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Composite Index of Anthropometric Failure among 2-5 years Anganwadi Children of Bilaspur, Chhattisgarh, India

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KEYWORDS

Undernutrition, Anganwadi, Nutritional status, Anthropometry, Children

ABSTRACT

Background: Nutritional status of children is of paramount interest of all health surveys world-wide. Anthropometry is an important parameter for assessing nutritional status of children of growing age. Severe and acute undernutrition can be easily assessed using anthropometry. Objective: To assess the nutritional status using Composite Index of Anthropometric Failure (CIAF) among 2-5 years of anagwadi children of Bilaspur, Chhattisgarh. Method: A cross-sectional study was conducted among 502 children (268 boys and 234 girls) aged 2-5 years from 30 anganwadi centers in Bilaspur District, Chhattisgarh. Data were collected after obtaining verbal consent from the parents of children prior to commencement of measurement. The statistically significant value was considered at P < 0.05.Results: The result shows that the Overall 42.30 % of the children (boys: 45.9%; girls: 41.5%) reported no anthropometric failure (Group A). And 56.17% shows anthropometric failure (Group B-Y). Similarly, more girls (58.5 %) than their counterpart (54.1 %) are undernourished. The sex combined mean difference in weight and height was observed statistically significant at (p< 0.001) level. Conclusions: The result shows that the children under study are in critical situation with respect to their nutritional status. And CIAF has capacity to improve the efficiency of the various ongoing nutritional intervention programs by identifying the single or double or multiple failure groups. Therefore, the CIAF for become essential to introducing the nutritional intervention program in the community based population.

Introduction

Children under the age of five are the most vulnerable and deprived section of the society (Dasgupta et al., 2014). In first two years of children, the rate of growth is much faster than the later age for height and weight both (Goswami, 2016). First 1000 days of life of children is very crucial and need sufficient nutrition and special attention for their proper growth and development (Titoria et al., 2019). There are many factors which are linked with anthropometric failure of under 5 years of children like, poverty, social, economical, political issues, inadequacy of proper food, breast feeding practices, colostrums is given or not, birth weight, vaccination, sanitation, lack of drinking water, de-worming, place of delivery, low maternal height, low maternal education and occupation of mother (Subramanian et al., 2009; UNICEF, 2012). Country-wise study reveals that anthropometric failure is more throughout low-to middle income countries (Finlay et al., 2011; Ponce et al., 2018). Globally 161 million under five years of children were found chronically undernourished (UNICEF, 2015). India has been reported the largest number of stunted and underweight children in the world (Anwar et al., 2013; Bharali,

2019). Though India's economic growth is remarkable in the past decade, but child malnutrition has been observed exclusively slow (Boregowda et al., 2015). In Bilaspur District, Chhattisgarh, 34.1% stunted, 26.8% wasted and 33.3% children were found underweight (NFHS, 2015-16). Chronic undernutrition affects the early stages of life of children, causes improper growth and development to their full potential, both mentally and physically (gupta et al., 2015). Nutritional problems are extensive in almost all state in India, but they are particularly widespread in Central and Eastern India like Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, and Orissa (Arnold, 2009). Overall in Chhattisgarh, 37.6% children below the five years are reported stunted; 23.1% are wasted (acute undernutrition); 37.7% are underweight (both acute and chronic undernutrition) and 3% children are overweight respectively (NFHS 4, 2015-16). It is necessary to identify the factors affecting children's appetite and anorexia. It is a kind of psychiatric illness of eating disorder which leads to an extremely low body weight relative to their height and body type (Morris and Twaddle, 2007). For better health of children many nutritional programme are running by government. Integrated Child Development Services (ICDS) programme has been implemented for over-all development of children, and its main aim is to reduce morbidity, malnutrition and mortality by providing supplementary food, immunization, psychological, physical and social development (Daral et al., 2017). This scheme benefits more than 8.4 crore preschool children throughout the country (Sahoo et al., 2016). ICDS is a globally recognized community based early child care programme which runs through huge network of Anganwadi workers and helpers in all Anagwadi centres (Manhas et al., 2012). With this brief background the main objective of the present study is to assess the nutritional status using composite index of anthropometric failure (CIAF) among 2-5 years of anganwadi children of Bilaspur, Chhattisgarh.

Composite Index of Anthropometric Failure (CIAF):

The Composite Index of Anthropometric Failure (CIAF) is a useful tool to identify the association between morbidity risk and malnutrition (Svedberg, 2000). For the first time Professor Peter Svedberg proposed CIAF in 2000 but this classification was further modified by Nandy et al., in 2005 because stunted children can be wasted or underweight; underweight children can be wasted or stunted and wasted children can be wasted or stunted. Another subgroup for those children who are only underweight but not stunted or wasted (group-Y) (Nandy et al., 2005). Total 7 (Group A-Y) groups of anthropometric failure were identified in the model. Group A represents those children who are not anthropometric failures, their height weight is appropriate for their particular age, where as Group B-Y shows the anthropometric children. Group B (wasting only), Group F (stunting only) and Group Y (Underweight only) shows single anthropometric failure, Group C (wasting and Underweight) and Group E (stunting and underweight) shows double anthropometric failure and Group D (wasting, stunting and Underweight) shows multiple anthropometric failures (Nandy et al., 2005). Svedberg argued that children experiencing multiple anthropometric failures would be at greatest risk of ill health (Nandy and Svedberg, 2012).

Materials and Methods

A cross-sectional study was conducted among 502 sample size (268 boys and 234 girls) from 30 Anganwadi Centers in Bilaspur District, Chhattisgarh. The age of the children ranges from 2-5 years and were recorded from birth certificate provided by Primary Health Centre (PHC). Information was collected on anthropometric measurement, socioeconomic, demographic and biological factors. Data were collected with verbal permission from the parents of children and necessary approval from the anganwadi centers, village authorities. Parents were informed about the aims of the study. Interview schedule was opted for collecting data.

Measures of under nutrition

The following are the commonly used indicators of undernutrition that are based on anthropometric data:

- Underweight: Weight for Age < –2 standard deviations (SD) of the Standards median in the reference population. Severe underweight is considered if WAZ is < -3 (WHO, 2010).
- Stunting: Height for Age < –2 SD of the WHO Child Growth Standards median in the reference population. Severe stunting is considered if HAZ is < -3 (WHO, 2010).
- Wasting: Weight for Height < –2 SD of the Standards median in the reference population. Severe wasting is considered if WHZ is < -3 (WHO, 2010).
- Composite Index Anthropometric Failure (CIAF) : The CIAF aggregating the children suffering from single, double and multiple failures. There total 7 groups, Group A shows No Anthropometric failures where as Group B-Y shows different anthropometric failures (Nandy et al., 2005)

Statistical analysis

All statistical analyzes were done using the Statistical Packages for Social Sciences- 21 (IBM SPSS Statistics). Descriptive analysis was done to calculate frequency, mean and standard deviation. Figures and graph were prepared in Excel sheet. ANOVA and Chi-square were used to see the significant difference. The statistically significant value was considered at $p< 0.05$. Nandy et al., (2005) classification of Composite Index of Anthropometric Failure (CIAF) were adopted.

Formula to calculate z-score

$z = (x - \mu) / (\sigma / \sqrt{n})$

Where, z = z-score

x & μ = sample mean, n & σ = Standard deviation

For measuring prevalence of malnutrition in children, CIAF was followed. According to CIAF classification children can be divided into following seven groups:

Group	Variable	Wasting	Stunting	Underweight
A	No Failure	No	No	No
B	Wasting only	Yes	No	No
C	Wasting and underweight	Yes	No	Yes
D	Wasting, stunting and underweight	Yes	Yes	Yes
E	Stunting and underweight	No	Yes	Yes
F	Stunting only	No	Yes	No
Y	Underweight only	No	No	yes

Source: Nandy et al., 2005

Result

Table 1: Age and Sex composition of the studied preschool children

Age (years)	Boys n (%)	Girls n (%)	Total n (%)
2	38 (14.2)	27 (11.5)	65 (12.9)
3	67 (25.0)	78 (33.3)	145 (28.9)
4	83 (31.0)	59 (25.2)	142 (28.3)
5	80 (29.9)	70 (29.9)	150 (29.9)
Total	268 (100)	234 (100)	502 (100)

Table 1 shows overall combined age and sex composition of the studied children. Out of 502 children boys constitute 268 (53.3%) and girls constitute 234(46.6%) respectively. The highest frequency of children 150 (29.9%) were found in the age group of 5 years and the lowest frequency of children were found in the age group of 65 (12.9%) respectively.

Table 2: Mean and standard deviation of weight, height and BMI of studied children

Age in Years	Sex (n)	Body weight (kg)		Height (cm)		BMI (kg/m2)	
		Mean	SD	Mean	SD	Mean	SD
2	Boys (38)	11.58	2.42	86.90	8.27	15.49	3.37
	Girls (27)	9.60	1.09	82.89	9.14	14.49	2.49
3	Boys (67)	12.04	2.04	90.99	7.38	14.59	2.11
	Girls (78)	11.61	1.78	89.62	7.40	14.51	1.88
4	Boys (83)	14.03	2.27	97.09	8.05	14.91	1.96
	Girls (59)	12.51	1.65	95.08	6.39	13.90	1.75
5	Boys (80)	15.75	2.90	101.79	7.21	15.17	2.10
	Girls (70)	14.13	2.35	100.43	7.97	14.13	3.01
Total	Boys (268)	13.70	2.92	95.50	9.29	14.99	2.29
	Girls (234)	12.36	2.35	93.45	9.46	14.24	2.32
F		71.898		86.886		1.033	
P		0.000		0.000		0.378	

Where; F= ANOVA, p = Significance level

Table 2 show the age and sex composition of the studied children. Out of 502 children, boys comprised (53.3%) and girls constitute (46.6%) respectively. Table also shows overall mean and standard deviation of weight of boys and girls are 13.70 kg (2.92 kg) and 12.36 kg (3.04 kg) respectively. Moreover, after combining all ages, the mean body mass index (BMI) of boys (14.99 kg/m^2, ± 2.29) is slightly higher than girls (14.24 kg/m^2, ± 2.32). This table clearly shows that there is significant age difference for mean height ($p<0.001$) and weight ($p<0.001$), except for BMI.

Table 3: Prevalence of Composite Index Anthropometric Failure among studied children

Age (in years) à	Sex	2 (n=65)		3 (n=145)		4 (n=142)		5 (n=150)		TOTAL (n=502)		Overall Sex difference
Group(CIAF) â		n	%	n	%	n	%	n	%	n	%	
A	Boys	18	47.4	25	37.3	41	49.4	39	48.8	123	45.9	X2=11.895, df=6, 0.064
	Girls	14	51.9	36	46.2	20	33.9	27	38.6	97	41.5	
B	Boys	8	21.1	6	9.0	4	4.8	5	6.3	23	8.6	
	Girls	2	7.4	8	10.3	4	6.8	4	5.7	18	7.7	
C	Boys	0	0	5	7.5	4	4.8	3	3.8	12	4.5	
	Girls	2	7.4	8	10.3	2	3.4	5	7.1	17	7.3	
D	Boys	2	5.3	2	3.0	2	2.4	1	1.3	7	2.6	
	Girls	1	3.7	1	1.3	4	6.8	8	11.4	14	6.0	
E	Boys	2	5.3	19	28.4	13	15.7	19	23.8	53	19.8	
	Girls	6	22.2	21	26.9	18	30.5	14	20.0	59	25.2	
F	Boys	6	15.8	7	10.4	15	18.1	11	13.8	39	14..6	
	Girls	2	7.4	4	5.1	7	11.9	6	8.6	19	8.1	
Y	Boys	2	5.3	3	4.5	4	4.8	2	2.5	11	4.1	
	Girls	0	0	0	0	4	6.8	6	8.6	10	4.3	
CIAF(B-Y)	Boys	20	52.6	42	62.7	42	50.6	41	51.3	145	54.1	
	Girls	13	48.1	4	53.8	39	66.1	43	61.4	137	58.5	

**Chi-square analysis: p<0.05*

Table 3 depicts that an overall of 42.30% of the children (boys: 45.9%; girls: 41.5%) have no anthropometric failure (Group A). On the other hand 56.17 % (overall) are suffering from CIAF (Group B-Y) (boys: 54.1% and girls: 58.5%). It has been further observed that the girls were more affected in sex-specific undernutrition in different CIAF categories (i.e. Groups C, D, E and Y) than boys, except in Group B and F. The overall sex difference in CIAF categories were observed statistically non-significant (x^2=11.895; df = 6, p< 0.064).

Table 4: Sex specific nutritional status (Stunting, underweight, wasting and CIAF) among the studied children

Age (in years) →	Sex	2 (n=65)		3 (n=145)		4 (n=142)		5 (n=150)		TOTAL (n=502)	
Nutritional status (category) ↓		n	%	n	%	n	%	n	%	n	%
Stunted	Boys	10	26.3	27	40.3	32	38.5	31	38.8	100	37.3
	Girls	09	33.3	27	34.6	29	49.1	27	38.6	92	39.3
Underweight	Boys	6	15.8	29	43.3	24	28.9	25	31.2	64	31.3
	Girls	10	37.0	31	39.8	28	47.4	33	47.1	102	43.5
Wasted	Boys	11	29.9	15	22.3	12	14.4	09	11.2	47	17.5
	Girls	05	18.5	17	21.7	12	20.3	17	24.3	51	21.7
CIAF	Boys	20	52.6	42	62.7	42	50.6	41	51.3	145	54.1
	Girls	13	48.1	42	53.8	39	66.1	43	61.4	137	58.5

Table 4: depicts shows that 54.1% boys and 58.5% girls are suffering from single, double and multiple failures. The prevalence CIAF is found highest among Girls (58.5 %); stunted (39.3 %); underweight (43.5 %) and wasted (21.7%) than boys, CIAF: (54.1 %); stunted (37.3 %); underweight (31.3 %) and wasted (17.5 %) respectively.

Table 5: Nutritional status (Stunting, underweight, wasting and CIAF) among the studied children

Age (in years) →	2 (n=65)		3 (n=145)		4 (n=142)		5 (n=150)		TOTAL (n=502)	
Nutritional status(category) ↓	n	%	n	%	n	%	n	%	n	%
Stunting	19	29.23	54	37.24	61	42.95	58	38.70	192	38.24
Underweight	16	24.16	60	41.37	52	36.61	58	38.70	186	37.05
Wasting	16	24.60	32	22.06	24	16.90	26	17.33	98	19.52
CIAF	33	50.70	84	57.93	81	57.04	84	56.0	282	56.17

Table 5 shows the sex combined prevalence of nutritional status of studied children. Overall (56.1 %) children were identified with CIAF (Group B-Y). Prevalence of stunting is highest (38.24%) followed by underweight (37.05%) and wasted (19.52%) among studied children. The prevalence of stunting, underweight, wasting and CIAF were found highest at the age of 4 years, 3 years, 2 years and 3 years respectively.

Table 6: Association between socio-demographic characteristics and anthropometric failure among studied children

Sl. No.	Socio-demographic characteristics	Total	Anthropometric Failure (CIAF)		Chi-square (χ^2)
			Present N (%)	Absent N (%)	
	Exclusively breast feeding	Yes = 460	255 (55.4)	205 (44.5)	1.225, df=1; 0.268
		No = 42	27 (57.1)	15 (35.7)	
	Colostrums	Yes = 432	242 (56.0)	190 (43.9)	0.031, df=1; 0.860
		No = 70	40 (57.1)	30 (42.8)	
	De-worming	Yes = 382	217 (56.8)	165 (43.1)	0.258, df=1; 0.611
		No = 120	65 (54.1)	55 (45.8)	
	Delivery Place	Home = 288	165 (57.2)	123 (42.7)	0.020, df=1; 0.886
		Hospital = 214	121 (56.5)	83 (38.7)	
	Delivery Type	Normal = 447	252 (56.3)	195 (43.6)	2.072, df=3; 0.558
		Caesarean= 56	32 (57.1)	24 (42.8)	
	Sanitation	Open = 285	154 (54.0)	131 (45.9)	0.045, df=1; 0.817
		Close = 217	115 (52.9)	102 (41.0)	
	Gestational age	Preterm = 17	10 (58.8)	7 (41.1)	2.446, df=2; 0.294
		Term = 365	212 (58.0)	153 (41.9)	
		Post Term=120	60 (50.0)	60 (50.0)	
	Birth weight	Low Birth weight (LBW)= 94	55 (58.5)	39 (41.4)	0.256, df=1; 0.613
		Normal birth weight = 408	227 (55.6)	181 (44.3)	

	Education status of Mother	Illiterate = 167	98 (58.6)	69 (41.3)	2.234, df=4 ; 0.693
		Primary = 137	76 (55.4)	61 (44.5)	
		Secondary = 96	55 (57.2)	41 (42.7)	
		Higher Sec.= 51	24 (47.0)	27 (52.9)	
		Undergraduate = 51	29 (56.8)	22 (43.1)	
	Occupation status of Mother	Housewife = 135	78 (57.7)	57 (42.2)	4.134, df=4; 0.388
		Wage labor = 262	146 (55.7)	116 (44.2)	
		Cultivation = 85	51 (60.0)	34 (40.0)	
		Service = 19	8 (42.1)	11 (57.8)	

Table 6 shows that, exclusively breast feeding, colostrums intake, delivery place, delivery type, sanitation, gestational age, birth weight, education of mother has positive effect on the presence of anthropometric failure among the studied children. Similarly, de-worming and occupation of mother has a negative effect on anthropometric failure among them. But the difference is not significant for any variables used.

Discussion

The CIAF helps to decide the actual proportions and to find out the relative risk of undernourishment in various disaggregated sub-groups (Groups B–Y) (Solanki et al., 2014). Chronic undernutrition is linked to slower cognitive development and serious health issues later in life that decreases the living standard, education, labor efficiency, and also the economic productivity of people of a country (Dhone et al., 2012; Kumar 2015).

Figure 1 shows the comparison of present study with other nation studies. It shows that the prevalence of CIAF of present study is found lower than six reported studies: National average (Nandy *et al* 2005), Purulia West Bengal (Das & Bose, 2009), Bankura West Bengal (Mukhopadhyay & Biswas 2010), Raipur Chhattisgarh (Boregowda *et al* 2015), Tirki Khurd, Delhi (Gupta *et al* 2017), North West Delhi (Titoria *et al* 2019) and found higher than Singur, West Bengal (Dasgupta *et al* 2014), Kolkata, West Bengal (Dasgupta *et al* 2015), Ballbgarh, Haryana (Gupta *et al* 2015), Odisha (Goswami M., 2016), Banglore (Keri *et al* 2016), Sonowal Kachari, Assam (Bharali *et al* 2019), North Kolkata (Lahiri and Lahiri 2020). It has been observed that the girls were more affected (Groups C, D, E and Y) than boys, except for Group B and Group F. Overall 56.17% (Group B-Y) children are suffering from anthropometric failures. It is essential to know the socioeconomic conditions and food consumption patterns and nutritional status due to which malnutrition has become the major issue.

Figure 2 (a) and (b) shows the comparison of mean height (cm) of present studied boys and girls with national and international references. It shows that the mean height of the present study boys and girls were lower than other standards (CDC 2000 & WHO 2006) except for the values of ICMR (2010). The mean height of the present study is slightly higher than the ICMR standards from the age of 2 to 4 years for both boys and girls but at the age of 5 years for boys and girls both the mean height is almost similar to the ICMR standards. Among both boys and girls the height is increasing with their age.

Figure 3 (a) and (b) shows the comparison of mean weight (kg) of present studied boys and girls with national and international references. Mean weight of both boys and girls (present study) were observed

lower than all reference standards (CDC 2000 and WHO 2006) except for ICMR (2010). Mean weight for both boys and girls is slightly above than ICMR values but at the age of 3 years of boys the mean weight is almost same to the ICMR value and in case of girls at the age of 3 and 5 years the mean weight is almost same as ICMR standards. Overall increasing rate of boys weight is higher than the increasing rate of girls weight,

Figure 4 (a) and (b) shows the comparative chart of mean BMI (kg/m^2) of both boys and girls with national and international references. For boys at the age of 2 and 3 years the mean BMI is less than the other standards but from the age of 4 to 5 years mean BMI has been increased above the ICMR standards. In case of girls the mean BMI is found lower than the all other standards.

Conclusion

The extent of undernutrition can't be expressed by simple conventional indicators of child undernutrition. It requires combined measure of nutritional assessment method, that better reflect the incidence then mere single method. Employing of CIAF will help in assessment of both severe and acute cases of undernutrition and it also facilitate in examine the trend of growth of the children suffering from different extent of anthropometric failure. Overall 56.17% (boys: 54.1% and girls: 58.5%) children were suffering with anthropometric failure (Group B-Y) that shows the serious and critical situation. The present study shows that the nutritional status of children is not satisfactory and they need special attention. The CIAF has potential to improve the quality and outcome of the various ongoing nutritional intervention programs by identifying the single or double or multiple failure groups. Therefore, the CIAF become important for introducing the nutritional intervention program in the community based population.

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Figures

Figure 1: Comparison of present study with other similar studies using CIAF

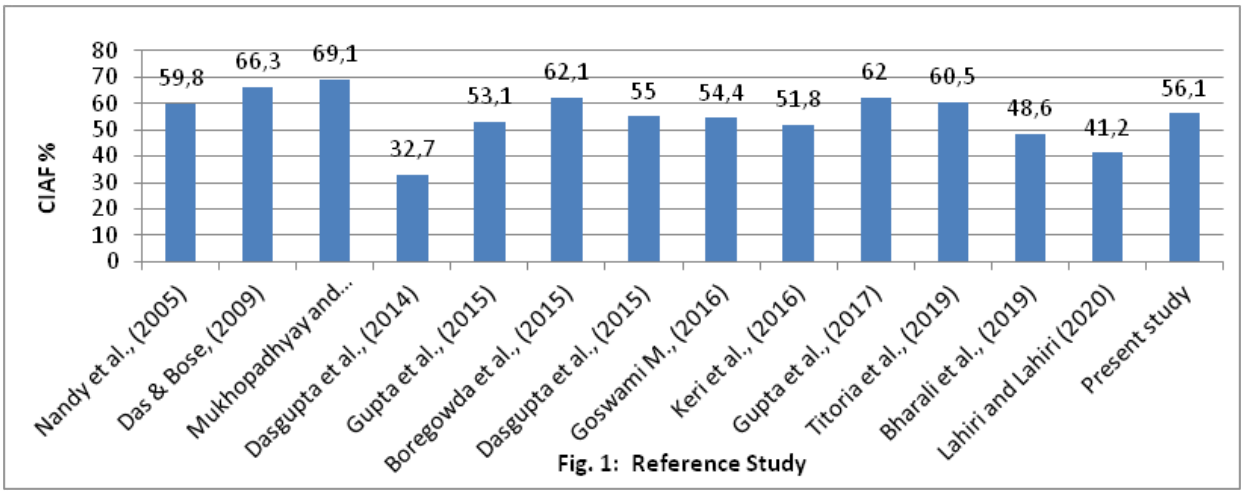
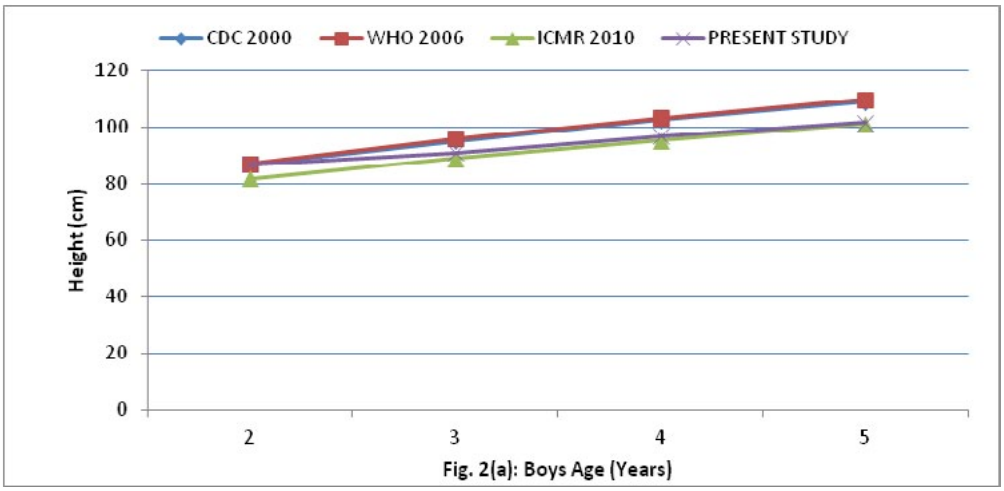


Figure 2 (a & b): Comparison of mean height (cm) of present studied boys and girls with National and International references.



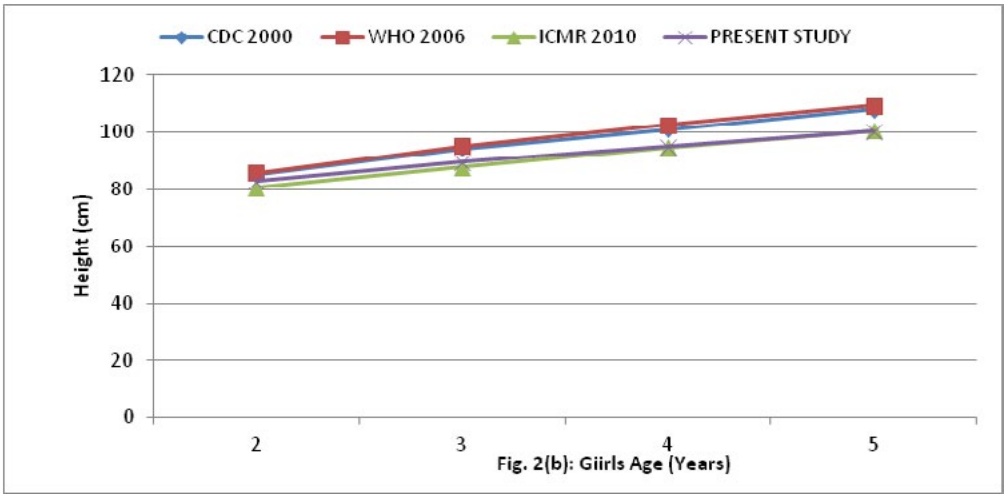
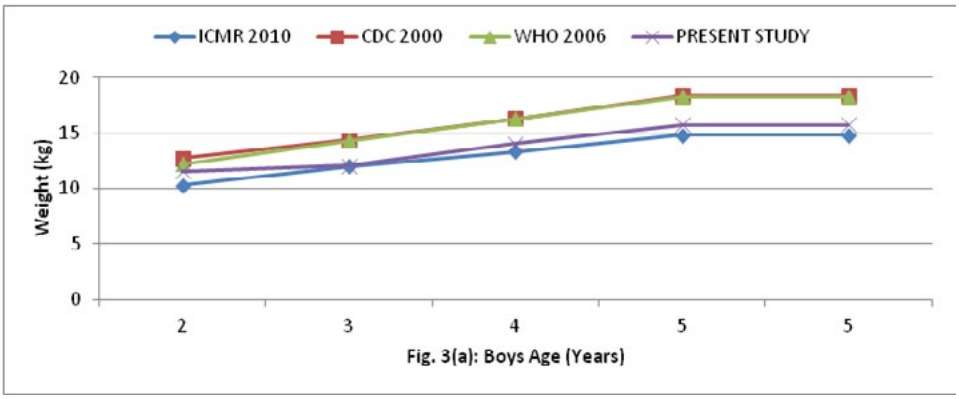


Figure 3 (a & b): Comparison of -mean weight (kg) of present studied boys and girls with National and International references.



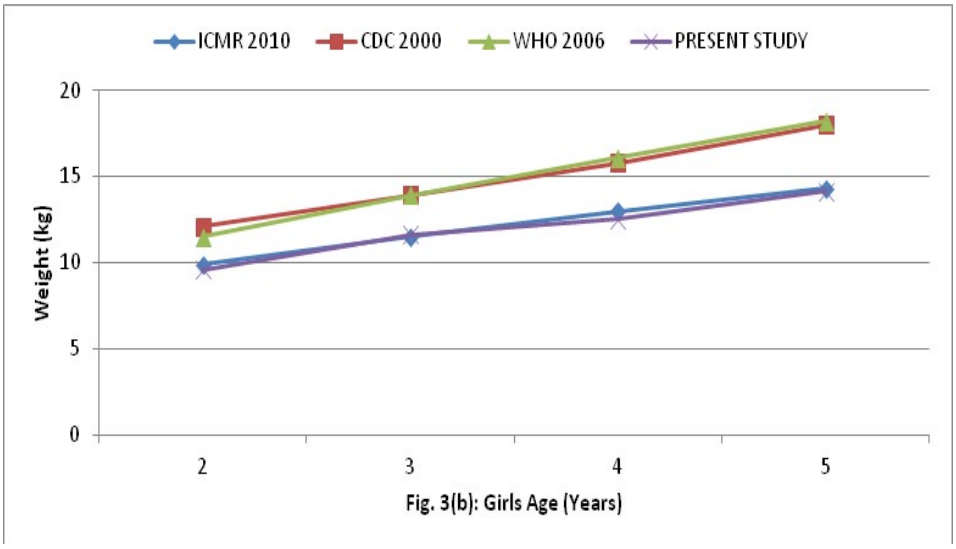


Figure 4 (a & b): Comparison of mean BMI (kg/m2) of present studied boys and girls with National and International references.