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ORIGINAL RESEARCH

Treatment Outcomes of Severe Acute Malnutrition and Its Determinants Among Paediatric Patients in Quetta City, Pakistan

Nazir Ahmed[1], Fehmida Umar[2], Fahad Saleem[1], Qaiser Iqbal[1], Sajjad Haider[1], Mohammad Bashaar[3]

[1]Faculty of Pharmacy & Health Sciences, University of Balochistan, Quetta, Baluchistan, Pakistan; [2]Gynecology & Obstetrics Unit 1, Sandeman Provincial Hospital Quetta, Quetta, Baluchistan, Pakistan; [3]Research Services Division, SMART Afghan International Trainings & Consultancy, Kabul, Afghanistan

Correspondence: Mohammad Bashaar, SMART Afghan International Trainings & Consultancy, Kabul, Afghanistan, Tel +93 788233865, Email dr.mbashaar@gmail.com

Purpose: Severe acute malnutrition (SAM) is the most prevalent reason for admission to a paediatric unit, and it is a leading cause of mortality in many countries, including Pakistan. This study aimed to assess treatment outcomes and associated factors among children aged 6–59 months with severe acute malnutrition.

Patients and Methods: A retrospective cohort study was conducted at the Outpatient Therapeutic Feeding Program Centre established at the Sheikh Khalifa bin Zayed Al Nahyan Medical Complex Quetta. Out of 225 patients' records, data from 182 (80.8%) records were analysed based on the inclusion criteria. The SAM logbook was used as a source of data. Predictors of treatment outcomes were identified by applying a regression model with $p<0.05$ taken as significant.

Results: One hundred and twenty (65.9%) of the children were diagnosed with SAM, while the remaining 34.1% had Moderate Acute Malnutrition. Ninety-five (52.2%) children were included in the marasmus, while 47.8% were included in the Kwashiorkor cohort. The recovery rate was 68.6%; 22.5% were non-responsive, 11% defaulted on the program, and 3.5% died during management. The multivariate logistic regression identified the presence of diarrhea and the use of amoxicillin as significant prognosticators of treatment outcomes. Consequently, the odds of recovery on SAM among children with diarrhea [AOR = 0.60, 95% CI: (0.35–0.75)] were lower than those without diarrhea. Likewise, children on PO amoxicillin had higher chances of recovery [AOR = 2.45, 95% CI: (2.21–4.68)].

Conclusion: This study found that the recovery rate among children treated for SAM was poor based on the established Sphere Standard recommendation. In addition to community-based educational campaigns, capacity enhancement of OTP and frequent monitoring of services as well as program evaluation based on the management protocol is recommended to reduce the frequency of SAM among children.

Keywords: treatment outcomes, severe acute malnutrition, determinants, paediatric patients

Introduction

Malnutrition (MN) refers to the imbalance of nutrients in the human body. Defined by the World Health Organization as deficiencies or excesses in nutrient intake, imbalance of essential nutrients, or impaired nutrient utilization,[1] Katoch et al argued that the definition of MN is not universally accepted.[2] Generally, the communal ideology reflects that MN results due to undernutrition or poor intake of nutrients by an individual. On the contrary, high nutrient intake and an erroneous amount of nutrient consumption are also described as MN.[3] Subsequently, MN is caused by a variety of interconnected factors[4] and is divided into two broad groups of conditions: undernutrition (including stunting, wasting, underweight and micronutrient deficiencies) and overweight, obesity, and diet-related non-communicable diseases.[5] Affecting the global population irrespective of location, age, wealth, or gender, MN is a universal crisis and explains about 45% of deaths among children under five. Furthermore, MN elevates the risk of non-communicable diseases contributing to global deaths and disabilities.[5]

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In line with what is being discussed, The United Nations International Children's Emergency Fund (UNICEF), the World Health Organization (WHO), and The World Bank (WB) Group estimated that 149.2 million children had stunting, 45.4 million had wasting, 38.9 million were categorized as overweight and out of those 3.1 million children died because of MN in 2020.[6] Within this context, the WHO has emphasized addressing issues related to MN at the earliest. Especially among infants, Severe Acute Malnutrition (SAM), including its variants with or without medical consequences, must be prioritized.[7] Severe Acute Malnutrition is diagnosed in children with extremely low weight for height (below −3 z scores of the median WHO growth criteria), by obvious severe wasting, or by the presence of oedema in both feet and the mid-upper arm circumference (MUAC) of 115 mm.[8] Severe Acute Malnutrition is categorized as kwashiorkor and marasmus, and both of these can commonly coexist.[9] Treatment for SAM is provided by using the Community-based Management of Acute Malnutrition model, one of which is an Outpatient Therapeutic Program (OTP) to treat cases without medical complications. This model was made possible by developing ready-to-use therapeutic food (RUTF), allowing most of the treatment in the patient's home.[10] To summarize, MN (severe acute or acute) has placed a persistent economic, social, and medical impact on communities and countries,[11] and is a constant global interest to researchers, social scientists, healthcare professionals, and policymakers.

As discussed earlier, half of the global children's deaths result from hunger and MN. A systematic review published in 2022 acknowledged child MN as a significant public health problem whereby 149 million children <5 years of age were estimated to be stunted, and 45 million were wasted.[12] Within this context, the bulk of instances (55 and 39%, respectively) occur in low- to middle-income Asian and African nations.[13] According to Hosen et al, stunting and underweight affect 37.9% and 33.6% of children in South Asia, and undernutrition is responsible for about 45% of fatalities in children below the age of five.[14] Given what has been said, the subcontinent alone is home to 58 million stunted children or 39% of all stunted children worldwide.[15,16] Shifting our concern to SAM in Pakistan, the country's frightening malnutrition rate results in an estimated three million deaths per year in children under the age of five, or 65.2 deaths per 1000 live births.[17] Pakistan has the third-highest proportion of stunted children globally, behind Nigeria and India. Stunting prevalence was projected to be 45%, with wasting at 10.5% and underweight at 31.6% in Pakistan.[18] Additionally, the Government of Pakistan reported an estimated 5.9% of Pakistani children under five with both wasted and stunted growth. This prevalence of concurrent wasting and stunting was highest in rural areas (6.8%), among children of mothers with no formal education (7.7%), and in households with the lowest quintiles of wealth (10.7%). Geographically speaking, Sindh province has the most significant frequency of concurrent stunting and wasting (10.0%), followed by Balochistan (6.5%), Punjab (4.3%), and Khyber Pakhtunkhwa (3.7%).[19]

Although recognized as a continuous crisis for decades, MN is still a silent threat to Pakistan's health, development, and future. Even though there is evidence of progress in various healthcare domains, MN is alarmingly prevalent and hinders the nation's growth and prosperity. Therefore, it is high time to prioritize this crisis and take immediate action to address its root causes. Investment in sustainable solutions, raising awareness, and fostering collaboration are needed.[20] Within this frame of reference and based on the broad strategic plan of the Pakistan Multi-Sectoral Nutrition Strategy (2018–2025), Pakistan has created plans for stunting reduction (as well as wasting management, maternal and adolescent nutrition) at the federal and provincial levels. By increasing the Average Annual Reduction Rate for stunting from 0.5% to 1%, this approach aims to lower the prevalence of stunting from 40% in 2018 to 33% in 2025. According to this approach, a multi-sectoral response has been designed and is being implemented to some extent in all of Pakistan's provinces.[21] One of the core components is the OTP, which uses ready-to-use therapeutic meals, community outreach, and mobilization, making treatments for the management of SAM accessible at decentralized treatment locations within primary healthcare settings. Although the OTP services are offered for free at healthcare centers, there is limited evidence of research-based program evaluation from Pakistan. Moreover, little is known about the outcomes level and factors determining the recovery rate of children from SAM. This scarcity of information regarding the evaluation of the OTP services in Quetta was a contributing reason for this research and is the study's unique contribution to the literature for local and international investigators. Hence, the current study aimed to fill these gaps by assessing the treatment outcomes of the OTP offered in Quetta City, Pakistan, regarding recovery, default, non-respondent, and mortality rates. Furthermore, the study was also focused on highlighting the factors associated with SAM among children aged 6–59 months.

Materials and Methods

Setting and Study Design

The study was conducted at Sheikh Khalifa Bin Zayed Al Nahyan Medical Complex (SKBZMC). Located at the periphery of Quetta city, SKBZMC is a general hospital fully equipped with the requirements of a modern hospital. The hospital started its operations in March 2003 and provides care to most of the local population at a subsidized cost that has been incurred by the Government of Balochistan since 2012.[22]

The OTP is offered to malnourished children under the administrative management of the Provincial Nutrition Directorate, Health Department, Government of Balochistan. Specialized healthcare workers, including physicians, pharmacists, and nurses, are trained to manage children with SAM with or without medical complications. Based on the protocol for the Community-based management of SAM,[23] nurses, in consultation with the physicians screen the children with SAM for admission into the program. Once admitted, the children are provided routine medications (where needed), monitor the child's progress, and provide referrals to inpatients when children fail appetite tests or develop complications. All services including screening, admission cost, RUTF, medications, and inpatient facilities are provided free of cost to the children.

We conducted a retrospective cohort study. The research design is suitable for indicating the temporal sequence between exposure and outcome. Furthermore, a cohort study allows examining multiple effects of a single exposure and avoids selection bias. However, differential losses to follow-up can bias retrospective cohort studies. To avoid loss to follow-up, every single possibility was adopted by the research team and data was extracted from every available source. Using the data of SAM children admitted to SKBZMC between 1st January 2022 to 31st December 2022. The data was collected from January 2023 and was finalized on 28 February 2023 (two months).

Study Participants and Eligibility Criteria

This was a retrospective review of the eligible record of children treated for SAM in the SKBZMC. Children of age between 6–59 months, receiving treatment between January 1, 2022, and 31 December 2022, having MUAC values < 11.0 cm[24] or with bilateral pitting nutritional oedema,[25] and with no medical complications were selected for the study. We also categorized patients without oedema as marasmus and patients with oedema as the kwashiorkor group. On the contrary, patients referred to the OTP from other feeding centers, and being stable on arrival were excluded.

Sample Size and Procedure

Based on the study objectives and eligibility criteria, we screened all children who visited the hospital for the management and treatment of SAM during the year 2022. Two hundred and twenty-five records were screened, and one hundred eighty-two children fulfilled the eligibility criteria. Hence, 43 records were discarded (13 patients aged> 6 months, 30 incomplete records) and an analysis of 182 children was carried out.

Data Collection and Quality Assurance

The first author collected the data. A pre-validated structured questionnaire based on an extensive literature review[26–29] was used to extract information from the patient's records. The first author was trained by a research team and two physicians to ensure data accuracy and quality.

The first section of the questionnaire monitored the socio-demographic characteristics of each child including age, weight, locality, chaperone, gender, mother's living status, and travel time to the malnutrition center. The second section of the questionnaire recorded admission criteria presence/absence of bilateral pitting oedema, breastfeeding status, MUAC values, and the type of MN identified among the respondents. The third and fourth sections of the questionnaire offered clinical presentations, appetite test findings, and routine medications prescribed to the patients at the time of admission. The research team cleaned the data, ensuring completeness and consistency with continuous feedback from the physicians of the OTP unit.

Operational Definitions

Severe Acute Malnutrition: Weight-for-height ratio of below 70% of the median NCHS reference, presence of nutritional or bilateral pitting oedema, and or MUAC < 11.5 cm.

Malnutrition type: Grouped as marasmus (non-oedematous) and kwashiorkor (oedematous) based on the diagnosis.

Treatment outcome: The treatment outcome was categorized into the "recovered group" and "non-recovered group" from SAM at the OTP unit in the current study.

Recovered: A child attaining 15% body weight and without oedema (two successive visits or weeks) declared cured by the healthcare professionals were categorized as recovered.

Non-recovered: If a child failed to recover at the end of the eighth week (2 months), he/she was rated as non-responsive and hence was referred to inpatient settings.

Defaulter: In case of absence of three consecutive follow-up visits, the child was declared as a defaulter.

Death: A patient in OTP who died during the management of SAM.

Appetite test: A child was said to pass the appetite test when he/she could consume the amount of RUTF recommended for his/her body weight.

Admission type: Admission to OTP refers to new admission [admitted for the first time or after 2 months of recovery] and readmission (admitted within 2 months).

Ready to Use Therapeutic Food: According to the protocol, children receive different numbers of RUTF [F-75 (75 kcal and 0.9 g protein per 100 mL) and F-100 (100 kcal and 2.9g protein per 100 mL)] sachets depending on body weight (as soon as the child stabilizes on 75 kcal, he/she is shifted to "catch-up formulation" of 100 kcal until wasted tissues are rebuilt).

Medications: Admission medication included amoxicillin, vitamin A, mebendazole, and metoclopramide.

Rate of MUAC and weight gain: The rate of MUAC gain in mm/day and weight gain in g/kg/day was calculated for the marasmus group. However, for the kwashiorkor group, the rate of MUAC and weight gain was assessed once the oedema resolved.

Measurement of Variables

Body weight: Weight was measured by using the UNICEF infant, spring-type scale.[30]

MUAC: MUAC was measured with the help of UNICEF MUAC, 11.5 Red, PAC-50. The MUAC tape was placed on the left upper arm of a child with the arm hanging down the side of the body in a relaxed position.[31]

Fever: Fever was measured by taking the temperature rectally as recommended by the American Academy of Paediatrics.[32]

Oedema: Normal thumb pressure was applied on both feet for three seconds and edema was confirmed by shallow print on both feet.[33]

Diarrhea, nausea, and vomiting: These parameters were assessed by the physicians based on their observations and apparent signs and symptoms of the children.

Statistical Analysis

Data were entered into and analysed by SPSS v 26.0. Descriptive analysis was initially conducted for the entire data. Treatment outcomes were dichotomized into recovered and non-recovered. The Kolmogorov–Smirnov test was used for normality assessment. Bivariate and Multivariate regression was also carried out to determine the association between dependent and independent variables. All statistical tests in this study were declared significant at <0.05.

Ethical Approval and Consent to Participate

This study was carried out in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of the Faculty of Pharmacy & Health Sciences, University of Balochistan, Quetta (FoP&HS/IRB/74/22). Permission from the Executive Director of SKBZMC was also acquired. All patients' records were fully

anonymized before data collection and the authors had no access to information that could identify individual participants during or after data collection. Being a retrospective record review, the requirement for informed consent was waived by the Institutional Review Board of the Faculty of Pharmacy & Health Sciences, University of Balochistan, Quetta.

Results

Socio-Demographic Characteristics of the Malnourished Children

The study included 182 children who were managed for SAM under the OTP from January – December 2022. The gender distribution was almost equal ie, 96 (52.7%) males and 86 (47.3%) females. Most children (136, 74.7%) were in the age group of 6–15 months followed by 30 (16.5%) in the age group of 16–25 months. The mean weight of the cohort was 5.15±1.18 kgs with a median of 5. Most children had urban residency (151, 83%) and were accompanied by their mothers (140, 76.9%). One hundred and sixty-seven were within one hour's distance of the OTP center's location as shown in Table 1.

Table 1 Socio-Demographics and Related Characteristics of Children with SAM

Characteristics	Frequency	Percentage
Age (months)		
6–15	136	74.7
16–25	30	16.5
26–35	4	2.2
36–45	10	5.5
46–54	2	1.1
Weight (kgs)		
< 5	69	37.9
5–10	113	62.1
Locality		
Quetta Rural	151	83.0
Quetta Urban	20	11.0
Kalat	4	2.2
Noshki	2	1.1
Chaghi	2	1.1
Much	3	1.6
Chaperone		
Mother	140	76.9
Father	25	13.7
Blood relative	17	9.4

(*Continued*)

Table 1 (Continued).

Characteristics	Frequency	Percentage
Gender		
Male	96	52.7
Female	86	47.3
Mother's living status		
Alive	168	92.3
Deceased	14	7.7
Travel time to the malnutrition center		
Within 1 Hour	167	91.8
Two Hours	12	6.6
Three Hours	3	1.6

Treatment Outcomes of the Outpatient Therapeutic Feeding Program

As mentioned earlier, the Sphere Standard acceptable ranges were used as a benchmark for evaluating treatment outcomes. One hundred and fifteen (68.65) children were cured and discharged from the OTP program. Forty-one (22.5%) were non-responsive and were referred to inpatient settings. Twenty (10.9%) defaulted on the program and 6 (3.2%) died during the management process. The relapse, screening refusal data, and vaccination history were not recorded by the healthcare professionals at the OTP unit (Table 2).

Assessment of Malnutrition and Its Types

The MUAC was used to diagnose malnutrition among all children. One hundred and twenty (65.9%) of the children had MUAC values of < 11 cm and hence were categorized as SAM. The remaining 34.1% had MUAC values ranging from 11–12.5 cm and were diagnosed with Moderate Acute Malnutrition (MAM). Fifty-four (29.7%) children were breast-feeding and data for thirty-two (17.6%) was not recorded. Ninety-five (52.2%) of the children had no oedema and were included in the marasmus while 47.8% were included in the Kwashiorkor cohort (Table 3).

Co-Morbidities Among the Children at the Time of Admission to the OTP Program

Forty-one children had diarrhea at enrolment to the OTP program followed by nausea and vomiting in 24.7% and fever in 28.5% of the children. Cough was also reported among 26.3% while the appetite test was positive for 74.1%. Nearly 80% recorded stool frequency of 1–3 times a day and urine flow (defined in terms of the size and force of the patient's urine stream) was positive among 93.4% of the children (Table 4).

Table 2 Treatment Outcomes of the Outpatient Therapeutic Feeding Program

Treatment Outcomes		
Cured and discharged (recovered)	115	68.6
Referred to inpatient (non-responsive)	41	22.5
Defaulter	20	10.9
Death	6	3.2

Note: Relapse, screening refusal, and vaccination data were not recorded.

Table 3 Assessment of Malnutrition and Its Types

Characteristics	Frequency	Percentage
Admission criteria		
MUAC	182	100.0
MUAC (cm)		
<11	120	65.9
11–12.5	62	34.1
Breastfeeding		
Yes	54	29.7
No	96	52.7
Not Recorded	32	17.6
Malnutrition type		
Kwashiorkor (Bilateral Pitting Edema positive)	67	36.9
Marasmus (Bilateral Pitting Edema negative)	115	63.1

Table 4 Co-Morbidities at the Time of Admission to the OTP Program

Characteristics	Frequency	Percentage
Diarrhea		
Present	41	22.5
Absent	141	77.5
Nausea and vomiting		
Present	45	24.7
Absent	137	75.3
Fever		
Present	52	28.5
Absent	120	71.5
Cough		
Present	48	26.3
Absent	134	73.6
Appetite		
Positive	135	74.1
Negative	47	25.9

(*Continued*)

Table 4 (Continued).

Characteristics	Frequency	Percentage
Stool frequency (per day)		
1–3	146	80.2
4–5	28	15.4
> 5	8	4.3
Urine flow		
Positive	170	93.4
Negative	12	6.6

Management and Medication for Malnutrition

The management and medication for malnutrition are presented in Table 5. The RUTF (plumpy nuts) was offered to all children. Admitted cases with severe to moderate acute malnutrition to OTP were managed following the Pakistan National Guidelines for Community-based Management of Acute Malnutrition.[23] Out of the 182 children whose

Table 5 Management and Medication for Malnutrition and Co-Morbid

Characteristics	Frequency	Percentage
RUTF (Plumpy nuts)		
Prescribed	182	100.0
Not prescribed	0	0
Retinol (Vitamin A, 5000IU/day)		
Prescribed	77	42.3
Not prescribed	105	57.7
Anthelmintic (Mebendazole, 100 mg, BID for 3 days)		
Prescribed	44	24.2
Not prescribed	138	75.8
Antiemetic (Metoclopramide, 0.5 mg/kg in 24 hours for 5 days)		
Prescribed	9	4.9
Not prescribed	173	95.1
Antibiotic (Amoxicillin, 70–100 mg/kg/day in two divided doses for 5 days)		
Prescribed	69	37.9
Not prescribed	113	62.1
Analgesic (Paracetamol, 10 mg/kg, 3 times per 24 hours)		
Prescribed	25	13.7
Not prescribed	157	86.3

medication records were available for review, the most prescribed medication was Vitamin A (PO, 42.3%) followed by Amoxicillin (PO, 37.9%) and Mebendazole (PO, 23.6%).

Treatment Outcomes and Associated Factors

In the bivariate logistic regression analysis of malnutrition, the dependent variable was assessed for a relationship against the independent variables. The significant variables with $p < 0.05$ (adjusting confounders) were later entered into the multivariable logistic regression model. The multivariate logistic regression identified the presence of diarrhea and the use of amoxicillin as significant prognosticators of treatment outcomes. Consequently, the odds of recovery on SAM among children with diarrhea [AOR = 0.60, 95% CI: (0.35–0.75)] were lower than those without diarrhea. Likewise, children on PO amoxicillin had higher chances of recovery [AOR = 2.45, 95% CI: (2.21–4.68)].

Discussion

Severe Acute Malnutrition is a growing concern worldwide. Although much attention is provided to SAM, the efforts to decrease the frequency and prevalence around the globe are not yet satisfactory. Kassaw et al estimated that 1–2 million children die every year due to SAM, majority of them live in South Asia and Sub-Saharan Africa.[34] Within this context, Asia is home to the largest number of children under 5 years of age with SAM[35] and hence the SAM-related complications are also expected to be on the higher side. Shifting our concerns to SAM in Pakistan, UNICEF reported that nearly half of all children in Pakistan are chronic while 11% are acutely malnourished. The country has the worst breastfeeding indicators in South Asia and hence SAM contributes to high mortality and morbidity rates among children under 5 years of age. Those who survive are faced with poor mental and physical growth that leads to a significant economic impact on the country's development and prosperity.[36] To overcome this problem, Pakistan with the help of UNICEF and other organizations offers an OTP program for SAM children, however, a detailed study of the effectiveness of these programs and treatment outcome measures is not available in the literature. We, therefore, conducted this study to highlight the treatment outcomes and the associated factors related to the OTP program offered to children with SAM in Quetta City, Pakistan.

The result revealed that 115 (68.6%) SAM children admitted to OTP recovered. The recovery rate of the current study is lower than the Sphere Standard acceptable ranges (mortality < 3%, default < 15%, and recovered > 75%),[37] and to what is reported by several studies of the same nature.[38–42] However, it is comparable to other studies reporting recovery rates from SAM.[43–47] The conflicts of the recovery rates are attributed to the difference in settings where the OTP program was offered which is not the same in various healthcare settings. Also, the variance might be due to differences in socioeconomic status, quality of care provided for children, health-seeking behaviour, availability, and accessibility of therapeutic foods and medications at the time of OTP enrolment. Promisingly, the recovery rate is higher than reported in a study in Karachi, Pakistan.[48] Even though the recovery rate is not appreciated as per the Sphere Standards, comparing the results with the published literature revealed that the OTP program effectively achieved good survival and recovery rates. Similarly, the increased efforts of the Government and the support of UNICEF to improve maternal and child nutrition through several community-based programs may have also played a key role in this improvement. Nevertheless, we see a huge room for improvement, and increasing the recovery rate should be a priority for healthcare professionals and policymakers dealing with SAM in Pakistan.

Marasmus (63.1%) was the predominant form of MN in the current study and the finding is parallel to studies from other parts of the world.[43,45,47,49] The finding is not overwhelming as marasmus is more common in the age group below two years[50] which is also the case in this study as >70% of the study population was in the age category of < 24 months. An encouraging finding of the study was the death rate whereby this study reported a lower proportion of deaths (3.2%). The proportion of death rate is also lower than the recommended minimum Sphere Standard which should be <10%.[37] The lower death rate is attributed to the appropriate management of the children at the OTP and children reaching the OTP without complications. Our hypothesis is supported by a study from Ethiopia whereby the authors also presented similar reasons for lower death rates.[43]

This hospital-based study found that rates of SAM were noticeably identical for both genders (52.7% for males and 47.3% for females) and 74.7% had an age range of 6–15 months. Although there is no scientific evidence connected to

this finding, the gender distribution is the same as reported by other studies.[43,51,52] Nevertheless, there is one observation that we would like to highlight and discuss here. In the developing world, socioeconomic parameters and gender-related preferences are important factors that result in malnutrition. Within this context, male babies are favoured more by their parents, and gender inequality (quantity and quality of food provision) is widely reported and observed. We agree with the assertions of Shafiq et al, whereby the authors described that even today a female child is considered less important than a male child.[53] The authors also reported that this gender-based discrimination is noticed in nutrition provision, education, and health. Hence, many female children suffer from SAM compared to their counterparts.[53] However, the current study while comparing the proportion found no gender-based favour and SAM was noticed in equal percentages among males and females and that is a positive sign of reduced gender-based discrimination.

Results of the current study highlighted that nearly thirty percent of the children were breastfed, while over 50% were not. The role of breastfeeding in the prevention of MN is well recognised in the literature.[54,55] Although the current study was not aimed to associate breastfeeding and MN, the lack of breastfeeding and development of MN is linked to several factors. Malnutrition negatively impacts school outcomes, cognitive development, and overall Gross Domestic Product which in the long term are disastrous to any nation. Our claims are in line with what is reported by Katoch et al in their two different systematic reviews.[56,57] The authors discussed the deleterious effects of MN and its negative effect on the health and overall well-being of society. The authors further concluded indirect consequences that must be dealt with a prompt necessity.[58] Consequently, based on the findings of the current study and upon the available evidence educating mothers exclusively about breastfeeding is recommended to avoid MN-related complications.

In the current study, the use of amoxicillin and the recovery from diarrhea were identified as predictors of treatment success. The use of PO amoxicillin has shown a positive impact on treatment outcomes specifically in the cases of SAM. Correlating our results, children receiving PO amoxicillin reported improved recovery from SAM as compared to those who did not take them with odds of 3.38 and 1.95 respectively.[43,47] The supportive role of amoxicillin in SAM is well documented in the literature. Trehan et al in their controlled trial concluded that adding amoxicillin to the management of SAM resulted in remarkable improvements in recovery rates. Significant improvements in weight and gain in the MUAC were also observed. The authors consequently established that adding amoxicillin to therapeutic regimens for SAM was associated with significantly improving retrieval and mortality rates.[59] Likewise, Williams and Berkley in their systematic review established the continued use of broad-spectrum oral amoxicillin for treating children with uncomplicated SAM as outpatients which again supports the results of the present study.[60]

Results of the current study reported an association of diarrhea with SAM. The odds of recovery on SAM among children with diarrhea were lower compared to those without diarrhea. It is a well-known fact that diarrhea is usually associated with infections that result in further nutritional consumption. This shares nutrients and may delay the recovery time among children with SAM. The relationship between diarrhea and physical growth is recognized whereby the presence of diarrhea and a delay in recovery time was associated in literature.[61–63] Each diarrheal episode makes MN worse as diarrhea causes cytokine-induced MN which results from the actions of proinflammatory cytokines.[64] Hence, diarrhea-related MN interaction represents a dangerous web that can be disentangled by promoting breastfeeding, improving hygiene conditions, and improving nutrition. However, concurrently using PO antibiotics (amoxicillin) among children with MN can increase antibiotic-associated diarrhea episodes (AAD). Although AAD is documented in the literature, the underlying mechanisms of AAD in children remain unclear. Kuehn et al, in their review, highlighted the increased incidence of AAD following the use of oral penicillin and therefore advised consideration when prescribing antibiotics, especially in children.[65] Consequently, we recommend closely monitoring the malnourished children on amoxicillin and taking immediate remedial actions if AAD develops.

Limitations

The study does have certain limitations. The relapse, screening refusal, and vaccination data were not recorded at the OTP center. These are important indicators and could have provided additional information. The generalizability of the findings is always questionable in a single-centered study.

Recommendations

We recommended a study with multiple OTP centers and a larger sample to get an in-depth view of MN and the accompanying factors. Relapse, screening refusal, and vaccination data must be included to get a clear picture of MN and its associated factors that will help in developing effective interventions for malnourished children.

Conclusion

Recovery rates reported by the current study are below the cut-off points of the minimum standards, nevertheless, the death rate was lower. Diarrhea was a statistically significant factor that impeded the recovery rate of children with SAM. On the other hand, PO amoxicillin was a positive indicator of recovery. Consequently, healthcare providers should pay exclusive attention to SAM cases with diarrhea and ensure strict follow-up according to the protocol. Healthcare providers must be provided with continuous medical education specifically focused on managing conditions like diarrhea that will help them in the targeted management of MN. We also recommended providing community-based health education and counselling for mothers regarding breastfeeding, hygiene measures, and when to approach the OTP center to avoid complications among the SAM children. A well-informed and educated mother will be an excellent resource in reducing MN frequency hence reducing the healthcare burden and enhancing community well-being.

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Disclosure

The authors report no conflicts of interest in this work.

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