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# Comparative study of anthropometric measurements of school children with and without mid-day meal programme

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### Abstract
Cross sectional study was conducted to compare nutritional status among children of 14- 16 years age of three different sets of schools namely Private High School Campus without mid-day meal programme, Govt. High School Hebbal with ISCKON mid-day meal programme and Govt. High School Bashettahalli Doddaballapur, with Govt. mid-day meal. Height, weight and body mass index were measured and compared with standards. Mean height of various age and gender combination revealed lower per cent compared to both IAP and NCHS standards. Whereas weight showed decreasing trend in male subjects as compared to female subjects whose weight increased with increase in age. Similar trend was observed in case of NCHS standards. Subjects of PHSC and GHSH had marginal difference for weight for age as compared to subjects of GHSB. BMI of all three school subjects was significantly lower than the WHO standards irrespective of age and gender. Based on the results of this study, it can be concluded that majority of the subjects from all the three schools belonged to below the defined anthropometric standards. However, comparatively PHSC without MDM subjects showed better nutritional status compared to schools with MDM.

**Keywords:** Anthropometry assessment, school children, mid-day meal, school children, nutritional status, id anthropometry, BMI, height and weight

## 1. Introduction
Nutritional status of an individual is the condition of the health as influenced by the utilization of nutrients in the body. Adolescence is the significant period of human growth and maturation. This period is characterized by an exceptionally rapid rate of growth which exceeds only during foetal life and early infancy. Nutritional needs are also more during this period of life cycle. However, inadequate diet and unfavorable environmental conditions may adversely influence the growth and nutrition of adolescents. Anthropometric measurements are sensitive indicators of health, growth and development in children and inexpensive method available to assess the size, portion and composition of human body (WHO 1995) [15]. According to WHO, the ultimate intention of nutritional assessment is to improve human health.

## 2. Material and Methods
A total of 1092 school children from three different schools formed the sample. The samples drawn were cross sectional and included both male and female subjects. Data collection was carried out based on random sampling procedure. The age was recorded as indicated in the school records. Height was measured using portable height rod and weight by personal weighing balance with minimum clothing. Height and weight Measurements were recorded and were compared with IAP and NCHS standards. Whereas BMI was calculated and compared with WHO standards.

## 3. Results
The investigation was carried out on a total of 1092 subjects representing 14, 15 and 16 year age group (8th, 9th and 10th class) belonging to three different schools *viz.* PHSC (Private High School campus, Bangalore without Mid-Day Meal), GHSH (Government High School, Hebbal with ISKCON Mid-Day Meal) and GHSB (Government High School, Bashettihalli with Government Mid-Day Meal) represented the sample size of 324, 438 and 330 respectively.

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The samples drawn were cross sectional and included both male and female subjects. Age wise classification showed that 286, 468 and 338 subjects belonged to 14, 15 and 16 years respectively; whereas, gender wise segregation revealed that 567 male and 525 female subjects. Data collection was carried out based on random sampling procedure (Table 1).

There is an increasing trend in the mean height of the male subjects as per succeeding shift in age group with the height (cm) of 145.8±8.6, 150.5±8.5 and156. ±8.7; while females also showed similar trend with values of 143.5±7.3, 148.7±7.5 and 150.5±6.8 for 14, 15 and 16 years respectively. It can be seen from the Table 2 that calculated standard deviation depicted the variation in different age and gender combination. Cumulative mean of various age and gender combination revealed lower per cent compared to both IAP and NCHS standards. Collectively, for IAP standards, female subjects were found to meet higher per cent standard in the range of 93.2 to 96.5 as compared to male subjects met the lower percentage standards in range of 92.9 to 93.8 per cent. Same trend was observed for the NCHS standards. Females met higher per cent standards of 89.5, 91.9 and 92.7 per cent

as compared to males at 89.4, 89.1 and 90.0 per cent for ascending age group under study. Calculated t value for the defined combinations showed highly significant results indicating variation among the study population for both the standards.

The mean value for both male and female subjects indicated that as age increased weight also increased with the mean of 35.4 ± 8.2, 39.0±9.0 and 43.2 ± 9.1 in male subjects and 36.4 ± 8.7, 40.8 ± 7.8 and 43.2±8.2 in female subjects of 14, 15 and 16 years respectively (Table 3). Calculated standard deviation showed the variation in different age and gender combination. When mean ± SD was compared with IAP standards, male subjects had a per cent to standard weight with a range of 78.8 to 80.5 per cent as compared to 84.7 to 91.9 per cent in case of females who fared better in weight parameter. Data also showed decreasing trend in weight of male subjects as compared to female subjects whose weight increased with increase in age. Similar trend was observed in case of NCHS standards. t'' value for the defined combinations showed highly significant results indicating variation among the population for both the standards (Table 3).

**Table 1:** Age and gender wise distribution of the subjects

| Gender | PHSC without MDM (n=324) Age (Years) | | | | GHSH with ISKCON MDM (n=438) Age (Years) | | | | GHSB with Govt. MDM (n=330) Age (Years) | | | | Total (N=1092) Age (Years) | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14 | 15 | 16 | Total | 14 | 15 | 16 | Total | 14 | 15 | 16 | Total | 14 | 15 | 16 | |
| Boys | 62 | 65 | 66 | 193 | 44 | 104 | 64 | 212 | 52 | 66 | 44 | 162 | 158 | 235 | 174 | 567 |
| Girls | 39 | 54 | 38 | 131 | 44 | 109 | 73 | 226 | 45 | 70 | 53 | 168 | 128 | 233 | 164 | 525 |
| Total | 101 | 119 | 104 | 324 | 88 | 213 | 137 | 438 | 97 | 136 | 97 | 330 | 286 | 468 | 338 | 1092 |

PHSC – Private High School Campus, Hebbal, Bangalore
GHSH – Government High School Hebbal, Bangalore
GHSB – Government High School Bashettihalli, Doddaballapur

**Table 2:** Mean ± SD for height (cm) of the subjects as compared with IAP and NCHS standards

| Age (Years) | Sex | IAP Standards | NCHS Standards | N | Height (cm) Mean ± SD | % standard | | t Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | IAP | NCHS | IAP | NCHS |
| 14 | M | 157.0 | 163.1 | 158 | 145.8 ± 8.6 | 92.9 | 89.4 | 16.37 ** | 25.29 ** |
| | F | 154.0 | 160.4 | 128 | 143.5 ± 7.3 | 93.2 | 89.5 | 16.27 ** | 26.19 ** |
| 15 | M | 162.0 | 169.0 | 235 | 150.5 ± 8.5 | 92.9 | 89.1 | 20.74 ** | 33.36 ** |
| | F | 155.5 | 161.8 | 233 | 148.7 ± 7.5 | 95.6 | 91.9 | 13.84 ** | 26.66 ** |
| 16 | M | 166.5 | 173.5 | 174 | 156.2 ± 8.7 | 93.8 | 90.0 | 15.62 ** | 26.23 ** |
| | F | 156.0 | 162.4 | 164 | 150.5 ± 6.8 | 96.5 | 92.7 | 10.36 ** | 22.41 ** |

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GHSH – Government High School Hebbal, Bangalore
GHSB – Government High School Bashettihalli, Doddaballapur
IAP – Indian Academy of Pediatrics
NCHS – National Center for Health Statistics
** Significant at 1% level

**Table 3:** Mean ± SD of the subject's weight (kg) as compared with IAP and NCHS standards

| Age (Years) | Sex | IAP Standards | NCHS Standards | n | Weight (Kg) Mean ± SD | % to standard | | t Value | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | IAP | NCHS | IAP | NCHS |
| 14 | M | 44 | 50.8 | 158 | 35.4 ± 8.2 | 80.5 | 69.7 | 13.18 ** | 23.61 ** |
| | F | 43 | 50.3 | 128 | 36.4 ± 8.7 | 84.7 | 72.4 | 8.58 ** | 18.08 ** |
| 15 | M | 49.5 | 56.7 | 235 | 39.0 ± 9.0 | 78.8 | 68.8 | 17.88 ** | 30.15 ** |
| | F | 45 | 53.7 | 233 | 40.8 ± 7.8 | 90.7 | 76 | 8.22 ** | 25.24 ** |
| 16 | M | 54 | 62.1 | 174 | 43.2 ± 9.1 | 80 | 69.6 | 15.66 ** | 27.4 ** |
| | F | 47 | 55.9 | 164 | 43.2 ± 8.2 | 91.9 | 77.3 | 5.93 ** | 19.83 ** |

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IAP – Indian Academy of Pediatrics
NCHS – National Center for Health Statistics
NS – Non significant
* Significant at 5% level
** Significant at 1% level

Keeping cut off level as percent of median for NCHS standard, the grand to total results of Gomez classification of malnutrition in both age and gender wise showed higher per cent of moderately malnourished subjects at 39.1 per cent followed by mild and severely malnourished subjects at 25.5 and 19.5 per cent respectively. Whereas normal category occupied the last position at 15.9 per cent only. Same trend was observed across all the schools where majority of the subjects placed under moderate malnutrition and well-nourished was found to be in the last position (Table 4).

Among three schools under investigation higher per cent of the well-nourished subjects were found in PHSC without MDM at 23.8 per cent. Around 27 per cent of mild malnutrition was prevailed in both PHSC without MDM and GHSH with ISCKON MDM whereas GHSB subjects were moderately and severely malnourished at 42.7 and 25.5 per cent respectively. Comprehensive scores across the schools define higher per cent of moderate malnutrition prevailing with a range of 37.8 to 39.9 per cent in all the three age groups and same trend was observed in gender wise classification of malnutrition with a range of 38 to 40 per cent in both the genders studied. chi square results

revealed a non-significant outcome in all the three schools. Whereas, categorized data for entire three schools showed a significant variation at one per cent level. In gender wise classification both GHSH and GHSB showed highly significant results at one per cent level whereas, chi-square values across schools revealed highly significant results at one per cent level.

Higher per cent of subjects belonged to below the WHO standard at 79.09 per cent in GHSB. About 70.29 per cent of subjects amongst the three schools investigated were found to be below the WHO standard (Table 5) Results based on the age wise distribution revealed that higher per cent of 14 year old subjects in GHSB with Govt. MDM were below the standard category at 80.4 per cent. Whereas higher per cent of 15 and 16 year old subjects of PHSC without MDM belonged to below WHO standard at 80.7 and 76.9 per cent respectively. Gender wise distribution of the subjects showed that higher per cent of both male and female subjects" of GHSB with Govt. MDM belonged to below the standard category at 79.6 and 78.6 per cent respectively. Chi square analysis for age and gender wise distribution showed significant result.

**Table 4:** Degree of malnutrition (age wise) as per Gomez and IAP (Weight/Age) classification

| Classification | Cut off level as % of NCHS median | Type/Degree of Malnutrition | PHSC without MDM (n=324) | | | | GHSH with ISCKON MDM (n=438) | | | | GHSB with Govt. MDM (n=330) | | | | Total (N=1092) | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 14 yrs | 15 yrs | 16 yrs | Total | 14 yrs | 15 yrs | 16 yrs | Total | 14 yrs | 15 yrs | 16 yrs | Total | 14 yrs | 15 yrs | 16 yrs | |
| | | | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) | N (%) |
| **Gomez** | >90 | Normal | 29 (28.7) | 29 (24.4) | 19 (18.3) | 77 (23.8) | 12 (13.6) | 28 (13.1) | 21 (15.3) | 61 (13.9) | 13 (13.4) | 13 (09.6) | 10 (10.3) | 36 (10.9) | 54 (18.9) | 70 (15.0) | 50 (14.8) | 174 (15.9) |
| | 75-90 | Mild | 21 (20.8) | 32 (26.9) | 35 (33.7) | 88 (27.2) | 17 (19.3) | 63 (29.6) | 41 (29.9) | 121 (27.6) | 16 (16.5) | 28 (20.6) | 25 (25.8) | 69 (20.9) | 54 (18.9) | 123 (26.3) | 101 (29.9) | 278 (25.5) |
| | 60-75 | Moderate | 42 (41.6) | 41 (34.5) | 40 (38.5) | 123 (38.0) | 31 (35.2) | 83 (39.0) | 49 (35.8) | 163 (37.2) | 35 (36.1) | 60 (44.1) | 46 (47.4) | 141 (42.7) | 108 (37.8) | 184 (39.3) | 135 (39.9) | 427 (39.1) |
| | <60 | Severe | 9 (08.9) | 17 (14.3) | 10 (09.6) | 36 (11.1) | 28 (31.8) | 39 (18.3) | 26 (19.0) | 93 (21.2) | 33 (34.0) | 35 (25.7) | 16 (16.5) | 84 (25.5) | 70 (24.5) | 91 (19.4) | 52 (15.4) | 213 (19.5) |
| | Chi Square | | 7.977 NS | | | | 9.222 NS | | | | 10.244 NS | | | | 16.461 * | | | |
| **IAP** | >80 | Normal | 41 (40.6) | 42 (35.3) | 39 (37.5) | 122 (37.7) | 20 (22.7) | 72 (33.8) | 44 (32.1) | 136 (31.1) | 20 (20.6) | 32 (23.5) | 30 (30.9) | 82 (24.8) | 81 (28.3) | 146 (31.2) | 113 (33.4) | 340 (31.1) |
| | 70-80 | Grade-I | 23 (22.8) | 39 (32.8) | 33 (31.7) | 95 (29.3) | 17 (17.0) | 53 (24.9) | 33 (24.1) | 101 (23.1) | 20 (20.6) | 30 (22.1) | 25 (25.8) | 75 (22.7) | 58 (20.3) | 122 (26.1) | 91 (26.9) | 271 (24.8) |
| | 60-70 | Grade-II | 28 (27.7) | 21 (17.6) | 22 (21.2) | 71 (21.9) | 25 (28.4) | 49 (23.0) | 34 (24.8) | 108 (24.7) | 24 (24.7) | 39 (28.7) | 26 (26.8) | 89 (27.0) | 77 (26.9) | 109 (23.3) | 82 (24.3) | 268 (24.5) |
| | 50-60 | Grade-III | 9 (08.9) | 15 (12.6) | 7 (06.7) | 31 (09.6) | 19 (21.6) | 34 (16.0) | 22 (16.1) | 75 (17.1) | 28 (28.9) | 29 (21.3) | 15 (15.5) | 72 (21.8) | 56 (19.6) | 78 (16.7) | 44 (13.0) | 178 (16.3) |
| | >50 | Grade-IV | 0 (00.0) | 2 (01.7) | 3 (02.9) | 5 (01.5) | 9 (10.2) | 5 (02.3) | 4 (02.9) | 18 (04.1) | 5 (05.2) | 6 (04.4) | 1 (01.0) | 12 (03.6) | 14 (04.9) | 13 (02.8) | 8 (02.4) | 35 (03.2) |
| | **Chi Square** | | 10.000 NS | | | | 16.403 * | | | | 9.844 NS | | | | 13.259 NS | | | |

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IAP – Indian Academy of pediatrics  
NS – Non significant  
* Significant at 5% level  
** significant at 1% level  

**Table 5:** Age and gender wise distribution of Body Mass Index (BMI) of the subjects as per World Health Organization (WHO) standards

| Age (Years) | Gender | PHSC without MDM (n=324) | | GHSH with ISKCON MDM (n=438) | | GHSB with Govt. MDM (n=330) | | Total (N=1092) | | Chi Square |
|---|---|---|---|---|---|---|---|---|---|---|
| | | < STD | > STD | < STD | > STD | < STD | > STD | < STD | > STD | |
| 14 | M | 42 (67.7) | 20 (32.3) | 30 (68.2) | 14 (31.8) | 42 (80.8) | 10 (19.2) | 114 (72.2) | 44 (27.8) | 2.867 NS |
| | F | 24 (61.5) | 15 (38.5) | 30 (68.2) | 14 (31.8) | 36 (80) | 9 (20) | 90 (70.3) | 38 (29.7) | 3.557 NS |
| 15 | M | 52 (80) | 13 (20) | 67 (64.4) | 37 (35.6) | 54 (81.8) | 12 (18.2) | 173 (73.6) | 62 (26.4) | 8.175 * |
| | F | 44 (81.5) | 10 (18.5) | 62 (56.9) | 47 (43.1) | 55 (78.6) | 15 (21.4) | 161 (69.1) | 72 (30.9) | 13.372 ** |
| 16 | M | 57 (86.4) | 9 (13.6) | 46 (71.9) | 18 (28.1) | 33 (75) | 11 (25) | 136 (78.2) | 38 (21.8) | 4.341 NS |
| | F | 23 (60.5) | 15 (39.5) | 35 (47.9) | 38 (52.1) | 41 (77.4) | 12 (22.6) | 99 (60.4) | 65 (39.6) | 10.64 ** |
| Age | 14 | 66 (65.3) | 35 (34.7) | 60 (68.2) | 28 (31.8) | 78 (80.4) | 19 (19.6) | 204 (71.3) | 82 (28.7) | 6.107 * |
| | 15 | 96 (80.7) | 23 (19.3) | 129 (60.6) | 84 (39.4) | 109 (80.1) | 27 (19.9) | 334 (71.4) | 134 (28.6) | 14.659 ** |
| | 16 | 80 (76.9) | 24 (23.1) | 81 (59.1) | 56 (40.9) | 74 (76.3) | 23 (23.7) | 235 (69.5) | 103 (30.5) | 11.585 ** |
| Gender | M | 151 (78.2) | 42 (21.8) | 143 (67.5) | 69 (32.5) | 129 (79.6) | 33 (20.4) | 423 (74.6) | 144 (25.4) | 9.227 ** |
| | F | 91 (69.5) | 40 (30.5) | 127 (56.2) | 99 (43.8) | 132 (78.6) | 36 (21.4) | 350 (66.7) | 175 (33.3) | 7.016 * |
| **Total** | | 242 (74.69) | 82 (25.31) | 270 (61.64) | 168 (38.36) | 261 (79.09) | 69 (20.91) | 773 (70.79) | 319 (29.21) | |

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NS – Non significant  
* Significant at 5% level  
** Significant at 1% level

## 4. Discussion

In the present study, the nutritional status of the study subjects was assessed by anthropometry. Results revealed that, height of subjects was significantly lower than the IAP and NCHS standards irrespective of age and gender. Naik (2005) [8] reported similar results where, the mean height of the study subjects in Karnataka were 10 per cent lower than NCHS standards irrespective of gender. The results are also on par with results of Shamssain (1991) [13]. Bharati *et al.* (2005) [4] and Nwokora *et al.* (2006) [9] with respect to anthropometric measurements of school age (6 – 16 years) children. The mean values of male as well as female subjects showed an increasing trend as per succeeding shift in age group but boys had better height compared to girls, similar results were also reported by Hitendra *et al.* (2000) [7], Panda *et al.* (2000) [10], Bhoite and Iyer (2011) [5] among the adolescents of 10-15 years. (Table-2)

Female subject's weight as compared to male subjects shows decreasing trend in weight as the age increased. The probable reason for girls showing higher weight could be attributed to the fact that girls begin their adolescent growth spurt earlier than boys. Similar reasons were quoted by Shamssain (1991) [13] and Nwokora *et al.* (2006) [9] and Sunita and Jain (2005) [14] who observed that nutritional status of girls were better than boys in rural Bihar.

The percentage of children who have low weight for age (underweight) can reflect „wasting" (i.e. low weight for height). Wasting in children is a symptom of acute under nutrition, usually as a consequence of insufficient food intake or a high incidence of infectious diseases, especially diarrhea. Wasting in turn impairs the functioning of the immune system and can lead to increased severity and duration of and susceptibility to infectious diseases and an increased risk for death (Anon 2007) [2].

Subjects of PHSC and GHSH had marginal difference for weight for age as compared to subjects of GHSB, where higher per cent of subjects were found to be wasted. Reason for on par results in both PHSC and GHSH could be that subjects in PHSC without MDM belonged to higher socioeconomic class, higher educational, occupational and nutritional knowledge of parents could have influenced on their nutritional status as it has depicted by their better weight for age status whereas in GHSH (with ISCKON MDM) possible reason for better weight for age could be that these subjects received MDM food from ISCKON where they were provided with variety of foods which included rice, sambar, palav, curd (thrice a week) and sweet items (once in a week) these contribute to calories which would have influenced their weight as compared to MDM provision in GHSB where there was no provision of calorie dense sweet item.

Results of the study revealed that BMI of all three school subjects was significantly lower than the WHO standards irrespective of age and gender. The mean values of male as well as female subjects showed an increasing trend as per the succeeding shift in age group. Female subjects had higher BMI values compared to males. Similar pattern was observed by Bembem (2010) [3] the prevalence of thinness was higher among boys than girls. The prevalence rate of underweight in boys (17.7%) was higher than girls (16.2%) (Premnath *et al.* 2010) [11]. Rao and Veena 2008 [12] reported almost similar pattern of thinness among tribal adolescent boys (63%) and girls (42%) in India. Anand *et al.* (1999) [1] also reported that boys (43.8%) were more affected than girls (30.1%).

Among the three schools under the investigation GHSB with Govt. MDM had higher percentage of subjects below WHO standard at 79.09 per cent respectively as compared to subjects in other two schools.

Reason for variation in BMI of three schools could be due to the difference in their height and weight parameters. In PHSC without MDM most of the subjects had better height and weight as it has resulted in normal BMI, whereas GHSH (with ISCKON MDM) subjects mean height was less as compared to mean weight for their age and also higher TSF values, these could have resulted in overweight and obese among these subjects. While GHSB subjects with Govt. MDM had lower mean height and weight which had resulted in underweight. Bembem (2010) [3] observed in her study that there is a direct relationship between BMI and per cent body fat. Similar observations were reported by Choudary and Khishore (2004) [6]. In the present study also similar trend was found in GHSH subjects TSF values where high as it has resulted in higher BMI (overweight and obese).

## 5. Conclusion

Based on the results of this study, it can be concluded that majority of the subjects from all the three schools belonged to below the defined anthropometric standards. However, comparatively PHSC without MDM subjects showed better nutritional status compared to schools with MDM.

## 6. References

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