Mid-Arm Circumference and Triceps Skin-Fold Thickness in Rural School Children

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Research Article

Abstract: The cross sectional study was carried out to study mid-arm circumference and triceps skin-fold thickness in rural school children of 5–13 years of age. Study was carried out at schools of Sangli district in Maharashtra, India. A total of 910 rural school children (500 boys and 410 girls) were taken for study. Girls had higher values of mid-arm circumference and triceps skin-fold thickness than those of boys of rural schools. There was no fixed Indian standard for mid-arm circumference, so the values in present study were compared with other worker's study who had conducted their study significantly in well-nourished and affluent school children who did not have any constraints on growth imposed either by malnutrition or infection. Rural school children were found to have lower values of mid-arm circumference and triceps skin-fold thickness than well-fed, affluent school children and this might be attributed to better socio-economic status in the latter.

Key words: Mid-arm circumference, School children, Socio-economic status, Triceps skin-fold thickness.

Introduction

The physical growth occurs with a similar pattern but the rate may not necessarily follow a strict chronological correlation. The genetic endowment has an important role to fashion the pattern of growth in an individual which makes her/him distinct from each other. However, environment has an equally important influence which expresses itself as individual differences[1]. Genetic factors set a ceiling on growth, but become effective only when nutritional and other factors have reached an optimum level[2]. Mid-arm circumference provides overall information regarding the status of muscle development. Poor muscle development or muscle wasting are cardinal features of all form of protein calorie malnutrition, especially those of early children. This region is easily accessible, even with a young child sitting in front of the examiner on his mother's lap [3]. Skin-fold thickness measurement acts as a useful indicator of body fat and hence of calorie reserves [4,5]. The distribution of fat varies considerably with age in both sexes throughout life and girls have greater skin- folds than boys from birth onwards[3]. Bhandari et al[6], Phadake M.V.[7], and Indira Bai K et al[8] have studied the anthropometry in rural school children and showed that physical parameters in rural children were at lower level than other Indian and western standards. With this in mind, a study was undertaken to compare mid-arm circumference and triceps skin-fold thickness in rural school children of 5–13 years of age in Sangli district of Maharashtra, India with the studies conducted by different workers.

Materials

A cross-sectional study was conducted in healthy school children from the rural areas of Sangli district. This study included the children in the age group between 5 to 13 years. A total of 910 school children (500 boys and 410 girls) from rural areas of Sangli district were taken for study. A special proforma was prepared to register name, age, sex and socioeconomic status of children. Rural school children studied were from free government schools. Detailed physical examination was carried out and only healthy children were selected for study. Appropriate ethical permission for human studies was obtained from the concerned authority before commencement of this study.

Methods

The study was conducted in school premises itself in a room provided by school authorities. Age was recorded by noting the date of birth in the school register. The measurements such as mid-arm circumference and triceps skin-fold thickness were taken by standard methods as reported by Jelliffe D.B.[3]. Mid-arm circumference: The left arm was measured, while hanging freely, at its midpoint (i.e. between the tip of acromian process of the scapula and the olecranon process of the ulna) with the help of fiber tape. The tape was applied gently, but firmly, around the limb to avoid the compression of the soft tissues. It was measured to the nearest 0.1 cm. Triceps skin-fold thickness: Here, left arm, at the midpoint between the tip of the acromion process of the scapula and the olecranon process of the ulna was the site selected for the measurement of triceps skin-fold thickness. The measurement was made with the arm hanging relaxed at the side. The skin-fold over the triceps parallel to the long axis was picked between the thumb

and forefinger of the left hand, clean away from the underlying muscle and measured at this point with the help of 'UNA' skin-fold thickness caliper. The reading was taken to the nearest 1 mm. The caliper had a standard contact surface or the pinch area of 30 sq.mm and maintained a constant pressure of 10 gm per sq.mm through range of skin-fold thickness at all distances of separation of the jaws. The caliper was standardized daily before beginning of work.

Statistical analysis: Data was analyzed into one year interval. In each age group, mean, standard deviation (S.D.) were calculated. The variables were compared using 'Z' test. Differences were considered statistically significant when 'p' values were less than 0.05.

Results

The present study was a cross-sectional study of physical growth in rural school children of Sangli district in age group of 5 to 13 years. Table 1 shows the distribution of boys and girls of rural schools. Table 2 shows the values of mean mid-arm circumference in rural school children. The mean mid-arm circumference in boys of rural school is less than that of girls. The difference is statistically significant in age groups 6-7 and 12-13 years. Girls have higher values of mid-arm circumference than those of boys. Comparative values of mean mid-arm circumference in children of rural school, and Raghavan et al.[5], Agarwal et al.[9] and D.B. Jelliffe's study[3], are presented in Table 3. The mean values in rural school children are lower than that of Raghavan et al study and Agarwal et al study in both sexes and the differences are

statistically significant in all age groups. The mean values in both boys and girls of rural school are also found to be lower than that of D.B. Jelliffe's study in both sexes. As the standard deviation of mean mid-arm circumference has not been quoted in D.B. Jelliffe's study, the comments about the statistical significance of difference cannot be offered. Table 4 shows the values of mean triceps skin-fold thickness in boys and girls of rural school. The mean triceps skin-fold thickness in girls is more than that of boys in all age groups. The difference is statistically significant in all age groups. Table 5 shows the comparative values of mean triceps skin-fold thickness in children of rural school, and Raghavan et al.[5], Agarwal et al.[9] and Bhasin et al.[4] study. The values observed in rural school children in both sexes are less than that of Raghavan et al study in all age groups. There is statistically significant difference in age groups 6-8 and 10-12 years in case of boys and in 6-8 and 8-10 years in case of girls. The mean values in rural school children in both sexes are lower than that of Agarwal et al study in all age groups. The difference between these values in both sexes and the values of Agarwal et al study is statistically significant in age groups 10-13 years in case of boys and in 9-13 years in case of girls. The values observed in rural school children in both sexes are also lower than that of Bhasin et al study and the statistically significant difference is found in age groups 6-9 and 10-12 years in case of boys, and in 6-11 years in case of girls.

Table 1: Distribution of Boys and Girls of Rural School according to age

Age in years	Boys	Girls	Total
5+	47	41	88
6+	50	49	99
7+	61	46	107
8+	60	67	127
9+	72	56	128
10+	82	60	142
11+	73	54	127
12+	55	37	92
TOTAL	500	410	910

Table 2: Mean Mid-Arm circumference in cm in children of Rural Schools

Age in years	Boys		Girls		Z value	p value	Remark
	Mean	S.D.	Mean	S.D.			
5+	14.4	0.86	14.5	1.01	0.50	>0.05	NS
6+	14.5	0.86	15	0.97	2.71	<0.01	S
7+	15.3	1	15.4	0.96	0.52	>0.05	NS
8+	15.5	1.03	15.7	1.44	0.91	>0.05	NS
9+	16.2	1.57	16.3	0.98	0.44	>0.05	NS
10+	16.7	1.39	16.9	1.29	0.88	>0.05	NS
11+	16.6	1.71	17	1.24	1.53	>0.05	NS
12+	18	2.13	18.9	1.99	2.07	<0.05	S

Table 3: Comparison of Mid-Arm circumference in cm in Rural School children with different standards

Age in yrs	School children	Present Study		Raghavan et al Study		Agarwal et al Study		Jelliffe Standard	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
5+	Boys	14.4	0.86	*16.42	1.70	-	-	-	-
	Girls	14.5	1.01	*16.3	1.310	-	-		
6+	Boys	14.5	0.86	*16.68	1.55	*16	1.32	17.3	-
	Girls	15	0.97	*16.96	1.604	*16	1.55	17.3	
7+	Boys	15.3	1	*17.36	1.85	*16.2	1.69	17.8	-
	Girls	15.4	0.96	*17.7	2.142	*16.5	1.71	17.8	
8+	Boys	15.5	1.03	*17.72	2.03	*16.6	1.89	18.4	-
	Girls	15.7	1.44	*18.00	2.160	*17.2	2.17	18.4	
9+	Boys	16.2	1.57	*18.55	2.29	*17.1	2.02	19	-
	Girls	16.3	0.98	*18.75	2.444	*17.9	2.2	19.1	
10+	Boys	16.7	1.39	*18.98	2.41	*17.8	2.06	19.7	-
	Girls	16.9	1.29	*19.28	2.262	*18.8	2.43	19.9	
11+	Boys	16.6	1.71	*19.58	1.59	*18.5	2.49	20.4	-
	Girls	17	1.24	*19.78	2.313	*19.8	2.69	20.7	
12+	Boys	18	2.13	*20.29	2.45	*19.3	2.47	21.2	-
	Girls	18.9	1.99	*21.04	2.567	*20.7	2.92	21.5	

* Indicates values are statistically Significant (P<0.05)

Table 4: Mean Triceps Skin-fold Thickness in mm in children of Rural Schools

Age in years	Boys		Girls				
	Mean	S.D.	Mean	S.D.	Z value	p value	Remark
5+	7.3	1.51	9.2	1.69	5.53	<0.001	HS
6+	6	1.32	7.4	1.34	5.24	<0.001	HS
7+	7.4	1.33	8.2	2.03	2.32	<0.05	S
8+	8.2	1.76	9.6	1.86	4.36	<0.001	HS
9+	8.8	2.39	9.8	1.64	2.80	<0.01	S
10+	8.9	2	10.5	2.33	4.29	<0.001	HS
11+	8.5	2.5	10.8	2.02	5.73	<0.001	HS
12+	9.5	2.7	12.2	3.05	4.36	<0.001	HS

HS-Highly significant, S- Significant

Table 5: Comparison of Triceps Skin-fold Thickness in mm in Rural School children with different standards

Age in yrs	School children	Present Study		Raghavan et al Study		Agarwal et al Study		Bhasin et al Study	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
5+	Boys	7.3	1.51	7.6	2.94	-	-	7.4	1.47
	Girls	9.2	1.69	9.6	1.88	-	-	9.7	1.41
6+	Boys	6	1.32	*8.14	2.29	6.2	2.21	*8.23	1.54
	Girls	7.4	1.34	*10.1	2.42	7.6	2.85	*10.12	1.69
7+	Boys	7.4	1.33	*8.7	3.04	7.5	3.63	*8.6	1.66
	Girls	8.2	2.03	*10.67	3.65	8.6	3.58	*10.46	1.69
8+	Boys	8.2	1.76	8.7	3.06	8.3	3.61	*8.77	1.61
	Girls	9.6	1.86	*10.66	3.50	9.9	4.33	*10.6	1.63
9+	Boys	8.8	2.41	9.2	3.51	9.4	4.04	9.4	1.73
	Girls	9.8	1.64	*11.05	3.75	*10.8	4.58	*11.09	1.46
10+	Boys	8.9	2	*9.5	3.70	*10	4.52	*9.57	1.75
	Girls	10.5	2.33	11.2	3.58	*11.9	5.07	*11.22	1.72
11+	Boys	8.5	2.5	*9.58	3.49	*10.5	4.92	*9.57	1.71
	Girls	10.8	2.02	11.2	3.88	*13	5.58	11.3	1.8
12+	Boys	9.5	2.7	9.8	3.91	*10.7	5.68	9.8	1.61
	Girls	12.2	3.05	12.8	4.26	*13.9	6.05	12.5	1.73

* Indicates values are statistically Significant (P<0.05)

Discussion

Primary school children are important child population segment, as they form the first institutionalized group that can be approached for health, nutritional and educational interventions with ease [10]. Growth and nutrition are very much interrelated. If adequate amount of calories and protein are not available in the diet, the child's physical growth is likely to be affected [11]. Girls have higher values of mid-arm circumference and triceps skin-fold thickness than those of boys. It is because of more subcutaneous fat in girls than in boys. Girls have more subcutaneous fat than boys at all ages from birth and particularly from age 5 or 6 onwards [3]. Similar observations were reported by Raghavan et al. [5], Shrivastav D.K. et al. [12], Bhasin et al. [4] and Agarwal et al.[9] . The mean values of mid-arm circumference and triceps skin-fold thickness in this present study are less than that of Raghavan et al. [5], Agarwal et al. [9], Bhasin et al.[4] and Jelliffe D.B.[3] study in both sexes. Raghavan et al, Agarwal et al, Bhasin et al and Jelliffe D.B. had conducted their studies significantly in well-nourished and affluent school children who did not have any constraints on growth imposed either by malnutrition or infection. In this study, rural school children are from poor socioeconomic status. Insufficient calorie and protein intake are common in the poor socio-economic children. This is in line with Indira Bai k et al [8] and Bhandari et al study[6] who found the anthropometric indices of rural school children were less than that of Indian and Western standards as a result of poor socio-economic status of the people of the area as also found in this present study.   Akhtar M et al [13] also showed that mid-arm circumference and triceps skin-fold thickness in children of higher socio-economic status were more than children of lower socio-economic status. Inadequacy of calories places a constraint on the ultimate size of the individual. Adequacy of calories is critical to bring the expression of full growth potential and its constraints will place a restraint thereon [1]. Protein energy malnutrition has been a common health problem of the third world. It is much less common and usually less severe in adults as they do not need proteins for growth. Nevertheless, it is of much serious concern among children of school-going age who are deprived of good and ample nutrition on account of their poor socio-economic status, ignorance and lack of health promotional facilities [13].

Conclusion

Rural school children show lower values when compared with well-nourished and affluent school children. This may be because of poor socio-economic status of the children in rural areas. Insufficient calorie and protein intake are common in the poor socio-economic children. Nutritional factor plays a bigger role than genetic factor in influencing growth. Well-fed children of different countries grow in a similar pattern in spite of different racial origins. Health education, improving people and environmental hygiene, and regular health screening and treatment of children at all occasions are the essential factors that must be considered in rural areas.

Acknowledgement

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