our findings from Sierra Leone, Burkina Faso, and the United States highlight the importance of addressing the interactions between various immediate, underlying, and enabling determinants of child nutrition. Bridging gaps at each level of determinants can help future nutrition assistance programs to adopt more holistic, context-specific strategies that more effectively and sustainably support improved child health and nutrition outcomes. Although the need for comprehensive

nutrition programs is well-established (Bhutta et al., 2013; Hossain et al., 2017; WHO, 2017), our findings across these three diverse settings underscore the importance of integrated, multidimensional approaches to enhance the enabling environment for child nutrition in resource-constrained and/or crisis-affected contexts.

Connecting Contexts: Burkina Faso, Sierra Leone, and the United States

This research draws on three distinct contexts, yet commonalities emerge across them. Burkina Faso and Sierra Leone represent low-resource and humanitarian settings in West Africa, while data from the United States during the COVID-19 pandemic illustrates an acute public health crisis in a high-income country. While often assumed that high-income, well-resourced countries like the United States, do not experience challenges as compared to low-income countries, the reality is more nuanced, as all countries have opportunities to strengthen efforts. Across all three contexts, household poverty among participating households remained a critical barrier to families' access to nutritious food, negatively impacting children's ability to maintain good nutrition.

In Burkina Faso and Sierra Leone, systemic poverty and poorly developed economic and social systems intensified challenges related to access to nutritious foods and may have placed children at elevated risk for malnutrition. In the United States, the pandemic may have increased risk of poverty, food insecurity, and hunger for many low-income Americans, with US government-provided nutrition assistance programs providing important support. Despite differences in resources and infrastructure across countries and contexts, these experiences highlight a shared vulnerability: many low-income families are just one crisis away from being at risk for food insecurity and potentially malnutrition.

Further, the UNICEF Conceptual Framework for Child Nutrition (2020), proved to be a useful tool for examining potential factors influencing child nutrition outcomes in diverse low as well as high-income contexts. While often used to inform programs and policy in low-income countries, we were successfully able to use the framework to identify determinants of child nutrition in a high-income country, like the United States.

Economic Barriers as an Important Enabling Factor for Child Nutrition

Importantly, economic challenges influenced nutrition outcomes across all three contexts. In Sierra Leone and Burkina Faso, extreme poverty left families reliant on grain-based diets, which, while calorie-rich, lacked essential nutrients for healthy growth. High levels of household food insecurity eventually led to children's enrollment in nutrition assistance programs aimed at preventing wasting and stunting. However, these programs provided only temporary relief, failing to address the structural poverty that perpetuates malnutrition.

Similarly, in the United States, the economic challenges from the COVID-19 pandemic exacerbated food insecurity, particularly among low-income families. P-EBT helped mitigate financial strain by providing additional food resources for families to maintain their children's diets. Parents reported that the program allowed them to avoid substituting cheaper, less nutritious foods, thereby preserving dietary quality during economic hardship.

These findings underscore the potential importance of addressing economic barriers as an important determinant of child nutrition. To achieve sustainable improvements, interventions should consider moving beyond immediate nutritional support to address the systemic economic challenges that perpetuate food insecurity and malnutrition.

Recognizing the Important Influence of Underlying Determinants of Child Nutrition

In Sierra Leone and Burkina Faso, underlying determinants such as poor WASH practices, limited dietary diversity, and inadequate caregiving behaviors also contributed to child malnutrition, including wasting and stunting. These findings focus on the West African contexts, as relevant data were unavailable for the U.S. study.

Suboptimal WASH Practices and Unclean Home Environments

In both Sierra Leone and Burkina Faso, poor WASH practices emerged as an underlying determinant of child nutrition outcomes. Handwashing was infrequent among caregivers and children, particularly at key times such as before eating or after toileting the child. In Sierra Leone, soap use was limited to child bathing, while in Burkina Faso, water scarcity further limited soap use and application during handwashing or food preparation.

Unclean home environments also exacerbated risks. In Sierra Leone, children often played unsupervised on dirt floors and frequently mouthed unsanitary objects. In Burkina Faso, home compounds were often described as dirty by local enumerators, with garbage and animal droppings scattered throughout. Domestic animals roamed freely in areas where children played and ate, increasing potential exposure to fecal-oral pathogens. These conditions may have undermined the effectiveness of nutritional assistance programs by potentially impairing nutrient absorption and compromising child health.

Addressing these broader determinants could involve application of various interventions such as clean play environments, regular handwashing with soap, and strategies to separate domestic animals from children's living spaces. Implementing these measures in nutrition assistance programs, as has been done successfully in other settings can potentially reduce

exposure to harmful pathogens and maximize program benefits (Reid, Null, & Humphrey, 2018, Nassur, Abdirahman, & Ismail, 2022).

Improving Child Feeding and Diets

The importance of age-appropriate, high-quality, and safe diets for promoting child nutrition is well documented, but practices remain suboptimal globally (Bhutta et al, 2013). Across all three contexts—Burkina Faso, Sierra Leone, and the United States—our research underscores the need and opportunity for broader efforts to improve child feeding practices and dietary quality beyond the direct benefits of supplemental food or cash provided temporarily by nutrition assistance programs.

In West Africa, children enrolled in malnutrition prevention programs often consumed suboptimal diets dominated by grains with limited diversity. However, breastfeeding emerged as a protective practice in both Sierra Leone and Burkina Faso, where it was associated with reduced stunting risk. Despite this, breastfeeding and complementary feeding often declined during illness, highlighting the need for caregiver education on continued feeding practices during sickness.

Complementary feeding practices lacked diversity, with children’s diets in Sierra Leone reliant on rice, cassava, and potato leaves, while Burkina Faso diets were similarly grain-based but slightly more varied. Caregivers supplemented these diets with small amounts of animal-sourced proteins and vegetables, constrained by poverty and food insecurity. Future SBC programs could focus on practical strategies to incorporate affordable, nutrient-dense, locally available foods into daily routines.

In the U.S., programs like P-EBT benefits helped families to maintain participating children's dietary quality by facilitating parents' purchase of healthier foods. Their access to healthy foods was particularly important in the context of the COVID-19 pandemic in the United States, where parents were concerned about overeating and sedentary behavior among their children due to school closures. The United States experiences a high burden of child overweight and obesity (Wang & Gago, 2024), so P-EBT benefits' ability to facilitate children's access to nutritious foods was potentially important to preventing child hunger and maintaining dietary quality. Incorporating similar monetary transfer mechanisms in other low-resource settings could potentially help families access a broader range of nutritious foods while benefiting from supplementary foods. This dual approach has gained traction globally as monetary transfer programs increasingly demonstrate the potential to improve dietary quality and child nutrition outcomes (Gentilini et al., 2020).

Supporting Mothers as Primary Caregivers, While Leaning on Others

Across all three contexts, mothers were the primary caregivers, often balancing caregiving responsibilities with household or farm work. In Sierra Leone and Burkina Faso, grandmothers, co-wives, and other relatives played secondary roles, while fathers were minimally involved, typically engaging in play rather than feeding or care. In the U.S., the pandemic increased caregiving burdens for mothers as school closures required them to manage work and childcare simultaneously.

Leveraging household dynamics offers opportunities to enhance nutrition assistance interventions. Engaging extended family members in caregiving roles and providing targeted support for mothers can amplify the impact of nutrition assistance programs. Encouraging shared

responsibility for childcare among caregivers can foster a more supportive environment for promoting child nutrition and development (Bhutta et al, 2013, WHO, 2017).

Considerations for Future Behavior Change Activities within Malnutrition Prevention and Treatment Programs

Our findings highlight several areas to enhance future SBC interventions within malnutrition prevention and treatment programs, particularly in contexts like Sierra Leone, Burkina Faso, and future nutrition assistance programs in the United States. While not a standalone solution, SBC is an important complement to malnutrition programs, addressing immediate and underlying determinants of child nutrition through targeted behavioral shifts.

A primary focus should be on promoting clean and safe play environments for children. While well-documented in the literature (Reid et al., 2018; Budge et al., 2021; Rosenbaum et al., 2021), this is often underemphasized in current nutrition assistance programs. Encouraging caregivers to place children on clean mats under supervision can help significantly reduce exposure to dirt and harmful pathogens, mitigating risks from mouthing unsanitary items such as debris or animal feces (Reid et al., 2018; Budge et al., 2021; Rosenbaum et al., 2021). Programs should consider fostering awareness about the risks of unsanitary play areas and provide affordable solutions like access to mats or playpens to minimize fecal-oral infections for young children.

Promoting regular handwashing with soap at critical times is another evidence-based intervention (Bhutta et al., 2013). Handwashing before food preparation, eating, feeding children, and after waste handling or farming can significantly reduce pathogen transmission.

Community-driven campaigns and accessible handwashing stations can help reinforce this practice, benefiting both children and caregivers by preventing illnesses.

In contexts like Burkina Faso, where domestic animals are frequently in close proximity to children, strategies to corral animals in designated spaces away from living and cooking areas are important. These measures can minimize contamination from animal droppings and prevent animals from consuming food from utensils used by young children, thereby reducing the risk of fecal-oral infections and helping to improve household hygiene.

Improving food hygiene practices is equally important (Bhutta et al, 2013). Caregivers should be further educated about covering prepared foods, reheating cooked leftovers, and using clean utensils during meal preparation and feeding of children. Proper food storage can reduce foodborne illnesses and ensure food safety, directly contributing to benefiting child health.

Enhancing dietary diversity should remain central to SBC efforts in future nutrition assistance programs (Bhutta et al, 2013). SBC interventions in these programs should focus on empowering caregivers to incorporate affordable, nutrient-dense, locally available foods, such as animal-sourced proteins, fruits, and vegetables, into children's diets. Practical strategies like community demonstrations and caregiver nutrition education on preparing culturally appropriate meals can help integrate these practices into daily routines. In the United States, leveraging SBC within programs like P-EBT could help encourage families to use benefits for purchasing healthier options, such as fresh produce, to address important risks like childhood obesity and poor dietary quality or overconsumption of unhealthy snack foods. The incorporation of SBC to promote continued consumption of nutritious foods is important, in the sense that one in five children in the United States is overweight or obese (Wang & Gago, 2024), so well-tailored and evidence-based SBC could help promote healthier eating behaviors among American children.

Caregiver counseling should also emphasize continued feeding during child illness. Maintaining nutrient intake during sickness is essential for recovery and preventing further nutritional decline. Small, frequent meals, continued breastfeeding, and nutrient-rich foods should be prioritized by caregivers.

By emphasizing the potential benefits of behavior change in both the West African and American contexts, these targeted nutrition interventions are important for fostering sustainable improvements for child health, nutrition, and overall development. This is particularly important in resource-limited and challenging environments, where barriers to health and nutrition may continue to persist.

Summary and Recommendations for Future Research and Programs

We observed that nutrition assistance programs in Sierra Leone, Burkina Faso, and the United States effectively addressed their immediate goals by providing temporary supplementary nutritious foods (SNFs) in MAM treatment or stunting prevention programs, or financial assistance to purchase food through P-EBT benefits during the COVID-19 pandemic. However, these programs did not address broader underlying and enabling determinants of child nutrition, such as inadequate WASH practices, unsanitary home environments, and suboptimal feeding behaviors. Future nutrition assistance programs could consider more integrated, multidimensional strategies that address these various barriers to more sustainably improve child nutrition outcomes.

In the future, policymakers, practitioners, and communities could further prioritize investments in more holistic interventions that consider the UNICEF Framework's immediate, underlying, and enabling determinants. In West Africa, programs could consider focus on

strengthening broader healthcare and WASH systems, while also promoting dietary diversity, and helping to address household poverty. In the U.S., integrating SBC into programs like P-EBT could help enhance dietary quality and encourage long-term positive nutrition behavioral change.

Building on these findings, future research could consider focus on evaluating the effectiveness of integrated interventions that address multiple determinants of child malnutrition. This aligns with global calls for “double duty” actions to more holistically address the triple burden of malnutrition—stunting, wasting, and overnutrition globally (WHO, 2017). For instance, nutrition programs aimed at preventing stunting could consider combining cash benefits with tailored behavior change communication to encourage the purchase of nutrient-rich foods, while simultaneously facilitating improving WASH practices and infrastructure within participating households. Additionally, examining the long-term impacts of programs like P-EBT on dietary behaviors and child nutrition—particularly in comparison to other food assistance programs like SNAP—could help provide valuable insights for enhancing the design and implementation of similar programs in the future. Future studies could also explore the combined effects of integrating WASH and nutrition interventions in resource-limited settings, as well as assess how caregiving structures and family dynamics influence the effectiveness of stunting prevention efforts in resource-limited settings in a global context. These future research areas are important to developing family-centered approaches and addressing the multifactorial drivers of child malnutrition in various contexts.

Conclusions

Addressing child malnutrition underscores the importance removing silos specific to certain nutrition outcomes in research and nutrition assistance program implementation. More integrated, systems-based approaches that consider stunting, wasting, micronutrient deficiencies, and risks of overnutrition among child more holistically are important for fostering resilience and promoting overall child nutrition and well-being. These more comprehensive and integrated strategies are crucial for reducing malnutrition's prevalence and ensuring healthier futures for children worldwide.

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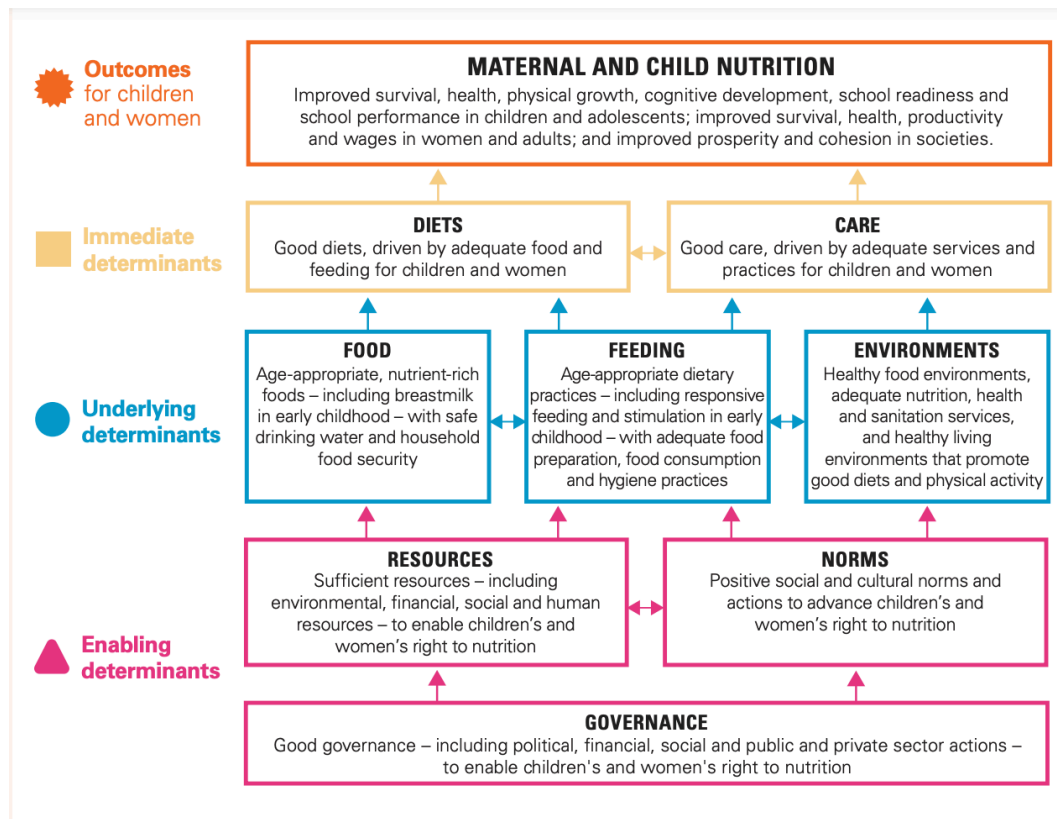
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Appendices

Appendix 1

Tables and Figures from Background and Research Significance

Figure 1. UNICEF Conceptual Framework for Child Nutrition (2023).



Appendix 2

Tables and Figures from Research Methods Overview

Table 1. Behaviors and Practices of Interest

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child
	Whether caregiver fed child or if child self-fed

	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child
	Water source for the household (stream, pump, etc.)

Appendix 3 – Tables and Figures from Article 1

Table 1. IYCF Practices, Behaviors & Household Conditions of Interest for the IHO

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child

	Whether caregiver fed child or if child self-fed
	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child
	Water source for the household (stream, pump, etc.)

Table 2. Characteristics of Participants of MAM Treatment Program

	Female	Male	Totals
Recovered from MAM	116 (56%)	91 (44%)	207

Regressed to SAM	33 (69%)	15 (31%)	48
Totals	149 (58%)	106 (42%)	255

Table 3. Caregivers Individually Observed Caring for Children

Caregiver	Times Caregiver Observed
Mother	25,791
Grandmother	2,661
Father	1,116
Aunties / Other females (e.g., neighbor)	1,060
Child's siblings	
Sister	1,287
Brother	792

Table 4. Foods Consumed by Children During Home Observation Period

Food	Times Observed
Study food porridge	14,724
Non SNF porridge (local porridge)	154
Rice	6,889
Cassava root	1,115
Sweets (i.e., biscuit, cake, sweet bread, donut, other sweets)	1,416
Water	1,787
Other green vegetables (e.g., local greens)	1,894

Soup	898
Fish (in stew, grilled, fried)	583
Potato sauce	591
Groundnut sauce	497
Sugar-sweetened beverages (i.e., soda or juice)	444
Other Fruit (e.g., mango, pineapple, orange)	671
Milk	297
Fresh coconut	198
Cooked corn	199
Cooked okra	185
Boiled beans	156
Cucumber	139
Cooked Egg	204
Raw onion	147
Other meat (e.g., beef, chicken, goat in stew, fried, or grilled)	79

Table 5. Gender and Age Summary Among Children Who Developed SAM

Age	Sex		Totals
	Female	Male	
≤ 12 months	22	10	32
≥ 12 months	10	5	15
Totals	32	15	47

Appendix 4 - Tables and Figures from Article 2

Table 1. IYCF Practices, Behaviors & Household Conditions of Interest

IYCF Practice	Behavior of interest
Child Feeding	Types of food fed to child
	Whether caregiver fed child or if child self-fed
	Type of serving vessel for child's food
	Number of times child fed per day by caregiver
	Whether child was breastfed or not
Child Care	Who provided caregiving for child
	Whether child was left alone to play
	What activities the child engaged in throughout the day
WASH Practices	Caregivers' self-handwashing before or after preparing child's food
	Caregiver self-handwashing before feeding the child
	Caregiver washing child's hands before or after the child ate
	Caregiver washing of child's hands after getting dirty
Household environment	Cleanliness of the household environment
	Mouthing of household objects
	Whether domestic or farm animals were present around the child

	Water source for the household (stream, pump, etc.)
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Table 2. Distribution of Children with IHO Data by SNF Group

SNF Group	Number of Children
CSBP	30
CSWB	39
SC+	34
RUSF	38
Total	141

Table 3. Frequency of Child Caregiving Activities by Various Caregivers

Child's Caregiver	Times observed caregiving
Mother of beneficiary child	1,101
Co-wives	88
Grand mother	35
Father	29
Elder siblings	33

Table 4. Other Observed Activities by Mother in the Household

Activity Description	Number of times Observed
Preparing meals	1,651
Drawing water	857
Washing dishes	545

Holding child	301
Sweeping the home compound	290
Collecting firewood	232

Table 5. Caregiver WASH Behaviors Observed

WASH behaviors	Times behavior was observed
Cleaning/rinsing the child's defecation	645
Bathing child	459
Caregiver washing own hands or child hands before a meal	250
Caregiver not washing own hands or child hands before a meal	582

Table 6. Variety of Foods Observed Being Provided to Children During the Study Period

Description	Observations from IHO
Study food	615
Other Cereals (e.g. rice, millet)	1,733
Roots/tubers	42
Legumes (e.g. beans, peanuts)	525
Vegetables (e.g. greens, carrots, beans)	796
Milk	57
Eggs	8
Meat/fish	225

Other foods (e.g. biscuits, fruits, stews/sauce, snacks)	1,826
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Table 7². Regression Output for Factors Associated with Child Stunting

Variable	Odds Ratio	Std. Err.	Z	P> z 	[95% Conf. Interval]
Age of mother	1.028175	0.037038	0.77	0.441	[0.9580854, 1.103392]
Wealth quintiles (1)	1.972913	1.516118	0.88	0.377	[0.43751, 8.896679]
Wealth quintiles (2)	1.742356	1.472316	0.66	0.511	[0.3325516, 9.12882]
Wealth quintiles (3)	1.001741	0.8471079	0.0	0.998	[0.1909631, 5.254867]
Wealth quintiles (4)	2.9257	2.288258	1.37	0.17	[0.6316624, 13.5511]
Breastfeeding	0.4087337	0.1853708	-1.97	0.049	[0.1680349, 0.9942171]
Consumption of animal	1.098564	0.5173955	0.2	0.842	[0.4364465, 2.765155]

² Regression diagnostics: R²: 0.0647

source food in past 24-hrs					
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Model Output

Logistic regression Number of obs = 141

LR chi2(8) = 9.10

Prob > chi2 = 0.3339

Log likelihood = -65.728216 Pseudo R2 = 0.0647

Variable (n=141)	Odds Ratio	Std. Err.	Z	P> z 	[95% Conf. Interval]
Age of mother	1.028175	0.037038	0.77	0.441	[0.9580854, 1.103392]
Wealth quintiles (1)	1.972913	1.516118	0.88	0.377	[0.43751, 8.896679]
Wealth quintiles (2)	1.742356	1.472316	0.66	0.511	[0.3325516, 9.12882]
Wealth quintiles (3)	1.001741	0.8471079	0.0	0.998	[0.1909631, 5.254867]
Wealth quintiles (4)	2.9257	2.288258	1.37	0.17	[0.6316624, 13.5511]

Breastfeeding	0.4087337	0.1853708	-1.97	0.049	[0.1680349, 0.9942171]
Consumption of animal source food in past 24-hrs	1.098564	0.5173955	0.2	0.842	[0.4364465, 2.765155]
Maternal education	0.5403185	0.3318915	-1.0	0.316	[0.1621056, 1.80095]
Control	0.4535423	0.6780664	-0.53	0.597	[0.0242121, 8.495775]

Appendix 5 Interview Guide from Article 3.

Dollar Stores Study Interview Guide

INTERVIEW QUESTIONS

-START-

***Interviewer say:** Let's start with an ice breaker. What was your favorite food you during your childhood and why?*

(Interviewer note: Respond to their answer. Share your favorite childhood food to connect with them.)

Key Topic Area 1: General Dollar Store Shopping

Interviewer say: First, I would like to learn about your dollar store shopping in general.

1. Tell me about your use of dollar stores.
 - a. Thank you. Now, think about your weekly purchases at all stores combined, how much of those purchases are typically at dollar stores?
2. What do you typically buy at dollar stores?
 - a. What are the reasons you choose to purchase those things at dollar stores compared to other stores?
 - i. Probe, if limited response: Can you tell me more about that?
3. What do you like about dollar stores?
 - a. Probe (if limited response): Could you tell me more about that?
4. What, if anything, do you not like or want to change about dollar stores?
 - a. Probe (if limited response): Could you tell me more about that?
5. What kinds of foods or drinks do you typically purchase at dollar stores?
 - i. Do you buy milk, eggs, meat, or bread at dollar stores?
 1. Probe, why or why not.
 - ii. Do you buy fresh fruits, vegetables at meats at dollar stores?
 1. Probe, why or why not.
- b. Why do you buy foods and drinks at dollar stores rather than other stores?
 - i. Probe (if limited response): Could you tell me more about that?

Key Topic Area 2: Dollar Stores Shopping During COVID-19

Interviewer say: Next we would like to hear about your shopping at dollar stores during the COVID-19 pandemic.

6. In what ways, if any, has your shopping at dollar stores changed during the pandemic?
 - a. Probe: Has what you buy there changed?
 - i. Have how often you go there changed?
 - ii. Has how much you buy changed?
7. Prior to the pandemic, where did you get most of your food?
 - a. What about now, during the pandemic?
8. How has the pandemic influenced your decision to buy certain foods and drinks at dollar stores?

Key Topic Area 3: SNAP & WIC Usage at Dollar Stores

Interviewer say: We are at the next set of questions. I would now like to learn about your participation in social programs.

9. Do you participate in the WIC or SNAP program?
 - a. *If yes progress to other questions*
 - b. *If no: (skip to conclusion)*
10. In general, how does your participation in WIC or SNAP influence which stores you do your food shopping at?
11. What types of foods or drinks do you purchase at dollar stores using your benefits?
 - a. In what ways, if any, is this different than what you purchase at other stores using your benefits?
 - b. Do you use your benefits to purchase foods or drinks at dollar stores?

- i. Probe why or why not.

12. How has the pandemic changed how you use your benefits for food shopping?

- a. What about your shopping at dollar stores?

Key Topic 4: Child Feeding During COVID-19

Interviewer say: We are at the final set of questions. I would now like to learn about child feeding during the pandemic.

13. Do you have children? (Note: they may have already indicated whether they have children earlier in the interviews)

- a. If yes, progress to next question (14).
- b. If no, progress to conclusion of interview.

14. Where do you typically do food shopping for your children?

- a. How much do you do at dollar stores?
- b. Has this changed during the pandemic? If so, how?
 - i. If limited answer, probe: can you tell me more about that?

15. Have your children's diets changed during the pandemic?

- a. How so?
- b. Are you feeding them more or less of certain foods?
 - i. Why or why not?

CONCLUSION:

Interviewer say: Thank you so much for your insights.

Before we finish, are there other things that you would like to discuss? Do you have any questions or comments? We truly appreciate your feedback.

We have a fact sheet on dollar stores and food resources in your community. Would you like us to send it to you via email? (If yes say, ok we will send after this call.)

Great, we are finished! Which way do you prefer to receive the gift card, by email or mail? Ok, noted. We will send it within 3 business days of this interview. (*Interviewer note: If regular mail- need address. Ask for it.*)

Thank you again!

-END-