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Traditional physical practices as determinants of motor fitness: A study on tribal children in West Bengal

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Abstract
This study examines the impact of indigenous physical activities on motor fitness among tribal school boys in Jalpaiguri district, West Bengal. A total of 200 male students, aged 12-16 years, were selected from five rural schools and categorized equally into four age groups (12-13, >13-14, >14-15, >15-16 years) through purposive sampling. Motor fitness was assessed using the AAHPERD Youth Fitness Test, covering pull-ups, sit-ups, 50-meter sprint, shuttle run, standing broad jump, and 600-meter run. Quantitative analyses using descriptive statistics, one-way ANOVA, and Turkey's HSD post-hoc tests revealed significant age-wise improvements (p<0.001) in all six motor fitness components. Notably, pull-up and sit-up means more than doubled from youngest to oldest group, while sprint, shuttle run, and 600-meter run times decreased markedly, signifying improved speed, agility, and cardiovascular endurance. Turkey's HSD showed that most significant gains occurred in early adolescence, with continuous improvement across variables except for some plateauing in speed and endurance after age 15. The findings highlight the substantial benefits of regular indigenous activity for motor fitness development and recommend integration of such practices within school curricula. Further research is suggested to broaden understanding to other genders and regions.

Keywords: AAHPERD test, West Bengal, Jalpaiguri, ANOVA, Turkey's HSD, indigenous physical activities, motor fitness, tribal school boys, adolescence, purposive sampling

Introduction
Adolescence represents a critical period of rapid physical, physiological, and psychosocial development (WHO, 2022; Patton, *et al*., 2016) [23, 15]. During this phase, physical fitness is shaped by a combination of genetic, environmental, nutritional, and socioeconomic influences (Ghosh, 2024; Tomporowski, *et al*., 2008) [7, 21]. In India's Dooars region of West Bengal, tribal populations maintain distinctive cultural identities, lifestyles, and socioeconomic circumstances, which may affect physical fitness patterns among adolescents (Ghosh, 2024; Sil, 2012) [7, 19]. Previous research suggests that differences in living conditions and activity environments contribute to variations in health and physical performance across population groups (Abadi and Nugroho, 2024; Ghosh and Kathayat, 2023; Sabzi, *et al*., 2023) [1, 8, 17]. The present study aims to systematically compare the physical fitness components of tribal male students aged 12-16 years using standardized assessment protocols. Additionally, this research seeks to identify key determinants underlying observed fitness disparities, with the broader goal of informing school-based health interventions and evidence-based policy development in similar sociocultural contexts.

Materials and Methods
This quantitative, cross-sectional study included a purposive sample of 200 tribal boys aged 12 to 16 years, recruited from five rural schools in the Jalpaiguri district of West Bengal. Participants were stratified into four age groups: T_1 (12-13 years), T_2 (>13-14 years), T_3 (> 14-15 years), and T_4 (> 15-16 years), with 50 boys in each group. Eligibility required active engagement in regular indigenous games, ensuring the sample reflected habitual participation in traditional physical activities.

Motor fitness was evaluated using the AAHPERD Youth Fitness Test, which comprises six components: Pull-ups (assessing upper body strength and endurance), sit-ups (core muscular endurance), 50-meter sprint (speed), shuttle run (agility), standing broad jump (explosive leg power), and 600-meter run (cardiovascular endurance).

Descriptive statistics (mean and standard deviation) were calculated for each performance variable across age groups. Differences between age groups were analyzed using one-way analysis of variance (ANOVA). Where the ANOVA indicated significance, Turkey's Honest Significant Difference (HSD) post-hoc test was conducted to identify specific pairwise differences. Statistical significance was set at $p<0.05$ and $p<0.001$.

Results

Table 1: Mean and standard deviation of selected motor fitness components among tribal school boys across four age groups

Selected Variables		Different Age Groups				Statistical Methods
		12-13 (T_1), N=50	>13-14 (T_2), N=50	>14-15 (T_3), N=50	>15-16 (T_4), N=50	
AAHPERD Youth Fitness Test	Pull-ups	4.24 1.9	6.16 1.49	7.72 2.00	10.1 2.7	M SD
	Sit-ups	25.7 3.54	28.7 3.74	33.32 4.66	41.14 4.68	M SD
	50 mtr.	8.96 0.83	8.62 0.77	8.18 0.45	8.04 0.59	M SD
	SR		9.52 0.92	9 0.93	8.43 0.88	M SD
	SBJ	205.1 5.62	210.64 4.84	214 5.99	219.48 5.13	M SD
	600 mtr.	125.2 17.6	120 3.45	120.8 21.91	112.66 5.86	M SD

M=Mean, SD=Standard Deviation

Table 2: Age wise ANOVA for selected motor fitness component scores among tribal boys

Source of Variation		Pull-ups	Sit-ups	50 mtr.	SR	SBJ	600 mtr
Groups (Between groups), DF=3	SS	921.98	6783.86	26.51	35.11	5451.9	4055.34
	MS	307.32	2261.29	8.84	11.7	1817.3	1351.78
Error (within group), DF=196	SS	838.42	3435.9	90.14	165.68	5744.5	40971.22
	MS	4.28	17.53	0.46	0.85	29.31	209.04
Total	SS, DF=199	1760.39	10219.76	116.65	200.79	11196.39	45026.56
F-value		71.84	128.99	19.22	13.85	62.01	6.47
P-value		0.00	0.00	0.00	0.00	0.00	0.00

DF=degree of freedom, SS=Sum of square, MS=Mean square

Table 3: Turkey's HSD comparisons for selected motor fitness components among tribal school boys by age group

Pair		Pull-ups	Sit-ups	50 mtr.	SR	SBJ	600 mtr
T_1: T_2	D	1.92	3	0.35	0.17	5.54	5.2
	Q=D/SE	6.56	5.07	3.63	1.29	7.24	2.54
	P-value	0.00	0.00	0.05	0.8	0.00	0.28
T_2: T_3	D	1.56	4.62	0.43	0.52	3.36	0.8
	Q=D/SE	5.33	7.8	4.49	4.01	4.39	0.39
	P-Value	0.00	0.00	0.01	0.03	0.01	0.99
T_3: T_4	D	2.38	7.82	0.15	0.57	5.48	8.14
	Q=D/SE	8.14	13.21	1.52	4.41	7.16	3.98
	P-Value	0.00	0.00	0.7	0.01	0.00	0.03
SE		0.29	0.59	0.1	0.13	0.77	2.04
CM		1.07	2.17	0.35	0.48	2.81	7.49

D=Different between means, SE=Standard error, CM=Critical mean

The findings of the present study are summarised in Tables 1-3

Table 1 presents the mean values for the six motor fitness components pull-ups, sit-ups, 50-meter sprint, shuttle run, standing broad jump, and 600-meter run-across the four age groups of tribal school boys. Results indicate progressive improvements in performance with age.

- **Pull-ups:** Mean repetitions increased from 4.24 (SD=1.90) at ages 12-13 to 10.10 (SD=2.70) at ages 15-16, reflecting substantial upper body strength gains.
- **Sit-ups:** Means rose from 25.70 (SD=3.54) to 41.14 (SD=4.68), indicating improved core muscular endurance.
- **50-meter sprint:** Times decreased from 8.96 seconds (SD=0.83) to 8.14 seconds (SD=0.59), demonstrating better sprinting speed.
- **Shuttle run:** Times decreased from 9.35 seconds (SD=0.94) to 8.43 seconds (SD=0.88), reflecting enhanced agility and quickness.
- **Standing broad jump:** Distances increased from 205.10 cm (SD=5.62) to 219.48 cm (SD=5.13), showing improved explosive leg power.
- **600-meter run:** Times decreased from 125.20 seconds (SD=17.60) to 112.66 seconds (SD=5.86), indicating superior aerobic endurance.

Table 2 contains the results of the one-way ANOVA, which revealed statistically significant differences among the four

age groups for all six motor fitness variables, $p<.001$. The large F-values for each test confirm that performance systematically improves from early to late adolescence.

Table 3 presents Turkey's HSD post-hoc comparisons, identifying where specific age-group differences occurred. Most components displayed significant gains between each successive group, except for the 50-meter sprint and 600-meter run, which showed a plateau effect beyond the 14-15 years group. Overall, results support the conclusion that motor fitness develops consistently across adolescence, with variation in improvement rates between components.

Discussion

The present findings confirm that tribal adolescent boys in Jalpaiguri exhibit steady improvement in multiple motor fitness domains between ages 12 and 16. Consistent with prior research suggesting that adolescence is a critical period for rapid neuromuscular and cardiovascular development (Ghosh and Roy, 2025; Lloyd and Oliver, 2012; Malina, *et al*., 2004) [9, 12, 14]. The steady gains in pull-ups and sit-ups likely reflect the combined effects of increased muscle mass, neuromuscular coordination, and habitual physical activity (Patton, *et al*., 2016; Bandyopadhyay, 2015; Tomporowski, *et al*., 2008; Beunen and Malina, 1988) [15, 2, 21, 3]. The improvement in standing broad jump distances indicates progressive development of lower-limb explosive strength, consistent with studies reporting age-related increases in muscle cross-sectional area and fast-twitch fiber recruitment (Chatterjee, *et al*., 2010; Van Praagh and Doré, 2002) [4, 22]. Enhancements in shuttle run performance and 50-meter sprint times suggest improved speed and agility, possibly due to better motor control, stride mechanics, and anaerobic energy system capacity (Gabbett, 2008) [5]. Interestingly, the plateau effect observed in the 50-meter sprint and 600-meter run after 14-15 years may be related to maturation timing differences. Adolescents reaching peak height velocity earlier may achieve near-maximal performance in certain fitness components sooner than their peers (Majumdar, *et al*., 2010; Philippaerts, *et al*., 2006) [13, 16]. This trend also underscores the influence of both biological maturation and environmental factors such as training exposure, nutrition, and socio-cultural differences of tribal groups (Singh and Purty, 2018; Kumar, *et al*., 2015) [20, 10].

Analysis

The impact of indigenous physical activity on the motor fitness of tribal school boys has been systematically assessed, using consistent robust quantitative statistical methods. Descriptive statistics indicated progressive, significant improvements across all measured motor fitness variables-namely, pull-ups, sit-ups, 50-meter sprint, shuttle run, standing broad jump, and 600-meter run-across the four age groups (see Table 1). These gains underscore expected age-related developmental trends in adolescent populations (Sabzi, *et al*., 2023; Patton, *et al*., 2016) [17, 15].

The results of the one-way analysis of variance (ANOVA) demonstrated that performance differed significantly among the four age groups for each fitness variable, with all F-values surpassing thresholds for statistical significance, $p<.001$ (see Table 2), thereby confirming that motor fitness increases reliably with age. Post-hoc analyses employing Turkey's HSD identified the developmental windows where the most pronounced gains occurred-typically from early to mid-adolescence for indicators of strength and endurance, and from mid to late adolescence for speed and cardiovascular capacity (see Table 3). These outcomes support prior literature regarding the benefits of habitual, culturally rooted physical activities and the developmental trajectory of motor skill acquisition during adolescence (Sabzi, *et al*., 2023; Sarkar and Mondal, 2012; Majumdar, *et al*., 2010; Malina, *et al*., 2004) [18, 13, 17].

Collectively, the ANOVA and Turkey's HSD results provide strong empirical evidence that sustained participation in indigenous physical activities uniquely and positively enhances multiple domains of motor fitness among tribal school boys. These findings support the integration of culturally relevant physical activities within school curricula as an effective strategy for promoting holistic adolescent health and fitness (George, *et al*., 2025; Linga, *et al*., 2024; Sabzi, *et al*., 2023; Tomporowski, *et al*., 2008) [6, 11, 17, 21].

Conclusion

This study evaluated the impact of indigenous physical activities on the motor fitness of tribal school boys aged 12-16 years in Jalpaiguri district, West Bengal, using the AAHPERD Youth Fitness Test. The results clearly demonstrate that sustained engagement in culturally relevant, physically demanding activities is associated with significant improvements across multiple motor fitness components, including strength, endurance, speed, agility, and explosive power.

Performance gains were observed progressively with advancing age, with statistical tests confirming highly significant differences between age groups ($p<.001$). The developmental trends observed suggest that early and mid-adolescence represent critical periods for building fundamental motor abilities, while some performance measures-particularly sprint and endurance capacity-tend to stabilise after age 15.

The findings emphasise the importance of integrating indigenous games and activities into school-based physical education, not only to enhance adolescent fitness levels but also to preserve valuable cultural traditions. Such an approach can contribute to holistic youth development, bridging physical health promotion with cultural heritage preservation. By applying these insights, educators and policymakers can design age-appropriate, context-sensitive interventions that support the physical potential of rural and tribal adolescents.

Recommendations

Based on the findings of the present study, the following recommendations are proposed to enhance motor fitness development among tribal adolescent boys and to inform policy and practice, - (i) Integration of structured fitness programs into the school curriculum: Physical education in rural and tribal schools should incorporate both modern exercise methods and culturally relevant indigenous games, as these have been shown to significantly improve strength, endurance, agility, and overall fitness. (ii) Focused interventions for underperforming age groups: Since the study identified plateauing of speed and endurance performance after age 15 and varying rates of improvement across components, targeted training modules should be designed for specific age groups to address these slower-developing abilities. (iii) Community and parental engagement: Active involvement of parents and the local community should be encouraged to reinforce the benefits of physical activity beyond school hours, preserving cultural play traditions while enhancing health outcomes. (iv) Regular fitness monitoring and evaluation: Periodic assessment of students' motor fitness

using standardised tools like the AAHPERD Youth Fitness Test should be institutionalised, enabling educators to track developmental progress and adjust training programs accordingly. (v) Nutritional support programs: School health initiatives should ensure that students have access to adequate nutrition, as optimal physical performance is closely linked to balanced dietary intake, especially during adolescence. (vi) Further research: Additional studies, including longitudinal designs and gender-inclusive samples, should be undertaken to examine long-term effects of indigenous physical activities, as well as the contribution of dietary, environmental, and psychosocial factors to motor fitness development.

Implications for practice and policy

The results of this study have several practical and policy-level implications for improving adolescent motor fitness, particularly in rural and tribal contexts. (i) For educators and schools: Physical education teachers should integrate indigenous games and activities into the regular PE curriculum to enhance motor fitness while preserving cultural heritage. Age-specific training strategies should be implemented, especially for older adolescents where performance plateaus were observed in speed and endurance. Regular assessments using standardized tools (e.g., AAHPERD Youth Fitness Test) will enable educators to monitor individual and group progress, and tailor programs accordingly. (ii) For health professionals: School health teams and community health workers can use these findings to design physical activity promotion programs that align with the natural movement patterns and cultural traditions of the population. Incorporating nutrition screening and counselling alongside fitness activities is vital to support healthy physical development, particularly in tribal regions where nutritional disparities may affect growth and performance. (iii) For Policymakers and Government Programs: The evidence underscores the importance of formulating policies that promote culturally relevant, low-cost, and sustainable physical activity programs in rural schools. Government education and health departments should allocate specific funding for indigenous sports equipment, teacher training in culturally responsive PE, and infrastructure to support active play. Integrating motor fitness development into broader child health and education policy frameworks can help bridge existing health disparities between tribal and non-tribal populations. (iv) For community stakeholders: Local governance bodies, traditional leaders, and parents can be mobilised to actively support physical activity initiatives, ensuring community ownership and sustainability. Community-based sporting events rooted in indigenous games can strengthen both social cohesion and youth physical fitness outcomes.

Conflict of Interest

The authors declare that there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The study was conducted independently, without any commercial, financial, institutional, or personal relationships that could be construed as influencing the research outcomes. All procedures adhered to recognised ethical standards for research involving human participants.

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