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Original Research Article

Assessment of nutritional status in under five children admitted to tertiary care hospital and comparison of different nutritional indices

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ABSTRACT

Background: Childhood is a phase of swift growth and development after infancy. One of the foremost public health problems in developing countries like India is extensive prevalence of under nutrition among school children resulting in delayed cognitive development and severe health impairment. Aim was to assess the prevalence and factors associated with undernutrition and comparison of different nutritional indices in under five-year children.
Methods: A descriptive observational study conducted among 300 children under five years admitted to a tertiary care hospital for a duration of 1 year by simple random sampling technique. A pre-tested semi-structured questionnaire was employed to interview the children and their mothers. The data obtained was subjected to statistical analysis using statistical package for the social sciences (SPSS) version 26.0.
Results: The overall prevalence of underweight among under five children was 50%, wasting was 40.7% and 39.7% of children were stunting. Stunting was significantly associated with higher birth order (Chi-square test=8.21, p value=0.04). undernutrition was significantly associated with lower socio-economic status. Dugdale index have higher sensitivity and specificity and maximum area under curve as per ROC and concluded as best tool for screening the malnutrition in under five children.
Conclusions: Malnutrition is a major public health problem leading to morbidity and mortality in children. It requires focussed action to mitigate the impact of malnutrition in under five children.

Keywords: Age independent indices, Area beneath the curve, Gold standard, Sensitivity, Undernutrition

INTRODUCTION

Childhood is a stage characterized by fast development following infancy. Children are often regarded as the biggest natural asset of every nation. Comparatively speaking to industrialized nations, India still needs to improve the health of school-age children aged 5 to 14, despite having achieved freedom for a long time. The nutritional needs of these youngsters differ from those of adults, as evidenced by their high pace of growth.

Assessing the nutritional status of children is an essential method for evaluating their general well-being and growth.[1]

Undernutrition is the result of inadequate food consumption and recurring infectious diseases. It is characterized by three components: wasting (low weight-for-height), stunting (low height-for-age), and underweight (low weight-for-age). Wasting is the term used to describe low weight-for-height. It typically signifies a recent and significant reduction in weight due to insufficient food intake and/or the presence of an infectious condition, such as diarrhoea, that has led to weight loss. A young child who is significantly malnourished has an elevated likelihood of mortality; however, there are available interventions for therapy. Stunting refers to a condition when a person has a low height for age. It is the outcome of long-term or repeated insufficient nutrition, typically linked to unfavourable

socioeconomic circumstances, inadequate maternal health and nutrition, numerous illnesses, and/or incorrect feeding and care of infants and young children during their early years. Stunting impedes children from attaining their full physical and cognitive capabilities. Underweight is the term used to describe children who have a low weight-for-age. An underweight child may have stunting, wasting, or a combination of both.[1]

Undernutrition significantly increases the vulnerability of children to mortality caused by common diseases, multiplies the occurrence and intensity of these infections, and hinders the process of recovery and a significant outcome of long-term rates. Therefore, regularly screening children for signs of malnourishment allows for early detection, which is crucial for promptly treating and preventing severe problems.

Objectives

Objectives of the study were: to assess the different nutritional indices for screening of malnutrition, to compare the nutritional status among different socioeconomic groups, and to study the burden of undernutrition among 1-5 years children.

METHODS

Study design

It was an observational study.

Study duration

The duration of the study was from December 2022 to November 2023.

Study setting

The study included under 5 children admitted in the paediatric ward of Malda Medical College and Hospital.

Sample size

Sample size calculated at 95% confidence level assuming a prevalence of malnutrition 65% among under five children (according to Elizabeth).[2] At the relative allowable error of 5.5% of prevalence, calculating by the formula given.

$$n = Z^2P(1-P)/d^2$$

Required sample size was 288, which was rounded to 300.

Inclusion criteria

Under 5 children admitted in the study setting, children of whose parents gave written informed consent, and IPD patients were included in the study.

Exclusion criteria

Children having chronic systemic diseases, who did not give consent, and children >5 years of age were excluded.

Study method

A predesigned pre-tested questionnaire was used for collecting the data. Questionnaire consists of age, gender, residence, weight, height, mid upper arm circumference, head circumference, and socioeconomic status, birth order, immunization status. The study was done after obtaining written informed consent from both parents or either mother/father of the child. The WHO growth charts and modified BG Prasad classification 2023 were used for reference.[3] Anthropometry and clinical examination were used to assess nutrition. Children were measured according to the anthropometric parameters set by the World Health Organization (WHO).[4] Following the collection of measures, the required Z scores for various indices, such as weight/age, height/age, and weight/height, were calculated using Z score tables and WHO Z score charts. Children who are stunted, wasted, or underweight are classified as having under nutrition. Children were considered fully immunized who were received all vaccines up to 5 years of age as per national immunization schedule and who were not received a single vaccine as non-immunized and rest were partially immunized. Data was compiled in Microsoft excel and analysed with statistical package for the social sciences (SPSS) version 26.0.

Statistical analysis

Data were entered Microsoft Excel and analysed with SPSS version 26.0. To find the association between two categorical variables the Chi square test was used and for quantitative variables ANOVA and student t test were used. Results were expressed in frequencies, percentages, mean and standard deviation (SD). A p value of <0.05 was considered statistically significant. Receiver operating characteristic curve used to determine sensitivity, specificity and area under curve of different age independent indices against gold standard indices.

RESULTS

In the underweight category, almost every age group is equally affected, in stunting, >3-4 years were mostly affected (48.3%) than the other age groups, and in wasting category, the age group of >4-5 years, were mostly affected (45.6%) (Table 2).

Among the non-immunized, 46 (49.5%) cases had underweighted, 37 (39.8%) cases had stunting, and 39 (41.9%) cases had wasting (Table 3).

Among underweight category, 66 (58.4%) cases of birth order 3, and 21 (44.7%) cases of birth order 4 were seen. In the stunting category, 48 (42.5%) cases of birth order 3,

and 20 (42.6%) cases of birth order 4 were seen. Among wasting category, 52 (46%) cases of birth order 3, and 14 (29.8%) cases of birth order 4 were seen. Significant association found between birth order and stunting (Chi-square test 8.25; p value=0.04) (Table 4).

Table 1: Demographic variables of study participants.

Variables	Parameters
Gender (n=300)	
Male	181
Female	119
Anthropometric parameters	
Mean age (in months)	31.77
Mean weight (kg)	10.29
Mean expected weight (kg)	12.75
Mean height (cm)	85.94
Mean MAC (cm)	13.25
Mean HC (cm)	45.52
Prevalence as per WHO (%)	
Underweight	50
Wasting	39.7
Stunting	40.7
Type of family (n=300)	
Nuclear	130
Joint	170
Immunization status	
Fully immunized	132
Partially immunized	75
Not immunized	93

Table 2: Under-weight, stunting and wasting based on age.

Age (years)	Underwei-ght (%)	Stunting (%)	Wasting (%)
1-3	82 (50.9)	65 (40.4)	68 (42.2)
>3-4	30 (50)	29 (48.3)	18 (30)
>4-5	38 (48.1)	25 (31.6)	36 (45.6)
Total	150 (50)	119 (39.7)	122 (40.7)
Chi-square test	0.17	4.04	3.78
P value	0.92, ns	0.13, ns	0.15, ns

NS: Non-significant

In the lower and lower middle categories, total 83 cases were seen in the underweight category, 39 cases were seen in the stunting category and 88 cases were seen in the wasting category. Significant association found between socio-economic status and undernutrition (Table 5).

As per IAP, 2 (0.7%) cases belonged to very severe malnutrition, 6(2%) cases belonged to severe malnutrition, and 39 (13%) cases belonged to moderate malnutrition (Table 6).

As per Kanawati's index, 20 (6.7%) cases belonged to severe malnutrition, 120 (40%) belonged to moderate and rest cases 45 (15%) belonged to mild malnutrition (Table 7).

Table 3: Under-weight, stunting and wasting based on immunization.

Immuni-zation	Underweight (%)	Stunting (%)	Wasting (%)
Fully	61 (46.2)	55 (41.7)	46 (34.8)
Partially	43 (57.3)	27 (36)	37 (49.3)
No	46 (49.5)	37 (39.8)	39 (41.9)
Total	150 (50)	119 (39.7)	122 (40.7)
Chi-square test	2.38	0.64	4.23
P value	0.31, ns	0.73, ns	0.12, ns

NS: Non-significant

Table 4: Under-weight, stunting and wasting based on birth order.

Birth order	Underwei-ght (%)	Stunting (%)	Wasting (%)
1	17 (50)	19 (55.9)	11 (32.4)
2	46 (43.4)	32 (30.2)	45 (42.5)
3	66 (58.4)	48 (42.5)	52 (46)
4	21 (44.7)	20 (42.6)	14 (29.8)
Total	150 (50)	119 (39.7)	122 (40.7)
Chi-square test	5.58	8.25	4.76
P value	0.13, ns	0.04, s	0.19, ns

NS: Non-significant, S: significant

Table 5: Under-weight, stunting and wasting based on SES.

SES	Underwei-ght (%)	Stunting (%)	Wasting (%)
Upper	0	6 (28.6)	0
Upper middle	14 (24.6)	29 (24.6)	1 (1.8)
Middle	53 (50.5)	45 (42.9)	33 (31.4)
Lower middle	49 (79)	28 (45.2)	43 (69.4)
Lower	34 (61.8)	11 (20)	45 (81.8)
Total	150 (50)	119 (39.7)	122 (40.7)
Chi-square test	59.74	14.19	113.63
P value	0.0001, s	0.007, s	0.0001, s

NS: Non-significant, S: significant

Table 6: Malnutrition as per IAP.

Malnutrition as per IAP	Frequency	Percentage (%)
Normal	132	44.0
Mild	121	40.3
Moderate	39	13.0
Severe	6	2.0
Very severe	2	0.7
Total	300	100.0

Table 7: Malnutrition as per Kanawati's grading.

Malnutrition as per Kanawati's grading	Frequency	Percentage (%)
Normal	115	38.3
Mild	45	15.0
Moderate	120	40.0
Severe	20	6.7
Total	300	100.0

As per Rao's index 56 (18.7%) cases belonged to mild to moderate malnutrition, 95 (31.7%) cases belonged to severe malnutrition (Table 8).

Table 8: Malnutrition as per Rao's.

Malnutrition as per Rao's grading	Frequency	Percentage (%)
Normal	149	49.7
Mild to moderate	56	18.7
Severe	95	31.7
Total	300	100.0

As per Dugdale's index 51 (17%) children belonged to mild to moderate malnutrition and rest 115 (38.3%) belonged to severe malnutrition (Table 9).

Table 9: Malnutrition as per Dugdale's index.

Malnutrition as per Dugdale's grading	Frequency	Percentage (%)
Normal	134	44.7
Mild to moderate	51	17.0
Severe	115	38.3
Total	300	100.0

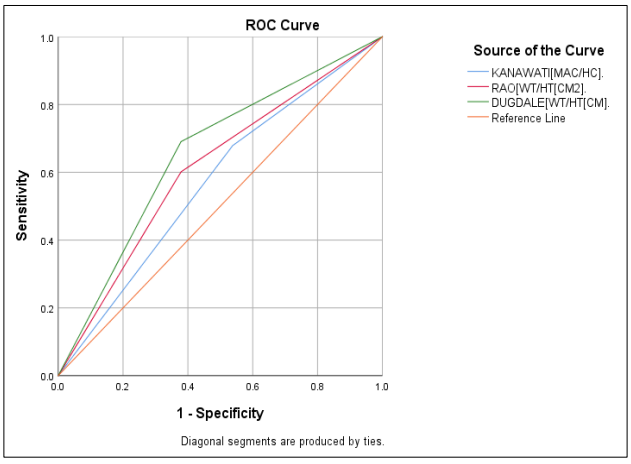

Figure 1: Receiver operating characteristic curve for various indices and comparison of different age independent indices.

Gold standard for the ROC curve is the IAP classification and Area under the curve for Kanawati [MAC/HC] was 0.57, for Rao [WT/HT[CM2] was 0.611, and for Dugdale [WT/HT[CM] was 0. 656. Sensitivity, specificity of Kanawati was 67.9%, 46.2%, sensitivity, specificity of Rao was 60.1%, and 62.1, sensitivity, specificity for Dugdale was 69%, and 62.1% (Figure 1).

DISCUSSION

In the present study, male preponderance was observed with a male to female ratio of 1.52:1. In all the age groups, the majority were males than females. The association between age and gender distribution was non-significant. The higher prevalence of underweight, stunting, wasting observed in our study was almost 50% in up to 4 years, 48.3% in >3-4 years,45.6% in >4-5 years age group respectively.

A community-based study conducted by Vardhman Mahavir Medical College and Safdarjung Hospital to know the nutritional status in under five children in an urban area of south Delhi showed the prevalence of underweight, stunting was higher in more than 24 months' age group was 20.6%, 30.3% respectively.[5]

In the present study overall prevalence of underweight among under five children was 50%, wasting was 40.7% and 39.7% of children were stunting. According to national family health survey (2019-2021) the prevalence of underweight was 32.1, wasting was 19.3% and 35.5% children are stunted in India.[6] In west Bengal, the survey conducted by the ministry of health and family welfare 2019-21 the prevalence of underweight was 32.2%, wasting was 20.3% and 33.8% are stunted.[7] The prevalence we found higher in our study it probably due to low socioeconomic status, joint family, higher birth order and improper immunization in our study setting.

In the present study combined non-immunized and partially immunized children were having higher prevalence of undernutrition while comparing with rest of the children it is mainly due to most of our study participants from rural background and lack of knowledge about immunization. It was observed in our study that underweight, stunting and wasting was higher in children more than 2 birth order i.e. 3 or 4 birth order. But in few cases stunting was observed in first birth order and there is significant association between stunting and birth order ($p \leq 0.05$). A supportive study done in Maharashtra reported as compared to birth order 2 or more than 2, children with birth order less than two were more likely to be stunting.[8] It may be because teenage marriages are common in our study settings. It triggers the link of early child bearing, low birth weight babies resulted in undernutrition.

The prevalence of underweight, stunting and wasting was observed higher in children belongs to lower and lower middle class was 61.8%, 45.25 and 81.8% respectively. We found a significant association between SES and malnutrition ($p<0.05$). A supportive case control study done in Karnataka revealed that family with lower economic status have higher undernutrition.[9] Socio-

economic status was important factor to determine the malnutrition. Probably due to poor sanitation and hand hygiene, more incidences of diarrhoeal cases and infectious diseases.

The most commonly used anthropometric parameters for the classification of nutritional status in under five children are weight-for-age, height-for-age, head and mid-upper arm circumference. From these commonly used parameters, most of the classification are dependent on height, weight and age and they were using most popularly to defines nutritional status. Most of the researchers have used either one or two of the indices, but rarely utilized all the indices.

Incidence of undernutrition usually depends upon the classification we were used to determine nutritional status. Among the three most commonly used measurements, the greatest prevalence of malnutrition is observed when weight for age is applied. In a study conducted by Naik et al, malnutrition was reported in 6% of males and 78.9% of females in rural Punjab, as assessed by weight-for-age measurements.[10] The lowest incidence of malnutrition was observed when height-for-age was used as criterion.

In present our study we found the prevalence of malnutrition in a tertiary care hospital as per IAP (age dependent) was 56%, and as per age independent indices Kalawati's, Rao's, Dugdale's index was 61.7%, 51.4%, and 55.3% respectively. The rate of undernutrition in the referenced study, as reported by Dugdale, was 22.1%, while the study on nutritional anthropometry and preschool child feeding practices in working mothers of Central Orissa by Mishra and Mishra found the incidence of poor nutrition to be 17%.[11]

In the study on the detection of undernutrition among preschool children by Raje et al, 66.67% of children were suffering from nutritional deficiencies, as per the Kanawati and McLaren index, which recorded rates of 74.2% and 48.3%, respectively.[12] We found in our study some higher prevalence of malnutrition as per Dugdale index while comparing with supported study.it may be due to study setting, method used and sample size.

In our study we used IAP classification as reference line (gold standard) for ROC curve and the area beneath the curve for Kanawati [MAC/HC] amounted to 0.57, for Rao [WT/HT [CM²] it represented 0.611, and for Dugdale [WT/HT [CM] it equalled 0.656. we found Dugdale's index showing the maximum area under curve in our study. An analogous study conducted by Katyal et al assessed the validity of nutritional indices among under-fives in the catchment area of a rural health and training centre at a teaching institute in Bareilly.[13] The total area under the curve for Rao's, Dugdale's, and Kanawati's was determined to be 0.687, 0.780, and 0.559, respectively.

The sensitivity of Kanawati, Rao's, and Dugdale's was 46.2%, 62.1%, and 62.1% respectively. The specificity was 67.9%, 60.1%, and 69% for Kanawati, Rao's, and Dugdale's index respectively found in present study. A similar study done by Gandra et al shows the sensitivity was 62.9%, 68.3%, and 85.7% for Kanawati index, Rao index, and Dugdale's index respectively result of this study corresponding to our study.[14] The specificity was 73.9%, 73.9%, and 86.9% for Kanawati index, Rao index, and Dugdale's index respectively.

Limitations

Limitations of the study were: shorter duration of study-period of study was only 12 months; in order to understand the temporal association and dynamics of malnutrition, a cohort prospective study was more appropriate; and result interpreted in this study based on sample data cannot be generalized for the whole geographical area due to diverse socio cultural and geographical parameters.

CONCLUSION

In our study we found the prevalence of underweight (50%) was higher than the wasting (39.7%) and stunting (40.7%) in under five children. In the present study we observed birth order and socioeconomic status has a significant (p value <0.05) effect on undernutrition. As the precise age might not always be accessible possibly due to data entry mistakes in recording the date of birth or parents providing an estimated age this can result in age-dependent criteria, such as weight for age, which, although questionable, is still regarded as highly effective in assessing the nutritional status of children. Consequently, various non-age-dependent measures have been explored. Among the available age-neutral standards for nutritional status, the Dugdale index is particularly notable, as it has shown higher accuracy, sensitivity (62.1), specificity (69%) and the highest area beneath (0.656) the curve when compared to other age-independent indices. It can be confidently stated that Dugdale is the most reliable index for the assessment of malnutrition, demonstrating the highest area under the curve and the greatest sensitivity and specificity. It can function as the most effective tool for screening the major public health issue of malnutrition in under five children.

However, due to limitation of this study, more extensive researches required before extrapolating this trend to general population.

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REFERENCES

1. Sharmila JMK, Umadevi R, Eashwar AVM. Prevalence and determinants of under-nutrition among children aged 5-10 years in an urban area of Kancheepuram district, Tamil Nadu. Int J Community Med Public Health. 2020;7:4449-55.
2. Elizabeth KE. Nutrition and child development. Paras Medical Publisher. Seventh Edition. 2024.
3. Mahantshetti S, Singh J, Dhandapani S. Updated Modified BG Prasad Classification for October 2023. Natl J Community Med. 2024;15(1):89-90.
4. World Health Organization. WHO Child growth Standards Length/height for age, weight for age, weight for length/weight methods and development. Available at: http://www.who.int/childgrowth/publications/tecnicalreportpub/en/indexhtml. Accessed on 28 February 2025.
5. Goyal M, Singh N, Kapoor R, et al. (February 13, 2023) Assessment of Nutritional Status of Under-Five Children in an Urban Area of South Delhi, India. Cureus 15(2): e34924. doi:10.7759/cureus.3492
6. Ministry of Health and Family Welfare. NFHS 5(2019–21) Fact sheet. Available at: https://rchiips.org/NFHS/pdf/NFHS5/India.pdf. Accessed on 28 February 2025.
7. Ministry of Health and Family Welfare. NFHS 5(2019–21) Fact sheet. https://rchiips.org/NFHS/pdf/NFHS5/westbengal.pdf. Accessed on 28 February 2025.
8. Murarkar S, Gothankar J, Doke P, Pore P, Lalwani S, Dhumale G, et al. Prevalence and determinants of undernutrition among under-five children residing in urban slums and rural area, Maharashtra, India: a community-based cross-sectional study. BMC Public Health. 2020;20(1):1559.
9. Ansuya, Nayak BS, Unnikrishnan B, George A, Shashidhara YN, Mundkur SC, et al. Risk factors for malnutrition among preschool children in rural Karnataka: a case-control study. BMC Public Health. 2018;18(1):283.
10. Naik PA, Zopf TE, Kakar DN, Singh M, Sandhu S. Primary school children in rural Punjab: Nutritional and anthropometric profile. Indian Pediatr. 1975;12:1083-95.
11. Mishra BK, Mishra S. Nutritional anthropometry and preschool child feeding practices in working mothers of central Orissa. Stud Home Comm Sci. 2007;1:139-44.
12. Raje V, Raje V, Punamia A, Kumar S, Patil S. Detection of undernutrition among preschool children. J Evol Med Dent Sci. 2013;2:9305-9.
13. Katyal R, Singh SP, Joshi HS, Joshi G, Singh A. An assessment of the validity of the nutritional indices among under-fives in the catchment area of rural health and training center of a teaching institute in Bareilly. J Family Med Prim Care. 2016;5(2):383-6.
14. Gandra NR, Masillamoni KJ. Assessment of nutritional status of children aged 34-92 months using various nutritional status indices and validity of age independent indices. Int J Contemp Pediatr. 2019;6(6):2593-7.

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