

ORIGINAL ARTICLE**Factors Influencing Morbidity and Mortality in Hospitalized Children with Severe Acute Malnutrition: An Observational Study**¹Anuj Chaudhary, ²Rajiv Arora¹Assistant Professor, Department of Physiology, Gold Field Institute of Medical Sciences, Faridabad, Haryana, India;²Assistant Professor, Department of Paediatrics, Major S D Singh Medical College & Hospital, Farukhabad, Uttar Pradesh, India**ABSTRACT:**

Background: Addressing the critical issue of Severe Acute Malnutrition (SAM) is pivotal for substantial reductions in both under-5 mortality and morbidity. The impracticality and cost inefficiency of hospitalizing and providing inpatient care for all affected children underscore the need for strategic intervention. Therefore, it becomes crucial to identify the factors influencing morbidity and mortality in children suffering from SAM. These factors can serve as valuable indicators for prioritizing and directing interventions, optimizing the use of resources, particularly in developing countries. In light of these considerations, the study aims to identify predictors of morbidity in children afflicted with SAM. **Methods:** In this observational study conducted at a hospital, we enrolled consecutive children aged between 2 months and 4 years who met the WHO case definition for Severe Acute Malnutrition (SAM) and exhibited complications necessitating hospitalization. The study focused on assessing sociodemographic, clinical, and biochemical factors to understand their influence on morbidity and mortality among these children. **Results:** Out of the 1852 children screened for Severe Acute Malnutrition (SAM), 252 (13.6%) met the case definition. However, the final analysis focused on 212 children. Among these, the prevalent co-morbidities included diarrhea, followed by pneumonia, tuberculosis, and HIV. Through multivariate regression analysis, the study identified shock, hypoglycemia, severe anemia, and bacteremia as independent risk factors significantly associated with both morbidity and mortality in these children. **Conclusion:** The morbidity and mortality of children affected by Severe Acute Malnutrition (SAM) are influenced by a myriad of factors. It is crucial to pinpoint the early warning signs responsible for untimely deaths, enabling the timely hospitalization, triage, and prioritization of interventions, particularly in resource-limited settings.

Keywords: Severe Acute Malnutrition, Children, Predictors, Outcome, Mortality

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INTRODUCTION

Malnutrition, a pervasive global issue, continues to exert a profound impact on the health and well-being of children. Accounting for a staggering 60% of the 11 million annual deaths among children under the age of five, its repercussions are both immediate and enduring. Tragically, two-thirds of these fatalities unfold within the critical first year of life, emphasizing the urgent need for comprehensive intervention strategies.¹ The spectrum of childhood under-nutrition encompasses various nutrition disorders, including underweight, wasting, stunting, and micronutrient deficiencies. Underweight, a composite measure derived from low weight-for-age, encapsulates both wasting (low weight-for-height) and stunting (low height-for-age). Wasting, characterized by a diminished weight-for-height ratio, signifies acute malnutrition arising from recent nutritional inadequacies, such as insufficient food intake or the aftermath of infections like diarrhea, leading to substantial weight loss. The definition of severe acute malnutrition is comprehensive, encompassing criteria such as a weight-for-height less than -3 z scores of the median WHO growth standard, a mid-upper-arm

circumference (MUAC) less than 115 mm, visible severe wasting, or the presence of nutritional edema. While severe acute malnutrition transcends geographical boundaries, its impact is most pronounced in sub-Saharan Africa, where the burden is disproportionately borne.^{2,3} Infants and young children, in particular, face heightened vulnerability to severe acute malnutrition due to their increased nutritional demands for optimal growth and cognitive development. This vulnerability is further underscored by the peak age for severe acute malnutrition, occurring between 6 and 18 months—a critical period marked by accelerated growth and crucial brain developmental milestones.

In the face of these challenges, addressing malnutrition demands a multifaceted approach that goes beyond immediate health interventions. It necessitates comprehensive strategies encompassing nutrition education, access to balanced diets, healthcare infrastructure enhancement, and socioeconomic support, especially in regions where the impact of malnutrition is most pronounced. Only through concerted efforts can the global community

hope to mitigate the pervasive and far-reaching consequences of childhood malnutrition.

Severe Acute Malnutrition (SAM) emerges as a formidable challenge to child health, exerting a profound impact on morbidity and mortality, particularly in the developing world.⁴ Its implications extend beyond the individual child, posing a significant hurdle to the realization of Millennium Development Goal 4—aimed at reducing under-five mortality by two-thirds. A recent assessment has underscored the imperative for strengthened efforts in preventing child deaths, highlighting the urgency of this global health concern. The median under-five case fatality rate for severe acute malnutrition typically hovers between 30% and 50%, underscoring the severity of the threat it poses. SAM can manifest as both a direct cause of death and as an indirect contributor, amplifying the case fatality rate to levels as much as nine times higher than observed in well-nourished children. This escalation is particularly pronounced when children with severe acute malnutrition concurrently face common childhood illnesses such as diarrhea and pneumonia. Understanding the intricate interplay between severe acute malnutrition and common childhood illnesses is crucial. SAM not only heightens the vulnerability of affected children to these illnesses but also exacerbates their severity, leading to an alarming increase in the risk of mortality. The intricate relationship between malnutrition and infectious diseases creates a vicious cycle, where malnutrition weakens the immune system, rendering children more susceptible to infections, while the infections, in turn, further compromise nutritional status. Effectively addressing severe acute malnutrition demands a comprehensive approach that spans prevention, early detection, and timely intervention. Nutritional rehabilitation programs, community-based initiatives, and improvements in healthcare infrastructure are integral components of this multifaceted strategy. Moreover, an emphasis on educating communities about proper nutrition and early recognition of warning signs can contribute significantly to breaking the cycle of malnutrition and its associated mortality. In the quest to achieve global health goals, tackling severe acute malnutrition emerges as a critical step. By understanding its intricate dynamics and adopting holistic interventions, the international community can pave the way toward reducing the burden of morbidity and mortality in children, especially in resource-limited settings.^{5,6}

The World Health Organization's (WHO) consensus management guidelines for Severe Acute Malnutrition (SAM) represent a critical framework designed to address the multifaceted challenges posed by this severe health condition. These guidelines delineate a strategic approach, encompassing different phases of intervention aimed at improving the outcomes for children suffering from SAM. The stabilization phase, a cornerstone of the WHO guidelines, is dedicated to

identifying and treating life-threatening issues that may accompany SAM. This immediate and intensive phase is crucial for the survival of the child, focusing on stabilizing their condition before proceeding to subsequent stages of intervention. The staged introduction of milk-based nutritional rehabilitation is another pivotal aspect of the guidelines. This recognizes the importance of providing essential nutrients in a carefully managed manner to avoid complications and facilitate the gradual recovery of the child's nutritional status. Micronutrient and vitamin supplementation further enhance this process, addressing specific nutritional deficiencies that commonly accompany SAM.⁷ In addition to nutritional aspects, the guidelines emphasize the empirical use of antimicrobial and anti-helminthic treatments. This recognizes the heightened vulnerability of children with SAM to infections, and the importance of addressing these co-existing health challenges to improve overall outcomes. Despite the positive impact observed through the implementation of Medical Nutrition Therapy (MNT) based on the WHO guidelines, achieving the recommended sphere standards, particularly a Case Fatality Rate (CFR) below 5%, presents persistent challenges. In resource-limited settings, a multitude of factors, such as limited healthcare infrastructure, insufficient resources, and sociocultural nuances, can impede the seamless application of these guidelines. Therefore, addressing SAM in resource-limited settings necessitates a nuanced and context-specific approach. This may involve community-based initiatives, capacity-building programs for healthcare providers, and collaboration with local communities to ensure the sustainability and effectiveness of interventions.⁸ Understanding the broader determinants of health, including socioeconomic factors and cultural beliefs, is essential for tailoring interventions that resonate with the unique challenges faced in these settings. The journey towards mitigating SAM-related morbidity and mortality is an ongoing endeavor that requires continuous adaptation, innovation, and a commitment to addressing the underlying systemic issues that contribute to the persistence of this health challenge. Through a holistic and collaborative approach, global health initiatives can strive to make substantial progress in reducing the impact of Severe Acute Malnutrition in resource-limited environments.

MATERIALS AND METHODS

In the pursuit of a thorough exploration of Severe Acute Malnutrition (SAM) in children, our hospital-based observational study employed a meticulous approach. We enrolled consecutive children aged 2 months to 5 years, irrespective of gender, who met the stringent criteria outlined by the World Health Organization (WHO) for SAM. These children presented with various complaints necessitating hospitalization and were carefully selected, ensuring that they did not meet any exclusion criteria. To

uphold ethical standards, the study received approval from the institutional ethics committee, and written informed consent was diligently obtained from the parents of each participating child. The determination of the sample size, set at 150, was based on a pragmatic approach, considering the anticipated average number of malnourished children within the specified age range likely to be admitted during the designated study period. The data collection process was comprehensive, utilizing a prestructured proforma designed to capture a broad spectrum of information. This encompassed detailed anthropometric parameters, offering insights into the physical development and nutritional status of the subjects. The socio-demographic profile section delved into crucial factors such as age, gender, education, income, immunization history, and feeding practices, with a particular focus on breastfeeding practices.

In addition to these foundational elements, the proforma documented intricate clinical details related to the presenting complaints and relevant investigations. Both routine and case-specific investigations were included, tailoring the approach to the unique clinical circumstances of each child. This holistic data collection approach aimed to paint a comprehensive picture of the health and living conditions of the children in the study. By intricately weaving together socio-demographic, anthropometric, and clinical details, the study sought not only to characterize the individual cases but also to contribute to a broader understanding of the contextual factors influencing SAM. The findings aimed to inform targeted interventions, both at the individual patient level and within the broader public health landscape, thereby advancing our collective efforts in addressing the intricate challenges associated with childhood malnutrition. Through this multidimensional exploration, the study aspired to contribute valuable insights that could potentially shape policies and practices aimed at improving the outcomes of children grappling with Severe Acute Malnutrition.

In the rigorous pursuit of accurate diagnostic information, our study implemented a meticulous approach to sample collection and testing procedures. Blood cultures were obtained aseptically using BACTEC bottles containing universal broth. Subsequently, these samples were transferred to the microbiology department for incubation and plating, ensuring a controlled and sterile environment for optimal results. The urine collection process involved strict aseptic precautions, employing either suprapubic puncture or a clean catch mid-stream sample. Initial testing involved nitrite testing by dipsticks at admission, while the remaining samples were sent to the microbiology department for routine microscopy and culture.

Mantoux testing, a crucial diagnostic step, utilized a 5 TU (tuberculin units) solution. A positive result was determined by the presence of an induration greater than 10 mm after 72 hours, contributing valuable insights into the potential presence of tuberculosis.

Fasting early morning gastric aspirates, collected in plain sterile vials, were employed for the detection of acid-fast bacilli, aiding in the diagnosis of certain respiratory conditions. Malaria testing comprised a comprehensive approach, involving thin and thick smears along with antigen detection for *Plasmodium vivax* and *falciparum*, using 1 ml EDTA blood.

This multifaceted approach enhanced the accuracy of malaria diagnosis. Furthermore, in alignment with national guidelines (NACO guidelines), testing for HIV-1 was conducted in all suspected cases, adding another layer of diagnostic precision to the study. Beyond the diagnostic phase, our study delved into the comprehensive management of children hospitalized with Severe Acute Malnutrition (SAM). A standard protocol was adhered to, ensuring consistent and evidence-based care for all participants. The outcomes were meticulously recorded, with individuals categorized as either discharged and improved after a 6-month follow-up on an outpatient basis (Group I) or, regrettably, as having succumbed to the condition, whether within the hospital or during the subsequent 6-month follow-up on an outpatient basis (Group II). This structured approach not only enhanced the diagnostic robustness of the study but also provided a foundation for understanding the long-term outcomes and challenges associated with Severe Acute Malnutrition in hospitalized children.

RESULTS

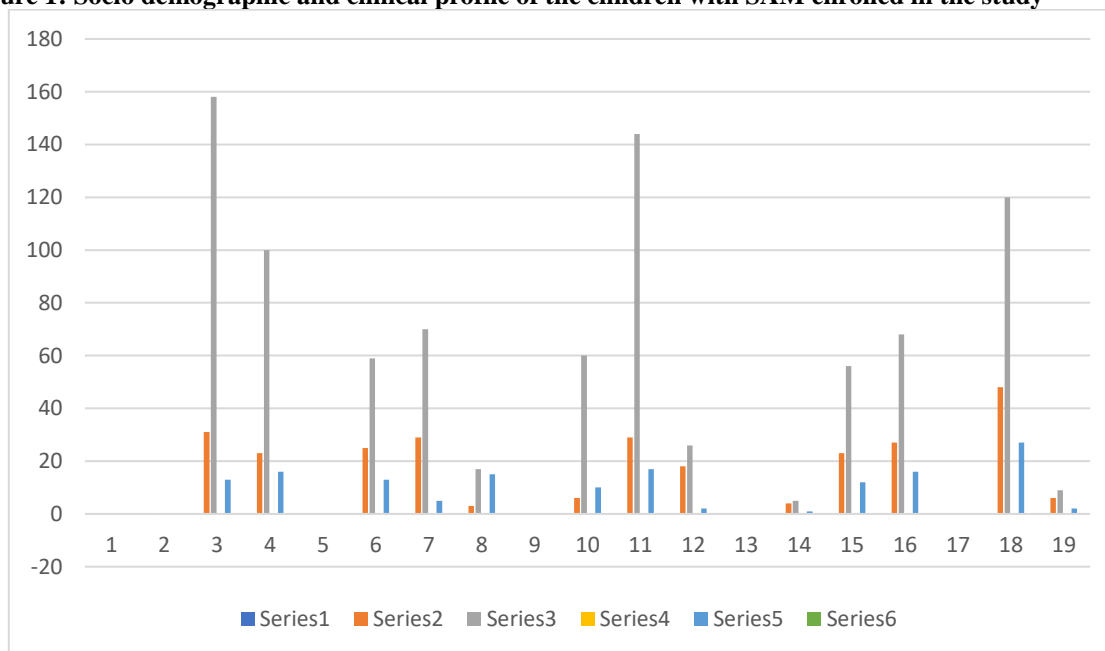
In the comprehensive screening effort conducted over a 20-month period, encompassing a total of 1852 children aged 2 months to 5 years, the prevalence of Severe Acute Malnutrition (SAM) emerged as significant. Among the screened cohort, 252 children, constituting 13.6% of the total, fulfilled the stringent case definition criteria for SAM. However, in the final analysis, a subset of 212 children was considered, as 39 individuals were excluded due to the presence of exclusion criteria.

This process underscores the meticulous nature of the study's methodology, ensuring that the analysis focuses on a cohort that aligns closely with the specified criteria, thereby enhancing the accuracy and reliability of the findings. The exclusion criteria likely played a crucial role in refining the study population to better meet the research objectives and maintain a high standard of scientific rigor. The ensuing analysis of this refined group contributes to a more precise understanding of the factors and characteristics associated with Severe Acute Malnutrition in the specific age range under investigation.

Table 1: Socio demographic and clinical profile of the children with SAM enrolled in the study

VARIABLES	2 to 6 months(N=54) (25.4%)	7 to 24 months(N=129) (60.7%)	25 to 60 months (N=18) (13.9%)	P Value
Male	31 (56.5)	158(60.9)	13 (45.8)	0.102
Female	23 (43.5)	100 (39.1)	16 (54.2)	
Maternal Education				0.086
Illiterate	25 (47.2)	59 (45.3)	13 (44.1)	
Literate	29 (52.8)	70 (54.7)	5 (55.9)	
Pedal edema	3(2.8)	17 (13.2)	15(49.2)	<0.001*
Mode of feeding Exclusive				0.001
Breast Feeding	6 (11.1)	60 (23.2)	10(32.2)	
Predominant/Partial Not Breast Fed	29 (53.7)	144(55.8)	17(59.3)	
Days of Hospital Stay				0.604
<3 Days	4 (7.4)	5 (3.9)	1 (3.4)	
4-7 Days	23(43.5)	56(43.4)	12(40.7)	
>7 Days	27(49.1)	68(52.7)	16(55.9)	
Outcome Discharged	48 (88.9)	120 (93)	27 (91.5)	0.422
Death	6 (11.1)	9 (7)	2 (8.5)	

Figure 1: Socio demographic and clinical profile of the children with SAM enrolled in the study



DISCUSSION

The identification of five independent risk factors for mortality in children with Severe Acute Malnutrition offers a nuanced understanding of the intricate web of challenges associated with this critical health condition.⁹ Vomiting, emerging as the most impactful risk factor, underscores the severity of its consequences. The fivefold increase in the risk of death for children with vomiting on admission highlights the potential cascading effects, notably dehydration leading to renal impairment. The necessity for interventions such as nasogastric tube (NGT) or intravenous (IV) fluid administration further emphasizes the critical nature of managing vomiting in these cases. The consistency of this finding with observations in North Gondar suggests the universal

importance of addressing vomiting as a key clinical concern in Severe Acute Malnutrition. The tripling of the risk of death associated with diarrhea aligns with similar observations in different regions, indicating the compounding effects of diarrhea on hypovolemia. The interplay between vomiting and diarrhea amplifies the challenges in maintaining fluid balance, requiring careful and tailored interventions to mitigate these risks effectively. The use of an NGT emerged as another significant risk factor, contributing to a little over a threefold increase in mortality risk.¹⁰ This association underscores the importance of vigilant monitoring and management of complications related to NGT use, corroborating findings from other healthcare settings. The study emphasizes the need for a cautious approach when implementing interventions

involving NGT to minimize associated risks. Anemia, identified as a significant factor, almost doubling the likelihood of death, draws attention to the multifaceted challenges associated with this hematological condition. The study suggests potential issues such as poor responses to transfusion and delays in administering transfusions due to the high patient volume, pointing to systemic challenges in resource-limited settings. Similar associations between anemia and mortality reported in diverse settings further validate the global impact of anemia on the outcomes of Severe Acute Malnutrition. Moreover, the study highlights the increased risk of death for children experiencing more than one episode of Severe Acute Malnutrition, particularly if re-admitted with a relapse. This underscores the need for sustained efforts in post-discharge care and community-based interventions to prevent relapses and improve long-term outcomes.¹¹ Beyond clinical factors, the study delves into contextual elements, including serving a poor pastoralist community, delayed presentation, lack of maternal participation in feeding programs, overprescription of intravenous therapies, early treatment discontinuation due to financial constraints, and poor adherence to WHO Severe Acute Malnutrition treatment guidelines. These contextual factors underscore the importance of addressing not only immediate clinical issues but also broader systemic and community-level challenges in managing Severe Acute Malnutrition. In conclusion, the study provides a comprehensive and detailed insight into the multifaceted nature of Severe Acute Malnutrition, offering valuable information for healthcare practitioners, policymakers, and community stakeholders. The findings underscore the need for a holistic and context-specific approach in designing interventions to mitigate the identified risk factors and improve the overall outcomes of children affected by Severe Acute Malnutrition.¹²

The case management of children hospitalized with Severe Acute Malnutrition (SAM) and complications proved to be exceptionally challenging, with outcomes influenced by a myriad of factors. The study reported a case fatality rate (CFR) of 8.2%, indicating the proportion of children who succumbed to the condition during hospitalization. While this CFR is notably lower than rates reported in other African studies, it still fell short of meeting the acceptable level of care outlined by the Sphere standards, which recommend a death rate of less than 5%. The study's CFR, comparable to a reported rate of 10.8% from Bangladesh, suggests a level of consistency in outcomes across different settings.¹³ However, the acknowledgment that the CFR failed to meet established standards prompts a closer examination of the challenges and potential areas for improvement in the case management of SAM. Beyond adherence to standardized WHO guidelines for case management, the study identifies several critical steps that contributed to more favorable outcomes. Triage

played a pivotal role in identifying and prioritizing patients based on the severity of their condition. The timely recognition and management of emergency signs were crucial in averting adverse outcomes, highlighting the importance of vigilant and responsive healthcare practices. The study underscores the significance of screening and managing co-morbid conditions, recognizing that the presence of additional health challenges can exacerbate the complexities of SAM. This holistic approach to care aligns with the understanding that addressing not only the primary condition but also associated health issues is essential for improving outcomes.¹⁴ Availability and optimal utilization of resources, particularly locally prepared therapeutic diets, played a key role in providing adequate care. This emphasizes the importance of resource management in resource-limited settings, where access to specialized nutrition can be a determining factor in the success of treatment. Furthermore, the study emphasizes the pivotal role of healthcare providers, including doctors and nursing staff, in delivering individualized round-the-clock care of high quality. This highlights the importance of a multidisciplinary approach, where the collaboration and expertise of different healthcare professionals contribute to comprehensive and patient-centered care. In conclusion, while the study reported a CFR that falls short of established standards, it provides valuable insights into the challenges and successes in the case management of children with SAM and complications. The identified critical steps, from triaging patients to individualized care and resource utilization, offer guidance for refining and strengthening healthcare practices in similar contexts. Continuous efforts to enhance case management protocols and resource availability can contribute to improving outcomes for children facing the complex challenges of Severe Acute Malnutrition.¹⁵

The study reveals that certain clinical and biochemical parameters are closely associated with adverse outcomes in children with Severe Acute Malnutrition (SAM) and complications. The presence of emergency signs at admission, including shock, dehydration, hypothermia, and edema, emerged as clinical parameters indicating a higher risk of unfavorable outcomes. Additionally, biochemical indicators such as hypoglycemia, dyselectrolytemic states (hypokalemia and hyponatremia), and evidence of blood culture-proven sepsis were identified as factors predisposing to increased mortality. These findings align with previous research, particularly the work of Maitland et al., who proposed a Triage System for identifying high-risk groups of children with severe malnutrition in resource-limited settings.¹⁶ This system emphasizes the importance of recognizing specific clinical features, such as shock, impaired consciousness, bradycardia, and hypoglycemia, as markers of immediate risk of early death and the need for urgent intervention and close

monitoring. The study acknowledges the practical challenges in resource-limited settings, emphasizing that hospitalizing all children with SAM is neither feasible nor cost-effective. Therefore, the identification of high-risk groups becomes crucial for optimizing healthcare delivery. The study's multivariate logistic regression identified shock, hypoglycemia, severe anemia, and bacteremia as significant independent risk factors associated with mortality. This insight enables healthcare providers to screen and identify these "red flags," facilitating the early hospitalization of children at the highest risk of mortality. In the context of limited resources and manpower, early targeted interventions become paramount.¹⁷ By focusing on the subset of children with SAM who exhibit these high-risk factors, healthcare providers can optimize resource utilization and deliver interventions that have the potential to modify outcomes positively. This approach aligns with the broader goal of improving the efficiency and effectiveness of healthcare delivery in resource-limited settings, where prioritization based on risk factors becomes a strategic imperative. In conclusion, the study not only identifies specific clinical and biochemical parameters associated with adverse outcomes in children with SAM but also underscores the importance of targeted and early interventions. By implementing a triage system and recognizing red flags, healthcare providers can maximize the impact of available resources and enhance the overall quality of care for this vulnerable population.

CONCLUSION

The study's focus on identifying a subset of children with Severe Acute Malnutrition (SAM) by discerning clinically observable signs and biochemical markers of mortality underscores the importance of early intervention to optimize resources and improve outcomes. The proactive approach of actively searching for co-morbid conditions such as Tuberculosis, HIV, and underlying septicemia is deemed mandatory, given their significant implications for mortality in children with SAM. The call for future studies with larger sample sizes echoes the need for a more comprehensive and statistically robust assessment of the risk factors contributing to mortality in this vulnerable population. A larger dataset would enable a more nuanced analysis, allowing for the identification of additional risk factors and the validation of the findings from the current study on a broader scale. Rationalizing the utilization of resources is a key consideration, particularly in resource-limited settings where challenges in healthcare infrastructure and manpower are prevalent. Large-scale studies can contribute significantly to refining and tailoring interventions, ensuring that they align with the specific risk profiles of children with SAM. This, in turn, has the potential to lead to more targeted and effective strategies for managing severe acute malnutrition. In conclusion, the

study advocates for a strategic and data-driven approach in the management of children with SAM. The emphasis on early intervention, risk stratification, and the active search for co-morbid conditions represents a step forward in optimizing healthcare delivery for this vulnerable population. Future research endeavors with larger sample sizes are encouraged to further strengthen the evidence base and inform comprehensive strategies for improving outcomes in the management of severe acute malnutrition.

REFERENCES

1. The Sphere Project. Humanitarian charter and minimum standards in humanitarian response. The Sphere Project Publications; 2011, 3rd Edition.
2. Ashworth A, Chopra M, McCoy D, et al. WHO guidelines for management of severe malnutrition in rural South African hospitals: effect on case fatality and the influence of operational factors. *Lancet* 2004; 363: 1110-1115.
3. Schofield C, Ashworth A. Why have mortality rates for severe malnutrition remained so high? *Bull World Health Organ* 1996; 74: 223-229.
4. Management of severe malnutrition: a manual for physicians and other senior health workers. Geneva: World Health Organization; 1999.
5. Ethiopian Federal Ministry of Health: Protocol For The Management Of Severe Acute Malnutrition Children In Ethiopian Context. 2007.
6. Abraha M. W., Nigatu T. H. Modeling trends of health and health related indicators in Ethiopia (1995- 2008): a time-series study. *Health Research Policy and Systems.*: 2009;
7. International Institute for Population Sciences. National Family Health Survey 3, 2005-2006. Mumbai: IIPS; 2006.
8. Collins Steve et al. Management of severe acute malnutrition in Children. *Lancet* 2006; 368:1992-2000.
9. Maitland K, Berkley JA, Shebbe M, Peshu N, English M, Newton CR. Children with severe acute malnutrition: can those at highest risk of death be identified with the WHO protocol? *PLoS Med.* 2006; 3(12):e500.
10. Bachou H, Tumwine JK, Mwadime RK, Tylleskär T. Risk factors in hospital deaths in severely malnourished children in Kampala, Uganda. *BMC Pediatr.* 2006 Mar 16.
11. Kliegman RM, Stanton BF, Geme JS, Schor N, Behrman RE et al. Pathophysiology of Body Fluids and Fluid Therapy. In: Kliegman RM et al editors. *Nelson textbook of paediatrics*, 19th edn. Philadelphia, PA: WB Saunders, 2011; p. 212-249.
12. Ashworth A, Khannum S, Jackson A, Schofield C. Guidelines for inpatient treatment of severely malnourished children. Geneva: World Health Organization, 2003.
13. Bhatnagar S, Lodha R, Choudhary P, Sachdeva HPS, Shah N, Narayan S. IAP guidelines 2006 on hospital based management of severely malnourished children (adapted from WHO guidelines). *Indian Pediatr* 2007;44: 443-61.
14. Hossain MI, Dodd NS, Ahmed T, Miah GM, Jamil KM, Nahar B, Alam B, Mahmood CB. Experience in Managing Severe Malnutrition in a Government

- Tertiary Treatment Facility in Bangladesh. *J Health Popul Nutr.* 2009; 27(1): 72–79.
15. Bernal C, Velásquez C, Alcaraz G, Botero J. Treatment of severe malnutrition in children: experience in implementing the world health organization guidelines in turbo, Colombia. *J Pediatr Gastroenterol Nutr.* 2008; 46: 322–8.
 16. Talbert A, Thuo N, Karisa J et al. Diarrhoea complicating severe acute malnutrition in Kenyan children: A prospective descriptive study of risk factors and outcome. *PLoS One.* 2012; 7(6):e38321.
 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 J.* 2011; 10:110.