ISSN: 2577 - 8005

Research Article

Medical & Clinical Research

A high prevalence of stunting in six-moth children is associated with food behavior of mother and common infant feeding in rural area of Lwiro, a longitudinal study.

KAVIRA MALENGERA Celine[1,2,3], MURHABAZI BASHOMBWA Augustin[7], TSONGO KIBENDELWA Zacharie[4], BARHWAMIRE KABESHA Theophile[5*], WEMBONYAMA OKITOTSHO Stanis[6]

[1]*Universite de Goma, Ecole de Sante Publique, Democratic Republic of the Congo.*

[2]*Departement de Sante Publique et Family Medecine, Universite Evangelique en Afrique, Democratic Republic of the Congo.*

[3]*Departement de Nutrition, Section Protection Maternelle et Infantile, Centre de Recherche en Sciences Naturelles, Democratic Republic of the Congo.*

[4]*Universite de Kisangani, Democratic Republic of the Congo.*

[5]*Universite Officielle de Bukavu, Democratic Republic of the Congo.*

[6]*Universite de Lubumbashi, Democratic Republic of the Congo.*

[7]*Universite de Kaziba, Democratic Republic of the Congo.*

[*]Corresponding Author

BARHWAMIRE KABESHA Theophile, Universite Officielle de Bukavu, Democratic Republic of the Congo.

Submitted:01 Mar 2023;**Accepted**: 07 Mar 2023;**Published**:15 Mar 2023

Citation: *KAVIRA MALENGERA Celine, MURHABAZI BASHOMBWA Augustin, TSONGO KIBENDELWA Zacharie, BARHWAMIRE KABESHA Theophile, WEMBONYAMA OKITOTSHO Stanis (2023) A high prevalence of stunting in six-moth children is associated with food behavior of mother and common infant feeding in rural area of Lwiro, a longitudinal study. Medical & Clinical Research 8(3): 01-19.*

Abstract

Background: *Stunting (height or age below 2 SD) is a major public health worldwide; however published studies regarding food and feeding malpractices of both mothers and their children and its impact on stunting are scarce in South-Kivu Province.*

Methods: *We conducted a longitudinal study in rural area of Lwiro. One hundred thirty six mother-infant pairs were concerned by the study. The data was entered in Excel and analyzed by SPSS (Statistical Analysis Software) version 26.0. WHO Anthropometrics software helped to calculate Z score. The descriptive statistic was performed to determine the prevalence of independents variables. In addition, a multinomial logistic was run to establish predictor's factors of all stages of stunting. A multinomial logistic regression model was fitted to calculate the odds ratios and their related 95% confidence interval for all stages of stunting by socioeconomic, household characteristic and food malpractice.*

Results: *The study highlights a low prevalence (3/130, 2.3%) of underweight, a critical prevalence (32.7%) of wasting and a very high prevalence (84.6%) of stunting in the study region. Of the last, (35.4%, 46/130), (26.9%, 35/130) and (22.3%29/130) are severely, mildly and marginally stunted respectively. However, a high prevalence of overweight (38.1%, 51/134) and a low prevalence of obese mothers (11/134, 8.2%) are observed in the region. A statistically association between severe stunting of children and to be married and living with a husband and living in Cegera village, p=0.04 and p=0.034 respectively. Thereby, children from Cegera's region are eighteen, nine and forty-two more likely to be severe, moderate and mild stunting. Secondly, the result showed that spacing pregnancy for 2 to 3 years was statically associated with moderately stunted (p=0.028). Children from aforementioned mothers were seven and three times more likely to be moderate and mild malnourished. The results found that children who were weighted low at birth were protected against severe stunting (OR<1), but were exposed to both moderate and mildly stunting (OR>1). Likewise, children born smaller were predisposed to both moderate and mildly stunting (OR>1). In fact, children from lactating mothers who have not changed meal during lactation were around three more likely to be severe and moderate stunting, respectively. Regarding feeding behavior of the infants, being exclusively breastfed within 6 month has protected against all the three stages (OR<1) of stunting. Not breastfeeding the infants at day times was statistically associated with two stage of stunting (severe and moderate) (p=0.032 and 0.036). On the other hand, complementary feeding with porridge and with fruits were statistically associated with severe stunted (p=0.000 and 0.029) and moderate stunting (p=0.000 and 0.005). In fact, children fed with cow milk, powder milk, porridge,*

fruits, vegetables and, family plate or family food, were exposed to stunting (OR>1). Lactating mothers are not aware about good food for life, food content and, duration of complementary feeding.

A multifaceted (nutrition and health of the infant and reproductive health of the mother) project is needed in the region in order to solve the matter. As malnutrition of both mother and children are linked, an education intervention is needed individually and in the community, and it should focus on the region where malnutrition is more prevalent.

Keywords: Public Health, Malnutrion, Demographic and Health Survey, Complementary Feeding, Small for Gestational Age, Pregnancy, Breastfeeding

Introduction

Stunting (height or age below 2 SD) is a worldwide public health problem [1]. It is referred to a child who is very short to his or her age and, it is one of indicators of child nutrition issue. Children are defined as stunted if their height-for-age is more than 2 standard deviations below the WHO Child Growth Standards median [2]. It is well known that stunting has an effect earlier in child corporeal and cognitive growth, and later in life, non communicable diseases are experienced ((PDF) Socio-Economic Inequality in Stunting among Children Aged 6-59 Months in a Ugandan Population Based Cross-Sectional, n.d.) [3]. Stunting mainly appear within the 1000 days, from birth to 23 months and far at the age of five [4]. It is a past undernutrition [5]. Stunting is the common type of malnutrition with an estimation of 156 million currently in the whole world [6]. Habitual, these children are living in low and middle income country. In the Democratic Republic of Congo (DRC), the prevalence of child stunting is increasing and it is ranked among the highest in whole world [7].

According to the Demographic and Health Survey (DHS), the country is facing a double burden of malnutrion of both mothers and children. Forty-three percent (42.7 %) of children fewer than five years are stunted (22.5 % severely stunted). Among women aged 15-49 years 14.4 % are underweight (body mass index<18.5 kg/m2) (Democratic Republic of the Congo Demographic and Health Survey 2013-2014| GHDx, n.d.) [8]. These data depict a double burden of malnutrition given the co-existence of under- and over-nourished in the population of DR Congo. Therefore, they should attract attention of researchers and policy makers. Reduce its prevalence is main concern of public health intervention because malnutrition has persisted in the region despite many research and nutrition interventions. But, studies conducted and intervention implemented in the study area, targeted only hospitalized children for Severe Acute Malnutrition (SAM) [9,10] and recently some researchers carried up recently in the study region have focused on long term effect of Severe Acute Malnutrition [11-14], while, chronic malnutrition is ravaging children in hiding in the region.
This study aims to establish the prevalence malnutrition (Underweight, wasting and stunting in 6 moths-old infant) in the study area and to analyze the relationship between food habit and food malpractice of both mothers and 6 months old children with chronic malnutrition in the study area.

Methods

Quantitative Research

Trial design: A longitudinal study was conducted from birth to 6 months (from 10th October to 4th December 2019). The present study is a part of a PhD follow up study which started at two to seven days after birth (baseline), at forty days after birth (during postnatal scheduled time), at 3 and, 6 months of life as well. A cohort of 143 mother-infant dyads was enrolled in the study at Lwiro maternity and neighboring villages, which are integrated in Lwiro Health Center. But, only 136 lactating mothers were eligible for the study.

Setting and Participants

At baseline, the pair was eligible if the mother has delivered a unique baby without any severe malformation, aged from 18 to 45, with desire of breastfeeding the baby and without any diseases at final stage. In addition, unique child, wellbeing with no any abnormality at birth was also selected. Mothers, who came from another region even if they were delivered in abovementioned maternity or at Lwiro health Center, were not concerned by the study. Moreover, those who were not comfortable with filling or answering questionnaire as well as those who were not around the days of the survey (moving to another region) were completely excluded from the study.

From baseline (from 2-7 days) to end line (6months), a pres-study testing questionnaires according to common language was done. The group members were also educated within one week for coaching ahead before we started the fieldwork. At each follow-up, corresponding information was collected. At baseline, data concerning socio-economic and demographic background, and household characteristics and reproductive health were collecting. In addition, information concerning breastfeeding practices was gathering. Data regarding household characteristic, socioeconomic baseline data and changing food during pregnancy were also followed. As it is a follow up study in which we aimed to establish the impact of inappropriate diet on nutrition status of infants, the baseline data were also taken into consideration.

The morbidity of the couple mother-infant was assessed. Furthermore, at six months, data concerning eating more a particular meal three types of food) as follows, meat food, legumes, vegetables were collected. At end line, information regarding breastfeeding practices, complementary feeding and supplementary feeding were also collected. Information about

infant feeding practices was also collected. Interviewers were also trained on how to take anthropometric measurements. The clinics were visited by supervisors visited during home visit at least once a week to see how interviewers practice and how the work was evolving. At 42 days assessment, any information was concerning this study.

During the follow up, some participants took treatments for intestinal worms during antenatal care and others after birth or during the respective visits (42 days assessment, 3 months and 6 months). Based on the hypothesis that educating lactating mothers may help to decrease the risk of malnutrition in children under the age of six months. We conducted an intervention study focused on childbearing mothers. The education has begun at 3 months appointment and ended at 6 months but the results will be published later.

Anthropometry

Weight, length, head circumference (HC), Mid Upper Arm circumferences (MUAC) and sex of the infant were recorded from birth to 6 months. Mather Height (cm), Weight (kg) and MUAC (cm) were assessed at 3 and 6 months. However, at delivery (from 2 to 5 days postpartum) only MUAC were measured. The mother's age at delivery and pre-pregnancy height were asked at delivery. Infant weight was measured at the nearest of 1 kg, with light clothes, using an electronic scale (seca 336) at birth and with a suspended spring scale at 42 days, 3 and 6 months in that last order. From 42 days, 3 to 6 months, infant length was measured at the nearest 0.1 cm with a recumbent length board. Maternal height (to the nearest 0.1 cm) and weight (to the nearest 0.2 kg) were measured also at 42 days, 3 and 6 months. For every measurement, the measure was repeated four times if the difference between the two was >0.2 kg and >0.2 cm, to ensure the high quality of the data.

Sample Size

First of all, we randomly chose the study area (villages that are concerned by the study). The sample was selected from lactating women using a systematic sampling at baseline, 143 women were considered at the beginning. During the follow-up, five mothers and their children were not located during the home appointment. Two childbearing mothers were not concerned by the study because they did not answer ours questions. Nevertheless, when performing analysis for looking for outliers for the mother's weight, four weights of the mothers were strong and might affected the analysis. Besides, two outliers failed out of the mean for both Head Circumference and MUAC (Mid Upper Arm Circumference) of the children. Thus, they were not concerned by the analysis connected to the anthropometric measurement. When searching for outliers based on the Z score cut-off, two variables were deleted, therefore the sample become 136 mothers- children dyads for analysis with regard to nutrition status.

Data management and Statistical Analysis

Variables

Z-score Height-for-age (severe, moderate and mildly stunting) was defined as dependent variable and independent variables were household and socioeconomic characteristics and reproductive health, as well as, food habit, feeding habit and complementary feeding.

Variables Transformation

The BW (Birth Weight) and SGA (Small for Gestational Age) variables were dichotomized. The LBW was defined as <2.5 kg and normal birth weight (NBW) ≥2.5 kg and the SGA as less than 10th percentile while the normal height as more than 10th percentile (the value that divides the data, so 10% is below 10th percentile). The infant weights, the length and the age were transformed into Z-score of weight/length for age and sex. Z-scores below -2 for length/height-for-age (HAZ), weight-for-length/height (WHZ), and weight-for-age (WAZ) were defined using Child Growth Standards (WHO, 2006) as stunting, wasting, and underweight, respectively. Mother education level was transformed into binary variables, one defined as never attend school, illiterate and elementary level and, two as secondary level/professional and higher level of education/institut supérieur/university. Number of pregnancies was ranged and transformed into binary variables, first pregnancy (primigravide) defined as less than two pregnancies and, the second as two and more 2 pregnancy (multigravide).

In addition, education level was categorized as following: Secondary and high school as the first category and never attend school, Illiteracy and elementary in second category. Marital status was also divided in two categories. The first group is married women and living together with husband, married and husband living elsewhere, divorced, and living with partner without marriage, single). However, for the later, at last, they belonged to those who were deleted, because they are not in the data base. Spaced pregnancy was categorized in two groups.

The first group is pregnancies which are less than 24 months; and the second from 24 months to more. Moreover, mother's employment was also divided into employed (famers, small business and others jobs) and unemployed. Number of people and number of children in the household were divided into groups of more than 6 and more than five, respectively. Age was divided into 4 groups (<25 years old, 25to 29-, 30 to 340- and, 35 and more years old. Furthermore, the head of HH was categorized in menship (Father and his both parents) and womenship (mother and her both parents). Likewise, breastfeeding practice was divided into two groups.

The first group was exclusively breastfeeding (BF) at 4-6 months and the second, exclusively breastfeeding before 4 months of age. Regarding the missing values, age at marriage has missing values (62/143), and was excluded from the analysis from baseline data set. Furthermore, monthly and weekly income was not considered because women were not able to give a reasonable income, were also excluded from the study from the beginning of the follow up study.

Cleaning Data: The data was cleaned by two different persons

Statistical Analysis

The data was entered in Excel and analyzed by SPSS (Statistical Analysis Software) version 26.0. A WHO Anthropometrics software helped to calculate Z score. The descriptive statistic was performed to determine the prevalence of some variables. In addition, a multinomial logistic was run to establish predictor's factors of all stages of stunting. A multinomial logistic regression model was fitted to calculate the odds ratios and their related 95% confidence interval for all stages of stunting by socioeconomic, household characteristic and food malpractice.

Ethical Agreement

After proceeding for the inclusion in the study, childbearing mother gets an informal consent that was written in Swahili, the vernacular language in the area of the study. Then after, the form was signed by both the interviewee (lactating mother) and the interviewer (responsible of Lwiro Maternity or Lwiro Health Center). In fact, those who could not sign the form used the fingerprint. Besides, the proposal was approved by both German and DR Congo ethic committees of Freiburg Ethik Kommission in Germany and the Commission Institutionnelle d'Ethique in Bukavu, respectively. Meanwhile, some meetings with the Health Division of South-Kivu Province, the head of the Health Zone, the head of Hospitals, and the head of the Health Centers as well were held for study set up and for community workers protection within the home appointments. The government was informed about the study.

Qualitative Research

FGDs (Focus Group Discussion): First, before we started the Focus Group Discussion (FGD), we welcomed the participants for accepting our invitation. Then after, we introduced the teamwork and explained the purpose of the study in a few words, as well as the benefits of participating. In addition, we explained the subject (nutrition knowledge, food habit, decision maker in the household as well as the complementary feeding). We requested consent to record the conversation and to write their answers. We allowed everyone to freely express themselves their perspectives without interference. Afterwards, we ensured the confidentiality of their answers. The section lasted one hour. In total, 8 per group lactating women attended the FGD section. We have explored challenges for breastfeeding, complementary feeding, supplementary feeding and, food habit of the mother, as well.

Results of the Study

Quantitative Research

MOTHER CHARACTERISTICS	
Household characteristics	**Frequencies/Means**
Number of children in the HH (134)*	6.41±2.876
Number of people in the HH (N=134)*	4.328±2.784
Head of HH	
Womenship (mothers and her parents)	4(3.0)
Menship (husband and his parents)	1.31(97.0)
Number of pregnancy (+pregnancy of this newborn) (N=132)	4.151±3.097
Socio-economic characteristic	
Age(y) (N=132) a: Age asked at baseline of the mother	
<25	56(42.4)
25 to 29	28(21.4)
30-34	21(15.9)
35 and more	27(20.5)
Marital status (N=134)	
Married living together with husband	59(44.0)
Married, husband living elsewhere	1(0.7)
Divorced	1(0.7)
Living with a partner without marriage	73(54.5)
Education level of the mother (N=136)	
Never attended school	11(8.1)
Attended school<3 years	3 (2.2)
Elementary level (attended school 3-6 years)	49 (35.3)
Secondary level (attended school 7-12 years)	73(53.7)

Higher level of education	1 (0.7)
Spaced pregnancy (N=133)	
9-12 months	1(0.8)
1-2years	54(40.6)
2-3years	44(33.1)
More than 3years	5(3.8)
No relevant (Primipara)	29(21.8)
Anthropometric parameters of the mother	
Weight (134)*	59.186±5.838
Height (N=134) cm*	153.422±5.620
MUAC (133)* b cm	26.636±2.117
BMI; Kg/m2 (134)*b: Lack of corresponding sum of frequencies with total sample size is due to missing data and to outliers)	25.239±3.044
Less than 18.5	1(0.7)
18.5 to <24.99	71(53.0)
25 to 29.99	51(38.1)
30 and more	11(8.2)
Morbidity of the mother	
Yes	9(6.9)
No	124(93.1)
Residence (N=136)	
Buloli	8(5.9)
Cegera	24(17.6)
Kabuga	20(14.7)
Kahungu	28(20.6)
Lwiro	36(26.5)
Maziba	20(14.7)
INFANT CHARACTERISTICS	
Sex (N=136)	OR=0.88
Male	64(47.1)
Female	72(52.9)
Hb/dL(136)*; a: Lack of corresponding sum of frequencies with total sample size is due to missing data	10.794±1.217
Anthropometric parameters of the infants	
Weight (134)*b kg	7.197±0.656
Height cm*	61.861±3.251
MUAC (133)* b cm	14.173±1.043
Head Circumference (134)*	43.614±1.280
BMI; Kg/m2 (134)*b: Lack of corresponding sum of frequencies with total sample size is due to missing data and to outliers)	18.912±1.882
ZWH(130)*b	1.402±-1. 276
-2 to < -1	3(2.3)
-1 and more	127(94.9)
ZWA(N=130)*b	(-)0.606(0.820)
<-3	2(1.5)

-3 to <-2	4(3.1)
>-2 to <-1	35(26.9)
-1 and more	89(68.5)
ZHA(N=130)*b	(-)2.326(1.529)
<-3	46(35.4)
-3 to <-2	35(26.9)
>-2 to -<1	29(22.3)
-1 and more	20(15.4)
Morbidity of the infants	
Diarrhea within the last 2 weeks (N=134)	
Yes	5(3.7)
No	129(96.3)
Fever within the last 2 weeks (N=134)	
Yes	7(5.2)
No	127(94.8)
Cold within the last 2 weeks (N=134)	
Yes	20(14.9)
No	114(85.1)

Table 1: Household-economic and socioeconomic characteristic.

Variables of the study	**Severe stunted(N=46)**				**Moderately stunted(N=35)**				**Mildly stunted(N=29)**			
	β	**Wald(Chi square)**	**OR(95% CI)**	**P-value**	**β**	**Wald(Chi square)**	**OR(95% CI)**	**P-value**	**β**	**Wald(Chi square)**	**OR(95% CI)**	**P-value**
Socioeconomic status and household characteristic of respondents												
Size of Household (6 and more)	-0.419	0.614	0.658(0.197-2.190)	0.495	-0.944	0.657	0.389(0.107-1.412)	0.151	-0.999	0.721	0.368(0.90-1.513)	0.166
Number of children in the household (<5Vs. ≥5)	0.249	0.809	1.282(0.262-6.264)	0.759	0.51	0.803	1.664(0.345-8.027)	0.526	1.294	0.959	3.647(0.557-23.890)	0.177
Age(y)(N=132)a: Age asked at baseline of the mother												
<25	1.374	1.034	3.954(0.521-29.969)	1.184	1.526	1.093	4.599(0.540-39.161)	0.163	2.395	1.287	10.963(0.879-136.705)	0.063
25 to 29	0[b]	-	-	-	0[b]	-	-	-	0[b]	-	-	
30-34	-	-	-	-	-	-	-	-	-	-	-	
35 and more	-	-	-	-	-	-	-	-	-		-	
Marital status	-	-	-	-	-0.013	-	0.987(0.462-2.109)	0.973	-	-	-	
Married, living together with husband	-1.731	0.854	0.177(0.034-0.927)	0.04	1.612	0.866	0.199(0.036-1.089)	0.063	-2.166	0.95	0.115(0.018-0.737)	0.02
Married, husband living elsewhere	-	-	-	-	-	-	-	-	-	-	-	-
Divorced	-	-	-	-	-	-	-	-	-	-		-
Living with a partner without marriage	c	-	-	-	0.234	0	1.263(1.263-1.263)	NA	-0.276	0	0.759(0.759-0.759)	NA
Head of household												
Womenship(mothers plus her parents)	0.681	0.106	1.976(0.33-119.680)	0.745	-2.273	1.069	0.761(0.014-42.019)	0.894	1.069	2.296	2.912(0.032-262.012)	0.641
Menship(mothers plus his parents)	-	-	-	-	-	-	-	-	-		-	-

Main occupation of the mother												
Farmer at own farm	0.179	2.175	1.196(0.017-84.924)	0.934	c	-	-	-	-2.949	2.219	0.05(0.001-4.054)	0.184
Farmer at someone else	-	-	-	-	-	-	-	-	-	-	-	-
Small business	0.585	1.985	1.795(0.037-87.882)	0.768	-1.955	1.601	0.141(0.006-3.261)	0.222	-0.502	1.803	0.605(0.018-20.741)	0.781
Without employment	0.54	1.907	1.716(0.041-72.004	0.777	-2.456	1.57	0.086(0.004-1.860)	0.118	-1.601	1.733	0.202(0.007-6.029)	0.356
Other	0[b]	-	-	-	0[b]	-	-	-	0[b]	-	-	-
Residence												
Buloli	c	-	-	-	c	-	-	-	c	-	-	-
Cegera	2.916	1.375	18.475(1.247-273.751)	0.03	2.208	1.513	9.099(0.452-182.976)	0.149	3.73	1.519	41.672(2.124-817.543)	0.01
Kabuga	2.282	1.31	9.794(0.751-127.761)	0.082	2.52	1.38	12.426(0.832-185.644)	0.068	2.179	1.596	8.834(0.387-201.662)	0.172
Kahungu	1.601	1.37	4.960(0.338-72.744)	0.243	2.452	1.389	11.617(0.764-176.723)	0.077	3.061	1.457	21.339(1.227-371.141)	0.04
Lwiro	1.111	0.952	3.038(0.471-19.610)	0.243	1.27	1.05	3.562(0.454-27.912)	0.227	0.262	1.237	1.299(0.115-14.668)	0.836
Maziba	0b	-	-	-	0b	-	-	-	-	-	-	-
Reproductive health												
Number of pregnancy (including pregnancy of this newborn) (primigravid/ primipara vs. multigravid)	0.73	1.373	2.074(0.612-7.028)	0.241	-0.028	0.745	0.973(0.226-4.189)	0.971	0.553	0.771	1.314(0.215-8.043)	0.473
Number of children born alive (Including the newborn) (< 6vs. ≥6)	-0.197	0.07	0.821(0.191-3.531)	0.791	0.47	0.844	1.6(0.308-8.363)	0.578	0.284	0.938	1.329(0.211-8.35)	0.762
Number of children now (Including the newborn) (< 6vs. ≥6)	-0.599	0.631	0.685(0.197-2.190)	0.495	-0.083	0.595	0.920(0.287-2.954)	0.889	-1.265	0.844	0.282(0.054-1.477)	0.134
Birth spaced												
9-12 months	0b	-	-	-	-	-	-	-	0b	-	-	-
1-2years	0.924	0.717	2.520(0.618-10.276)	0.197	1.194	0	3.3(3.3-3.3)	NA	0.3	0.776	1.35(0.295-6.183)	0.699
2-3years	0.251	0.69	1.286(0.332-4.972)	0.716	1.917	0.871	6.8(1.233-37.497)	0.03	-0.036	0.739	0.964(0.227-4.102)	0.931
More than 3years	-	-	-	-	1.145	0.857	3.143(0.586-16.845)	0.181	-0.981	1.339	0.375(0.027-5.169)	0.464
No relevant (Primipara)	-	-	-	-	0.693	1.225	2.0(0.181-22.056)	0.571	-	-	-	-
Other	0[b]	-	-	-	0[b]	-	-	-	-	-	-	-
Infant characteristic	-	-	-	-	Infant characteristic		-	-	-	-	-	
Sex of the infants												
Male	-1.452	3.345	0.232(0.049-1.109)	0.067	-0.672	0.806	0.511(0.105-2.479)(0.677-4.227)	0.404	0.273	0.924	1.314(0.215-8.043)	0.768
Female	0[b]	-	-	-	0[b]	-	-	-	-	-	-	-

Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors, Wald: Chi-square; OR: odds ratio; CI: Confidence Interval; p-value: significant at 0.05 level; 4: The reference category is 4(well nourished); 0b: This parameter is set to zero because it is redundant; b: Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing, d: For all no answers, NC: Non calculate, NA: Not appropriate; Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors.

Table 2: Household socioeconomic characteristics, Reproductive Health and morbidity are predicting children's stunting.

Variables of the study	Severe stunted (N=46)				Moderately stunted (N=35)				Middly stunted (N=26)			
	β	Wald(Chi square)	OR(95% CI)	P-value	β	Wald(Chi square)	OR(95% CI)	P-value	β	Wald(Chi square)	OR(95% CI)	P-value
Morbidity of both mother and children[4]												
Children morbidity[4]												
Cold two weeks before the survey (Yes Vs. No)	-0.579	0.303	0.56(0.71-4.409)	0.71	1.069	0.627	2.913(0.206-41.106)	0.429	0.347	0.081	1.415(0.130-15.392)	0.775
Fever two weeks before the survey (Yes Vs. No)	0.739	0.262	2.093(0.123-35.477)	0.609	-0.374	0.049	0.688(0.025-18.926)	0.825	0.242	0.023	1.274(0.056-28.947)	0.879
Diarrhea two weeks before the survey (Yes Vs. No)	12.723	0.003	NA	0.957	2.225	1.755	9.258(0.344-249.232)	0.185	15.796	0b	-	0.984
Vomit two weeks before the survey												
Vomit two weeks before the survey (Yes Vs. No) [0b]	-0.618	NA	-	-2.687	0b	NA	NA	NA	-15.533	0b	-	0.984
Adjusted Hb of the children	-0.139	0.465	0.870(0584-1.297)	0.495	-0.321	2.273	0.72.5(0.477-1.101)	0.132	-0.398	3.539	0.671(0.443-1.017)	0.06
Low Birth weight infants	0.859	0.7	0.424(0.057-3.168)	0.403	-2.021	3.26	0.133(0.015-1.1189)	0.071	-1.288	1.272	0.276(0.029-2.589)	0.259
Small for gestational age	-0.004	0.051	0.996(0.961-1.032)	0.821	0.029	2.416	1.029(0.992-1.068)	0.12	0.009	0.215	1.009(0.971-1.048)	0.643
Mother's morbidity[4]												
Sickness 2 weeks before the survey (Yes Vs. No)	1.647	2.501	5.193(0.674-40.0)	0.114	1.686	1.653	5.396(0.413-70.488)	1.199	0.737	0.479	2.089(0.259-16.839)	0.489
Adjusted Hb of the mothers	0.288	1.023	1.333(0.763-2.328)	0.312	0.288	1.023	1.333(0.763-2.328)	0.312	0.206	0.52	1.229(0.702-2.149)	0.471

Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors, Wald: Chi-square; OR: odds ratio; CI: Confidence Interval; p-value: significant at 0.05 level; 4: The reference category is 4(well nourished); 0b: This parameter is set to zero because it is redundant; b: Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing, d: For all no answers, NC: Non calculate, NA: Not appropriate; Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors.

Table 3: Morbidity of the both mothers and children.

Variables of the study	Severe stunted (N=46)				Moderately stunted (N=35)				Mildly stunted (N=26)			
	β	Wald (Chi square)	OR (95% CI)	P-value	β	Wald (Chi square)	OR (95% CI)	P-value	β	Wald (Chi square)	OR (95% CI)	P-value
EATING BEHAVIOR OF THE MOTHER AT 6 Month[4]												
Like eating more fruit (Yes Vs. No)	1.777	2.714	5.913(0.714-48.989)	0.099	1.525	1.967	4.596(0.545-38.723)	0.161	1.775	2.599	5.898(0.682-1.007)	0.107
Like eating more vegetables (Yes Vs. No)	-0.921	2.23	0.398(0.119-1.334)	0.135	-0.704	1.236	0.494(0.143-1.712)	0.266	-1.279	3.532	0.278(0.073-1.056)	0.06
Like eating more animal food (Yes Vs. No)	0.288	0.229	1.333(0.411-4.329)	0.632	0.387	0.411	1.472(0.451-4.804)	0.522	0.667	1.008	1.948(0.556-6.824)	0.297
Changing food at during lactation (Yes Vs. No) ask at end line	1.073	1.204	2.923(0.430-19.849)	0.272	1.557	1.675	4.745(0.499-50.143)	0.196	15.929	NA	NA	NA
FEEDING BEHAVIOR OF CHILDREN at 6 Month												
COPLEMEMTARY AND SUPPLEMENTARY4, [b]												

Supplementary feeding (Yes)	-1.284	1.279	0.277(0.03-2.563)	0.277	-0.512	0.23	0.599(0.074-4.855)	0.631	-1.398	1.038	0.247(0.017-3.637)	0.308
Complementary feeding with cow milk (Yes)	-14.297	0.001	6.179(0.000-b)	0.972	-14.441	0.001	5.351(0.000-b)	0.972	-13.414	0.001	1.493(0.000-b)	0.974
Complementary feeding with powder milk (Cowbell) (Yes)	0.297	1.191	1.346(0.355-5.103)	0.662	0.823	1.191	2.278(0.519-9.992)	0.275	0.322	1.888	1.38(0.322-5.925)	0.665
Complementary feeding with porridge(maize, plantain banana, sorghum, rice) (Yes)	24.634	1130.3	4.993(1.188-2.099)	0,000	24.403	852.7	3.961(NA-NA)	0,000	25.57	NC	NA	NC
Complementary feeding with fruits(Yes)	1.662	4.757	5.272(1.184-23.486)	0.029	1.602	4.003	4.964(1.033-23.852)	0.005	0.871	1.362	2.390(0.553-10.332)	0.243
Complementary feeding with vegetables (Yes)	-13.269	0.001	1.728(0.000-b)	0.974	-12.958	0.001	2.357(0.000-b)	0.975	-13.674	0.001	1.152(0.000-b)	0.974
Complementary feeding with family food or family plate (Yes)	0.94	2.343	2.560(0.768-8.534)	0.126	0.561	0.782	1.753(0.505-6.078)	0.377	0.302	0.221	1.352(0.384-4.758)	0.638
Exclusively Breastfeeding (Yes)	-0.782	0.341	0.458(0.0033-6.310)	0.559	-0.246	0.034	0.782(0.056-10.909)	0.855	-1.052	0.444	0.349(0.384-4.758)	0.505
BREASTFEEDING BEHAVIOR AT 6 MONTH[3]. 0[b]												
Not breastfed infant at night (Yes)	-0.458	1.539	0.633(0.307-1.304)	0.215	-2.69	0.514	0.764(0.367-1.593)	0.474	-	-	-	-
Not breastfed infant at night (No)	0b	-	-	-	-		-	-	-	-	-	-
Not breastfed infant during the day (Yes)	0.551	4.607	1.735(1.049-2.871)	0.032	0.539	4.405	1.714(1.036-2.838)	0.036	-	-	-	-
Not breastfed infant during the day (No)	0b	-	-	-	-	-	-	-	-	-	-	-
SCREENING LOW BIRTH WEIGHT AND SMALL FOR GESTATIONAL CHILDREN [4, 0b]												
SGA (Yes)	19.46	NA	NA	NA	0.577	0.235	1.781(0.173-18.368)	0.628	0.342	0.073	1.407(0.119-16.658)	0.786
SGA (No)	0b	-	-	-	-	-	-	-	-	-	-	-
LBW(Yes)	-0.862	0.358	0.422(0.025-7.106)	0.911	0.141	0.013	1.152(0.098-13.558)	0.911	0.785	0.433	2.192(0.211-2.741)	0.511
LBW (No)	0[b]	-	-	-	-	-	-	-	-	-	-	-
SCREENING VISION ISUUES AT BASELINE[4]												
Vision problem at twilight(Yes)	-0.856	0.351	0.425(0.025-7.197)	0.553	-38.37	1349.39	NA	0,000	-19.021	329.717	NA	0,000
Vision problem at twilight(Yes)	0[b]	-	-	-	-	-	-	-	-	-	-	-
Vision problem at day time(Yes)	0.916	0.311	2.5(0.1-62.605)	0.577	37.77	NC	NA	NC	18.596	NC	NA	NC

Vision problem at day time(Yes)	0[b]	-	-	-	-	-	-	-	-	-	-	-

Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors, Wald: Chi-square; OR: odds ratio; CI: Confidence Interval; p-value: significant at 0.05 level; 4: The reference category is 4(well nourished); 3: The reference category is 3(mildly nourished); 0b: This parameter is set to zero because it is redundant; b: Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing, d: For all no answers, NC: Non calculate, NA: Not appropriate; Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors.

Table 4: Food habit of mothers and children, LBW, SGA, and Vision problem as well by stunting.

Variables of the study	Severe stunted (N=46)				Moderately stunted (N=35)				Mildly stunted (N=26)			
	β	Wald (Chi square)	OR (95% CI)	P-value	β	Wald (Chi square)	OR (95% CI)	P-value	β	Wald (Chi square)	OR (95% CI)	P-value
EATING BEHAVIOR OF THE MOTHER AT 6 MONTH[4]												
Like eating more fruit (Yes Vs. No)	1.777	2.714	5.913(0.714-48.989)	0.099	1.525	1.967	4.596(0.545-38.723)	0.161	1.775	2.599	5.898(0.682-1.007)	0.107
Like eating more vegetables (Yes Vs. No)	-0.921	2.23	0.398(0.119-1.334)	0.135	-0.704	1.236	0.494(0.143-1.712)	0.266	-1.279	3.532	0.278(0.073-1.056)	0.06
Like eating more animal food (Yes Vs. No)	0.288	0.229	1.333(0.411-4.329)	0.632	0.387	0.411	1.472(0.451-4.804)	0.522	0.667	1.008	1.948(0.556-6.824)	0.297
Changing food at 6 months (Yes Vs. No)	1.073	1.204	2.923(0.430-19.849)	0.272	1.557	1.675	4.745(0.499-50.143)	0.196	15.929	NA	NA	NA
FEEDING BEHAVIOR OF CHILDREN at 6 Month												
COPLEMEMTARY AND SUPPLEMENTARY[4, b]												
Supplementary feeding (Yes)	-1.284	1.279	0.277(0.03-2.563)	0.277	-0.512	0.23	0.599(0.074-4.855)	0.631	-1.398	1.038	0.247(0.017-3.637)	0.308
Complementary feeding with cow milk(Yes)	-14.297	0.001	6.179(0.000-b)	0.972	-14.441	0.001	5.351(0.000-b)	0.972	-13.414	0.001	1.493(0.000-b)	0.974
Complementary feeding with powder milk (Cowbell)(Yes)	0.297	1.191	1.346(0.355-5.103)	0.662	0.823	1.191	2.278(0.519-9.992)	0.275	0.322	1.888	1.38(0.322-5.925)	0.665
Complementary feeding with porridge(maize, plantain banana, sorghum, rice)(Yes)	24.634	1130.3	4.993(1.188-2.099)	0.000	24.403	852.7	3.961(NA-NA)	0.000	25.57	NC	NA	NC
Complementary feeding with fruits(Yes)	1.662	4.757	5.272(1.184-23.486)	0.029	1.602	4.003	4.964(1.033-23.852)	0.005	0.871	1.362	2.390(0.553-10.332)	0.243
Complementary feeding with vegetables(Yes)	-13.269	0.001	1.728(0.000-b)	0.974	-12.958	0.001	2.357(0.000-b)	0.975	-13.674	0.001	1.152(0.000-b)	0.974
Complementary feeding with family food or family plate(Yes)	0.94	2.343	2.560(0.768-8.534)	0.126	0.561	0.782	1.753(0.505-6.078)	0.377	0.302	0.221	1.352(0.384-4.758)	0.638
Exclusively Breastfeeding (Yes)	-0.782	0.341	0.458(0.0033-6.310)	0.559	-0.246	0.034	0.782(0.056-10.909)	0.855	-1.052	0.444	0.349(0.384-4.758)	0.505
BREASTFEEDING BEHAVIOR AT 6 MONTH [3,0b]												
Not breastfed infant at night(Yes)	-0.458	1.539	0.633(0.307-1.304)	0.215	-2.69	0.514	0.764(0.367-1.593)	0.474	-	-	-	-
Not breastfed infant at night(No)	0[b]	-	-	-	-	-	-	-	-	-	-	-
Not breastfed infant during the day(Yes)	0.551	4.607	1.735(1.049-2.871)	0.032	0.539	4.405	1.714(1.036-2.838)	0.036	-	-	-	-
Not breastfed infant during the day(No)	0[b]	-	-	-		-	-	-	-	-	-	-
The reference category is 3(marginally stunted), b: This parameter is set to zero because it is redundant, NC: Non calculate	-	-	-	-	-		-					
SCREENING LOW BIRTH WEIGHT AND SMALL FOR GESTATIONAL CHILDREN [4,0b, b]												
SGA (Yes)	19.46	NA	NA	NA	0.577	0.235	1.781(0.173-18.368)	0.628	0.342	0.073	1.407(0.119-16.658)	0.786
SGA (No)	0b	-	-	-	-	-	-	-	-	-	-	
LBW(Yes)	-0.862	0.358	0.422(0.025-7.106)	0.911	0.141	0.013	1.152(0.098-13.558)	0.911	0.785	0.433	2.192(0.211-2.741)	0.511

LBW (No)	0b	-	-	-	-	-	-	-	-	-	-	

Exp β (they are the exponentiation of the coefficients (there are odds ratios for the predictors; Wald: Chi-square; OR: odds ratio; CI: Confidence Interval; p-value: significant at 0.05 level; 4: The reference category is 4(well nourished); 3: The reference category is 3 (mild stunting); 0b: This parameter is set to zero because it is redundant; b: Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing, d: For all no answers, NC: Non calculate, NA: Not appropriate; Exp β (they are the exponentiation of the coefficients) there are odds ratios for the predictors.

Table 5: Food behavior of mothers and children, LBW children, SGA childbearing and vision issue of the mothers by children's stunting.

I. Qualitative Research

Theme	Codes	Representative quotes
A. Nutrition knowledge	In your opinion, what is good food for health?	Three type of food are good for health "(Mother 1)". Diversify food is good for health "(Mother 2)". I think what we eat is good as we are well nourished "(Mother 3)".
	Who teaches you about good food for health?	Nurses at antenatal care "(Mother 1)", A friend "(Mother 2)", My mothers "(Mother 3)", A neighbor "(Mother 4)".
	I heard from some of you about some good food and, I want also to know your opinion? Advantage, disadvantage and frequency of consumption	
	Meat	Meat is not good for health because it may causes cancer I do not eat too much "(Mother 1)". Meat is not good for health because it may create diseases like hypertension, I eat it regularly because my husband is a baker. "(Mother 2)". meat is good for health, it increases appetite. I like eat it 4 times a week "(Mother 3)". Meat is good for health because it contains protein. I eat it when I have money "(Mother 4)".
	Fruits	Fruits are good for health because increases appetite I do not eat too much because it is expensive "(Mother 1)". Fruits are good for health, I eat it when it is the season, then it is cheaper and available "(Mother 2)". Fruits are good for health, it sweet. I like eat it 2 times a week "(Mother 3)". Fruits are good for health. But, I do not eat it because of lack of money. I have to pay school fees and food "(Mother 4)".
	Vegetables(commonly called legume=Mbogamboga)	Vegetables are good for health but sometimes creates diarrhea to people who are suffering from amoebias "(Mother 1)". Vegetables are good for health as they increases blood. I eat it very often because "(Mother 2)". The same opinion as mother 1. But, I eat it 3 times a week as I was taught at antenatal care that it brings vitamins in the body "(Mother 3)".
	Regarding the abovementioned foods, is it good to give them to a child? I f yes why?	"Yes it is good to give them to a child, but vegetables creates diarrhea "(Mother 1)". No, the child is breastfed "(Mother 2)". Yes, only fruits when the child has constipation "(Mother 3)".
	What do you think about carrots, leek, eggplant, garlic, green pepper, onions, tomatoes,Are they good for health?	"Yes they are good for health because they increases taste "(Mother 1)". Yes, the same reason "(Mother 2)". Yes, the same reason "(Mother 3)".
	Some of you told about small fish. Do you also know about their importance for health? Can you give them to your child?	No, they are not good for health because they cause kwashiorkor. I cannot give it to my child "(Mother 1)" NO, the same reason "(Mother 2)" NO, the same reason "(Mother 3)" NO, the same reason "(Mother 4)".

	Could you please tell us what foods you know and their content? And, what food cannot be eaten together with another one? Why not?	"Carrot heals eyes and vegetables increase the blood , meat has protein "(Mother 1)" Vegetables have vitamin "(Mother 2)" Sugar cane brings force "(Mother 3)" Sugar brings energy "(Mother 4)" Fruit brings appetite "(Mother 5)"Fruit brings energy "(Mother 6)" fruit brings vitamins "(Mother 7)", Rice and sorghum stop constipation "(Mother 8)"."We are not aware about which food must not be eaten together (all mothers). Could you please explain this to us? (Mother 8)".
Household (HH) situation		
	In your HH, who decide which food to eat?	Usually me, but sometimes my husband ask for his favorite meal "(Mother 1) "Me " (Mother 2) "It is me (Mother 3)
	In your HH, who decide the utilization of money?	My husband "(Mother 1)" my husband for big issues, but for food it is me "(Mother 2)" My husband "(Mother 3)". Both of us "(Mother 4)". My mother -in-law, we are still living at their house "(Mother 5)".
	Are you eating the same food with your husband? If no, why this difference?	"Yes we eat together. Only some organ inside the chicken (heart, ventricle) "(Mother 1)" "We eat together "(Mother 2)" Mother 3 to mother 8, we believed that God is the supplier; He will take care of our children. That is why we are not involved in family planning program.
	Are giving the same food adults eat to your children? If yes why?	No "(Mother 1)" Yes, when he/she is Angry "(Mother 2)" Yes when she asked for eat by crying "(Mother 3)". Yes, because I am sometimes not around and he/she is "(Mother 4)" Yes, when she /he is not satisfy by breast milk "(Mother 5)".
	Concerning your children, please tell us how you have started giving them food (porridge)	I start giving a liquid porridge (plantain banana) as he/she is still young "(Mother 1)" I start give her/him cow milk as it is available and cheaper "(Mother 2)". I start with rice porridge before MASOSO "(Mother 3)" I start giving MASOSO "(Mother 4)" I started giving him/her liquid sorghum porridge "(Mother 5)."
	When are you giving to your children animal foods, vegetables and fruits?	When he start eating the family meal "(Mother 1)" When he/she is sick I give fruit "(Mother 2)". When he ask for food and we are eating "(Mother 3)".

Outcomes

Quantitative Result

The results of Household, socioeconomic and anthropometric characteristics are presented in the Table I. They revealed that the average of family size and the number of children in the HH were 6.41(2.876) persons and 4.328(2.784) persons, respectively.

Almost the totality of the HH is led by a man (97.00%, 131/134). The average number of pregnancy is 4.151(3.097) pregnancies. Childbearing mothers are 27.417(6.837) years old on average. Besides, less than half (42.4%, 56/132) are less than 25 years old.

The Weight, Height and MUAC (Mid Upper Arm Circumstance) of the lactating mothers are respectively on average of 59.186(5.836) kg, 153.422(5.62)cm and 26.636(2.117)cm, in that order. The average of the BMI (Body Mass Index) of the mothers is 25.636(2.177), with a very high prevalence of overweight (38.1%, 51/134) and a low prevalence of obese 8.2% lactating mothers.

The average of the size of household and, the number of children in the household are 6.41(2.876) and 4.328(2.784) persons, respectively. The study population is more distributed in Lwiro with (26.5%, 36/136).

Concerning the nutrition status of the children, the average Weight is 10.794(1.217) Kg, and, the one's of MUAC is 14.173(1.043) cm. The average of children's Head Circumference is 43.614 (1.280) cm. The female sex is predominant with (52.9%, 72/136,), the sex ratio is 0.88. The average children's hemoglobin is 10.794 (1.217) gr/dL. The children's nutrition status is characterized by a mere prevalence of marginally wasted (2.3%, 3/130). However, more than one-fifth of children are moderately underweight

(26.9, 35/130). Nonetheless, (35.4%, 46/130), (26.9%, 35/130) and (22.3%29/130) are severely, mildly and marginally stunted with an overall high prevalence of stunting (84.6%). A chronic malnutrition characterized those children. Therefore malnutrition is a public Health issue in the study region.

Table II, summarized the association between Household, and socio-economic and Reproductive Health characteristic of the mothers, as well as the morbidity of both mother and infant pair with stunting in six-old month children. The results are as follows: Firstly, the multinomial regression analysis revealed a statistically link between severe stunting of children and the fact that mothers were married and were living with their husband (p=0.04). But, children from those mothers were protected against all stages of stunted (OR<1). On the other hand, others characteristics (see table II) have not shown any statistic significance (p>0.05) with severe stunting in children. Besides, a statistically significance was observed between severe stunting of children and the fact that they came from Cegera (p=0.034). Children from Cegera's region are eighteen, nine and forty two more likely to be severe, moderate and mild stunting (OR: 18.475; CI: 1.247-273.751; OR: 9.099; CI: 0.452-182.976; OR: 41.672(2.124-817.54). While, children from family that came from Kabuga was around ten times more likely predisposed only to severe stunting (OR: 9.794; CI: 0.751-127.761). Furthermore, children from mothers who come from Kahungu were around five and eleven (OR: 4.960; CI: 0.338-72.744; OR: 11.617; CI: 0.764-176.72) more likely to be severe and moderate stunting.

Children from Lwiro are three, around four and more than one more likely to be severely, moderate and mild stunted (OR: 3.038; CI: 0.471-19.610; OR: 3.562, CI: 0.454-27.912; OR: 1.299; CI: 0.115-14.668) respectively.

Moreover, number of pregnancies (multigravid) exposed children to severely and mildly malnourished (OR: 2.074; CI: 0.612-7.028; OR: 1.329; CI: 0.211-8.35). Likewise, the number of children in the HH (6 and more) is one, two and three more times to predispose children to severe, moderate and mild malnutrition (OR: 1.282; CI: 0.262-6.264; OR: 1.664; CI: 0.345; OR: 3.647; CI: 0.557-23.89; OR: 1.329; CI: 0.211-8.35) in that order. Children from family that was led by a women was around two and thereabouts three more likely to be severely stunted (OR: 1.976; CI: 0.33-119.680; OR: 2.912; CI: 0.032-262.012). Nonetheless, the odds of severe and moderate stunting were around four and five more likely to appear in children when mothers were less than 25 years old (OR: 3.954; CI: 0.262-6.264; OR: 4.599; CI: 0.540-39.161;).

In addition, the odds of severe stunting were two more likely among children from the mothers who have their own farm (OR: 1.196; CI: 0.017-84.924), and among those who were doing small business (OR: 1.795; CI: 0.037-87.882), and among unemployment mothers as well (OR: 1.716; CI: 0.041-72.004).
Other factors not mentioned above were protecting children against being severely stunted (OR<1). Secondly, the result showed that only the fact of spacing pregnancy for 2 to 3 years was statically associated with moderately stunted (p=0.028). Children from aforementioned mothers were seven and three times more likely to be moderate malnourished (OR: 6.8; CI: 1.233-37.497).

Children who came from Kabuga were twelve and around nine more likely to be moderately and mildly stunted (OR: 12.426; CI 0.832-185.64; OR: 8.8934; CI: 0.387-201.662). Besides, children from mothers who were married and staying with their husband were lower likelihood of moderate stunting (OR: 0.199; CI: 0.036-1.089). Other none mentioned variables, the evidence for the statistic significant were not shown (p>0.05) see table II. Furthermore, Children from first-time mothers were two times more likely (OR: 2.0; CI: 0.181-22.056) to be moderately malnourished.

Other factors none mentioned in this section were protecting children from being marginally stunted (OR<1). Lastly, the same analysis revealed that the fact of living in both study region (Cegera and Kahungu) was statistically associated with marginally stunting in children (p=0.014 and p=0.036), respectively.

Children who came from Kahungu region were twenty-one more likely to be mildly stunted (OR: 21.339; CI: 1.227-371.14). In addition, the fact of being married and living together with husband was associated statistically with marginally stunting (p=0.023). Nevertheless, the fact children who came from those mothers are less likely to expose them from mildly malnourished (OR: 0.115; CI: 0.0018-0.737).

For other variables, the evidence was not shown when the mothers were aged less than 25 years old (p=0.063), but the odds of being mildly stunted for children were high (OR: 10.963; CI: 0.879-136.70).

Other factors were protecting children against being mildly stunted (OR<1) (Table 2). On the other hand, the children from mothers who spaced pregnancy between one to two years were 1.35 times more likely to be marginally stunting (OR: 1.35; CI: 0.295-6.183). Moreover, male sex children are 1.314 times more likely to become mildly stunted (OR:1.314; CI: 0.215-8.043).

For all, we are comparing severe, moderate and marginally stunted with well- nourished children. In sum, the study highlights a medium prevalence of overweight and obese mothers (11/134, 8.2%).

Besides, it is showed up a low prevalence (3/130, 2.3%) of underweight and a critical prevalence (32.7%) of wasting and a very high prevalence (84.6%) of stunting, as well, according to WHO thresholds Public Health significance level [2].

Table III, summarizes the morbidity of both mothers and children associated with children's stunting. Meanwhile, no variables remained statistically associated with severe stunted (p>0.05).

Nonetheless, children who got fever were 2.093 times more likely to be stunted severely (OR: 2.093; CI: 0.123-35.477). Besides, children from sick mother's were five times more likely to be severely stunted (OR: 5.193; CI: 0.674-40.0) and, children from anemia's mothers were 1.333 times more likely to become malnourished (OR: 1.333; CI: 0.763-2.328).

Others predictors were protecting children from being severe stunting (OR<1). Concerning moderate stunting, a weak association was observed between LBW and moderate malnourished (p=0.07). However, children who had diarrhea and cold were exposed to moderately stunting (OR: 9.258; CI: 0.344-249.232 and OR: 2.913; CI: 0.206-41.106), respectively. In contrary, the fact of being small for gestational age was negatively associated with moderate stunting (OR: 1.029; CI: 0.992-1.068). Others determinants were protecting children from being marginally malnourished (marginally stunted) (OR<1).

At last, a marginally association was observed between children's anemia and mildly malnourished (p=0.06) and, other variables have not shown a statistic evidence (p<0.05). Although, children who develop cold and fever were 1.415 and 1.274 times more likely to be mildly stunted (OR: 1.415; CI: 0.130-15.392 and, OR: 1.274; CI: 0.056-28.947), correspondingly. In addition, sickness and anemia of the mother were factors associated with marginally stunted (OR: 2.089; CI: 0.259-16.839 and OR: 1.229; CI: 0.702-2.149).

Furthermore, to be born small according to the gestational age was positively associated with mildly stunted (OR: 1.407; CI: 0.119-16.658).

Table IV, summarizes food behavior of mothers and children, LBW children, SGA childbearing and vision issue of the mother associate with children's stunting.

Concerning food behavior of the mother, All characteristics have not shown any statistic significance (p>0.05) with stunting in children. However, children from mothers who were not getting used to eat more fruit and more animal food were severe (OR: 5.913; CI: 0.714-48.989 and OR: 1.333; CI: 0.411-4.329), moderate (OR: 4.596; CI: 0.545-38.723 and OR: 1.472; CI: 0.451-4.804) and mildly stunted (OR: 5.898; CI: 0.628-1.007 and OR: 1.948; CI: 0.556-6.824) in comparison with well nourished.

Indeed, not eating more vegetable were protecting children from being severe, moderate and mild stunting (OR<1). Children from lactating mothers who have not changed meal during lactation were predispose to severe (OR: 2.923; CI: 0.430-19.849) and moderate stunting (OR: 4.745; CI: 0.499-50.143) in comparison with well-nourished children. Regarding feeding behavior of the infants, complementary feeding with porridge and with fruits were statistically associated with severe stunted (p=0.000 and 0.029) and moderate stunting (p=0.000 and 0.005).

In fact, children fed by cow milk (OR: 6.179; OR: 5.351and OR:1.493), powder milk (OR:1.346; CI: 0.355-5.103; OR: 2.278; CI:0.519-9.992; OR: 1.38; CI: 0.322-5.925), porridge (OR:4.993; CI:1.188-2.099; OR: 3.961; NA), fruit (OR: 4.964; CI: 1.033-23.852; OR: 2.390; CI: 0.553-10.332), vegetables(OR: .728; OR: 2.357; OR:1.152)and, family plate or family food as well (OR: 2.560; CI: 0.768-8.534, OR: 1.753; CI: 0.505-6.078, OR:1.352; CI: 0.384-4.758) respectively, were exposed to three stage of stunting (severe, moderate and mildly stunted) comparing with well nourished children.

On the other hand, the fact of being supplemented with vitamin (multivitamin or complex vitamin B) and being exclusively breastfed within 6 month were protective against all the three stages (OR<1). Relating to breastfeeding behavior, not breastfeeding the infants at day times was statistically associated with two stage of stunting (severe and moderate) in six months old children (p=0.032 and 0.036). Indeed, the fact of not breastfed the children during days times have exposed them from being Severe stunted (OR:1.735; CI: 1.049-2.871; OR:1.714; CI:1.036-2.838) in that order, in comparison with mildly stunted. On the other hand, not breastfeeding at night have protected against severe and moderate stunted (R<1).

When screening Low Birth Weight and Small for Gestational Aged children from birth to six month, the results showed that children who were weighted low at birth were protected against severe stunting (OR: 0.422; CI: 0.025-7.106), but were exposed to both moderate and mildly stunting (OR: 1.152; CI: 0.098-13.558; OR: 2.192; CI: 0.211-2.741) compare with well nourished. Likewise, children born smaller were predisposed to both moderate and mildly stunting (OR: 1.781; CI: 0.173-18.368) and (OR: 1.40407; CI: 0.0119-16.658), respectively.

Focus Group Discussion Results

Meanwhile, two main themes (A) nutrition knowledge about good food for health and theme B (Household situation) were assessed. Concerning the first topic, mothers highlighted the "three type of food" as a good food for health (mother1) and, "diversity of meal" for (mother2). The last states, as we are well nourished apparently, this mean that the food we eat is good. Other mothers were pouched to say something during the discussion, but they have not said anything.

As a result, 2 out of 3 were aware of good food. However, one out of 4, has received information respectively from the nurse, friend, mother and neighbor. This showed the information comes from elsewhere. As an outcome, mother's followed what nurses and their mothers have said than what is stated by others persons, this is the matter. Four mothers out of 8 gave advantages and disadvantages of consuming meat, fruits and vegetables (green leaves).

The fist mother states the "meat brings cancer", therefore, she wanted eat it more. The second mother said that "meat causes blood pressure" Only one mother try to give the frequency "4 times"of eating animal food and it tastes good (mother 3).

Besides, one knew that "it contains protein" (mother 4). As an outcome, a bad message (meat creates diseases) was spread in the area, and, the taste is a reason why a mother like eat meat. The advantages and consequences of eating fruits, all of mothers point out that "fruits are good for heath. But there is contradiction about the matter of market price of fruit. The first and the last (fourth) stated that fruits are "expensive" and the second states that "they are cheaper".

As the results, this might depended on the revenue of the household. Two others stated that it is because "they are sweet" (Mother 3) and "increases appetite" (Mother 4). The mother 2, said that "fruit are available" during "season".

During discussion, mothers showed that they don't have the same revenue that is why; fruit may be cheaper for one and expensive for the other. Moreover, the fruit role in the body is to increase appetite, as they are tasted good. According to mothers in the study area, vegetables are good for health. However, it is"aggravated amoebias" (mother 1 and mother 3). Two of them stated that Vegetables "brings vitamins (mother 3) and "increases blood (mother 2). As a outcome, half of them are informed about the content of vegetables but, another half has distorted information. During discussion, all of mothers gave their own experience concerning the role of vegetables in aggravating diarrhea. Two mothers out of 3 believed that is good for child's health to eat meat, fruit and vegetables, however, it is known in the region that "vegetables creates diarrhea" to young children (mother 1). The last mother highlighted that "fruit is recommended to children when they have issue of constipation. The second mother, states that, a breastfed children may not eat other meal (meat, vegetables and fruits) instead of breast milk.

During discussion, the first idea was supported by the group. Regarding small fish, all mothers stated that small fish (kabuchungu/ or ndagala) is not good for health. It creates kwashiorkor. In the session discussion, all of them highlighted that it has nothing inside. During FGDs session, we would to know what the content of common food is, and why others cannot be eaten together. "Carrot healed eyes and vegetables increased the blood , meat has protein "(Mother 1)" Vegetables have vitamin" (Mother 2) "Sugar cane brings force" (Mother 3) "Sugar brings energy" (Mother 4) "Fruit brings appetite" (Mother 5) "Fruit brings energy" (Mother 6) "fruit brings vitamins" (Mother 7), "Rice and sorghum stop constipation" (Mother 8).

"We are not aware about which food must not be eaten together. Could you please explain this to us? (Mother 8)". As a result, three type of food is not well-known by women in the region. Few mothers are informed about food content and no one is aware about which food cannot be eaten together. In addition, we just realized that they have a vulgar knowledge. Regarding the second theme, the decision about which food to eat, is generally make by the mothers (both mothers1 and mother 2). However, the decision regarding expenses is in majority made by men and their mothers. The couple eats together except if it is a food taboos for women "heart and ventricle of a chicken said (mother 1)".

The family meal is given to children (all mothers), when the child is hungry (both mother 1 and mother 5), due to crying, both mother 3 and mother 4). A mother believes that beast milk may not be enough for the baby, "we give family meat when the child when he/she is not satisfied by the breast milk mother 5". When mothers started giving porridge was said by 3 mothers.

All of them started giving porridge, "Plantain bananas as the child is still young (mother1)", "cow milk, available and cheaper (mother 2)", "rice porridge first and then after MASOSO (Maize, Sorghum and Soy), (mother 3)", begin with directly "MASOSO" (mother 4) and "sorghum porridge (mother) 5". The result shows that they are not informed about when the must started complementary feeding and with which food they might started. Regarding the time when children may eat animal food, vegetables and fruits. One out of three stated that when the child will start eating three types, when they will start to eat "the family food, mother 1)" but "they will be given on demand of the child or when he cries (Mother 3)". "When the child is sick, but only fruit may be given, mother 2", not three foods. This shows that they do not know when they should have started the complementary feeding of their children. Mother 3 to mother 8, god is our children's supplier, Mother 8, and we do not care about who will feed our children, He is the one who plan, who will support our family. He asks us to not care about tomorrow and He does not like family planning.

The last topic was not plan in the focus group discussion, but, as she mentioned that, we just considered include in our result.

Discussion

To date, few studies have explored the association of food habit and food malpractice of both mothers and children with chronic malnutrition in six months old children in South-Kivu. This discussion is concerned only result with p-value less that 0.05 and corresponding odds ratio. The study showed up an increased of the stunting prevalence (84.6%) in rural area of Lwiro.

This result is worrying, because, since for more than 4 decades, nutritional researches and interventions have been carried out in the region. It could be an improvement; unfortunately, chronic malnutrition is ravaging children in hiding. Meanwhile, it is still discussed between experts in nutrition concerning the fact that there is evidence that stunting children could catch up in growth and brain development before 24 months.

Indeed, it is possible if and only if the there is availability of food in the area and if mother are aware of what food (content) they should eat and give to their children. If not, the problem can stay and may creates health and nutritional issues later in life [15]. Therefore, it is better to combat malnutrition in all its forms in the region of Lwiro.

This aforementioned result is very high than the one published in Uganda (30.1%) [3]. This may be due to the fact that in Uganda's study, the rich and middle households were also included in the study; While Lwiro is a rural area where households are very

poor and there is lack of market in the region. Regrettably, in this study we could not have information regarding household outcome as mothers were not able to estimate their monthly and weekly revenues. Besides, in their studies, they took into consideration children under the age of five. While, in ours, only breastfed children were concerned by the study. Another recent study got the contradictory result (44.4%) [5]. The difference may be attributed to the difference of study population. Moreover, the data were from a Demographic and Health Survey (DHS). This study highlighted a critical prevalence (32.7%) of wasting. Factors associated to wasting will be published elsewhere.

A recent study found that in rural and urban area of Bukavu more than half children are malnourished, 35.4% are underweight and (20.8%) are overweight [16]. As noted above, our study has not explored factors associated with wasting. The result will be published elsewhere. On the other hand, Lwiro is facing a double burden of malnutrition of mothers and children. The study revealed a high prevalence of overweight and a low prevalence of obese (38.1% and 8.2%) in lactating mothers, respectively. Or, it is believed that when BMI increased (overweight and obesity), this may lead to non infection diseases. In addition, some disabilities appear in children later in life. These issues, may aggravate health and nutrition status of children [17].

Meanwhile, WHO endorsed that mothers who are obese, with BMI more than 30 are likely to stop breastfeeding early, this may influence nutrition status of children [18,19]. In addition, those women have a late lactogenesis II [18]. This study, find out another probable reason of not exclusively breasted children in the study area of Lwiro, but, it is contradicting a little bit, because, in an area where children are malnourished, mothers are overweight and, obese. We believe that this means that obesity is becoming pandemic problem and may attract the intention of the policy makers. On the other hand, obesity in the region could be due to the fact that when lactating mothers are hungry, they usually eat sugary food like sugarcane and tea. Few mothers are informed about food content and no one is aware about which food cannot be eaten together. When comparing the present children with the previous one, birth interval less than 2 to 3 years, had statistic significance and important high interval odds ratio for moderate stunting (p=0.028) and OR: 6.8; CI: 1.233-37.497. In a study conducted in the whole country, the same year, in comparison to the first born children, the children who had <24 months preceding birth interval had significantly higher odds ratio of stunting (OR=1.38; 95% CI: 1.061.79) [7].

The result is the same even if the study population is different and the sample is big for their study. According to the FGD results, 3 out of 4 lactating mothers believed that God is the supplier; He does not like family planning as He is the one who plan and who will take care of their children. If family planning is not well understood in the region, it may negatively influence both breastfeeding practices and stunting. A multifaceted (Reproductive and Health and nutrition) intervention may be implemented to solve the matter. It is known that short birth interval is link to exclusively breastfeeding [20]. However, children exclusively breastfed in this study were protected against all stage of stunting (OR<1).

The study showed a relationship between family residence and stunting. In fact, living to Kabuga is only predisposing to severity of malnutrition (OR: 9.794; CI: 0.751-127.761). While, coming from Lwiro, Kahungu and Cegera predisposed to all form of stunting (OR>1), even taught, the risk is high and the association is prove statistically when children are living in Cegera (p=0.034); OR: 18.475; CI: 1.247-273.751; OR: 9.099; CI: 0.452-182.976; OR: 41.672(2.124-817.54; p=0.034).

These results help to know which region (Cegera) needs more nutritional intervention than others (Lwiro, Kahungu and Kabuga). An up to date study recommended a long nutrition program and a screening of stunting because when they have implemented the project within 3 years, an improvement was observed in nutritional behavior, which is a pathway to improving child nutrition outcomes, these may help decrease the prevalence of stunting in the region.

On the other hand, their program has influenced iron and folic acid intake, pre-lacteal feeding and exclusive breastfeeding. Or, these are keys of decreasing malnutrion in fewer than five children [21]. The results of our study is not in line with previous one in which living in rural areas was protective from stunting (OR=0.67, 95%CI 0.48-0.92) [5].

The study indicated that to get married and living with husband predisposed to two stage of stunting (severe and marginally) (p=0.04; p=0.023), respectively. But, children from those mothers were protected against all stages of stunted (OR<1). Referring to the Focus Group Discussion results, in the region of Lwiro, the decision concerning expenses is made by the husband or his mother. Mothers are not allowed to buy healthy foods for their children and for their family.

A study conducted in a rural area of Tanzania showed there is the lack of internal house agreement in rural region; this may be an obstacle to effort of empowerment [22]. The FGDs showed the meal is eaten together is the family.

This result is in contradiction with the ones fund in Ethiopia, which showed that there is inequality of sharing food in households [23]. Regarding feeding malpractice of the infants, complementary feeding with porridge and with fruits were statistically associated with severe stunted (p=0.000 and 0.029) and moderate stunting (p=0.000 and 0.005). In fact, children fed by cow milk (OR: 6.179; OR: 5.351and OR:1.493), powder milk (OR: 1.346; CI: 0.355-5.103; OR: 2.278; CI: 0.519-9.992; OR: 1.38; CI: 0.322-5.925), porridge (OR: 4.993; CI: 1.188-2.099; OR: 3.961; NA), fruit (OR: 4.964; CI: 1.033-23.852; OR: 2.390; CI: 0.553-10.332), vegetables(OR: .728; OR: 2.357; OR: 1.152) and, family plate or family food (OR: 2.560; CI: 0.768-8.534, OR: 1.753; CI: 0.505-

6.078, OR: 1.352; CI: 0.384-4.758) respectively, were exposed to three stage of stunting (severe, moderate and mildly stunted) comparing with well nourished children.

These results revealed inadequate feeding practices in the study area and showed that the keys 6th (do not supply breastfed infant any food or fluids other than breast milk except if it is prescribed by a medical doctor) and 9th (train mothers on the utilize and danger of feeding bottles) keys of clinical practices for breastfeeding are still not respect in the study area [24]. Moreover, this aforementioned feeding malpractice exposed children against all stages of stunting. A recent study showed that infants from mothers with insufficient complementary feeding are around seven likely to become malnourished (OR: 6.88; 95% CI: 1.24-18.37) [16].

On the other hand, the fact of being supplemented with vitamin (multivitamin or complex vitamin B) and being exclusively breastfed within 6 month were protective against all the three stages (OR<1). I believe that Vitamin B-complex is related to all water-soluble vitamins, except of vitamin C. It is common place that in developed countries a great number of the population is suffering from insufficient of vitamins groups of vitamin B. Therefore, when there is lack of adequate diet, this, might be supplemented to protect from brain health and malnutrition [25].

Relating to breastfeeding behavior, not breastfeeding the infants at day times was statistically associated with two stage of stunting (severe and moderate) in six month old children (p=0.032 and 0.036). Indeed, the fact of not breastfed the children during days times was 1.8 and 1.7-fold risk of being severe and moderate stunting; in comparison with mildly stunted.

The result of our study showed a statistic link between being fed with porridge and fruits and both severe and moderate stunting (p=0.000 and 0.029) (p=0.000 and 0.005) respectively. Although, common inadequate complementary feeding (cow milk, powder milk, porridge, fruit, vegetables and family foods) were given to children instead of breast milk, therefore have predisposed to all stages of stunting (Severe, moderate and mild), (OR>1). A recent study conducted in the region showed that inappropriate infant and young feeding practices is predisposed to undernutrition (AOR 6.88; 95% CI 1.24, 18.37) [16]. However, they have not demonstrated which stage predisposes the most. Moreover, they have conducted a community study and they have searched for the relationship with undernutrition (Length- for-Age) which reflects both chronic and acute malnutrion, but, our study is a longitudinal study in which we focused on stunting (Height for Age), because it is a chronic malnutrion and, it is a past development failure indicator [26]. In addition, stunting might have a long term impact. Cow milk influence growth for malnourished children and for well nourished, however women are not aware of which components inside the milk has an effect in cognitive growth, however, there is limited knowledge of which components in milk have growth-stimulating effects [27].

An up to date study found contradictory result with ours. For them, milk consumption reduces the probability of being stunting of 1.9%, CI: 95; 0.02- (-0.01), and the influence is very high when the children comes from a wealthy family. It is known that percentage differs from region and from wealthy level of families [28]. Thus, it is acceptable that, in a poor region like Lwiro, children could develop stunting, even if they were complementary fed with cow milk. The complementary feeding with fruit has also a negative impact on children nutrition status, maybe because childbearing mothers have given fruit as a food complement, but not as a first complementary food. This could have helped initiate children in complementary feeding.

This is supported by Maria et, al in a study which revealed that diet based on fruit at the beginning of weaning is link to 1.6 month advance in initiate a child in feeding complement [29]. In addition, generally, when a child is fed with other food than breast milk, he will take less MB and, therefore, he will not meet up a child's nutrition requirements. Sometimes, they are not mixed two or more foods it with because of lack of money; these kind of food may provide fewer nutrients [30]. Mothers in the study area, in FGDs section, they affirmed cooking porridge with panty water as children are still young; this may better explain the matter of developing stunting after feeding by aforementioned complementary feeding. In addition, the FGDs showed that lactating mothers are aware about the three type of food and their importance for health, but they do not know which one belongs to each category.

Awful information regarding meat and small fishes was spread in the area, and could be a cause of malnutrition in the region. Because in the poverty area of Lwiro, small fiches are available, but they cannot eat them, as they know that they bring kwashiorkor. As to find meat is not easy, because of financial issues and lack of market in the study region, meat should be replaced by small fishes.

Conclusion

To sum up, this study highlights a low prevalence (3/130, 2.3%) of underweight, a critical prevalence (32.7%) of wasting and a very high prevalence (84.6%) of stunting in the region of Lwiro. However, a high prevalence of overweight (38.1%, 51/134) and a low prevalence of obese mothers (11/134, 8.2%) are also observed in the region. Cegera village was very exposed than others. The lack of attending Family Planning has consequences in birth spaced and, automatically to malnutrition of children under the age of six months. The study showed that being born underweight and being born small for gestational age have protected children from being severe stunted, but have exposed to moderate and mild stunting. Food behavior of mothers has exposed to severe and moderate stunting.

On the other hand, exclusively breastfeeding has protected against being malnourished in whole stage. Complementary feeding with porridge and, with fruits have exposed to both severe and moderate stunting. Our findings could help strengthen previous intervention in the region to identify region where stunting is predominant, in order to implement new project with regard to education. As there

is a lack of knowledge about good food for health, foods content f, and regarding when starting the complementary feeding, as well as when giving the family foods to a child I believe that, maternal nutrition and infant nutrition are strongly associated. Nutrition specific interventions should focus their efforts on improving the nutritional status of mothers at the community and individual levels to reduce infant malnutrition. Future research should search for factors associated with wasting in the region and, could caring out a cohort study regarding complementary feeding of children and its long impact of health and nutrition status of the children ender the age of five. Reproductive heal program in general and family planning in particular have to be improved in the study region. Programs must take into consideration intra-house decision maker regarding everyday expenditure for optimal target.

Acknowledgment

The authors express they warm appreciation to all interviewers and respondent for their input during the study. Besides, we recognize both Bread For the World and UEA (Universite Evangelique en Afrique) organization and institution for their financial support and encouragement. At last, we express our thankfulness to the head of Miti-Murhesa Health Zone and his team for having facilitated field-work. Moreover, the head of Lwiro Health Center and the head of Lwiro hospital find here the expression of our profound appreciation.

Weakness of the Study

However, there are some limitations of the study. Lactating mothers were not able to give their weekly and monthly income which could help us knowing if there is a problem of low income in the study area or not.

Author's Contribution

Celine Kavira Malengera was about concerned in the conception, design, collection, cleaning data, analysis, interpretation, report and manuscript writing. The supervison of the study was done by Prof Theophile Kabesha. He also read and guided the data cleaning and arranged the text. Augustin also implicated in data collection of the data. Prof Wembonyama Okitotsho Stanis and Prof Tsongo Kibendelwa Zacharie were concerned in supervision and reading the work. All authors allowed the publication of the paper.

Conflicts for Interest

Authors have no apparent conflicts of interest to make public.

References

1. Tasic H, Akseer N, Gebreyesus SH, Ataullahjan A, Brar S, et al. (2020) Drivers of stunting reduction in Ethiopia: A country case study. American J Clinical Nutrition 112(Suppl 2):875S-893S.
2. Villar J, Ismail LC, Victora CG, Ohuma EO, Bertino E, et al. (2014) International standards for newborn weight, length, and head circumference by gestational age and sex: The Newborn Cross-Sectional Study of the INTERGROWTH-21st Project. The Lancet 384(9946):857-868.
3. https://www.researchgate.net/publication/335060758_Socio-economic_Inequality_in_Stunting_among_Children_Aged_6-59_Months_in_a_Ugandan_Population_Based_Cross-sectional
4. Akombi BJ, Agho KE, Hall JJ, Merom D, Astell-Burt T, et al. (2017) Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. BMC Pediatrics 17(1):15.
5. Khan S, Zaheer S, Safdar NF (2019) Determinants of stunting, underweight and wasting among children < 5 years of age: Evidence from 2012-2013 Pakistan demographic and health survey. BMC Public Health 19(1):358.
6. Campisi SC, Cherian AM., Bhutta ZA (2017) World Perspective on the Epidemiology of Stunting between 1990 and 2015. Hormone Research in Paediatrics, 88(1):70-78.
7. Kismul H, Acharya P, Mapatano MA, Hatløy A (2017) Determinants of childhood stunting in the Democratic Republic of Congo: Further analysis of Demographic and Health Survey 2013–14. BMC Public Health 18:74.
8. https://ghdx.healthdata.org/record/democratic-republic-congo-demographic-and-health-survey-2013-2014
9. Dramaix M, Hennart P, Brasseur D, Bahwere P, Mudjene O, Tonglet R, Donnen P, Smets R (1993) Serum albumin concentration, arm circumference, and oedema and subsequent risk of dying in children in central Africa. British Medical J 307(6906):710-713.
10. Kambale RM, Kasengi JB, Kivukuto JM, Cubaka LM, Mungo BM, et al. (2016) Infectious profile and mortality of children aged 0-5 years admitted with severe acute malnutrition: A retrospective cohort study conducted in the Therapeutic Nutritional Center in Bukavu, Republic of Congo. The Pan African Medical J 23:139.
11. Mwene-Batu P, Bisimwa G, Ngaboyeka G, Dramaix M, Macq J, et al. (2021) Severe acute malnutrition in childhood, chronic diseases, and human capital in adulthood in the Democratic Republic of Congo: The Lwiro Cohort Study. American J Clinical Nutrition 114(1):70-79.
12. Mwene-Batu P, Bisimwa G, Baguma M, Chabwine J, Bapolisi A, et al. (2020) Long-term effects of severe acute malnutrition during childhood on adult cognitive, academic and behavioural development in African fragile countries: The Lwiro cohort study in Democratic Republic of the Congo. PloS One 15(12):e0244486.
13. Mwene-Batu P, Lemogoum D, de le Hoye L, Bisimwa G, Hermans MP, et al. (2021) Association between severe acute malnutrition during childhood and blood pressure during adulthood in the eastern Democratic Republic of the Congo: The Lwiro cohort study. BMC Public Health 21(1):847.
14. Mwene-Batu P, Wells J, Maheshe G, Hermans MP, Kalumuna E, et al. (2021) Body composition of adults with a history of severe acute malnutrition during childhood using the deuterium dilution method in eastern DR Congo: The Lwiro Cohort Study. American J Clinical Nutrition 114(6):2052-2059.
15. Soliman A, De Sanctis V, Alaaraj N, Ahmed S, Alyafei F, et

al. (2021) Early and Long-term Consequences of Nutritional Stunting: From Childhood to Adulthood. Acta Bio Medica: Atenei Parmensis 92(1):e2021168.
16. Kambale R (2020) Infant and young child feeding practices and nutritional status in two Health Zones of South Kivu, Eastern Democratic Republic of Congo: A community-based study J Pediatrics, Perinatology and Child Health 6 (2022):350-360.
17. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
18. Jevitt C, Hernandez I, Groër M (2007) Lactation complicated by overweight and obesity: Supporting the mother and newborn. J Midwifery & Women's Health 52(6):606-613.
19. Nomura K, Minamizono S, Nagashima K, Ono M, Kitano N (2020) Maternal Body Mass Index and Breastfeeding Non-Initiation and Cessation: A Quantitative Review of the Literature. Nutrients 12(9) : E2684.
20. Chirwa TF, Mantempa JN, Kinziunga FL, Kandala JD, Kandala NB (2014) An exploratory spatial analysis of geographical inequalities of birth intervals among young women in the Democratic Republic of Congo (DRC): A cross-sectional study. BMC Pregnancy and Childbirth 14:271.
21. Elisaria E, Mrema J, Bogale T, Segafredo G, Festo C (2021) Effectiveness of integrated nutrition interventions on childhood stunting: A quasi-experimental evaluation design. BMC Nutrition 7(1):17.
22. Anderson CL, Reynolds TW, Gugerty MK (2017) Husband and Wife Perspectives on Farm Household Decision-making Authority and Evidence on Intra-household Accord in Rural Tanzania. World Development 90:169-183.
23. Coates J, Patenaude BN, Rogers BL, Roba AC, Woldetensay YK, et al. (2018) Intra-household nutrient inequity in rural Ethiopia. Food Policy 81:82-94.
24. public health updats (2018, August 1) Ten Steps to Successful Breastfeeding. https://publichealthupdate.com/ten-steps-successful-breastfeeding/
25. Kennedy DO (2016) B Vitamins and the Brain: Mechanisms, Dose and Efficacy-A Review. Nutrients 8(2):68.
26. Cogill B (2003) Anthropometric Indicators Measurement Guide. Food and Nutrition Technical Assistance Project.
27. Grenov B, Michaelsen KF (2018) Growth Components of Cow's Milk: Emphasis on Effects in Undernourished Children. Food and Nutrition Bulletin 39(2_suppl):S45-S53.
28. Herber C, Bogler L, Subramanian SV, Vollmer S (2020) Association between milk consumption and child growth for children aged 6-59 months. Scientific Reports 10(1):6730.
29. Giannì ML, Bezze E, Colombo L, Rossetti C, Pesenti N, et al. (2018) Complementary Feeding Practices in a Cohort of Italian Late Preterm Infants. Nutrients 10(12):1861.
30. Complementary feeding: Family foods for breastfed children (n.d.). Retrieved November 29, 2022, from https://www.who.int/publications-detail-redirect/complementary-feeding-family-foods-for-breastfed-children