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Age-related variations in one-mile run/walk performance among 9- to 11-year-old school girls

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Abstract
This study examined age-related differences in cardiorespiratory endurance among school-going girls aged 9, 10, and 11 years. A total of 1,500 students (500 from each age group) from DAV schools in Delhi NCR participated. The one-mile run/walk test is a common method used to assess cardiorespiratory endurance. The results demonstrated a clear improvement in performance with age: the average completion times were 14.68 minutes for 9-year-olds, 13.10 minutes for 10-year-olds, and 12.30 minutes for 11-year-olds. There were significant difference obtained between age groups ($p< 0.001$), and post-hoc analysis confirmed significant performance differences across all groups. The study concludes that cardiorespiratory endurance increases with age in this cohort, offering a baseline for tracking cardiovascular fitness enhancement and emphasizing the importance of encouraging physical activity during early childhood.

Keywords: Cardiorespiratory endurance, muscular strength, muscular endurance

Introduction
Physical activity is essential for individuals of all ages, particularly for children and adolescents, as it contributes to their overall health and development. Engaging in regular exercise promotes cardiovascular health, muscular strength, and endurance, all of which are important for maintaining physical fitness throughout life. For children, consistent physical activity not only improves general health but also plays a critical role in minimising the risk of developing chronic conditions like obesity, hypertension, and insulin resistance. Cardiorespiratory endurance, which reflects the efficiency of the heart, lungs, and muscles during sustained physical activity, is a key indicator of overall health and fitness. It allows individuals to exercise for extended periods and is often measured through tests that assess the body's ability to supply and utilize oxygen during moderate to intense physical activity. Improving cardiorespiratory endurance can lead to enhanced oxygen uptake, enabling children to engage in different form of physical activity such as running, walking, or cycling with greater ease and for longer durations.
Understanding age-related changes in cardiorespiratory endurance is particularly important for guiding physical education and health promotion efforts in schools. This study focuses on assessing how cardiorespiratory endurance, as measured by the one-mile run/walk test, differs across school-going girls aged 9, 10, and 11 years. By analyzing these disparities, the study seeks to understand how cardiovascular fitness develops during childhood and emphasize the significance of encouraging participation in physical activities during the early years of age."

Methodology
This study sought to explore age-related differences in performance on the one-mile run/walk test among school-going girls aged 9 to 11 years. A total of 1,500 female students participated, with 500 girls from each age group (9, 10, and 11 years). The participants were selected from several DAV group schools in the Delhi NCR region using purposive sampling. All participants were in good health and regularly engaged in physical education classes as part of their school curriculum. This approach ensured a representative sample for assessing variations in cardiorespiratory endurance across the different age groups.

Selection of Test

The One-Mile Run/Walk Test was used to measure the participants' cardiovascular endurance.

This test is commonly used in educational settings due to its effectiveness in measuring aerobic capacity and endurance in children. It provides a reliable indicator of overall cardiovascular fitness and is well-suited for assessing endurance in a school-based environment.

Procedure

Before starting the test, participants received detailed instructions about the One-Mile Run/Walk Test procedures. They were briefed on how to perform the test and the objectives involved. The test was conducted on a standard 400-meter track, with each participant covering a total distance of 1,600 meters (one mile). Participants were free to choose their pace, whether running or walking, to complete the distance in the shortest time possible. To ensure smooth execution and avoid congestion, participants completed the test in small groups. Before starting the test, a 10-minute warm-up session was held, which included light jogging and dynamic stretching to prepare the participants physically and minimize the risk of injury.

Data Collection

The time taken for each participant to complete the one-mile run/walk was recorded using a stopwatch. Trained research assistants were stationed at the track to ensure precise timing and to provide guidance throughout the test. Each participant's performance was documented in minutes and seconds.

Ethical Considerations

The participant submitted informed consent duly signed by their parents to act as subjects for the study. The participants were given the choice of withdrawal from the research at any time if they feel so. The tests were conducted under ethical guidelines for research involving human subjects, ensuring the safety and well-being of all participants.

Statistical Analysis

Descriptive statistics, including mean and standard deviation, were calculated for the time taken to complete the one-mile run/walk test for each age group. To assess age-related differences in performance, an analysis of variance (ANOVA) was performed. Post hoc tests were subsequently conducted to pinpoint significant differences between the age groups. Additionally, to find out the relationship of age with performance correlation coefficient was calculated. The significant threshold to statistical analyses was kept at $p < 0.05$.

Table 1: Mean and standard deviation scores of cardiorespiratory endurance in girls aged 9 to 11

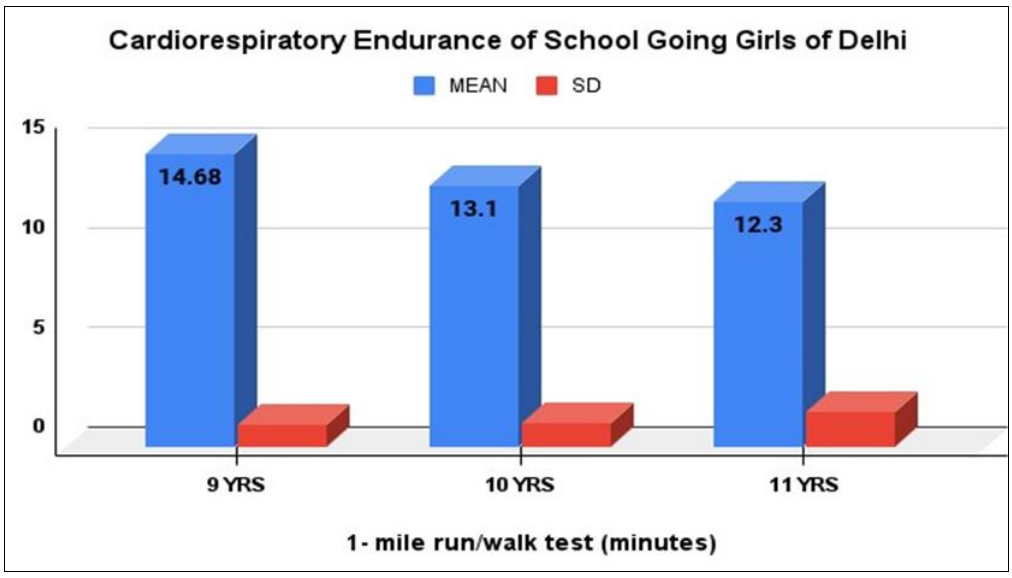
Cardiorespiratory Endurance in School-Going Girls of Delhi [Mean and Standard Deviation]						
Test Item	9 Yrs		10 Yrs		11 Yrs	
	Mean	Sd	Mean	Sd	Mean	Sd
1- mile run/walk test (minutes)	14.68	1.13	13.10	1.23	12.30	1.81

Analysis of the Data

Table 1 presents the mean and standard deviation values for the cardiorespiratory endurance in school girls aged 9 to 11 years. The results indicate an age-related enhancement in cardiorespiratory endurance, with 9-year-olds averaging 14.68 minutes (SD = 1.13), 10-year-olds averaging 13.10 minutes (SD = 1.23), and 11-year-olds averaging 12.30 minutes (SD = 1.81) to complete the test. This data reveals a consistent decrease in completion time with increasing age, suggesting a notable improvement in aerobic capacity as the children grow older.

The mean and standard deviation scores obtained in the selected age groups have been presented in Figure number 1.

Fig No. 1: Mean and Standard Deviation Scores of performance in Cardiorespiratory Endurance in Girls aged 9, 10, and 11 years.



ANOVA Results

To assess whether the differences in performance between age groups were statistically significant, a one-way ANOVA was conducted. The result of the analysis has been tabulated below.

Table 2: ANOVA Values of performance in Cardiorespiratory Endurance in Girls aged 9, 10, and 11 years

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1469.328	2	734.664	364.471	.000
Within Groups	3017.501	1497	2.016		
Total	4486.829	1499			

The results, detailed in Table 2, revealed a significant F-ratio ($F = 364.471$, $p < 0.0005$), indicating that there are meaningful differences in cardiorespiratory endurance among the three age groups.

These ANOVA results confirm that the variations in mean completion times for the one-mile run/walk test among the age groups are highly significant ($p < 0.0005$).

To understand the difference between various age groups since F statistics was significant, Tukey post hoc test was computed and the result is summarized in table below:

Table 3: ANOVA Post Hoc Test Values of Performance in Cardiorespiratory Endurance in Girls aged 9, 10, and 11 years

Cardio-Respiratory Endurance Tukey HSD						
Age groups		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
9	10	1.584*	.089	.0005	1.37	1.79
	11	2.381*	.089	.0005	2.17	2.59
10	11	.797*	.089	.0005	.58	1.00
* There is a significant mean difference ($p < 0.05$).						

Post Hoc Analysis (Tukey HSD)

To pinpoint the specific differences between age groups, a Tukey HSD post hoc test was performed, with results summarized in Table 3. This analysis showed significant differences between all age groups ($p < 0.001$):

- The difference in time between 9 and 10-year-old was 1.584 minutes ($p < 0.0005$).
- The difference in time between 9 and 11-year-old was 2.381 minutes ($p < 0.0005$).
- The difference in time between 10 and 11-year-old was 0.797 minutes ($p < 0.0005$).

These findings confirm that, with increasing age, there is a notable improvement in performance on the one-mile run/walk test. Specifically, 11-year-old completed the test in the shortest time, followed by 10-year-old, with 9-year-old showing the longest completion times.

Discussion of Findings

The study reveals a notable age-related enhancement in cardiorespiratory endurance among school-going girls aged 9 to 11 years. The average time to complete the one-mile test reduced from 14.68 minutes for 9-year-olds to 12.30 minutes for 11-year-olds, highlighting a consistent improvement in performance as the girls aged. As age increased, the mean completion time for the one-mile run/walk test decreased significantly, indicating an improvement in cardiovascular fitness with growth. The analysis demonstrated statistically significant differences between the age groups, confirming that older girls performed better on the test.

The ANOVA results revealed significant differences in performance between the age groups ($p < 0.0005$). Post hoc comparison confirmed that there were differences in test completion times between all age groups were statistically significant.

Few research studies support the findings of age-related improvements in cardiorespiratory endurance and the importance of promoting physical activity among school-aged children: The study by Beets & McKenzie, (2014) [5], highlights the correlation between physical activity and improvements in cardiorespiratory endurance among children, demonstrating that increased physical activity contributes to better aerobic capacity and endurance as children age. Eisenman and Wickel (2009) [6] discuss how physical fitness, including cardiorespiratory endurance, typically improves with age due to physiological development and increased participation in physical activities. The findings by Ortega *et al*., (2008) [14]. Examines how cardiorespiratory fitness improves with age and emphasizes the role of physical fitness as an indicator of overall health and well-being in children. Malina and Bouchard (2004) [10] offer a comprehensive review of the impact of physical activity on physical fitness development, particularly cardiovascular endurance, and how this varies across different age groups. The WHO (2010) recommendations support the notion that physical activity is necessary for maintaining and improving cardiovascular fitness among children and adolescents, reinforcing the findings that aerobic exercises positively impact cardiorespiratory fitness over time. These studies collectively reinforce the observation that cardiorespiratory endurance improves with age and the significance of encouraging physical activity involvement for cardiovascular development in children.

The results underscore the significance of promoting physical activity and aerobic exercises among school-aged girls to support their cardiovascular development.

Conclusion

The following conclusions are drawn in light of the results obtained and data analysis:

- The study confirms that cardiorespiratory endurance improves with age among school-going girls, as evidenced by a decrease in the mean time to complete the one-mile run/walk test.
- The statistically significant differences between age groups highlight the developmental enhancement in aerobic capacity over time.
- These findings emphasize the need for ongoing encouragement of physical activity and structured aerobic exercises to support cardiovascular health and fitness during these critical developmental years.
- The study serves as a useful reference for evaluating and fostering cardiovascular endurance in young girls and supports the implementation of comprehensive physical education programs.

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