ORIGINAL ARTICLE

Change of health-related fitness with respect to age for adolescent boys

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ABSTRACT

Adolescence marks a crucial period for the establishment of physical health and fitness, shaping future adult health trajectories. This study aimed to investigate the changes in health-related fitness concerning age among adolescent boys. A sample of 80 students aged 13-16 from Upashahar Maddhamic Viddalay, Jashore, was selected at random to assess health-related fitness components including low back and hamstring flexibility, abdominal muscle strength endurance, upper-body strength (chin-ups), and body composition. Fitness was assessed by measuring the components of Health-Related Physical Fitness as prescribed by AAHPERD (1984). In addition to these fitness components the body composition of the subjects was assessed by measuring triceps and subscapular skin folds, all their parameters were the criteria for measurement in the present study. Statistical analyses, including mean values, standard deviation, and 't' tests (where table value at .05 levels for of 38 was 2.02), were conducted to determine significant differences across age groups. The results indicate that abdominal muscle strength endurance, as measured by sit-ups, showed significant differences at .05 level between age groups, with class VII and IX exhibiting higher mean values compared to class VIII and X. This suggests that factors such as academic pressure and lifestyle choices may impact physical fitness levels among adolescent boys. However, when considering upper-body strength, flexibility, and body fat percentage, the study did not find significant differences between age groups. This indicates that these aspects of health-related fitness may be less influenced by age alone and more by individual factors or environmental influences.

Keywords: Physical education, Adolescent boys, Health-related fitness, Flexibility, Muscle strength, Body composition.

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INTRODUCTION

Adolescence is a critical period in which physical health and fitness are established, laying the foundation for future patterns of adult health (Mitchell, 2019). During this stage of development, there are significant changes that occur in terms of biological and social factors, such as puberty and the attainment of social roles (Barendse & Pfeifer, 2021; Frank, 1945). These changes, along with various social determinants and risk and protective factors, can greatly impact the uptake of health-related behaviours among adolescent boys (Adelmann, 2005; Reingle et al., 2013). One important aspect of health during adolescence is health-related fitness. Health-related fitness refers to the overall physical well-being and ability of individuals to perform daily activities and tasks (Solera Sánchez, 2022). It encompasses various components, including cardiovascular endurance, muscular strength and endurance, flexibility, and body composition (Gopal, 2014). Understanding the changes in health-related fitness with respect to age is crucial for promoting and maintaining optimal health among adolescent boys (Maciulevičienė et al., 2018). There is a growing body of research that suggests that health-related fitness levels can vary significantly during adolescence (García-Hermoso, 2023). Regular physical exercise during adolescence has been associated with numerous health benefits including improved muscle and bone health, increased strength and endurance, reduced risk of chronic diseases such as overweight and diabetes, improved self-esteem and psychological well-being, and reduced stress, anxiety, and depression (Archer, 2014; Harold W. Kohl et al., 2013; Jančiauskas, 2018; Warburton, 2006; Wolf, 2001). Given the importance of physical fitness for adolescent boys, it becomes essential to understand how health-related fitness changes with respect to age in this population.

Multiple factors contribute to the changing landscape of health in adolescence. These factors include prenatal and early childhood development, the specific biological and social changes that occur during puberty, and social determinants and risk and protective factors that influence adolescents' health-related behaviours (Jimenez et al., 2023; Sawyer et al., 2012; Viner et al., 2017). The shape of adolescence is rapidly evolving, with the age of onset of puberty decreasing and the age at which mature social roles are achieved increasing (Viner et al., 2017). Previous studies have shown that there is a positive correlation between age and health-related fitness components, such as agility, speed, vertical jump, and broad jump (Binishi & Skenderi, 2024; Boby & Shara, 2023; Doğru, 2019; Emeljanovas et al., n.d.; Gisladottir et al., 2024).

A remarkable lack of research has been done on Bangladeshi children, whose cultural background may influence the relationship between age and fitness differently. Cultural norms may limit an individual's degree of fitness, for example, by placing a higher value on education than on physical activity. Examining the relationship between age and physical fitness could help shape policy in the field of education by assisting in the development of curriculum that support physical education while promoting learning. Development of health-related physical fitness is a natural consequence of the development of the physique in the process of growth and development (Utesch et al., 2018). The status of fitness depends on many factors like age, sex, nutrition, life style, participation in physical activities etc (Harold W. Kohl et al., 2013). Study of class VII to class X difference has become an important focus for the researcher from different fields. It is understood that in the life style, cultural pattern, food habit, living condition, attitude and many other aspects of human living there are difference between the classes (Jeong & Lee, 2021; Nemec, 2020). Same is the case for physical fitness and physique for schoolboys from class VII- X. The only difference is their age and lifestyle. In our country the school has to face two board exams in the class of VIII & X. It may put an impact in their body composition also. The food habit and health related fitness is different from one class from other. Thus the present study was planned to analyse the change of health-related fitness with respect to age for adolescent boys of Bangladesh.

METHODOLOGY

Present study was conducted to know the status of Health Related Physical Fitness of Adolescent boys. A total of 80 students within the age group of 13-16 years were selected as subjects for the present study where 20 of them were from class VII, 20 from class VIII, 20 from IX and 20 from X selected from Upashahar Maddhamic Viddalay, Jashore. Fitness was assessed by measuring the components of Health-Related Physical Fitness as prescribed by AAHPERD (1984). The measured fitness components were, low back and hamstring flexibility (measured by sit and reach test), abdominal muscle strength endurance (measured by bent knee sit ups test for one min) in addition to these fitness components the body composition of the subjects was assessed by measuring triceps and subscapular skin folds, all their parameters were the criteria for measurement in the present study. Before conducting the tests, subjects were assembled in a room and took consent of the subjects. The purpose of the tests were explained and told to exert as best as possible in the tests for achieving their best performance. For collecting data, the tests were conducted in the following order. At first the skin folds for different sites of the body were measured. Thereafter the subjects were tested for low back and hamstring flexibility by sit and reach test. Then the subjects were tested for abdominal muscle strength endurance by Bent knee sit ups test.

Statistical analysis

For statistical analysis, mean, standard deviation (SD), and 't' test were calculated by the below mention formulae:

$\bar{X} = \frac{\sum X}{N}$ (Where, $\bar{X}$denotes the mean, "$\sum X$" denote the sum total of scores and N denotes the number of scores)

S.D $(o) = \sqrt{\frac{(X-\bar{X})^2}{N}}$ (where o denotes the standard deviation, $\sum(X-\bar{X})^2$denote the total of square of the deviation and N denotes the number of scores)

't' test (t)= $\frac{\bar{X}1-\bar{X}2}{d\sqrt{[(01)/N1+(02)^2/N2]x}}$

RESULTS

The Mean Values and SD of sit ups, chin up, sit and reach and body fat % are given in the Table 1.

Table 1. Mean values of sit ups, chin-up, sit and reach and body fat %.

Class	Sit Ups	Chin ups	Sit and reach	Body fat %
VII	29.45 ± 3.904	3.4 ± 1.392	6.65 ± 6.234	12.856 ± 3.934
VIII	24.45 ± 5.97	3.45 ± 2.290	6.5 ± 4.60	15.046 ± 5.923
IX	30.55 ± 6.806	4.6 ± 2.177	8.7 ± 5.588	15.749 ± 5.694
X	27 ± 5.932	5.8 ± 3.627	29.45 ± 7.083	16.092 ± 5.399

It is seen from the Table 1, both the groups were within the age group of 13-16 years. Further, it is seen that the mean sit ups of class VII is 29.45 and SD is ±3.904. For class VIII the Mean of sit ups is 24.45 and SD is

±5.97. For class IX the Mean of sit up is 30.56 and SD is ±6.806 and for class X the mean is 27 and SD is ±5.932.

The mean values of chin up of class VII, VIII, IX and X are 3.40, 3.45, 4.6 and 5.9 and the SD are ±1.392, ±2.290, ±2.177 and ±3.627. The mean values of sit and reach of class VII, VIII, IX and X are 6.65, 6.5, 8.7 and 5.375. The SD of sit and reach of class VII, VIII, IX and X are ±6.234, ±4.60, ±5.588 and ± 7.83.

The mean values of body fat % of class VII, VIII, IX and X are 12.856, 15.046, 15.749 and 16. 092. The SD of The SD body fat of class VII, VIII, and X are ±3.934, ±5.923, ±5.694 and ±5.399. It is noted that, the boys from class VII and IX has greater mean value then class VIII and maybe it is because of the board exam or something else. Or the eating habit may be a cause. The formula to measuring % body fat is 1.35(sum of 2 SK)-.012(sum of 2 SK) 2-4.4.

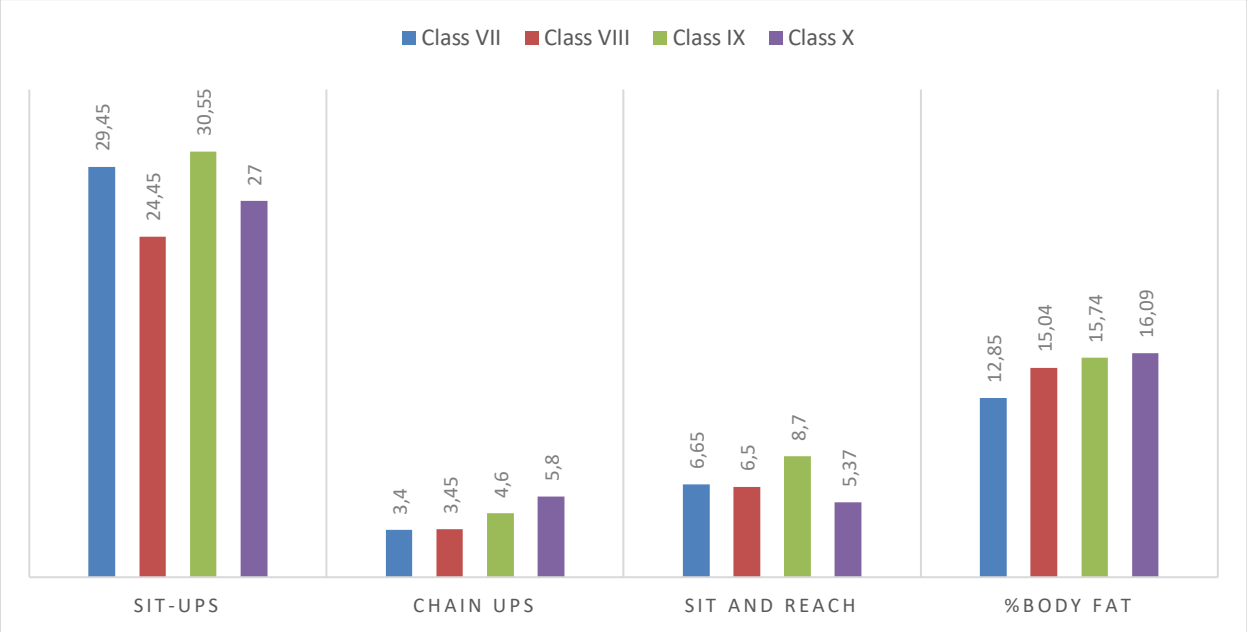

Figure 1. The bar graph on Mean values of sit ups, chin-up, sit and reach and body fat %.

Table 2. Testing statistical significance of mean difference in sit-ups.

Mean value				Mean Difference	Degrees of freedom	"*t*"	Remark
VII	VIII	IX	X		N1+N2-2		
29.45	24.45			5	38	3.134	Significant
	24.45	30.55		-6.1	38	3.038	Significant
		30.55	27	3.55	38	1.759	Not Significant

Note. Table value at .05 levels for df 38 is 2.02.

It is noted that, the boys from class VII and IX has greater mean value then class VIII and X. Maybe it is because of the board exam or something else. In class VIII and X the parent's and the students give much importance to education then playing games and sports. And the boys from class VII and IX gets much playing time then class VIII and X. But the 't' value (Table 2) indicates that the mean difference in abdominal strength endurance between the groups was statistically significant at .05 level except for IX and X.

Next component for Health-related Physical fitness was chin-up (upper-body strength). The mean values and corresponding's' value have been presented in Table 3.

Table 3. Testing statistical significance of mean difference in chin-up.

Mean value				Mean Difference	Degrees of freedom	"*t*"	Remark
VII	VIII	IX	X		N1+N2-2		
3.40	3.45			-0.05	38	0.0836	Not Significant
	3.45	4.6		-1.15	38	1.628	Not Significant
		4.6	5.8	-0.12	38	1.269	Not Significant

Note. Table value at .05 levels for df 38 is 2.02.

It is noted that, the boys from class VII and IX has greater mean value then class VIII and X. Maybe it is because of the board exam or something else. In class VIII and X, the parent's and the students give much importance to education then playing games and sports and physical exercise. And the boys from class VII and IX gets much playing time then class VIII and X. But the 't' value (Table 4) indicates that the mean difference in upper-body strength between the groups was statistically not significant at .05 level.

Next component for Health-related Physical fitness was sat and reach. The mean values and corresponding's' value have been presented in Table 4.

Table 4. Testing statistical significance of mean difference in sit and reach.

Mean value				Mean Difference	Degrees of freedom	"*t*"	Remark
VII	VIII	IX	X		N1+N2-2		
6.65	6.5			0.15	38	0.086	Not Significant
	6.5	8.7		-2.2	38	1.359	Not Significant
		8.7	5.375	3.325	38	1.648	Not Significant

Note. Table value at .05 levels for df 38 is 2.02.

It is noted that, the boys from class VII and IX has greater mean value then class VIII and X in sit and reach test. Maybe it is because of the board exam or something else. In class VIII and X, the parent's and the students give much importance to education then playing games and sports. And the boys from class VII and IX gets much playing time then class VIII and X. But the 't' value (Table 4) indicates that the mean difference in Low-back and hamstring flexibility between the groups was statistically not significant at .05 level.
Next component for Health-related Physical fitness was % body fat. The mean values and corresponding's' value have been presented in Table 5.

Table 5. Testing statistical significance of Mean Difference in body fat %.

Mean value				Mean Difference	Degrees of freedom	"*t*"	Remark
VII	VIII	IX	X		N1+N2-2		
12.856	15.046			-2.19	38	1.378	Not Significant
	15.046	15.749		-0.703	38	0.382	Not Significant
		15.749	16.092	-0.343	38	0.195	Not Significant

Note. Table value at .05 levels for df 38 is 2.02.

It is noted that, the boys from class VII and IX has greater mean value then class VIII and X. Maybe it is because of the board exam or something else. In class VIII and X, the parent's and the students give much importance to education then playing games and sports and physical exercise. And the boys from class VII and IX gets much playing time then class VIII and X. But the 't' value indicates that the mean difference in body fat % between the groups was statistically not significant at .05 level.

DISCUSSION

This study offers critical insights into the patterns of health-related fitness of adolescent boys. The research revealed variations in physically fitness components between age groups. These results may be informative regarding the influence of age on the components of health-related fitness critical to this demographic.

The results of the study show that the differences in abdominal muscle strength endurance were significant between several age groups. The most noticeable discrepancies were between class VII to VIII, and VIII to IX. These results indicate that adolescent boys undergo distinguishable changes in abdominal muscle strength endurance as they pass through different stages of adolescence. Academic pressure, varying lifestyle changes, and social influence could be responsible for some of these variations. It is, however, worthwhile to note that the class IX had the highest mean values of sit-ups. Adolescents at this stage may have more abdominal muscle strength endurance when compared to their counterparts at other stages. Comparing these findings with existing literature reveals both similarities and differences with previous research conducted in diverse cultural and geographic settings. Similar to studies conducted in other countries, this research identified significant differences in abdominal muscle strength endurance between certain age groups, indicating potential variations in physical fitness levels as adolescents' progress through adolescence (Dotsenko & Minniakhmetov, 2022; Hafsteinsson Östenberg et al., 2022; Nimkar et al., 2020; Vitali et al., 2019).

Moreover, the differences between these age groups were not statistically significant. These factors may not significantly affect the upper body and chin-up strength in all stages of this developmental period across age groups. Some variations in the average values have also been recorded across age groups, with none of them showing a significant statistical difference. It is necessary to conduct more research to determine the factors influencing the patterns in upper-body strength in teenage boys. However, the lack of significant differences in upper-body strength across age groups aligns with findings from some studies that suggest upper-body strength may not vary significantly during adolescence (Ervin et al., 2014; Guimarães et al., 2021; Skattebo et al., 2016; Tingelstad et al., 2023).

As with the upper-body strength, we did not identify any statistical significance surrounding the variations in low back and hamstring flexibility. Specifically, the sit-and-reach test indicated no meaningful differences across the youth culture. This means that levels of flexibility may be quite constant during the adolescent period in boys irrespective of the specific age. However, mean values showed some degree of variation across the age groups. Although the groups exhibited different mean values, these could not be confirmed as statistically significant. As such, additional moderation is required to find out precisely what affects the flexibility among adolescent boys. In terms of flexibility, the current study's findings of no significant differences between age groups contrast with some previous research indicating age-related improvements in flexibility during adolescence (Ávalos-Ramos et al., 2023; Rangul et al., 2011; Shao & Zhou, 2023; Shokrvash et al., 2013; Van Sluijs et al., 2021). This disparity may be attributed to cultural differences in physical activity habits, lifestyle factors, or methodological variations in assessing flexibility.

The results also showed that there were no statistically significant variations in body fat percentage among the various age groups. This indicates that among adolescent boys in Bangladesh, age may not have a significant impact on variances in body fat percentage. It is important to note, however, that although there was a minor variation in mean values between age groups, this difference was not statistically significant. To more precisely identify the variables influencing differences in body fat percentage among teenage boys, more research may be required. The absence of significant differences in body fat percentage across age groups in this study is consistent with findings from certain research, suggesting that body fat percentage may remain relatively stable during adolescence in some populations (De Pádua Cintra et al., 2013; Gemelli et al., 2020). However, contrasting findings from other studies have reported age-related changes in body composition, indicating potential cultural and contextual influences on body fat distribution and metabolism (Kim et al., 2013; Trang et al., 2019).

Understanding the changes in health-related fitness with respect to age among adolescent boys is crucial for developing targeted interventions and promoting optimal health outcomes. The findings of this study provide valuable insights into the physical fitness patterns among adolescent boys in Bangladesh. However, further research is needed to explore the complex interplay of factors influencing health-related fitness during adolescence, including socio-cultural influences, lifestyle behaviours, and environmental factors.

Additionally, future studies could benefit from larger sample sizes and longitudinal designs to examine the trajectory of health-related fitness across different stages of adolescence more comprehensively. Moreover, qualitative research methods such as interviews or focus groups could help elucidate the underlying factors shaping health-related fitness behaviours and outcomes among adolescent boys. By addressing these research gaps, policymakers, educators, and healthcare professionals can develop targeted interventions to promote physical activity, healthy lifestyles, and overall well-being among adolescent boys in Bangladesh and beyond.

CONCLUSION

In conclusion, our study aimed to analyse the changes in health-related fitness with respect to age among adolescent boys. We found that there are significant variations in certain components of health-related fitness across different age groups, while others remain relatively consistent. Our findings indicate that abdominal muscle strength endurance, as measured by sit-ups, showed significant differences between age groups, with class VII and IX exhibiting higher mean values compared to class VIII and X. This suggests that factors such as academic pressure and lifestyle choices may impact physical fitness levels among adolescent boys. However, when considering upper-body strength, flexibility, and body fat percentage, our study did not find significant differences between age groups. This indicates that these aspects of health-related fitness may be less influenced by age alone and more by individual factors or environmental influences.

AUTHOR CONTRIBUTIONS

The authors contributed to the study as follows: Asif Iqbal contributed to study design, data collection, statistical analysis, and funds collection. Farjana Akter Boby was involved in study design, data collection, statistical analysis, manuscript preparation, and funds collection. Dr. Mohammad Sohel participated in statistical analysis, manuscript preparation, and funds collection. Hannan Mia was responsible for manuscript preparation, and funds collection.

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No potential conflict of interest was reported by the authors.

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