COMBATTING CHILD MALNUTRITION: HOW EFFECTIVE ARE NUTRITIONAL TREATMENTS IN EASTERN DRC?[1]

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ABSTRACT

Sub-Saharan Africa is the second most undernourished region in the world, with an estimated 265 million people in 2009. The Democratic Republic of the Congo (DRC) has the highest percentage of undernourished people in the region, 75% from 2004 to 2006. Lack of infrastructure, organization and security routinely obstruct data collection in this reported region of the world but this study successfully utilized local institutions to overcome many of these obstacles. This report details and explains one possible solution to child malnutrition in the Eastern DRC, specifically in the town of Butembo in the North Kivu region. The Georgio Cerruto Therapeutic Nutrition Center at the Université Catholique du Graben in Butembo offers a nutritional therapy treatment that attempts to combat moderate and severe forms of malnutrition. Our team has evaluated this clinical treatment and compared it with control data from a sample collected in a rural area outside of Butembo. Utilizing an Average Treated on the Treated (ATT) method in a post-treatment research design, our data offers significant insights into the effectiveness of these nutritional treatments and the broader prevalence of child malnutrition compared to local and global standards. Our findings are some of the first to come from this of this part of the country, ultimately increasing the research capacity in the DRC.

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1. BACKGROUND

The Democratic Republic of the Congo (DRC) is located in Central Africa and is the second largest nation on the continent after Algeria. With fewer than twenty-five miles of coastline, the DRC is a nearly landlocked country with a tropical climate.[3] The DRC is endowed with natural resources, including copper, cobalt, gold, and diamonds; however, the country has continued to have a weak economy and one of the lowest Human Development Index (HDI)[4] rankings in the world.[5]

Conflict and civil war experienced in the DRC since it gained independence in 1960 have triggered poor performance in areas of health, education, and living standards.[6] Not only did the Congolese suffer from internal conflicts, strife from neighboring countries from the east, specifically Rwanda and Uganda, spilled into the DRC in the 1990s. Renegade elements of these conflicts remain to this day in the DRC's eastern region of North Kivu. Prior to the Rwandan genocide, rebel forces occupied eastern DRC and following the genocide, Rwandan forces and hundreds of thousands of refugees entered the country. This further increased the likelihood of small-arms conflict in the North Kivu region.[7]

Amidst decades of fighting in North Kivu, Butembo, a city 1,480 kilometers from the capital of Kinshasa, has experienced substantially less conflict than neighboring cities. The roughly 700,000 Congolese now living under Butembo's relative security often attribute their safety to Butembo's economy. The local economy is based on trade rather than direct mineral extraction that is easily exploited by use of force.[8] Though Butembo's weak public infrastructure lacks central power generation, a functioning post office, or a single paved road, Butembo's standard of living benefits from a public water utility and a number of privately funded universities and hospitals. Today, a small United Nations post and a detachment of the Congolese military, Forces Armées de la République Démocratique du Congo (FARDC), provide Butembo with a level of security that is uncommon in a majority of North Kivu. However, this security is far from complete as theft, kidnapping, assault, and murder remain pressing concerns that discourage many NGOs from establishing a presence on the ground in the region.

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[3] CIA 2014.
[4] HDI is a composite index that measures a country's achievement based on three factors: health, knowledge, and standard of living. DRC has an index of 0.304 and is, therefore, ranked 186 of 186. This score leaves DRC tied with Niger as the worst performer.
[5] UNDP 2013.
[6] BBC 2014.
[7] CIA 2014.
[8] IRIN 2004.

2. LITERATURE

Malnutrition is arguably the number one risk to health worldwide as it threatens the well being of more than two billion people in the world today.[9] According the World Food Programme's Hunger Glossary, malnutrition is defined as:

> "A state in which the physical function of an individual is impaired to the point where he or she can no longer maintain natural bodily capacities such as growth, pregnancy, lactation, learning abilities, physical work and resisting and recovering from disease."[10]

Around the globe, malnutrition is an underlying cause in one-third of all child deaths, a total of 2.6 million children a year. For those who do survive, one of every four children throughout the world suffers from "stunting," a condition where their bodies do not fully develop as a result of chronic malnutrition and nutritional deficiencies.[11]

There are several ways to measure malnutrition. First, undernourishment can be evaluated using the minimum dietary energy requirement (MDER), which is a weighted average of energy requirements for different groups of the population based on age and gender. Second, the Global Hunger Index (GHI) is a country ranking that incorporates three indicators, 1) the percentage of the population that is undernourished, 2) the prevalence of underweight children under the age of five, and 3) the mortality rate of children under the age of five.[12] And third, anthropometric measures assess child growth, weight, and Body Mass Index (BMI).[13]

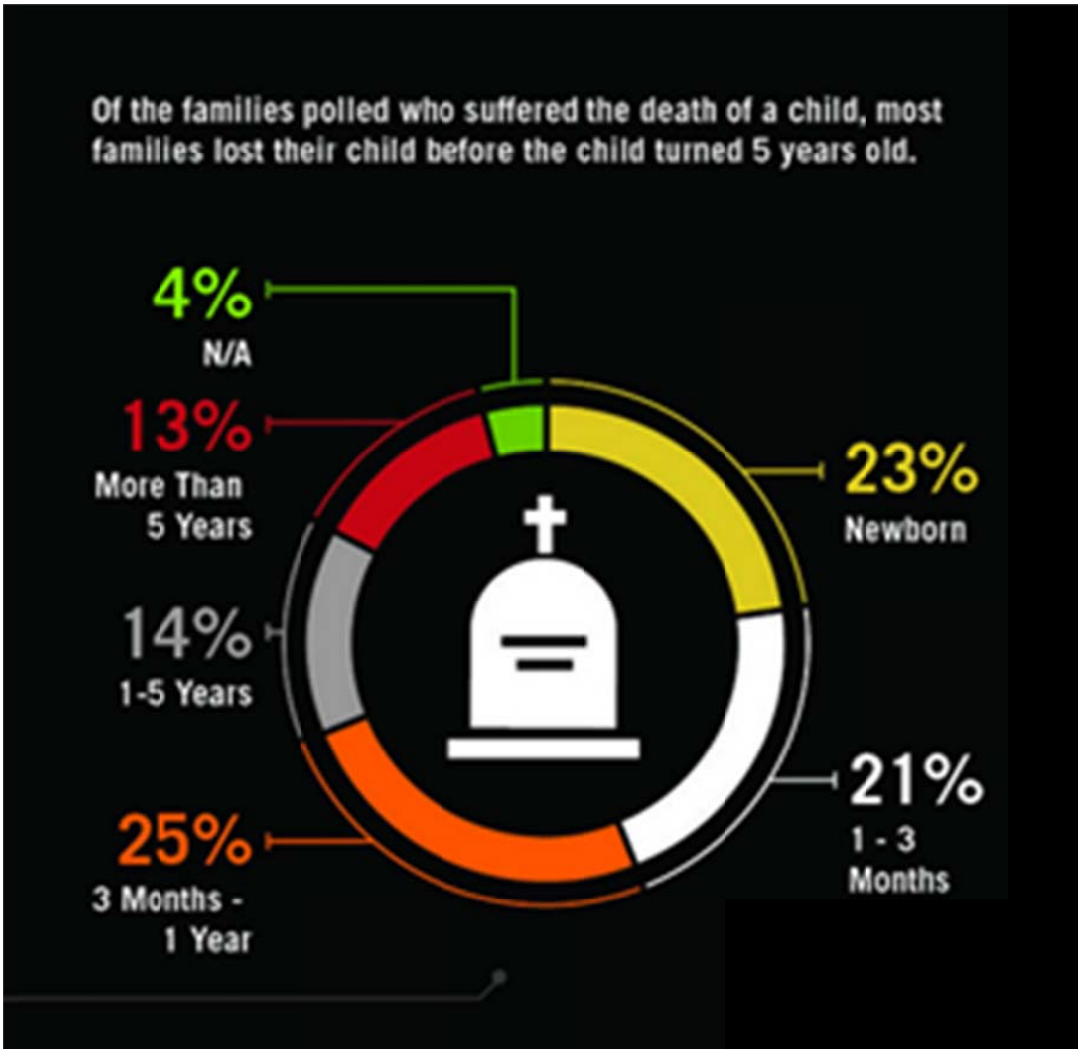
Using these health measurements and others, researchers have shown that the Democratic Republic of Congo has extremely high levels of malnutrition.[14] Given that a healthy average MDER is 1,750 calories, seventy-five percent of the Congolese population was undernourished for the 2004 to 2006 study.[15] As of 2007, 28.2% of all Congolese children under the age of five were shown to be underweight. From 1990 to 2009, the GHI score for the DRC increased by fifty-three percent[16], which is indicative of a strong correlation with national instability.[17]

According to the CIA's World Factbook, the average Congolese woman has 4.8 children while the maternal mortality rate is 540 deaths for every 100,000 live births.[18] The DRC ranks

[9] IFAD/FAO/WFP 2011.
[10] WFP 2014.
[11] IFAD/FAO/WFP 2011.
[12] IFPRI 2013.
[13] Pfingu and Meyers 2010.
[14] USAID IHP 2011.
[15] Pfingu and Meyers 2010.
[16] GHI scores should be as small as possible. Other developing countries, including Brazil, Saudi Arabia, and Vietnam, have reduced their GHI scores by fifty percent or more since 1990 (Pfingu and Meyers 2010).
[17] Pfingu and Meyers 2010.
[18] CIA 2014.

twelfth of 224 countries with regards to infant mortality with 73.15 deaths for every 1,000 live births[19] while its under-five mortality ranking is fifth of 194 nations with 146 deaths per 1,000 children.[20] The Eastern Congo Initiative (ECI), an American based grant-making and advocacy organization, conducted a survey that showed that of those Congolese children who die before age five, 69% are younger than one-year-old.[21] These results can be seen in Figure 1 below. These health indicators suggest that Congolese children, particularly infants, are extremely vulnerable to malnutrition and mortality.

Figure 1: Age of Death for Children for Under-Five Mortality in DRC



[19] CIA 2014.
[20] UNICEF 2014.
[21] ECI 2014.

3. METHODOLOGY

3.1 Research Questions

Our research was primarily concerned with gaining information on the effectiveness of the Giorgio Cerruto Therapeutic Nutrition Center – hereafter referred to as simply "clinic" – in battling malnutrition in the area. We designed our research to answer two main questions: 1) What is the prevalence of child malnutrition in the Bunyuka Parish? and 2) Does clinical treatment positively affect the nutritional status of children?

The first question was of special interest to the Bunyuka Parish, one of our partners in the control study. Bunyuka is a much smaller rural community located twelve kilometers outside of Butembo. Buyuka is known for its small woodworking shop established by missionaries over seventy-five years ago. Bunyuka has no central water or electricity, but does have two small clinics and a few electrical generators that supply power to a small number of the local population. Unlike Butembo, many residents of Bunyuka do not speak French and solely rely on tribal language, Nandi, and a local dialect of Swahili. Bunyuka is noticeably more impoverished than Butembo. We chose the largest church in this area, Bunyuka Parish as the preferred target for our control survey. Following our trip, we produced a report for our partners at the Parish based solely on data analysis from the control group.

The second question addresses the more specific effects of the Cerruto clinic on malnourished children. To answer this question, we surveyed a sample of former patients from the clinic and measured indicators for their current health status. By measuring the general level of malnutrition in the area through Bunyuka Parish, we were able to determine the average treatment effect for those children who actually went through therapy at the Cerruto clinic (i.e. Average Treatment Effect on the Treated [ATT]). The clinic offers a twenty-one day nutritional therapy treatment and sees an average of fifty cases each month. It has many stakeholders invested in its success, including the Giorgio Cerruto Foundation and the Université Catholique du Graben (UCG). In order to evaluate the effect of the clinic, we administered a field survey to assess the condition of malnutrition in the area.

3.2 Ethical Considerations

When dealing with the health of a family there is a level of precaution that must be considered to mitigate the effects of addressing sensitive topics. This is especially true where malnutrition is life threatening and prevalent, as it is in eastern DRC. Our study required months of pre-planning with Congolese advisors on the sensitivity of talking about malnutrition. We learned that people were able and willing to talk about their nutritional status and that they were open and surprisingly truthful about the extent of malnutrition within their families. This observation is supported by prior studies, as other organizations such as the Demographics and Health Surveys have conducted extensive surveying of the area and asked many questions that

might be considered inappropriate within the American context.[22] The implementation of our surveys proved this to be true as we received full and truthful survey responses from over 900 families in both our treated and untreated samples.

4. SURVEY IMPLEMENTATION AND LOGISTICS

4.1 Research Design

In December of 2013, four students from the George Bush School of Government and Public Service at Texas A&M University were assigned to one of the United States Agency for International Development's (USAID) newest initiatives: the Higher Education Solutions Network; more specifically the Conflict and Development Lab at Texas A&M University. For a graduate capstone project, these students were chosen to serve the interests and wishes of the Conflict and Development Lab (ConDev) as research consultants in the DRC. In six short months, the group of students had successfully planned, developed, and implemented two surveys; in order to collect and analyze unique data to offer insights for our client, ConDev.

Per our research questions stated above, our team decided to implement two research designs for our study involving child health. Our primary method of field research included various forms of survey methodology. First, we implemented a control study analyzing the prevalence of malnutrition in Bunyuka, DRC. These findings were compared against World Health Organization (WHO) global standards as a baseline. Second, we implemented an Average Treatment Effect on the Treated (ATT) in our treatment group, those that went through the clinic's nutritional therapy treatment. Comparatively, our team analyzed, through two primary indicators of child health, weight-for-age and height-for-age, whether there were differences in these indicators between our treated and untreated samples. Important to note, however, is that our ATT effect lies in a post-treatment design. We are working to retrieve pre-treatment data for our treated sample in order to comprehensively assess and before and after treatment effect.

4.2 Pre-Survey

One of the greatest strengths of our research was the ability to field test and restructure our final survey through a preliminary survey. Utilizing the local resources of Mr. Gavin Finnegan and the clinic and UCG's administrators and students, our pre-survey was administered to a number of mothers and Butembo residents. In addition, in preparation for our main survey implementation later that month, Mr. Finnegan trained enumerators to look for various research biases. All enumerators were literate and educated and they were all members of the same communities as our eventual respondents.

This pre-survey, as you can see in Figure 2, was vital to reforming our main survey instrument, in both content and formatting. Several questions related to income, power, and

[22] EDS-DRC 2007.

social well-being measurements were in need of reform following the pre-survey. Through this pre-survey, we learned that certain phrasing, order, and structure of our questions needed to be revised in order to achieve optimal results. For example, one of our questions asked about electricity in a household as a measure of wealth. Other reports and research groups had used this as a good indicator for wealth in informal economies; however, in the context of Butembo and the people we were surveying, electricity was not something attainable nor was it widely used.

Figure 2: Pre-Survey in Butembo

Overall, our surveys were between twenty and twenty-five questions, varying by treatment or control survey, and required approximately fifteen minutes to complete. Also, our team utilized several forms of health charts in order to record the physical characteristics and measurements of each member of the family present, both in treatment and control.

4.3 Personnel

In addition to the strengths provided by our pre-survey, another strength of our research was the support and logistical capabilities of the team's local resources, both in the US and in the DRC. At ConDev, experts in the fields of communication, health, agriculture, econometrics, and

statistics added tremendous assistance to our project, specifically in the data analysis and reporting aspects of our project. In the DRC, Finnegan was able to establish a network of trustworthy and capable personnel to implement our surveys and receive approval from the proper authorities. We joined with local radio broadcasters, teachers, health officials, and public administrators in order to get around Butembo and the DRC at large most efficiently. These partners also allowed the team flexibility to change or reform the project's logistics if necessary. Finally, the backbone and background roles of our project were filled by a number of UCG graduate students. These students were responsible for implementing our main survey, measuring families during survey days, and collecting and inputting data later in our trip. These students were the most important personnel of the project and in the future there is space for potential collaboration on additional research projects, specifically in the fields of agriculture and clean energy.

4.4 Control Survey

Of the project's ten-day trip to Butembo, the control survey was implemented at Bunyuka Parish on the second day of our stay in the DRC. From the direction of Finnegan and personnel mentioned above, the Bunyuka Parish was chosen as the site for our control study. Bunyuka was chosen for three specific reasons. First, the church staff, specifically the head priest, Father John Belongo, encourages the implementation of better nutrition practices and better sources of protein around Bunyuka. Our team chose Bunyuka in order to support the church's goals and provide nuanced information as to the community's nutrition situation. Second, the physical grounds of Bunyuka Parish were adequate for a large control study such as ours. Due to the large amount of respondents, the physical grounds produced enough space to accommodate our sample. Third, and most importantly, as a clinical trial, Bunyuka was far enough from Butembo to prevent any spillover between treatment and control. However, we also chose an area outside of Butembo where clinical and pharmaceutical treatment is still widely available. In our control sample, less than five percent of respondents had attended the UCG clinic.

Two weeks prior to the implementation of the survey, Finnegan delivered announcements at the end of each mass to encourage parishioners to invite their family and friends to attend the survey. He also worked with Belongo to provide written invitation to a local Seventh Day Adventist congregation.

In a single Sunday, more than 700 families and over 2,250 women and children were surveyed and measured from the congregation, creating a large sample from our target population. Our team organized the survey process during the first mass of the morning. We established a particular route for mothers and children to travel throughout the church grounds to reach our survey stations. Respondents were handed surveys at the end of mass and advised to walk to the first station. Prior to entering the line, mothers were instructed to give their older children "tags" (numbered and perforated pieces of the survey) while still keeping their main survey document. Tags were used as a way to later match each child's measurements with their

mother's survey in the event they participated separately. This procedure allowed our team to analyze nutrition at the household, rather than just individual level.

Figure 3: Survey at Bunyuka Parish

Mothers that randomly received the survey at the end of the church service were asked to visit three stations. At the first station they completed the nutrition survey, answering questions pertaining to the family's health (the line of participants in the middle-left of Figure 3 above). Finnegan recruited and trained sixty enumerators, mostly women from the Parish, to administer the survey. The second station performed measurements (the line of participants in the bottom left of Figure 3 above). Mothers completed a brief health chart of questions at this station (sex, age, education level, and observable signs of edema and kwashiorkor). Each member of every family was measured for height and weight. After taking measurements, mothers were given a second tag, in exchange for the original survey and chart. The second tag served as entrance into the third and final phase of the survey. The third station provided participants with a free one-kilogram bag of uncooked soya beans for their household. Soya served as our most direct form of incentive to complete the survey. UCG medical staff and the local clergy member identified soya as a nutritious source of protein. Soya was a direct incentive for completing the survey process and, perhaps more importantly, it is a treatment for kwashiorkor. Increasing soya adoption is a goal of the church administration and the UCG doctors, so implementation of our surveys offered the opportunity to benefit the population by introducing a staple crop that would improve the health of the community.

4.5 Treatment Survey

Five days after our control survey, our team implemented the treatment survey at the UCG clinic. During those five days, the existing UCG network of community representatives was used to recruit children and families that previously received treatment at the clinic. UCG already uses representatives to monitor and locate malnourished children for immediate treatment. Our team utilized this network for recruitment into our treatment research.

Our treatment survey was nearly identical to that of our control with several additions. We measured families and children using the same instruments and indicators for health and noted similar aspects of trust and compliance as with the control respondents in Bunyuka. As in Bunyuka, a meal was given to respondents after the survey as added incentive to complete the process. Overall, 215 families were surveyed and 351 children were measured. This sample had significantly fewer participants than our control sample, however, this is not a weakness of our project. The treatment size is still large given the history of the clinic and the capacity to recruit previously treated children and it allows for an adequate comparison to our control sample. Figure 4 below offers a glimpse into the treatment survey process. The available space at the clinic was significantly smaller than at our control site; however, the facilities offered adequate space for implementation and logistical compliance. Survey respondents are seen taking the survey on the left of the figure while children are being measured on the right side of the figure.

Figure 4: Survey at UCG Clinic

5. CONTROL SURVEY RESULTS

This next section discusses the findings analyzed from our control sample only. These figures only apply to the Bunyuka Parish and will be used as control against our treatment sample later in the report. These findings include: the prevalence of kwashiorkor and edema, self-reported nutritional statuses, a comparison to World Health Organization (WHO) standards, and emphases on gender, education, and dietary habits/preferences.

5.1 Kwashiorkor and Edema

After respondents completed the main survey instrument they were asked to complete a small health chart, primarily for measurements of height and weight. In addition to being measured for height and weight, each member of each family was observed for two particular health conditions: the presence of edema and kwashiorkor. Both indicators of malnutrition can be observed through conducting a push test and noting an abnormality in hair color.

Table 1: Whether children show signs of edema and/or hair discoloration.

	Hair Discoloration		
Edema	No	Yes	Total
No	941	156	1,097
Yes	118	241	359
Total	1,059	397	1,456

Note: Sample = 1,456.

Table 1 shows prevalence of edema and indicators of kwashiorkor. Mr. Blaise Pascal Furaha, a medical intern at the Cerruto clinic at UCG, trained enumerators to identify signs of edema and kwashiorkor. Edema was measured using a push test on the lower leg. Hair discoloration is a possible sign of kwashiorkor therefore enumerators were taught to take note of it as well. In terms of prevalence, we have almost 2,000 observations for edema and hair color. Specifically, 13.4% of children under the age of sixteen exhibited both edema and indicators of kwashiorkor. People with either edema or indicators of kwashiorkor were 9% and 9.3% respectively. The more interesting finding is that almost one-third (31.8%) of children had at least one or both indicators of severe malnutrition. This finding is alarming because every third child from our sample showed signs of edema and/or kwashiorkor.

5.2 Self-Reported Nutritional Status

Table 1: Mothers' self-report of nutritional status of their children.

Nutritional Status of Children	Percent
Excellent	2.73
Satisfactory	11.93
Below Satisfactory	22.27
Very Bad	63.07
Total	100.00

Note: Sample = 700.

Table 2 presents evidence and legitimacy for Belongo's concern about the nutritional status of his congregation: 63% of mothers believe their family nutritional status is "very bad." More broadly, 85% of families believe their children have insufficient nutrition ("below satisfactory" and "very bad" combined).

5.3 WHO Standards

As mentioned above, there is currently no comparative data on child health in Butembo or the surrounding areas; thus Figures 5 through 8 show a comparison with data from the World Health Organization's (WHO) Child Growth Standards.[23] These figures, disaggregated by gender, compare Bunyuka Parish children to an average healthy child (established by WHO) and measure the average child's weight-for-age (WFA) and height-for-age (HFA). Our sample disaggregates children's health in quartiles (25th, 50th, 75th).

[23] WHO Multicentre Growth Reference Study Group 2006.

Figure 5: WHO and Bunyuka Comparison of Weight for Age Median Outcomes

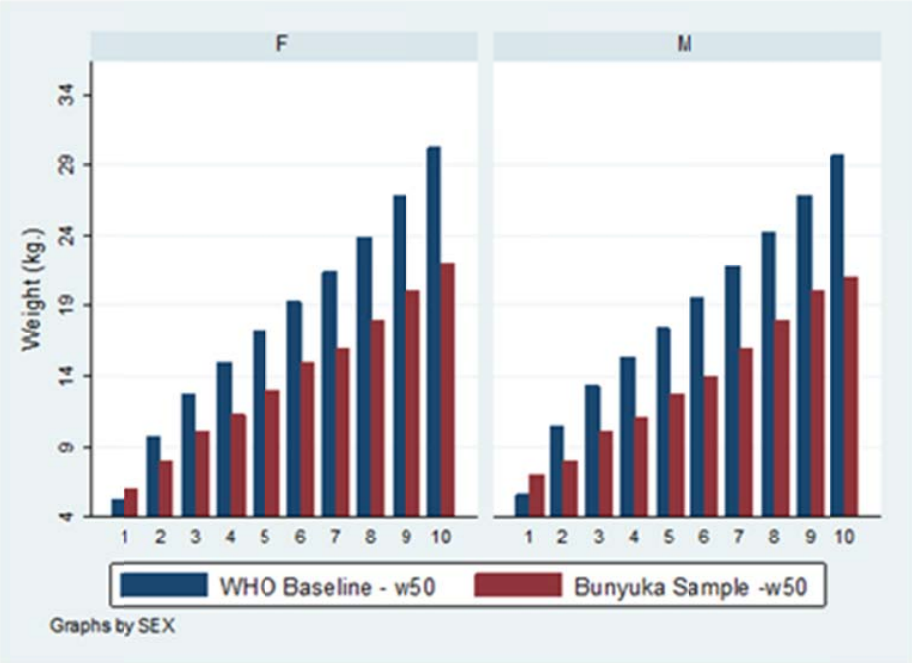
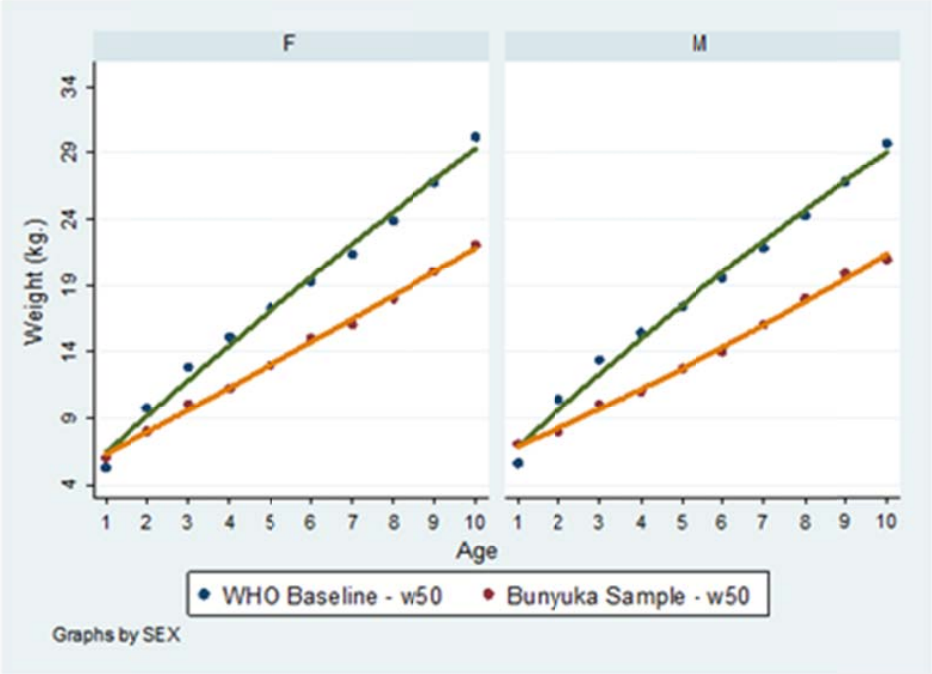


Figure 6: WHO and Bunyuka Comparison of Weight for Age Median Outcomes



Figures 5 and 6 depict WFA while Figures 7 and 8 depict HFA. Using same-quartile comparison at the 50th percentile for WFA comparison, Figure 5 above shows that the WHO baseline data is far above that of the Bunyuka sample. As age increases, children in Bunyuka consistently fall below the baseline of an average healthy child. In addition, Figure 6 shows a more distressing finding; as age increases, the gap in WFA between those in the Bunyuka and WHO studies continues to diverge. This indicates that children in the Bunyuka Parish, if malnourished as an infant, have little chance of catching up with the global standard of health. In fact, their condition worsens as they reach adolescence. Given national reports in the DRC, these findings are not surprising, which demonstrates the importance of this issue.

Figure 7: Comparison of Below-Average WHO Outcomes with Bunyuka Median Outcomes

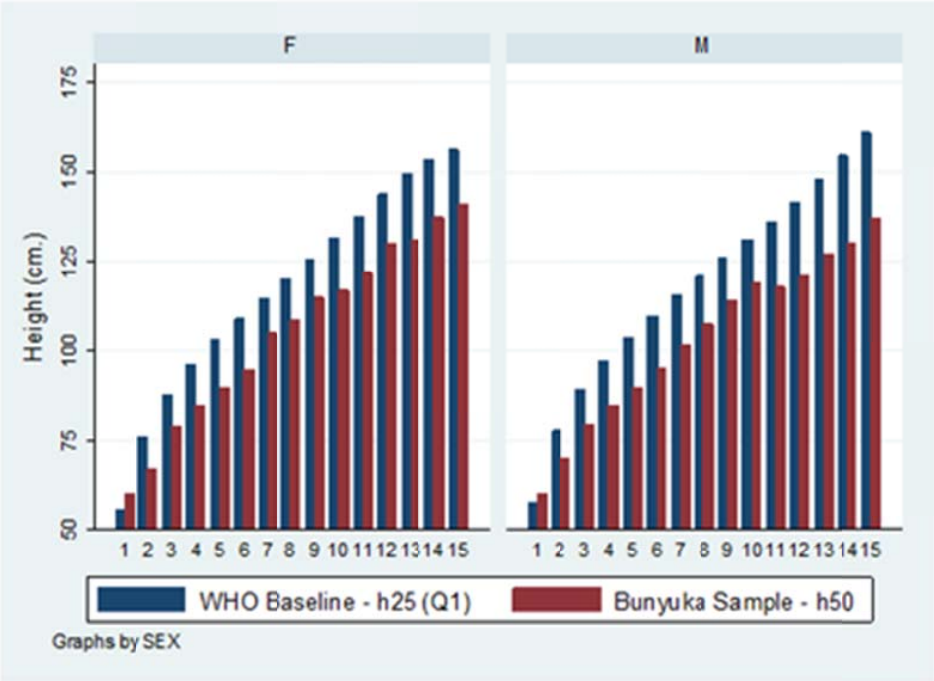
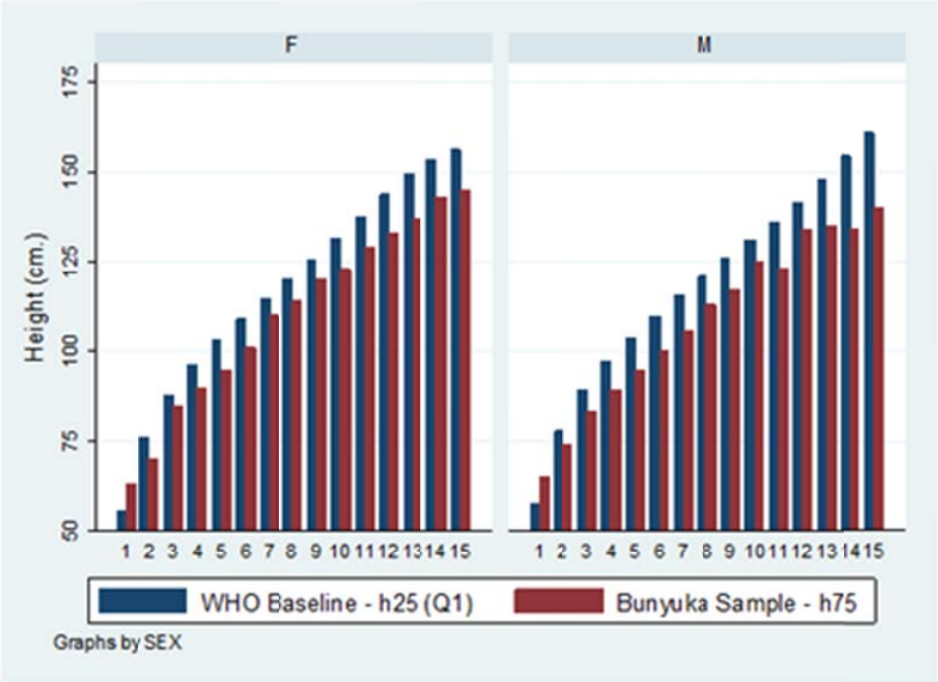


Figure 8: Comparison of Below-Average WHO Outcomes with Above-Average Bunyuka Outcomes



Figures 7 and 8 highlight the other common indicator for child health, HFA. Both figures compare a child's HFA in Bunyuka Parish to the WHO standard. Figure 7 compares WHO's lowest 25th percentile with Bunyuka's 50th percentile, while Figure 8 compares the same WHO percentile with Bunyuka's 75th percentile. For HFA, WHO's 25th percentile is higher than both the 50th and 75th percentiles in Bunyuka. Substantively, these figures show that even the relatively healthy children measured in Bunyuka are still malnourished compared to the lower end of the WHO standard. These findings indicate that children's HFA in Bunyuka are still far from an acceptable level according to global standards. Our findings show that each quartile for WFA and HFA measurement is lower in Bunyuka than the WHO standard and continually diverges as age increases.

5.4 Gender

Prior to our observations and analyses, our team anticipated variation in health indicators for each gender. Eastern DRC and much of Sub-Saharan Africa prefer male children over female children for a variety of reasons and this can be seen clearly in the status of male/female health.[24] Given this trend, we would expect to see female children less healthy than male children. However, our findings actually show that female children are healthier than male children. This

[24] Chen, 1981; Thomas, 1990; Birch, 1980.

difference is not substantial, however, it is interesting given our expectation. Per our control, there are possible reasons for this difference. For example, perhaps families consider attending church to primarily be a female activity. We will explore this further in our comparison group.

5.5 Education

In addition to the observable traits of severe malnutrition, our findings show the effects of increased amounts of maternal education on a child's health. Most experts agree that there is a correlation between maternal education and a child's health.[25] We projected that our data would tell us more about this correlation.

Table 3: Child's average height (cm.), by age and mother's level of education.

	Age				
Years of Education	0	1	2	3	4
0	58.58	64.24	75.76	83.93	86.44
1 to 6	59.17	64.50	80.00	78.00	80.67
>6	61.5	64.5	83	85.75	84.25
Average	59.42	65.47	77.41	82.56	83.81

Note: Sample varies by category. Height is measured in centimeters.

Table 3 shows a child's average height given their age and their mother's completed level of education. Mother's education is disaggregated into: 1) no formal education, 2) completed some primary education, or 3) completed more than six years of education. For ages three to five, our data suggests no effect of formal maternal education on a child's height. However, for infants, ages newborn to two, there is an increase in height as years of maternal education increase. Newborns of mothers who have completed more than six years education exhibit a 5% increase in height compared to newborns with mothers who have no primary education. Two-year olds with mothers who completed more than six years of education exhibit a 9.5% increase in height compared to two-year olds with mothers who have no primary education. Based on our HFA findings, we can conclude that on average women who have more than six years of education have healthier infants than women who have no primary education.

5.7 Dietary Habits/Preferences

Several conclusions can be made regarding the dietary habits of local families who attend the church at Bunyuka. Information regarding what families consume is analyzed in Tables 4 and 5.

[25] Günes 2013; Desai and Alya 1998; Cleland, 1998; Cochrand, et al. 1980.

Table 4: What families eat the most.

Food	Percent
Cassava	74.37
Rice	2.37
Beans	6.96
Corn	0.47
Bananas	0.79
Meat	0.47
Potatoes	12.82
Other	1.74
Total	100.0

Note: Sample = 632.

Table 4 shows almost 75% of the 632 mothers asked said that their families ate cassava most often, while 13% of mothers answered potatoes and 7% answered beans. Less than 4% of mothers stated they ate the most of something other than cassava, potatoes, or rice.

Table 5: What families eat the most of given their reported nutritional status.

What Families Eat the Most	Nutritional Status of Children				
	Excellent	Satisfactory	Below Satisfactory	Very Bad	Total
Cassava	11	60	101	294	466
%	2.36	12.88	21.67	63.09	100.0
Rice	0	2	3	9	14
%	0.00	14.29	21.43	64.29	100.0
Potatoes	0	11	16	54	81
%	0.00	13.58	19.75	66.67	100.0
Meat	0	0	0	3	3
%	0.00	0.00	0.00	100.0	100.0
Corn	0	0	1	2	3
%	0.00	0.00	33.33	66.67	100.0
Beans	5	2	13	23	43
%	11.63	4.65	30.23	53.49	100.0
Bananas	0	0	2	3	5
%	0.00	0.00	40.00	60.00	100.0
Other	0	1	4	5	10
%	0.00	10.00	40.00	50.00	100.0
Total	16	76	140	393	625

Notes: Sample = 625.

Table 5 compares what food is most commonly consumed with the reported nutritional status of the mother's children. As the results show, there is a large amount of variation in reporting. Families that eat cassava most often, 74% of the surveyed population, largely reported "below satisfactory" and "very bad" nutritional status but 15% of cassava-consuming families reported "excellent" and "satisfactory" nutritional status. On the other hand, those eating the most meat (only three families total), arguably the most expensive option, all reported 'very bad" for the nutritional status of their children.

Table 6: Whether families borrowed food in the last month.

Family Borrowed Food	Frequency	Percent
Yes	524	76.50
No	161	23.50
Total	685	100.0

Note: Sample = 685.

Table 7: Days per month families borrowed food.

Days	Percent	Cumulative Percent
1	20.15	20.15
2	24.58	24.58
3	22.00	22.00
4	11.65	11.65
5	10.72	10.72
>5	10.91	10.91
Total	100.0	100.0

Note: Sample = 541.

We asked mothers whether their family had to borrow food from neighbors in the past month. As Table 6 indicates, 76% of mothers replied that they had. Further, as shown in Table 7, 66% of mothers that did have to borrow food said they borrowed food one to three days while 22% borrowed food four or five days during the month. About 10% had to borrow food more than five days. These findings show evidence of mild forms of food insecurity in the Bunyuka area.

Table 8: Reported nights per week the mother goes to bed hungry.

Nights per Week	Percent	Cum. Percent
0	24.04	24.04
1	10.72	34.76
2	15.77	50.53
3	25.73	76.26
4	9.95	86.21
5	4.59	90.80
6	2.91	93.71
7	6.28	100.0
Total	100.0	

Note: Sample = 652.

Table 9: Nights/week family goes to bed hungry: By mother's literacy

Nights per Week	Percent	
	Illiterate	Literate
0	28.84	21.55
1	12.56	10.07
2	14.42	16.86
3	23.26	26.23
4	12.56	8.90
5	1.86	6.09
6	1.86	3.04
7	4.65	7.26
Total	100.0	100.0

Note: Sample = 642.

To substantiate this concern, we report answers from a survey question asking how many nights per week the mother goes to bed hungry. As Table 8 indicates, less than 25% of the surveyed population reported they did not go to bed hungry. More than 75% of respondents did go to bed hungry at least one night per week, the most frequent response being three nights per week. More than 13%, or ninety respondents, reported going to bed hungry five or more nights per week.

We next perform a tabulation of the number of nights a family goes to bed hungry and the mother's literacy rate. Researchers have found a positive correlation between maternal education and their children's nutritional status. Table 9compares the number of nights per week

mothers go to bed hungry with their literacy rates. Interestingly, we find the opposite of what we expected from the literature. Of illiterate mothers, a greater percentage report going to bed hungry zero nights per week and fewer report going to bed hungry five to seven nights per week.

6. TREATMENT SURVEY RESULTS

6.1 Visits to UCG Clinic

Due to financial restrictions, families must often choose which child they will send to the clinic if more than one is malnourished. A return visit is unlikely as it is financially difficult for the family, but it is also a burden for that family to be without the mother for a long period of time. The mother is expected to accompany the child to the clinic for the duration of the treatment, which complicates the care of other children in the family. On average, families only seek treatment one time and do not return to the clinic, against the recommendations of the doctors who advise check-ups and/or further therapy.

Table 10: Number of times children visit the clinic

# of Visits	Frequency	Percent
0	18	6.34
1	195	68.66
2	43	15.14
3	13	4.58
4	3	1.06
5	4	1.41
6	5	1.76
7	3	1.06
Total	284	100

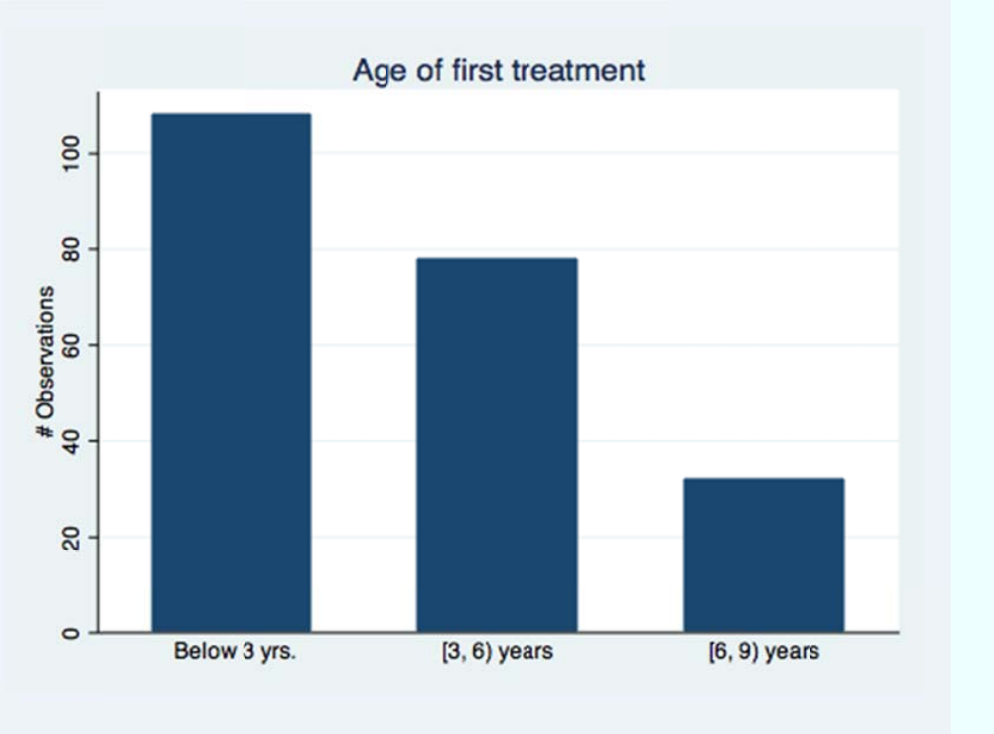
Note: Sample = 284.

Table 10 above details these findings as almost 70% of families only take their children to the clinic once. By only visiting once, families are going against the recommendations and best wishes of the doctor who almost always request that patients and children come back consecutively for follow-up treatments. In discussions with health officials at the clinic, these findings are consistent with their experiences and opinions of patients. For a number of reasons, children are receiving sub-optimal frequencies of treatment for effective recovery from different forms of malnutrition.

6.2 Ages of Treatment Children

As seen below in Figure 9, most respondents were treated at under three years of age for the first time, but a large number were also treated for the first time between ages three and six. While early intervention is ideal, after treatment the child generally returns to the same lifestyle as before treatment. Although the clinic provides educational resources regarding proper nutrition, the family may not be able to afford the nutritious foods that are recommended. As a result, the nutrition at home may not be sufficient to prevent undernourishment in the future and due to financial constraints it is unlikely that the family will return to the clinic either to follow the recovery process of the child or for further nutritional therapy.

Figure 9: Age of First Treatment



6.3 Short-term vs Long-term Impacts

Figure 10: Quartile Treatment Effect: By Age Group

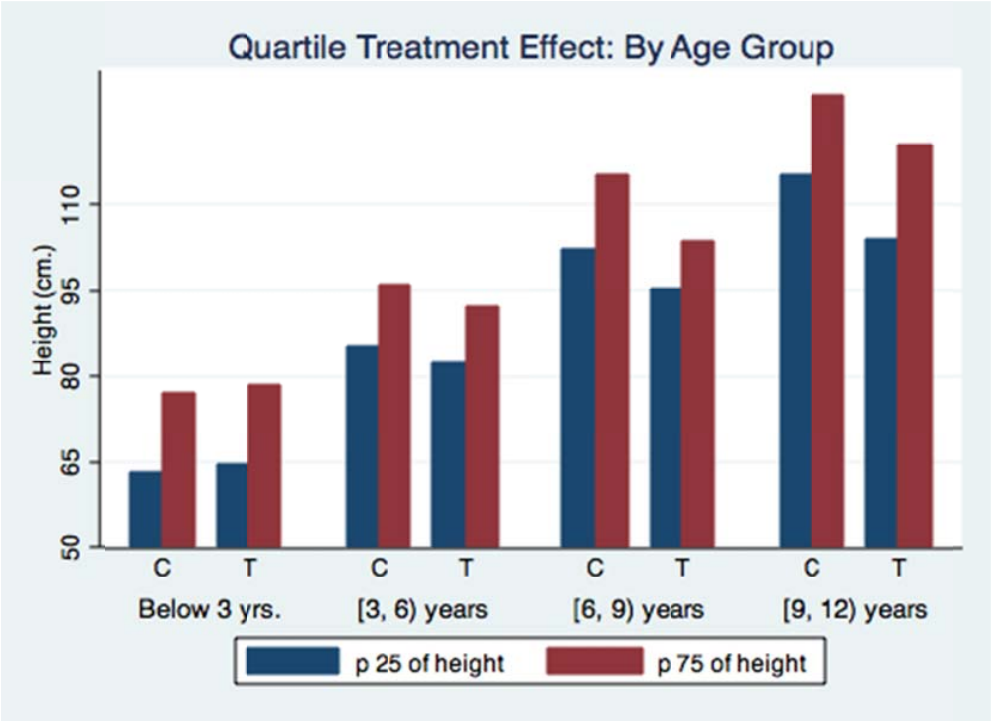


Figure 10 is disaggregated by age and shows the twenty-fifth and seventy-fifth quartile effects of treatment compared to those children who were not treated (the control group from Bunyuka Parish). For the infant to three age group for control and treatment there is a positive treatment effect. This suggests that the children receiving treatment are healthier compared to children of the same age group in the control survey. We believe that this is the case due to the nature of the treatment provided at the clinic, which allows the children to recover at an early age. However, when looking to higher age ranges, the control group begins to overtake the treatment group. As the age of the child increases, the effect of the treatment decreases. The treatment is still beneficial as a lifesaving measure, but it is no longer useful in the prevention of stunting or in repairing the damage to growth already incurred. The treatment is beneficial in treating malnutrition, but with regard to the overall health of the child, it proves most effective when obtained under three years of age, before the lasting effects of stunting.

6.4 Results of Treatment

The nutritional therapy from the UCG clinic positively impacts the nutritional status of children; however, it has proven most effective for children treated under three years of age. If a

child is malnourished early in life and does not receive treatment, then the child is less likely to grow at the same rates as others in the same age range. Depending on the duration of the malnutrition and the age at which the child was treated, stunting may have already occurred and the child will not achieve the same rate of growth as other children of the same age. Although this is a risk, it remains the ideal course of action to seek treatment as severe malnutrition can lead to further health concerns and early treatment is in the best interest of the child.

The treatment is most beneficial if administered at a younger age and in the earlier stages of malnourishment. Treatment at a younger age provides an equal start for children. Children treated later in life are less likely to reach the same height for their age group. Stunting is more prevalent at earlier ages, which is why early treatment is critical.

6.5 Gender

Members of the UCG clinic administration articulated that there was not a prevalent gender bias regarding malnutrition treatment. A family is not more or less likely to seek treatment for one child over another based on gender considerations; however, families are often unable to treat multiple children. A family may be able to seek treatment for one child, but is then unable to seek subsequent treatments for that child or other children.

7. COMPARISON OF SURVEY RESULTS

Comparing the results from both the control and treatment surveys yields powerful statements about the prevalence of malnutrition in the area as well as the effectiveness of the Cerruto clinic in delivering lasting assistance to children suffering from malnutrition. There are several significant findings from our data, the most important is that children benefit from the treatment. However, with inconsistent returns to the clinic for follow up treatment, older children in the treatment group are worse off than children in the control group (see Figure 10). This implies that families with children in need of treatment generally seek treatment for children under the age of three. This is confirmed by the fact that over half of respondents' first treatment was under the age of three with little rates of return for follow-up treatment (see Figure 9). Substantively, children who are taken to the clinic at a young age experience great benefits due to the therapy. However, when they return home they experience the same conditions of nutritional instability that leads to hindered growth throughout their childhood. There is a great need for empowering families to follow the advice of the nutrition doctors at the clinic and to return for subsequent treatment.

7.1 Nutritional Status

It should be noted that the population is very aware of their need for seeking treatment. The control sample at Bunyuka was less likely than the treated sample to report their families'

nutritional status as unsatisfactory, although both sample were significantly (see Table 2). Further, nearly all respondents (99%) believe that seeking medical attention from a doctor is the best response to severe malnutrition. The control and treatment groups were very similar in this regard; however, there are a few differences between them that should be explored.

Both groups suffer from malnutrition; however, the treatment group has a significantly higher proportion of families that primarily consume cassava. While the majority of families in the control group eat primarily cassava (67%), this is also true for over 90% of the treatment group (see Table 4). Despite dietary recommendations from doctors at the clinic, treatment families continue to consume cassava at a higher rate than control families.

7.2 Obstacles to Treatment

There is also a significant difference in the way that the two groups perceive the obstacles to receiving treatment. Those who have not been treated nearly unanimously (98%) believe that the most significant deterrent is the cost of treatment. The average cost of treatment according to those who have undergone treatment was 5USD. In a population with an average income under the World Bank global poverty threshold of 1USD per day, this is a significant financial commitment. While the majority of the treatment sample (78%) still believe cost to be the primary obstacle, they also recognize another significant obstacle not represented in the control population. Among treated respondents, there is a significant understanding that treatment requires the mother to leave the family to be with the child at the clinic. Thirteen percent of treated respondents see this as the second largest deterrent. This obstacle was not expressed by those who had not gone through treatment.

7.3 Gender

One of the most surprising findings from our research was the lack of a gender bias in the samples. Given the general trend in developing countries, we expected to find that girls exhibited a greater degree of malnutrition than boys, but we found a relatively even representation in both samples. The control survey at Bunyuka Parish showed that girls and boys were similarly malnourished when compared to WHO standards. From the treatment survey, 56% of those treated at the clinic were girls, suggesting relatively equal access to treatment for both genders.

Overall, we see that those families who send a child to be treated at the Cerruto Clinic are more likely to eat the low-cost, low-protein cassava than the average population. While the largest barrier to being treated for both groups is the cost of treatment, those who have gone through treatment also recognize the opportunity cost of the mother being away from the family more so than the general population. In the context of instability resulting from conflict, the mother's presence in the family is vital. In our interactions with the director of the Cerruto Clinic, we learned that many of their patients are internally displaced people from outside Butembo. The director observes that many have resettled in Butembo after being threatened by

the conflict, which is a common occurrence in conflict zones. While our research did not aim to uncover evidence of this, it is understood to widely be the case. This would be an important component in follow-up studies in the area.

8. LIMITATIONS

Several potential limitations should be noted with regards to this study. First, the scope of the project is limited to an area within a radius of Butembo, in North Kivu, DRC. The findings can only be directly attributed to this region and will not universally apply to other areas; however, the methodology used for this research can serve as a baseline for future research both in North Kivu and in other regions.

Second, the study was not immune to framing biases. The presence of foreigners during the survey implementation could have prompted respondents to provide answers considered more socially desirable to appease the enumerators, Bunyuka parishioners or religious officials, UCG clinic staff, or members of the research team. The longer than anticipated wait time may have motivated either the respondents or enumerators to move quickly through the questions in order to finish quickly.

Third, the use of the WHO Child Growth Standards, while internationally recognized as a reputable baseline, is less accurate than a baseline formulated for the health of Congolese children more specifically. Another limiting factor is the lack of pre-treatment data available for comparison. The data available for the children treated at the clinic is solely from the measurements taken during our treatment survey, therefore we are unable to chart their growth progress before and after treatment. For the control survey, the prevalence of kwashiorkor limits the reliability of the weight measurements if edema is present. The students conducting the measurements were trained to identify edema, but in less severe cases it may have gone undetected.

9. CONCLUSION

This report had two main objectives: 1) show the prevalence of malnutrition in the North Kivu region, specifically in the areas of Butembo and Bunyuka, and 2) demonstrate the effectiveness of clinical treatment on the health status of children there. Our research and analysis produced several significant results. First, the prevalence of malnutrition is still rampant in Eastern DRC. Children in Bunyuka are still far behind even the lowest global health percentages as presented by the WHO. The healthier children of Bunyuka are still less healthy than the least healthy children measured by global averages. Second, through our analysis of the Giorgio Cerruto Therapeutic Nutrition Center, our findings suggest that the clinical treatment does in fact positively affect the health status of children. However, this clinical treatment is most significant for children who have not yet reached their third birthdays. Children, from newborn to three-years-old are positively and significantly affected by nutritional therapy. These

clinical findings offer several substantive interpretations. Since the clinical treatment affects younger children, both the surrounding religious and health institutions need to encourage mothers, especially those with infants, to bring their children into treatment clinics. These mothers need to be made aware of costs, both in terms of finances and health, in order to receive a significant effect from the treatment. In addition, these findings suggest that the clinical treatment offers children an equal start to other children of the same age. The third and final interpretation of our data is, contrary to the common perception of gender norms in the DRC, our project did not uncover any substantial gender biases in child health and nutrition. Based on our sample, the data does not suggest any substantial gender biases, in either direction.

The DRC, specifically the North Kivu region, has witnessed and endured some of the most intense and long-lasting conflict on the African continent. Our project has laid a foundation for future work in the Butembo and Bunyuka areas. Our hope is that further research and innovative solutions will follow to further combat malnutrition and child mortality in the North Kivu region of the Eastern DRC.

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