Research Article

Prevalence of Severe Acute Malnutrition Among Under Five Children in Selected Tribal Population

Dr. Pa. Raajeswari[1], Dr. M. Sylvia Subapriya[2] and Dr. R. Anitha[3*]

[1,2]Department of Food Science and Nutrition, Avinashilingam Institute of Home Science and Higher Education for Women, Coimbatore-641 043, Tamil Nadu, India.
[3]Department of Foods and Nutrition, Muthurangam Govt Arts College (A), Vellore-632002, Tamilnadu.

ABSTRACT

***Background* & *Objectives*:** The nutritional status of children in their early years is critical for their proper growth and development. Severe Acute Malnutrition (SAM) is a public health issue that affects children worldwide and in developing countries, yet progress in combating the many types of malnutrition is relatively slow. The main objective of the present study was to determine the nutritional status of children aged 6 to 59 months living in the Attappady block of Palakkad District. ***Materials and Methods*:** A community-based cross-sectional study was conducted among 334 children from 1600 households in the province, out of a total of 12600 households. The children's sociodemographic, dietary, and clinical information were collected using a pretested semi-structured questionnaire. Three easily and quickly measurable parameters namely height, weight, and Mid Upper Arm Circumference (MUAC) were measured using the standard protocol. The children were considered as having underweight and stunting if their weight for age and height for age were below -2SD of WHO standards (Jensen *et al*, 2019). ***Results*:** The present study comprised 173 (51.8%) male and 161(48.2%) female children out of the total 334 children observed in the study. Male children were found to have a higher prevalence of underweight and stunting. The risk factors such as low birth weight, inadequate protein intake, respiratory infection, history of frequent episodes of diarrheal diseases, and presence of worm infestation were significantly associated with under-nutrition. Assessment of Infant and Young Child Feeding Practices revealed that improper nutritional care during younger age is the positive contributing factor to under-nutrition in young children. ***Conclusions*:** The high prevalence of Severe Acute Malnutrition among under-five children was recorded and a strong positive correlation was observed between age, body weight, crown heel length, and MUAC in both boys and girls. The plight of nutritional deprivation in early pregnancy and the marginal poor nutritional status of the tribal children were the risk factors for SAM among tribal children. The findings showed that child nutrition in tribal Attapaddy is complex, requiring multi-sectoral, multi-disciplinary, and multi-level intervention to alleviate malnutrition.

Key words: Severe Acute Malnutrition (SAM), Malnutrition, Attapaddy, Nutritional Status, Mid Upper Arm Circumference

Introduction

Malnutrition is a multidimensional issue affecting the health of the child which refers to under-nutrition resulting from inadequate consumption, poor absorption or excessive loss of nutrients (Anitha and Raajeswari, 2022).

Undernutrition is one of the leading causes of morbidity and mortality globally among under-five children contributing to 60% of deaths (Uribe-Quintero *et al.*, 2022). In India, the prevalence of undernourished children is the highest in the world and doubles that of Sub-Saharan Africa indirectly affecting morbidity, mortality, productiv-

ity and economic growth (Alebel *et al.*, 2021). India has the largest tribal population which accounts for 8.6 percent of the total population of the country, numbering 104.3 million. There are 573 Scheduled Tribes living in various parts of the country and speaking their languages. The state of Madhya Pradesh has the most tribals (16.40 million), followed by Orissa (7 million) and Jharkhand (6.6 million) (Chaurasia, 2018: Census, 2011). Around 40% of Indian tribal children under the age of five are stunted, with 16% severely stunted. Mild to severe stunting is common in both tribal and non-tribal children. Tribal children, on the other hand, had a higher rate of severe stunting (16%) than non-tribal children (9%), 55 percent underweight and 54 percent wasted (CNNS, 2016-18). The tribal population is particularly vulnerable to under nutrition, because of their geographical isolation, socioeconomic disadvantage and inadequate health facilities. Attapaddy is one such tribal block located near the boundaries of the states of Kerala and Tamil Nadu, in the Palakkad district. The block has a population of 63000 with about 5000 under-fives. The tribal block of Attappady in the Palakkad district of Kerala came into the limelight when recurring deaths of 35 infants were reported during July-August 2013 which were attributed mainly to widespread undernutrition, and extremely poor maternal and child health status. Children from scheduled tribes have the poorest nutritional status on practically every metric and the highest frequency of wasting (28 %) among under-fives (Dey and Bisai, 2019). Children whose mothers have no education are roughly five times more likely to be significantly underweight than children whose mothers have more years of schooling (Kabir *et al.*, 2018). An individual's nutritional status is usually the result of the number of factors that interact at different levels. One of the primary criteria that have a considerable impact on nutritional status is the consumption of an adequate amount of food, both in terms of quantity and quality. Furthermore, an individual's eating pattern is a critical component in determining the occurrence of disease, and negative consequences such as low birth weight, malnutrition, disability, poor quality of life, and mortality are all linked to bad eating patterns (Senthilkumar *et al.*, 2018). Recognizing the role of diet at the onset of many diseases, and assessing the nutritional status of an individual, family and community are important for public health. Malnutrition impedes body metabolism and retards proper utilization of immunity. Initial data collection through assessment by the National Institute of Nutrition and reports obtained from nutrition surveillance systems established by *Jatak* online IT-enabled systems showed that about 2.55 preschool children had Severe Acute Malnutrition which is about 150 can be excepted to SAM which is nine times higher risk of dying than the malnourished, it was important to address

the issue at the earliest. Hence the present study was aimed with the following objectives.

Objectives

1. To assess the nutritional status of children aged 6 to 59 months living in Attappady block of Palakkad district (Kerala).
2. To determine the prevalence of severe acute malnutrition among tribal children under five years of age in three-gram panchayat in Attappady.
3. To assess the socio- economic status and other related associated factors that causes severe acute malnutrition.

Materials & Methods

Planning Phase of Survey, Selection of Enumerators and Conduct of Survey:

In conjunction with the district authorities, block development departments (Tribal, ICDS, Health and NRLM) and UNICEF nutrition Specialists, the survey was planned. UNICEF, Chennai office collaborated with Avinashilingam Institute for Home Science and Higher Education for Women and was identified as the core team to carry out a survey on the field. Nine enumerators from the Attappady block were included in the team. In order to guide the field team on their roles and responsibilities during the entire process of data collection, a 12 days training program was conducted by the technical team of UNICEF.

Selection of the area

The Attappady block of Palakkad District, Kerela was chosen as the venue to carry out the study. A total of 80 clusters were selected from which 1600 households out of 12,600 households in the province were selected by segmentation, systematic and simple random sampling method.

Selection of the sample

Three hundred and thirty-four children under five years of age were selected from a list of all the 1600 households in the selected locality. The Sampling definitions for the SMART survey is described as 1. Sampling Universe - Whole Attapaddy Block, 2. Sampling Frame 1st stage- 3 Gram Panchayats (GP), 3. Sampling Frame 2nd stage- 192 Hamlets, 4. Sampling Unit - Households in each Gram Panchayats, 5. Basic Unit -Head of the family and 6. Index Subject - Preschool children under 5 years.

The sampling universe for the whole survey was all households in the three-gram panchayats of the Attapaddy block. The sampling frame for the first stage of sampling was the list of all Oorus (hamlets) in three GPs. While, the sampling frame in the second stage of sampling consisted of the list of households in each selected GP, the sampling unit was the hamlet and the basic sampling unit was the household. The survey subjects were the head of the family and the mother of the preschool child. The index subject was children 0-5 years of age for measuring nutritional anthropometry.

Demographic Details:

Demographic details of the children regarding age, gender, parents' details, socio economic status of the parents, and living environment were collected using the questionnaire namely Nutrition Survey Questionnaire for children aged 6-59 months, questionnaire on details of mortality and morbidity and IYCF questionnaire per child (0-23 months) developed for the survey by UNICEF (2011).

Tools used for the study:

Crown Heel Length/ Height

The recumbent length was measured for children less than two years old. Standing height is shorter at 0.7 cm than the recumbent length in general. Height was measured by making the children stand upright for older children (2 to 5 years). A height board (stadiometer) mounted at a right angle between a level floor and against a straight, vertical surface such as a well or pillar was used to measure the height (WHO, 2008).

Body weight

Body weight is the most widely used and reproducible anthropometric measurement for the assessment of nutritional status. It indicates the body composite of all body constituents like water, minerals, protein, bone etc (Bamji *et al.*, 2019). The weight of the children was measured using a portable weighing machine and recorded to the nearest 0.01kg using according to Jelliffe *et al.*, (1991).

MUAC

MUAC is the circumference of the left upper arm and is measured at the mid-point between the tips of the shoulder and elbow. In children 6 -59-month-old, MUAC <110 mm indicates severe acute malnutrition and is recommended as a criterion of admission to therapeutic feeding programs. MUAC of the children was measured using an inch tape accurately.

Bilateral Pitting Oedema

Oedema of both feet was recorded as per the guidelines of WHO (2008). Oedema of both feet and facial oedema were taken as a sign of Severe Acute Malnutrition (II Degree). A child needs referral, even if other signs of kwashiorkor are not present which was taken as a sign for Severe Acute Malnutrition (III) Degree

Details on Immunization and Incidence of Diarrhoea

For children 9 to 59 months old, details on measles vaccinations and administration of vitamin A dose (in the last 6 months) were ascertained from the mothers. The details were coded with numbers 0 indicating immunization not received by the child (No), 1- immunization done and recorded in the immunization card, 2- immunization done without card and 8- when the mother/caregiver did not know whether immunization was given to the child.

Details on Infant and Young Child Feeding (IYCF) Practices

The details were collected from the mother/caregiver of children 0 to 23 months of age as provided in the questionnaire provided by USAID. (2011).

Classification of Malnutrition

Stunting, wasting, and underweight are all indicators of malnutrition in children (Mahgoub, *et al.*, 2006). Moderately or severely wasted children are those whose weight-for-crown heel length/height indication is more than two or three standard deviations below the median for the international reference population (ages 0-59 months) (WHO, 2011).

Collection of the Data

The data was collected after getting due permission from the concerned authorities. The demographic data was collected using Nutritional Survey Questionnaire for children aged (6-59 months) questionnaire on details of mortality and morbidity and IYCF questionnaire per child (0-23 months) developed for the survey by UNICEF (2016) were used to obtain the required information. The children's

nutritional status was determined using a standard technique and appropriate assessment tools.

Results and Discussion

Distribution of tribal children according to their age and gender

Table I presents the age group and gender-wise distribution of the tribal children. Of the 334 tribal children included in the survey, 10.4 percent were boys and 13.7 percent were girls between 6 to 12 months of age. Boys constituted 47 percent and girls constituted 43 percent in the 1-to-3-year age group when combined two years together and 42.8 percent of boys and 42.9 percent of girls were in the 3-to-6-year age group of children. Around 12 percent of the children were 6 to 12 months of age, 45.2 percent were between 1 and 3 years of age and 42.82 percent were 3 to 6 years of age. On the whole there were 173 (51.8%) male and 161 (48.2%) female children included in the study. Parimalavalli (2012) from her study on the Vellala Tribal children of Yercaud Taluk reports that 56 percent and 44 percent of the tribal children were males and females respectively. Manjunath *et al* (2014) from their study on Kadukuruba tribes in Karnataka also reported similar findings that male and female children constituted 51.5 and 48.5 percent of the under-five in the study.

Mean Crown Heel Length / Height, Body Weight and Mid Upper Arm Circumference

The mean crown heel length/height of boys and girls is presented in Table II. The mean crown heel length of boys, 6 to 12 months of age was 68.99 cm and that of girls was 67.80 cm. In the 1-to-2-year age group, the mean height of boys was 75.78 cm and that of girls was 76.13 cm. The mean height of boys, 2 to 3 years of age was 86.35 cm and that of girls was 83.86 cm. In the 3-to-4-year group, the mean height of boys was 92.41cm and that of girls was 91.85 cm. In 4- to 5-year group the mean age of boys was 97.12 cm and that of girls was 97.36 cm. The comparison of crown heel length/height between girls and boys in the present study is on par with the study of Manjunath *et al*., (2014) who found that the overall prevalence of underweight, stunting, and wasting among the Kadukurba tribes is 60.4 %, 55.4 %, and 43 %, respectively. Their prevalence rate of underweight was also found to be similar to our study. The overall prevalence of undernutrition among koramudi tribal children aged 2-13 years includes underweight-52.9%, stunting-49.6% and wasting -22.7%. Boys had 1.45,1.6- and 2.0-times greater risk of underweight, stunting and wasting respectively. The tribal children covered in the SMART Survey were significantly (p<0.01; p<0.05) shorter than their respective ICMR counterparts. However, there was no statistically

Table I: Age group and Gender wise distribution of tribal children (N=334)

Age Group (months)	Boys		Girls		Total	
	N	%	N	%	N	%
6-11	18	10.4	22	13.66	40	11.98
12-23	38	22.0	37	22.98	75	22.45
24-35	43	24.85	33	20.49	76	22.75
36-47	47	27.15	44	27.34	91	27.25
48-60	27	15.60	25	15.53	52	15.57
Total	173	100	161	100	334	100

Table II: Mean Crown Heel Length/Height (Cm) of Boys and Girls (N=334)

Age (months)	Standard				Present Study (PS)		t value		Boys vs Girls
	WHO (2006)		ICMR (2010)				PS vs ICMR (2010)		
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
6-11	75.7	74.0	71.2	69.4	68.99±3.3	68.07±3.0	2.86*	2.29*	0.74[NS]
12-23	81.75	80.2	81.9	80.4	75.77±3.7	76.13±3.7	10.44**	6.91**	0.45[NS]
24-35	91.95	90.75	91.9	90.7	86.15±5.8	83.86±3.9	6.57**	9.79**	1.90[NS]
36-47	99.7	98.9	99.8	98.9	92.41±5.1	91.87±4.6	9.38**	10.1**	1.35[NS]
48-60	106.7	106.1	106.7	106.1	96.57±3.9	97.36±4.3	11.28**	9.66**	0.65[NS]

*- Significant at 1% level; ** - Significant 5% level; NS – Not Significant

significant association between gender in terms of crown heel length and height of the under-five tribal children.

The mean body weight and MUAC of boys and girls are presented in Table III. The mean body weight of boys, 6 to 12 months of age was 7.33 kg and that of girls was 6.79 kg. In the 1-to-2-year age group, the mean body weight of boys was 8.76 kg and that of girls was 8.3 kg. The mean body weight of boys, 2 to 3 years of age was 10.88 kg and that of girls was 10.33 kg. The mean body weight of boys, 3 to 4 years of age was 12.33 kg and that of girls was 11.93 kg and those of boys in the 4-to-5-year category was 12.70 kg and for girls was 13.03 kg. In general, comparison of height and weight measurements of under five children in the present survey shows that the values were on par or slightly lower than the respective WHO (2010) standards. This could be because data of under-five children of settlers residing in Attappady had to be included in the survey during sampling, some of whom were overweight. Trimming of data during statistical analysis also did not alter the results significantly since both extremely low and high values had to be removed according to statistical norms. Comparison of body weight between girls and boys in the present study showed that Gender disparity was obvious in the body measurements of the children. The mean height (83.4cm) and weight (10.15kg) of the girl children were significantly less than the mean values of boys included in the present study.

The mean MUAC of boys, 6 to 12 months of age was 141.22mm and that of girls was 133.9. In the 1-to-2-year age

group, the mean MUAC of boys was 144.39mm and that of girls was 138.1mm. The mean MUAC of boys, 2 to 3 years of age was 147.39mm and that of girls was 143.2mm. The mean MUAC of boys, 3 to 4 years of age was 152.7mm and that of girls was 149.6mm and those of boys in the 4-to-5-year category was 151.0mm and for girls was 150.1mm. Compared to the cut off of 125mm the MUAC values recorded in the present study were significantly ($p<0.01$) higher. Hence the mean MUAC values were also compared with the standard values of Jelliffe (1966). Similar findings of MUAC values higher than ICMR (2000) standard value were recorded among tribal children in the Nilgiris by Pavithra Krishna *et al*, (2014).

Grading of the children based on Weight Scores

Grading of children according to weight for crown heel length/ height showed that 72.5 percent and 77.7 percent of boys and girls were in the normal category. However, most of these children had much lower weight and correspondingly lower height values than the standards and hence were apparently in the normal category. The prevalence of moderate wasting was found in 23.7 and 20.4 percent of boys and girls respectively. Severe malnutrition (wasting) was almost double (4%) among boys than among girls (1.9). Using ENA software, the prevalence of malnutrition in the present study was ascertained to be GAM – 19.8
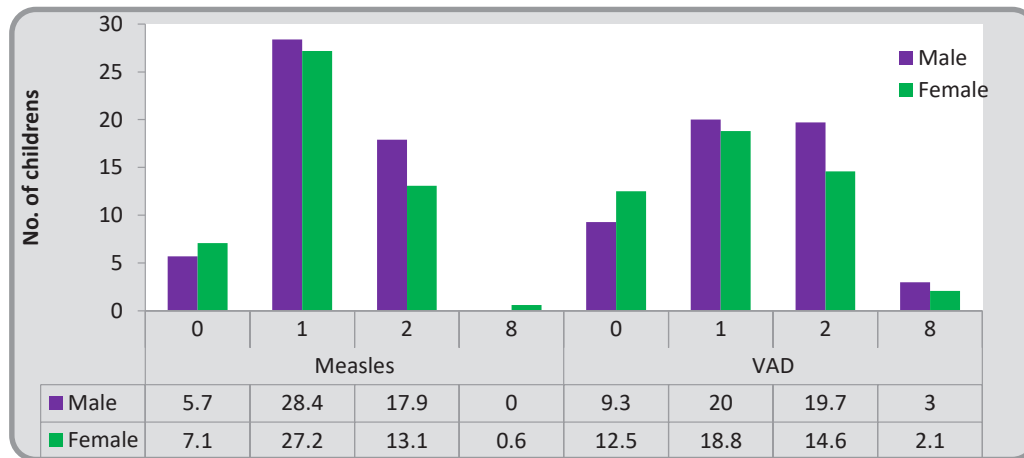
Table III: Mean Body Weight (Kg) of Boys and Girls (N=334)

Age (months)	Gender	Weight (Kg)				MUAC (mm)		
		WHO (2010)	Mean	Difference	t-Value	Jelliffe (1966)	Mean	Difference
6-11	Boys	7.50	7.33	0.17	0.69NS	122	141.22	19.22
	Girls	6.97	6.79	0.18	0.87NS	122	133.90	11.9
12-23	Boys	9.25	8.76	0.49	2.78*	131	144.39	13.39
	Girls	8.70	8.30	0.40	0.05**	128	138.10	10.1
24-35	Boys	10.95	10.88	0.07	0.28NS	133	147.39	14.39
	Girls	10.40	10.33	0.07	0.27NS	129	143.20	14.2
36-47	Boys	12.65	12.33	0.32	1.34NS	140	152.7	12.7
	Girls	12.05	11.93	0.12	0.52NS	137	149.60	12.6
48-60	Boys	14.15	12.90	1.25	5.45*	141	151.0	10.0
	Girls	13.70	13.03	0.67	2.43**	139	150.10	13.1

*- Significant at 1% level; ** - Significant 5% level; NS – Not Significant

Table IV: Grading of the children based on weight scores (N=334)

Grades	Boys		Girls		Total	
	N	%	N	%	N	%
Normal	125	72.5	125	77.7	250	74.9
Moderate	41	23.7	33	20.4	74	22.2
Severe	7	4.0	3	1.9	10	2.9
TOTAL	173	100	161	100	334	100

	Male	Female
Measles		
0	5.7	7.1
1	28.4	27.2
2	17.9	13.1
8	0	0.6
VAD		
0	9.3	12.5
1	20	18.8
2	19.7	14.6
8	3	2.1

0- Not Immunised; 1 - Immunised (with Immunisation card); 2 - Immunised (without card); 8 - do not know

Fig. I: Immunisation Against Measles and Vitamin A Deficiency

Table V: Categorisation of Children Based on Gender and Height

Age (months)	Malnutrition (%)				Normal (%)		Total (%)	
	-2SD		-1SD					
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
6-35	2	0.6	40	12.0	131	39.2	173	51.8
36-60	4	1.2	35	10.5	122	36.5	161	48.2
Total	6	1.8	75	22.5	253	75.7	334	100

$\chi^2 = 1.890$; df = 2; p = 0.01

percent; SAM-2.7 percent and MAM-17.1 percent. The prevalence of moderate and severe wasting reported in the present study is 22.2 percent and 2.9 percent respectively.

Immunisation against Measles and Vitamin A Deficiency

Figure 1 reveals the details on the immunization status of the children. While 5.7 % of boys and 7.1 % of girls were not immunized against measles, 28.3 percent of boys and 27.2 percent of girls were immunized against measles and had the record in the immunization card. Nearly 17.9 percent of boys and 13.2% of girls were immunized against measles, but did not have the immunization card a small group of 0.6 % of mothers could not reconnect whether their daughters were immunized against measles.

Categorization of children based on Gender and Height

The association between gender and height is discussed in Table – V. A statistically significant association was found between gender and height ($\chi^2 = 1.890$, p<0.01)

in the present study which is comparable with studies of Harding *et al* (2018). Kumar *et al* (2018) conducted the study on under five Indian tribals, urban slum dwellers and out patients and also reported the significance at less than 5 % association between gender and malnutrition in general.

Correlations Between Discrete Variables

The overall values of the correlation coefficient between the four parameters namely, age, body weight, crown heel length / height, and MUAC of the under-five tribal children is given in Table – VI. There was a high positive correlation between age, body weight and crown heel length/height of the children (r=0.814 and r=0.913 respectively). The correlation between age and MUAC was low but positive (r=0.369). Body weight correlated highly positively with age (r=0.814), crown heel length / height (0.928) and MUAC (0.708). Crown heel length / height showed a high positive correlation with age (r=0.923), body weight (r=0.928) and a low positive correlation with MUAC (r=0.478). MUAC showed a high positive correlation with body weight (0.708) and a low correlation with age (r=0.369) and crown heel length / height (r=0.478).

Table VI: Correlation Between Discrete Variables (N=334)

Parameters	Age (months)	Body Weight	Crown Heel Length / Height	MUAC
Age (months)	1.0	0.814	0.913	0.369
Body Weight	0.814	1.0	0.928	0.708
Crown Heel Length / Height	0.923	0.928	1.0	0.478
MUAC	0.369	0.708	0.478	1.0

Conclusion

The SMART survey revealed the plight of deprivation and marginal nutritional status of the tribal children. Though no statistically significant gender difference was observed in the crown heel length/height and body weight of the children, the mean value of these vital body parameters was miserably lower than both WHO and ICMR growth standards. The prevalence of Severe Acute Malnutrition and Moderate Acute Malnutrition was on par with national averages and those in other tribal groups in the country. MUAC values were incompatibly higher than the cut-off levels of WHO and standard values by Jelliffe and need to be explained scientifically. The outcome of this study shows that child malnutrition in tribal Attappady is multifaceted and requires multi-sectoral, multidisciplinary and multilevel interventions to address. There is an urgent need to qualify for providing effective pointers to policymakers and holders to plan and implement intervention programs so as to mitigate malnutrition among under five tribal children to start with and extend it to other vulnerable age groups as well. Every citizen of the country has to help improve a lot of our tribal brethren and enhancement of their nutritional status could form the very basis for their empowerment.

Acknowledgement

Conflict of Research

There is no conflict of research in this work.

References

Alebel, A., Demant, D., Petrucka, P., & Sibbritt, D. (2021). Effects of undernutrition on mortality and morbidity among adults living with HIV in sub-Saharan Africa: a systematic review and meta-analysis. BMC infectious diseases, 21(1), 1-20.

Anitha, R. (2022). Nature, Prevalence, and Impact of Undernutrition on Intelligence Among School Children: A Cross-Sectional Study from South India. ECS Transactions, 107(1), 637.

Bamji, S. Mehtap., Kamala.K., Brahmam. G.N.V (2019). Textbook Of Human Nutrition 4Ed, Oxford & IBH Publishing Co Pvt.Ltd.

Chaurasia, A. R. (2018). The State of Development in Villages of India: An Analysis of the 2011 Census Data. Indian Journal of Human Development, 12(3), 305-325.

Dey, U., & Bisai, S. (2019). The prevalence of under-nutrition among the tribal children in India: a systematic review. Anthropological Review, 82(2), 203-217.

Harding, K. L., Aguayo, V. M., & Webb, P. (2018). Factors associated with wasting among children under five years old in South Asia: Implications for action. PloS one, 13(7), e0198749.

Jelliffe, D. B., & World Health Organization. (1966). The assessment of the nutritional status of the community (with special reference to field surveys in developing regions of the world. World Health Organization.

Jensen, G. L., Cederholm, T., Correia, M. I. T., Gonzalez, M. C., Fukushima, R., Higashiguchi, T., ... & Van Gossum, A. (2019). GLIM criteria for the diagnosis of malnutrition: a consensus report from the global clinical nutrition community. Journal of Parenteral and Enteral Nutrition, 43(1), 32-40.

Kabir, M. R., Rahman, M., Al Mamun, M. A., & Islam, H. (2018). Prevalence of malnutrition and associated factors affecting the nutritional status of Adivasi (tribal) children aged 24-59 months in Bangladesh. Asian Journal of Medical and Biological Research, 4(2), 178-185.

Kumar, D., Sharma, K. K., & Varghese, K. A. (2018). Assessment of Immunization of Under Five Children of Tribal and Non-Tribal Rural Communities in Southern Rajasthan. National Journal of Community Medicine, 9(08), 561-565.

Mahgoub, S. E., Nnyepi, M., &Bandeke, T. (2006). Factors affecting prevalence of malnutrition among children under three years of age in Botswana. African Journal of Food, Agriculture, Nutrition and Development, 6(1).

Manjunath, R., Jagadish Kumar, K., Kulkarni, P., Begum, K., &Gangadhar, M. R. (2014). Malnutrition among under-five children of Kadukuruba tribe: need to reach the unreached. Journal of clinical and diagnostic research: JCDR, 8(7), JC01.

Parimalavalli, R. (2012). A study of socio-economic and nutritional status of the tribal children. Studies of Tribes and Tribals, 10(2), 183-187.

Pavitra Krishna K.U and Sylvia Subapriya M (2014), Prevalence of Vitamin- A and Iron Deficiencies among primitive Tribal children in Nilgiris District, International Journal of Food and Nutritional Sciences, 3,6,712-720.

Prakash, S. J., Bihari, G. S., Prakash, S. V., &Nath, S. P. (2013). Study of Nutritional Status Among Under Five Children Attending Out Patient Department at A Primary Care Rural Hospital. Bareilly (UP) Sch J App Med Sci, 1(6), 769-73.

Rao, V. G., Yadav, R., Dolla, C. K., & Kumar, S. (2005). Undernutrition& childhood morbidities among tribal preschool children. Indian Journal of Medical Research, 122(1), 43.

Senthilkumar, S. K., Chacko, T. V., & Suvetha, K. (2018). Nutritional status assessment of children aged 0-5 years and its determinants in a tribal community of Coimbatore district. International Journal of Community Medicine and Public Health, 5(7), 2835.

United Nations System Standing Committee on Nutrition. (2011). Module 6 Measuring Malnutrition: Individual Assessment. New York: United Nations; 2011

Uribe-Quintero, R., Álvarez-Castaño, L. S., Caicedo-Velásquez, B., & Ruiz-Buitrago, I. C. (2022). Trends in undernutrition mortality among children under five years of age and adults over 60. Biomédica, 42(1), 41-53.

USAID. (2011), Infant and Young Child Feeding Practices Monitoring Tool and Guide. USAID'S I and YC Nutrition Project

World Health Organization. (2008). World health statistics 2008. World Health Organization.

World Health Organization. (2010). The world health report: health systems financing: the path to universal coverage. World Health Organization.

World Health Organization. (2011). Summary: World report on disability 2011 (No. WHO/NMH/VIP/11.01). World Health Organization.

World Health Organization. (2012). Noncommunicable disease risk factory survey, Myanmar 2009 (No. SEA-Tobacco-40). WHO Regional Office for South-East Asia.