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NUTRITIONAL ASSESSMENT USING COMPOSITE INDEX OF ANTHROPOMETRIC FAILURE (CIAF) AMONG SCHOOL-GOING CHILDREN IN J&K, INDIA

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Abstract ---Malnutrition continues to be the principal cause of ill-health and pre-mature mortality and morbidity among children in developing world. The present study is an attempt to assess the overall prevalence of undernutrition using composite index of anthropometric failure (CIAF) among school- going children of district Doda in Jammu & Kashmir. Three educational zones - Assar, Bhagwah & Doda - in the district were chosen purposively for collecting the data. A total of 360 school-going children (184 boys and 176 girls) aged 6-14 years were measured. The Composite Index of Anthropometric Failure (CIAF) based on three commonly used undernutrition indicators height for age (HAZ), body mass index for age (BMIAZ) and weight for age (WAZ) was used to evaluate the nutritional status of the children following WHO-2007 reference standard. Overall, it was found that for all ages (6 - 14 years) and sexes, the prevalence of stunting (low height for age), wasting (low BMI for age) and underweight (low weight for age) were 21.11 percent, 9.44 percent and 18.89 percent respectively. The odds of stunting (OR = 1.29; 95% CI:0.78-2.15), wasting (OR = 2.75; 95% CI:1.27-5.93) and underweight (OR = 2.49; 95% CI: 1.14-5.41) were higher among female children. Results further indicated that the overall CIAF for zone Bhagwah, Assar and Doda were reported as 67.5 percent 48.33 percent, and 33.33 percent respectively.

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Zone Bhagwah is at higher risk in terms of undernourishment as compared to zone Assar and Doda.

Keywords: nutritional status, stunting, wasting, under- weight, Composite Index of Anthropometric Failure (CIAF), school-going children, BMI

1 INTRODUCTION

Malnutrition among children is a major public health problem in India [1]. There are various factors that directly or indirectly affect the nutritional status of children. Birth size [2] women's education, maternal nutrition [3] [4], Low mothers' BMI (*BMI < 18.5*), anaemic mothers (*Hb < 12 g/dl*) [5] birth order, birth weight [6], maternal age, residence, antenatal care, child's sex, child's size at birth, toilet facility, child's stool disposal system [7] and the income level of households [8] are the main determinants of anthropometric failures among the children. Despite considerable progress, there remain challenges in addressing the problem of undernourishment [9]particularly among school-going children [10]. Nutritional status of school-going children has a paramount importance because the foundation for their lifetime health, strength and intellectual vitality is laid during this period. It is a dynamic period for determining their physical, mental as well as financial health throughout their life [11] and might be treated as a serious health problem [12].

There is no universally accepted definition of malnutrition. The World Health Organization (WHO) defines malnutrition as the cellular imbalance between the supply of nutrient and energy and the body's demand for them to ensure growth, maintenance, and specific functions. Malnutrition can be explained by an imbalance between nutrient intake and nutrient requirements over time [13]. It is the state of being poorly nourished, which can be caused by lack of one or more nutrients (e.g proteins, vitamins, fats) known as undernutrition, or an excess of nutrients identified as overnutrition. The medical dictionary defines undernutrition as a form of malnutrition resulting from a reduced supply of food or from an inability to digest, assimilate and use the necessary nutrients.

Malnutrition is a condition that results from eating a diet in which nutrients

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are either not enough or too much such that the diet causes health problems. It may involve calories, proteins, carbohydrates, vitamins or minerals. When the nutrients are deficient it is called undernutrition, while too many nutrients is called overnutrition [14].

According to United Nation Children's Fund [15] malnutrition is a broad term commonly used as an alternative to undernutrition but technically it also refers to overnutrition. People are malnourished if their diet does not provide adequate calories and protein for growth and maintenance or they are unable to fully utilize the food they eat due to illness (undernutrition). They are also malnourished if they consume too many calories (overnutrition). It is also defining malnutrition as disorders resulting from an inadequate diet or from failure to absorb or assimilate dietary elements.

During the 1950s and 1960s, kwashiorkor and protein deficiencies were seen as the major nutritional problems[16]. Kwashiorkor is a severe form of malnutrition, caused by a deficiency in dietary protein. The extreme lack of protein causes an osmotic imbalance in the gastrointestinal system causing swelling of the gut diagnosed as an edema or retention of water [17].

The concept of malnutrition used in the present study includes undernutrition, whose z-score is 2 standard deviations below the median weight (or height) of the median of the reference population. This type of malnutrition is more prevalent in developing countries like India.

Nutritional status is a major determinant of the health and well-being of children. Inadequate or unbalanced diets and chronic illness are associated with poor nutrition among children. A study by National Family Health Survey [NFHS] [18] calculates the prevalence of undernutrition in terms of three indices of nutritional status- weight-for-age (underweight), height-for-age (stunting) and weight-for-height (wasting) were based on anthropometric measurements. It estimated that in Jammu & Kashmir, 21.0 percent of children less than five years of age were underweight and 26.9 percent were stunted. The proportion of children who were severely undernourished was 9.70 percent according to weight for height (stunted). In addition, wasting was quite evident in Jammu & Kashmir, affecting 19.0 percent of children under five years of age.

Thus, undernutrition is a condition which hinder good health, caused by

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inadequate food intake and can be measured directly by measuring the amount of calories intake or indirectly - by measuring the indicators of adverse outcomes of low energy balance i.e., the symptoms and consequences that one should look for and what level or degree is their need for alarm.

2. Objectives of Study

The present study was carried out in district Doda of Jammu & Kashmir with the following objectives:

1) To know the prevalence of undernutrition among school going children of 6-14 years old in primary and middle schools of district Doda of Jammu & Kashmir.

2) To construct the composite index of anthropometric failure (CIAF) based on three – stunting, wasting and underweight - commonly used indicators of undernutrition.

3 Material & Methods

The purpose of the present study was to assess the nutritional status by using composite index of anthropometric failure (CIAF) of school going children in primary and middle schools in district Doda of Jammu and Kashmir:

a) Area under Study

The study was carried out in district Doda of Jammu & Kashmir, India. Out of 10 educational zones: three zones -i.e. Assar, Bhagwah and Doda were randomly chosen for the purpose of the present study.

b) Sample Size

A total of 360 school-going children between the age group of 6-14 years constituted the study subjects for the present study.

c) Questionnaire

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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The information regarding anthropometric characteristics of the children were attained through a pre-tested questionnaire.

d) ANTHROPOMETRIC MEASUREMENT

In the present study an Indirect Approach (Anthropometric Approach) was used to assess the nutritional status of the children. For measuring the height and weight of the children a stature meter (height measuring) tape and digital weighing machine were used. The z-scores system was used to classify stunting (low height for age), wasting (low BMI for age) and underweight (low weight foe age) following the internationally accepted cut-off points with reference to WHO 2007 standard. A child who is below minus two standard deviation (-2SD) from the median of a reference population in terms of height- for-age, BMI for age and weight for age was considered as stunted, wasted and underweight respectively.

e) STATISTICAL ANALYSIS

Data was analyzed using statistical software epi info 7 (available at www.cdc.gov). Z-scores system was used to measure the nutritional status of the children by using software

-WHO ANTHRO Plus (version v1.0.4) by comparing with WHO reference 2007.

4 COMPOSITE INDEX OF ANTHROPOMETRIC FAILURE (CIAF)

A development economist [19] argues that conventional indices i.e. stunting, wasting and underweight are not sufficient for measuring the overall prevalence of undernutrition among young children. These conventional indicators of malnutrition indicated different aspects of anthropometric failure. For example, [20] estimated that among children less than 5 years old in the world, the prevalence of stunting, wasting, and overweight was 23.8 percent, 7.5 per- cent and 6.1 percent respectively. By using these indices only, we failed to answer the question as how many undernourished children are there in the world population?

Svedberg suggests that if children with wasting, stunting and underweight are considered, or to be in a state of anthropometric failure' a new aggregate indicator is needed. The needed indicator must incorporate all

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undernourished children, be they wasted and/or stunted, and/or underweight. He proposes to construct a 'Composite Index of Anthropometric Failure' (CIAF). This Svedberg's model of Composite Index of Anthropometric Failure (CIAF) originally identifies six groups of children. These groups include children with height and weight appropriate for their age (No Failure) and also the children whose height and weight for their age are below the norm and are experiencing one or more type of anthropometric failure (Table 1.1).

Table 1.1 **Svedberg's Classification of Children with Anthropometric Failure**

Group Name	Description	Wasting	Stunting	Underweight
A	**No Failure** Children whose height and weight are above the age-specific norms (i.e. above -2 z scores) and do not suffer from any anthropometric failure	No	No	No
B	**Wasting Only** Children with acceptable weight and height for their age but who have subnormal weight for height	Yes	No	No
C	**Wasting and Underweight** Children with above norm heights but whose weight for age and weight for height are too low.	Yes	No	Yes
D	**Wasting, Stunting and Underweight** Children who suffer from anthropometric failure on all three measures.	Yes	Yes	Yes
E	**Stunting and Underweight** Children with low weight for age but who have acceptable weight, both for their age and for their short height.	No	Yes	Yes

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DOI 10.17605/OSF.IO/5XJVW

F	**Stunting Only** Children with low height for age but who have acceptable weight, both for their age and for their short height.	No	Yes	No
Y	**Underweight Only** Children with low weight for age but who have acceptable height, both for their age and for their short weight.	No	No	Yes

COMPOSITE INDEX OF ANTHROPOMETRIC FAILURE (CIAF) = B+C+D+E+F+Y

Source: Svedberg (2000) [19], Group Y (underweight only) was taken from Nandy et al. (2005) [21]

Therefore, the composite index of anthropometric failure (CIAF) is a better indicator of nutritional status than traditional measures of stunting, wasting and underweight because it determines overall anthropometric failure [22], [23]. The Composite Index of Anthropometric Failure (CIAF) is calculated as follows:

$$\boldsymbol{CIAF = B + C + D + E + F + Y}$$

Where,

CIAF = Composite Index of Anthropometric Failure, B =Wasting Only,

C =Wasting and Underweight,

D =Wasting, Stunting and Underweight,

E =Stunting and Underweight,

F =Stunting only and,

Y =Underweight only

5 RESULTS & DISCUSSION

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A total of 360 school-going children ((176 females and 184 males) participated in the present study were examined in district Doda of Jammu & Kashmir to know their nutritional status in terms of stunting, wasting and underweight for constructing the composite index of anthropometric failure (CIAF). The mean age was 9.13 years, with ages ranging from six to fourteen years and most with ages 8-10 years (66.66percent).

5.1 Nutritional Status of School- going Children by Gender (6-14 years)

Table 1.2 shows sex-wise prevalence of different levels of nutritional status with reference to WHO 2007 growth reference. Results indicated that the prevalence of stunting, wasting and underweight was found to be highest among females as compared to their male counterpart. Among males, 19.02 percent, 5.44 percent and 5.43 percent belonged to stunting, wasting and underweight respectively. On the other hand, among females, 23.30 percent belonged to stunted nutritional status, 13.64 percent wasted and 12.50 of the females were underweight. However, the results were found significant for wasting (χ^2 *= 7.0751, df =2, P= 0.007816*) and underweight (χ^2 *= 14.1832, df = 2, P = 0.000166*) and insignificant for stunting (χ^2 *= 0.9865, df = 2, P = 0.320591*). Overall, it was found that for all ages (6 - 14 years) and sexes, the prevalence of stunting (low height for age), wasting (low BMI for age) and underweight (low weight for age) were 21.11 percent, 9.44 percent and 18.89 percent respectively. In univariate analysis, the odds of stunting (*OR = 1.29; 95% CI:0.78-2.15*), wasting (*OR = 2.75; 95% CI:1.27-5.93*) and underweight *(OR = 2.49; 95% CI: 1.14-5.41*) were higher among female children.

Table 1.2. **Nutritional status among school-going children by gender**

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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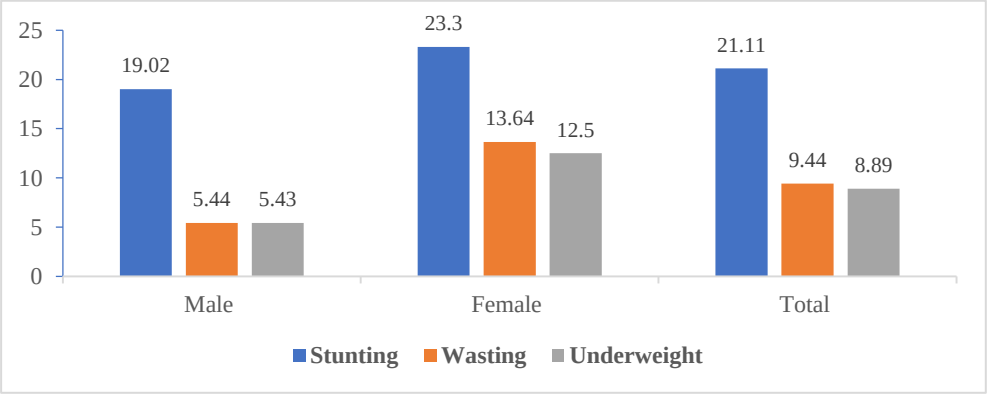
(6 – 14 years) (n = 360)

Nutritional Status	Male (n=184)	Female (n=176)	Total (n=360	Chi-Square (χ^2)	Odds (OR) (95%CI)	Ratio
Stunting (Height-for-Age)	35 (19.02)	41 (23.30)	76 (21.11)	χ^2 = 0.9865* P = 0.320591	1.29 2.15)	(0.78-
Wasting (BMI-for-Age)	10 (5.44)	24 (13.64)	34 (9.44)	χ^2 = 7.0751** P = 0.007816	2.75 5.93)	(1.27-
Underweight (Weight-for-Age)	10 (5.43)	22 (12.50)	32 (8.89)	χ^2 = 14.1832** P = 0.000166	2.49 5.41)	(1.14-

Source: Field Survey, Values in brackets are in percentages
*Not significant
** Significant at 95% level

Fig. 1.1 Prevalence of undernutrition by gender (6-14 years) (n=360)



The findings of the study are line with the study conducted in West Bengal,

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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Vol:54 Issue:08:2021
DOI 10.17605/OSF.IO/5XJVW

India [12], where it was found that girls are at higher risk of undernourishment as compare to their male counterpart and the nutritional status of school going children during early childhood was unsatisfactory [24].

1.5.2 Zone-wise Prevalence of Undernutrition in the present study

Data in Table 1.3 indicated that the prevalence of stunting was 19.17 percent, 28.33 percent and 15.83 percent in zone Assar, Bhagwah and Doda respectively. The prevalence of wasting was reported as 8.33 percent, 10.83 percent, and 9.17 percent respectively in zone Assar, Bhagwah and Doda. The corresponding figures for underweight were observed as 11.58 percent, 17.39 percent, and 5.32 percent respectively.

Table 1.3 **Nutritional status among school-going children by zones (6-14 Years) n=360)**

Nutritional Status	**Zone-Assar (n=120)**	**Zone-Bhagwah (n=120)**	**Zone-Doda (n=120)**	**Total (=360)**	**Chi-Square (χ^2)**
Stunting (Height-for-Age)	23 (19.17)	34 (28.33)	19 (15.83)	76 (21.11)	$\chi^2 = 6.0378$** P = 0.048855
Wasting (BMI-for-Age)	10 (8.33)	13 (10.83)	11 (9.17)	34 (9.44)	$\chi^2 = 0.4547$* P = 0.796638
Underweight (Weight-for-Age)	11 (9.17)	16 (13.33)	5 (4.17)	32 (8.89)	$\chi^2 = 6.2424$** P = 0.044105

Source: Field Survey, Values in brackets are in percentages
*Not significant
** Significant at 95% level

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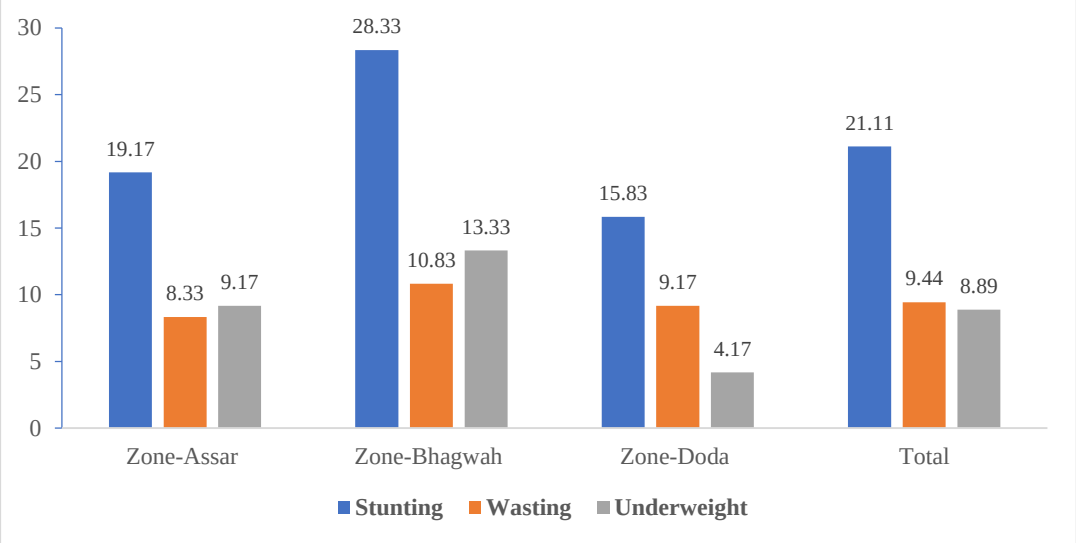
E-Publication: Online Open Access
Vol:54 Issue:08:2021
DOI 10.17605/OSF.IO/5XJVW

Fig. 1.2 Prevalence of undernutrition by zone (6-14 years) (n=360)



In all the three indicators i.e. stunting, wasting and underweight, zone Bhagwah is at higher risk of child malnutrition as compared to other two zones. The difference is significant for stunting ($\chi^2 = 6.0378$, $df = 2$, $P = 0.048855$) and underweight ($\chi^2 = 6.2424$, $df = 2$, $P = 0.044105$). The reason for this may be the existence of a low level of mean annual income of the family and low agricultural production in the zone. The data indicated that in zone Bhagwah a low level of mean family income was reported compared to Assar and Doda zones.

1.5.3 Composite Index of Anthropometric Failure (CIAF) in the present study

For the construction of Composite Index of Anthropometric Failure (CIAF), [19] originally suggested six subgroups (leveled as A, B, C, D, E, and F) of anthropometric failure. The seventh subgroup Y (underweight only) is adopted from [21]. In the present study, we used seven subgroups of anthropometric failure for the construction of Composite Index of Anthropometric Failure (CIAF).

Table 1.2 presents the prevalence of child undernutrition based on the

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different classification of CIAF, which enables us to interpret the conventional indices of child undernutrition in terms of overall prevalence. In Zone-Assar, it was found that, out of the seven sub-groups with undernourished children, group F (containing children who were stunted only) was the highest (19.17 percent), followed by group Y (underweight only) and group B (wasting only).

The overall CIAF for zone - Assar was reported as 48.33 percent which was lower than the overall prevalence CIAF (49.72 percent) in the study area. Zone-Doda reported a low prevalence of child undernutrition, as it was observed that the prevalence of undernourishment in group F, group B, and group Y was reported as 15.83 percent, 9.17 percent and 4.17 percent respectively. The CIAF for Doda was observed as low (33.33 percent) compared to Assar and Bhagwah. The reason may be that the mean family income of the zone was recorded as higher than other two zones. Data revealed that in Zone-Bhagwah, the prevalence of undernourishment among group F (stunting) was the highest (28.33 percent) followed by group Y (underweight only) and group B (wasting only). The overall CIAF was reported as 67.5 percent which remained highest among all the three zones - Assar, Bhagwah and Doda.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
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E-Publication: Online Open Access
Vol:54 Issue:08:2021
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Table 4. **Subgroups of anthropometric Failure among children aged 6 – 14 years**

Group Name	Description	Zone-Assar (n=120)		Zone-Bhagwah (n=120)		Zone-Doda (n=120)		Total (n=360)	
		No. of Children	%	No. of Children	%	No. of Children	%	No. of Children	%
A	**No Failure** Children whose height and weight are above the age-specific norms (i.e. above -2 z scores) and do not suffer from any anthropometric failure	62	51.67	39	32.50	80	66.67	181	50.28
B	**Wasting Only** Children with acceptable weight and height for their age but who have subnormal weight for height	10	8.33	13	10.83	11	9.17	34	9.44
C	**Wasting and Underweight** Children with above norm heights but whose weight for age and weight for height are too low.	5	4.17	3	2.50	2	1.67	10	2.78
D	**Wasting, Stunting and Underweight** Children who suffer from anthropometric failure on all three measures.	2	1.67	3	2.50	0	0.00	5	1.78
E	**Stunting and Underweight** Children with low weight for age but who have acceptable weight, both for their age and for their short height.	7	5.83	12	10.00	3	2.50	22	6.11
F	**Stunting Only** Children with low height for age but who have acceptable weight, both for their age and for their short height.	23	19.17	34	28.33	19	15.83	76	21.11
Y	**Underweight Only**	11	9.17	16	13.3	5	4.17	32	11.3

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Vol:54 Issue:08:2021
DOI 10.17605/OSF.IO/5XJVW

Children with acceptable height for their age but who have subnormal weight for age				3				9
CIAF = B+C+D+E+F+Y =	**58**	**48.33**	**81**	**67.5**	**40**	**33.33**	**179**	**49.72**

Source: Field Survey,

The reasons may be low mean annual household income, which was reported as Rs. 138916 as compared to Rs. 157750 and Rs. 199691 in Assar and Doda zones respectively. Besides lower mean income, zone Bhagwah is a dry belt having no irrigational facilities makes it difficult to grow fresh vegetables and other agricultural produce. Zone- Assar, which is famous for fresh vegetable production, helps the people to enhance their income levels on the one hand and on the other hand, they need not to buy the fresh vegetables from the market for most of the time in the year.
Therefore, it can be concluded that the composite index of anthropometric failure (CIAF) enables us to know the overall prevalence of undernourishment in a particular setup. After analysis we are able to say that Zone Bhagwah was at higher risk of child undernutrition as compared to zone Assar and Doda, where the mean difference in mean annual family income, difference in agricultural activities can be some of the reasons.

6 Conflicts of Interest

There is no conflict of interest.

7 Acknowledgement

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