



P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2020; 7(6): 04-09
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www.kheljournal.com
Received: 02-09-2020
Accepted: 04-10-2020

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The effect of physical activity on academic performance and mental health: Systematic review

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Abstract

The relationship among physical activity, academic achievement and mental health has long been theorized to be of profound importance in understanding human behavior and development. This review article aims specifically to highlight the state of existing research pertaining to the relationship between physical activity and the state of mental health. Different studies, summarized here, have found that healthy levels of physical activity generally correlate with mental health and academic achievement. In general, this review result has showed that there was a significant relationship between physical fitness level and academic achievement and higher academic achievement was associated with higher levels of physical fitness. Physical activity is a relatively cheap and non-harmful lifestyle intervention that can easily be implemented into school settings.

Keywords: Academic achievement, mental health, physical activity,

Introduction

It is recommended youth participate in at least 60 minutes per day of physical activity that is developmentally appropriate, enjoyable, and involves a variety of activities ^[1]. Different research recommended 60 minutes of physical activity a day can easily be accumulated in school during physical education class, recess, intramural sports, and before or after-school extracurricular activities ^[1]. According to the CDC (2010) insufficient physical activity can lead to an increase in obesity and other poor health outcomes such as diabetes, hypertension and stroke, cardiovascular disease, some cancers, depression and anxiety, sleep disorders, weak muscles and bones, and early death. While research has focused much of its attention on the overall effects of physical activity on bodily health, growing evidence supports the benefits of physical activity for brain health ^[2]. Physical activity has been shown to improve mental health indicators such as anxiety, depression, and self-concept ^[1]. improve learning and cognitive function) ^[3, 4, 5], and increase academic achievement ^[6]. Although physical activity is important for body and brain health, many adolescents are not meeting the recommended guidelines. Therefore, it is important to explore the perceptions of adolescents to better understand which factors influence physical activity so an effort can be made to increase the number of adolescents meeting the physical activity recommendations.

While the consequences of physical activity on health are well-known, the outcomes on academic achievement are not yet fully understood. It has been shown physical activity has a positive relationship with academic achievement ^[7]. Examining the association between participation in physical activities and academic achievement is important for many reasons. Understanding the relationship between participation in sport activities, academic achievement and cognitive development is very important for teachers, school psychologists and other stakeholders. If student's participation in sport activities has association with academic achievement and cognitive development, then student athletes should have be encourage and supported to continue sports participation rather than viewed as being distracted from their participation. The current study contributes to the literature by examining the effect of sports participation on academic achievement, and mental health of students (cognitive development).

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Objectives of the study

- To examine the association physical activities and academic achievement
- To investigate the effect of physical activity on mental health

Methods

The review of related literature search strategy were used the terms in relation with physical activity and academic performance, mental health, mental development, psychological health, cognitive development, depression, anxiety, non-communicable diseases and etc. A search was conducted in the following bibliographic databases: online research databases, web of knowledge, and science direct, sport discus, Google scholar, Scopus, Web science, Science PG, Science Education, the references of all saved articles and organizations were reviewed for relevant citations.

Screening of Articles for Eligibility

Based on titles and abstracts, reference the articles were screened for eligibility, i.e. included publications regarding physical activity and mental health and academic performance. All included articles were read intimately and significant information was extracted. From the selected publications, organizations and articles the following data such as year of study, characteristic of analysis, evaluation and results/findings/conclusions were extracted. The electronic databases and the manual search of reference lists identified 135 articles. On the basis of title and abstract, we excluded 68 studies that did not meet inclusion criteria. All information was obtained directly from the articles.

Effects of Physical Activity on Adolescent Health

According to the U.S Department of Health and Human Services, [8], physical activity in children and adolescents reduces the likelihood that as adults these individuals will develop chronic diseases such as heart disease, hypertension, type- 2 diabetes, and osteoporosis. Regular physical activity in children and adolescents has been shown to improve cardio-respiratory fitness, strengthen muscles, support bone growth, promote healthy body weight, build self-esteem, and reduce anxiety and stress (USDHHS). Several studies also discuss the impact of physical activity on academic achievement. One particular study states “children who are more physically active are more likely to achieve better academically” [9]. Based on these findings, it should be the role of society to provide many opportunities for children and adolescents to incorporate physical activity into their daily life and thereby help lay the foundation for a life-long, healthy lifestyle.

Effects of Physical Activity on Adolescent Brain Health

While it is known physical activity is important for improving cardiovascular health, emerging research focuses on the benefits of exercise on brain health [4]. Discussed how exercise may be the most simple and significant method for improving the aspects of children’s mental performance central to cognitive development. Four important points on how exercise impacts the brain and improves cognitive processes involved in learning and memory are: (a) enhancing circulation so individual neurons can get more oxygen and nutrients, (b) stimulating the production of the mood enhancing neurotransmitters and nerve growth factors such as brain-derived neurotrophic factor (BDNF), (c) creating new brain cells in a process called neurogenesis, and (d) improving plasticity [10].

Oxygen circulation: The brain needs a continuous supply of oxygen and glucose as its source of fuel. While glucose comes from foods eaten, the oxygen supply comes from physical activity. As individuals perform physical activity, this increases the number of capillaries in the brain which allows for the transport of oxygen in the blood. The amount of oxygen in the blood has an impact on the cognitive abilities of an individual. The more oxygen available to the brain, the better a student will perform cognitive tasks [11]. States “armed with the knowledge that movement is connected to cognitive learning, teachers and administrators need to encourage more movement in all classrooms at all grade levels”. As a result, it would be ideal for teachers to incorporate physical activity into every lesson in order to oxygenate the brain and facilitate attentiveness in students.

Production of neurotransmitters and neurotrophins:

Along with oxygenating the brain, found intense physical exercise improves cognitive function by increasing levels of neurotransmitters and neurotrophins responsible for relating mood and short-and long-term learning success. The research shows “exercise accelerates learning and improves long-term retention of learned material”. While the neurotransmitters are involved in emotion, learning, and memory, brain-derived neurotrophic factor is involved in the survival and growth of neurons.

Researchers have found that as exercise increases, BDNF levels increase in an area in the brain called the hippocampus, which is related to memory and learning. This BDNF molecule has a direct impact on cognitive function, neurogenesis, and plasticity [12, 13] showed how exercise produces BDNF and how this molecule has a direct impact on cognitive function. This study gave researchers the evidence they needed to support the notion that exercise improves learning, mental performance, and long-term memory retention [2]. describes BDNF as “miracle grow for the brain” (p.40). He discusses the importance of this molecule for regulating neurotransmitters such as serotonin involved in mood regulation, for encouraging new growth of neurons in a process called neurogenesis, and for enhancing, strengthening, and protecting connections between neurons known as plasticity. BDNF for the brain is like water for the body, essential. They both require much praise, because without them the body and brain would die.

Neurogenesis: One of the most profound advances in neuroscience and education is neurogenesis, or growth of new neurons [14]. While it was once believed neurons could not be replaced once they died, new research is showing how exercise has the ability to promote the birth of new brain cells. This process of neurogenesis occurs in the hippocampus. According to [14], exercise stimulates the growth of new brain cells in a process called neurogenesis. This study showed “physical activity can regulate hippocampal neurogenesis, synaptic plasticity, and learning”. Neurogenesis has become monumental in neuroscience because it refutes the old theory that dead brain cells can never be replaced. It was not until [12] that the connection was made suggesting exercise results in the production of BDNF which elevates the production of new neurons (neurogenesis), thereby enhancing learning.

Plasticity: A final outcome of exercise on improved learning is through a process called plasticity. Everything individuals do, think, and feel, is regulated by how the brain cells are connected to one another [2]. It is through the repetitive firing

of these neurons that connections are strengthened which plays a role in how learning occurs^[12]. point out that exercise is a simple way to support and maintain brain plasticity by inducing BDNF and neurogenesis in the hippocampus.

Obesity and overweight rates among all groups in society, regardless of age, sex, race, socioeconomic status, educational level, or geographic region have noticeably increased within the last twenty years^[15]. Obesity and overweight are not just a personal matter; it is also public health epidemics that affects education achievement outcomes, economic productivity, state budgets and in turn affect students' academic achievement^[16, 17]. In addition to disease prevention, studies suggest that physical activity directly benefits cognition and academic achievement. In one study, in which children jogged for thirty minutes two to four times per week, researchers measured an increase in activity in the prefrontal cortex, suggesting greater cognitive function. However, the cognitive gains were only sustained while children maintained the jogging regimen^[18, 19]. If an individual follows a physically active lifestyle, it has been found to be an effective way of improving fitness and overall health^[20]. In other way, the absence of a physically active life-style can adversely affect fitness and properly-being, increasing the risk of somatic health problems such as cardiovascular diseases, hypertension, diabetes mellitus, osteoporosis, and some types of cancer^[21]. In addition, regular PA is known to have a positive impact on mental health^[22]. A number of meta-analyses of intervention studies of the effect of exercise training have revealed that exercise may have a significant moderate to high anti-depressive effect^[23-25]. In other way if students have poor physical fitness different problems are appearing in addition to academic achievement problems such as sleep apnea, which has been linked to problems with learning and memory, liver problems, orthopedic problems and asthma. If there is Sleep apnea problem in children, it can to impair a child's ability to concentrate and stay alert during the day, which could have a negative impact on academic performance^[26] also reported, based on their study results, being physically fit reduces the risk of cardiovascular disease, colon cancer, diabetes, dying prematurely, and obesity. Increased physical activity levels and fitness can improve bone and musculoskeletal function and help alleviate or relieve depression, anxiety and stress (mental health)^[26].

Generally the previous research findings from large-scale observational studies indicate that participation in physical activity has a small to moderate effect in prevention and management of the risk of depression and anxiety which in turn have effect on academic achievement and mental health^[27, 63].

The Association between Physical activity and Academic achievement

Different scholars suggest that there is a positive correlation between physical fitness levels and academic achievement levels of students. As schools explore all avenues to improve student academic success, researchers believe that participation in different physical activity have positive impact on students' academic achievement, so every stakeholder should understand it. According to^[28, 29] studies suggested that students participating in 5 hours of vigorous physical activity a week had stronger academic performances in math, English, and science than do students who participate in just 2 hours of fitness activity every week. She also argued that sport skills teach students about prepositions, adverbs, and communication skills and those students are more likely

to retain their learning by being active. Another crucial element being considered by researchers and part of the theoretical framework of the study was the association between physical fitness levels and academic achievement. Students are being asked to increase their academic performance in the classroom and teachers are seeking ways to help them achieve as well.

With information being obtained about the poor physical fitness levels of many students there is ample reasons for concern on the part of educators about this growing epidemic in our world. The prevalence of obesity in today's children is detrimental to the student's health and is purported to have a negative impact on student learning and achievement. Research has shown that physical movement and physical activity assists children in learning more effectively^[38]. revealed concern about epidemiological findings that indicated that children are less active and more obese than ever before despite initiatives to combat this. According to brain research by^[39], a child's earliest learning is based on motor development. He found that there is a connection between the cerebellum (motor control part of brain) and such cognitive functions as memory, spatial orientation, attention, language, and decision making. In addition, Jensen has further confirmed that most of the brain is activated during physical activity and that sitting for more than ten minutes at a time results in reduced concentration^[40], further showed that exercise is highly correlated with neurogenesis, the production of brain cells that is correlated with improved learning and memory. Students cannot sit still for long periods of time before the flow of blood and oxygen to their brain slows down considerably which inhibits the learning process^[40]. According to^[41] showed that time spent being physically active did not detract from education achievement and in some instances were associated with improved scholastic performance. The study of^[42] also found a positive association of physical activity with academic achievement.

In general, different findings have showed that there was a significant relationship between physical fitness level and academic achievement and higher achievement was associated with higher levels of physical fitness. Those studies also found that children who are more physically fit tend to perform better in the classroom and have better school attendance and fewer discipline problems. Here, given more time for physical education did not hurt academic performance and that students tended to perform better in the classroom^[43, 51].

Studies on children: the association of physical activity and fitness with cognitive function are relatively few in number but generally show a positive association between physical activity and cognitive function of students^[52]. revealed that involving in regular exercise and on more aerobic fitness are related to greater brain volume, improved neurophysiological responses to stimuli as measured by EEG (electroencephalography), and better levels of growth factors that promote growth of brain tissue, neurogenesis, and angiogenesis^[53]. alsosuggested from their finding that physical fitness levels of students were strongly and significantly related to academic achievement regardless of other socio-demographic and physical fitness variables and seems to high in late middle to early high school. They recommended that policymakers should consider physical education subject in middle and high schools and that physical education allotted times should be increased with an emphasis on more cardiovascular fitness^[54, 47, 54]. also conclude that from their study aerobic fitness was a

significant predictor of academic performance.

According to [39] finding on brain research shows a positive and significant correlation between physical activity levels and cognitive (brain) development [41]. Also indicated that time allotted to being physically active did not reduce academic achievement of students and in most cases, was shown to be more beneficial [55]. reported that student's regular participation in different sports activities showed improved attributes such as increased brain function and nourishment, higher energy/concentration levels, changes in body build affecting self-esteem, increased self-esteem and better behavior which may all support cognitive function [56, 57]. also indicated that consistent physical activity led to increased cerebral blood flow, changes in hormone levels, enhanced nutrient intake and greater arousal in brain functioning. Additionally [58], found that specific regions of the basal ganglia of the brain, which support cognitive control, are enlarged in physically fit children. Furthermore, physically fit children displayed superior performance in behavioral activities that required complicated skills and control. Another studies by [58, 59] revealed that physically fit children performed better on associational memory tasks and also found that physically fit children displayed faster cognitive processing speed that indicated that these children had greater attentional ability and faster processing of the stimulus being presented. [60] Completed a study that demonstrated that children who were physically active showed improvement on fluid intelligence tests (measures ability to reason quickly and to think critically). Different findings showed clearly, movement and physical activity can positively affect the overall development of a child.

The study looked at the relationship from both a behavioral and neuroelectric perspective, which is the subject's ability to recognize, respond to, and discriminate between different visual stimuli. When the researchers measured brain activity, they found that fit children allocated more resources towards identifying the stimuli and were also able to process the stimuli faster. Behaviorally, the children made fewer errors than their less fit peers [61, 63].

Improving component of fitness (aerobic, muscular, and body composition) has the most influence on improving cognitive functioning. Currently this determination has not been established [61, 64]. Different scholars caution regarding absolutely linking physical fitness levels and improved academic achievement, cognitive functioning, reduced depression and social/cognitive stimulation, which resulted in improved cognitive functioning [65, 67].

Conclusion

In general, different findings have showed that there was a significant relationship between physical fitness level and academic achievement and higher achievement was associated with higher levels of physical fitness. Those studies also found that children who are more physically fit tend to perform better in the classroom and have better school attendance and fewer discipline problems. Here, given more time for physical education did not hurt academic performance and that students tended to perform better in the classroom

The absence of a physically active lifestyle of students can adversely affect their health and total well-being, increasing the risk of chronic diseases/non-communicable diseases such as cardiovascular diseases, hypertension, diabetes mellitus, osteoporosis, and some types of cancer. In other way if students have poor physical fitness, different problems are

appearing in addition to academic achievement problems such as sleep apnea, which has been linked to impair a child's ability to concentrate and stay alert during the day, which could have a negative impact on academic performance. Increased physical activity levels can improve bone and musculoskeletal function and help alleviate or relieve depression, anxiety and stress (mental health). Generally, this review article have shown participation in physical activity has a small to moderate effect in prevention and management of the risk of depression and anxiety which in turn have effect on academic achievement and mental health

Recommendations

- The future generations not enjoying a better quality of life or shorter life expectancy than their parents are a frightening outlook. Steps are should be taken by government and concerned body to fight this problem.
- In addition, the decreased levels of cognitive functions will have a negative impact on the people's productivity and creativity. Parents and educators must work together to prevent students from overweight and/or obese and from non-communicable diseases.
- If the matter is ignored, future generations can pay the worth. Policy makers should give longer for education to form students more active and each stakeholder should use increased participation in sports activities as a technique to enhance students' academic performance and psychological state.

Conflict of interest: The author does not have any possible conflicts of interest.

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