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The severity of malnutrition among children with pneumonia and diarrhoea: moderate acute malnutrition- a neglected entity

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Introduction: Acute malnutrition is a global health problem. In India, 38% of under-5 children are stunted, 21% are wasted and 36% are underweight. Prevalence in Karnataka of wasting is 26.1%, Severe Acute Malnutrition (SAM) is 10.5% and that of diarrhoea and pneumonia is 4.5% and 1.2% respectively. Both SAM and Moderate Acute Malnutrition (MAM) have serious consequences. This study was undertaken to find the proportion of MAM among children with pneumonia and diarrhoea. **Objectives:** To study the prevalence and severity of malnutrition (SAM and MAM) among children admitted with pneumonia and acute diarrhoea. **Methodology:** Cross-sectional study of 97 children aged 1 month to 5 years admitted with pneumonia or acute diarrhoea were included. Anthropometry, treatment details and complications were recorded and analysed. Diagnosis of Pneumonia, diarrhoea, SAM and MAM was based on WHO guidelines. **Results:** More females were malnourished when compared to males. Prevalence of diarrhoea and pneumonia were the same among MAM and SAM children. Association of the severity of malnutrition with complications and with the duration of hospital stay was noted. **Conclusions:** Complications and morbidities in MAM are similar to SAM, hence, it is important to diagnose MAM and treat it vigilantly as in SAM. It is important to recognize and monitor MAM which may often go neglected.

Keywords: Moderate acute malnutrition, Severe acute malnutrition, Diarrhoea, Pneumonia

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Introduction

Acute malnutrition is a major global health problem [1,2]. According to the World Health report, 52 million children under 5 years around the world, were classified as having acute malnutrition in 2012, of which 33 million children had moderate acute malnutrition (MAM). Hence, MAM affects one in ten children under 5 years of age in underdeveloped and developing countries.

According to NFHS- 4, in India, 38% of under-5 children are stunted, suggestive of chronic undernutrition, 21% are wasted, which is a sign of acute undernutrition, while 36% are underweight [3].

There are significant regional variations in the prevalence of MAM. Prevalence of wasting in Karnataka is 26.1% and Severe Acute Malnutrition (SAM) is 10.5% [3]. One in six under-5 children in South Asia suffered from MAM in 2013. India has the highest-burden, with over 25 million children under 5 with MAM or SAM [1]. Prevalence of diarrhoea and pneumonia in Karnataka is 4.5% and 1.2% respectively [3]. Children with malnutrition, have roughly three times higher risk of mortality from common communicable diseases than if they were well-nourished.

Both SAM and MAM have serious consequences, contributing to increased morbidity and mortality and also impaired intellectual development, suboptimal adult work capacity and increased risk of disease in adulthood. Interventions to address undernutrition should, therefore, include a strong component of MAM management which is often neglected. As the present national programmes are focussed more on children with SAM, the present study was undertaken to find out the proportion of MAM amongst the two leading causes of under 5 mortality, namely pneumonia and diarrhoea.

Objectives

To study the prevalence and severity of malnutrition (SAM and MAM) amongst children (1 month to 5 years of age) admitted with community-acquired pneumonia and acute diarrhoea.

Methodology

01. **Setting:** Paediatrics ward, Cheluvamba Hospital (tertiary care teaching hospital), Mysuru, Karnataka.
01. **Duration:** a period of 6 months from March 2019 to August 2019
02. **Type of study:** cross-sectional study
03. **Sampling method:** Purposive sampling
04. **Sample calculation:** Sample size of 90 was calculated using the formula $n = z^2(pq)/d^2$ [z=1.96, p= prevalence of diarrhoea = 4.5%, prevalence of pneumonia = 1.2% [3], q=1-p, d= 95% C.I.].
05. **Inclusion criteria:** Children between 1 month and 5 years of age with community-acquired pneumonia or diarrhoea admitted to Cheluvamba hospital, Mysuru.
06. **Exclusion criteria:** Children with obvious secondary causes for malnutrition such as chronic illness or global developmental delay
07. **Data collection procedure:** A cross-sectional study of children between the age group of 1 month and 5 years who were admitted to Cheluvamba hospital from March 2019 to August 2019, with community-acquired pneumonia or acute diarrhoea was done. Anthropometry at the time of admission, treatment details and complications were recorded in a pre-designed study proforma.
08. **Data analysis:** On the basis of WHO guidelines the following were defined:
    01. Diagnosis of 'Pneumonia' (fast breathing and/or chest indrawing) and 'severe pneumonia' (pneumonia with any danger sign) [4]. Diagnosis of diarrhoea: the passage of >3 loose stools/ day (or more frequent passage than is normal for the individual).
    02. Diagnosis of SAM: 6 mon- 5 years: Weight-for-height (length) < -3 SD or Bilateral pitting pedal edema or MUAC <11.5cm. 0 -6 mon: weight-for-length < -3SD or Bilateral pitting pedal edema [5].
    03. Diagnosis of MAM: weight-for-height (length) between -2 to -3 SD or MUAC between 11.5-12.5 cm [6].
    04. Anthropometry: Length was measured for <2-year age group using infantometer, height for 2-5year age group using a stadiometer, weight using electronic weighing scale (sensitive up-to 10g), (MUAC) Mid upper arm circumference (6mon -5 year) using the cross-tape method in the non-dominant arm.

Weight-for-height used for diagnosis of SAM (< -3SD) and MAM (-2 to -3 SD) was plotted as per WHO growth charts. Descriptive statistics like Frequency, Percent, Mean, Standard deviation and inferential statistics like Chi-square test, ANOVA test was used.

09. **Ethical clearance:** obtained from the institutional ethics committee

Results

Table-1: Gender distribution among the severity of malnutrition

	Gender		Total
	Male (%)	Female (%)	
Normal	43 (70.5%)	15 (41.7%)	58 (59.8%)
MAM	9 (14.75%)	12 (33.3%)	21 (21.65%)
SAM	9 (14.75%)	9 (25%)	18(18.55%)
Total	61 (62.9%)	36 (37.1%)	97 (100%)

More number of females were malnourished, and a greater number of males were well-nourished, which was statistically significant (p = 0.018)

Table 2: Age distribution among the severity of malnutrition.

	AGE			Total
	< 6 months	6-12 months	>12 months	
Normal	9 (15.5%)	29 (50%)	20 (34.5%)	58
MAM	0 (0%)	9 (42.9%)	12 (57.1%)	21
SAM	0 (0%)	8 (44.4%)	10 (55.6%)	18
Total	9 (9.3%)	46 (47.4%)	42 (43.3%)	97

There was no statistically significant association between age and severity of malnutrition. (p-value 0.065).

Table-3: Severity of diarrhoea versus severity of malnutrition.

	No diarrhoea	No dehydration	Some dehydration	Severe dehydration	Total
Normal	39 (67.2%)	3 (5.2%)	16 (27.6%)	0 (0%)	58
MAM	14 (66.7%)	2 (9.5%)	4 (19%)	1 (4.8%)	21
SAM	13 (72.2%)	-	5 (27%)	0 (0%)	18
Total	66 (68%)	6 (6.2%)	24 (24.7%)	1 (1%)	97

There was no statistically significant association between the severity of diarrhoea and malnutrition. (p-value 0.586). Therefore the prevalence of diarrhoea was the same among both MAM and SAM children.

Table-4: Severity of pneumonia versus severity of malnutrition

	Severe pneumonia	Pneumonia	No pneumonia	Total
Normal	2 (3.4%)	37 (63.8%)	19 (32.8%)	58
MAM	1 (4.8%)	14 (66.7%)	6 (28.6%)	21
SAM	1 (5.6%)	12 (66.7%)	5 (27.8%)	18
Total	4	63	30	97

There was no significant association between the severity of pneumonia and malnutrition.

Therefore the prevalence of pneumonia was the same among both MAM and SAM children.

Table 5: Complications among severity of malnutrition.

	No complications	Empyema	Sepsis	Tuberculosis	Total
Normal	57 (98.3%)	1 (1.7%)	0 (0%)	0 (0%)	58
MAM	20 (95.2%)	0 (0%)	1 (4.8%)	0 (0%)	21
SAM	15 (83.3%)	0 (0%)	2 (11.1%)	1 (5.6%)	18
Total	92 (94.8%)	1 (1%)	3 (3%)	1 (1%)	97

There is a statistically significant association between complications and severity of malnutrition [more complications are noted in the SAM group and MAM group (p-value 0.023)]

Table-6: Comorbidities among classification of malnutrition.

	Anaemia	No co-morbidities
Normal	7 (12.1%)	48 (82.2%)
MAM	4 (19%)	14 (66.7%)
SAM	1 (5.6%)	11 (61.1%)
Total	12	73

More children with MAM had anaemia (19%) than SAM and normal groups. Fewer children with normal anthropometry had comorbidities. These data were statistically significant (p = 0.026).

Table 7: Duration of hospital stay among the classification of malnutrition

	Number	Mean	SD	Std. Error	Minimum	Maximum
Normal	58	6.4828	3.02180	0.39678	1.00	18.00
MAM	21	8.2381	5.40282	1.17899	3.00	24.00
SAM	18	13.388	4.85240	1.14372	3.00	21.00
Total	97	8.1443	4.74339	0.48162	1.00	24.00

P-value was 0.005 showing a statistically significant association between the severity of malnutrition and duration of hospital stay being maximum in SAM followed by MAM and then the normal group.

No statistically significant difference in the duration of stay in ICU.

Discussion

Diarrhoea and pneumonia contribute to a third of worldwide childhood mortality. Both the infections are part of a vicious cycle of malnutrition and infection. Children who are undernourished are more prone to infections and have a higher morbidity and mortality rate [7]. A study by Christi MJ et al showed an association between complications, morbidities and severity of malnutrition [8]. Even in the present study, the statistically significant association between complications and severity of malnutrition was noted.

In a study by Isanaka et al, it was concluded that on the basis of prevalence of undernutrition, the current global projections of mortality associated with SAM and MAM could be underestimated [9]. Programmes for the management of MAM have not been revised for the past 3 decades unlike those with respect to SAM, and hence needs appropriate and urgent amendments [10].

Nutrition care in children and mother will essentially contribute to national development. According to The Global Nutrition Report, the benefit-to-cost ratio is 16:1 for investment in nutrition among 40 middle and low -income countries. Preventing undernutrition at the earliest and throughout life is important [11].

In a study in Bangladesh, among 209 boys and 191 girls with pneumonia and diarrhoea, 17% were found to have SAM. high prevalence of pneumonia (62.72%) and diarrhoea were found in infancy, and in 1-2-year age group [12]. In the present study, SAM was found in 18.5%, which is comparable, even the prevalence of pneumonia (66%) was comparable. In the present study, more number of girls were undernourished. A positive association was noted between the duration of hospital stay and severity of malnutrition.

Diarrhoea has short-term effects on nutrition and long-term consequences on the growth of the child [12]. In the present study, the prevalence of diarrhoea was same in SAM and MAM group.

In a study by Brown KH et al, among 100 children admitted for SAM, 90% had evidence of infection at the time of admission, 75% had pneumonia, 43% had diarrhoea and death rate was 21%, the most frequent cause being infections. Mortality was more in younger children [13].

In the present study, there was no mortality and 72.2% of SAM children had pneumonia, 27.7% had diarrhoea, while in the MAM group, 71.4% had pneumonia and 33.3% had diarrhoea.

Terri J Ballard et al, in their study, concluded that underweight and stunting were positively associated with acute lower respiratory infections and improving nutrition contributed to lowering the incidence of acute lower respiratory infections [14].

Tupasi TE et al, in their study, concluded that the relative risks for morbidity and mortality for both acute upper and lower respiratory tract infections were higher in children with malnutrition compared to normal children [15]. In the present study, 72.2% of SAM and 71.4% of MAM had pneumonia which was more than that in the normal group (67%).

Chisti MJ et al, in their study, concluded that malnutrition was associated with a significant increase in mortality risk in children with pneumonia. Also, the odds ratio and relative risk were higher for children with SAM than MAM [8]. In the present study, there was no mortality though morbidities were comparable in SAM and MAM group. Anaemia was noted to be more in the MAM group.

In the present study, the complications like sepsis and duration of stay were more in SAM children. SAM significantly increases the risk of under-5 mortality and also indirectly increases mortality by increasing the case fatality rate in infections like diarrhoea and pneumonia. Mortality in children with SAM is essentially the effect of infection [16].

Christi MJ et al, in their study on post-discharge mortality in children with severe malnutrition and pneumonia in Bangladesh among 405 children admitted for SAM and pneumonia, 8.7% had mortality within 3 months of discharge, among which new respiratory and gastro-intestinal symptoms were common.

Hence, follow-up of the children after discharge from the hospital has a role in early recognition of complications and reducing mortality [17]. In another study by Christi MJ et al, demographic and socioeconomic status, including over-crowding and smoking were contributory factors to pneumonia-related deaths. Education and increasing public awareness are necessary means to reduce these risks [18].

In a study conducted in South Africa, Bamford et al, analysed the improvements in case fatality rates in under-5 children. Required measures to reduce under-5 mortality include a reduction in mother-to-child HIV transmission, improvement in infant and young child feeding, better immunization coverage, earlier and easier access to health care, the betterment of social and community health as a whole [19].

Jones DK, et al, in their study concluded that along with nutrition, addressing the infection and inflammation plays a key role; along with anthropometric measurements, it is important to assess the child's health in-toto [20].

In a study by Tickell KD et al, children with a MUAC of < 12.5cm had more severe diarrhoea and danger signs when compared to better-nourished counterparts. Diarrhoeal pathogens such as cryptosporidium, virulent E.coli, Entamoeba histolytica, Shigella, Salmonella, Campylobacter, Pleisiomonas shigelloides have been associated with acute malnutrition.

However, the higher disease severity is more likely to be due to socio-economic constraints and increased vulnerability associated with acute malnutrition, than due to different pathogenic flora. [21].

According to Williams PCM and Berkley JA, in their study in 2018, it was suggested that irrespective of uncomplicated or complicated SAM, a broad-spectrum antibiotic should be used, namely, amoxicillin via oral and parenteral route respectively. All the children in the present study were similarly started with Amoxicillin by parenteral route as per the WHO guidelines [22].

In a systematic review and meta-analysis in 2020, F 100 was similar in effect to Ready-to-use therapeutic food, prophylactic antibiotic usage had better recovery in terms of disease as well as weight gain; high and low dose vitamin A supplementation were comparable in terms of mortality and gain in weight [23].

In a study in Afghanistan, it was concluded that parental education and income status, availability of safe drinking water, sanitary latrines, hygiene all play a key role in reducing the prevalence of acute nutrition among under-5 children [24]. Hence, in improving the nutritional status in children, national programs, programmatic policies in the betterment of the community in entirety are necessary.

In a study by Manary MJ, on the management of acute moderate and severe malnutrition, the adverse consequences of pneumonia and diarrhoea on physical and intellectual development, and the importance of appropriate timely management to prevent these complications have been reviewed [25].

Hence, if MAM children are neglected, they may later land up in SAM and lead to more mortality due to complications and also prolonged hospital stay leading to a financial burden to the family and nation. Integrated management of MAM and SAM helps in the better recovery rate and good community coverage [26].

Therefore, if concentration on MAM children as much as SAM children in the national programmes the following advantages are gained-

01. Reduce the incidence of Pneumonia and diarrhoea, the 2 leading causes of Under 5 mortality in children.
02. By reducing the burden of SAM, the mortality due to complications like septicemia are prevented.
03. By decreasing the duration of hospital stay in these children (by preventing them from developing SAM), the financial burden is reduced.

Limitations of the present study are that:

01. There was no follow-up of the children to assess their nutritional status and catch-up growth following treatment and prevalence of diarrhoea and pneumonia in the same group of children following nutritional rehabilitation
02. As per the present study was a hospital-based study, the results cannot be generalized to the community.

Conclusions

The prevalence of diarrhoea and pneumonia, which are the leading causes of under-five mortalities, were found to be same in both children with Moderate Acute Malnutrition and Severe Acute Malnutrition.

Complications and morbidities in MAM are similar to SAM, hence, it is important to diagnose MAM and treat it vigilantly as in SAM. It is important to recognize and monitor MAM which may often go neglected.

Recommendation

It is important to monitor and take a necessary intervention to treat MAM as seriously as in SAM both by the treating Paediatrician and in National Health Programmes.

What does this study add to the existing knowledge?

01. Children with severe acute malnutrition are more prone to Pneumonia and Diarrhoea and their complications. The prevalence of diarrhoea and pneumonia, which are the leading causes of under-five mortalities, were found to be same in both children with Moderate Acute Malnutrition and Severe Acute Malnutrition.
02. Hence, it is important to diagnose MAM and treat it vigilantly as in SAM

Author's contributions

All the authors contributed to the study. **Dr. M R Savitha** conceived and designed the study and revised the manuscript for important intellectual content. **Dr. M R Prashanth** designed the study proforma, sample collection process, helped design the study and revised the manuscript. **Dr. B. Thanuja** collected and compiled the data and drafted the paper. **Dr. M R Savitha**, **Dr. M R Prashanth**, **Dr. B. Thanuja** analysed the data, edited, reviewed and approved the final paper.

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