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Maternal Protein Supplementation for Child Malnutrition in Guatemala

INTRODUCTION

Nearly 200 million children suffer the effects of malnutrition worldwide; that represents nearly one third of the world's children. *Malnutrition* is defined as "deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients," according to the World Health Organization (WHO). WHO prioritizes malnutrition as a major global health concern, given that its impact on global systems can be catastrophic (WHO, 2016). Malnourished children face learning difficulties in school, earn less wages in their adult years, and face barriers to participation in their communities affecting their social, knowledge, and economic capital. Children suffering from undernutrition are also more susceptible to disease, including both communicable and noncommunicable diseases later in life (WHO, 2019). Malnutrition creates long-term detriments to national economies and social development in communities, and can further push families and their respective communities into poverty (USAID, 2019b). Climate change, gender inequality and poverty are just a few major global issues currently interacting with social systems to compound the severity and pervasiveness of malnutrition and its inherent impact on the global community.

The United Nations Sustainable Development Goals #2 (Zero Hunger) and #3 (Good Health and Wellbeing) aim to ensure proficient access to nutritious foods and to ensure healthy lives and promote well-being at all ages by calling for action to all nations indiscriminate of their level of prosperity on the global economic scale (United Nations, 2019). Though they are lofty

and complex goals to achieve, many nations have taken strides to achieve Zero Hunger and Good Health and Wellbeing for their citizens. Some, however, face larger barriers than others in achieving these goals and as such, have become receptive to foreign aid and support in their efforts to achieve these goals. Guatemala is one of these nations.

Guatemala boasts the world's sixth-highest rate of chronic malnutrition, and holds the number one highest rate in Latin America. Nearly 47% of the 2 million children under five in Guatemala are stunting; in indigenous populations, this percentage jumps to nearly 70%; 13% of children under five are underweight (USAID, 2019). The Sustainable Development Goals Zero Hunger and Good Health and Wellbeing explicitly call for attention to vulnerable populations such as children under five in impoverished (and in this case, indigenous) regions who require special acknowledgement and intervention in order for these goals to be met on a global scale. Reducing and ideally eradicating malnutrition in Guatemala is critical, but how can such a complex issue be appropriately addressed?

Proposed work: Provide maternal supplementation with balanced energy protein to women and girls of reproductive age in indigenous regions in Guatemala. The proposed work considers the unique contextual factors that may harm or encourage intervention(s) for mitigating stunting and undernutrition in Guatemala's indigenous populations as well as the efficacy and efficiency of previously conducted studies addressing similar issues. The proposed work is based on the evaluation of maternal, infant and child malnutrition interventions, specifically those highlighted by The Lancet Maternal and Child Nutrition 2013 Series, which suggest that the most effective course of action to properly address child malnutrition is through nutrition-specific packages of care including the administration of maternal nutritional supplementation at 90% coverage (Imdad & Bhutta, 2012). The following proposal discusses the burden and significance of child malnutrition on both a global and local scale, the research

leading to the proposed intervention, and the importance of partnering with CARE in an effort to reduce and ideally eradicate child malnutrition in indigenous regions in Guatemala.

DISEASE BURDEN & SIGNIFICANCE

What is Malnutrition

The World Health Organization (WHO) defines malnutrition as “deficiencies, excesses or imbalances in a person’s intake of energy and/or nutrients.” There are two kinds of malnutrition: undernutrition and overweight or obese. Undernutrition - which includes stunting (low height for age), wasting (low weight for height) and the deficiencies of important nutrients and vitamins in the diet - takes high priority on the agendas of international/global organizations, particularly those working with indigenous populations and especially those working with children under five (WHO, 2016). For the purposes of this intervention, malnutrition in the form of undernutrition will be addressed in children under five living in the indigenous regions of Guatemala.

WHO identifies six (6) global targets to improve maternal, infant and young child nutrition in Guatemala: 40% reduction in the number of children under five who are stunted; 50% reduction of anaemia in women of reproductive age; 30% reduction in low birth weight; no increase in childhood overweight; increase the rate of exclusive breastfeeding in the first 6 months to at least 50%; and reduce and maintain childhood wasting to less than 5% (WHO, 2019). There are a variety of indicators used to measure the outcomes of interventions aimed at meeting these goals. The primary outcome indicators named are: the percentage of stunting in children 0-59 months; the percentage of anaemia in pregnant women; the percentage of anaemia in non-pregnant women; the percentage of overweight in children 0-59 months; the percentage of exclusive breastfeeding under 6 months; and the percentage of wasting in children 0-59 months (WHO, 2019).

Disease Impact

Malnutrition has the most detrimental impact on children under the age of five. An estimated 155 million children under the age of five are stunted, 52 million are wasted and 17 million are severely wasted worldwide (WHO, 2018). The risks associated with malnutrition begin in-utero and in early childhood; children who do not receive adequate nutrition in these stages of development may never attain full possible height and their brains may never develop to their full cognitive potential. Malnourished children face learning difficulties in school, earn less wages in their adult years, and face barriers to participation in their communities affecting their social, knowledge, and economic capital. Children suffering from undernutrition are also more susceptible to disease, including both communicable and noncommunicable diseases later in life (WHO, 2019). Malnutrition creates long-term detriments to national economies and social development in communities, and can further push families and their respective communities into poverty (USAID, 2019).

Burden of Disease: Global

Around 45% of deaths among children under five years of age are linked to undernutrition. Stunting affected an estimated 21.9% of children under 5 and wasting threatened the lives of an estimated 7.3% in the year 2018 (UNICEF et al, 2019). DALYs (the sum of potential life lost due to disability) attributable to underweight in children for the globe (in thousands) are 137,801; this number represents the single largest risk factor to health at the global level, where in underdeveloped nations, it causes more than 13% of all deaths and represents 15% of all DALYs (WHO, 2005). Stunting can cause irreversible damage to both physical and cognitive functions in children which can cause devastating effects for the rest of that child's lifetime including higher risk of infection, development of noncommunicable diseases in adulthood, low economic and social output, and the potential for undernourished mothers to transmit harmful effects to the next generation; malnutrition in mothers leads to underweight

babies who are immediately disadvantaged. If no intervention is implemented within the newborn's first 1,000 days of life, irreparable harm can be induced in that child, which prevents the child from reaching full economic and social capital (UNICEF et al, 2019). Furthermore, malnourished children often present with poor health in their reproductive years, leading to malnourishment in pregnancy, which leads to the birthing of malnourished babies. This cycle perpetuates chronic malnutrition in impoverished communities (UNICEF et al, 2019). The prevalence of stunting in children under five is currently the highest in regions of Southern Asia (32.7%), Eastern and Middle Africa (32.1% and 35.2% respectively), and Oceania (38.2%). This means that the next generation consists largely of stunted children who may live with irreparable developmental harm for the rest of their lifetimes, potentially causing large economic burden at both household and national levels.

Wasting refers to a child who is too thin for his or her height. Wasting occurs when there is rapid weight loss or a failure to gain weight, and is a life-threatening condition in the absence of intervention (UNICEF et al, 2019). Southern Asia is the only region considered to have "high" wasting prevalence (14.6%). In Asia and Oceania, wasting is putting nearly 1 in 10 children under 5 at increased risk of death (UNICEF et al, 2019).

Malnutrition continues to bear a heavy burden on low- and lower-middle-income countries. Africa and Asia bear the greatest brunt of malnutrition in all forms, particularly populations of children under five, young adolescents (especially adolescent mothers), and women (UNICEF et al, 2019).

Burden of Disease: Guatemala

Guatemala has the sixth-highest rate of chronic malnutrition in the world, and the number one highest rate in Latin America. Nearly 47% of the 2 million children under five in

Guatemala are stunting; in indigenous populations, this percentage jumps to nearly 70%; 13% of children under five are underweight (USAID, 2019). DALYs attributable to underweight in children in the AMR D region (including countries Bolivia, Ecuador, Guatemala, Haiti, Nicaragua, and Peru) are 16,610 (in thousands). This value comprises 15% of the total DALYs in the region (WHO, 2005).

Indigenous children in Guatemala face similar risks to the global child population in respect to undernutrition; children who have chronic malnutrition face not only stunted growth and undernutrition, but also a diminished mental capacity and a substantial decrease in earning power, which negatively impacts the development of Guatemala as a nation overall (Loewenberg, 2009; USAID, 2019). Loss of productivity due to decreased cognitive functioning impacts families at both the household and community level. Indigenous populations rely heavily on sustenance farming to produce family income (Gargiulo, 2017). When children are unable to work or receive an education which can enable them to make an income later in life, the family risks depleting resources (in food, water, and materials) to care for their children without those same children being able to contribute to household income later in life. On a national level, underweight children cost Guatemala \$3.1 million, or 11.4% of GDP in lost productivity in 2004; childhood anaemia alone was associated with a 2.5% drop in adult wages (World Bank, 2011).

Determinants & Risk Factors

Guatemala has high levels of inequality, with indigenous regions (comprising about 40% of the population) suffering the worst consequences of poverty, malnutrition, mortality and reduced access to education and health services (USAID, 2019). Stark income inequality directly translates to the inability of families in indigenous regions to purchase nutrient-rich foods for the household such as beans and eggs (Loewenberg, 2009). Poor, sometimes non-existent infrastructures deplete communities of electricity and clean running water, worsening living

conditions and enabling malnourishment to thrive; the introduction of diarrheal diseases to already malnourished communities highly inhibits children from receiving and absorbing essential nutrients for growth (Loewenberg, 2009). Other factors that worsen malnutrition for children in indigenous regions in Guatemala include substandard housing, exposure to communicable diseases, inadequate health care or limited access to such, limited educational opportunities, poor feeding and breastfeeding regimens and large family size leading to scarce resources for children (Ansuya et al, 2018; Loewenberg, 2009). Certain diseases such as tuberculosis, measles, and diarrheal diseases are directly linked to acute malnutrition. In fact, a combination of undernutrition and infection weakens the metabolism and creates a vicious cycle of infection and undernourishment (Action Against Hunger, 2018).

Underlying the social and institutional determinants of health is poverty; poverty is the general underlying cause of malnutrition and stunting in indigenous children under five. Despite Guatemala having the largest economy in Central America and one of the strongest in Latin America overall, two-thirds of the population still lives on less than \$2 a day (World Bank, 2017). In fact, national poverty rates have only increased in recent years, from 51% in 2006 to nearly 59% in 2014. Indigenous populations have even worse poverty rates; 79% of them live in poverty, 40% of which live in extreme poverty (Gargiulo, 2017).

Climate change has been named a major cause of food insecurity, which is directly linked to malnutrition especially in indigenous communities where sustenance farming is the main source of household income. Changing climate conditions are negatively impacting the land farmers use to grow crops with which they sell in local and global markets. This pushes families into poverty, ultimately exposing children to food insecurity and lack of energy/nutrient intake at an early developmental age (WFP, 2018). Lack of external support for farmers coping with adverse effects of natural disasters and climate change due to physical and cultural

barriers between indigenous regions and urban areas causes agricultural production to decline, forcing families further into acute food insecurity (Gargiulo, 2017).

The language barrier indigenous people face when accessing health services only complicates the possibility of acquiring quality, nutrition-specific healthcare or education services. Furthermore, because cultural practices differ quite greatly from those in urban areas of Guatemala, indigenous populations tend to be discriminated against in health institutions, perpetuating distrust toward health care personnel by indigenous communities; instead, local women choose to see their traditional healer who may be uneducated on nutrition “best practices” (USAID, 2019).

Poor maternal health is another major risk factor for child malnutrition. Maternal undernutrition contributes to 800,000 neonatal deaths annually worldwide through small for gestational age births (Bhutta et al, 2013). Stunting, wasting, and nutrient deficiencies are estimated to underlie nearly 3.1 million child deaths annually (Bhutta et al, 2013). If mothers are deficient in micronutrients that their babies need to survive on both during gestation and after birth, their children consequently are born undernourished. If micronutrient supplementation, proper breastfeeding habits, or complementary nutrient-dense feeding are not implemented within the first 1,000 days of a child’s life, those children risk acquiring irreparable harm in their physical and cognitive development (Bhutta et al, 2013).

Education may be key in promoting healthy nutrition in indigenous communities; only 27% of mothers who are educated are malnourished, while 67% of uneducated mothers are (USAID, 2018). Mothers might benefit from nutrition education in particular, because many are unaware that only 51% of children ages 6-23 months receive the minimum acceptable diet (WHO, 2014-15). Vitamin and mineral deficiencies are considered to cause “hidden hunger,” or the phenomenon that a child may appear physically healthy to the naked eye, while deficiencies

in nutrients impact well-being internally (World Bank, 2011). Thus, it is entirely possible that some families may not recognize their child is malnourished; a lack of education in indigenous populations, particularly to young girls and mothers, may contribute to malnutrition in this way.

INTERVENTION BACKGROUND

Health Problem and Sequelae

Around 45% of deaths among children under five years of age are attributed to undernutrition (stunting and wasting). Stunting adversely affected an estimated 21.9% of children under five and wasting threatened the lives of an estimated 7.3% in the year 2018 (UNICEF et al, 2019). Guatemala has the sixth-highest rate of chronic malnutrition in the world; this is the number one highest rate in Latin America. Nearly 47% of children under five are stunting; in indigenous populations, this percentage jumps to nearly 70% (USAID, 2018). For children under two years-old, the consequences of undernutrition (including both stunting and wasting) can be irreparable and have far-reaching consequences that impede the overall development of the nation (WHO, 2016). Irreversible damage includes reductions in adult height (stunting), poor cognitive skills, lower levels of educational attainment, and reduced income (Ramirez et al, 2014).

Poverty is the general underlying cause of undernutrition in indigenous children under five in Guatemala. Despite Guatemala having the largest economy in Central America, two-thirds of the population lives on less than \$2/day (World Bank, 2017). The rate of poverty in indigenous populations in Guatemala is 79%, 40% of which live in extreme poverty (Gargiulo, 2017). Deprivation of resources and lack of coping mechanisms coupled with factors such as climate change, inadequate health care, exposure to communicable diseases, substandard housing and sanitation, limited education both generally and specific to nutrition practices, poor feeding and breastfeeding regimens, poor maternal health, physical and social segregation from

urban societies with urban resources, discrimination, and high fertility rates in adolescent populations each act to compound the effects of undernutrition on children under five (Ansuya et al, 2018; Black et al, 2013; Gargiulo, 2017; Imdad & Bhutta, 2012; Ramirez et al, 2014).

Deficiencies of essential vitamins and minerals are consequences of the above factors; if intervention does not occur within the first 1,000 days of a child's life, risk of irreparable harm in physical and cognitive development is substantial (The Lancet, 2013). The Lancet Maternal and Child Nutrition Series of 2013 properly and thoroughly describes both old and new interventions aimed at alleviating the impact of undernutrition in children worldwide. Their nutrition series features dozens of interventions that have been implemented since their last Maternal and Child Nutrition series in 2008; only critical studies are included in this review. The Lancet Maternal and Child Nutrition Series of 2013 makes the suggestion that for undernutrition to be properly addressed, "nutrition-specific packages of care" will need to be implemented (The Lancet, 2013). A brief discussion of what is included in those packages of care is provided here.

Summary of Interventions

Women of Reproductive Age and During Pregnancy

Folic acid supplementation during pregnancy is suggested to improve mean birth weight of neonates, with a 79% reduction in the incidence of megaloblastic anaemia (The Lancet, 2013) in the context of both developed and developing nations. Low birth weight is associated with nutrition deficits and an indicator for undernutrition; folic acid supplementation to the mother is also suggested to lessen the burden of low birth weight on undernutrition. The Lancet (2013) conducts this meta-analysis to clearly demonstrate how proximal factors of undernutrition in children are apparent in maternal health, and suggest that to ensure the health of a newborn baby, maternal health should be a priority. Addressing proximal factors like deficiencies in folic acid is quite narrow, however, and might miss addressing some critical

interactions that folic acid may induce once absorbed (if absorbed at all) that would impact the outcome.

Maternal supplementation with balanced energy protein has been shown to reduce the incidence of stillbirths and improve birth weight of neonates (Imdad & Bhutta, 2012). Imdad & Bhutta (2012) pooled data from 16 studies to show that balanced protein-energy supplementation has a positive impact on birth weight. The research was pulled from interventions done in England, USA, Gambia, Columbia, India, Iran, Burkina Faso, Chile, South Africa, and Scotland. The results showed that balanced energy protein supplementation increased birth weight by 73g and reduced risk of small for gestational age (SGA) births by 34%, with more pronounced effects in malnourished women (Imdad & Bhutta, 2012). The connection that Imdad & Bhutta (2012) made between nutritional status of women before and during pregnancy and the health status of neonates born thereafter supports the notion that maternal malnutrition is a key contributor to poor fetal growth, low birth weight, and infant morbidity and mortality particularly associated with undernutrition (p. 1). Even though two Latin American countries are included in the review, the results can not be assumed to be conclusive for indigenous populations in Guatemala. Both the Columbia study and the Chile study addressed underweight pregnant women from particularly poor areas, the context in which these studies were conducted is likely much different than the context indigenous women are living in in Guatemala, and thus, while the results are important for consideration in intervention implementation, they cannot be assumed to be replicated in indigenous regions in Guatemala.

Gestational hypertensive disorders are the second leading cause of maternal morbidity and mortality and are associated with increased risk of preterm birth and fetal growth restriction (Bhutta et al, 2013). Bhutta et al (2013) cite a Cochrane review of 13 trials which suggest that **calcium supplementation during pregnancy** in women at risk of low calcium intake can

reduce maternal hypertensive disorders and preterm birth; their pooled analysis of the 13 trials showed that calcium supplementation during pregnancy reduced gestational hypertension by 35%, pre-eclampsia by 55%, and preterm births by 24% (p. 455). This review was based on the observation that Mayan Indians in Guatemala, who traditionally soak their corn in lime before cooking, had a high calcium intake and low incidence of pre-eclampsia and eclampsia (Hofmeyr et al, 2014). Addressing gestational hypertensive disorders in pregnant women can have positive effects on newborn babies particularly in their weight and linear growth; both factors are highly associated with undernutrition. The limitation of the Cochrane review, however, is that it did not specify from what regions their experimental population came from. Women were selected for the study based on specific criteria of risk, not region of residence or existence of distal factors. While the data is important to consider in terms of how maternal health impacts infant and child health, the specific results might not replicate in indigenous Guatemalan populations today.

Provision of quality prenatal care has also been associated with positive outcomes in maternal and child nutrition (Ramirez et al, 2014). Poor fetal growth or stunting in the first two years of a child's life can cause irreversible damage; this is the problem that Ramirez and colleagues (2014) addressed in their study. Prenatal care programs typically identify high-risk mothers and include nutritional and educational interventions such as information and advice on food hygiene, diet, and lifestyle choice (Ramirez et al, 2014). The Lancet (2013) discusses the importance of nutritional and educational interventions for high-risk populations and their association with improved birth weight, an indicator for malnutrition; a strength of this study is the focus on improving child health through improving maternal health. Further, they indicated that prenatal care is strongly associated with a reduction in child stunting in Colombia and Peru, yet they had mixed results for mothers in Bolivia (Ramirez et al, 2014). Colombia was noted to

have better access to clean water, and to have a more urbanized infrastructure such that it leads to better quality of prenatal care in this context (Ramirez et al, 2014). The implications of this study are that the systems in which services are being administered are situated in larger structures that impede or enhance delivery of those services. For example, indigenous populations in Guatemala do not have *physical* access to quality health centers or to clean water sources due to isolation in society and geographically, and therefore prenatal care as an intervention in isolation would not suffice in addressing malnutrition in that context.

Interventions in Infants and Children

WHO recommends initiation of breastfeeding within 1 hour of birth, exclusive breastfeeding of infants until 6 months of age, and continued breastfeeding until 2 years of age or older (Bhutta et al, 2013). **Promotion of breastfeeding and supportive strategies** such as counselling and educational interventions have been shown to increase exclusive breastfeeding by 43% at day 1, 30% until 1 month, and by 90% from 1-5 months of age (Bhutta et al, 2013). Results are mixed as to how easily the practices are adopted in households and by caretakers, but the implication of these studies shows that consistent breastfeeding can have a positive impact on the health of the child. Limitations of this meta-analysis include the inability to assess effectiveness of breastfeeding and supportive strategies in preventing child malnutrition, because most studies used for analysis tested efficacy only (Bhutta et al, 2013). Another limitation is that the intervention population was global; specific regions of Guatemala where stunting is particularly prevalent may not be included in these studies or may not be properly represented and thus, the results must be applied through a lens of caution.

Hand-in-hand with promoting breastfeeding regimens is the **promotion of dietary and complementary feeding** for children ages 6-23 months (Ruel & Menon, 2002). Demographic

and Health Surveys (DHS) for 5 Latin American countries were used to explore the association between feeding practices and child height-for-age Z-scores (HAZ). The data show that timely introduction of safe and nutritionally rich foods in addition to breastfeeding at about 6 months of age until 23 months of age is positively associated with linear growth of children in 5 Latin American countries (Ruel & Menon, 2002). Ruel & Menon (2002) also draw an important conclusion that complementary feeding practices paired with breastfeeding regimens are even more important for children who: are of lower SES, are Ladino compared with indigenous origin, are older than 1 month of age, and whose mothers had primary schooling or higher than primary education. The limitations here, however, are that Demographic and Health Survey data from indigenous populations are likely not captured as often or accurately as that of populations living in urban areas with access to health facilities, which may mean that the importance of complementary feeding and consistent breastfeeding may be even more crucial for children of indigenous origin than suggested by this study.

Educational programs implemented in food insecure regions are also shown to reduce stunting and improve HAZ, but have virtually no effect on preterm birth rates (Imdad & Bhutta, 2012). Provision of complementary foods in the absence of education was not associated with significant gains in HAZ and therefore, was inconclusive as to whether or not stunting could be prevented through provision of complementary foods (Imdad & Bhutta, 2012). Again, though Imdad & Bhutta (2012) include two studies done in Latin American contexts (Columbia and Chile), the regional and social differences from these locations to that of Guatemala are inherently different and thus, there may be other competing factors involved that determine the efficacy of education programs in Guatemala that are not discussed in this review.

Multiple micronutrient supplementation in children has been shown to significantly decrease the incidence of anaemia in malnourished children, but only provides small benefits to

linear growth and weight gain (Soofi et al, 2013). Methods of multiple micronutrient supplementation tested in this study were micronutrient powders with and without zinc. Results showed that only small benefits to linear growth occurred after administration of micronutrient powders on a population of malnourished children ages 6 -18 months in Pakistan. Interestingly, Soofi et al (2013) showed that micronutrient powders with zinc significantly decreased the incidence of anaemia in their study population, but simultaneously increased the incidence of diarrhea. Diarrhea and other communicable diseases are significant factors that perpetuate the prevalence of undernutrition in children under five; this study urges the use of caution in implementing micronutrient powder regimens with populations living with high risk of diarrhea burdens. Though this intervention addresses the main consequence of undernutrition through supplementing deficiencies of essential vitamins and minerals, the study population is not similar to that of Guatemala. The social, political, and economic factors impacting each population are inherently unique to the location, and as such, these results cannot be assumed to be reproduced in indigenous Guatemalan children.

In cases of severe acute malnutrition, **ready-to-use therapeutic foods (RUTF)** are suggested to be effective in increasing rates of weight gain and recovery time for children under five (Bhutta et al, 2013; The Lancet, 2013). Trehen et al (2013) made an important discovery in their study on usage of RUTF in Malawi for children 6 to 59 months of age; children in this sequelae with severe acute malnutrition recovered faster and gained more weight when the addition of antibiotics to RUTF regimens was employed. The implications of this study suggest that external factors such as communicable diseases are factors that immediately impact nutritional recovery and mortality rate in young children, particularly in Malawi, a region considered to have a high prevalence of severe acute malnutrition. These studies support the usage of RUTF in treating undernutrition, but they do not explicitly tie the results to positive

outcomes on chronic malnutrition, which stunting is an indicator for. It has not yet been proven that RUTF regimens have long-term impacts on regional chronic malnutrition, though the evidence here supports its usage in the field for immediate impacts. Another limitation is that Guatemalan children are in contact with different types of bacteria and may receive a range of different infections in their early development separate from those in Malawi; context is critical in scaling up interventions on a global scale.

What Makes a Thorough Intervention

Based on the above meta-analyses and The Lancet Maternal and Child Nutrition 2013 Series, nutrition-specific packages of care are suggested to be the most impactful on undernutrition and stunting and are considered the most cost-effective (Bhutta et al, 2013; Imdad & Bhutta, 2012; The Lancet, 2013). Nutrition-specific packages of care include: optimum maternal nutrition during pregnancy, infant and young child malnutrition package (breastfeeding promotion, complementary feeding education and provision), and micronutrient supplementation and management of severe acute malnutrition. All interventions must be adopted with 90% coverage to show significant results (Bhutta et al, 2013). Therapeutic feeding for severe acute malnutrition followed by infant and young nutrition packages are suggested to save the most lives at 90% coverage (Bhutta et al, 2013; Imdad & Bhutta, 2012). Interventions when done in isolation have a significant impact on reducing child undernutrition, so the idea that pairing or compounding interventions simultaneously will further reduce negative impacts of undernutrition in children under five is compelling. However, most interventions included in this review pulled data from all over the world, meaning that to address stunting and undernutrition in indigenous regions in Guatemala, the evidence provided here can merely serve as a guide to “best practices” rather than a booklet of expected results.

ORGANIZATION

About CARE

CARE is a 501(c)(3) nonprofit charity organization whose mission is to “save lives, defeat poverty, and achieve social justice,” (CARE, 2019). Empowering women in the local communities in which they work is at the core of CARE’s approach in achieving its mission. CARE attempts to intervene in a variety of industries to alleviate poverty. However, CARE places women and children at the root of their served population(s) because it believes that poverty cannot be overcome until “all people have equal rights and opportunities,” and women and children have historically been excluded (CARE, 2019). In so doing, CARE strives to continuously provide services in empowering women and girls, responding to emergencies, fighting world hunger, improving access to health care, and granting access to quality education for young children and girls.

CARE is currently working in 93 countries around the globe and is simultaneously running and monitoring 950 programmes in line with its mission to save lives, defeat poverty, and achieve social justice. It has set a goal to reach 50 million poor and vulnerable people and increase their food and nutrition security and climate change resilience by 2020.

Organizational Strengths

CARE leverages many *established partnerships* to ensure the success of its programs, each uniquely tailored to the culture and population receiving the benefits of such programming. Among those partnerships include: USAID (sponsors of programming, specifically for women’s empowerment and health), Sall Family Foundation (focused on reducing the prevalence of anemia in women and children and reducing child stunting), Cargill (bolstering nutrition efforts through strengthening agriculture systems), Power of Nutrition (owners of a mandate to raise \$1 billion in new funding to support nutrition starting in 2018), and the Bill & Melinda Gates Foundation.

Other strengths include its tight *relationship to local and international research institutions*, to which CARE credits for their knowledge on “how to best end malnutrition,” (CARE, 2019). They specifically point to the Lancet nutrition interventions of 2013 as a major contributor to its program development. CARE offers direct links on their website to this research and more with which they use to develop all their programs. This level of *transparency* establishes *credibility* with donors, staff, and new audiences.

CARE also has the *operational ability* to place staff in 93 countries, making its services available to many; last year, CARE was able to reach 3.6 million children and their families and provide them with access to nutrition services and information. This is a major lift in the global effort to fight world hunger. CARE also has the ability to respond adequately and immediately to natural disasters and humanitarian emergencies.

Organizational Weaknesses

Due to the high number of programs CARE runs simultaneously, *resources* and *attention* to one particular area of development can be strained or minimal. *Donor requirements* for where their money goes and how it is spent can also impede CARE from focusing on any particular initiative at a single time. Global crises also divert attention and resources away from any particular program at a single time; for example, the refugee crisis and famine resulting from the Syrian War have grabbed much of CARE’s attention and resources the past few months, potentially impeding other programs from reaching its goals in a timely, efficient manner.

CARE also does not appear to partner with other global-health-specific organizations in other countries. For example, I could not find evidence on its website that it works with Ministries of Health in the countries in which CARE does work. This could be information that is not transparent to the public but is in fact reality, though the sharing of this information would only further give CARE credibility. Partnering with local governmental institutions would likely bolster

CARE's efforts in alleviating poverty through addressing the policies behind the systemic, endemic trends that enable poverty in the first place.

CARE for Child Malnutrition in Guatemala

CARE has an established presence in Guatemala and has held this position in the nation since 1959 (CARE, 2019). All programming CARE implements uses nutrition-sensitive approaches in order to establish a strong foundation for better nutrition for *all*. CARE makes eight (8) key program design recommendations for improving nutrition impacts that can be considered “nutrition-sensitive approaches”: Target the first 1,000 days of a child's life and women of reproductive age; design for highest impact through implementing nutrition-specific interventions in programs centering on nutrition; contribute to nutrition outcomes in all sectors, including food security, agriculture, climate change, and water & sanitation; promote gender equality; use existing community structures as platforms for improving nutrition; change social norms through community dialogue and engagement with influential actors; plan for emergencies; and prioritize sustainability through promoting community and government ownership of nutrition interventions and participatory M&E systems (CARE, 2019).

CARE is taking particularly special steps to reduce stunting in children in Guatemala. Reducing the prevalence of stunting would signal success on many fronts: food systems, health systems, education, WASH infrastructure, and safety nets (CARE, 2019). To do so, CARE is implementing a multi-disciplinary approach called the Collective Impact for Nutrition to address the immediate determinants of fetal and child nutrition and development. CARE focuses specifically on the first 1,000 days of a child's life, the period known by researchers as the most critical time for a child's development in which irreversible harm can be inflicted if proper development and nutrition is not ensured. CARE ensures that its service population receives not

only improved nutrition practices but also the necessary foundation for adopting them (CARE, 2019).

CONTEXT

There are many barriers in addressing the malnutrition crisis in Guatemala, specifically in indigenous Mayan regions where nearly 70% of children under five suffer grave consequences of stunting and undernutrition. Lack of funding to healthcare services goes hand-in-hand with lack of capacity in rural healthcare centers. The government allocates a mere 2.4% of its GDP to health, disproportionately affecting families in rural and indigenous communities (World Bank, 2017). Even if the government were to allocate more funding to healthcare and send more doctors into rural communities, a lack of communication training among healthcare providers is still evident in the discrimination that indigenous peoples experience through interpersonal relations with healthcare providers. This same discrimination bleeds into policy-making that prohibits indigenous medicinal practices in urban healthcare centers. Implementing inclusive policies to healthcare could potentially mitigate discrimination. However, a threat to enduring policy change lies in the political structure of government in Guatemala; presidents are required to serve only a singular term in office, prompting high rotation of government employees every four years (SDGF, 2012).

It is evident that the current climate for change in Guatemala is rife with challenges. These challenges exist in local regions of Totonicapán, Quiché, and Huehuetenango as well as in the national leadership; these regions of Guatemala exist within what is called the Western Highlands, known for its chain of volcanoes on the southern side and the high Cuchumatanes mountain range in the north. Between these landscapes lies miles of tropical forest at lower elevations and pine, cedar and oak forests in higher elevations. The higher elevations (typically where Mayan populations reside in) rely on maize and potatoes as their main sources of food in

the household, due to the land on which they have access to grow crops (Rough Guides, 2019), hence the reason that malnutrition and stunting tends to be so high in these regions.

Communities in these regions are faced with non-existent infrastructures, depleting families of electricity and cleaning water, worsening living conditions and enabling malnourishment to thrive. Physical separation from public life paired with the lacking infrastructure to handle disease allows communicable disease to plague populations, particularly vulnerable children (Loewenberg, 2009).

The proposed work attempts to mitigate the impact that physical and social separation have on these communities by addressing proximate factors to maternal and child health.

PROPOSED WORK

Maternal malnutrition is a key contributor to poor fetal growth, low birth weight, and infant morbidity and mortality in respects to undernutrition. Specific determinants for low birth weight in low- and middle-income countries include poor maternal nutritional status at conception, inadequate gestational weight gain due to poor dietary intake and short maternal stature due to mother's own childhood undernutrition (Imdad & Bhutta, 2012). To tackle child malnutrition at its first threat of inception would be to address the malnutrition in pregnant women and women of child-bearing age.

Maternal supplementation during pregnancy and reproductive age is considered an essential piece of the 'nutrition-specific' packages of care implied by The Lancet Maternal and Child Nutrition 2013 Series as being the most effective at 90% coverage (Bhutta et al, 2013; Imdad & Bhutta, 2012). The provision of balanced energy-protein supplementation has been identified as a critical intervention which has historically produced positive results in respect to increasing low birth weight in neonates. Imdad & Bhutta (2012) pooled 16 studies which showed improvement of birth weight of neonates with balanced energy protein supplementation to

mothers. The pooled results indicated a mean increase in birth weight by 73g and reduced risk for small for gestational age (SGA) births by 34%, with even more pronounced effects in malnourished women (mean birth weight differential = 100g) (Imdad & Bhutta, 2012).

Delivering higher quality prenatal care to indigenous women in Guatemala was another consideration for the proposed work based on extensive research which showed its importance in determining child health and malnutrition status (Ramirez et al, 2014). However, indigenous women in Guatemala face large barriers in receiving quality maternal healthcare including language barriers, physical isolation, discrimination, and a lack of resources and staff necessary to reach the desolate locations in which they live. Administering balanced protein-energy supplements to indigenous women will mitigate the negative impacts of not being able to access quality healthcare as well as protect their children from morbidity and mortality following birth without needing to overhaul the medical system in Guatemala at large which would be both costly and inefficient.

Proposed work: *Provide maternal supplementation with balanced energy protein to women and girls of reproductive age in indigenous regions in Guatemala. Regions in which the proposed work will take place are Totonicapán, Quiche, and Huehuetenango, where rates of chronic malnutrition reach a shocking 70% (USAID, 2018).* The following outlines the outcomes, indicators of success, and specific activities that will be implemented to achieve a reduction in child undernutrition in regions suffering the highest rates of chronic malnutrition in Guatemala.

Outcomes

All outcomes will be measured in Totonicapán, Quiche, and Huehuetenango.

- Increase accessibility to nutrition experts for women and girls of reproductive age suffering the worst impact(s) of chronic malnutrition.

- Increase awareness of health benefits of protein-energy supplementation during pregnancy.
- Increase birth weight of neonates to mitigate risk to disease and irreparable harm due to undernutrition at birth.
- Improve the overall health of women and girls of reproductive age.

Indicators of success

- Number of women reporting use of balanced protein-energy supplements.
- Birth weight of neonates.
- Maternal gestational weight.
- Height / length of newborns (to measure stunting)
- Prevalence of stunting and undernutrition in these regions after 2 years.
- Prevalence of maternal stunting and undernutrition in these regions after 2 years.

Activities

All activities will be implemented in Totonicapán, Quiche, and Huehuetenango.

- Provide balanced protein-energy supplements for pregnant women and girls of reproductive age *once a day for 2 years*.
- Educate the community of malnourished women about the benefits of supplementation.
- Educate husbands/family members of malnourished mothers about the benefits of supplementation.
- Ensure routine home visits for women of reproductive age in these communities through *monthly* visits (the frequency of visits will be reevaluated after the initiation of the intervention to determine how often this resource is needed by

women in the community). Providing home visits mitigates the challenges that local women have in accessing public health facilities for care.

- Collaborate with CARE to establish a firm, trustworthy presence in the community. Collaboration with CARE will include efforts to:
 - Ensure that full nutrition-specific care packages are adequately provided at 90% coverage as recommended by The Lancet Maternal and Child Nutrition 2013 Series.
 - Bolster efforts for maternal health care;
 - Ensure that children reach health birth weights *and* receive critical nutrition within the first 1,000 days of birth to further mitigate risks to morbidity and mortality due to external factors impacting malnutrition (i.e. insufficient diet post-birth and insufficient breastfeeding practices).
- Hire and train adequate community health workers (ideally local) to administer balanced protein-energy supplementation to communities and act as liaisons between CARE and indigenous women. The ideal number of community health workers who will be hired is five (5) per region, or fifteen (15) total. In order to determine the adequate number of staff required for project implementation, a qualitative pilot study will need to be implemented first. This pilot study will assess the current need for community health workers in each region, and the current resources available to each region as they pertain to the administration of health care services. Training will include topics on protein-energy supplementation practices for better maternal health and Mayan traditional practices and language(s) local to these regions in an effort to mitigate

discrimination and build trust between community health workers and local women.

Timeline

Within the first month, a qualitative pilot study will run to assess the current need for community health workers in Totonicapán, Quiche, and Huehuetenango. By month 4, the adequate number of community health workers (ideally local to Guatemala) will be hired and trained, as well as become familiar and affiliated with CARE and their existing operations in Guatemala. By month 6, staff will be sent to Totonicapán, Quiche, and Huehuetenango (ideally 5 per each location) to conduct home visits and introduce their presence in the community. Staff will need to be stationed in or near Totonicapán, Quiche, and Huehuetenango for the first month to establish trustworthy relationships with local women and their families and conduct education-based sessions about balanced protein-energy supplementation and their benefits. After a presence has been established in the community, approximately 1 month later, community health workers will provide protein-energy supplementation to all women of child-bearing age in packages that supply women with one-month's supply of the product.

After introducing the product to local women, community health workers will conduct home visits *once monthly* (pending community feedback about possible need for frequency to be higher) to provide the next month's supply and check-in with women about their adoption of the product into their daily lives.

After 2 years, the program will be reevaluated for efficacy and efficiency and holes in operations will be addressed appropriately through CARE. To create intergenerational impact, the project will need to have long-standing presence in the

community; therefore, it is ideal that the project extends beyond this initial 2 years pending evaluation at this time.

Monitoring and Evaluation

The main source of monitoring and evaluation will come from the home visits that are conducted by community health workers once monthly. *If the frequency of visits is deemed inadequate through community feedback, we are flexible to increasing visits.*

During home visits, community workers can assess qualitative and quantitative measures of success, including birth weight of neonates and maternal gestational weight. These measures will be evaluated *quarterly* and used to determine the efficacy and efficiency of the project in Totonicapán, Quiche, and Huehuetenango.

Assumptions

There are many assumptions that may determine the overall success of this project. Deserving the highest consideration is the assumption that women will adopt the supplementation regimen per-protocol and do not reject the product or working with our community health workers. Indigenous women have endured years of discrimination due to their traditional practices and language barriers, so the top-down approach we are taking by bringing outsiders into their community to conduct visits and provide education can easily be rejected by local women. To mitigate this risk, efforts will need to be made to make women feel that they have agency in their health and that of their children, as well as agency in how the regimen is delivered and what their current needs are in the home that may need to be addressed first before project implementation can occur. Another big assumption and possible challenge is that our indicators assume that no other external factors play a role in determining the outcome. For example, low birth weight can be caused by many other factors outside of maternal nutrition, but our work is

not addressing other concerns adequately; we are assuming that CARE is monitoring and evaluating other factors in this outcome through their current programming.

Other assumptions include: CARE has the capacity and ability to work with our team; we have permissions to enter Guatemala to do such work; we have physical access to Totonicapán, Quiche, and Huehuetenango or the means to provide the necessary transportation that our staff would require to reach these locations; the product will create similar results for women in Guatemala as was seen in other regions in Latin America, namely Colombia and Peru (Imdad & Bhutta, 2012); our efforts will be bolstered by the work CARE is already doing in Guatemala rather than competing with that work.

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