

Coherence among Physical Fitness, Socioeconomic Status, Scholastic Achievement and Creativity – An Empirical Approach

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ABSTRACT

Physical fitness may have profound impact on cognitive activities, required in individual's academic functions and creative expressions. On account of scarcity of adequate scientific data in the relevant field, the current study was aimed to explore this area at different socio-economic status (SES) of the society. The study was conducted in school going girls of Kolkata, West Bengal, India. 131 girl students of class 11th standard (average age 17 yrs) were recruited in the study by stratified random sampling method from four higher secondary schools of southern region of Kolkata, West Bengal, India. The study variants namely, physical fitness, academic achievement, creativity and SES were determined by standard methods of measurement. Statistical analyses like one way analysis of variance (ANOVA), Bonferroni's post hoc analysis, Pearson's product moment correlation analysis and canonical correlation were done with the help of SPSS version 23.0 version. Results showed that girls belonging to high socio-economic status possessed best physical fitness status followed by the girls coming from low and medium socio-economic status, respectively. Pearson's product moment correlation analysis depicted significant positive correlation of academic achievement with different physical fitness parameters and significant negative correlation with obesity indicators. Another observation revealed positive correlation between physical fitness and SES. Canonical correlation analysis revealed positive correlation among physical fitness and creativity parameters. The present study may serve as a strong scientific basis in favour of the organised physical education programme to promote physical and cognitive development of young students studying in various class standards at different stages of education.

Keywords: Academic achievement, Creativity, Physical fitness, Socio-economic status.

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INTRODUCTION

Physical fitness is the corner stone in building a skilled and productive human resource for the progress of a nation. Physical fitness in earlier times was considered as the ability to carry out day-to-day activities without unwanted fatigue.¹ However, with change in lifestyle and technological advancement in modern time, physical fitness is recognised as a measure of body's capacity to act effectively and efficiently at work and at leisure,² to keep healthy and to resist diseases and ailments. Physical fitness refers to presence of a healthy mind in a sound body.³ Therefore, good physical fitness status may cause well coordination between bodily movement and mental abilities like creativity and academic functions.

It is obvious that good mental health (which is a part of general health) is very much desired to carry out effective cognitive functions of brain. In such case, study of physical fitness (to know about general health) and its association with cognitive functions like academic achievement and creativity may lead to some observations valuable from the perspectives of sports and exercise physiology and educational psychology.⁴

A voluminous work on physical fitness had been documented numerous physiological advantages including control of body weight, keeping away obesity, maintaining healthy heart and cardiac function, staying free from bone diseases, delayed aging etc.⁵

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However, from the review of available literature, it has been revealed that the extensive and systematic studies on mental health or cognitive health benefits of enhanced physical fitness were yet to confirm. Some other research gaps have also been identified from the reviews like. Relevant work in Indian context is scanty. Relationship of physical fitness with academic achievement and creativity has not yet been clearly validated, and no work has been conducted to investigate the nature of relationship of physical fitness with academic achievement and creativity along the high, medium and low socioeconomic background which are very profound in Indian society.⁵

Literature also suggested the combined effects of physiological and psychological changes sometimes

adversely affect the educational achievements, self-esteem, self-reliance, inter personal relationships with parents, peers and other members of the society at the transitional phase of adolescence.¹ Research revealed these problems are more profound in adolescent girls than their male counterparts in Indian socio-cultural settings.² It was assumed, coherence among Physical Fitness, Socioeconomic Status, Scholastic Achievement and Creativity among adolescent girls should be addressed in a multidisciplinary approach instead of a single approach involving biological, psychological and social aspects to get more effective outcome.

Considering the above discussed research gaps, the present study was set to observe the coherence of physical fitness with academic achievement and creativity in school going adolescent girls at 11th standard belonging to different socio-economic status (SES) and residing in Kolkata, India.

MATERIALS AND METHODS

Selection of Subjects

131 school going girls studying in 11th standard (Class XI) were recruited in the study on the basis of random stratified sampling method from four higher secondary schools of southern region of Kolkata, West Bengal, India. Their age was calculated from their date of birth as recorded in the photo ID issued by the Government of India. They were explained about the entire experimental procedure. Necessary informed consent was obtained from the school authorities and the parents of the subjects.

Determination of Fitness Profile Parameters

- Cardiorespiratory fitness was determined in terms of predicted VO_{2max} by Queen's college step test method.⁶
- Anaerobic power was determined by 60-yard dash test.⁷
- Explosive muscular strength was measured by Vertical Jump Test. This measurement gave the value of standing reach height.⁷
- Muscle flexibility of the participants was determined by modified sit and reach test method.⁷
- Agility was measured by Shuttle run test.⁷
- Muscular endurance of abdominal muscle was assessed by 1 minute sit up test.⁸
- Body composition was determined by using skinfold method following the formulae of Jackson *et al.* and Siri.^{9,10}

- Body height and body mass of the participants were determined by using a weighing machine fitted with height measuring rod (Avery India Ltd, India). BSA and BMI were calculated by using the standard equations.^{11,12}
- Waist hip ratio was calculated from the waist and hip circumferences.
- The socio-economic status of the sample group was determined with the help of modified version of Kuppaswami's Scale.¹³
- Academic achievement of the students was determined by analysing their marks, obtained in the Madhyamik or equivalent board examination. The obtained marks of the students were classified into three categories namely, low, medium and high score groups.^{14,15}

Statistical Analysis

Data were presented as mean \pm SD. One way analysis of variance (ANOVA) was done followed by Bonferroni's post hoc analysis. Pearson's product-moment correlation coefficient (r) was computed to evaluate the relationship of different physical fitness parameters with academic achievement and creativity components. Canonical correlation analysis was also performed. Level of significance was set at $p < 0.05$. The entire statistical analysis was performed by using SPSS Software, version 23.0.

RESULTS

Values of different fitness profile parameters in different SES groups have been presented in Table 1. The high SES group had highest scores of VO_{2max} , flexibility, explosive muscular strength (VJT) and muscular endurance. Again, the Low SES group had highest scores in anaerobic power in comparison to other two groups.

Relationship of academic achievement with various physical fitness parameters has been shown in Table 2. The result depicted significant correlation of academic achievement with VO_{2max} ($p < 0.01$) and muscle flexibility ($p < 0.05$).

Table 3 displayed the SES wise values of different components of body-composition. The Medium SES population depicted highest % Fat. On the contrary the High SES group resulted significantly higher value ($p < 0.01$) of LBM than both the medium and low SES groups.

The relationship between physical fitness parameters and creativity components has been analysed by Canonical

Table 1: SES wise Values of Different Fitness Profile Parameters.

SES Groups	QCT HR (beats/min)	VO_{2max} ($ml.kg^{-1}.min^{-1}$)	Agility (sec)	Flexibility (cm)	VJT (cm)	Muscular Endurance (steps/min)	Anaerobic Power (sec)
Low ($n_1=33$)	158.06 \pm 31.69	46.24 \pm 13.31	14.16 \pm 1.92	2.70 \pm 3.45	25.42 \pm 3.90	14.30 \pm 6.01	17.151 \pm 1.51
Medium ($n_2=80$)	151.6 \pm 27.26	44.94 \pm 11.45	14.30 \pm 2.32	2.67 \pm 3.38	22.67 \pm 4.64	13.05 \pm 6.41	16.72 \pm 1.81
High ($n_3=18$)	154.88 \pm 18.22	47.65 \pm 7.65	13.56 \pm 1.96	4.35 \pm 3.38	25.4 \pm 3.36	14.41 \pm 3.39	16.55 \pm 1.57

SES = Socioeconomic status, QCT = Queen's College Step test, HR = Heart rate, VJT= Vertical jump test,

Table 2: Correlation of Academic achievement and Physical fitness Parameters

	VO_{2max} ($ml.kg^{-1}.min^{-1}$)	Agility (sec)	Flexibility (cm)	VJT (cm)	Push up (steps/min)	Anaerobic Power (sec)
Academic achievement	0.260 **	0.035	0.162*	0.044	0.010	0.074

VJT = Vertical jump test, * $p < 0.05$, ** $p < 0.01$

Table 3: Body-composition Parameters in different SES groups

SES groups	BD (gm/CC)	% Fat	%LBM	Total Fat (kg)	LBM (kg)
Low(n=33)	1.41 ± 0.00	14.69 ± 1.73	85.30 ± 1.92	6.80 ± 1.22	39.45 ± 8.64
Medium(n=80)	1.06 ± 0.00	14.81 ± 1.82	85.18 ± 1.82	8.23 ± 1.11	39.19 ± 6.29
High(n=18)	1.06 ± 0.00	14.56 ± 1.6	85.43 ± 1.68	6.71 ± 1.30	47.33* ± 10.58

BD = Body density, * $p < 0.01$

Table 4: Canonical Correlations between Physical Fitness Parameters and Creativity

F_1	F_2	F_3	F_4	F_5	F_6	F_7
0.847	0.638	0.430	0.317	0.271	0.213	0.144

Highest canonical correlation (F_1) = 0.847

correlation method (Table 4). The canonical correlation (r) between the physical fitness and creativity was 0.84. This value ($r=0.84$) indicated high positive correlation between physical fitness parameters and creativity components.

DISCUSSION

From the present observation it could be inferred that subjects of medium SES occupied highest position in body weight, BMI and % Fat which are the indicators of sedentary life style.¹⁶ On the contrary, lowest value of body weight, BMI and % Fat in high SES group indicated their non-sedentary or active life style. These observations were similar to the study done on school going adolescents (12.5 – 17.5 years of age) in Australia and Europe.^{17,18}

The present study revealed some important findings on the relation of physical fitness and academic achievement. The middle SES group expressed greatest value of Percent fat (%fat), total fat and lowest value of LBM than the other two SES groups. All those findings indicate the highest probability of overweight and obesity in middle SES group compared to other two SES groups. This observation basically adds to the established data of earlier works¹⁹ which showed poor academic success in children who are either overweight or obese. It was reported that individuals with more body fat may lack attentiveness and proper executive functions like flexibility in mental tasks.²⁰ However, some contradictory reports are also available which reported no effect of excessive body fat on academic performance.²¹

Another important observation was the occurrence of highest scores in most of the fitness parameters of high SES population. Those fitness parameters were namely, VO_{2max} , flexibility and muscular endurance. The results altogether denote best physical fitness status of high SES population compared to other two SES populations. Along with the favourable supports made generally by the high

SES population, proper diet and nutrition play an important role in growth and development of children and adolescents. Those results may have many folds physiological and psychological advantages.²² Regular physical activity may reduce plasma noradrenaline.^{23,24} It may also increase the transfer of the serotonin precursor tryptophan across the blood brain barrier, leading a calming effect in children and adolescents and enabling them to sit and put attention on academic matters.²⁵ The similar view was shared by the SHAPE study.²⁶ They demonstrated that the classroom behaviour of 10 year old children was improved following a programme of daily physical work out. Another research had also depicted that blood flow to the cerebral cortex of the brain was increased following bouts of exercise and thus ensured greater supply of oxygen to the brain cells to keep the organ active for prolong period of time.²⁷ Supportive observation was made by McAuley.²⁸

The result depicted significant negative correlation of academic achievement with sum of skin folds measurement ($p < 0.01$). These observations were found to be similar to the observation, mathematics and science had significant positive correlation with physical activity promotion system.²⁹ The academic scores of girls than boys were more significantly correlated with physical fitness.³⁰ Similar observation was reported in earlier studies.^{28,31,32}

Result shown in table 4 revealed strong correlation of physical fitness with cognitive activity applied in creative functions. A possible explanation of such observation may be found in different study where it was suggested that regular physical activity reduces plasma noradrenaline level and increases the rate of transfer of the serotonin precursor tryptophan across the blood brain barrier, leading to a calming effect in children and adolescents and enabling them to sit and think diversely which is expressed as creative potentials as also reported by Fink.³³

A possible connection of such finding is muscular fitness is the backbone for all sorts of non-verbal creative works like painting, dancing, gymnastics and all other psycho-motor activities. Review of earlier works also suggest several organised non-verbal creative activities like running, walking, dancing etc are good means to achieve physical fitness and vice versa.³⁴ Regular walking exercise increased creative production.³⁵ Socio-economic status of was not of any notable effect on creativity.

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