

Outcome of Malnourished Children Admitted in the Nutritional Rehabilitation Home

Lalan Prasad Rauniyar,¹ Maya Rouniyar,² Rashmi Jha,³ Aman Kumar Yadav,⁴ Mukesh Kumar Sah⁵

¹Department of Pediatrics, BP Koirala Institute of Health Sciences, Dharan, Sunsari, Nepal, ²Department of EM and GP, BP Koirala Institute of Health Sciences, Dharan, Sunsari, Nepal, ³Nutritional Rehabilitation Center, GNS Hospital, Saptari, Madhesh Province, Nepal, ⁴Nepal Medical College, Jorpati, Kathmandu, Nepal, ⁵General Practitioner and Emergency Medicine Physician, Department of Emergency Medicine and General Practice; Sunsari District Hospital, for Patan Academy of Health Sciences, Lalitpur, Nepal.

ABSTRACT

Background: Globally, the burden of malnutrition, especially undernutrition, as well as the consequences of malnutrition is of the rise which is especially of significant concern for underdeveloped countries. Countries like Nepal are also facing a similar problem of malnutrition. In Madhesh province, among the under 5 children the incidence of chronic malnutrition is 29.3%. Our aim is to assess the malnourishment in the children of Madhesh province in Nepal.

Methods: This cross-sectional quantitative study was carried out among 409 malnourished children who were admitted from July 17, 2018 to July 16, 2022 at NRH in Gajendra Narayan Singh Hospital. Collected data were fed into Microsoft-excel and analyzed using SPSS software, version-2016. As data were normally distributed, frequency, percentage, mean and standard deviation were calculated for descriptive analysis. To find out the association of categorical variables, the Chi-square test or Fisher's Exact test was used where appropriate. P-value <0.05 was significant.

Results: Out of 409 malnourished cases, 145 cases were SAM ($SD < -3$) and 264 cases were MAM (-2 to $-3SD$) at the time of admission. The mean increment in the weight was 1.14 ± 0.44 kg. The average length of stay was 19.82 ± 8.73 days. There is a significant difference ($p < 0.001$) in the length of stay among the SAM and MAM cases of our study and a difference in the increment of weight in comparison to mean weight gain (1.14 ± 0.44 kg) with respect to the length of stay of the malnourished child who stayed for more than 28 days and less.

Conclusions: There is significant weight gain in malnourished children after management at the Nutritional Rehabilitation Center.

Keywords: Height; increment in weight; malnourished child; moderate acute malnutrition; nutritional rehabilitation home

INTRODUCTION

Adequate nutrition is essential for the growth and development.¹ Childhood under-nutrition, in the form of stunting, wasting, or intrauterine growth restriction, is an important contributing factor to the high-levels of childhood illness and death in developing-countries.²⁻⁶ Globally, malnutrition is considered as silent-killer and its burden is high.⁷ In Madhesh province, among the under 5 children the incidence of chronic malnutrition is 29.3%.⁸ Evidences also indicate that poor weight gain (wasting) may lead to higher risk of stunting among the children.^{3,9} The prevalence of stunting has declined

from 57% in 1996 to 25% in 2022. During this same period, the prevalence of wasting declined from 15% to 8%.¹⁰

Thus this study is likely to unmask the iceberg of under nutrition and hidden malnourishment among the children of Madhesh Province. Our aim is to assess the malnourishment in children of Madhesh province in Nepal. NRH is controversial in the management of malnutrition in some counties.¹¹

METHODS

A cross-sectional analytical study was conducted at

Correspondence: Dr Lalan Prasad Rauniyar, Department of Paediatrics, BP Koirala Institute of Health Sciences, Dharan, Sunsari, Province 1, Nepal. Email: lpr3234@gmail.com.

Gajendra Narayan Singh Hospital, Rajbiraj. A total of 409 malnourished cases that met the study criteria admitted to NRH of the hospital. The admitted malnourished child were enrolled without any discrimination of sex, race, religion, and geography. Only the malnourished children with weight for height $\leq -2SD$ with or without any grade of oedema were considered for this study. Malnourished children who had chronic comorbidities (Cerebral palsy, Congenital Heart Disease, Tuberculosis, Thalassemia, Downs Syndrome), stayed for less than 7 days only, children of age more than 5 years and the child who had developed acute illness that required refer or ICU transfer were excluded from this study. The study was carried out from July 17, 2018 to July 16, 2022 at NRH in Gajendra Narayan Singh Hospital. At NRH the malnourished child was managed with nutritional supplements as per WHO guideline.¹² Along with micronutrients supplement, the admitted children were fed with F-75 and its amount is increased gradually day by day. F-100 was given once appetite was returned. Using Google form sheet (a structured Pro-forma) data were collected.

Initial data were collected from the patient registration and record book of NRH of the Gajendra Narayan Singh. Data were collected using google software for the convenience.

The socio-demographic variables included were age, gender, and address. The age of the patients was categorized as ≤ 6 months, 7-12 months, 13-24 months, >24 months. Gender was categorized as Male and Female. The address was categorized according to Madhesh Province (districts of Madhesh province) and Others. Another independent variable, length of hospital stay was categorized as 8-14 days, 15-28 days and >28 days. The dependent variable of this study includes Weight and Height of the children.

The data were fed into Microsoft excel and analyzed using SPSS software, version 2016. As data were normally distributed, frequency, percentage, mean and standard deviation were calculated for descriptive analysis. To find out the association of categorical variables, Chi-square test was used for statistical analysis for categorical data. A P-value less than 0.05 was considered statistically significant.

This study was started after approval from NHRC (Ethical approval Registration. Number.: 556/2022 P, Reference Letter Number.: 1536). Consent was taken from GNS Hospital, Rajbiraj, Saptari. There was neither risk to the participants nor was any intervention performed. The data collected was kept confidential and was not used for any other purpose besides this study. Helsinki's

ethical principle was followed during the study process.

RESULTS

A total of 409 malnourished children aged < 5 years admitted for more than >7 days to NRH were analyzed. Out of 409 malnourished cases 145 cases were SAM ($SD < -3$) and 264 cases were MAM (-2 to $-3SD$) at the time of admission. In our study 229 (56%) were male and only 180 (44.6%) were female. Among the SAM 61.4% were male and only 38.6% were female and among the MAM 53.0% were male 47.0% were female. Table 1 also shows most of the admitted cases were of age group 13 months - 24 months (40.6%) followed by > 24 months (28.9%) and 7 months - 12 months (28.6%). Only 2% of admitted cases were of less than 6 months of age. Similar pattern is noted among the SAM and MAM cases (Table 1). In our study, almost all of the cases were (95.8%) from Madhesh province and only 4.2 % cases were from other nearby provinces. Most of the patient who got admitted stayed for almost 1 month. The table 1 shows 52.1% cases stayed for 15-28 days where as 31.8% cases stayed for 8-14 days. Similar pattern is noted among SAM and MAM cases.

In our study mean weight at the time of study was 7.99 ± 4.69 kg, and mean weight at the time of discharge was 8.95 ± 2.73 kg. This shows there was increment of weight during the stay at NRH. The mean increment in the weight was 1.14 ± 0.44 kg. The average length of stay was 19.82 ± 8.73 days. The average age at the time of admission was 22.63 ± 15.49 months.

The average weight gain among the study population during their stay at NRH was 64.65 ± 26.32 gm/kg/day. The weight gain among male was 66.02 ± 26.15 and among female was 62.91 ± 26.50 . The weight gain among the SAM was 61.27 ± 24.29 gm/Kg/day and that among the MAM was 66.51 ± 27.24 gm/Kg/day.

In the table 2 different demographic variables are compared with weight at the time of admission and discharge and length of stay at NRH, age at the time of admission and increment of weight. Mean weight at the time of admission (8.61 ± 5.54) and discharge (9.37 ± 2.86), age at the time of admission (23.96 ± 15.87) among MAM was more than that of SAM and among the all malnourished cases but the mean length of stay (23.92 ± 9.69) and the increment of weight (1.31 ± 0.45) was more among SAM than that of MAM and among the all cases. Similarly, Mean weight at the time of admission (8.59 ± 5.87) and discharge (9.43 ± 2.77), mean length of stay (19.97 ± 8.70), mean age at the time of admission (24.56 ± 16.1), and the increment of weight (1.17 ± 0.42) was more among male than that of female.

Table 2 also shows, mean length of stay was more for the malnourished children of age group 7-12 months (20.26±9.47) in comparison to other age groups and the mean increment of weight was more among the malnourished child of age group > 24 months (1.40±0.52). In our study, those who was referred or left the hospital against medical advice were not considered and all considered cases for our study had achieved the goal and discharged only after patient had improved on malnourishment. Among the improved children

those who have achieved median SD score had more mean weight at the time of discharge (9.113±3.25), mean length of stay (20.47±9.27), and mean increment of weight (1.30±0.58) than those who have achieved <median SD score. However, mean weight at the time of admission (8.02±4.91) and the mean age at the time of admission (22.86±15.62) were more in comparison to those value among the malnourished child who had achieved median SD score.

Table 1. Socio-demographic characteristics of Malnourished children.

Variables	Category	Freq.	Percent	Weight for Height for admission (Z score) <-3SD (SAM) n1=145			Weight for Height for admission (Z score) -2SD to -3SD (MAM) n2=264		
				Male (Row %)	Female (Row%)	Total (Column %)	Male (Row %)	Female (Row%)	Total (Column%)
Age Mean±SD = 22.63±15.49	≤ 6 months	8	2.0%	3 (75%)	1 (25%)	4 (2.8%)	1 (25%)	3 (75%)	4 (1.5%)
	7-12 months	117	28.6%	28 (60.9%)	18 (39.1%)	46 (31.7%)	24 (33.8%)	47 (66.2%)	71 (26.9%)
	13-24 months	166	40.6%	36 (56.2%)	28 (43.8%)	64 (44.1%)	58 (56.9%)	44 (43.1%)	102 (38.6%)
	> 24 months	118	28.9%	22 (71.0%)	9 (29.0%)	31 (21.4%)	57 (65.5%)	30 (34.5%)	87 (33.0%)
Gender (M:F =1.27)	Male	229	56.0%	-	-	89 (61.4%)	-	-	140 (53.0%)
	Female	180	44.0%	-	-	56 (38.6%)	-	-	124 (47.0%)
Address	Madhesh Province	392	95.8%	83 (60.1%)	55 (39.9%)	138 (95.2%)	135 (53.1%)	119 (46.9%)	254 (96.2%)
	Others	17	4.2%	6 (85.7%)	1 (14.3%)	7 (4.8%)	5 (50%)	5 (50%)	10 (3.8%)
Length of NRH Stay	8-14 days	130	31.8%	12 (40.8%)	13 (52.0%)	25 (17.2%)	60 (57.1%)	45 (42.9%)	105 (39.8%)
	15-28 days	213	52.1%	49 (64.5%)	27 (35.5%)	76 (52.4%)	69 (50.4%)	68 (49.6%)	137 (51.9%)
	>28 days	66	16.1%	28 (63.6%)	16 (36.4%)	44 (30.3%)	11 (50.0%)	11 (50.0%)	22(8.3%)

Table 2. Comparison of mean weight at the time of Admission and Discharge, Length of NRH stay and weight gain according to different variables.

Variables	Category	Mean ±SD					
		Weight at Admission (kg) mean±SD	Weight at Discharge (kg) mean±SD	Length of stay(days) mean±SD	Age at admission (months) mean±SD	Increment of weight (kg) mean±SD	
Status of nutrition at admission	SAM (< -3SD)	6.86±2.06	8.17±2.26	23.92±9.69	20.19±14.53	1.31±0.45	
	MAM (< -2SD)	8.61±5.54	9.37±2.86	17.56±7.24	23.96±15.87	1.05±0.42	
Gender	Male	8.59±5.87	9.43±2.77	19.97±8.70	24.56±16.10	1.17±0.42	
	Female	7.22±2.30	8.32±2.55	19.62±8.80	20.17±14.35	1.11±0.47	
Age	≤ 6 months	4.18±1.50	5.16±1.45	18.0±6.59	4.62±1.76	0.97±0.22	
	7-12 months	5.82±0.98	6.80±0.97	20.26±9.47	10.23±1.69	0.99±0.33	
	13-24 months	7.16±0.91	8.24±0.91	19.83±8.73	17.01±3.13	1.08±0.38	
	> 24 months	11.57±7.41	12.32±2.44	19.47±8.16	44.03±11.73	1.40±0.52	
Status of nutrition at discharge (N)	Normal Nutrition	Median	7.82±2.91	9.113±3.25	20.47±9.27	21.09±14.69	1.30±0.58
	< Median		8.02±4.91	8.925±2.64	19.71±8.66	22.86±15.62	1.12±0.41

Analytical table 3 shows, there is significant difference ($p < 0.001$) in the length of stay among the SAM and MAM cases of our study however no statistical difference is found among SAM and MAM in regards to gender, age and residence of the malnourished children. Another analytical table shows there is significant statistical difference in the increment of weight in comparison to mean weight gain (1.14 ± 0.44 kg) with respect to length of stay of the malnourished child who stayed for more than 28 days and less (Table 4).

Table 3. Association between demographic variables with nutritional status of children at the time of admission to NRH.

Variables	Category	Status of malnutrition at admission		p-value
		SAM, < -3SD (column %)	MAM, -2SD to -3SD (Column %)	
Gender	Male	89 (61.38%)	140 (53.03%)	0.104*
	Female	56 (38.62%)	124 (46.97%)	
Age	≤ 6 months	4 (2.76%)	4 (1.52%)	0.088#
	7-12 months	46 (31.72%)	71 (26.89%)	
	13-24 months	64 (44.14%)	102 (38.64%)	
	> 24 months	31 (21.38%)	87 (32.95%)	
Address	Madhesh Province	138 (95.17%)	254 (96.21%)	0.614*
	Others	7 (4.83%)	10 (3.79%)	
Length of NRH Stay	8-14 days	25 (17.24%)	105 (39.77%)	<0.001*
	15-28 days	76 (52.41%)	137 (51.89%)	
	>28 days	44 (30.35%)	22 (8.34%)	

*Test Applied is Chisquare test. #Test Applied is fisher-exact test. p-value <0.05 is statistically significant

Table 4. Association between average weight gain increment and length of hospital stay of children.

Variable	Category	Increment in weight		p-value
		≤ 1.14 kg	>1.14 kg	
Length of Stay	Up to 28 days	230	113	<0.001*
	>28 days	18	48	
Total				

*Test Applied is Chisquare test. p-value <0.05 is statistically significant

Table 5 shows that effective weight gain was seen among the malnourished children who had achieved the nutritional status of Median SD (1.30 ± 0.58) in comparison to those who had achieved < Median SD (1.12 ± 0.41)

Table 5. effectiveness of Nutritional Intervention among malnourished children.

Status of malnutrition at discharge	Frequency (%)	Mean weight difference
No malnutrition	55 (13.5%)	1.30(±0.58)
< Median SD	354 (86.5%)	1.12(±0.41)

DISCUSSION

In the NRH of Gajendra Narayan Singh Hospital 572 malnourished children were admitted but only 409 cases who met selection criteria for this study were considered. During the admission, among the 409 cases of this study most of the case 264 (64.5%) were of moderate acute malnutrition (MAM) whereas only 145 (35.5%) malnourished cases were severe acute malnutrition (SAM) This is very similar to the result obtained by Paudel AG et.al. in a study conducted in Pokhara Academy of Health Sciences, western regional hospital (PAHS, WRH) of Gandaki Province, in Nepal where 70.2% of cases were MAM and 29.8% cases were SAM and our result is also supported by the national census and report by Mandal PK but contrary to this most of the cases were SAM (80%) and only 20% cases were MAM in a study conducted in Karnataka, India by Ningadali SG et.al.^{8,13-15} This variation with the study of Ningadali et.al. is probably due to difference of knowledge regarding malnutrition and educational status among the parents of the two different area and also due to the criteria for inclusion of the cases.

In this study there was a good mean increment of weight (1.14 ± 0.44 kg) among the participants in comparison to the similar studies conducted at Pokhara, Gandaki Province by Paudel AG et.al where mean weight increment was (0.64 kg) and study done in Karnataka, India by Ningada et.al (mean weight gain = 0.51 kg).^{13,15} The good increment of weight is also noted in a report of Mandal PK (mean weight gain = 1.56) but the sample size was very small as comparable to our study.¹⁴ In our study those who have stayed for >28 days had good increment of weight and the increment of the weight is significantly associated with the length of the stay in NRH ($p < 0.001$) which is support by the most of the study conducted in this regions where increment was significantly associated with length of stay in NRH.² The mean increment of weight among the SAM cases were 1.31 ± 0.45 and among the MAM cases were 1.05 ± 0.42 and among the male was 1.17 ± 0.42 and among the female was 1.11 ± 0.47 . Similarly, among the mean increment of weight among ≤6 months of ages was 0.97 ± 0.22 , among 7-12 months of age was 0.99 ± 0.33 , among 13-24 month of age was 1.08 ± 0.38 and among >24 month of age was

1.40±0.52. These categorical variations of this study are also supported by the study done by Paudel et.al. in similar set-up of Nepal.¹³

In our study the average weight gain among the study population during their stay at NRH was 64.65 gm/kg/day which is very good weight gain with respect to WHO recommendation where good weight gain is considered when weight gain is >10 gm/kg/day. According to WHO recommendation the weight gain is moderate if the weight gain is 5-10 gm/kg/day and poor if the weight gain is <5 gm/kg/day.¹² The weight gain among male was 66.02±26.15 and among female was 62.91 gm/kg/day. However the weight gain among the SAM was 61.27 gm/kg/day and that among the MAM was 66.51 gm/kg/day. In similar study done by Paudel et.al. and Savadogo et.al, the average weight gain was very less. In the study done by Paudel et.al the average weight gain was only 4.13 gm/kg/day which is poor according to WHO recommendation and the weight gain among the male was 4.03 and 4.25 which is contrary to our study. However, in the study done by the Savadogo et.al, though the weight gain is comparatively low with respect to our study the average weight gain is good according to WHO recommendation.^{12,13,16}

we have included all improved cases of malnutrition in our study and excluded those who were referred and left the NRH against the medical advice. Among 409 cases the most all cases had no malnutrition at the time of discharge but among them 354 (86.5%) cases had achieved <median SD value whereas only 55 (13.5%) cases had achieved the median SD. Among those who had achieved Median SD had mean weight gain of 1.30 (±0.58) and among those had achieved <median SD had mean weight gain 1.12 (±0.41 kg) only and as these are new findings, there are no evidence to support this finding.

In our study, the mean length of stay of all cases is 19.82±8.73 which is higher than the study done in Chattishgarh, India by Tandon M et.al. where mean length of stay was 10.45±3.8.² About 30.35% of all severely acute malnutrition cases were stays for more than 28 days longer duration whereas only 8.34% of moderate acute malnutrition were stayed for more than 28 days. This shows malnourished status (SAM versus MAM) of the admitted children are strongly associated (p<0.001) with length of stay of the malnourished children. This result is supported by the other similar studies.¹³ There is no statistical association of status of malnutrition with age, gender and address of the cases but in another study done by Paudel et.al. age is statistically associated with

status of malnutrition (p<0.001) whereas gender and the address are not associated with status of malnutrition as in our study.¹³

In our study most of the cases were male and M:F ratio was 1.27 and this result is similar to other studies also but the study done by Tandem et.al. M:F ratio was 1.^{2,13,17}

It was a single centered retrospective study design and the data collected from secondary source, manual record file, of the NRH at Gajendra Narayan Singh Hospital, Rajbiraj, Saptari, Nepal.

CONCLUSIONS

There is significant weight gain of malnourished children after management at Nutritional Rehabilitation Center. The effectiveness of food supplement at NRH is more among severe acute malnourished children in comparison to moderately malnourished children. Though the weight gain is noted, the average gain in weight is still below the WHO recommendation. So it is necessary to reassess the protocol Nutritional supplement for the Madhesh province NRH for better outcome with the service of NRH. The NRH at Madhesh province was found to be very effective in improving the condition of admitted malnourished children as a significant difference was observed between the mean weight at discharge and the mean weight at admission for the study group and it was statistically associated with length of stay at NRH.

ACKNOWLEDGMENTS

We acknowledge Dr. Prakash Prasad Sah, Medical Superintendent of GNS Hospital Rajbiraj, Saptari, Madhesh Province Nepal. We also acknowledge Ujwal Gautam from BPKIHS and Mr. Raj Kumar Sangroula from New Era, Rudramati Marg, Kathmandu, Nepal for their contribution in editing the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Ijarotimi OS. Determinants of childhood malnutrition and consequences in developing countries. *Current Nutrition Reports*. 2013 Sep;2:129-33. doi:[10.1007/s13668-013-0051-5](https://doi.org/10.1007/s13668-013-0051-5).
2. Tandon M, Quereishi J, Prasanna R, Tamboli AF, Panda B. Performance of nutrition rehabilitation centers: A case study from Chhattisgarh, India. *International journal of preventive medicine*. 2019;10. doi:[10.4103/ijpvm](https://doi.org/10.4103/ijpvm).

3. Richard SA, Black RE, Gilman RH, Guerrant RL, Kang G, Lanata CF, et al. Diarrhea in early childhood: short-term association with weight and long-term association with length. *American journal of epidemiology*. 2013 Oct 1;178(7):1129-38. doi: [10.3945/jn.111.154922](https://doi.org/10.3945/jn.111.154922)
4. Pravana NK, Piryani S, Chaurasiya SP, Kawan R, Thapa RK, Shrestha S. Determinants of severe acute malnutrition among children under 5 years of age in Nepal: a community-based case-control study. *BMJ open*. 2017 Aug 1;7(8):e017084. doi:[10.1136/bmjopen-2017-017084](https://doi.org/10.1136/bmjopen-2017-017084)
5. Pelletier DL, Frongillo Jr EA, Schroeder DG, Habicht JP. The effects of malnutrition on child mortality in developing countries. *Bulletin of the World Health Organization*. 1995;73(4):443. [\[Article\]](#)
6. Karki U, Thapa A, Thapa S, Paneru B. Severity of Malnutrition in Developing Countries like Nepal due to COVID-19. *One Health Journal of Nepal*. 2021 Jul 23;1(1):68-71. [\[Article\]](#)
7. Joshi PC. Malnutrition in children: A serious public health issue in Nepal. *Health Prospect*. 2012;11:61-2. doi:[10.3126/hprospect.v11i0.7439](https://doi.org/10.3126/hprospect.v11i0.7439)
8. Demographic Health Survey 2022.
9. Black RE, Allen LH, Bhutta ZA, Caulfield LE, De Onis M, Ezzati M, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *The lancet*. 2008 Jan 19;371(9608):243-60. [10.1016/S0140-6736\(07\)61690-0](https://doi.org/10.1016/S0140-6736(07)61690-0)
10. SDGs_Baseline_Report_final_29_June-2017.
11. Gillam SJ. Mortality risk factors in acute protein-energy malnutrition. *Tropical doctor*. 1989 Apr;19(2):82-5. doi:[10.1177/004947558901900214](https://doi.org/10.1177/004947558901900214)
12. World Health Organization. *Guideline: Updates on the Management of Severe Acute Malnutrition in Infants and Children*; World Health Organization: Geneva, 2013.
13. Paudel AG, Ghimire G, Shrestha S, Bastola R, Sigdel Y, Gurung N. Evaluation of Malnutrition in Children Admitted in Nutritional Rehabilitation Home of Pokhara Academy of Health Sciences-A Retrospective Cross-Sectional Hospital Based Study. *Medical Journal of Pokhara Academy of Health Sciences*. 2020 Nov 28;3(2). doi:[10.3126/mjpahs.v3i2.35613](https://doi.org/10.3126/mjpahs.v3i2.35613)
14. Mandal PK. Factors Associated with Undernutrition of Children Admitted in Koshi Zonal Hospital Nutritional Rehabilitation Home. *Tribhuvan University Journal*. 2018 Dec 31;32(2):29-36. doi:[10.3126/tuj.v32i2.24701](https://doi.org/10.3126/tuj.v32i2.24701)
15. Ningadalli SG, Angolkar M, Herekar VR, Hirachand AD, Sah JK, Madikar S. Impact of Facility Based Dietary Management on Severe Acute Malnutrition in Children Aged 6 to 60 Months Admitted in Nutritional Rehabilitation Centre of KLES's Dr. Prabhakar Kore Hospital of Belagavi City-A Longitudinal Study. *International Journal of Science and Research (IJSR)*. 2015;4(5):2133-7. [\[Download PDF\]](#)
16. Savadogo L, Zoetaba I, Donnen P, Hennart P, Sondo BK, Dramaix M. Prise en charge de la malnutrition aiguë sévère dans un centre de réhabilitation et d'éducation nutritionnelle urbain au Burkina Faso. *Revue d'épidémiologie et de santé publique*. 2007 Aug 1;55(4):265-74. doi:[10.1016/j.respe.2007.05.006](https://doi.org/10.1016/j.respe.2007.05.006)
17. Irena AH, Mwambazi M, Mulenga V. Diarrhea is a major killer of children with severe acute malnutrition admitted to inpatient set-up in Lusaka, Zambia. *Nutrition journal*. 2011 Dec;10(1):1-6. doi:[10.1186/1475-2891-10-110](https://doi.org/10.1186/1475-2891-10-110)