GLOBAL JOURNAL OF MEDICINE AND PUBLIC HEALTH

Assessing childhood malnutrition in Haiti: Meeting the United Nations Millennium Development Goal #4

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ABSTRACT

Background

The United Nations (UN) Millennium Developmental Goal #4 addresses needed reductions in childhood mortality. A major cause of death in Haitian children is malnutrition and starvation.

Objectives

Our primary objective was to identify population characteristics of children living in rural Haiti that may place them at higher risk of malnutrition than others. Armed with this knowledge, community health workers can recognize and attribute resources to those most in need. We will also examine the overall nutrition status in the population of interest and compare to the UN Millennium Goal statistics.

Study design

The study cohort consisted of 103 children under the age of 5 years, who were consecutively seen in a rural medical clinic from 4 communities in the Thomazeau region of Haiti over a 7-day time period. Families were asked the following five questions: (1) How many children do you have? (2) What is the birth order of this child (1st, 2nd, etc.)? (3) What is the distance between your house and clean water? (4) Do you obtain water for your family? (5) What was the highest grade you finished in school? The medical team recorded each child's gender, age, height, weight, household size, when the last meal was eaten, and last time protein was ingested. Nutritional status was assessed using World Health Organization growth standards. The data was then analyzed to determine each child's level of malnutrition as measured by weight-for-height Z-score (number of standard deviations [SD] below reference value), percentage of malnutrition for all children surveyed, and whether correlations existed between malnutrition level and number of siblings, household size, or location. Trends were defined as associations significant at $p<0.10$.

Results

The average age of the cohort was 2.1 years (range of 0-4 years). Average weight-for-height Z-score, number of siblings, and total number in the household were -0.29, 3.8, and 7.0, respectively. Eleven children (10.9%) were found be moderately malnourished (2-3 SD below normal Z-score) and an additional 5.9% were severely malnourished status (>3 SD below normal Z-score). Using a parsimonious multivariable regression model to compare family structure factors to anthropomorphic variables, multiparity was positively associated with Z-score ($p<0.05$), suggesting that later birth-order may be protective. There was also a significant difference in

GJMEDPH 2015; Vol. 4, issue 2

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Conflict of Interest—none

Funding—none

nutritional status among the 4 communities surveyed with the two that were the furthest (2-hour walk) having 10.9% and 12.9% of children malnourished.

Conclusion

In this cohort, malnutrition is prevalent in this region of rural Haiti. Children of new versus experienced mothers may have children at higher risk perhaps because new mothers are less knowledgeable and skilled at securing proper nutrition for their babies. Alternatively, more experienced mothers may simply have more resources. Additionally, distance from a medical clinic may prevent treatment for endemic parasites and other common illnesses compounding the effects of food shortage. Based on these findings, we can educate community health workers to focus attention and resources toward these at-risk families to prevent malnutrition and decrease child mortality thus progressing towards the UN Millennium Goal #4.

INTRODUCTION

The United Nations (UN) Millennium Developmental Goal #4 is to reduce childhood mortality among under-fives by two-thirds by 2015; a reduction by half has been achieved to date.[1] In 2012, 6.6 million deaths occurred in children under the age of five years. Most of these deaths were due to leading infectious diseases such as pneumonia, diarrhea and malaria, and, out of the children who died, many were already weakened by undernutrition. Undernutrition is a contributing factor in around one half of the under-five deaths worldwide, mainly in low-income countries where malnutrition and infectious diseases are highly concentrated and predominant among the poor.[2] Whereas malnutrition is specifically defined as nutrient imbalance, undernutrition is defined as not getting enough of a specific nutrient or of all nutrients in general. Haiti has one of the world populations experiencing chronic undernutrition, chronically not getting enough energy or food to eat, and this is a major cause of mortality in the country's children. Haiti, the poorest country in the western hemisphere, has some of the highest rates of childhood undernutrition (22%-25%) and protein malnutrition in the world: between 40% and 75% of children are reported to have some level of malnutrition.[3]

Malnutrition is a condition caused by a diet which is depleted of nutrients with the potential to cause numerous health problems. The nutrients that are depleted can by defined as macronutrients (carbohydrates, protein, and fat) or micronutrients (vitamins and minerals.) Depending on which type of nutrient that is deficient, different symptoms can develop. For example, when depleted of macronutrients (not getting enough to eat), the body responds by increasing the use of energy reserves such as muscle and fat which causes decreased growth leading to individuals that are shorter and/or thinner compared to those with adequate macronutrient intake. Three biometric ratio Z-scores are monitored by World Health Organization to facilitate making comparisons across samples -- height-for-age, with expected range of standard deviations of 1.10-1.30, weight-for-age (1.00-1.20), and weight-for-height (0.85-1.10).[4] In 2012, one fourth of children under the age of five years old were estimated to be stunted, meaning they had inadequate height for their age. Although this represents a significant decline from 1990 when 40% of young children were stunted, it still illustrates the detrimental effects malnutrition can pose for children. Micronutrient depletion, also known as "hidden hunger," occurs when essential vitamins and minerals are absent from the diet. The most common micronutrient deficiencies are iron, Vitamin A, and iodine deficiencies which can lead to anemia, blindness, and goiters. When an individual becomes extremely undernourished, this is referred to as starvation which can lead to decrease in height, poor energy levels, and down regulation of the immune system which then leads to more infections and problems with thermoregulation. Young children are more at risk for malnutrition because they do not have the large energy stores adults have during a period of reduced nutrient intake.[4,5]

The percentage of children under age five around the globe who are moderately to severely underweight has decreased from 27.5% in 1995 to 11.4% in 2012.[1] As a whole, however, children who lived in rural areas

were two times more likely to be underweight than children living in an urban setting, and the largest malnutrition gap between rural and urban children was found by the United Nations to be in the Caribbean and Latin America.[1] In these two locations, 8% of rural children under age five were severely malnourished, defined as at least three standard deviations (SD) below normal weight-for-height Z-score, and 34% were moderately malnourished (2-3 SD below normal Z-score), for a total of 42% undernourished. Since the nutritional status of children under age five is a surrogate marker for malnourishment in the population as a whole, the information from children under age five years may be utilized to draw conclusions about the population as a whole.

The United Nations research has concluded that populations most at risk for malnutrition are rural children and individuals with low incomes. Persons living in Thomazeau, Haiti meet these criteria. A study conducted by Victora and colleagues, analyzing growth-faltering patterns in 54 countries including Haiti, confirmed the association of low income with childhood growth stunting.[6] These investigators also indicated that the most opportune time to intervene and prevent undernutrition is when children are under the age of two years. The ultimate goal is to use these outcomes to better train and equip basic field community health workers to identify and intervene with children at increased risk for malnutrition. Past research in Haiti has indicated that utilizing a prevention model and providing food assistance to all children aged 6–23 months resulted in a 4%-6% decrease in stunting, wasting, and underweight measures when compared to the recuperative approach which only provided food assistance to underweight (weight-for-age Z scores <–2) children age 6–59 months.[7] If at-risk children can be identified before they become severely malnourished, health care workers can work to devote resources to those most in need and implement preventive strategies to combat child undernutrition. By doing this, children will avoid the permanent physical and mental consequences that malnutrition can cause. Against this background, this study set in rural Thomazeau, Haiti, focused on children under the age of five years and sought to identify characteristics that may predispose them to a higher risk of malnutrition.

METHODS

In order to perform this study, anthropometric information consisting of physical data and other factors was collected. Anthropometric information determines a child's nutritional status by comparison with a normative mean and thus determines the prevalence of malnutrition in the surveyed sample. Acute and chronic malnutrition were quantified using the anthropometric tools of three Z-scores described below. Population-based nutrition indicators were then used to assess, prioritize, and target at-risk individuals in the community. The data was prospectively collected by the regional medical clinic as part of a medical outreach initiative; this retrospective data analysis was approved by the Texas A & M University Institutional Review Board.

The study cohort consists of 103 children under the age of 5 years, who were consecutively seen in a rural medical clinic serving 4 communities in the Thomazeau region of Haiti over a 7 day time period. With the help of a Creole translator, the following five questions were asked of each individual child's mother or primary caregiver while they were in the clinic waiting area:

1) How many children do you have?
2) What is the birth order of this child (1st, 2nd, etc.)?
3) What is the distance between your house and clean water?
4) Do you obtain water for your family?
5) What was the highest grade you finished in school?

In addition to answers from the preceding questions, the following patient demographic information was recorded about each child: name, age, gender, height, weight, the number of people in their home (household size), the last time the child ate a meal, the last time protein was ingested, the time required to walk from their house to get water, and the child's current grade level in school.

To maintain confidentiality, each child under the age of five was assigned a meaningless ID number for data collection purposes. Considered the best way to assess child malnutrition the World Health Organization growth standards were used to determine each child's Z-scores or standard deviations from the normative mean growth index of weight-for-height. A Z-score below -3 is considered severely malnourished, a Z-score between -3 and -2 is considered moderately malnourished, and a Z-score between -2 and +2 was considered adequately nourished (Defining and Measuring Malnutrition).[8] The data was then analyzed to determine overall percentage of malnutrition among all children surveyed, and correlations between level of malnutrition, number of siblings, number of people in the home, and where the child lived. We defined "trends" as associations significant at p<.10 rather than applying the standard alpha criterion of p<.05. We tolerate a higher risk of Type I error, or the chance of erroneous rejection of a true null hypothesis (hypothesis of no association), when the stakes are high, as with child malnutrition, and the sample size is modest. In this kind of investigation, identifying mutable factors is of paramount importance.

RESULTS

In this cohort study, the average age of the children was 2.1 years with a range of 0 to 4 years; 52% were girls. One third (35%) of children had their last meal more than one day ago. Per mother's report, water was more than 1 hour away for 17%, the baby was their first (63%), and they had had no protein to eat in more than a day (50%). The average Z-score was -0.49 with a standard deviation (SD) of 1.24 and a range from -4.04 to +2.94 (median, -0.55). The average number of children per household was 2.3 (SD 2.0; range 1-11). The total number of people living in each home averaged 7.0 persons (SD 2.6; range 1-16). Eleven of the 103 children under age five years (10.9%) were found to be moderately malnourished and 6 (5.9%) were in a severely malnourished state. In the multivariable regression model on weight-for-height Z-score, only parity was found to be significantly associated with malnutrition from among the questions answered by families (see Table 1).

Table 1 Factors Associated with height-for-Weight Z-Score among 103 Children under Age 5 in Rural Haiti

Factor	Regression Coefficient	
Age	-0.06	0.61
Female	-0.53	0.10
Parity	0.22	0.05
Temperature: low	-0.05	0.91
Last meal at least 1 day ago	-0.0001	1.00
Last protein at least 1 day ago	-0.06	0.89
Water at least 1 hour away	-0.71	0.13

There was also a significant difference in nutritional status across the four communities which were included in this survey. The community served by the clinic was determined by day of the week as the clinic transports persons from the neighboring villages. The two communities with a longer commute of two hours to the nearest healthcare facility had 10.9% and 12.9%, respectively, of children found to be malnourished. Further analyses showed that the group who had to travel the furthest had 17.7% (6/34) of children being severely malnourished and 14.1% moderately malnourished. In contrast, a group which was located closer to the clinic did not have any children that were severely malnourished and only 10.7% (3/28) were moderately malnourished. In summary, in one region, as many as one in three children living in outlying areas were malnourished

while the community in closer proximity to healthcare services had only one in ten children being malnourished.

DISCUSSION

Malnutrition is a serious threat in many regions of Haiti and especially for children under five years of age.[9] Malnutrition contributes not only to poor cognitive development in children but also to lower earning capacity in adulthood.[6] Previous projects have worked to increase income in poorer communities, so family earners could provide sufficient nutrition for their families. However, now the primary focus takes a holistic approach, working to improve nutrition in order to improve the health of the community and thus reduce poverty. When children are severely malnourished in their early formative years, the effects on development and cognition may be non-reversible and thus, have long-lasting effects on the community as a whole. Although at the current time, malnutrition is widespread across Haiti for many reasons related to infrastructure and geography, if we can determine which children in this region are most at risk and intervene with them, we can optimistically safeguard them from long-term consequences of malnutrition and starvation.

Childhood undernutrition remains one of the biggest public health challenges today. Poor fetal growth or stunting in the first 2 years of life leads to irreversible damage, including shorter adult height, lower attained schooling, reduced adult income, and decreased offspring birth weight.[6] The findings of this cross-sectional study support the concept that community workers in rural regions should be employed and should focus on areas that are at risk of having a higher percentage of malnourished children.[10] The large differences in malnourished populations could also be a result of a rural verses urban setting. The more isolated and distant rural communities could be especially overextended for resources leading to a shortage of food to feed the entire population. Within these areas, community workers might need to concentrate attention and resources on mothers having their first child in order to prevent children from becoming malnourished.

So, why are so many more children malnourished in rural Haiti than in the cities of Haiti, Latin America, or the rest of Caribbean? One reason could be the contrast in income between rural and urban areas, which is especially notable in Haiti. The Gini index is a tool that measures the distribution of income (or, in some cases, consuming expenditure) among households within an economy. The Gini coefficient ranges from 0, which is perfect equality, to 1 which is the most possible uneven distribution.11 The Gini coefficient for Haiti rose to 0.61 in 2012, making Haiti a country that had one of the most unequal distributions of wealth in the world. Small farmers, who live in rural areas, have been reported to be among the poorest because of their size of operation, low production, and lack of assets or access to credit. The incidence of extreme poverty in Haiti is 37.8% in rural communities and 8.8% in urban areas.[12] We suspect this contrast contributes to the stark difference in malnutrition rates for children under 5 years in rural versus non-rural Haiti, and also relative to the Caribbean and Latin America together.

As shown in this cohort, malnutrition in young children is unacceptably prevalent in this region of rural Haiti, affecting 16.8%. In our sample of 103 rural under-fives, we found that children of new mothers were more likely to be malnourished than children of experienced mothers. This finding suggests that mothers with more children may provide protection against malnutrition due to experience or access to resources, or that new mothers are more at risk for having malnourished children for other reasons. New mothers may be less skilled at securing proper nutrition for their babies and have less social power to bargain for scarce resources. Primiparas should be targeted for education and assistance in obtaining proper nourishment for their babies.

In Haiti, women are the primary caregivers and ultimately responsible for their child's health and nutrition. Consequently, a mother's autonomy and control of resources influences child care and nutrition outcomes favorably. It has been found that mothers who have more autonomy are more likely to have children who are less malnourished.[13-15] These findings show that in Haiti, several measures of women's empowerment are significantly associated

with child growth outcomes. Empowerment includes education and skill sets. Attention should, therefore, be given to these measures when planning and implementing child nutrition programs as well as when seeking the participation of women in those programs. More complex analyses are needed to show the actual magnitude of the effect of women's empowerment on child growth outcomes. In addition, the concepts of empowerment are sometimes difficult to capture in survey data, and thus caution is warranted in interpreting.

In addition, since our data demonstrated that the communities more than two hours distant to medical care had a higher percentage of children with malnourishment, it may be surmised that distance to adequate healthcare may play a significant role in children who are at risk. A possibility as to why this exists is that long distances from a medical clinic may prohibit treatment for treatable illnesses such as endemic parasites and other common illnesses that may lead to malabsorption, diarrheal illnesses, and additional weight loss. Perhaps if more health care services were brought to rural areas, the incidence of treatable illnesses that contribute to malnutrition would decrease. Another reason may be the remoteness of these communities with little access to proper resources to provide amongst their community.

Utilizing the information from this study, further investigation can be done to assess strategies that may impact communities that are further away from healthcare. One way to do so is through educational processes. By educating community members about not only about issues with nutrition but also about other problems faced by the community, members can take an active part in improving the social root causes that contribute to child under nutrition.[16] Research conducted by Havemann et al. implemented a community nutrition program in Kenya which utilized the Participatory Learning and Action process.10 By increasing awareness and developing multi-sectoral teams for various issues in the community, members were able to use dialogue social cohesion to achieve for themselves rather than depending on hand-outs such as food or money. After a three year follow-up, communities without intervention had similar levels of underweight and stunting at baseline and after 3 years. However, communities who had received interventions, showed significant improvements after 3 years in the levels of underweight children. Implementation of this type of program may also prove to be beneficial in the rural communities of Haiti to decrease the prevalence of malnutrition in children.

CONCLUSION

We can educate community health workers to focus attention and resources on first-time mothers as well as families that live further away from health care clinics. By doing so in the most rural areas of Haiti, we can progress towards prevention of malnutrition and decrease child mortality as part of global efforts to achieve the UN Millennium Goal #4.

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