## Original Research Article

# Assessment of under nutrition using composite index of anthropometric failure among under five children of tribal population

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**ABSTRACT**

**Background:** Under nutrition is one of the most imperative problems among children that needed to be addressed in the realm of public health. Undernourished children cannot maintain natural biological abilities, such as growth, recuperating from ailments, learning and physical development. Poor feeding practices along with illnesses like diarrhoea, pneumonia, helminthic infections etc. are major determinants of under nutrition in India. The tribal populations in India are identified to be the autochthonous people of the land thereby being one of the major sufferers of under nutrition. This study aimed at finding out the prevalence of under nutrition among under-five children in tribal population in Tiruchirappalli district of Tamil Nadu.

**Methods:** This community based cross-sectional analytical study was done among Malayali Tribes population of Puthur village, Pachamalai Hills, Trichy to determine the prevalence of under-nutrition using CIAF and WHO Z scoring system and its risk factors by multivariate analysis.

**Results:** Out of 100 children, about 85% were undernourished as per CIAF criteria. In the Multivariate analysis, children of employed mother and children who were not given exclusive breast feeding were associated with Under nutrition which was statistically significant (p<0.05).

**Conclusions:** CIAF could be considered as a better measure than any other single index to identify the problem in the community. The study also emphasizes the significance of proper IYCF practices among employed mothers and improvement of MCH services in Tribal population during antenatal and immediate postnatal period to bring down the prevalence of under nutrition.

**Keywords:** Under nutrition, Tribal, CIAF, IYCF

## INTRODUCTION

Under nutrition is one of the major causes for all deaths in children. It does this by deteriorating children's strength and making illness more perilous. For an undernourished child it is difficult to withstand an attack of pneumonia, diarrhoea or any other illness. The main reason for under nutrition is poor feeding, care and infections. Nutritional deficiency makes children fatigued and fragile, and drops their IQs, so thereby leading to their poor performances in school. The sequence of under nutrition and poverty repeats itself, generation to generation. Exclusive breastfeeding for the atleast first 6 months and initiation of complementary feeding along with breast feeding can have a major impact on children's survival, growth and development.[1]

Under nutrition in children can present itself in several ways, and it is most commonly assessed by anthropometric measurements like height, weight and

mid upper arm circumference. A child is called stunted when he or she is too short for his or her age and called wasted when he or she have low weight for height and called underweight when he or she has low weight for his or her age. A child can present with underweight or stunted or wasted or with any of the combinations.

Worldwide, under nutrition affects one in three people and each of its major forms dwarfs most other diseases globally (WHO, 2000). Under nutrition affects all age groups, but it is especially common among the poor and those with insufficient access to adequate food, water and health care facilities. More than 70% of children with protein-energy malnutrition were present in Asia, 26% in Africa, and 4% in Latin America and the Caribbean (WHO 2000). South Asia has the maximum proportions and by far the principal number of undernourished children in the world.[1]

In India alone there are nearly 60 million children who are underweight, and the prevalence is higher in rural than the urban areas.[2,3] The number of malnourished children in India is among the highest in the world and is twice than that of the sub-Saharan region.[4] According to WHO, the projected numbers (in million) of underweight, stunted and wasted preschool children in 2015 in Asia is around 60, 84 and 39 million respectively. According to NFHS-3, among under five children, about 43.1% males and 43.9% females are underweight, about 47.9% males and 48% females are stunted, about 20.7% males and 19.3% females are wasted.[5]

The tribal population of the country, as per 2011 census, is 10.43 crore, constituting 8.61% of the total population. The state of Tamil Nadu contains 7,94,697 number of ST (Scheduled Tribes).[6] Their proportion in the state is 1.1% to that of other population as per 2011 census. Malayali tribes are the majority in Tamil Nadu with around 89,225 mainly located in districts of Dharmapuri, North Arcot, Pudukottai, Salem, South Arcot and Tiruchirapalli.[7] In Tamil Nadu, about 29.8% were underweight, 30.9% were stunted and 22.2% were wasted among the under five children.[5]

CIAF is the latest, comparatively strong index as it predicts all the parameters for approximation of nutritional status of a child.[8] CIAF provides the burden of under-nutrition as a solitary indicator and helps in detection of children with multiple anthropometric failures. The tribal population are poor in some key health indicators viz infant mortality, neonatal mortality, child mortality, antenatal check-up, percentage of institutional deliveries, maternal mortality, child full immunization etc. as per NFHS 3 data.[5] This study aimed at finding out the prevalence of under nutrition among under-five children in tribal population in Tiruchirappalli district of Tamil Nadu.

## METHODS

### Study area

A community based cross sectional study was conducted among Malayali tribes population of Pachamalai hills located between the districts of Tiruchirappalli, Perambalur and Salem, Tamil Nadu, South India. The hill is situated 2000 to 3000 feet above mean sea level and lies between 78.31' East and 11.28' North latitude. The total area is 14,122 sq. km. Pachaimalai, also known as the Pachais, are hills which are part of Eastern Ghats in Tamil Nadu in Trichy district. The geographical location of the area is 11°11′N 78°21′E / 11.18°N 78.35°E / 11.18; 78.35. There are about 21 villages with tribal population in and around Pachamalai Hills.[7] The list of villages is as follows: Manalodai, Thonur, Chinna Iluppur, Periya Iluppur, Sikkadu, Puthur, Puttur, Parathal, Nagur, Palayam, Thenpadi, Thalar, Kuruchi, Sengathur, Valaiyur, Kinathur, Thaneerpallam, Ramanathapuram, Chinna Vallam, Silaiyur and Nasakulam. The total population of all the villages is 8864 with around 1102 households. Among these 21 villages, Puthur was selected purposively as the study area.

### Study population

The under five children (0-5 yrs of age) residing in Puthur village were the study population.

***Study duration:*** Six months.

***Study period:*** 10th June 2015 to 10th December 2015.

### Study design

The study was a community based cross-sectional analytical study.

### Sample size

Taking the prevalence of underweight in tribal (scheduled tribes) under five children in NFHS-3 data = 54.5%,[5] allowable absolute error=10%, the sample size comes around 99.19. Keeping 10% for non-responsiveness, final sample size required was 100.

***Sampling design:*** Simple Random sampling

### Study instruments

- A pre-designed pre-tested schedule (interviewer administered questionnaire)
- Salter weighing machine
- Standard weighing (bathroom) scale
- A non-stretchable measuring tape
- Infantometer
- A battery torch

- Stethoscope
- Modified BG Prasad's scale (modified for May 2014)
- WHO Anthro for personal computers, version 3.2.2, 2011 Software
- Epi info statistical software

### Data collection

The purpose of the study was explained to all the mothers of the children and they were assured of confidentiality. After obtaining written consent for participation in the study, the schedule (interviewer administered questionnaire) was applied. A pre-designed, pre tested schedule in the local language (Tamil) which was translated and back-translated to verify content, criteria and semantic equivalence by bilingual and monolingual experts was prepared and used on the mothers of the under 5 children.

All the children were examined clinically, their anthropometric measurements like weight, height, mid upper arm circumference (MUAC) were taken using standard operating procedures, after taking written consent from their mothers with the help of a predesigned and pre tested schedule. The data included were weight, recumbent length (for children less than 24 months of age), height (for children more than 24 months of age) and mid upper arm circumference (for children 1–5 years of age). Weight was measured to the nearest 0.1 Kg in a Salter weighing machine and standard weighing (bathroom) scale. Height was measured against a non-stretchable tape fixed to a vertical wall, with the participant standing on a firm/level surface and it was measured to the nearest 0.1 cm. recumbent length (for children less than 24 months of age) was measured by using an infantometer. Each measurement was done twice, and the mean of the two readings was recorded.

Socio-economic status (SES) was determined by using Modified Prasad's scale (modified for 2014). Anthropometric data was analyzed using WHO Anthro for personal computers, version 3.2.2, 2011 Software (for children aged 0 to 59 months) for assessing growth and development of the children.

### Operational definitions

The definitions used for the study are as follows:

- Wasting (acute malnutrition) is defined as a Weight for Height Z-score (WHZ) of <-2. Severe wasting is considered if WHZ is <-3 OR if MUAC <11.5 cm
- Stunting (chronic malnutrition) is defined as a height for age Z-score (HAZ) of <-2. Severe stunting is considered if HAZ is <-3.
- Underweight (mixed acute and chronic malnutrition) is defined as weight for age Z-score (WAZ) of <-2. Severe underweight is considered if WAZ is <-3

- Thinness (measure of body fat) is defined as a BMIZ of <-2. Severe thinness was considered if BMIZ was <-3
- Composite Index of Anthropometric failure (CIAF) includes all children who are wasted, stunted, or underweight and their combinations (groups B–Y).[8]

### Statistical analysis

All the data was initially entered to Microsoft Excel 2010 and later these spreadsheets were used for analysis. Statistical analysis was done using Epi info statistical software. Descriptive statistics were calculated as frequency, percentage, mean and standard deviation, median and inter-quartile range. Descriptive data were represented using tables. For inferential statistics, various tests of significance were used according to the type of variables dealt with. For all the statistical tests of significance, $p < 0.05$ was considered to reject the null hypothesis. Taking presence of under nutrition [present or absent] as a dichotomous variable, logistic regression analysis was used. Firstly, a bivariate analysis was done to ascertain the relationship of dependent variable with other variables. Then, all the variables found to be significant in bivariate analysis were entered into a multivariate logistic regression analysis (Link Function=Logistic). Diagnostic tests were done after modelling to assess goodness-of-fit and assumptions pertaining to logistic regression.

## RESULTS

A total of 100 children below five years of age were surveyed. The mean age of children was: Mean±SD= 33.6±15.2 [months]. Majority of the children (25%) were in the age group of 4-5 years, 57% were males. All the children belonged to Hindu religion and Malayali tribes caste. Most of the children (53%) had a nuclear type of family. 54% of the mothers had completed till the primary level of education and 50% of the fathers had completed till the middle level of education. Majority of the mothers (53%) were Agricultural labourers working in farms as daily wages while the fathers (65%) were agricultural labourers working in farms as daily wages. The mean per capita income of the study population was: Mean±SD = 851.9±101.1 [PCI]. 60% of the children belonged to the upper lower socio economic class (Table 1).

The mean birth weight of the children was (Mean±SD= 2.49±0.4). Most of the children (66%) had normal birth weight. Among LBW babies, 2 out of 34 belonged to very low birth weight[#] category i.e. birth weight <1.5 kg. About 43% of the children were of first order Majority of the children (79%) were borne of term pregnancy. All the children got delivered in Government Hospital i.e. 100% of Institutional delivery. All were immunized till date. About 23% of the children were given prelacteal feeds with honey and sweet water being commonly used. Only 48% were given exclusive breast feeding for atleast first

6 months. Complementary feeding started at 6-7 months with semisolid food was considered proper and about 93% had started complementary feeding properly. Complementary feeding was not applicable for one child[@] since it was less than 6 months of age. Regarding the morbidity in children, diarrhoea was seen in 11%, acute respiratory infections in 18%, skin rashes in 9% and pallor in 13% (Table 2).

**Table 1: Sociodemographic characteristics (n=100).**

| S. No | Sociodemographic characteristics | Number (%) |
|---|---|---|
| | Age of the children | |
| | 0-6 months | 01 |
| | 6-12 months | 07 |
| 1 | 1-2 years | 24 |
| | 2-3 years | 24 |
| | 3-4 years | 19 |
| | 4-5 years | 25 |
| | Gender of the children | |
| 2 | Male | 57 |
| | Female | 43 |
| | Type of family | |
| 3 | Joint | 42 |
| | Nuclear | 53 |
| | Three generation | 05 |
| | Educational level of mother | |
| | Illiterate | 2 |
| 4 | Primary level completed | 54 |
| | Middle level completed | 43 |
| | Secondary level completed | 1 |
| | Educational level of father | |
| | Illiterate | 6 |
| 5 | Primary level completed | 41 |
| | Middle level completed | 50 |
| | Secondary level completed | 3 |
| | Occupation of mother | |
| 6 | Homemaker | 10 |
| | Agriculture (daily wages) | 53 |
| | Agriculture (own farm) | 57 |
| | Occupation of father | |
| | Agriculture (daily wages) | 33 |
| 7 | Agriculture (own farm) | 63 |
| | Carpenter | 2 |
| | Cook | 2 |
| | Socioeconomic class [based on modified Prasad's scale 2014] | |
| | Class I (PCI ≥5571) | 0 |
| 8 | Class II (PCI 2786-5570) | 0 |
| | Class III (PCI 1671-2785) | 2 |
| | Class IV (PCI 837- 1670) | 60 |
| | Class V (PCI <836) | 38 |

The descriptive measures of mean weight, height or length and mid upper arm circumference (MUAC) were shown in (Table 3).

**Table 2: Birth weight, birth order, IYCF practices and morbidity (n=100).**

| S.No | Child health data | Number (%) |
|---|---|---|
| | Birth weight of children | |
| 1. | Normal (≥2.5 kg) | 66 |
| | LBW (<2.5 kg)[#] | 34 |
| | Birth order | |
| | First | 43 |
| 2. | Second | 38 |
| | Third | 16 |
| | Four and above | 3 |
| | Term/preterm pregnancy | |
| 3. | Term | 79 |
| | Preterm | 21 |
| | IYCF practices Prelacteal feeds | |
| | Given | 23 |
| | Not given | 77 |
| | Exclusive Breast feeding | |
| 4. | Given | 48 |
| | Not given | 52 |
| | Complementary feeding | |
| | Started properly | 93 |
| | Not started | 6 |
| | Not applicable[@] | 1 |
| | Morbidity (past 2 weeks) Diarrhoea | |
| | Yes | 11 |
| | No | 89 |
| | Acute respiratory tract Infections | |
| | Yes | 18 |
| 5. | No | 82 |
| | Skin rashes | |
| | Yes | 9 |
| | No | 91 |
| | Pallor | |
| | Yes | 13 |
| | No | 87 |

**Table 3: Descriptive statistics of weight, height and MUAC (n=100).**

| Measures | Weight (kg) | Height/length (cms) | MUAC (cms) |
|---|---|---|---|
| **Mean** | 10.2 | 83.4 | 12.2 |
| **Median** | 10.0 | 84 | 12 |
| **SD** | 3.7 | 14.7 | 1.6 |
| **Range** | 4.0-19.5 | 8.0-120 | 10-14.5 |

With respect to nutritional status of children using WHO Anthro scores, 49% showed wasting (WHZ score), 72% showed stunting (HAZ score), 62% showed underweight (WAZ score) and 47% showed thinness (BMIZ score). Child is said to be undernourished if it falls under any

one of the last 6 criteria [B, C, D, E, F or Y] and except the first one [A]. In the current study, about 85% were undernourished according to CIAF criteria (Table 4).

**Table 4: Nutritional status of children (n=100).**

| S. No | Nutritional status of children | | Number or (%) |
|-------|-------------------------------|---|---------------|
| 1. | Wasting (WHZ score) | | |
| | No wasting | | 51 |
| | Wasting | | 19 |
| | Severe wasting | | 30 |
| | Stunting (HAZ score) | | |
| | No stunting | | 28 |
| | Stunting | | 24 |
| | Severe stunting | | 48 |
| | Underweight (WAZ score) | | |
| | No underweight | | 38 |
| | Underweight | | 9 |
| | Severe underweight | | 53 |
| | Thinness (BMIZ score) | | |
| | No thinness | | 53 |
| | Thinness | | 22 |
| | Severe thinness | | 25 |
| 2. | CIAF Criteria | | |
| | Group | Description | |
| | A | No failure | 15 |
| | B | Wasting only | 4 |
| | C | Wasting & underweight | 9 |
| | D | Wasting, stunting & underweight | 36 |
| | E | Stunting & underweight | 17 |
| | F | Stunting only | 19 |
| | Y | Underweight only | 0 |
| 3. | Undernutrition [as per CIAF Criteria] | | |
| | Absent/Normal | | 15 |
| | Present | | 85 |

**Table 5: Bivariate logistic regression analysis of under nutrition with various factors (n=100).**

| Independent variable | Undernutrition present N (%) | OR (95% CI) | P value |
|----------------------|------------------------------|-------------|---------|
| **Age of child (continuous variable)** | ---------- | 0.966(0.929-1.004) | 0.077 |
| **Gender of child** | | | |
| Male (57) | 54 (94.7) | 6.96(1.82-26.6) | 0.005 |
| Female (ref) (43) | 31 (72.1) | 1 | |
| **Type of family** | | | |
| Joint (42) | 37 (88.1) | 1.85(0.17-20) | 0.613 |
| Nuclear(53) | 44 (83) | 1.22(0.12-12.2) | 0.865 |
| Three generation (ref) (5) | 5 (80) | 1 | |
| **PCI** | | | |
| (continuous variable) | ----------- | 12.9(0.95-361.78) | 0.931 |
| **Education of mother** | | | |
| Above middle (56) | 47 (83.9) | 0.82(0.26-2.5) | 0.524 |
| Below middle (Ref) (44) | 38 (86.3) | 1 | |
| **Education of father** | | | |
| Above middle (53) | 48 (90.5) | 2.5(0.81-8.24) | 0.667 |
| Below middle (Ref) (47) | 37 (78.7) | 1 | |

| Independent variable | Under nutrition present N (%) | OR (95% CI) | P value |
|---|---|---|---|
| **Occupation of mother** | | | |
| Employed (90) | 80 (88.9) | 8.0(1.96-32.5) | |
| Homemaker (Ref) (10) | 5 (50) | 1 | 0.002 |
| **Birth weight** | | | |
| <2.5 Kg (34) | 30 (88.2) | 1.5(0.4-5.1) | |
| ≥2.5 kg (Ref) (66) | 55 (83.3) | 1 | 0.911 |
| **Birth order** | | | |
| 1st (43) | 36 (83.7) | 0.83(0.27-2.52) | |
| 2nd & above(Ref) (57) | 49 (85.9) | 1 | 0.543 |
| **EBF** | | | |
| Not given (52) | 49 (94.2) | 5.4(1.43-20.7) | |
| Given (Ref) (48) | 36 (75) | 1 | 0.029 |
| **Complementary feeding** | | | |
| Improper (7) | 2 (28.5) | 0.4(0.07-2.31) | |
| Proper(Ref) (93) | 80 (86.0) | 1 | 0.743 |
| **Morbidity (past 2 weeks)** | | | |
| Yes (21) | 20 (95.2) | 4.30(0.53-34.8) | |
| No (79) | 65 (82.2) | 1 | 0.790 |

**Table 6: Multivariate logistic regression analysis of under nutrition with various factors (n=100).**

| Independent variable | Undernutrition present N (%) | OR(95% CI) | AOR ( 95% CI ) |
|---|---|---|---|
| **Gender of child** | | | |
| Male (57) | 54 (94.7) | 6.96 (1.82-26.6) | 1.38 (0.57-17.7) |
| Female (ref) (43) | 31 (72.1) | 1 | 1 |
| **Occupation of mother** | | | |
| Employed (90) | 80 (88.9) | 8.0 (1.96-32.5) | 4.92 (1.13-26.9) |
| Homemaker (Ref) (10) | 5 (50) | 1 | 1 |
| **EBF** | | | |
| Not given (52) | 49 (94.2) | 5.4 (1.43-20.7) | 8.54 (1.19-48.9) |
| Given (Ref) (48) | 36 (75) | 1 | |

In the bivariate analysis, independent variables like gender of the child, occupation of mother and exclusive breast feeding showed association with the dependent variable under nutrition. Male child, children of employed mother and children who were not given exclusive breast feeding were associated with under nutrition which was statistically significant in bivariate logistic regression (p<0.05) (Table 5).

In the multivariate logistic regression, children of employed mother and children who were not given exclusive breast feeding were associated with under nutrition which was statistically significant (p<0.05) (Table 6).

**DISCUSSION**

In this cross sectional study done over a period of 2 months it was found that around 25% of children belonged to the age group of 4-5 years. About 57% were males and 53% lived in nuclear families. It was evident

that predominantly mothers had only primary school education (54%), though illiteracy was almost negligible. Most of these mothers (53%) were daily wage labourers working in the agricultural farms. On the other hand the fathers were relatively more educated, with 50% of them having completed middle school education. Like the women the men too were daily wage labourers in the fields. India being an agriculture intensive country, with most of its economic gain through farming – the subjects of this study too were predominantly working in fields and belonged to the lower middle (60%) socio economic status as per modified BG Prasad Scale (May 2014). Most appreciating feature in the study was that all the children got delivered in Government Hospital i.e. 100% of institutional delivery and moreover all were immunized till date similar to a study by Brahmbhatt et al where 98.8% were fully immunized.[12] Majority (66%) of children had normal birth weight, well above cut of 2.5 kgs with 79% of them being full term pregnancies. Among these children, predominant were of the first order. Only 3% of the children were of the fourth order and above. Regarding IYCF Practices: 23% were given

pre lacteal feeds with honey and sweet water most commonly. Exclusive breast feeding was strictly followed for only 48% children in which was very less when compared to another study by Brahmbhatt et al where 86.5% were exclusively breast fed.[12] Initiation of complementary feeds was proper in 93% of children. In comparison with each subset of CIAF score in this study A (15%) B (4%) C (9%), D (36%), E (17%), F (19%) to a similar study by Brahmbhatt et al A (1.8%) B (1.8%) C (21.6%) D (58.4%) E (15.8%) F (0.6%) the current study showed a huge prevalence of under nutrition in all aspects.[12] In this study 49% were wasted, 72% were stunted, 62% were underweight which was also high in comparison to a study done by Sen et al where prevalence of under-nutrition was observed to be 21.5% (wasting), 43.3% (stunting) and 52.0% (underweight) and in Seetharaman et al where 49.6% were stunted, 46.7% underweight and 20.2% were wasted.[13,14] It was also higher than the National level data where underweight, stunting and wasting were 47%, 45.5% and 15.5% respectively and the corresponding values for Tamil Nadu were 36.7%, 29.4% and 19.9%. Under nutrition was present in 85% of the children in this study which is more than observed by Seetharaman et al (68.6%) in Tamil Nadu lesser than observed by Brahmbhatt et al (98.2%) in Dakshina Kannada region of Karnataka. The study by Sen et al showed 63.6% using the CIAF.[12-14] Similar studies done in other parts of India reveal Mandal et al (73.1%) in Hooghly district of West Bengal, Anwar et al (62.5%) in rural Varanasi, Deshmukh et al (59.6%) in rural Wardha.[15-17]

From the logistic analysis it is evident that the gender of the child (p=0.005), occupational status of the mother (p=0.002) and exclusive breast feeding of the child (p=0.029) has a direct bearing on the CIAF scores and nutritional status of the child which was similar in comparison to the study done by Sen et al where multinomial logistic regression odds showed that children suffering from double and multiple failures were significantly associated with the socio-economic and demographic variables.[13]

## CONCLUSION

The study revealed higher proportion of under nutrition (85%) among tribal under five children. With multivariate analysis occupation of the mother and absence of exclusive breastfeeding were identified as the two important factors contributing to under nourishment in the study group. Improving child care practices among employed mothers and promoting exclusive breast feeding should be given due importance. Emphasizing the above two measures during antenatal period and immediate postnatal period would be helpful since the mother will be more receptive in these phases.

62% of the children had underweight and 49% had wasting. 72% of the children had stunted growth which reflects chronic under nutrition in these children. Based on CIAF criteria 85% of the children were under nourished. CIAF criteria were able to identify the overall proportion of affected children. CIAF could be a considered as a better measure than any other single index to identify the under nourished children in the community.

## ACKNOWLEDGEMENTS

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