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CO-MORBIDITIES ASSOCIATED WITH SEVERE ACUTE MALNUTRITION IN CHILDREN ATTENDING A TERTIARY CARE CENTRE OF JHARKHAND.

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Abstract-
Introduction-Childhood under nutrition is a foremost worldwide health issue and may lead to severe acute malnutrition (SAM) backing to upraised risk of co-morbidities and mortality in the children due to reasonably defective immunity. There is lack of data concerning collective outcomes in SAM so this study was done to identify the co-morbidities in SAM children.
Material and Methods-This study was a hospital-based descriptive type observational study done on the children of the age group 6months-5years diagnosed with SAM based on WHO criteria in a tertiary care hospital in Palamu, Jharkhand over a span of 6 months.
Result-Major clinical comorbidity associated with SAM children was found to be diarrhoea and acute respiratory tract infections (ARTI) and due to micronutrient deficiency it was anaemia and vitamin D deficiency.
Conclusion- Mortality in SAM highly depends on the co-morbidities and socio-demographic status of the SAM children so educating people regarding risk factors and timely diagnosis of the related comorbidities can ensure appropriate treatment and better prognosis of the disease.

Keywords-Malnutrition, SAM, Children, Co-morbidities etc.

Introduction-

Malnutrition is a broad term denoting over nutrition and under nutrition ensuing from inadequate intake, reduced absorption, or undue loss of nutrients.(1) According to the World Health Organization (WHO), malnutrition principally means “bad nourishment” and can signify quantity and quality of diet consumed.(2,3) Childhood under nutrition is a foremost worldwide health issue, backing to morbidity, mortality and upraised risk of illnesses.[4,5] In India malnutrition has resulted to >33% of under 5 year deaths.(6,7) If due to imbalanced nutrition, weight for height falls below -3 z scores of the median WHO growth standards along with evident severe wasting or with occurrence of nutritional oedema then it is referred as severe acute malnutrition (SAM).(8,9) SAM has been a

main hindrance to the accomplishment of the 4th Millennium Development Goal (MDG).[10] In India, nearly 6.4% of the <5 year children has SAM.[11] While, worldwide it is accountable for 60% of 10 million deaths per year in < 5 year children. Similar to malnutrition, SAM is at risk group, which disposes the children at a grander risk of dying from common infections, upsurges the incidence and severity of such infections, and pays for late recovery despite nutritional restoration.[12,13]
World widely children with SAM, because of reasonably defective immunity die with comorbidities mainly diarrhoea, acute respiratory tract infection, malaria etc.[14] along with communal micronutrient deficits causing anaemia, scurvy and symptoms of deficiency of Vitamin A, Vitamin D and Vitamin B complex.[15] Therefore, apt and timely diagnosis of the related comorbiditiescan ensure appropriate treatment and better prognosis of the disease. World widely numerous outcomes have been focused and documented separately in different studies but there is a lack of data which has precisely stratified collective outcomes concerning clinical picture of SAM children from Palamu, Jharkhand, India. Henceforth, we strategized this study to determine the chief clinical co-morbidities in SAM children attending or admitted to a tertiary care hospital of Palamu, Jharkhand, India.

Material and methods- This study was a hospital-based descriptive type observational study. The study included children of the age group 6months-5years diagnosed with SAM who attended and were admitted to Laxmi Chandravansi Medical College and Hospital, Palamu, Jharkhand, India over a span of 6 months from September 2024 to March 2025. None of the participation was made against the will of the parents/caregivers of the children and a written informed consent was taken from them after obtaining ethical clearance from the institutional ethical Committee. Diagnosis of SAM was made based on WHO criteria,[16] when any of these was noticed: Weight-for-height: Less than −3 SD and for infants (1–6 months) and/ or visible severe wasting, and/ or mid-upper arm circumference (MUAC) ≤115 mm, and/ or bilateral pitting edema. The age group <6 months and > 5 years and the children with chief congenital malformations and chronic systemic diseases were excluded from the study. Total of 132 children fulfilling the inclusion criteria were enrolled. A detailed anthropometric assessment was done comprising weight, height and MUAC. A complete general and systemic check- up was done along with a detailed history concerning socio-demographic factors, feeding history, prior illnesses and active illness along with comorbidity. Socioeconomic status (SES) was categorized following the modified Kuppuswami index.[17] Immunization status of children was appraised as per plan of National Immunization Programme (NIP).[18] Data were logged on a predesigned performa and later recorded in a microsoft Excel sheet. SPSS software version 16 was used for the analysis of the data. Statistical tests used were chi square test and p value less than 0.05 was considered significant.

Result-A total of 132 patients were enrolled in present study, out of which 67 (51%) were males and 65 (49%) were females as depicted in figure no.1

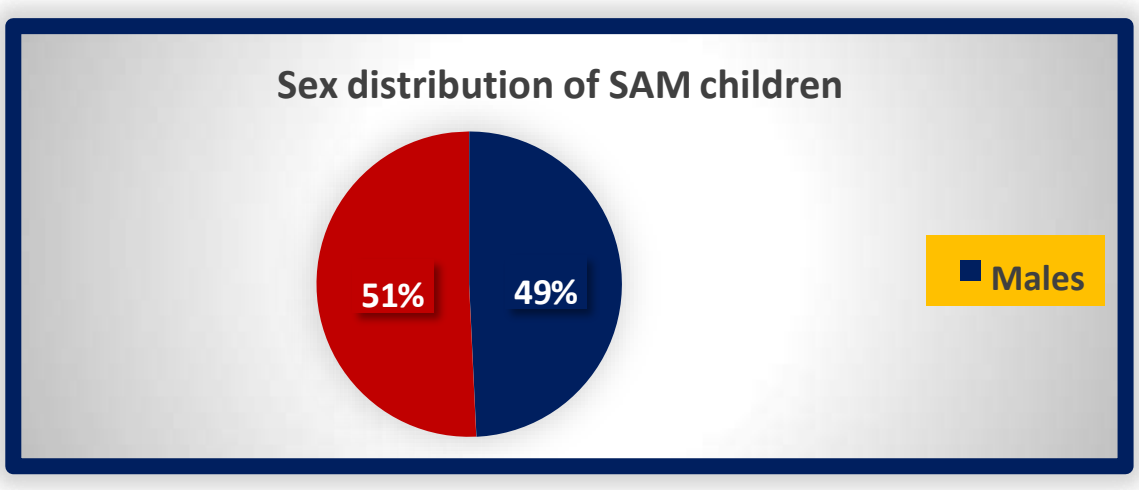

Figure No.1- Sex distribution of SAM children

The age of SAM patients in this study varied from 6-59 months. As shown in table no. 1, the SAM children enrolled in our study were divided into 3 age groups i.e. 6-12 months, 13-24 months and 25- 59 months. Out of 132 cases, maximum of the children were from the age group 13-24 months i.e. 69 (52.27%) followed by 43(32.57%) and 20 (15.15%) from age group 6-12 months and 25-59 months respectively. The age groups were not in significant association with gender. The present study has classified SAM patients on the basis of socioeconomic status (SES) and majority of the cases were from lower SES i.e. 102 (77.27%) trailed by Upper Lower, Upper middle and Lower middle SES with 20 (15.15%), 6 (4.54%) and 4 (3.03%) cases respectively.. The maternal educationof the SAM children was categorized as illiterate, primary educated, secondary educated and graduate and above with 51 (38.63%), 53 (40.15%), 26 (19.69%) and 2 (1.51%) cases respectively. The gender was observed to have no signification relation with SES or maternal education of the SAM children.

Table No. 1- Socio-demographic variables of the SAM children

		Total (132) n (%)	**Male (64)**	**Female (68)**	**Chi square**	**p-value**
Age(months)	6-12	43 (32.57)	23	20	1.019	0.600
	13-24	69(52.27)	33	36		
	25-59	20 (15.15)	8	12		
Socio-economic status	Upper middle	6 (4.54)	4	2	1.083	0.781
	Lower middle	4 (3.03)	2	2		
	Upper Lower	20 (15.15)	8	12		
	Lower	102 (77.27)	71	31		
Maternal Education	Illiterate	51 (38.63)	26	25	2.073	0.557
	Primary	53 (40.15)	26	27		
	Secondary	26 (19.69)	12	14		
	Graduate & above	2 (1.51)	0	2		
Total	132					

As far as birth history is concerned, majority of the enrolled children were second child of their parents
i.e. 40 (30.30%) followed by the birth order 1st, 3rd, 5th, 4th and 6th in number with 33 (25.00%), 26 (19.69%), 14 (10.60%), 13 (9.84%) and 6 (4.54%) children respectively. The present study is comprised maximally of the SAM children born with adequate birth weight i.e 119 (90.15%) and the remaining i.e 13 (9.84%) had low birth weight. Our study chiefly encompassed children who

were exclusively breast fed for >6 months i.e. 99 (75%) and the rest i.e 33 (25%) started having complimentary feeding before 6 months. In the current study majority of the SAM children i.e. 109 (82.57%) were completely immunized till date followed by 21 (15.90%) and 2 (1.51%) cases having incomplete and no immunization at all respectively. The gender of the SAM children showed non-significant association with the birth order, birth weight, feeding history and immunization history of the children.

Table No. 2- Birth, Feeding and Immunization history of the SAM children

		Total (132) n (%)	Male (64)	Female (68)	Chi square	p-value
Birth order	First	33 (25.00)	14	19	7.271	0.201
	Second	40 (30.30)	15	25		
	Third	26 (19.69)	16	10		
	Fourth	13 (9.84)	7	6		
	Fifth	14 (10.60)	7	7		
	Sixth	6 (4.54)	5	1		
Low birth weight(<2.5kg)	Yes	13 (9.84)	7	6	0.166	0.683
	No	119 (90.15)	57	62		
Exclusivelybreast fedfor>6 months	Yes	99 (75)	49	50	0.162	0.687
	No	33 (25)	15	18		
Immunization status	Complete till date	109 (82.57)	86	23	2.502	0.286
	Incomplete	21 (15.90)	6	15		
	Unimmunized	2 (1.51)	0	2		
Total	132					

Table No. 3 depicts that 58 (90.6%) out of 64 male children were associated with comorbities. Proportion of comorbities among female children was comparatively lower (77.9%). Comorbidities were found to be significantly associated with gender of the SAM children (p-value <0.05).

Table No. 3- Association of comorbities with gender

Comorbidities/Gender	Male	Female	Chi square	p-value
Yes	58	53	**3.965**	**0.046**
No	6	15		
Total	**64**	**68**		

Our study has considered co-morbidities basically in two forms i.e. clinical complications and and micronutrient deficiency. As revealed in table no. 4, the SAM children showed diarrhoea to be the main clinical co-morbidity i.e.56 (42.42%) followed by acute respiratory tract infections- ARTI , urinary tract infections, tuberculosisand sepsis with 34 (25.75%), 9 (6.81%), 6 (4.54%), 5 (3.78%) cases respectively. The meningitis, malaria and skin infections each affected 4 (3.03%) cases. Out of 132 cases, 3 (2.27 %), had seizures and 2 (1.51%) cases each had enteric fever, measles and shock. Our study reported anaemia as the chief micronutrient deficiency in 98 (74.24%) cases followed by Vitamin D, Vitamin A, Vitamin B deficiency and scurvy in 65 (49.24%), 17 (12.87%), 12 (9.09%) and 7 (5.30%) cases respectively.

Table No. 4- Types of Co-morbidities in SAM children

Type of co-morbidities		Total n (% age)
	Diarrhoea	56 (42.42)
	Acute respiratory tract infection	34 (25.75)
	Seizures	3 (2.27)
	Enteric fever	2 (1.51)
	Tuberculosis	6 (4.54)

Clinical Complications	**Skin infections**	4 (3.03)
	Sepsis	5 (3.78)
	Meningitis	4 (3.03)
	Malaria	4 (3.03)
	UTI	9 (6.81)
	Measles	2 (1.51)
	Shock	2 (1.51)
Micronutrient deficiency	**Anemia**	98 (74.24)
	Scurvy	7 (5.30)
	Vitamin A deficiency	17 (12.87)
	Vitamin D deficiency	65 (49.24)
	Vitamin B deficiency	12 (9.09)

Discussion-

SAM is a well-recognized condition with considerable morbidity and mortality. The children who endure, grow with the impairments caused by the disease and regardless of the rigorous efforts in past years by the organizations, the prevention and management of the disease is still a challenge [(19)] Our study was comprised of 132 SAM children of the age group 6months-5years with majority falling into the age group of 13-24months (52.27%) followed by 6-12months (32.57%). Which implies that maximum of the SAM children were below the age of 24 months as found by the other studies done by jena et al.[(20)]Aguayo et al.[(21)], Kumar et al.[(22)], Choudhary et al.[(23)]and Singh K et al.[(24)] In the early years of life, for prompt growth and tissue building sufficient source of energy is must so any reason causing inadequate supply make this age group more predisposed to SAM.

The present study had slight more prevalence of disease among males (51%) than females (49%) which may be due to the area people being ignorant for the health of female children, so our study depicts no gender prediction regarding prevalence of SAM which is in accordance with many past studies.[(21,23,25,26-28)] Though, Aguayo et al.[(21)]studied that the occurrence of malnutrition was more in females (55%) than males (45%). Study by and Shah and Javdekar[(29)] and other studies[(30,31)] also documented female multitude. The current study showed no association between the affected age group and gender of the patients.

The present study documented that out of 132 SAM children 109 (82.57%) were completely immunized till date with majority being males showing that the study area people being more concerned towards the health of male child. The findings of our study are in disparity with the outcomes of Das[(25)], Jena[(20)]and Sharma et al.[(32)]It could be due to more awareness among health care providers of the study area than past studies.

In our study, majority of the of SAM patients i.e. 77.27% were having lower SES which is in harmony to the study by Kumar et al.[(22)] and Choudhary et al.[(23)]which documented maximum of the affected population falling into lower SES respectively being 75% and 96%. Other authors [(26-28,33)]also reported that that malnutrition is association with SES. This association of prevalence of SAM with SES is due to insufficient and inappropriate food available to this class because of their low buying capacity. Further, our study found that mothers of SAM children were mainly uneducated or just had primary education, the reason might being Low SES. These findings were also consistent with the past studies.[(33, 34)]

The current study maximally (90.15%) had SAM children born with adequate birth weight and there was no significant pattern of birth order was observed in relation to SAM prevalence.

As per the feeding history is concerned, our study comprised majority (75%) of SAM children being exclusively breast feed for > 6months depicting adverse effects of extended breastfeeding on the nutritional status of the child. Our outcome is in accordance with the findings of Rasania and Sachdev,[(35)]Hossain et al.[(36)]and Nube and Assenso-Okyere[(37)]which observed noticeably poorer nutritional status in children receiving extended breast feeding and showed significant association of malnutrition with duration of breastfeeding. This association is the result of breast milk being an

inadequate diet for the child as the age advances and the reason behind the extended breast feeding could be accredited to the lack of awareness among mothers being uneducated and the other reason could be lower SES which makes complementary feeding unaffordable for the parents.

In the current study co-morbidities are considered basically in two forms, first is clinical complications and the other is micronutrient deficiency. The study documented diarrhoea (42.42%) to be the utmost common clinical co-morbidity and acute respiratory tract infections- ARTI (25.75%) to be the next most communal clinical co-morbidity. The findings of our study are in close association with Kumar et al.[22]as his study documented 54% cases of diarrhea and 27.8% cases of ARTI. The study by Tariq et al.[27]also observed comparable findings with 30.1% cases of diarrhoea being the chief comorbidity followed by 26.3% cases of ARTI. Colombian study,[38] African studies[39,40]and two other previous studies[34,41]also supported our outcomes as they showed diarrhea as the chief co- morbidity although the percentage of prevalence as higher than our study. Choudhary et al.,[23]Shah and Javdekar[29]and one more study in their cohort of SAM also stated acute gastroenteritis as the utmost communal co-morbidity trailed by respiratory tract infection.[34]Though in higher proportion. The findings are in contrast to our study were document by two previous studies,[42,43]which observed ARTI as the chief (37.3%) comorbidity trailed by acute gastrointestinal infection. Other study by Berti et al.[44]was also in disparity to our result as it described pneumonia (10%) as chief communal illness trailed by tuberculosis (6.6%) in SAM children.

The discrepancy in the occurrence of these two conditions could be described on the grounds of ecological and geographical factors like contact to dust, smoke, overpopulation and availability of hygienic food and drinking water.

The other clinical co-morbidities found in in very small proportion in our study are urinary tract infections, tuberculosis, sepsis, meningitis, malaria, skin infections, seizures, enteric fever, measles and shock. In present study, tuberculosis as found to be in 4.54 % cases which is much lesser than study by Kumar et al.[15]and by one African study[43](18%). Measles also shows association with nutritional status, in our study only 1.51% cases of measles were found in comparison to an earlier Indian study[15]with 3.8% of cases with past history of measles. Malaria and HIV infection were earlier described as chief comorbidities with incidence of 21% and 29.2% respectively[45]but in present study malaria was seen in 3.03% of cases and no HIV case was reported to be as co-morbidity. This confirms that there are diverse presentations of clinical conditions in SAM but the most communal co- morbidities are diarrhoea and pneumonia so these cases should be viewed more while hospitalization and management of SAM children to cut down the mortality rate in SAM.

Maximum of the studies have only observed infectious co-morbidities in SAM children and studies associated with micronutrient deficiencies in SAM children are very few in number. So further, our study has observed micronutrient deficiencies associated with SAM children.

Coinciding nature of micronutrient deficiencies and malnutrition is well elicited and it is known that deficiency of one micronutrient is classically related to the lack of others.[46]

The present study reported Anaemia (74.24%) as the chief micronutrient deficiency followed by Vitamin D (49.24%), Vitamin A (12.87%), Vitamin B (9.09%) deficiency and scurvy (5.30%). The study by Shah and Javdekar[29]and Choudhary et al.[23]supported our study as they also reported anaemia as the chief comorbidity though in higher proportion with 96.6% and 85% respectively in comparison to our study. A research from Columbia[47]showed 51% anaemia cases which is much lesser than ours. Nutritional aspects parallel with helminthic infestations could be the reason for increased prevalence of anaemia in SAM children. One previous report[34]is also in accordance with our results as they also found anaemia and Vitamin D deficiency as the two chief micronutrients deficiencies linked with SAM children. One study[46]reported results in disparity to our outcomes as it documented Vitamin D and Vitamin A deficiency as the chief communal micronutrient deficiencies related to SAM children.

Conclusion-

In our study, the main predisposed age group was 13-24month. Our study concludes thatvariables like socio-economicstatus, maternal education, birth history, feeding history and immunization status of the SAM children plays a role as risk factors in the disease so general public need to be educated about the importance of these factors to prevent SAM in children. Further the most communalco- morbidities seen in SAM children werediarrhoea, acute respiratory tract infections, anemia, vitamin D deficiency etc so timely diagnosis and dealing of the co-morbidities along with nutritional therapy will improve prognosis of the disease leading to healthy children and perkierprospect of the community.

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Conflicts of interest- None

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