‘PHYSICAL FITNESS TEST PERFORMANCE IN CHILDREN& ITS CORRELATION WITH ANTHROPOMETRIC PARAMETERS: AN OBSERVATIONAL STUDY’

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ABSTRACT

Introduction-It is observed that promoting healthy physical activity behaviors in children has immediate impacts on health and well being of children and serves as powerful strategy to prevent or minimize the occurrence of chronic disease in later life.

Objectives-To estimate the scores of various fitness tests performed by the study subjects and its relation with anthropometric measurements.

Methods- This prospective study included 270 children of 8 to 12 years age who fulfilled all inclusion criteria. They were selected randomly from six schools in Gwalior. Their height, weight and BMI were noted. Fitness tests included in this study were - curl ups, shuttle run, v-sit and reach, Endurance run and walk, pull-ups.

Results-Among 270 children between 8-12 years age 62.6% were male and majority of the subjects belong to lower middle class (45.9%). It was observed that boys performed better than girls in curl-ups, shuttle run, Endurance run- walk, pull-up($p<0.001$). Girls performed better in v sit reach test ($p<0.001$). Mean value for boys in curl-up test-39.12±3.71 repetitions, in shuttle run-11.292±0.5 seconds, endurance run walk-8.9479±0.6minutes, pull-ups- 3.28±1.091repetetions, v sit reach-3.186±0.5779 cm. Mean value for Girls in curl-up test-36.13±3.507repetetions, shuttle run-11.658±0.805 seconds, endurance run walk-10.1564±0.78 minutes, pull-ups-0.96±0.665repetetions, v sit reach-5.617±0.9222cm. Difference among various BMI groups was not significant for both boys and girls except for shuttle run and endurance run/walk in boys and curl-ups in girls.

Conclusion- The present study concludes that age and sex significantlycorrelate with physical fitness test. Boys perform better in all physical fitness tests except v- sit and reach. Girls perform better in flexibility test. BMI showed weak correlation with all physical tests.

Keywords- Physical fitness test, BMI, health, children.

INTRODUCTION

Childhood fitness is an emerging area of public health concern the world over. The prevalence of childhood obesity and morbidities associated with it are increasing. Some of the reasons attributed to this increase in obesity and decrease in fitness levels are improved economic status and better lifestyle choices increased academic demands that decrease the time effectively spent in physical activity and concerns of safety that parents voice as reasons for disallowing physical activity. On the flip side there are children with poor nutritional levels leading to poor fitness levels. While these children are not prone to lifestyle diseases they are also a cause for concern. Some of the reasons attributed to poor nutritional status are cultural beliefs concerning foods, poverty and lack of awareness [1-2]. Studies reported from India have identified decreased fitness levels and increased obesity in urban children with increasing urbanization and lesser availability of playing areas. In high-rise multistorey dwellings children are not getting enough opportunity to play outdoors hence physical fitness of the children is decreasing. However studies incorporating a comprehensive fitness evaluation are unavailable. It has been established that the burden of ensuring exercise in children falls on the schools where they go to study [3-4]. There are three main health-related fitness components: body composition, cardiorespiratory fitness strength and flexibility speed quality. In order to establish an appropriate school fitness programme baseline fitness level in the target children are essential. Hence we undertook this study with the objective to evaluate health-related and performance-related fitness levels of school-going children between the ages of 8 and 12 years [5-6].

AIMS AND OBJECTIVES

AIM-

The aim of this study is to know Body composition, physical fitness levels, and their correlation with each other among school going children.

Primary objectives are

1. To estimate the scores of various fitness tests performed by the study subjects.
2. To estimate the anthropometric measurements of the study subjects

Secondary Objective:

1. To correlate the scores of fitness tests with anthropometric measurements of the school-going children.

MATERIALANDMETHODS

The Single-Centre Observational Prospective study was conducted from 2022 to 2024 in a teaching institute affiliated Hospital.

SETTING: Primary and Middle- class schools of Gwalior urban area.

STUDY DESIGN: Cross Sectional Observational study.

SAMPLE SIZE: 270 healthy children aged between 8 to 12 years

Sample size is calculated by Following Formula:

$$n = N \frac{\frac{Z^2P(1-p)}{e^2}}{\frac{Z^2P(1-p)}{e^2} + N - 1} = 270$$

n= Sample Size
N = Population size = 30000(8 to12 year students in Gwalior)
Z = Confidence level = 95%
P = Sample Proportion = 50%
e= Margin of error = 5%

DURATION OF STUDY: Two years.

INCLUSION CRITERIA:

A total of 270 Healthy children between 8 to 12 years in government and private Schools of district Gwalior.

EXCLUSION CRITERIA:

1. Children or parents who were not willing to participating in the study.

2. Children who were sick or with any physical disability.

Method

1. A total of six Schools that offer primary to high school education following the Madhya Pradesh State Board and CBSE Board curriculum were randomly selected from Gwalior urban area.

2. Prior permission was obtained from school authorities.

3. Informed consent from the parents and children was taken.

4. Testing was done in the school playground. Anthropometric measurements including weight, height, BMI were done before subjecting them to fitness test. It includes following battery of fitness tests.

1. Curl-ups

It is a test for abdominal strength by maximum number of curl-ups performed in one minute.

2. Shuttle Run

It is a test for speed and agility. Testing Mark two parallel lines 30 feet apart and place two blocks of wood or similar object (approximate size of 2"x2"x4") behind one of the lines. Students start behind opposite line.

3. **Endurance Run/Walk**

It is a test for heart/lung endurance by fastest time to cover a designated distance. Testing was done on a safe one-mile distance. Time taken to cover the distance was recorded in minutes and seconds.

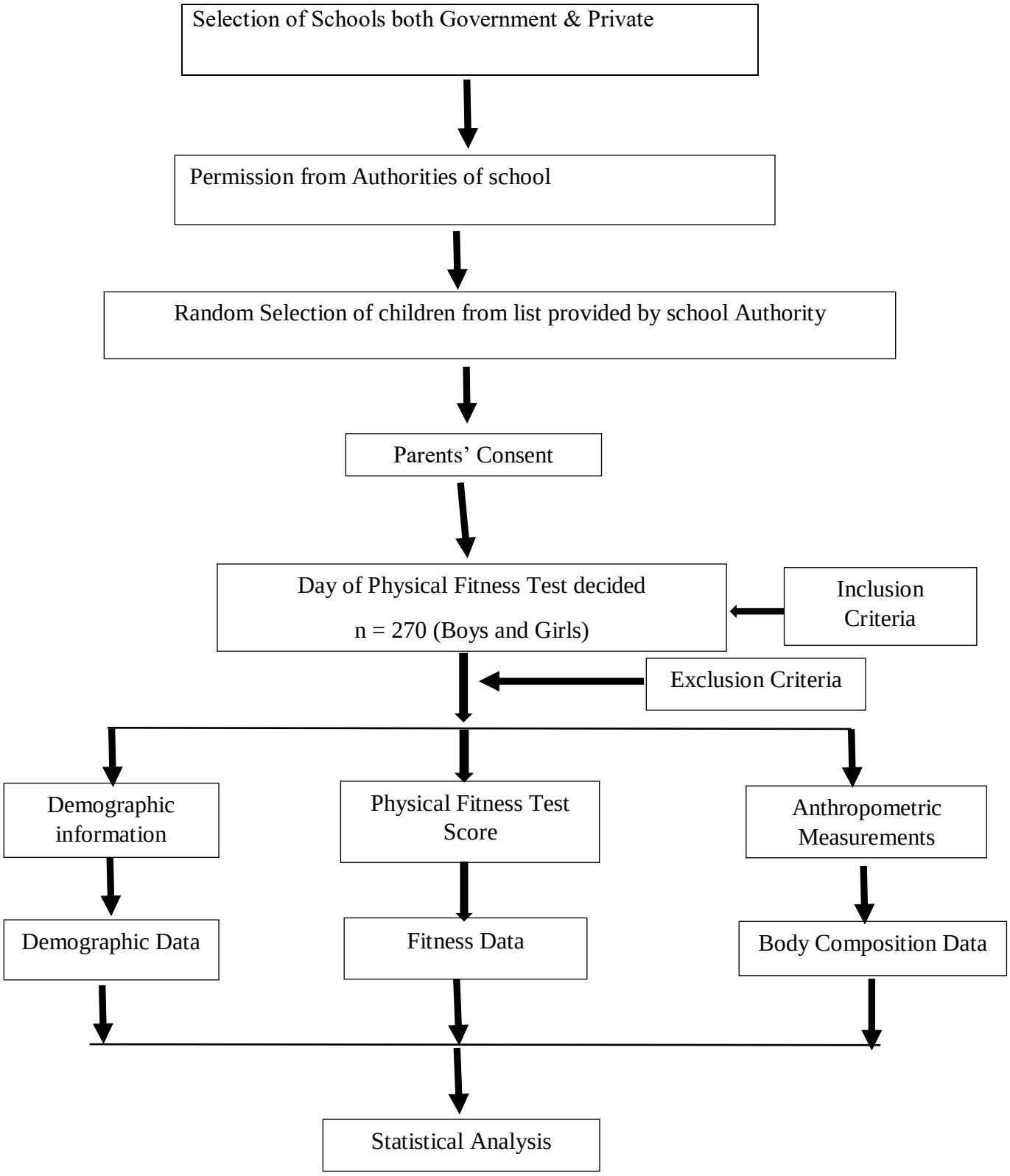
5. Pull-ups

It is a test for upper body strength/endurance by maximum number of pull-ups completed.

6. **V-Sit Reach**

It is a test for flexibility of lower back and hamstrings.

STUDY FLOW CHART



STATISTICALANALYSIS

Data was entered in Microsoft excel sheet and analyzed using SPSS version 16.0 and EPI INFO version 7.0. Descriptive statistics parametric tests of comparison and correlation was carried out using Pearson's correlation coefficient. Comparisons between various categories was done by students' test and other Appropriate statistical test will be applied to analyses the data.

RESULTS:

270 children were enrolled 169 (62.6%) were boys and 101 (37.4%) were girls. Out of 270 children 33.3% were of age group 8-9 years, 25.2% were of age group 9-10 years, 20% were of age group 9-10 years and 21.5% were of age group 11-12 years. Socioeconomic class distribution shows majority (45.9%) of the children belong to the lower middle class of the modified Kuppuswamy classification.

Table 1: Fitness test scores according to age groups among Boys

Fitness Test	**8 - 9 Years**	**9 - 10 Years**	**10 - 11 Years**	**11 - 12 Years**	**Total**	**F-value**	**P-value**
Curl-Up (No. of Repetition)	35.77±2.08	39.42±2.1	40.63±2.28	43.97±2.72	39.12±3.71	96.79	<0.001
Shuttle Run (Seconds)	11.839±0.3	11.22±0.4	11.031±0.2	10.547±0.3	11.292±0.5	96.1	<0.001
Endurance Run walk (Min: Sec)	9.4253±0.3	8.8578±0.7	8.6966±0.5	8.3647±0.34	8.9479±0.6	37.38	<0.001
Pull-Ups (No. of repetition)	2.42±0.897	3.38±0.747	3.75±0.803	4.4±0.724	3.28±1.091	45.998	<0.001
V-Sit Reach (cm)	2.573±0.2729	3.462±0.3084	3.566±0.5172	3.633±0.2426	3.186±0.5779	109.771	<0.001

*p -value <0.05 statistically significant at 5% level of significance.

Age-wise scores for various fitness tests shows that in boys mean value of the curl-up test is 39.12±3.71 repetitions, shuttle run is 11.292±0.5 seconds, endurance run/walk is 8.9479±0.6 minutes, pull-ups are 3.28±1.091 repetitions and V-sit reach is 3.186±0.5779 cm. It is observed that age significantly correlates with physical fitness. As shown in table with increasing age performance score of physical fitness tests was increasing.

Table 2: Fitness test score according to age groups among Girls

Fitness Test	8 - 9 Years	9 - 10 Years	10 - 11 Years	11 - 12 Years	Total	F-value	P-value
Curl-Up (No. of Repetition)	33.15±2.397	34.43±2.191	36.86±2.21	39.82±2.435	36.13±3.507	43.236	<0.001
Shuttle Run (Seconds)	12.389±0.28	11.457±0.204	11.359±1.0482	11.354±0.819	11.658±0.805	14.405	<0.001
Endurance Run walk (Min: Sec)	10.8404±0.6	10.1609±0.54	10.1627±0.426	9.4882±0.770	10.1564±0.78	22.391	<0.001
Pull-Ups (No. of repetition)	0.37±0.629	1.09±0.515	1.32±0.477	1.14±0.591	0.96±0.665	14.264	<0.001
V-Sit Reach (cm)	4.507±0.558	5.343±0.6714	6.073±0.2272	6.554±0.1934	5.617±0.9222	101.996	<0.001

*P-value<0.05 statistically significant at 5% level of significance

Age-wise scores for various fitness tests shows that in Girls mean value of the curl-up test is 36.13±3.507 repetitions, shuttle run 11.658±0.805 seconds, endurance run/walk is 10.1564±0.78 minutes, pull-ups are 0.96±0.665 repetitions and the V-sit reach-5.617±0.9222cm. It is observed that age significantly correlates with physical fitness. As shown in the table with increasing age performance on physical fitness tests has significantly increased.

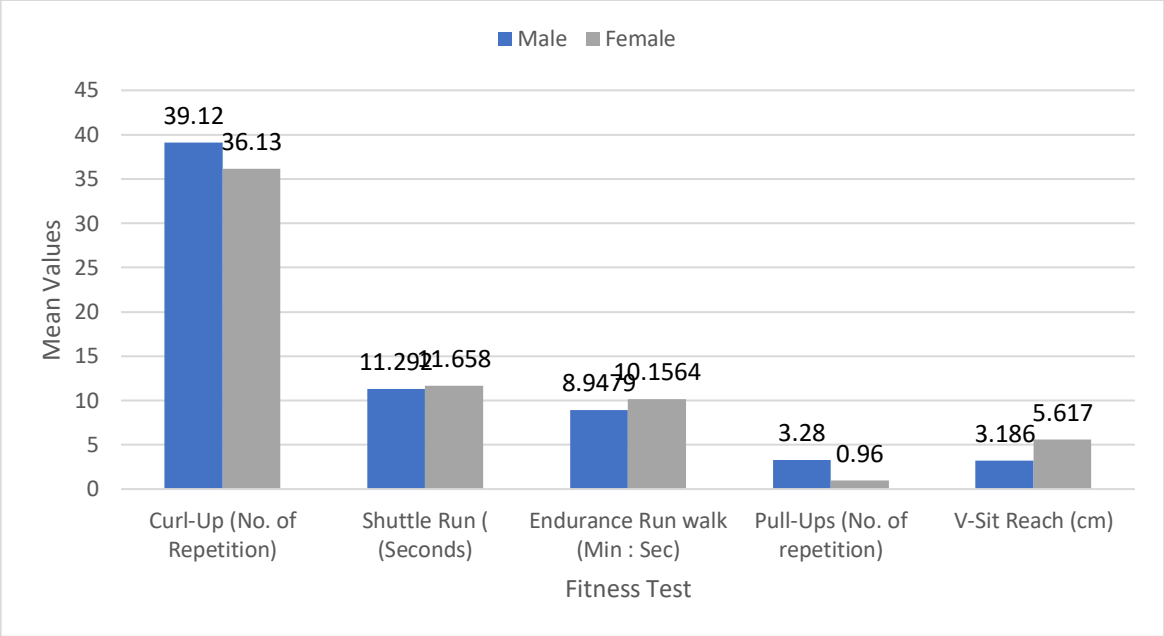


Figure 1: Fitness test score according to gender

*P-value<0.05 statistically significant at 5% level of significance.

Among sex parameters boys showed better performance in curl-ups, shuttle runs, endurance run-walks and pull-up tests than girls whereas girls showed better performance than boys in the V-sit-and-reach test. It was observed that gender-wise distribution showed a significant difference in physical fitness.

Table 3: Fitness test score according to the BMI centile in Boys

Fitness Test	< 25th Centile(n=49)	25 - 50 Centile(n=85)	50 - 71 Centile(n=27)	> 71th Centile(n=8)	Total(n=169)	F-test	P-value
Curl-Up (No. of Repetition)	39.12±4.126	39.62±3.629	38.11±2.887	37.13±3.643	39.12±3.711	1.992	0.117
Shuttle Run (Seconds)	11.445±0.7214	11.18±0.5305	11.296±0.4146	11.525±0.6964	11.292±0.5933	2.577	0.056
Endurance Run walk (Min: Sec)	9.1527±0.82419	8.8081±0.51032	8.9219±0.39765	9.2675±0.64342	8.9479±0.62698	4.07	0.008
Pull-Ups (No. of repetition)	3.2±1.323	3.46±0.995	2.89±0.801	3.13±1.126	3.28±1.091	2.091	0.103
V-Sit Reach (cm)	3.129±0.7074	3.199±0.534	3.252±0.4644	3.175±0.5651	3.186±0.5779	0.289	0.833

There is no significant difference found in boys except for the endurance run-walk and shuttle run tests. In which the 25th-50th percentile performs better than <25th percentile, 50th-71st percentile and overweight & obese children >71st percentile BMI groups.

Table 5: Fitness test score according to the BMI centile in Girls

Fitness Test	< 25th Centile(n=20)	25 - 50 Centile(n=54)	> 75th Centile(n=27)	Total(n=101)	F-test	P-value
Curl-Up (No. of Repetition)	36.2±3.205	36.79±3.607	34.78±3.238	36.13±3.507	3.082	0.05
ShuttleRun (Seconds)	11.82±0.5578	11.615±0.95	11.622±0.6405	11.658±0.8051	0.502	0.607
Endurance Run walk (Min:Sec)	10.3615±0.6983	10.076±0.86287	10.1622±0.67614	10.1564±0.7853	0.96	0.387
Pull-Ups (No. of repetition)	0.95±0.686	1.08±0.675	0.74±0.594	0.96±0.665	2.326	0.103
V-Sit Reach (cm)	5.355±0.8003	5.783±0.9715	5.485±0.8694	5.617±0.9222	1.98	0.144

*P-value<0.05, Statistically significant at 5% level of significance.

Among BMI parameters it was observed that significant difference was found in girls in curl-up test in which 25-50th percentile performed better than the <25th percentile and overweight & obese children (>75th percentile). There is no significant difference found in other physical fitness tests.

DISCUSSION –

In present study out of 270 children 169 (62.6%) were boys and 101 (37.4%) were girls. Age wise distribution shows that 33.3% of children belong to the age group of 8-9 years, 25.2% to 9-10 years, 20% to 10-11 years, and 21.5% were of the age group 11-12 years. According to modified Kuppuswamy classification majority belonged to the lower middle socio- economic class.

In present study mean score for curl-up test was (no. of repetition) 39.12±3.711 in boys & 36.13±3.507 in Girls. Similarly, **Vanhelst J et al**[9] conducted a study in France found mean score for curl up tests in boys were 31.0 ± 18.1 to 32.7 ± 19.6 and in girls were 24.3 ± 16.3 to 27.2 ± 17.3 no. of repetition and **Pinero J et al**[15] conducted a study in Spain and observed mean score for curl-up test in boys were 25 to 36 and in girls was 26 to 33 no. of repetition in same age groups.

In our study mean score for shuttle run was 11.292±0.593 sec in Boys, 11.658±0.805 sec in Girls. **Alexander J et al**[7] found mean time for shuttle run was 14.2 sec to 12.3 sec which is almost similar to present study whereas **Koulouvaris P et al**[16] conducted a study in Greece and observed different results as compared to our study. In their study score were 5.05 to 4.15 sec in boys and in girls was 5.34 to 4.45 sec in various age groups. It is because in their study distance covered for shuttle run was 20m.

In our study mean value for endurance Run/ walk (Min) was 8.9479±0.626 for boys & 10.1564±0.7853 for girls to cover 1600m distance. **Chih-Yu Hsu et al**[18] observed 4.9min in boys and 5.2min in girls which was low to our study it is because in their study distance was 800m compared to our study.

In our study mean value for pull-ups test was 3.28±1.091 (No. of repetition) in boys & 0.96±0.665 in girls. Similarly, **Pinero J et al**[15] observed mean score in boys were 1±2 and in girls were 0±1 repetition.

In our study mean values for V- sit Reach(cm) in boys was-3.186±0.5779 & for girls was-5.617±0.9222. **Vanhelst J et al**[9] found Mean value in both boys and girls was high compare to our study.

In our study age wise difference in mean score of various physical fitness tests was significant for both boys & girls. The result showed that with increasing age performance score in all physical fitness test were increasing. It is because muscular vigour increases as age advances.

Similar observations were made by **Alexander J et al**[7] in the 4×10 m shuttle-run test among 10 to 12year old children. Which is reflected by decrease in running time with increases in age.

Oliveira M. et al[8] conducted a study and found that with increase ages time taken to cover one mile distance decreased.

Similarly, **Vanhelst et al**[9] observed that mean value for Curl-up test, Sit and Reach was increasing with increase age.

Smith D et al[10] conducted a study and found that older children perform better in pull-up test that is similar to our study.

In present study physical fitness test score for pull-ups, shuttle runs, endurance run/walk were greater in boys except for the sit-and-reach test in which girls performed better than boys. Similar observation was made by **Dobosz J et al**[11] **who** conducted a study in school children aged 7 to 19 years in Poland. There was a significant difference in all physical fitness tests in boys and girls because boys have more muscular power than girls but in case of Sit and Reach test girls perform better than boys because girls are better in flexibility.

In our study there is no significant difference between BMI and physical fitness tests score in both boys & girls except in Shuttle run and Endurance run/walk in boys and curl-up tests in girls in which results showed that in BMI group of 25^{th}- 50^{th} centile the score were more compared to $<25^{th}$ centile (underweight) and >71th centile in boys and $>75^{th}$ centile in girls(obese). There is a common belief that overweight and obese children are less physically active than normal but by observation it is revealed that underweight children also have inferior performance.

Similar observations were made by **Gullu E et al**[12] and **Andreasi V et al**[13]

Adhvaryu K et al[14] found very weak negative correlation between BMI and partial curl-ups, endurance run, V-sit and reach and weak positive correlation was established between BMI and the shuttle run.

In our study mean score for curl-up test was (no. of repetition) 39.12±3.711 in boys & 36.13±3.507 in Girls. Similar results were observed by **Vanhelst J et al**[9] and **Pinero J et al**[15] in same age groups.

In our study mean score for shuttle run was 11.292±0.593 sec in Boys, 11.658±0.805 sec in Girls. **Alexander J et al**[7] found similar results and **Koulouvaris P et al**[16] observed a lower score. **Tomkinson G et al**[17] observed that shuttle run test score were more compared to our study.

In our study mean value for endurance Run/ walk (Min) was 8.9479±0.62698 for boys & girls was 10.1564±0.7853 to cover 1600m distance. **Chih-Yu Hsu et al**[18] observed 4.9min in boys and 5.2min in girls which was low to our study it is because in their study distance was 800m compared to our study.

In our study mean value for pull-ups test was 3.28±1.091 (No. of repetition) in boys & 0.96±0.665 in girls showing the higher upper limb muscle power in boys.

In our study mean values for V- sit Reach(cm) in boys was-3.186±0.5779 & for girls it was-5.617±0.9222 showing better flexibility in girls.

CONCLUSION

This study concludes

1. Age is significantly associated with physical fitness.

2. Gender is significantly associated with all physical fitness.

3. BMI also has an effect on physical fitness in both boys and girls.

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