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

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ABSTRACT

Context: Nutritional status is a sensitive indicator of community health and nutrition. There is a growing realization that adequate nutrition is a necessary first step in the improvement of quality of life. Malnutrition and infection are connected by a vicious cycle. It is one of the greatest international health problems and the biggest challenges being faced today. Thus, to know the magnitude of undernutrition among preschool children and to find out the sensitive tool for detection of undernutrition, this study was conducted among children under 5 years of age. Aims: To assess the validity of the nutritional indices for screening malnutrition. Settings and Designs: The study was a community-based, cross-sectional survey carried out in the catchment area of Rural Health Training Center, Rohilkhand Medical College, Bareilly. Subjects and Methods: Various anthropometric criteria like, Kanawati, McLaren, Rao, Dugdale and weight for age according to the Indian Academy of Pediatrics (IAP) (modified Gomez) classification were used to define nutritional status. Statistical Analysis Used: Data were entered and analyzed in SPSS and receiver operating characteristic (ROC) curves (sensitivity vs. 1 - specificity) were calculated for all the above mentioned indices. Results: Age dependent criteria such as IAP (48.2% malnourished) and McLaren (48.3% malnourished) were followed by the age independent criteria such as Kanawati (74.3% malnourished), Dugdale (45.5% malnourished), and Rao (33.1% malnourished) to classify the mild to moderate malnutrition. ROC showed Dugdala as the best index for the judgement of malnutrition showing maximum area under the curve. Conclusions: Malnutrition being a public health problem leads to morbidity which is a vicious cycle and needs proper attention to curb its detrimental effect on the children.

Keywords: Nutritional indices, rural health and training center, undernutrition

Introduction

Nutritional status of children is an indicator of nutritional problem of the entire community. The National Family Health Survey-III data projected that almost half of children under 5 years of age (48%) are stunted and 43% are underweight. The proportion of children who are severely undernourished is also notable: 24% are severely stunted and 16% are severely underweight. Wasting is quite a serious problem in India, affecting 20% of children under 5 years of age. Very few children under 5 years of age are overweight.[1] Another study conducted in a maternal and child health center, pointed out that 71.5% children were underweight as per weight for age, whereas 70.1% and 62.7% of children had deficit in height for age (stunting) and weight for height (wasting), respectively.[2]

Child undernutrition is internationally recognized as an important public health indicator, for monitoring nutritional status and

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health in populations. The devastating effects of undernutrition on human performance, health, and survival are well established today. A recent global analysis report demonstrated that child undernutrition is the leading cause of the global burden of disease. Undernutrition is an underlying factor in many diseases in both children and adults, and it contributes greatly to the disability-adjusted life years worldwide. It is particularly prevalent in developing countries, where it affects one out of every three preschool-age children.

This study is only a step toward the screening of undernutrition aiming to explore the most valid and reliable nutritional index as there are very few studies on validity of composite nutritional indices in this area.

**Subjects and Methods**

A comprehensive assessment of the nutritional status of the children was undertaken by taking the anthropometric measurements of children.

A cross-sectional study was carried out in a rural community named Rithora among the under-5 children for a period of 6 months. A list of villages in a defined geographical area was prepared. From this list, villages were randomly selected for the study. Data were collected by visiting every household selected through random sampling using a schedule. Children who were sick or had gone away temporarily were visited again.

Birth records maintained by Anganwadi workers were used to determine the age. In about 10% of the cases where records were not available, caretakers were interviewed to find out the age of the child. A “desi” calendar and local events calendar were used for facilitating age ascertainment. Age was computed in complete months. Children who were born before the middle of the month were counted in previous month while those who were born at or beyond middle of the month were counted in the next month.

Weight of the children was recorded on Salter spring balance to the nearest 50 g with minimal clothing. Length in <2-year-old children was measured by the infantometer and height in 2–5-year-olds by using anthropometry to the nearest 0.1 cm. Arm circumference was measured to the nearest 0.1 cm by fiber glass tape at mid-upper arm (mid-point between acromion and olecranon). Head circumference was measured by placing one end of tape on the glabella and placing it around the head over the opisthocranion point and again meeting at glabella. Chest circumference was measured at the level of nipple. Various anthropometric criteria such as Kanawati, McLaren, Rao, Dugdale, and weight for age according to the Indian Academy of Pediatrics (IAP) (modified Gomez) classification were used to define nutritional status.

Data were entered and analyzed in SPSS and receiver operating characteristic (ROC) curves (sensitivity vs. 1 - specificity) were calculated for all the abovementioned indices.

### Results

The various anthropometric indices were used to classify the mild, moderate, and severe malnourished children. About 23.6% of the children were mildly malnourished, whereas moderate malnourishment was found in 16.8%, and only 7.8% were severely malnourished as in Table 1 according to IAP classification [Table 1]. Similarly, according to McLaren index, 42% children were mild to moderate malnourished and only 6.3% were severely malnourished in [Table 2], i.e., 48.3% were stunted. 12.3% of the children were wasted according to weight for age [Table 3]. These above age dependent criteria were followed by the age independent criteria such as Kanawati, Dugdale, and Rao. Thereby, according to Dugdale index, it showed that 22.1% were severely malnourished and 23.4% were showing mild to moderate malnourishment while according to Kanawati, 43.2% showed mild malnourishment, 26.4% showed moderate malnourishment, and 6.5% were severely malnourished [Tables 4 and 5]. Similarly, according to Rao index, 27.1% showed mild to moderate malnourishment and 6.0% were severely malnourished [Table 6].

As far as the sensitivity and specificity of the nutritional indices is concerned, maximum sensitivity is achieved using as the Kanawati index followed by Dugdale, McLaren, Rao followed by weight for height, whereas maximum specificity is attained by the Rao, Dugdale, McLaren, Kanawati, and height for age which has least specificity [Table 7].

| Table 1: Grading of the under-5 children according to Indian Academy of Pediatrics (modified Gomez) classification |
|---------------------------------------------------------------|
| Indian Academy of Pediatrics (weight for age percentage) | Frequency | Percentage |
| <50 | 10 | 2.5 |
| 50-60 | 21 | 5.3 |
| 60-70 | 67 | 16.8 |
| 70-80 | 94 | 23.6 |
| >80 | 206 | 51.8 |
| Total | 398 | 100 |

| Table 2: Grading of the under-5 children according to McLaren index (stunting) |
|-----------------------------------------------------------------------------|
| McLaren (height for age percentage) | Frequency | Percentage |
| <80 | 25 | 6.3 |
| 80-90 | 167 | 42.0 |
| >90 | 206 | 51.8 |
| Total | 398 | 100.0 |

| Table 3: Grading of the under-5 children according to weight for height index (wasting) |
|-----------------------------------------------|
| Weight/height percentage | Frequency | Percentage |
| <80 | 49 | 12.3 |
| >80 | 349 | 87.7 |
| Total | 398 | 100.0 |
Gold standard for the ROC curve being IAP (modified Gomez) classification, the area under the curve for Rao, Dugdale, McLaren, Kanawati, weight for height are 0.687, 0.780, 0.709, 0.559, and 0.604, respectively, from which we can conclude that Dugdale is the best index for the judgement of malnutrition showing maximum area under the curve [Figure 1].

The correlation between the various indices taking IAP as the gold standard where correlation coefficient is 0.396, 0.409, 0.512, 0.129, and 0.312 for McLaren, Rao, Dugdale, Kanawati, and weight for height, respectively, and the P value being 0.000, 0.000, 0.010, 0.000, respectively, which is more than 0.01 showing its high significance.

The anthropometric measures for the classification of nutritional status are weight-for-age, height-for-age, optimal circumference (head and mid-upper arm circumference), etc. Of these, the most popular have been related to weight and height. Different researchers have employed either one or two of the indices, but rarely have all have been utilized.

It appears that incidence figures depend on the classification criteria employed. Of the three most popular measures, the highest incidence of malnutrition is obtained when weight-for-age is used. Naik et al. reported malnutrition figures of 81.6% among males and 78.9% among females in rural Punjab on the basis of weight-for-age. The lowest figures for malnutrition have been obtained when height-for-age was utilized as a criterion. For example, Naik et al. reported 50% and 44.9% malnutrition among males and females, respectively.

The prevalence of malnutrition in the indexed study according to 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 and stated the prevalence of malnutrition as 17%. In the study on detection of undernutrition among preschool children by Raje et al., 66.67% children were suffering from malnutrition according to Kanawati and McLaren index which was found to be 74.2% and 48.3% according to it, respectively, in our study. The same study stated that according to IAP and Rao index 42.59% and 41.67% children were malnourished, which is comparable with 48.2% and 33.1% found in our study.

**Table 4: Grading of the under-5 children according to Dugdale index**

| Dugdale | Frequency | Percentage |
|---------|-----------|------------|
| <0.79   | 88        | 22.1       |
| 0.79-0.88 | 93      | 23.4       |
| 0.88-0.97 | 114     | 28.6       |
| 0.97-1.1 | 72       | 18.1       |
| >1.15   | 31        | 7.8        |
| Total   | 398       | 100.0      |

**Table 5: Grading of the under-5 children according to Kanawati index**

| Kanawati | Frequency | Percentage |
|----------|-----------|------------|
| <0.25    | 26        | 6.5        |
| 0.25-0.279 | 98      | 24.6       |
| 0.28-0.31 | 172      | 43.2       |
| >0.32    | 102       | 25.6       |
| Total    | 398       | 100.0      |

**Table 6: Grading of the under-5 children according to Rao index**

| Rao      | Frequency | Percentage |
|----------|-----------|------------|
| <0.12    | 24        | 6.0        |
| 0.12-0.14 | 108     | 27.1       |
| >0.14    | 266       | 66.8       |
| Total    | 398       | 100.0      |

**Table 7: Validity of the nutritional indices for the detection of undernutrition**

| Indices    | Sensitivity (%) | Specificity (%) | Positive predictive value | Negative predictive value | $\chi^2$ | P     |
|------------|-----------------|-----------------|---------------------------|--------------------------|--------|------|
| Rao        | 51.7            | 85.8            | 77.2096                   | 65.62481                  | 0.483  | 0.000|
| Dugdale    | 70.8            | 85.2            | 81.6588                   | 75.82051                  | 3.256  | 0.71 |
| Kanawati   | 79.8            | 71.0            | 69.43493                  | 72.32304                  | 94.563 | 0.000|
| McLaren    | 70.8            | 71.0            | 69.43493                  | 72.32304                  | 226.131| 0.000|
| Weight/height | 21.3    | 99.4            | 97.06166                  | 57.57963                  | 0.492  | 0.483|

**Discussion**

The correlation between the various indices taking IAP as the gold standard where correlation coefficient is 0.396, 0.409, 0.512, 0.129, and 0.312 for McLaren, Rao, Dugdale, Kanawati, and weight for height, respectively, and the P value being 0.000, 0.000, 0.010, 0.000, respectively, which is more than 0.01 showing its high significance.

It can be very well concluded that Dugdale is the best index for the judgement of malnutrition showing maximum area under the curve and can serve as the best tool for screening the major public health problem of malnutrition.
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Conflicts of interest
There are no conflicts of interest.

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