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Predictors of nutritional management failure for under-five children with malnutrition in Nyamasheke District, Rwanda

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HIGHLIGHTS

- Positive relationships between increasing rate of malnutrition and the failure of nutritional management interventions among the children under-five years was observed.
- Health system predictors such as poor knowledge of Health workers about national guidelines used to reduce malnutrition and family related predictors like chronic childhood illness, lower income were both associated to the failure of nutritional management intervention programme

GRAPHICAL ABSTRACT

Predictors	Underweight		Stunted		Wasted	
	Odd Ratio (95% CI)	P-value	Odd Ratio (95% CI)	P-value	Odd Ratio (95% CI)	P-value
Duration in the program	0.84(0.35-2.05)	.715	0.61 (0.21-1.78)	.373	1.13(0.28-4.49)	**.039***
Duration of breastfeeding	1.83(1.46-5.13)	.061	0.7(0.45-7.02)	**.035***	1.92(0.73-8.61)	.452
Received immunization	0.95(0.25-3.58)	**.022***	1.01(0.21-4.87)	.200	0.65 (0.06-6.32)	**.001***
Diarrhoea	0.72 (0.34-1.53)	**.027***	0.95(0.39-2.38)	.955	1.09(0.35-3.39)	**.017***
Respiratory infection	0.80 (0.35-1.83)	.091	2.04(0.64-6.49)	.100	1.14(0.31-4.20)	.057
Worm disease	0.53 (0.24-1.14)	**.007***	0.60(0.24-1.48)	.100	1.28(0.38-4.27)	**.023***
Fever	0.76(0.36-1.61)	**.035***	0.76(0.31-1.87)	.622	1.84(0.55-6.09)	**.006***
Number of meals per day	0.98(0.46-2.07)	.069	1.15(0.47-2.81)	.230	1.85(0.60-5.73)	**.002***
Maternal education	1.07(0.29-3.90)	.917	0.38(0.09-1.46)	.161	0.34(0.06-1.80)	.208
Maternal age	0.89 (0.31-2.61)	.843	0.72 (0.21-2.92)	.719	1.96(0.31-12.12)	**.027***
Number of people per Household	1.21 (0.58-2.55)	.600	1.09 (0.44-2.64)	.848	0.76 (0.24-2.35)	**.020***
Monthly income	1.24(0.25-6.04)	0.791	0.82(0.15-4.57)	.827	0.91(0.08-10.22)	.941
Mother occupation	2.08(0.96-4.48)	0.060	1.48(0.60-3.64)	.728	2.20(0.66-7.25)	**.003***

*Significant association at $p < .05$
Reference for Nutritional status: Normal weight

Multivariate Analysis on the relationship between nutritional status and family predictors

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ABSTRACT

The general objective of this study was to assess the predicators of nutrition management failure among children under-five who participated in the nutrition program from 2012 up to 2015 in Nyamasheke District, Rwanda. The study included 169 children, out of which 78 were males and the remaining 91 were females. Of the children examined, 20.1% exhibited stunting growth of these 61.8% were females, 42.6% were underweight of these 51.4% were females and 10.1% were wasting of these 70.6% were males. Failure of nutritional management intervention was associated with both health system and family related factors. The common Health system predictors associated with failure of nutritional management programme were few activities related to the promotion of breastfeeding (OR: 5.0; 95 % CI: 1.56-16.2, P = 0.007), not following the Ministry of Health malnutrition management guidelines (OR: 5.85, 95% CI: 1.93417.69, P = 0.002), and poor knowledge about malnutrition management guideline (OR: 0.45, 95% CI: 0.21-0.99, P = 0.049). Family related predictors associated to the failure of nutritional management intervention include childhood illness such as fever (OR: 0.76, 95% CI: 0.36-1.61 P= 0.035), duration of breastfeeding (OR 0.7: 95% CI: 0.45-7.02 p = 0.035), number of meals per day (OR: 1.85 95% CI: 0.60-5.73; P = 0.002), and maternal age (OR: 1.96, 95% CI: 0.31-12.12; P = 0.027). These factors associated with failure of nutrition management should be considered

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in establishing effective measures for successful management and prevention of malnutrition.

1. Introduction

Malnutrition is a public health concerns worldwide, particularly affecting children under the age of five in developing countries (WHO 2012; Petrou & Kupek, 2010; Baxter, *et al*., 2014; Pollack, Ruttimann, & Wiley, 1985; Joosten & Hulst, 2008; Joosten & Hulst, 2008; Liu, *et al.*, 2001; Tierney, Sage, & Shwayder, 2010; Khor, 2003; Ahmed, *et al*., 2014; Bain, et al., 2013;de Onis, Blossner, & Borghi, 2012; Munthali, Jacobs, Sitali, Dambe, & Michelo, 2015). About 50.6 million under-five children are malnourished worldwide, and almost 90% of these children are from developing countries. Approximately 60% of all deaths among children under-five in developing countries could be attributed to malnutrition (WHO, 2012; de Onis, *et al*., 2000; Shinsugi, *et al*., 2015; Abubakar, Uriyo, Msuya, Swai, & Stray-Pedersen, 2012; de Onis, *et al*., 2012). Malnutrition is great factor associated with increased mortality among under-five children. Malnourished children have about four-times increased risk of overall mortality compared to well-nourished children (Black, *et al*., 2008; Caulfield, de Onis, Blossner, & Black, 2004; de Onis, *et al.*, 2013; WHO, 1999;Garenne, *et al*., 2009; Doherty, *et al*., 2002; Lazzerini, Rubert, & Pani, 2013). Moreover, these children are at higher risk of getting pneumonia, measles and malaria, and Parkinson's diseases (van Steijn, *et al*., 2014; Ma & Yamaguchi, 2000; Wang, Zhou, Cheng, Kopchick, & Bondy, 2004; Nguyen, *et al*., 2014; Nilsson, Ohlsson, Isaksson, Lindahl, & Isgaard, 1994; Vasquez-Garibay, Stein, Kratzsch, Romero-Velarde, & Jahreis, 2006). Malnutrition also affectedtheir growth, cognitive development, and ability to learn(Black, *et al*., 2008; WHO, 2012; Boyan, Wong, Fang, & Schwartz, 2007; Mackie, Tatarczuch, & Mirams, 2011; Stein, *et al*., 2008; Waage, *et al*., 2010; WB, 2006). About 14.8% of all disease adjusted life years (DALY) in children less than five years of age were related to malnutrition; affecting productivity and increased healthcare costs (UNICEF, 2013; WB, 2006).

Investing in eliminating malnutrition is essential (Black, *et al*., 2008; Waage, *et al*., 2010). Many initiatives included WHO 10-step approach, therapeutic feeding centres (TFC), community-based management of acute malnutrition (CMAM), and the development of ready-to-use therapeutic food (RUTF) were among the few programs implemented worldwide to reduce malnutrition with mixed results (Linneman, Matilsky, Ndekha, Manary, & Maleta, 2007; Briend & Collins, 2010; Victora, *et al*., 2005;Manary, Ndkeha, Ashorn, Maleta, & Briend, 2004; Murray & Manary, 2014; Sandige, *et al*., 2004; Ashworth, 2006; WHO, 1999; Chaiken, Deconinck, & Degefie, 2006; Burza, *et al*., 2015; Yebyo, Kendall, Nigusse, & Lemma, 2013). Malnutrition during childhood were most linked with poverty or social economic status of their families, the failure of nutritional management strategies in many countries was assessed as a predictor of malnutrition. (Puett & Guerrero, 2015; Hankard, *et al*., 2001; Bain, *et al*., 2013; Burza, *et al*., 2015; Faruque, *et al*., 2008; Sahu, *et al*., 2015; Huong, *et al*., 2014).

Remarkable advances have been made by the government of Rwanda towards achieving its Economic Development and Poverty Reduction strategy goals for 2008-2012 (Binagwaho, *et al*., 2014). Many efforts included setting national nutrition policy and offering low cost multiple micronutrient powders were implemented (Sandige, Ndekha, Briend, Ashorn, & Manary, 2004; Mugeni, *et al*., 2014). Despite the efforts, 45% of children under five suffered from chronic malnutrition in Rwanda (MoH, 2014; RDHS, 2015; Binagwaho, *et al*., 2011). A national wide nutrition program was launched in 2012 initiated by the Minister of Health of Rwanda with the objective of preventing, eliminating and managing malnutrition among children under-five. Yet, the prevalence of malnutrition among under-five year children increased from 39.8% in 2011 to 46.1% in 2014 in Western Province; the rate was higher than in other provinces (Kibogora District Hospital, 2014). No study was conducted in Rwanda to investigate the causes of the failure of nutritional management. Accordingly, this study was conducted to identify the factors of nutritional management failure of acute and chronic malnutrition in children in the hospital in the Nyamasheke district of Western Province of Rwanda.

2. Methods

2.1. Study Population

Medical files of all children under five years old who participated in the nutritional management programs in 12 Health Centres of Nyamasheke District for at least two years prior to 2014 were identified to randomly draw a sample of 169 children.

2.2. Malnutrition measurements

Malnutrition is usually measured by calculating the height-for-age (H/A), weight-for-age (W/A) and weight-for-height (W/H). The World Health Organization developed reference standards for these ratios. Children are classified as stunted if they have a height-for-age Z score less than 2 standard deviation (z-score <-2), underweight if weight-for-age Z score less than 2 standard deviations (z-score <-2) and wasted if weight-or-height Z score less than 2 standard deviations (z-score<-2) (WHO 2006). In the current study, we considered the height, weight, age, gender of children under five years old who were enrolled in the nutritional management programs of Nyamasheke District for at least two years and calculated the Z-score of the nutritional status. Low height-for-age Z-scores (HAZ), A HAZ score below -2 SD (< - 2 HAZ) represents stunted growth. For children in the age group below 2–3 years, < - 2 HAZ reflects a continuing process of 'failing to grow', 'stunted growth' or chronic malnutrition. Low weight-for-age Z-scores (WAZ), A WAZ score below -2 SD represents acute malnutrition. The WAZ score reflects body mass relative to chronological age. Low weight-for-height Z-scores (WHZ), A WHZ score below -2 SD is categorized as wasting, which usually indicates recent, severe weight loss, which is often associated with acute starvation or severe disease. The change in the Z-scores was used to determine the change in nutritional status.

2.3. Measurements and Predictors of Nutritional Management Failure

Nutritional management failure was measured by observing the number of children remained in the same nutritional status category as compared to the entry nutritional status. Information on the factors contributing to the failure of the program was collected using a structured questionnaire which included both close- and open-ended questions related to (1) protocols used to monitor the improvement among the children under the program, (2) trainings that they have received about nutritional management for under-five, (3) constraints faced in implementation of ongoing program. The questionnaire contained 26 items and was developed based on existing nutritional

management programs and literature. We piloted the questionnaire by using five social workers, and obtained Cronbach's Alpha coefficient of 0.78 and Content Valid Index of 0.65; indicating high validity.

2.4. Data Analysis

Data was checked for completeness and consistency before coding. Descriptive statistics were used to analyse the prevalence of each form of malnutrition. Multivariate logistic regression was used to analyze if parental characteristics, child characteristics and economic indicators affecting underweight and stunting.

The Odds Ratio (OR) with P≤0.05and 95% confidence interval (CI) were used to measure the strength of association. All statistical analyses were conducted using SPSS v.26.

2.5. Ethical Consideration

This study was approved by Mount Kenya University ethical Research Committee and Kibogora District Hospital. Signed written consents were obtained by the parents of children enrolled in the study and social workers. No name was recorded for this study.

3. Results and Discussion

3.1. Demographic characteristics of the participants

During this study socio-demographic characteristics of under-five children and their mothers were considered such as age, mother education level, occupation, and diseases history for children. The results on the socio-demographic characteristics were divided in two categories; the first category includes variables on the mother characteristics and the second included child characteristics specifically the history of diseases which may relate to poor nutrition (Table 1).

Table 1: Socio-demographic characteristics of Respondents: Mother characteristics according to Education level

	Mothers education level			
Variables	**No formal education n (%)**	**Primary education n (%)**	**Secondary education n (%)**	**Higher education n (%)**
Age of Mother (Year)				
<20	19 (31.1%)	15 (24.2%)	2 (9.1%)	6 (25.0%)
20-29	25 (41.0%)	9 (14.5%)	8 (36.4%)	8 (33.3%)
30-39	10 (16.4%)	12 (19.4%)	8 (36.4%)	9 (37.5%)
40-49	7 (11.5%)	26 (41.9%)	-	1 (4.2%)
Monthly household income				
5000-15000	40 (65.6%)	34 (54.8%)	9 (40.9%)	4 (16.7%)
15000-25000	15 (24.6%)	15 (24.5%)	9 (40.9%)	16 (66.7%)
25000-35000	6 (9.8%)	9 (14.5%)	-	1 (4.2%)
35000-45000	-	4 (6.5%)	4 (18.2%)	3 (12.5%)
Occupation				
Housewife	38 (62.3%)	42 (67.7%)	14 (63.6%)	13 (54.2%)
Paid work	23 (37.7%)	20 (32.3%)	8 (36.4%)	11(45.8%)
Number of people per household				
> 6	35 (57.4%)	37 (59.7%)	8 (36.4%)	4 (16.7%)
<6	26 (42.6%)	25 (40.3%)	14 (63.6%)	20 (83.3%)
Under-five death in the Family				
Yes	13 (21.3%)	19 (30.6%)	3 (13.6%)	7 (29.2%)

The results indicated that 41.0 % of mothers aged between 20-29 years old had no formal education only 4.2% of mothers aged 40-49 years old had high education level. More than a half of mothers 65.6% with no formal education had lower monthly income which was between 5000-15000 Rwandan Francs, small number of mothers with high education had monthly income range between 35000-45000 Rwandan Francs. Mothers with high education 45.8 % had monthly paid work, while big numbers of mother 67.7% with primary education were the housewife. More than a half of mothers with no formal education leave in the family with more that 6 people in their household including children and husband. Mothers with high education level 70.8% reported no under-five death in their family, means that having high education level may reduce the number of under-five death as mothers with this level have enough skills to prepare balanced diet for their children. Moreover, these results showed that most of the mothers who participated in the study were less educated, lower income, have a big number of children, not having income generation activities and not have balanced diet for their children. These may be contributed to the poor health status of their children which may in turn the cause of malnutrition.

Table 2: Socio-demographic characteristics of Respondents: Child characteristics according to sex

	Child Sex	
Variables	Boys	Girls
Age (Months)		
0-5	5 (6.4%)	9 (9.9%)
6-11	11 (14.1%)	9 (9.9%)
12-18	30 (38.5%)	32 (35.2%)
19-24	12 (15.4%)	17 (18.7%)
25-29	9 (11.5%)	4 (4.4%)
30-36	11 (14.1%)	8 (8.8%)
36+	-	12 (13.2%)
Duration of Breastfeeding (Months)		
Less than 6	22 (28.2%)	31 (34.1%)
6-12	2 (2.6%)	-
13-18	18 (23.1%)	22 (24.2%)
19-24	36 (46.2%)	38 (41.8%)
Number of Meals per day at home		
2 times	32 (41.0%)	45 (49.5%)
More than 2 times	46 (59.0%)	46 (50.5%)
Immunization	9 (11.5%)	5 (5.5%)
Diarrhoea	42 (53.8%)	48 (52.7%)
Respiratory infection	56 (71.8%)	70 (76.9%)
Fever	44 (56.4%)	52 (57.1%)
Worm infestation	44 (56.4%)	54 (57.1%)

The majority of children who participated in the study were aged 12-18 months. Among the boys participated in the study 38.5 % were aged 12-18 months while 35.2% were girls. Unexpectedly, the girls were found to have breastfeeding for long period than boys. In fact, 41.8% of the girls who participated in the study were breastfed between 19-24 months while 28.6 % of the boys participated in the study were breastfed less than 6 months. The results on the childhood frequent diseases occurred in the last two weeks preceding the survey showed that, 53.8% of the malnourished boys had diarrhoea, 76.8% of the girls have had respiratory infection, 56.4 % of the boys had a fever and 57.1% of the girls have had worm infestation. These were not surprising results because both girls and boys with malnutrition problems are at high risk of getting such diseases.

3.2. The prevalence of malnutrition among children under nutrition management programme

entered in the program at different age however all of them had less than five years old. Depending on the duration in the programme, the activities performed by both health care workers and mothers some children have been recovered others still had poor nutritional status. Figure 4.1 showed that 27.2% of children were recovered means that their weight and height were related to their age. Unfortunately, 42.6% of the children still have underweight status, 20.1% of the children still have stunting while

At the entry of the programme all children (169) were diagnosed with poor nutritional status within them, 60.4 % were underweight, 27.2% were stunted growth while 12.4% were wasted. The children 10.1% were found with wasting status. All of these children were in the nutritional management programme at least more than 6 months. Being in the programme in the period of 6 months should have more effects on the child nutritional status but the results showed unpredicted results with little number of recovered children. The present study performed additional analysis to look weather the sex had the effects child nutritional status as shown in table 3.

Table 3: Nutritional status at the entry of the programme and current Nutritional status in relation to Sex

Nutritional Status	Total n (%)	Boy n (%)	Girl n (%)	P-Value
Nutritional Status at the entry of the program				
Underweight (Weight-for-age Z-scores < -2SD)	102 (60.4%)	49(48%)	53 (52%)	
Stunted growth (Height for age Z-scores < -2SD)	46 (27.2%)	19(41.3%)	27 (58.7%)	0.741
Wasted (Weight for height Z-scores <-2SD)	21(12.4%)	10 (47.6%)	11(52.4%)	
Overall Malnutrition	100	78 (46.2%)	91(53.8%)	
Current Nutritional status				
Recovered	46 (27.2%)	18 (39.1%)	28 (60.9%)	
Underweight (Weight-for-age Z-scores < -2SD)	72 (42.6%)	35 (48.6%)	37 (51.4%)	
Stunted growth (Height-for-age Z-scores < -2SD)	34 (20.1%)	13 (38.2%)	21(61.8%)	0.110
Wasted (Weight for height Z-scores <-2SD)	17 (10.1%)	12 (70.6%)	5 (29.4%)	
Overall Malnutrition	123 (72.8%)	60(48.7%)	63(51.3%)	

SD: Standard Deviation
Figures in parenthesis indicates per cent

The finding presented in table 4.3, revealed that more girls 28 (60.9%) were recovered than boys 18 (39.1%). Surprisingly, in 72 children who were underweight at the data correction period, 34 (51.4%) were girls. The prevalence of malnutrition among the children under nutritional management at Kibogora District hospital was 72.8%. According to sex, the prevalence of malnutrition was 48.7% among boys and 51.3% among girls. In general population the prevalence of malnutrition is 37.4% as recently reported by the Rwanda Health demographic Survey, 2015 (RDHS, 2015).

Previous study conducted in Nicaragua found that the prevalence of underweight was 10.3%, stunting was 30.1%, while wasting 5% among 756 children who participated in the study (Sakisaka, *et al.*, 2006). In contrast a high prevalence of stunting 40.4% and lower rate of underweight were observed in Tanzania children (Abubakar, *et al*., 2012). Similarly to Nicaragua study, the present study observed lower prevalence of wasting 10.1% and nearly similar prevalence of stunting 20.1%. The high prevalence of underweight reported in the present study may due to that all participated children had the history of malnutrition. A recent study conducted among 300 children under nutritional management programme in India, reported a high rates 57.5% of children who did not gain normal weigh while given balanced died during the follow up (Sanghvi, Mehta, & Kumar, 2014). Similarly, the overall prevalence in the present study was 72.8%, means that these children did not gain final target weight despite of being in nutritional management programme where they could be given adequate diet.

3.3. The nutritional management interventions followed deal with malnutrition among under-five Children

The second objective of the study was to identify the nutritional management interventions used to deal with malnutrition among under-five Children. Information to achieve this objectives were collected from 24 Social workers, most of them were in charge of this programme in their respective health facility. The findings on this objective were summarized in table 4.

The findings on the Nutritional Management used by Social workers showed that educate mothers on the role of breastfeeding and promotion of exclusive breast feed at least first six months of child life were used by 70.8% and 41.6% respectively. However, mobilization about immunization was found rarely used as strategy which can help to deal with malnutrition problems in the region. Almost all of the Social workers 83.3% reported that they sometimes educate mothers how to take care of the child hygiene. Balanced diet is one of the key factor of dealing with under-five malnourished children were sometimes by Social workers in charge of malnutrition at the rate of 70.8%, it had been reported that more that 60% of Rwandan population do not get balanced diet. Educate the community to have a vegetables garden at their home as was initiated by the Government of Rwanda to eradicate malnutrition among under-five was often among the strategy use by 37.5 % Social workers who participated in the present study.

Promotional of agriculture product of food with high nutritional value were sometimes use to deal with this issue by 45.8% of the study respondents. Moreover, the Ministry of Health policy regarding malnutrition among under-five children was reported to be sometime followed by almost 87.7% of the Social workers in charge of nutritional management programme at Kibogora District hospital. In addition, Social workers in this program claimed to have less training about Malnutrition, where nearly a half 45.8% didn't have any training related to malnutrition in the last 12 months preceding the survey, while 70.8% reported that their skills and knowledge to deal with malnutrition problem were not enough.

Table 4: Nutritional management interventions followed by Social workers to treat acute and chronic malnutrition

Interventions	Frequency
Educate mother the importance of breastfeeding	
Sometimes	7 (29.2%)
Often	17 (70.8%)
Promotion of exclusive maternal breastfeeding up to 6 months	
Rarely	6 (25.0%)
Sometimes	8 (33.3%)
Often	10 (41.6%)
Immunization mobilization	
Rarely	10 (41.7%)
Sometimes	8 (33.3%)
Often	6 (25.0%)
Educate mothers how to keep personal hygiene of child	
Sometimes	20 (83.3%)
Often	4 (16.7%)
Educate the community about preparation of balanced diet	
Rarely	2 (8.2%)
Sometimes	17 (70.8%)
Often	5 (20.8%)
Encourage the community to have and how to make garden to ensure diversified food diet	
Never	7 (29.2%)
Rarely	4 (16.7%)
Sometimes	4 (16.7%)
Often	9 (37.5%)
Promotional of agriculture product of food with high nutritional value	
Rarely	7 (29.2%)
Sometimes	11 (45.8%)
Often	6 (25.0%)
Follow all existing policies related to nutrition management recommended by MoH	
Sometimes	21 (87.5%)
Often	3 (12.5%)
Nutritional management trainings in the last 12 months	
Yes	13 (54.2%)
Skills and knowledge about nutritional management	
Not enough	17 (70.8%)
Fair enough	7 (29.2%)

The improved malnutrition management strategies used by the Social workers participating in the present study may due to updated management system of all form of malnutrition developed by Rwanda Ministry of Health. The Rwandan Ministry of Health employed guidelines from the WHO using the updated 2006 child growth standards and the "Management of severe malnutrition" a manual for physicians and other senior Social workers, as substantial sources in developing the new national protocols for managing malnutrition (Binagwaho, *et al.*, 2011). The new document described underweight children under five years of age as being two standard deviations below their expected weight-for-age based on updated international growth standards issued in 2006. Chronic malnutrition (stunting) for children under-five years of age was described as being two standard deviations below the expected height-for-age. Wasting for children under-five years of age was defined as two standard deviations below the expected weight-for-height according to the new WHO international growth standards (MoH, 2003; WHO, 1999).

3.4. The relationship between rising of malnutrition and failure of nutritional management interventions in reduction of malnutrition among under-five

The third objective of the study was to determine the weather the increasing of malnutrition is associated with the failure of nutritional management intervention, in the same time identify the predictors related to this failure. To have a broad view on these predictors we divided into two categories including health system related predictors and family related predictors. Odd ratio at 95 % confidence interval and p-value at 0.05 significant levels were used to identify these predictors as shown in table 5 and table 6.

3.5. Health System predictors

The findings presented in table 5 reported the association between nutrition status (underweight, Stunted and Wasted) and Health care system predictors. The identified predictors of underweight were promotion of exclusive breastfeeding (OR: 5.0; 95 % CI: 1.56-16.2, p = 0.007), Immunization (OR: 0.05, 95 % CI: 0.01-0.25, p = 0.000), having vegetable garden at home (OR: 3.62 95 % CI : 1.047-12.52 p = 0.042), follow existing policy related to malnutrition (OR: 5.85, 95% CI: 1.93417.69, p = 0.002) and health workers skills and knowledge about nutritional management (OR: 0.45 , 95% CI: 0.21-0.99, p = 0.049). The predictors with OR less than one might be suggested as protective predictors of underweight while those with OR greater than one might be suggested as risk predictors of underweight. For example these results showed that not following the existing policy used in malnutrition management could have 5.8 times risk of continue to be underweight while the child have been in the program for more than 6 months compared those who recorded within the same period. Similarly, improving the skills and knowledge of health worker in charge of nutritional management program could in addition reduce the risk of continue to be underweight after six months in the programme at the rate of 45%.

The health system predictors of stunted were include education about the role of breastfeeding (OR: 12, 95% CI: 2.36-67.0, p = 0.003), Immunization (OR: 0.05, 95% CI: 0.01-0.279, p = 0.001), Education about preparation of balanced diet (OR: 4.37, 95% CI: 1.19-16.03, p = 0.026). These finding showed that the Social workers in charge of nutritional management who did not mobilize mothers about the importance of breastfeeding in the children health could had increase 12 times risk of the children to still stunting even after 6 months in the programme. Health workers who didn't educate mothers how to prepared balanced diet had increase 43.7% the risk of children to continue to be stunted after six months in the program.

Table 5: Multivariate Analysis on the relationship between nutritional status and health system predictors

	Underweight		Stunted		Wasted	
	Odd Ratio (95% CI)	**P-value**	**Odd Ratio (95% CI)**	**P-value**	**Odd Ratio (95% CI)**	**P-value**
Predictors						
Health education about breastfeeding	1.2(0.44-3.47)	.683	12 (2.36-67.0)	.003*	4.66(0.82-26.34)	.081
Promotion of exclusive maternal breastfeeding up to 6 months	5.0(1.56-16.02)	.007*	1.7(0.55-5.71)	.335	2.0(0.46-8.63)	.353
Immunization mobilization	0.05(0.01-0.25)	.000*	0.05(0.01-0.279)	.001*	0.10 (0.01-0.91)	.041*
Education about personal hygiene of child	1.38 (0.42-4.56)	.590	2.7(0.28-25.83)	.389	2.7(0.28-25.83)	.617
Education about preparation of balanced diet	2.62 (0.94-7.30)	.065	4.37(1.19-16.03)	.026*	4.37(1.19-16.04)	.724
Encourage the community to have and how to make garden to ensure diversified food diet	3.62 (1.047-12.52)	.042*	0.63(0.18-2.13)	.459	0.63(0.18-2.13)	.835
Promotional of agriculture product of food with high nutritional value	2.81(0.49-16.08)	.244	1.36(0.11-16.57)	.808	1.36(0.11-16.57)	.576
Follow all existing policies related to nutrition management recommended by MoH	5.85(1.93417.69)	.002*	3.0(0.90-9.96)	.073	3.0(0.90-9.93)	.193
Nutritional management trainings	0.46 (0.22-1.0)	.050	2.26 (0.81-6.29)	.119	2.26(0.81-6.29)	.760
Skills and knowledge about nutritional management	0.45 (0.21-0.99)	.049*	1.92 (0.78-4.74)	.156	1.9 (0.78-4.74)	.250

*Significant association at p<.05
Reference for Nutritional status: Normal weight

One health system predictor which was identified to be associated with wasted children is mobilization mothers to complete all required immunization for under-five children at OR: 0.10, 95% CI: 0.01-0.91, P = 0.041). This was identified as protective predictor of wasting, means that mobilizing mother to complete all immunization could in turn reduce another 10% of the wasting children after six months in the programme.

The common Health system predictors associated with failure of nutritional management programme were few activities related to the promotion of breastfeeding, not following the Ministry of Health malnutrition management guidelines, and poor knowledge about malnutrition management guideline. Similar findings were observed in previous studies, for example Rogers and his colleagues reported that lower knowledge of Health care workers about malnutrition management is a major barrier of eradicating malnutrition in children under-five (Rogers, Myatt, Woodhead, Guerrero, & Alvarez, 2015). A study conducted in India suggested that following the implementation of national guideline about malnutrition management would accelerate the success of all programmes aimed to fight against malnutrition in children under-five (Burza, *etal*., 2015). The failure of successful of nutritional management programme could not only due to health system predictors, family related predictors should be investigated as well.

3.6. Family related predictors of failure nutritional management programme

Family related predictors associated to the failure of nutritional management programme were carefully investigated in the present study. These predictors include childhood diseases which most likely affect children with malnutrition problem and general household status which may affect child health as presented in table 6.

Received all immunization was significantly associated to the underweight as a protective predictor (OR: 0.95, 95% CI: 0.25-3.58, P = 0.022). Frequent diarrhoea was identified as predictor of underweight (OR: 0.72, 95% CI: 0.34-1.53, P = 0.027). Worm disease (OR 0.53 95% CI: 0.24-1.14, p = 0.007) and fever (OR: 0.76, 95% CI: 0.36-1.61 P= 0.035) were also reported as the predictors of underweight. Number of people per household, income and mother occupation were identified as risk of underweight but not significantly associated. It was not as surprising results to identify all protective predictors, as it is well known that immunization, not suffer from diarrhoea and fever for underweight child could involve in quick recovery from this nutritional status to normal status.

One predictor which was significantly associated with stunting is duration of breastfeeding (OR 0.7: 95% CI: 0.45-7.02 p = 0.035). This showed that children who have been breastfeeding up to the age of 24 months had 70% reduced risk of continue to be stunting when they were in the nutritional management program within six months.

Table 6: Multivariate Analysis on the relationship between nutritional status and family predictors

	Underweight		Stunted		Wasted	
	Odd Ratio (95% CI)	**P-value**	**Odd Ratio (95% CI)**	**P-value**	**Odd Ratio (95% CI)**	**P-value**
Predictors						
Duration in the program	0.84(0.35-2.05)	.715	0.61 (0.21-1.78)	.373	1.13(0.28-4.49)	.039*
Duration of breastfeeding	1.83(1.46-5.13)	.061	0.7(0.45-7.02)	.035*	1.92(0.73-8.61)	.452
Received immunization	0.95(0.25-3.58)	.022*	1.01(0.21-4.87)	.200	0.65 (0.06-6.32)	.001*
Diarrhoea	0.72 (0.34-1.53)	.027*	0.95(0.39-2.38)	.955	1.09(0.35-3.39)	.017*
Respiratory infection	0.80 (0.35-1.83)	.091	2.04(0.64-6.49)	.100	1.14(0.31-4.20)	.057
Worm disease	0.53 (0.24-1.14)	.007*	0.60(0.24-1.48)	.100	1.28(0.38-4.27)	.023*
Fever	0.76(0.36-1.61)	.035*	0.76(0.31-1.87)	.622	1.84(0.55-6.09)	.006*
Number of meals per day	0.98(0.46-2.07)	.069	1.15(0.47-2.81)	.230	1.85(0.60-5.73)	.002*
Maternal education	1.07(0.29-3.90)	.917	0.38(0.09-1.46)	.161	0.34(0.06-1.80)	.208
Maternal age	0.89 (0.31-2.61)	.843	0.72 (0.21-2.92)	.719	1.96(0.31-12.12)	.027*
Number of people per Household	1.21 (0.58-2.55)	.600	1.09 (0.44-2.64)	.848	0.76 (0.24-2.35)	.020*
Monthly income	1.24(0.25-6.04)	0.791	0.82(0.15-4.57)	.827	0.91(0.08-10.22)	.941
Mother occupation	2.08(0.96-4.48)	0.060	1.48(0.60-3.64)	.728	2.20(0.66-7.25)	.003*

*Significant association at $p < .05$
Reference for Nutritional status: Normal weight

Several predictors were found to be significantly associated with being wasting while in the programme for more than 6 months, however some predictors were protective. Of these, duration in the program (OR: 1.13 95% CI: 0.28-4.49, p = 0.039), having diarrhoea (OR: 1.09, 95% CI: 0.35-3.39; P = 0.017), suffer from worm disease (OR: 95% CI: 1.28 0.38-4.27; P = 0.023), fever (OR: 1.84, 95% CI: 0.55-6.09; P = 0.006) , number of meals per day (OR: 1.85 95% CI: 0.60-5.73; P = 0.002), maternal age (OR: 1.96, 95% CI: 0.31-12.12; P = 0.027), and mother occupation (OR: 2.20, 95% CI: 0.66-7.25; P = 0.003) were identified as risk predictors of wasting while number of people per household (OR: 0.76 , 95% CI:0.24-2.35; P= 0.020) and received all immunization (OR: 0.65, 95% CI: 0.06-6.32, P = 0.001) were identified as protective predictors of wasting. Children who frequently got childhood illness are more likely to stay wasting for long period while there are in the nutritional management follow up programme. The finding showed that having few children and received all immunization could influence the quick recovery from being wasting to normal nutritional status.

Several previous studies children from poor family very lower income families, lower maternal education level and those born to the mothers with aged less than 18 or above 35 years were at high risk of suffering from malnutrition at early age (Huong, *et al*., 2014; Lenters, *et al*., 2013; Petrou & Kupek, 2010; Ramli, *et al*., 2009). In addition, duration of breastfeeding, childhood illnesses, number of pregnancies were also reported as the predictors of underweight, stunting and wasting (Abubakar, *et al*., 2012; Sakisaka, *et al.,* 2006).

A recent study conducted in Somalia found that the estimated national prevalence of wasting, stunting and low mid-upper arm circumference in children aged 6-59 months was 21 %, 31 % and 36 %, respectively. Although fever, diarrhoea, sex and age of the child, household size and access to foods were significant predictors of malnutrition, the strongest association was observed between all three indicators of malnutrition and the enhanced vegetation index. Eating vegetables was associated with a 38 %, 49 % and 59 % reduction in wasting, stunting and low mid-upper arm circumference, respectively. The Somalia study concludes that infection and climatic variations are likely to be key drivers of malnutrition. Better health data and close monitoring and forecasting of droughts may provide valuable information for nutritional intervention planning in Somalia (Kinyoki, Berkley, Moloney, Kandala, & Noor, 2015).

The present study identified feeding practices, socioeconomic status, chronic childhood illness was important in determining the weight of child as well as predictors of failure of nutritional management programs in a developing country like Rwanda.

4. Conclusions and recommendations

The prevalence rate of malnutrition among children under nutrition management programme at Kibogora District Hospital was 72.8%. The interventions used in nutritional management programme to reduce malnutrition among children under-five include educate promotion of breastfeeding up to two years, education about the preparation of balanced diet, education about child hygiene and proper use of national guideline to fight against malnutrition. Positive relationships between increasing rate of

malnutrition and the failure of nutritional management interventions among the children under-five years was observed. Health system predictors such as poor knowledge of Health workers about national guidelines used to reduce malnutrition and family related predictors like chronic childhood illness, lower income were both associated to the failure of nutritional management intervention programme.

The successful of nutritional management programme should be achieved when both Social workers and families with malnourished children worked together. Ministry of Health needs to increase trainings about National guidelines used to fight against malnutrition in Rwandan Children. Social workers must continue to educate mothers and community in general the role of appropriate /and or adequate feeding practices, immunization in reduction of childhood illness which may lead to malnutrition. Rwandan government must continue to set up the programmes which can help people to increase their income. Specifically, more attractive health education, regular child health check-ups with growth monitoring, antenatal care programs and favorable community health service packages may lead to substantial improvements in maternal and child health in poor community.

Conflict of interest

We declare that there is no conflict of interest with this work.

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