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Age and Gender Based Variations in Health-Related Physical Fitness among School Children in Prayagraj

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ABSTRACT

This study examined age and gender based variations in Health-Related Physical Fitness (HRPF) among school children. A total of **300 students** (150 boys and 150 girls), aged10-12,13-14,15-16 years of age were selected from three schools of Prayagraj district in Uttar Pradesh divided into three groups as Group A; Group B; and Group C. Five HRPF components—Body Composition (BC), Muscular Strength (MS), Muscular Endurance,(ME) Flexibility, And Cardiovascular Endurance(CE)were assessed using standardized tests. Simple descriptive statistics, independent t-tests, and one-way ANOVA were utilized for data comparison and interpretation. Results revealed that boys outperformed girls in muscular strength, muscular endurance, and cardiovascular endurance ($p < .01$), while girls demonstrated significantly better flexibility ($p < .01$). Age-based analysis showed consistent improvement in strength and endurance across the 10–16 age range. The study highlights the importance of developing age- and gender-specific HRPF norms physical educational value not limited to the in the school environment even beyond.

INTRODUCTION

Health-Related Physical Fitness (HRPF) is an essential component of children's physical, academic, and psychological development.Research consistently demonstrates that HRPF is strongly associated with long-term health outcomes, including metabolic efficiency, cardiovascular health, and reduced risk of chronic diseases (Ortega et al., 2008;). HRPF comprises five major components namely muscular strength, muscular endurance, flexibility, cardiovascular endurance, and body composition.

The global evidence shows declining youth fitness continuously as imposing issue. Girls and boys between the ages of 11 and 17 need immediate action to boost their levels of physical activity, as evidenced by the first-ever global trends for adolescent inadequate physical activity (WHO, 2019). HRPF evaluation or digital monitoring, despite WHO's call for "*technology-supported fitness assessment in schools*" (WHO, 2020; Belton et al., 2014).Cross-cultural differences in physical education programs and sports participation appear to influence HRF in children across the Mediterranean region (Aly et al., 2025).

However, despite its importance, HRPF assessment in Indian schools remains limited. Most schools rely on manual, inconsistent evaluation methods that lack standardization and long-term monitoring capabilities. In contrast, modern educational systems increasingly integrate digital technologies to improve assessment accuracy, track student progress, and support data-driven decision making.

Gender and age are key determinants of HRPF variations. Studies indicate that boys typically perform better in strength and endurance due to biological and hormonal factors (Malina et al., 2004), while girls tend to exhibit greater flexibility (Castro-Piñero et al., 2009). Age also influences HRPF components, with performance in strength, agility, and endurance improving as children develop neurologically and physiologically (Baquet et al., 2003). By recognizing children who lack physical fitness and encouraging healthy habits like being active, with a focus on the intensity of the activity, schools can play a significant role (Ortega et al., 2005).

The present study aimed to evaluating HRPF among 300 students across three schools and examining age and gender based variations with following adjectives.

- Assess HRPF levels of 300 school children aged 10–16 years.
- Compare HRPF components between boys and girls.

- Examine age-based variations in HRPF.

METHODOLOGY

Sample

To ensure balanced representation across the participating schools, a total sample of 300 students was selected for the study. Equal numbers of boys and girls were included from each institution to maintain uniformity and minimize sampling bias. The detailed distribution of the sample across the three schools was presented in Table 1

Table 1: ***Showing the sample across the three schools of Prayagraj***

School	Boys	Girls	Total
School A	50	50	100
School B	50	50	100
School C	50	50	100
Total	150	150	300

HRPF Components

Component	Test	Unit of Measurement
Body Composition	BMI	Weight in kg / (Height in meters) ^{2}
Muscular Strength	Push-Ups	
Muscular Endurance	Sit-Ups	
Flexibility	Sit & Reach	
Cardiovascular Endurance	600 M Run	

Statistical Techniques

Mean & SD were descriptive stats summarizing data (center & spread), while t-tests & ANOVA were inferential tests determining if group differences in means are *statistically significant*; a t-test compares *two* groups (boys and girls), whereas ANOVA compared (different age groups and schools) using an F-ratio (between-group variance / within-group variance) to assess if any group means differ significantly, often requiring post-hoc tests (Tukey) to find *which* groups differ in all schools.

RESULTS

The results of the study provide a detailed overview of the student's health-related physical fitness components. The findings reveal important trends in children's fitness, motivation, and lifestyle behaviours. The following tables were represented the results in a clear and organized manner.

Table 1 showed the age-wise distribution of the study sample, highlighting the proportion of students in each age category to support meaningful comparison in subsequent analyses.

Table 1: ***Age-Wise Group Distribution of School Children***

Age Group	*Boys (N)*	*Girls (N)*	*Total (N)*	*%*
10–12 years	55	50	105	35%
13–14 years	60	60	120	40%
15–16 years	35	40	75	25%
Total	150	150	300	100%

Table 1 showed the distribution of participants across three age groups. The **13–14 years group represents the largest proportion (40%)**, followed by **10–12 years (35%)**, while the **15–16 years group accounts for 25%** of the sample. This indicates that the study includes a balanced representation of early to mid-adolescent students, allowing meaningful comparison across age-related variations in physical activity and HRPF components.

Table 2 presents the gender-wise classification of students based on their Body Mass Index (BMI), showing the distribution of boys and girls across the underweight, normal, overweight, and obese categories.

Table 2 ***Gender-Wise BMI Classification of School Children***

BMI Category	Boys (N)	Boys (%)	Girls (N)	Girls (%)
Underweight	20	13.3%	16	10.7%
Normal	88	58.7%	98	65.3%
Overweight	28	18.7%	32	21.3%
Obese	14	9.3%	4	2.7%
Total	**150**	**100%**	**150**	**100%**

Table 2 showed the gender-wise BMI classification shows notable differences between boys and girls. A higher proportion of girls (65.3%) fall within the normal BMI range compared to boys (58.7%). Boys recorded a greater percentage of obesity (9.3%) than girls (2.7%), indicating higher weight-related risk among male students. Similarly, overweight prevalence was slightly higher among girls (21.3%) compared to boys (18.7%). Underweight percentages remained relatively close, with boys at 13.3% and girls at 10.7%. These findings highlight gender-based variations in nutritional status and body composition among school children.

Table 3 provided the mean summary of various HRPF components, including BMI, muscular strength, muscular endurance, flexibility, and cardiovascular endurance, enabling comparison between boys, girls, and the overall sample.

Table 3: ***Mean of Health-Related Physical Fitness among Boys and Girls School Children***

Component	Boys	Girls	Overall
BMI	20.7	20.6	20.65
Push-Ups	17.4	13.7	15.55
Sit-Ups	26.1	23.5	24.8
Flexibility	25.1	27.6	26.35
600m Run	5.38	5.64	5.51

Table 3 shows descriptive statistics for major HRPF components for boys and girls. Boys scored higher in **push-ups** (17.4 vs. 13.7) and **sit-ups** (26.1 vs. 23.5), indicating stronger muscular strength and endurance. Girls outperformed boys in **flexibility** (27.6 vs. 25.1), which is consistent with general developmental patterns. The **600m run time** shows boys completing the run slightly faster than girls, reflecting better cardiovascular endurance. Overall, the data indicate gender-based differences across several HRPF components.

Table 4 showed the statistical comparison between male and female students using the t-test, indicating the presence or absence of significant gender differences in HRPF component performance.

Table 4 ***Gender based Comparison of Health-Related Physical Fitness among Boys and Girls School Children***

Component	t-value	p-value	Result
BMI	0.93	.35	NS
Push-ups	7.12	< .001	Boys higher
Sit-ups	6.03	< .001	Boys higher
Flexibility	–5.81	< .001	Girls higher
Endurance	5.68	< .01	Boys higher

Table 4 presents gender-based comparisons using t-tests. There is **no significant difference** in BMI between boys and girls ($p = .35$). However, boys performed significantly better in **push-ups**, **sit-ups**, and **endurance tests** ($p < .001$), reflecting higher strength and endurance levels. In contrast, girls showed significantly higher **flexibility** scores ($p < .001$). These results confirm well-established gender trends in physical fitness components.

Table 5 presented the results of the age-based comparisons using one-way ANOVA to examine whether significant differences exist among students of different age groups across the selected HRPF components.

Table 5 ***ANOVA for HRPF Components across Age Groups of 10-12; 12-14; and 14-16 years among Boys and Girls School Children***

Component	F-value	p-value	Interpretation
Strength	9.22	< .001	Strength increases significantly with age; older students demonstrate higher muscular strength.
Endurance	10.44	< .001	Endurance improves with age; cardiovascular performance is significantly better in older age groups.
Flexibility	3.74	< .05	Mild but significant variation in flexibility across age groups.
BMI	1.92	.10	Not significant; BMI does not differ meaningfully across age groups

Table 5 presented both the age-wise distribution of the students and the ANOVA results for HRPF components across the three age groups. The distribution shows that the highest proportion of students

fall within the 13–14 years category (40%), followed by 10–12 years (35%) and 15–16 years (25%). The ANOVA findings indicate that strength ($F = 9.22$, $p < .001$) and endurance ($F = 10.44$, $p < .001$) significantly improve with age, reflecting natural physical growth and increased motor capacity among older students. Flexibility shows a mild but significant difference across age groups ($p < .05$), indicating gradual age-related variation. In contrast, BMI does not differ significantly among the three age groups ($p = .10$), suggesting stable body composition patterns across the sample. These results emphasize the importance of considering age-related development when evaluating fitness levels in school children.

DISCUSSION

The results confirm significant HRPF variations based on gender and age. Boys consistently demonstrated higher muscular strength, muscular endurance, and cardiovascular endurance. These findings align with the physiological advantages documented in adolescent boys (Malina et al., 2004). Girls outperformed boys in flexibility, supporting previous research showing greater joint elasticity in females (Castro-Pinero et al., 2009).

Age-based improvements in push-ups, sit-ups, and endurance indicate natural developmental progression, consistent with international evidence (Baquet et al., 2003). To avoid the clustering of cardiovascular disease risk factors, levels of physical activity should exceed the current international guidelines, which call for at least one hour of moderate-intensity physical exercise each day (Anderson et al., 2006).

CONCLUSION

HRPF varies significantly by gender and age among school children aged 10–16 years. Boys performed better in strength and aerobic tasks, while girls showed superior flexibility. A technology-supported HRPF evaluation framework enhances assessment accuracy and helps schools monitor fitness more effectively.

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