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Prevalence of Child Malnutrition in North Kivu, DRC: Evidence from Bunyuka Parish

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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. The Kivu region in Eastern DRC, in particular, has suffered through decades of conflict and lack of security and infrastructure obstruct data collection in this region. The main contribution of this paper is to present primary survey evidence on the prevalence of malnutrition in the village of Bunyuka in North Kivu. From a sample of over 700 mothers and 1400 children, we find significant prevalence of malnutrition and high dependence on nutritionally deficient food sources.

Keywords: DRC Kivu Region; Child Health Outcomes; Primary Survey.

I. INTRODUCTION

Sub-Saharan Africa is the second most undernourished region in the world, with an estimated 265 million people in 2009 (IFPRI, 2010). The Democratic Republic of Congo (DRC) has the highest percentage of undernourished people in the region, 75% from 2004 to 2006. Individuals are considered undernourished if they receive less than the minimum dietary energy requirement (1,750 calories per day). In addition, according to the International Food Policy Research Institute's (IFPRI) Global Hunger Index, the DRC's malnourishment value increased over 50% from 1990 to 2009 (IFPRI, 2010). IFPRI was unable to publish a report for hunger in the DRC in 2013 due to a lack of data. In their previous reports, instability and a lack of infrastructure have been two of the largest causes for hunger and malnutrition, specifically in the central and eastern regions of the country which have seen decades of conflict.

Lack of data in many of the fragile regions of the central and Eastern DRC prevents a thorough analysis of the local causes of nutritional deficiencies. This paper serves as one of the first locally driven and locally administered reports on child malnutrition in the North Kivu region in DRC. We seek answers to two questions:

1. What is the prevalence of child malnutrition and dietary malpractice in the Bunyuka Parish?
2. How does this compare to data twelve years earlier in 2001?

To answer these questions, over 700 mothers and 1400 children were surveyed and measured for indicators of nutrition in March 2014. The study involved the assistance of students

from the Catholic University of Graben (UCG), medical experts from the Butembo UCG Hospital, and Catholic priests and administrators from the Bunyuka Parish.

In Section II we discuss more on the situation in the DRC, through two specific lenses: 1) in relation to other nations with similar characteristics 2) in relation to one specific region of the country and our particular area of research, the North Kivu region. In Section III we present our findings; in sub sections we compare our Kivu indicators with World Health Organization (WHO) benchmarks; we present the effects of malnutrition; and compare pre-war outcomes data from UNICEF's Multiple Indicator Cluster Surveys (MICS) with our post-war outcomes. We attempt to understand the cause of continuing malnutrition through a survey of the mothers of these children. In Section IV we offer caveats and gaps in our design that point to fruitful future research opportunities. Section V offers concluding observations and outlines possible future steps.

II. BACKGROUND

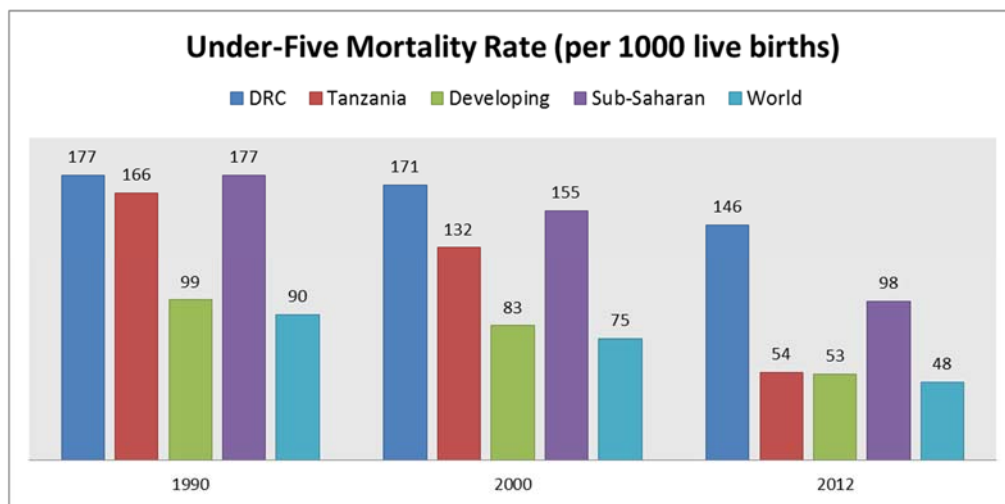
Child Mortality Rates 1990-2012

An extreme measure of child health outcomes is under-five mortality. The highest rate of deaths occurs in sub-Saharan Africa, and the prevalence in the DRC over the past two decades is clearly demonstrated in Figure 1.¹ Based on the most recent data from the United Nations Inter-agency Group for Child Mortality Estimation, Figure 1 compares under-five mortality rates (per 1000 live births) in the DRC to Tanzania, Sub-Saharan Africa, the developing world, and the world averages. Tanzania shares a border with the DRC, but also has other similar characteristics: low-country GDP, high ethnic and religious diversity, high unemployment, and an export-based economy. Tanzania is distinguished because it has had few international conflicts and the last major conflict occurring in 1971. Figure 1 shows that the rate of under-five mortality was 177 (per 1000 live births) in the DRC in 1990, no different from the rate for sub-Saharan Africa as a whole and similar to its neighbor Tanzania. Evidence that the conflict in DRC, especially in the Kivu region of Eastern DRC following the Rwandan genocide and its spillover into DRC, began taking its toll is in the contrast in the under-five mortality rate across regions in 2000. DRC remains at 171 deaths per 1000 live births, while it is greatly reduced by 12% to 155 deaths per 1000 live births in sub-Saharan Africa and by over 20% to 132 deaths per 1000 live births in Tanzania. Thus, DRC's conflict denies its citizens the advances in health care for infants and children that are beginning to be implemented in developing African countries. All else held constant, DRC should be following Tanzania's trend. Instead, it remains mired in a conflict-poverty trap.

The picture by 2012 remains dire, although there is evidence of improvements. The rate of under-five mortality in DRC has decreased over the 2000-12 decade by 14% to 146 deaths per 1000 live births. But the contrast with Tanzania and even sub-Saharan Africa is stark. Tanzania has rapidly improved its under-five mortality rate by nearly 60% to 54 deaths per 1000 live births while sub-Saharan Africa has reduced its rate by nearly 37% to 98 deaths per 1000 live births.

DRC is a populous country of 77.43 million people in 2012. The total number of under-five deaths in the DRC was equal to the total number of under-five deaths in Burundi, Central African Republic, Congo-Brazzaville, Rwanda, South Sudan, Tanzania, Uganda, and Zambia combined, or approximately 391,000 deaths.²

Figure 1: Rates of child mortality in 1990-2012



The North Kivu Region of DRC

While no data are available beyond 2001 for the Kivu region, we surmise the child mortality rates are higher here. The Eastern region is historically one of the most conflict-prone and under-nourished areas of the DRC. Our objective is to detail the current health situation in the east and compare these health outcomes with previously measured data. We bring two type of evidence. The first is a comparison of our data from Eastern DRC with contemporaneous benchmark WHO child health outcomes around the world. The second is comparison of our data from Eastern DRC with “pre-war” data collected by the UNICEF from the same region. This comparison sheds light on the impact of war on child health.

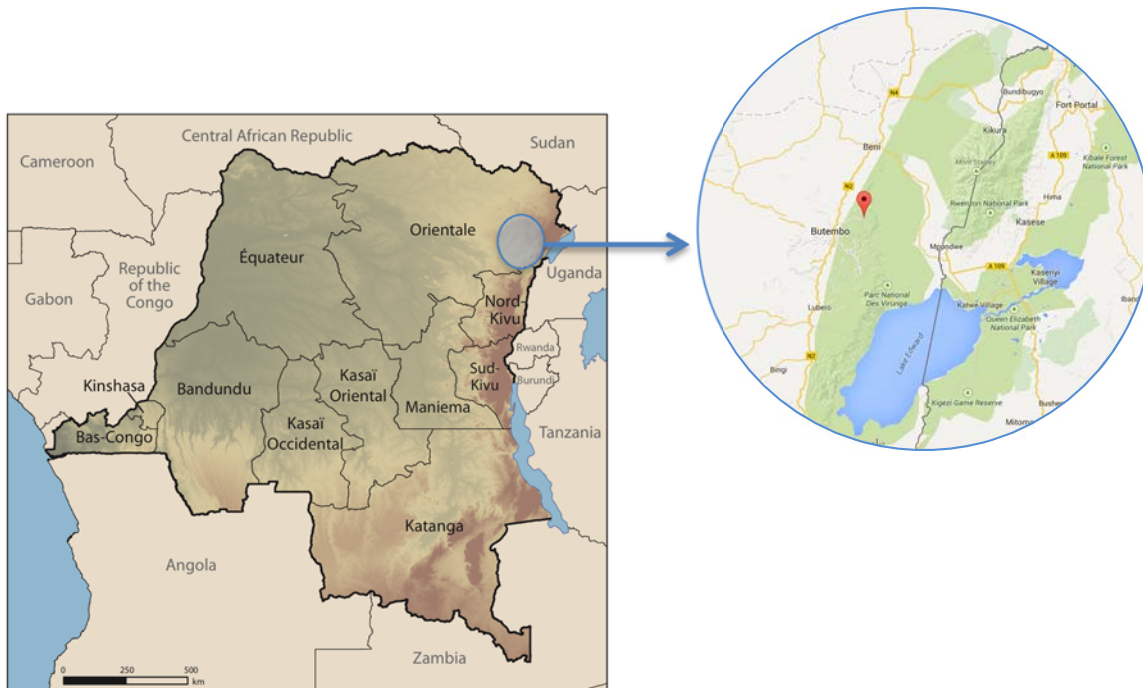
The North Kivu region has had especially poor performance in areas of health, education, and living standards, largely due to the conflict and civil war. Not only did the Congolese experience internal civil conflict, but also refugees from neighboring Rwanda and Uganda flooded into the DRC in the 1990s. Renegade elements of these conflicts still remain in 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 exacerbated small-arms conflict in the North Kivu region, as these forces joined or formed other rebel factions such as the Mai Mai, Congolese Rally for Democracy-Goma, M23, and others (Eriksson-Baaz and Verweijen, 2013).

The impact on children has been enormous. In 2001, the North Kivu region experienced the lowest percentage of primary school enrollment. Admission to primary school was only 3.7% overall in the North Kivu region, while Kinshasa, the capital city, experienced 41.9% primary school enrollment (UNICEF, 2001). Among the eleven DRC provinces, North Kivu had the third highest percentage in moderate and severe malnutrition. 24.2% of its children under the age of 14 were severely malnourished, while 45.4% were considered moderately malnourished.

Butembo, population ~200,000, is the second largest of the three cities in North Kivu province and has a university, hospital, and health care outreach services. Bunyuka is a village

located about 12 kilometers east of Butembo and is demarcated by the red flag in Figure 2. Bunyuka community members may walk or take other transport to Butembo to seek medical services.

Figure 2: Map of DRC³ with inset⁴ of enlarged area of Butembo and Bunyuka



III. NUTRITION SURVEY AND RESULTS

Standard indicators of child nutritional intake are height-for-age, weight-for-age, and the prevalence of edema among children. Edema is an indicator of the very serious protein-energy malnutrition condition called kwashiorkor and is characterized by swelling and/or puffiness particularly in the lower limbs. We used these three measures for our survey. Bunyuka was chosen as a survey site for several reasons. First, it properly represents the Kivu population, which is largely rural and lives in scattered, loosely connected villages. Second, like the majority of families in North Kivu, Bunyuka mothers and children regularly attend church services. In our pre-survey visits, we observed that the Sunday mass, attended overwhelmingly by women and children, were teeming. In fact, women completely filled the church during the service, while the kids played outside and waited for the children-only service that followed once the morning service was completed. This allowed us the opportunity to substitute a random household survey with a survey of a random sample from attendees at the Sunday mass; essentially a large survey was possible in short time. Finally, the head of the parish exhibited a strong interest in promoting nutritional awareness to his congregation even prior to the idea of our survey, and was a strong supporter of implementing the survey on church grounds.

Announcements were delivered two Sundays prior to the implementation of the survey,

encouraging parishioners to invite family and friends to attend the survey. To further encourage a community representative attendance, a written invitation was sent to Butembo's second largest parish, the local Seventh Day Adventist congregation. The Sunday of the survey was no different from other Sundays: women filled every seating space in the church. Mothers were randomly handed surveys (in their native language, Nandi) inside the church at the end of the church service. Of the approximately 1500 women at the mass, approximately 700 received the surveys. A kilo of raw uncooked soya beans was offered to mothers who completed the survey. We believe the offer of food did not create a selection bias (of the poorest) into the survey. The soya bean packet was mainly an incentive to stay beyond the mass and participate in the survey, once the survey was randomly received by the mother. The soya packet would be given after the survey was completed and measurement of children taken, a possibly long process. Unlike meat and rice, soya is not well known and not considered "superior".

Mothers with surveys were asked to visit three stations. At the first station, each mother presented the survey document to an enumerator, who interviewed each participant for between fifteen and twenty minutes to complete the survey. Sixty enumerators, mostly women from the parish, were recruited and trained to conduct the survey.⁵ Figure 3 shows the three stations and the movement of participants. The line of participants in the middle-left consists of enumerators administering surveys. Mothers then took the survey and proceeded to the second station, where we measured mothers and children. At the second station, mothers answered a brief matrix of questions about gender, age, education level, and observable signs of edema and kwashiorkor. Both, mother and children were measured for height and weight. After taking measurements, mothers were given a second tag, in exchange for the original survey and matrix. The second tag served as entrance into the third and final phase of the survey. The third station provided participants with their one-kilogram bag of uncooked soya beans for their household. Soya is also a treatment for kwashiorkor, and since soya is not widely grown and its attributes unknown to the public, our survey was an attempt to increase awareness and its adoption.

Figure 3: Survey at Bunyuka Parish



Table 1 presents evidence that concern about nutritional status is legitimate: 63% of mothers believed their family nutritional status was "very bad." More broadly, 85% of families believed

their children had insufficient nutrition (“below satisfactory” and “very bad” combined).

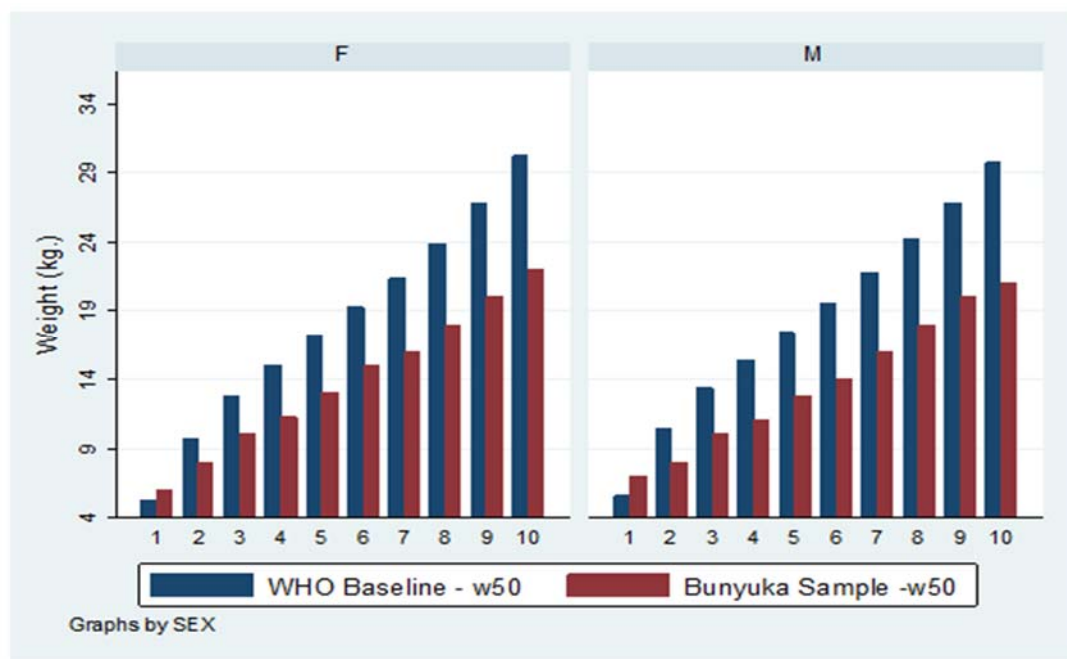
Table 1: Mothers’ self-report of nutritional status of their children.

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

Weight and Height Comparisons With Who Benchmarks

Our primary finding is significant prevalence of child malnutrition in Bunyuka Parish. As we have mentioned, there is no current comparative data on child health in North Kivu. We therefore use the World Health Organization’s (WHO) Child Growth Standards, worldwide (WHO, 2006). In Figure 4 we compare the weight of Bunyuka Parish children to the weight of an average healthy child according to the WHO standards, by age (between 1 and 10 years). The left panel compares females and the right panel compares males. In each age group the median weight in our sample is compared with the median WHO weight. Beyond the year of their birth, when the median weight for Bunyuka infants compares well with the WHO median, the outcomes worsen.

Figure 4: WHO and Bunyuka comparison of weight-for-age median outcomes



By age 3, the median Bunyuka female is underweight by more than 25% and the median Bunyuka male is underweight by 33%. By age ten, the median Bunyuka female underweight

percentage rises to 27% and climbs to over 40% for the median Bunyuka male.

Figure 5: WHO and Bunyuka comparison of weight-for-age median outcomes

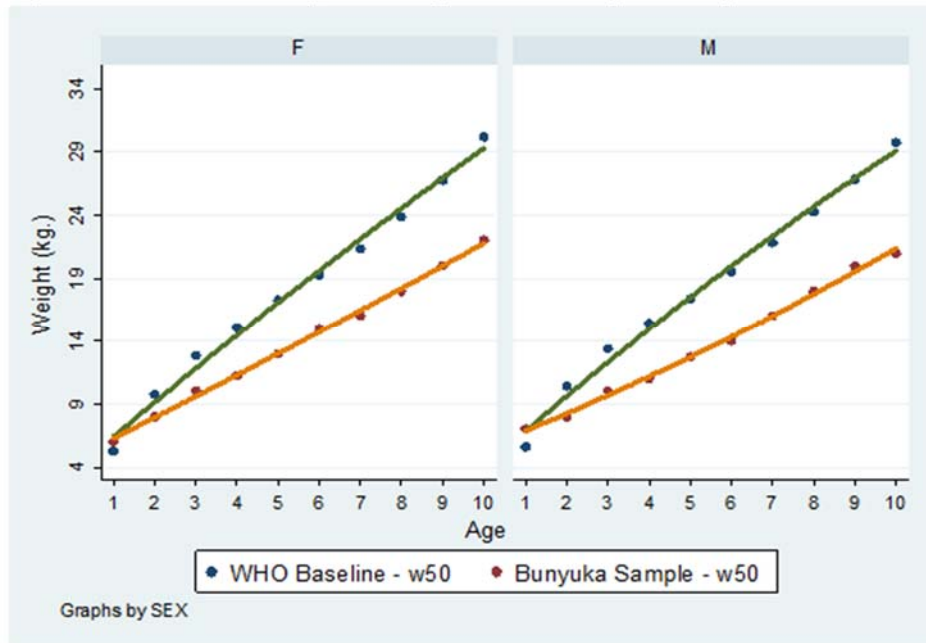


Figure 5 contains the same information as Figure 4, but clearly illustrates that the weight-for-age gradient of WHO median outcomes is steeper than the Bunyuka median outcomes for both genders. We offer two possible explanations. The first is that there is no catch-up after the onset of malnutrition, causing the weight-for-age line to become flatter. Meaning, malnutrition in the early years lowers the per year weight increase thereafter. The second explanation is that even if it is possible to reverse early childhood malnutrition and treatment is provided, persistent poverty in the region negates the treatment's positive impact. So, the flatter weight-for-age gradient is a consequence of continuing under-nutrition in the critical growth years. Further examination is needed as to which explanation is appropriate, because they imply different interventions.

The main cause for the adverse outcome is the lack of protein in daily food intake. As we will show, the self-reports on the survey from mothers indicate precisely this. Protein deficiency is a primary cause of edema, which is widely prevalent in Bunyuuka.

Figure 6: Below-average-height WHO outcomes compared to median Bunyuuka outcomes

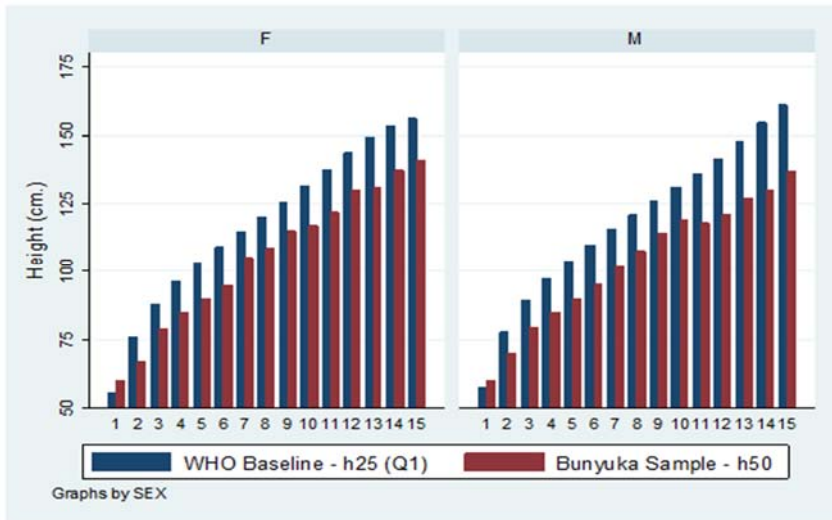
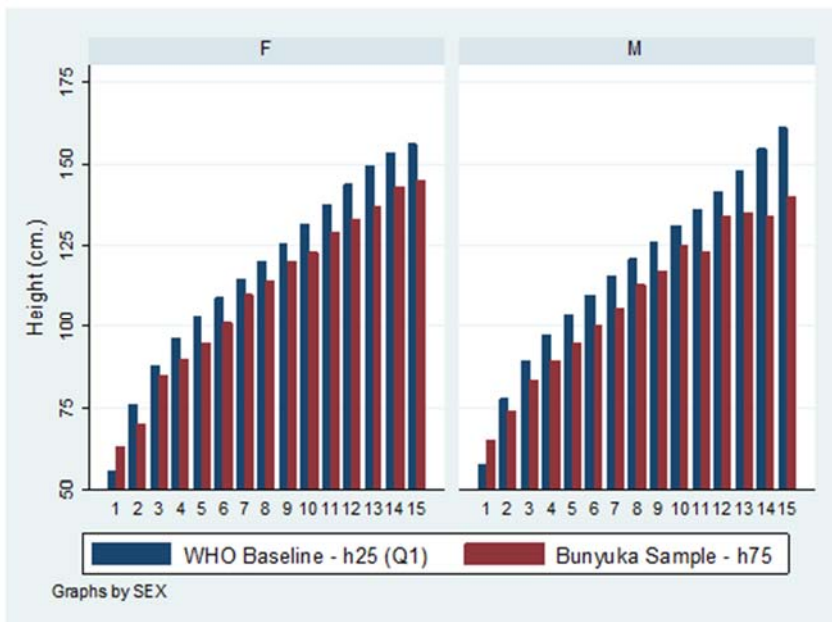


Figure 7: Below-average-height WHO compared to above-average Bunyuuka outcomes



In Figure 6 we compare children’s height-for-age in Bunyuuka to WHO outcomes by comparing the lowest quartile (25th percentile) WHO outcomes and the (50th percentile) Bunyuuka median outcomes. The median Bunyuuka height for both female and male children is significantly

lower than even the height of the bottom quartile of the WTO (worldwide) sample. We show in Figure 6 that Bunyuka children in the top quartile (75th percentile) of the survey are consistently shorter than children in the bottom (25th percentile) WHO quartile, with the difference being even greater for male children. As age increases, male children in Bunyuka consistently fall below the baseline of even a less-than-average-healthy child according to the WHO baseline. Substantively, we show in Figures 6 and 7 that even the relatively healthy children measured in Bunyuka are still malnourished since they fall short even when compared with the lower end of the WHO standard. These findings indicate that children’s height-for-age in Bunyuka are far below an acceptable level according to global standards. Our findings show that each quartile for weight-for-age and height-for-age measurement is lower in Bunyuka than the WHO standard and continually diverges as age increases.

A plausible conclusion is that children in the Bunyuka Parish, if malnourished in their infancy, have little chance of catching up with the global standard of health. In fact, their condition worsens as they reach adolescence. DRC-wide reports by USAID Integrated Health Project (2011) and USAID Office of Food for Peace (2010) are consistent with these results, although they are not as dire as those for Bunyuka Parish.

Self-Reported Health Outcomes

In our Bunyuka survey, children were observed for two particular health conditions: the presence of edema and kwashiorkor. Edema is excess water retention in body tissues that give the appearance of puffiness or bloated tissues. Kwashiorkor is a form of severe protein-energy malnutrition characterized by edema, hair discoloration, and can lead to many more serious medical ailments. Both indicators of malnutrition can be observed reliably by lightly pressing a child’s skin and noting an abnormality in hair color.⁶

We show in Table 2 the prevalence of edema and hair discoloration, a probable indicator of kwashiorkor, in our sample. Specifically, 16.5% of children under the age of sixteen exhibited both indicators of kwashiorkor. A striking statistic is that more than one-third of children had at either one or both indications of severe malnutrition. This finding is alarming: every third child that comes through the Bunyuka Parish shows signs of edema and/or kwashiorkor.

Table 2: Number of children showing signs of edema and/or hair discoloration

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

Note: Sample = 1,456.

In the sample, fully 27% of the children showed signs of kwashiorkor, and 25% of the children suffered from edema, whose key cause is protein deficiency. The underlying cause of Kwashiorkor (other than protein deficiency) is also likely a cause of edema: of the children that showed signs of kwashiorkor (hair discoloration), more than 60% also suffered from edema.

Does mothers' education improve children's health outcomes? We tabulate in Table 3 the 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 newborn to two-year old infants, there is an increase in height as years of maternal education increase. Newborns of mothers who have completed more than six years of 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.

It may be possible to conclude that women who have more than six years of education have healthier infants, on average, than women who have no primary education. In addition to simply the amount of education for women in the Bunyuka, women in the North Kivu on average have seven children and have their first child at age 20. In addition, in 2007, 24% of women aged 15-19 were already mothers or were pregnant. These young ages and high fertility rates add further emphasis to the importance of maternal and female education. According to our data, women who complete school will have healthier children, and possibly will decrease fertility rates through further sex/health education. Before these findings are the basis for intervention, more research is needed. It is possible that educated mothers are better informed about their child's health, especially during infancy, and they take the right actions. However, poverty restricts their abilities to continue that care in the later years. Possibly, newer infants come into play demanding more time and resources. Education and awareness by themselves may not solve the problem of child malnutrition.

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

Years of Education	Age					
	0	1	2	3	4	5
0	58.58	64.24	75.76	83.93	86.44	94.51
1 to 6	59.17	64.50	80.00	78.00	80.67	87.33
> 6	61.5	64.5	83	85.75	84.25	98
Average	59.42	65.47	77.41	82.56	83.81	93.16

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

Weight and Height Comparisons: Before the War And After

The Kivu region experienced conflict during the First Congo War that began in 1993 and ended in 1997, and the more intense Second Congo War that began in 1998 and ended in 2012. The Second Congo War was marked by the involvement of eight countries, and internal tribal conflicts that spilled into the Kivu region. Almost all Kivu households were impacted, mostly adversely, by the conflict. Lemarchand (2009) provides a detailed account of the wars, and Stearns (2011) brings focus to the North Kivu region on which our study is based. How children in the Kivu region have fared through this difficult period is of critical importance in paving the way

forward. Influential studies reviewed in the Encyclopedia of Health Economics are emphatic that the nutrition in the first two years of a child’s growth determines the child’s lifelong trajectory. Infection and poor nutrition in the pre-natal and first two years of a child’s life can “negatively impact an individual’s long-term cognitive development and lifetime physiological trajectory” (Koola and Zwane 2014).

We are assisted in our goal of finding how children in the Kivu region have been affected through the wars by UNICEF’s Multiple Indicator Cluster Surveys or MICS (UNICEF, 2014). UNICEF conducts international household surveys for the purpose of monitoring health outcomes of women and children in developing countries. The first round of MICS was completed in 1995, and four rounds have been done since then. DRC was twice included: MICS2 conducted in 2001 and MICS4 in 2010. The data we present in Figures 7 and 8 are from the Kivu sub-samples extracted from MICS2 and MICS4, consisting of 1346 and 2269 observations, respectively. The MICS data cover children under the age of 5. Though our Bunyuka survey has older children, we use the 711 observations on children below the age of 5.

In Figures 8 and 9, we compare median height and weight-for-age in 2001 (MICS2), 2010 (MICS4) and 2014 (Bunyuka) and our results from Bunyuka follow the same trend. Over the 12 years since the 2001 MICS2 was conducted, the stunting in children, perhaps owing to the First Congo War, remained the same (MICS4) or worsened (Bunyuka). This is perhaps among the worst long-term outcomes of a war that has already taken many lives, whose impact has yet to be felt and will play out in the years to come.

Figure 8: Comparison of median height-for-age outcomes in the Kivus over a decade: Bunyuka in 2014 and MICS in 2002 and 2010.

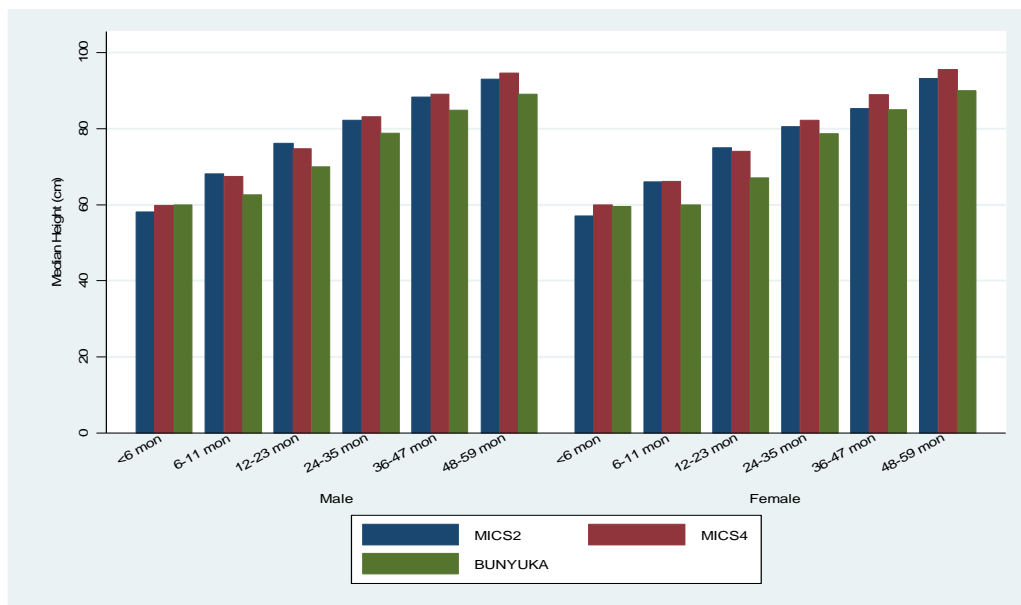
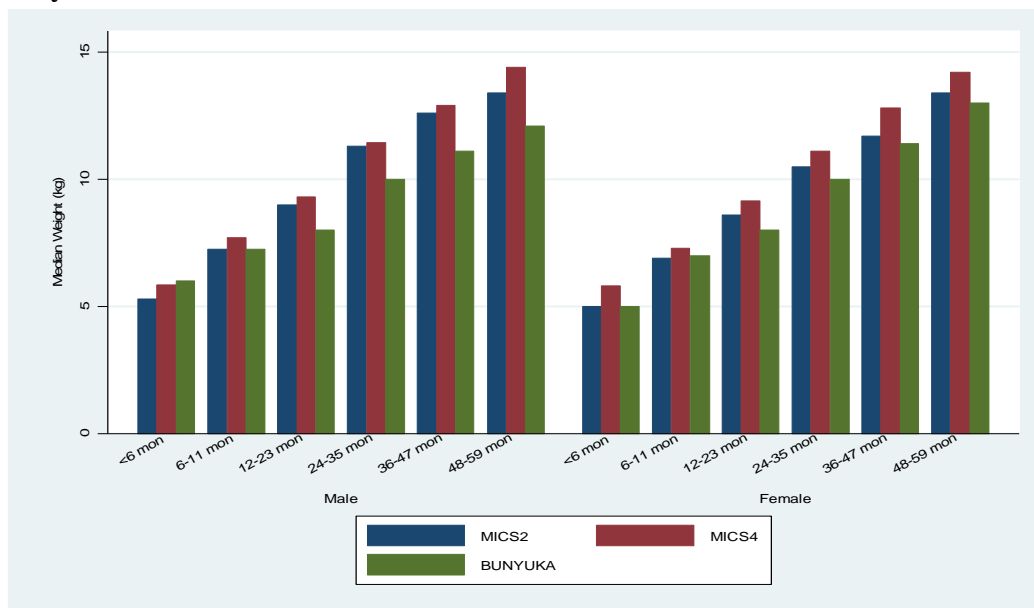


Figure 9: Comparison of median weight-for-age outcomes in the Kivus over a decade: Bunyuka in 2014 and MICS in 2002 and 2010.



Bunyuka Survey: Self-Reported Nutrition Issues

Unlike the MICS studies, responses by Bunyuka mothers to our survey questions afford several preliminary conclusions regarding the dietary habits of Bunyuka families, and offer a reason for the adverse health outcomes we see above.

Table 4: Primary food source of a typical family’s diet

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

We show in Table 4 that among the 632 mothers surveyed that cassava is the primary food

source at ~75%; while 13% percent of mothers reported potatoes and 7% reported beans. Less than 4% of mothers stated they primarily ate something other than cassava, potatoes, or rice. Cassava is plentiful and cheap, and often grows wild. However, it is chiefly a carbohydrate and has no protein content.

We detail in Table 5 the food most commonly consumed with the mother’s reported nutritional status of her children. Regardless of what food is consumed the most, the overwhelming majority of mothers are aware that the nutritional status of their children is very poor with 85% of mothers reporting their children’s nutrition being “below satisfactory” or “very bad”.

Table 5: Self-reported nutritional status of foods consumed

Primary Food Source	Nutritional Status of Children				Total
	Excellent	Satisfactory	Below Satisfactory	Very Bad	
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

Note: Sample = 625

To gauge how families cope with food insecurity, we asked mothers if they borrowed food in the last month and how many days per month they borrowed food. Of the 685 mothers we surveyed, 76% of them had borrowed food in the last month. We show in Table 6, that 66% of mothers borrowed food one to three days, 22% borrowed food four or five days during the month,

and 10% had to borrow food more than five days. These findings affirm the presence, even prevalence, of food insecurity in the Bunyuka area.

Table 6: Days per month mothers borrowed food

Days	Percent	Cumulative Percent
1	20.15	20.15
2	24.58	44.73
3	22.00	66.73
4	11.65	78.38
5	10.72	89.10
> 5	10.91	100.0
Total	100.0	

Note: Sample = 541

To substantiate this concern, we report answers from a survey question asking how many nights per week the mother goes to bed hungry. As we show in Table 7, only 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.

Table 7: Reported nights per week the mother goes to bed hungry

Nights per Week	Percent	Cumulative 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

Bunyuka Survey: Self-Reported Medical Treatment Issues

In Table 8 we show that 97% mothers take their children to the doctor or hospital when their children are ill and/ or are exhibiting signs of malnutrition.

Table 8: Methods of treatment mothers use if their children get sick

Method	Frequency	Percent
Doctor	491	70.95
Hospital	185	26.73
Other	16	2.32
Total	692	100.0

Note: Sample = 692

For example, the Giorgio Cerruto Therapeutic Nutrition Center at Catholic University of Graben (UCG) sees an average of fifty malnutrition patients every month. The Center has a high success rate in treating even severely malnourished children. In severe cases, the mother and child remain in-house for more than a month undergoing treatment.⁷

Table 9: Time required to walk to pharmacy, clinic, or hospital

Time	Percent		
	Pharmacy	Clinic	Hospital
<30 minutes	33.82	19.73	23.62
30 minutes - 1 hour	21.03	22.40	22.31
1 - 2 hours	33.09	27.15	28.83
2 - 4 hours	7.94	20.33	15.15
>4 hours	3.09	6.23	6.84
Unknown	1.03	4.15	3.26
Total	100.0	100.0	100.0

Note: Pharmacy sample = 680, Clinic sample = 674, Hospital sample = 605

We show in Table 9 that most of our respondents live between thirty minutes and two hours away, by foot, from the nearest clinic, pharmacy, or hospital. In Table 10 we report that over 93% of mothers responded that the biggest obstacle to getting children to health clinics is the cost, and fully 97% of respondents said that cost of treatment was the primary reason that they did not seek care from a doctor when dealing with illness and malnutrition. An important finding, therefore, is that distance from a health facility did not necessarily deter respondents from seeking care, but that cost of medical care was a greater obstacle.

Table 10: Obstacles for mothers to take their children to a doctor

Obstacle	Percent
Cost	93.77
Cost + Other Reasons	3.33
Other Reasons	2.90
Total	100.0

Note: Sample = 690

In a poverty-stricken setting these results should not be surprising. But it is also the case that treatment is available and effective if the patients desire it. Reducing the cost of care is a smaller problem than making the supply of proximate care possible in a conflict-prone region. Having achieved that difficult step, it appears to be less of a problem to reduce the cost of care.

Even though available clinics and doctors can successfully treat moderate and even severe malnutrition in infants, once the patient leaves the clinic and returns home a high-protein diet is necessary to keep the patient from reverting to their malnourished stage. Since the internationally supplied supplemental protein used during treatment are often inaccessible to the family, the families resort to the local custom of relying on protein poor cassava as their primary food intake. The clinic's treatment, while effective for the period of residence in the clinic, is rendered ineffective.

As is the case with many development challenges, the malnutrition challenge in North Kivu is connected to bigger challenges faced by this region. Conflict and poverty create a cycle that is difficult to break; one exacerbates the other.

IV. LIMITATIONS OF THE STUDY

The scope of our baseline survey is limited to one parish in one location - the Bunyuka Parish. Therefore, our findings can only be directly attributed to the Bunyuka Parish community. We do believe the sample is representative of the rural population in North Kivu, but other studies are needed before our findings are externally valid even in the same region. A second limitation is that though protein deficiency obviously negatively impacts the local nutritional well-being of Bunyuka, we are unable to causally identify the cause of malnutrition. Living conditions and contributors such as sanitation and clean water were not studied, but future studies should consider their influence. Third, our study is not immune to framing biases. The presence of foreigners may have led respondents to give socially desirable answers to please enumerators (who were from the parish), religious officials, and/or the research team. Longer than expected waiting times may have led respondents and enumerators to provide short, less accurate answers in order to finish quickly. However, the strong unanimity on many answers works against this criticism. When debriefed, our enumerators felt that respondents revealed the truth. Fourth, an important concern with our

comparisons with WHO Child Growth Standards is that while it is an accepted international baseline, a baseline based on the health of Congolese children – one that recognized their own cultural, social and anthropological characteristics – would be preferred. Finally, importantly, if a child possesses kwashiorkor, weight is not an important factor in identifying malnutrition. A child with kwashiorkor retains water and the child's weight would appear higher than it would otherwise. This effect may skew some of our results, only for weight, and potentially overestimate the effect. Thus, it is advantageous to look at weight-for-age through this lens, and primarily focus on height.

V. CONCLUSION

Given the high level of participation and community support seen in Bunyuka, there is substantial space for marketing and increased awareness of nutritional education and health practices. From our observations, the respondents are receptive towards the parish's recommendations for improved nutrition and health practices. We propose these steps, local to the community: 1) work with UCG representatives to monitor and facilitate the recruiting of malnourished children in the surrounding area to send to Giorgio Cerruto Therapeutic Nutrition Center at UCG, 2) if desired, draw nutrition, agriculture, and health students from UCG to conduct further research and implementation.

We also propose two future steps for UCG: 1) incorporate an education aspect into the treatment program at the Giorgio Cerruto Therapeutic Nutrition Center. The education program will transform the mothers that return into their communities into ambassadors of proper nutritional practices and potentially innovative technologies. 2) Further document and gather statistics on their incoming patients and their lifesaving work to be used during future fund raising and grant applications.

An encouraging aspect of our Bunyuka study is the potential for doing fieldwork in conflict zones. We hope it will be replicated in other parishes surrounding Butembo. The Cerruto Center and clinical staff have a preexisting network of representatives in multiple areas around Butembo, whose primary role is to monitor and recruit malnourished families for transport to the clinic. Their role may be facilitated with more research.

Ultimately, effective research into the problems faced in this region is strongly reliant on community support. The church is such an institution in North Kivu. The church is not only used for religious purposes, but also is a provider for social services including protection, water, and education. The institution may be the basis for deeper answers to “why” and “how” children and families become malnourished. Deeper research questions that our study motivates include:

1. What technologies can be used to better monitor malnutrition cases?
2. How do communities differ with regards to malnutrition?
3. How can the cost of nutrition treatments be reduced for rural populations?

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Notes

- 1 Globally, 50% of the number of under-five deaths is accounted by five countries: India, Nigeria, DRC, Pakistan, and China (UNICEF 2013). While India and China have made progress in controlling child mortality, due to their large population size they continue to account for the largest numbers of under-5 deaths. The rate per 1000 births is the highest in sub-Saharan Africa.
- 2 UN Inter-agency Group for Child Mortality Estimation. *Levels & Trends in Child Mortality Report*. 2013. New York, NY: United Nations Children's Fund
- 3 DRC Ministry of Planning. 2007. Democratic Republic of the Congo; Demographic and Health Survey 2007, Key Findings.
- 4 Insert map data ©2015 Google
- 5 They had undertaken a pre-survey of a small sample of mothers, which was used to update the final instrument (the pre-survey data were discarded).
- 6 Dr. Furaha, a co-author, was a medical intern at the Giorgio Cerruto Therapeutic Nutrition Center at UCG at the time, and trained enumerators to identify signs of edema and kwashiorkor. A push test on the lower leg indicates edema/no edema. Hair discoloration is a possible sign of kwashiorkor.
- 7 Treatment consists of regular consumption of "protein packs", which are basically peanut shakes. Cost of treatment at the clinic, funded by an NGO, is \$150 per month per patient.

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