International Journal of Research in Medical Sciences
Vishnupriya R et al. Int J Res Med Sci. 2025 Dec;13(12):5313-5317
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20253956

Original Research Article

Effect of structured physical activity on intelligence in underperforming school students

Vishnupriya R.[1]*, Kannan D.[1], Anantharaj K.[1], Poovarasan Murugaiyan[2], Yamini Umasankar[2], Diovin Derose Vianni[2], Prathap Suganthirababu[2]

[1]Department of Physiotherapy, JKK Munirajah Medical Research Foundation College of Physiotherapy, Komarapalayam and TN Dr. MGR Medical University Chennai, Tamil Nadu, India
[2]Department of Physiotherapy, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai, Tamil Nadu, India

Received: 06 October 2025
Accepted: 12 November 2025

***Correspondence:**
Dr. Vishnupriya R.,
E-mail: Vpvishnupriyaa114@gmail.com

ABSTRACT

Background: Poor academic performance in some children often stems from lack of concentration. Traditional measures like extra classes and repeated tests show questionable effectiveness. Exercise, however, may offer an alternative, as it enhances cognitive skills and academic performance. This study aims to examine the effect of structured physical activity (SPA) on intelligence in underperforming school students.
Methods: This experimental study was conducted among VI-X standard students from schools in Komarapalayam, Namakkal district. Eligible participants were 11-15 years old, full-time students from middle or low socio-economic groups. From 220 screened students (168 boys, 52 girls), 50 were selected. After obtaining parental consent, they were randomly allocated into two groups: SPA, n=25; 15 boys, 10 girls and general PA (GPA, n=25; 17 boys, 8 girls). The intervention was integrated into the school curriculum. Outcomes measured were intelligence (Bhatia battery test) and endurance, assessed at baseline and at alternate weeks over an 8-week period. Data analysis was performed using SPSS 26.0, with $p<0.05$ considered statistically significant.
Results: The result of the study shows considerable significance in both groups, where there is a remarkable improvement in the SPA group with t value of 7.67 ($p<0.005$), compared with GPA with t value of 8.44 ($p<0.005$).
Conclusions: This study concluded that SPA improves the activity on intelligence in underperforming school students when it was compared with regular PA.

Keywords: Underperforming students, Structured physical activity, General physical activity, Bhatia battery test of intelligence, School students

INTRODUCTION

Physical activity (PA) is crucial for healthy physical growth and mental growth.[1] Various research shows that PA aids in the improvement of learning as well as improvement in school performance.[2,3] Regular PA builds the bones, muscles and nerves. It also improves muscle strength and endurance. It improves self-esteem and reduces anxiety and stress.[4] Education is an essential aspect of human life. The performance of the school education reflects on their life. Poor performance in a few children results from various underlying problems.[5] Poor performance may cause the children to have lower self-esteem, stress, and depression. It causes problems for the children, the parents, the teachers and the school. There are multiple causes identified for the poor performance of school children, which include medical problems (asthma, epilepsy, malnutrition and hearing difficulty) learning disability, attention deficit hyperactive disorder, poor socioeconomic culture, psychiatric disorders and

environmental causes. Focusing on identifying the cause and providing management is the ultimate goal of teachers dealing with underperforming students.[6-8] Traditionally, school teachers often schedule learning classes, special workouts prescribed for the underperformers, but does these interventions are effective is questionable. At the same time, recent researchers have found that exercises may be an alternative solution for students who find it challenging to perform academically.[9] Exercise improves cognitive skills and academic performance.[10]

Exercises are an additional intervention that offers an option to the school students, parents, and teachers, focusing on individualized learning programs.[11] Exercise is identified to modify children's behavior and improve attention, and focus and reduce hyperactivity.[12]

SPA is a set of exercises created with multiple activities. SPA has a lot of positive effects on the child's mental status. Barr-Anderson, in 2007, identified that SPA program in adolescent girls improves their self-efficacy and PA levels. Choi et al stated that SPA could develop self-control, improves participation in school activities, improves caring, improve helping and also improve self-direction. Further, it was identified that SPA promotes positive psychological and emotional benefits and improves academic participation.[13-15] Multiple benefits are obtained following PA, such as improvement in social behavior and social participation, improvement in communication, maintain the body mass index, improvement the stereotypical behavioral patterns, and active participation.[16,17] Although there are multiple benefits found in PA, it is not considered an intervention for underperformers in Indian schools. So, this study aimed to identify the effect of SPA on intelligence in underperforming school students.

METHODS

The study was commenced after the approval from the Institutional ethical committee, JKKMMRF college of physiotherapy, Komarapalayam, Namakkal district. The study participants were recruited from various schools around Komarapalayam, Namakkal district, Tamil Nadu, India, with the students studying standard VIth to Xth with the age range from 11 years to 15 years. All the students were full-time school-going and belonged to the middle or low socio-economic group. The students were initially assessed for eligibility to include in the study.

Participants

Ten schools were selected for the study. A prior request letter was given to the school principal and the management. Once they accepted it, this study was started. The evaluator assessed students who were underperforming in the selected classes. Around 300 students (n=300; boys=198; girls=102) volunteered for the study; all underwent a general physical evaluation, including physical and mental evaluations. Students with a previous history of neurological disorders, respiratory disorders, or any skeletal deformities were neglected from the study. The evaluation also identifies the selection of the participant based on the selection criteria which was created prior. So, the students included in the final evaluation are 220 (boys;168; girls; 52). From this pool of eligible students, 50 were randomly selected for the study. Written consent was obtained from the school students' parents and guardians once the study was explained. The intervention of the study was incorporated along with the school curriculum. The selected students were randomly allocated into two groups; SPA with 25 students (boys; 15, girls; 10), and GPA included 25 students (boys; 17, girls; 8).

Procedure

The SPA was designed based on Subramanian et al exercises included sixty minutes of SPA and the need to do these activities for 60 minutes, three days a week.[18] The SPA sessions were administered by the physical educator teacher in the school for the selected participants separately. Aerobic exercises, coordination exercises, and strengthening exercises are included in the SPA. Regular follow-ups with the teachers monitor weekly progress were followed up for attendance and progression. The GPA was designed based on Subramanian et al and exercises included sixty minutes of GPA and the need to do this activity for 60 minutes three days a week. The GPA sessions were administered by the physical educator teacher in the school for the selected participants separately. The exercises include walking for 10 minutes at the regular phase, and general stretching and recreational activities are included. Regular follow-ups with the teachers monitor weekly progress were followed up for attendance and progression.

Outcomes

The outcome of the study was intelligence which was measured using the Bhatia battery test of intelligence. The data was collected on the children's first visit and then in subsequent weeks. As the study was conducted for eight weeks, eight-week data were collected, and alternate-week data were taken for the analysis. All the analysis was done using SPSS 26.0 (Statistical package for social sciences). The impact of the exercises was analysed, and the p value was fixed as 0.05 with statistical significance.

RESULTS

This study identifies the change of intelligence using Bhatia battery test of intelligence using parametric test. Both groups were normally distributed, the level of significance was set as $p<0.05$. collected data were analysed using SPSS 26.0. The demographical analysis was shown in (Table 1). The mean values and the t values are described in (Table 2 and 3).

Within the group, analysis shows a marked difference was obtained between the pre-test and post-test groups.

Table 1: Demographic data.

Category	Boys (Mean±SD)	Girls (Mean±SD)	P value
Age (in years)	13.06±1.48	12.78±1.44	0.000
Weight (kg)	33.81±4.28	32.67±4.43	0.000
Height (cm)	101.63±11.78	91.78±5.40	0.000

Table 2: Within group analysis of Bhatia battery test of intelligence.

Groups	Mean±SD	Effect size	T test value	P value
SPA: pre test	56.00±3.61	1.54	7.67	0.0001
SPA: post test	63.96±2.73			
GPA: pre test	56.08±2.75	1.69	8.44	0.0001
GPA: post test	58.88±2.82			

Table 3: Between group analysis of Bhatia battery test of intelligence.

Groups	Mean±SD	Effect size	Student t test	P value
SPA	63.96±2.73	1.43	6.47	0.0001
GPA	58.88±2.82			

Table 3 shows that there was an overall significance in the study. There is a marked difference obtained between the SPA and GPA groups. This study rejected the null hypothesis and stated that there was a significant difference obtained between the groups. The group who underwent SPA improved well when compared with the GPA.

DISCUSSION

This study aims to identify the effect of SPA on intelligence in underperforming students. Poor performance of school children is always a significant cause of concern. Many students need help grasping their studies and make careless mistakes.[19] The schools' standard management of the underperforming students is to conduct special classes, mentorship programs, and frequent test and tutorial classes. PA improves physical fitness, coordination skills, and self-esteem. Regular PA in children and adults is essential for promoting lifelong health and well-being and preventing various health issues.

Exercises demonstrated that the deployment of concentration to a particular cognitive activity was connected with increased behavioral and neural signals.[20,21] Exercise can lower insulin sensitivity, decrease inflammation, and encourage the production of growth factors, which are substances that have an impact on the well-being of brain cells, the development of new blood vessels within the brain, and even the number of new brain cells that are produced.[22] Exercise has demonstrated an extraordinary aptitude to influence molecular pathways involved with synaptic function underlying learning and memory.[23,24] There is an intrinsic relationship between the exercises and energy metabolism. Modulating energy related to the molecular systems is a crucial mechanism by which exercises affect synaptic plasticity and cognition.[25]

Exercises result in the modular system, which includes brain-derived neurotrophic factor (BDNF), which is at the interface of metabolism and synaptic plasticity and can be extremely important for exercise-induced cognitive enhancement.[26,27] Exercises demonstrated a higher amount of serum BDNF, and there has been a noticeable improvement in spatial memory. According to several studies, PA has been linked to improved cognitive performance, more substantial effects on overall health, and a considerable influence on brain plasticity.[28]Physical exercises improve the blood flow to the brain, improving cerebral health and the benefits of glucose and lipid metabolism. When compared to sedentary individuals, that several structural changes occurred after PA and were related to academic achievement.[29] Studies have also shown that children who engage in aerobic activity outperform sedentary peers of the same age on verbal, perceptual, and arithmetic tests.[30,31]

Limitations

The study follow-up was not long-term and the researcher does not monitor the exercises. In contrast, a trained physical education teacher applied it. There is no bias against the teachers since they know there are two groups.

CONCLUSION

This study concluded that SPA improves the activity on intelligence in underperforming school students when it was compared with regular PA.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Centers for Disease Control and Prevention. The association between school based physical activity, including physical education, and academic performance. Atlanta, GA: U.S. Department of Health and Human Services. 2010.
2. Collingwood TR, Sunderlin J, Reynolds R, Kohl HW 3rd. Physical training as a substance abuse prevention intervention for youth. J Drug Education. 2000;30(4):435-51.
3. Castelli DM, Hillman CH, Buck SM, Erwin HE. Physical fitness and academic achievement in third- and fifth grade students. J Sport Exercise Psychol. 2007;29(2):239-52.
4. Strong WB, Malina RM, Blimkie CJR. Evidence based physical activity for school-age youth. J Pediat 2005;146(6):732-7.
5. Karande, S., Kulkarni, M. (2005). Poor school performance. Indian J Pediatr. 2005;72(11):961-7.
6. Liu J, Raine A, Venables PH, Dalais C, Mednick SA. Malnutrition at age 3 years and lower cognitive ability at age 11 years: independence from psychosocial adversity. Arch Pediatr Adolesc Med. 2003;157:593-600.
7. Ozmert EN, Yurdakok K, Soysal S, Kulak-Kayikci ME, Belgin E, Ozmert E, et al. Relationship between physical, environmental and sociodemographic factors and school performance in primary schoolchildren. J Trap Pediatr. 2005;51:25-32.
8. Milton B, Whitehead M, Holland P, Hamilton V. The social and economic consequences of childhood asthma across the life course: a systematic review. Child Care Health Dev. 2004;30:711-28.
9. Wendt MS. The effect of an activity program designed with intense physical exercise on the behavior of ADHD children. Unpublished doctoral dissertation, State University of New York, Buffalo. 2000.
10. Dwyer T, Sallis IF, Blizzard L, Lazarus R, Dean K. Relation of academic performance to physical activity and fitness in children. Pediat Exerc Sci. 2001;73:225-37.
11. Putnam SC, Tette J, Wendt M. Exercise: A Prescription for At-Risk Students. J Physical Educat Recreat Dance. 2004;75(9):25-8.
12. Blakemore CL. Movement is essential to learning. J Physical Educat Recreat Dance. 2003;74(9):22-5.
13. Barr-Anderson DJ, Young DR, Sallis JF, Neumark-Sztainer DR, Gittelsohn J, Webber L, et al. Structured physical activity and psychosocial correlates in middle-school girls. Preventive Med. 2007;44(5):404-9.
14. Choi PHN, Cheung SY. Effects of an 8-week structured physical activity program on psychosocial behaviors of children with intellectual disabilities. Adapted Physical Activity Quarterly. 2016;33(1):1-14.
15. Hellison DR, Templin TJ. A reflective approach to teaching physical education. Champaign, IL: Human Kinetics. 1991.
16. Bass MM, Duchowny CA, Llabre MM. The effect of therapeutic horseback riding on social functioning in children with autism. J Autism Developm Disord. 2009;39(9):1261-7.
17. Bellini S, Peters JK, Benner L, Hopf A. A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. Remedial Special Educat. 2007;28(3):153-62.
18. Subramanian SK, Sharma VK, Arunachalam V, Radhakrishnan K, Ramamurthy S. Effect of Structured and Unstructured Physical Activity Training on Cognitive Functions in Adolescents-A Randomized Control Trial. J Clin Diagn Res. 2015;9(11):CC04-9.
19. John P, George SK, Mampilly AB. Handbook on poor school performance. 2001.
20. Hillman CH, Pontifex MB, Raine LB, Castelli DM, Hall EE, Kramer AF. The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. Neuroscience. 2009;159(3):1044.
21. Pontifex MB, Scudder MR, Drollette ES, Hillman CH. Fit and vigilant: The relationship between sedentary behavior and failures in sustained attention during preadolescence. Neuropsychology. 2012;26(4):407-13.
22. Mandolesi L, Polverino A, Montuori S, Foti F, Ferraioli G, Sorrentino P, et al. Effects of Physical Exercise on Cognitive Functioning and Wellbeing: Biological and Psychological Benefits. Front Psychol. 2018;9:509.
23. Bugg JM, Head D. Exercise moderates age-related atrophy of the medial temporal lobe. Neurobiol Aging. 2011;32:506-14.
24. Burdette JH, Laurienti PJ, Espeland MA, Morgan A, Telesford Q, Vechlekar CD, et al. Using network science to evaluate exercise-associated brain changes in older adults. Front Aging Neurosci. 2010;2:23.
25. Gomez-Pinilla F, Hillman C. The influence of exercise on cognitive abilities. Compr Physiol. 2013;3(1):403-28.
26. Erickson KI, Voss MW, Prakash RS, Basak C, Szabo A, Chaddock L, et al. Exercise training increases size of hippocampus and improves memory. Proc Natl Acad Sci U S A. 2011;108:3017-22
27. Etnier JL, Salazar W, Landers DM, Petruzello SJ, Han M, Nowell P. The influence of physical fitness and exercise upon cognitive functioning: A meta-analysis. J Sports Exerc Psychol. 1997;19:249-77.
28. Chaddock L, Hillman CH, Buck SM, Cohen NJ. Aerobic fitness and executive control of relational memory in preadolescent children. Med Sci Sports Exerc. 2011;43:344-9.
29. Lees C, Hopkins J. Peer reviewed: effect of aerobic exercise on cognition, academic achievement, and psychosocial function in children: a systematic review of randomized control trials. Preventing Chronic Dis. 2013;10:E174.

30. Sibley BA, Etnier JL. The relationship between physical activity and cognition in children: a meta-analysis. Pediat Exe Sci. 2003;15(3):243-56.
31. Voss MW, Chaddock L, Kim JS, Van Patter M, Pontifex MB, Raine LB, et al. Aerobic fitness is associated with greater efficiency of the network underlying cognitive control in preadolescent children. Neuroscience. 2011;199:166-76.

Cite this article as: Vishnupriya R, Kannan D, Anantharaj K, Murugaiyan P, Umasankar Y, Vianni DD, et al. Effect of structured physical activity on intelligence in underperforming school students. Int J Res Med Sci 2025;13:5313-7.