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Comorbidities and their Outcomes in Children with Severe Acute Malnutrition Visiting Pediatric Emergency Department at a Tertiary Care Hospital in Urban Slums of Karachi, Pakistan

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Abstract

Objective: Childhood malnutrition is a global problem. Around 20 million children become a victim of Severe Acute Malnutrition across the globe. Malnutrition is believed to contribute to nearly half of deaths among children under five years of age in Asian and African continents. Main aim of this study was to determine the frequency of co-morbidities (Measles, Acute Diarrhea, Pneumonia, Tuberculosis, and Malaria) and their outcomes in children presenting with severe acute malnutrition in Pediatrics emergency department at a tertiary care hospital Karachi.

Material and method: A descriptive cross sectional stufy conducted at Pediatric emergency department, Civil Hospital Karachi after obtaining the approval from The Research Evaluation Unit, CPSP, Karachi. The duration of study was 6 months from July 2018 to January 2019. All children aged 6-60 months, having weight for height ≤–3 Z-score, or mid upper arm circumference <115 mm, or presence of bilateral pedal edema were included in study. Patients were admitted from emergency department according to WHO's Severe acute malnutrition criteria with variable associated illnesses. Later, they were admitted in ward where they were observed and evaluated on daily basis to identify various morbidities until they were treated fully, expired during course of treatment, or left against medical advice at any time during hospital stay.

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Results: A total of 195 children were enrolled in study. Mean age of participants was 17.54 ± 3.2 months, 112 (57.44%) were male, 126 (64.62%) patients have MUAC of >=80 mm, 103 (52.82%) participants have edema, overall 160 (82.05%) patients were stabilized & discharged, 22 (11.28%) left against medical advice and 13 (6.67%) patients died. Out of 195 participants, 103 (52.82%) patients had acute watery diarrhea, 46 (23.59%) had pneumonia and 32 (16.41%) patients had tuberculosis.

Conclusions: Gastroenteritis, pneumonia, and tuberculosis are common comorbidities and contributes to high mortality.

Introduction

WHO defines severe acute malnutrition as weight for height ≤–3 Z-score, or mid upper arm circumference <115 mm, or presence of bilateral edema in children who are 6–59 months of age [1]. Universally around 20 million children become victim of Severe Acute Malnutrition each year, with primary burden being in Indian subcontinent and Black Africa [2]. In South East Asia mortality rate varies between 5-40 %, and complicated SAM has a case fatality rate of over 30% in some studies even when WHO recommended management is followed [3-5]. It has also been estimated that in Pakistan approximately 40 to 50% children less than five years are stunted, 13% children are moderately to severely wasted and 12% comprise of severe underweight [6].

Infections are a major cause of morbidity in children suffering from SAM. Gastroenteritis, respiratory tract infections, malaria, measles and tuberculosis account for the majority of infections seen in children with severe acute malnourishment [7].

Different studies have reported the variable prevalence of co morbidities among children suffering from SAM. A study conducted by a public sector tertiary care hospital in Karachi (NICH) in 2012 reported that infection was the most common co-morbid, with Diarrhea in 50.8% of cases, Pneumonia in 20%, sepsis in 16.2% and measles in 8.5% [8]. Another study conducted in Jodhpur in 2010 reported that most frequent co-morbid conditions observed with malnutrition were gastrointestinal tract infections in 60% of study participants, and respiratory tract infections in 52% [9]. A study conducted in India from August 2011 to July 2012 showed that out of total 104 children with severe acute malnutrition, diarrhea was comorbid in 54% of cases and acute respiratory tract infections were present in 27.8% of cases [10]. The study conducted by National Institute of Child Health in 2012 reported that among 130 study participants who were admitted with Severe Acute Malnutrition, 108 (83.1%) children were stabilized and discharged, 14 (10.8%) patients Left Against Medical Advice (LAMA) whereas 8 (6.2%) expired [8].

Malnutrition is believed to contribute to nearly half of the deaths of the children under five years of age in Asian and African continents [11]. The high mortality among SAM children is believed to be due to associated co-morbidities. Therefore, timely identification of the comorbid conditions and timely intervention can ensure a better outcome as these children are at a higher risk of poorer prognosis as compared to healthier individuals. As multiple outcomes have been studied separately in different studies in our part of the world but combined outcome has never been stratified in this specific age group ranging from 6ms to 5 years. Hence, the purpose of this study is to determine the frequencies of different infectious co-morbidities associated with SAM. The results of the study guide the clinicians to investigate different infectious co-morbidities and plan interventions appropriately based on evidence-based medicine. This will help in reducing the morbidity and mortality of under-five severely malnourished children. The objective of the study was to determine the frequency of Co-morbidities (Measles, Acute Diarrhea, Pneumonia, Tuberculosis, and Malaria) and their outcome in children presenting with severe acute malnutrition in the pediatric emergency department of Civil Hospital Karachi.

Methods

This descriptive case study was carried out in the Pediatric Emergency Department in Civil Hospital Karachi from July 2018 to January 2019. Non-probability consecutive sampling was applied. The Research Evaluation Unit, CPSP issued the approval letter with reference number CPSP/REU/PED-2014-183-3001 giving the approval to conduct the study.

By using the reference study reported percentage of 6.2% from mortality [8], the sample size was calculated. With 95% confidence interval and 3.5% margin of error using Raosoft Sample Size Calculator, the sample size was calculated to be 185. To account for the non-response, bias the sample size was inflated by 5%. Thus, the final sample of study participants to be recruited in this study was 195.

All children aged 6 months to 60 months presenting in the emergency department of Civil Hospital having one or more of following criteria: weight for height ≤–3 Z-score or mid upper arm circumference <115 mm or presence of bilateral pedal or generalized edema according to WHO classification were included in the study. Informed consent was obtained from the parent/guardian prior to inclusion in study.

Children with major congenital malformation (i.e. cleft lip/palate, Down's syndrome and spina bifida) or severe neurological impairment (i.e. autism, cerebral palsy and multiple sclerosis) evaluated on history, examination or diagnostic tests were excluded from the study. Also children having surgical illnesses (i.e. child with severe trauma to midfacial region, child who has undergone nasal surgical procedure, esophageal varices, and alkaline indigestion) impending oral or nasogastric feeding evaluated on history and examination were excluded.

After selecting patients of the required age group, an informed consent was taken from the patient's guardian by the on call duty doctor in the emergency department. Patients were enrolled who match the above-mentioned criteria. The weight of every patient was measured with an electronic weighing scale. The length was measured in children less than 24 months old in recumbent position using a length board positioned on a flat, steady surface such as a table. In children 24 months or more in age, upright height was measured using stadiometer. All children underwent detailed clinical and laboratory evaluation with particular emphasis on nutritional status and comorbidities by investigator in the Emergency Department. Demographic profile including age, gender, height, weight, MUAC, and length of stay in hospital, presenting complaints and related physical examination was recorded on a predesigned proforma by the investigator. Later, the patients were observed and evaluated on daily basis during the stay in the hospital to identify various morbidities until they were treated fully or expire during the course of treatment or leave against medical advice at any time

during the hospital stay.

SPSS version 20 was used to enter and analyze the data. Descriptive statistics were performed. Mean and the standard deviation was computed for numerical variables like age, weight, height and mid upper arm circumference; whereas frequency and percentages were used to present the categorical variable like gender, edema, comorbidities, and outcome as (discharge, mortality, and LAMA). Association of outcome variable with age, gender, edema and comorbidities were found through chi-square test. p-value ≤ 0.05 was taken as significant.

Results

During the study period 195 patients were enrolled in the study. The mean age of study participants was 17.54±3.2 months and 108 (55.38%) were >=24 months of age, 112 (57.44%) were male and 83 (42.56%) were female, 126 (64.62%) patients have MUAC of >=80 mm, the mean weight of the enrolled participant was 10.58±16.2 kg and 103 (52.82%) has weight <7 kg (Graph 4), 125 (64.1%) patients has height of <100 cm, 85 (43.59%) has edema. Among enrolled patients 103 (52.82%) has acute watery diarrhea followed by pneumonia in 46 (23.59%) and tuberculosis in 32 (16.41%) patients. The demographic parameters of study participants are presented in Table 1.

Table 1: Demographic parameters of study participants (n=195).

Parameters	n	%
Age Mean ± SD	17.54 ± 3.2 months	
<24 months	87	44.62
≥24 months	108	55.38
Gender		
Male	112	57.44
Female	83	42.56
Mid Upper Arm Circumference		
<80 mm	69	35.38
≥80 mm	162	64.62
Weight		
<7 kg	103	52.82
≥7 kg	92	47.18
Height		
<100 cm	125	64.10
≥100 cm	70	35.90
Edema		
Present	85	43.49
Absent	110	56.41
Comorbidities		
Acute diarrhea	103	52.82
Pneumonia	46	23.59
Tuberculosis	32	16.41
Measles	7	3.59
Malaria	7	3.59

Overall 160 (82.05%) patients were stabilized & discharged, 22 (11.28%) left against medical advice and 13(6.67%) patients died (Figure1).

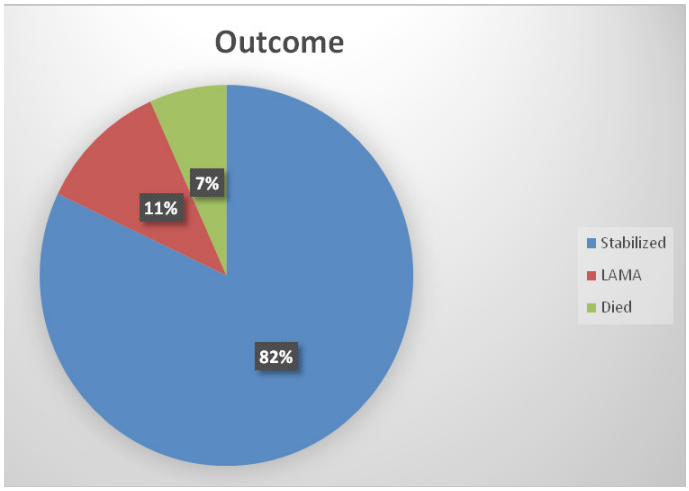

Figure 1: Distribution of outcome of study participants.

Table 2 shows the association of outcome with demographic parameters among study participants. Among stabilized patients 96 (60%) had ≥ 24 months while among died patients 10 (76.9%) were < 24 months while 3 (23.1%) were ≥ 24 months (p=0.013). Among patients that were stabilized 92 (57.5%) were male while among died patients 9 (62.9%) were male (p=0.539). Among study participants, patients with acute gastroenteritis had higher mortality. Among deaths observed during study 6 (46.2%) had acute diarrhea, 3 (23.1%) had measles, 2 (15.4%) had malaria (p=0.851).

Table 2: Association of outcome with demographic parameters of study participants.

Outcome	Stabilized		LAMA		Died		p-Value
Parameter	**n**	**%**	**n**	**%**	**n**	**%**	
Age (months)							0.013
<24	64	40.0%	13	59.1%	10	76.9%	
≥24	96	60.0%	9	40.9%	3	23.1%	
Gender							0.539
Female	68	42.5%	11	50.0%	4	30.8%	
Male	92	57.5%	11	50.0%	9	69.2%	
EDEMA							0.448
Present	87	54.4%	14	63.6%	9	69.2%	
Absent	73	45.6%	8	36.4%	4	30.8%	
Comorbidities							0.851
Acute diarrhea	86	53.8%	11	50.0%	6	46.2%	
Pneumonia	4	2.5%	2	9.1%	1	7.7%	
Tuberculosis	5	3.1%	1	4.5%	1	7.7%	
Measles	38	23.8%	5	22.7%	3	23.1%	

Discussion

Infections are the most common comorbidity in children with SAM [12]. In this study, acute diarrhea is the most common comorbid accounting for 52.8% cases followed by pneumonia 23.6%, tuberculosis 16.4%, measles 3.6%, and malaria 3.6% cases.SAM is a preventable and treatable cause of childhood mortality and morbidity [13]. Primary malnutrition is highly prevalent in Pakistan; in fact, as compared to other developing nations prevalence of childhood malnutrition is highest in Pakistan [14]. Children of less than 60 months age are at the greatest risk of malnutrition due to low dietary consumption, infectious illnesses, dearth of suitable care, and discriminatory food distribution within the family in developing countries, specifically in underprivileged populations [15,16]. UNICEF rightly describes the situation of children's malnutrition in 21st century as "More children are surviving but far too few are thriving". More concisely children suffering from malnutrition are not thriving the first thousand days of life which are believed to be crucial for building a foundation of healthy lifelong physical and mental growth[13]. As a result when they fail to thrive in early days, they fail to thrive later in adolescence and adulthood.

In this study the mean age of study participants was 17.54±3.2 months and 108 (55.38%) were >=24 months of age. Similarly, other studies reported mean age of study patients was 17.21±3.9 months and majority of children were <24 months of age [8-9,17]. An Ethiopian study showed the highest prevalence of wasting, underweight and stunting in study participants aged 12 to 23 months, which is comparable to our study [18]. In this study male population is more than female. Overall, 112 (57.44%) were male and 83 (42.56%) were female.

Edema was present in 43.49% of the study participants. In a study conducted in Ethiopia out of 351 children included in the study 214 (61.1%) had edematous malnutrition. Moreover the study also showed that proportion of edema is almost twice after 12 months of age with peak at 3-5years of age [19]. Edematous malnutrition is linked with increased morbidity and mortality [20]. A local study conducted in Pakistan at a tertiary care hospital in Karachi reported edematous malnutrition to be present in 19.2% of the total 130 children suffering from SAM enrolled in the study [8]. This is low as compared to our results. The exact mechanism of edematous malnutrition remains undefined with several theories available in literature [20].

In this study we studied the frequency and outcome of common co morbidities in malnourished children under the age of 60 months. Acute diarrhea was most common comorbid present in 52.8% of the cases followed by pneumonia 23.6%, tuberculosis 16.4%, measles 3.6%, and malaria 3.6% case. Many studies have described various prevalence of co morbidities among malnourished children. It was reported from a study from a tertiary care hospital that infection was the most common comorbid, where diarrhea accounted for 50.8% cases followed by pneumonia (20%), sepsis (16.2%) and Measles (8.5%). Micronutrient deficiencies were also common with anemia reported in 88.4% children with SAM [8]. The results are comparable to our study with diarrhea being the most common comorbid. Another study conducted in India reported that among 104 severe acute malnourished children recruited in the study, 54% had gastrointestinal disturbance and 27.8% suffered acute respiratory tract infections. Tuberculosis was associated co-morbidity in 22% of study participants. 3.8% of patients suffered from Malaria and another 3.8% had Measles, and HIV infection was seen in 2.9% cases [10]. Data obtained from a relatively older meta-analysis, which was carried out to analyze the risk of death due to malnourishment and the fraction of deaths by cause attributable to underweight. Data was obtained from 10 cohort studies conducted in various areas of the world. In that study among enrolled children the main causes of death were diarrhea accounting for 60.7% deaths, pneumonia resulted in 52.3% deaths, 44.8% deaths were due to measles and 57.3% deaths were due to malaria. A total of 52.5% of deaths were caused by undernutrition [4].

In this study, overall 82.05% patients were stabilized & discharged, 11.28% left against medical advice and 6.67% patients died. A study from tertiary care hospital reported the comparable results that among patients admitted with SAM, 83.1% children were stabilized and discharged, 10.8% patients Left Against Medical Advice (LAMA) whereas 6.2% patients were expired [8].

In study by A Laure the risk of infection was observed in children admitted in hospital in Niger. The figures from that study showed that the high level of infections were common in children with complicated SAM. Gastroenteritis (38.6%), respiratory tract infections (20.9%) and malaria (14.9%) were the most frequent conditions observed among under-nutrition children. Key reasons of death among enrolled children were sepsis, respiratory tract infections and tuberculosis [7].

In another study conducted in India it was observed that among 150 cases of SAM, diarrhea (34.7%) and respiratory tract infection (31.33%) were the dominant co-morbid conditions. While in 20% of cases tuberculosis was diagnosed and in 6.7% of cases measles was a co-morbid. There was a very high prevalence of intestinal helminthic infestation among malnourished children. Ascaris lumbricoides being the most common parasite involved with polyparasitism in 20% of cases [21].

In a study conducted at Indus hospital of 341 children with severe malnutrition, it was observed that these children are more prone to infections. Among the infections, AGE was most prevalent in 31.4% of cases followed by sepsis accounting for 15.6% of the cases. Apart from that hypokalemia was the most common electrolyte imbalance present in 46.6% of cases and anemia was most common hematological abnormality present in 95.3% of study participants [22].

In this study, we observed that the rate of mortality was higher in the children under 2 years of age as compared to those above 2 years of age. They accounted for 76.9% of total mortality. Among all the causes acute gastroenteritis accounted for most of the deaths. It was the cause of 46.2% of deaths followed by measles, which accounted for mortality in 23.8% of study participants who died. Malaria did not lead to any deaths in our study.

Worldwide approximately 16 million children below the age of 60 months suffer from SAM; Severe acute malnutrition is the most severe and visible form of undernutrition [23]. Children with this form of under-nutrition are nine times more likely to die from a disease as compared to well-nourished child of same age [23]. These deaths could be directly due to malnutrition or could be a result of any of the diseases like diarrhea or pneumonia. Probable risk factors associated with mortality are blood transfusion, intravenous fluids infusion, electrolyte imbalance (hyponatremia, hypokalemia), hypoglycemia and septicemia.

Under-nutrition is a major problem faced by the developing countries like Pakistan in terms of child health, with severe

acute malnutrition being the extreme manifestation of under-nutrition. These children are in a very critical state in terms of their survival and it is of prime importance to identify and address the primary disease as well as the comorbids to save the life of these children. Timely recognition can make a big difference to ensure a favorable outcome [24].

Moreover, strategies should be developed to reduce the burden of under-nutrition among children. Ensuring maternal education, implementation of breastfeeding programs, community health programs, proper family planning and nutritional education programs among masses can all benefit in preventing or at least in decreasing the burden of under-nutrition to some extent in a developing country like ours [25].

The study has some limitations. This study was carried out at single tertiary care hospital in Karachi, so findings cannot be generalized to the general population.

Conclusion

Gastroenteritis, pneumonia, and tuberculosis are common comorbidities among the severely malnourished children. The findings of this study suggest that malnutrition is multi-dimensional. Comorbidities are worsening the overall survival in these children. It is pivotal to design and practice the urgent management protocols so as to reduce mortality and morbidity in this population.

Ethics Approval/Disclosure

Ethical approval was obtained from "The Research Evaluation Unit, CPSP". The approval letter with reference number CPSP/REU/PED-2014-183-3001 was issued giving the approval to conduct the study.

Funding

Study was not funded by any organization or authority.

Patients Consent

Informed consent was obtained from guardians of all the patients prior to their inclusion in study.

Availability of Data and Materials

All the data is available and can be provided as needed.

Authors contributions

Dr. Sara Fatima (Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work).

Dr. Maryam Haider (Literature study, Drafting the work or revising it critically for important intellectual content).

Dr. Ammara Hameed (Questionnaire designing, data collection, data interpretation and analysis).

Dr. Syed Ghazanfar Saleem (Final approval of the version to be published).

Dr. Saadia Karim (Questionnaire designing, data collection, data interpretation and analysis).

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