*Original Article*

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# A Comparative Study Based Grading of Malnutrition by WHO Z Score and IAP Classification

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**Abstract**

Serious malnutrition is all around us and yet it is not obvious, for it exhibits the Iceberg phenomenon". By Anthropometric assessment one can detect the sub-clinical malnutrition very easily. Anthropometric measurements obtained in children are usually compared with that of a "reference standard". In developing countries anthropometry despite its inherent limitations still remains the most practical tool for assessing the nutritional status of the children. Biological, epidemiological and statistical evidence suggests that wasting and stunting represent different processes of malnutrition. Low height-for-age (stunting) is a principal indicator of long term growth impairment caused by malnutrition in the past. The present study aims at comparing the prevalence of malnutrition in WHO Z Score classification and IAP classification. *Method:* About 400 children in the age group of 1-5 years were studied for their Anthropometric indices. The anthropometric measurements were performed using the standard WHO anthropometric measuring tools. Standardized methods were used in all measurements and were compared with standard HARVARD classification of IAP and WHO Z Score classification. *Result:* Overall prevalence of malnutrition was found to be 67.5% according to IAP. Among 67.5% malnourished children the prevalence of underweight was more in girls (51.8%) than boys (48.1%). According to WHO classification prevalence of malnutrition was 68.7% of which 27.5% had severe malnutrition. Among 68.7% of underweight children about 25.7% were found to be below -3SD. Among 59.2% of stunted children about 26.5% below -3SD were observed. Among 13.5% of wasted children about 2.6% below -3SD were observed. According to IAP criteria among underweight (67.5%), preschool children, Grade I were 55.9%, Grade II 23.7%, Grade III- 16.2% and Grade IV were 4.07%. *Conclusion*: In the current study it was observed that the Z Score system obtained the result with 1.2% precision as compared to that of IAP classification. Thus it can be concluded that Z Score system is more accurate in early diagnosis of malnutrition.

**Keywords:** Malnutrition; IAP; Anthropometric; Anemia.

## Introduction

Optimal nutrition during early childhood lays a strong foundation for growth and development as well as long term health.

In children normal growth and development are sings of good health and nutrition, one of the best ways to measure child's health is to measure growth. One of the easiest way to do so is to weigh child regularly and to note his body weight increment with age in comparison with standard weight to the healthy children of the same age. In general, the growing child requires a high calorie intake because of activity and abundant good quality protein and minerals because of their rapid growth.

Deficiency diseases occur when food is not provided in sufficient quality and quantity for growth and development. One means of judging adequacy of diet in childhood is the plotting of height against corresponding weight with reference to age. Such record also is helpful in the clinical evaluation of general health. Since childhood is the period of active growth a well-nourished child can be expected to have a growth pattern characterized by predictable increments in both height and weight. Physical growth has become a readily

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available standard to assess the nutritional status. Of all population groups affected by malnutrition, young children need the most attention.

To get a measure of malnutrition in a population, young children can be weighed and their height measured and the results compared to those of a reference population' known to have grown well. Measuring weight and height is the most common way of assessing malnutrition in populations [1]. One out of every three children under five in developing countries is malnourished [2]. This unacceptable state of affairs leads to a great deal of human suffering both physically and emotionally. It is major drain on developing countries prospect for development because malnourished children require more intense care from their parents and are less physically and intellectually productive as adult [2].

Growth faltering can be detected in child long before any observable signs or symptoms of malnutrition become evident. Growth monitoring can therefore enable early diagnosis of health problems to be made and corrective measure to be taken [3].

## Method and Material

The present study was a prospective study conducted for two years at Index medical college hospital and research centre between Jan 2016 to June 2017.

This study was undertaken with the aim of evaluating the nutritional status of malnourished pre-school children (1-5Years) in relation to anthropometric measurements using WHO Z Score classification and IAP Classification in comparison to each other.

About 400 children in the age group of 1-5 years were studied for their Anthropometric indices. All children aged 1-5 years attending indoor outdoor clinic at Index Hospital and of nearby areas of Index hospital were included in the study. Non consenting children diagnosed with congenital disorders, major illness and non consenting parents were excluded from the study. The anthropometric measurements were done to assess the nutritional status wherein age was the only criteria used. Age was recorded by interviewing the parents or by the birth record of the child. Growth pattern of children were worked out for boys and girls separately, in respect of different body measurements were compared with international and national standards.

*Methodology*

Complete nutritional status and clinical status has been assessed using the questionnaire and clinical examination. The anthropometric measurements were performed using the standard WHO anthropometric measuring tools. For Anthropometric measurement Electronic weighing machine, WHO recommended measuring tape and Infantometer / stadiometer were used.

The anthropometric datas in present study were compared with the National Growth Data and with the international NCHS standard data. Literacy status of mother were recorded. Nutritional status was graded according to Z-score classification and I.A.P classification. The reference standard used was National Centre of Health Statistics (NCHS) for Z score classification and Harvard Standard for I.A.P. classification. In this study Z-score were calculated for all three indices, weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting) by using NCHS reference standard.

*Reference Standards*

According to the NCHS/WHO standards Wasting, stunting, and underweight is defined as low weight for height, height for age and weight for age respectively. For reporting of these indices, Z-scores (standard deviation scores) are used. The Z-score or standard deviation unit (SD) is defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. This can be written in equation form as: Z-score (or SD-score) = (observed value) - (median reference value) Standard deviation of reference population 2.10 Cut-Offs.

Cut -off based prevalence for the indicators were used in this study. The use of cut-off enables the different individual measurements to be converted into prevalence statistics. The cut-off used in this study with Z-scores is minus two standard deviations. The cut-off points for WHO classification (Z-Scores) was adopted for this study. Broadly children are considered normal if the Z-Scores are above -2 and malnourished if Z-Scores below -2. Mid upper arm circumference cut-offs are somewhat arbitrary due to its lack of precision as a measure of malnutrition. A cut-off of 11.0 cm is used for severely malnourished children. Those children below 12.5 cm are classified as moderate and severe.

*Statistics*

The data generated from the study was entered into SPSS, Epi info software and anthroplus software. Assessment of the children s nutritional status was done using the Nutritional Anthropometry software (Epi Info 2002 system) from the division of Nutrition, CDC, Atlanta. Univariate, bivariate and multivariate analyses were done to infer from the study data and anthroplus software.

## Result

The prevalence of underweight and stunting was observed as very high in our study 67.5%, 59.2%, whereas prevalence of wasting was high according to criteria for assessing severity of under nutrition in a population proposed by grostein et al. (1994) and WHO criteria 1995.

In the present study it was observed that there is an increase in prevalence maximally in between 1-2 years both for underweight and wasting whereas for stunting it was found that highest prevalence

| Classification | Low (%) | Medium | High | Very High |
|---|---|---|---|---|
| Under weight | Less than 10 | 10-19 | 20-29 | >30 |
| Stunting | Less than 20 | 20-29 | 30-39 | >40 |
| Wasting | Less than 5 | 5-9 | 10-14 | >15 |

occurred in 2-4years of age group. The prevalence of underweight and wasting were higher in girls in comparison to boys (underweight- 52% stunting – 50.8%, wasting – 62.9% for girls and for boys underweight- 47.2% stunting – 49.1%, wasting - 29.6%). According to IAP classification it was observed that 67.5% of preschool children were underweight as per grading- Grade I – 55.9%, II – 23.7%, III – 16.2% and IV – 4.07% were recorded. Age wise prevalence of PEM showed that there was a gradual decrease with age this relationship was significant ($p< 0.05$).

## Discussion

In developing countries anthropometry despite its inherent limitations still remains the most practical tool for assessing the nutritional status of the children. Biological, epidemiological and statistical evidence suggests that wasting and stunting represent different processes of malnutrition. Low height-for-age (stunting) is a principal indicator of long term growth impairment caused by malnutrition in the past. Wasting indicates a deficit in tissues and fatness compared with the amount expected for a child of the same height or length and may result either from weight loss or failure to gain weight. Thus low weight fir height commonly used to assess acute or recent malnutrition. Low weight-for-age (underweight) is a combined index that reflects both height for-age and weight-for-age data. The following studies are in support of our observations.

Nutritional status of preschool children residing in Coimbatore slums was assessed using the z-score system of classification and compared the z-score with IAP classification [17]. Seetharamanand co-workers, 2007). A total of 625children were selected for the study, among those 31.40 per cent were normal, 68.60 per cent were in a state of anthropometric failure. As per the z score system, 49.60 per cent were underweight (21.70% severely), 48.40 per cent were stunted (20.30% severely) and 20.20 per cent were wasted (6.90% severely). Whereas, as per IAP criteria, 51.40 per cent were undernourished and 3.20 percent were severely undernourished.

Vijayashree Mathad (2011) assessed the nutritional status of under-five years of age as a cross sectional study conducted in Kakati-A sub-centre, under the Primary Health Centre at Vantamuri in Belgaum district. The sample size was 290. The prevalence of underweight, stunting and wasting was observed to be 26.55%, 31.38% and 7.59%, while severe degree of underweight, stunting and wasting was observed in 5.86%, 27.24% and 6.51%, respectively, in terms of World Health Organization (WHO) 2006 classification. According to the Indian Academy of Paediatrics (IAP)classification, the prevalence of Grade I malnutrition was 121 (47.10%), Grade II was 29 (10.00%), and Grade III and IV were 4 (1.40%).

Growth in the first year of life is particularly vulnerable to environmental stresses. There is usually delay in starting weaning and if started otherwise with improper feeding. This results in failure to thrive. During first 4-5 months of life the childs requirement are met adequately by breast milk. However after 5 months the breast milk is insufficient and weaning is delayed. This leads to energy deficit in the childs diet.

The prevalence of malnutrition were significantly higher among female children then male children. This observation is also comparable with observations reported by Kapil, U , Bali , P (1989) [4], Luwang WC (1980) [5], Kumar, Rajesh [6], Aggarwal & Iyengar (1996), and Yadav, RJ and Singh, P (1999) [7]. Child rearing for male children is more

careful than female children in our male dominated society. The preferential treatment and feeding of male children over female has been commonly observed in India.

This Table 2 shows prevalence of underweight was significantly higher in girls 52% than boys 47.9% ($p \leq 0.05$). The prevalence of wasting was higher in girls 50.8% as compared to boys 49.1%. $p \leq 0.001$ Prevalence of stunting was similar among boys and girls ($p \leq 0.05$)

This table 3 shows prevalence of malnutrition in different ages according to weight for height criteria. It was observed that the highest prevalence was found in age group of 1-2. This association was highly significant ($p \leq 0.001$).

This table 4 shows prevalence of malnutrition in different ages according to height for age criteria. It was observed that the highest prevalence was found in age group of 3-4 yrs. This association was highly significant ($p \leq 0.05$).

This table 5 shows prevalence of malnutrition in different ages according to weight for age criteria. It was observed that the highest prevalence was found in age group of 1-2. This association was highly significant ($p \leq 0.001$).

**Table 1:** Nutritional status of the Pre-school children according to three basic indices: Number of Subjects (%)

| Index | Normal | Grade I | Grade II | Total |
|---|---|---|---|---|
| Weight-for-age | 125 (31.2%) | 172 (43%) | 103 (25.7%) | 275 (68.7%) |
| Height-for-age | 164 (41%) | 130 (32.7%) | 106 (26.5%) | 236 (59.2%) |
| Weight-fir-height | 346 (86.5%) | 44 (10.9%) | 10 (2.6%) | 54 (13.5%) |

**Table 2:** Malnutrition Prevalence % in Pre-school children in Relation to Sex

| Index | Boys | | | Girls | | |
|---|---|---|---|---|---|---|
| | No. (%) | Grade I (%) | Grade II (%) | No. (%) | Grade I (%) | Grade II (%) |
| Weight for age | 132 (47.2%) | 82 (29.8%) | 50 (18.1%) | 143 (52.0%) | 75 (27.2%) | 68 (24.7%) |
| Height for age | 116 (49.1%) | 70 (29.6%) | 46 (19.7%) | 120 (50.8%) | 64 (27.1%) | 56 (23.7%) |
| Weight for Height | 20 (37.0%) | 16 (29.6%) | 04 (7.4%) | 64 (62.9%) | 28 (51.8%) | 06 (11.1%) |

**Table 3:** Malnutrition Prevalence % in Pre-school Children In Relation to Age using Weight for Height (Wasting) criteria

| Age in Years | Number | Grade I | Grade II |
|---|---|---|---|
| 1 – 2 | 116 | 11.2 | 5.12 |
| 2 – 3 | 128 | 10.9 | 1.56 |
| 3 – 4 | 72 | 11.11 | 1.38 |
| 4 – 5 | 84 | 10.71 | 1.19 |
| All Age | 400 | 11.0 | 2.5 |

**Table 4:** Malnutrition Prevalence % in Pre-school Children In Relation to Age using Height for age (Stunting) criteria

| Age in Years | Number | Grade I | Grade II |
|---|---|---|---|
| 1 – 2 | 116 | 30 | 24.5 |
| 2 – 3 | 128 | 32.2 | 23.1 |
| 3 – 4 | 72 | 42.8 | 30.4 |
| 4-5 | 84 | 32.2 | 28.9 |
| All age | 400 | 32.7 | 26.5 |

**Table 5:** Malnutrition Prevalence % in Pre-school Children In relation to age using Weight (Underweight)for age criteria

| Age In Years | Number | <-2SD Grade I | <-3SD Grade II |
|---|---|---|---|
| 1 – 2 | 116 | 50.0 % | 27.5 % |
| 2 – 3 | 128 | 38.2 % | 28.9 % |
| 3 – 4 | 72 | 41.6 % | 25.0 % |
| 4 – 5 | 84 | 22.6 % | 32.1 % |
| All Age group | 400 | 43.0 % | 25.7 % |

**Table 6:** Nutritional Status as according to IAP Classification

| Grades | No. of cases | Percentage in Malnourished cases (%) | Percentage in total |
|---|---|---|---|
| I | 151 | 55.9% | 37.7% |
| II | 64 | 23.7% | 16.0% |
| III | 44 | 16.2% | 11.0% |
| IV | 11 | 4.07% | 2.75% |

From the observation it was seen like grade 1 malnutrition was most prevalent followed by grade II , III and IV (Table 6).

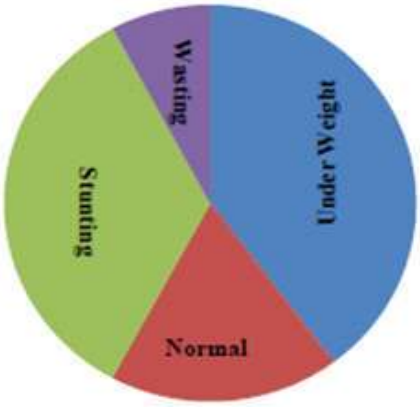


**Fig. 1:** Pie Chart showing malnutrition according to three basic indices (WHO)

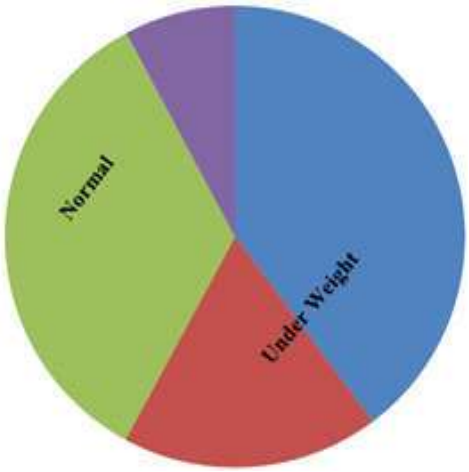


**Fig. 3:** Pie chart showing prevalence of malnutrition according to WHO

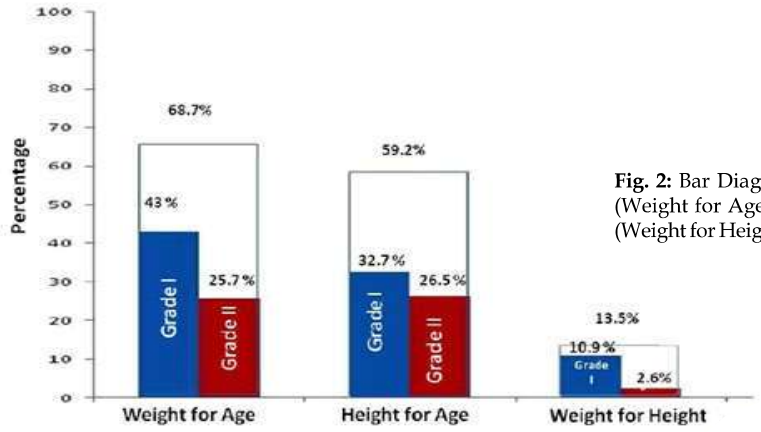


**Fig. 2:** Bar Diagram Showing Prevalence of Underweight (Weight for Age), Stunting (Height for Age) and Wasting (Weight for Height)

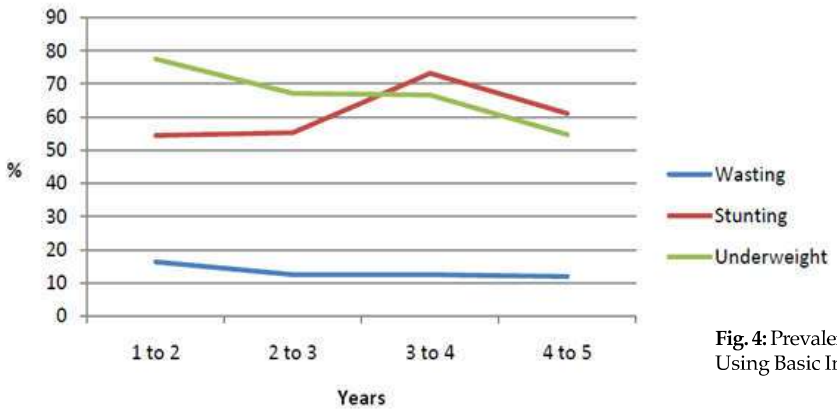


**Fig. 4:** Prevalence of Malnutrition In Different Age group Using Basic Indices Line Diagram

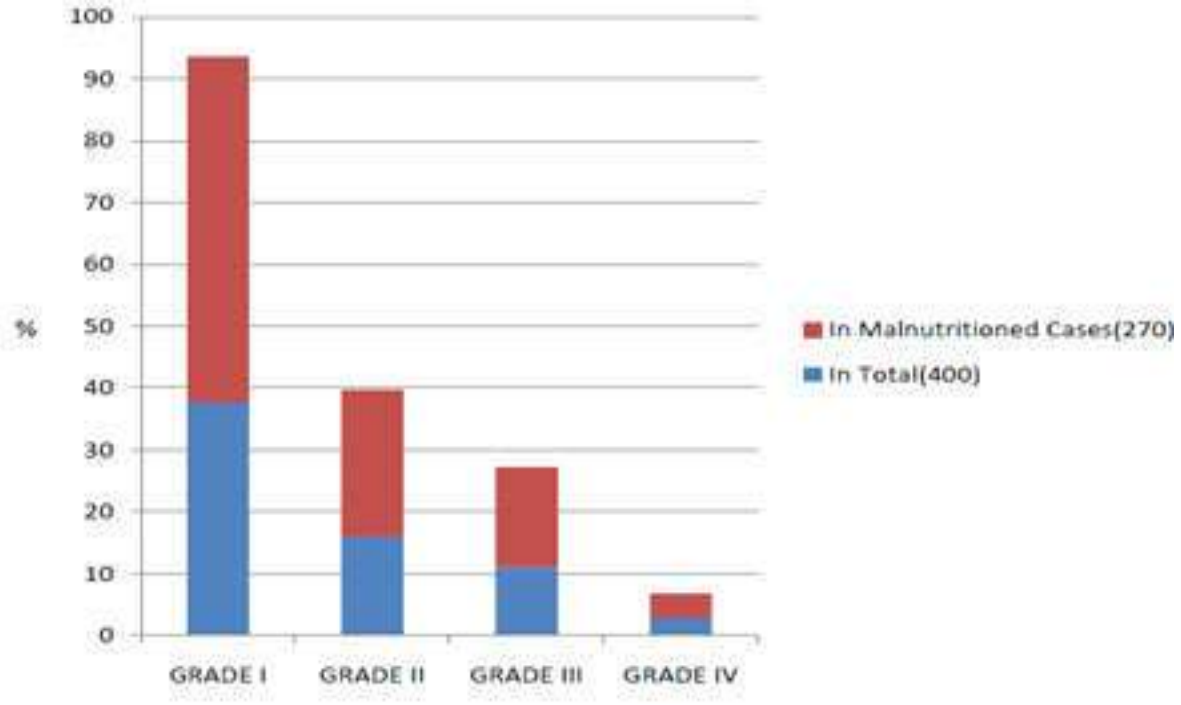


**Fig. 5:** Bar Diagram Showing Grading of Malnutrition (Using IAP Classification)

## Conclusion

To conclude, in the present study high prevalence of the under nutrition and its relation with age, sex among the under 5 children was documented significantly higher and much earlier by the WHO Z Score classification as compared to IAP Classification.

Changing the focus of nutrition from treatment to prevention will definitely take some time but this will provide more value for money spent. Efforts are needed to encourage the concept of preventive nutrition across population segments and not just 'high-risk' groups.

Pediatric healthcare is an apt segment to implement preventive nutrition behaviors because eating preferences are established early in life [8].

The present study is limited by its small sample size being only from one area of India. These results may therefore only be representative of a small community and not representative of the state or country.

The cost impact of measurements as effective screening measures would be phenomenal and this era of economic prudence such potential benefit warrants investment in research in this field.

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