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## **ASSESSMENT OF THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND COGNITIVE FUNCTIONING IN CHILDREN AND ADOLESCENTS**

**Abstract.** The benefits of being physically active on a person's overall health are well-documented. Over the last decades, scholars have attempted to investigate the potential interrelationship of physical activity, physical fitness, and cognition, the latter a term used to indicate general mental processes. The number of peer-reviewed articles on this subject is rapidly increasing. However, from the literature review it results that researchers are divided when it comes to establishing the positive impact that physical exercises have on a person's cognitive performance, especially among school age children. Early research suggested that intense physical activity causes fatigue, which has a negative impact on a student's academic performance. This theory supports parents' and teachers' long-held concerns that the time children spend while participating in physical activity affects their academic results. Therefore, physical education programs are being cut at an incredibly fast rate so that students devote more time while engaging in basic academic activities. On the other hand, a considerable number of studies have identified the positive or at least neutral effects of physical activity on academic achievements. As a result, based on the conflicting evidence, more research needs to be carried out in order to investigate the connection between physical activity and students' results in school subjects. Our objective is to review research findings on the impact of sports activities and the level of physical fitness on children's cognitive and mental health.

**Keywords:** mental performance, academic achievements, physical fitness, cognition, motor skills.

### **Introduction**

Physical educators frequently complain that a number of school administrators, teachers, and parents regard physical education as a secondary school subject in which students simply stretch

their legs, build muscle, or kick a ball. Some parents refuse to allow their children to participate in sports or exercise, preferring instead to keep them at home reading a book. As Zervas, Danis, and Klissouras pointed out in their study, the implication behind it

is that they undervalue the positive effects of being physically active in the children's development [1]. This goes in line with the traditional belief that rigorous physical activity produces fatigue, which in turn might negatively impact mental activity. This theory has also found scientific support in several early studies concluding that physical exertion negatively impacts children's cognitive ability [2; 3; 4]. One of the critical factors in determining whether physical activity produces positive or negative results in tests which assess mental performance appears to be one's level of physical fitness [5]. The goal of this study was to review literature with the focus on identifying a potential link between physical fitness parameters and sustained attention on a cognitive task.

### **Historical Background**

Organic, motor, and cultural components can all be found in the concept of physical fitness, as demonstrated in the handbook for the Eurofit test on physical fitness. This concept was the first research approach. The development of psychomotor capacities required for movement control, as well as muscular skills required to perform some motor tasks, is part of the motor dimension of physical fitness. This extremely complex component is commonly referred to as "motor fitness". It can't be measured with just one test; it requires a combination of tests that each measure a different factor. The organic dimension, which is closely linked to an individual's physical appearance, is concerned with energy production and output processes. The third facet of the physical fitness triad is the cultural dimension. It refers to and reflects the impact of factors such as the current state of affair of physical education in a country's system of education.

In 1967, Ismail and Gruber concluded that measures of coordination and balance were found to be in the long-term good predictors of a child's academic results. The impact of single, or acute, bouts of physical activity on participants' behaviour and mental performance is the focus of the second research approach. The effect of single bouts of

physical exertion on behaviour and cognition is measured while the individual is exercising or shortly after the exercise has ended. A number of scholars have come to the conclusion that acute bouts of exercise help adults with specific aspects of cognitive functioning [6; 7; 8; 9].

Acute bouts of physical activity, according to the literature, have positive short-term effects on the behaviour and cognitive performance of young adults exhibiting no clinical disorders. However, physical activity has also been found to have a positive effect in young aged individuals, who have a medical history of inability to stay focused, control impulsive behaviour, or engage in demanding motor activity [6; 10; 7; 11; 12; 13; 14]. The benefits of exercise training, on the other hand, were limited to improvements in children's physiological functioning [8].

### **Relationship of between physical activity and psychological well-being**

Children engaging on a regular basis in different forms of movement activity display improved psychological conditions. While children exercising less often exhibit a number of symptoms resulting from emotional distress, as compared to their more active counterparts. There is a link between physical activity and happiness that exists regardless of social class or health status as Mutrie and Parfitt identified in their revision of literature [15]. Physical activity in general appears to be beneficial for the emotional and psychological well-being of young adults, according to current evidence [13]. Sport and exercise can provide a valuable platform for young people to succeed, as evidenced by the resulting positive effects such an improved sense of personal worth, a higher level of perceived competence along with a better concept of their body image [15], with a stronger effect observed in the individuals who already display low levels of self-esteem. In addition, physical activity is found to have a positive effect, even though on a small scale, in relieving psychological complaints resultant from stress, anxiety, and depression among teenagers [9].

Children who are physically active have a greater likelihood to perform better in cognitive tasks as compared to their peers who exercise less. However, there isn't much solid experimental proof to back up this theory [9]. There is evidence that increasing the amount of time spent in school on health-related physical education does not impact at all children's school results and benefits children's health significantly [8; 9]. Even regular participation in sports does not impact negatively academic performance [6; 7; 9].

Earlier studies on the effects of daily physical activity on mathematics and reading performance found that there was no decline in academic performance despite the decreased amount of academic time spent engaging in the subject matters of science, mathematics, reading, language arts, and/or social studies in order to provide more time for physical activity [16; 17].

### **Discussion**

In P.E., the concept of motor skills is very important [18]. Even though some motor skills, such as walking or running, are highly over-learned, it is clearly an essential prerequisite for participation in virtually any physical activity or sports activity. If motor skills are learned incorrectly at a young age, they can limit performance at a higher level [5].

The ability to focus on relevant cues is directly proportional to one's chances of cognitive functioning and learning a task. Concentration refers to the ability to maintain complete focus on a single task at the expense of everything else. An individual's ability to pay attention is linked to their awareness of the constantly changing environment. The ability to concentrate and pay attention are critical components of the learning process. According to Abernethy, there can be hardly anything more important in learning and performing a specific sport skill than paying attention to the task at hand [19]. Processes linked to attention have been employed to describe how both cognitive and motor task learning are affected by information processing.

In order to appreciate the fact that good intellectual development can lead to good motor test results, there is a need to investigate the link between intellectual development and motor abilities. According to Assainte posture is extremely important to maintain balance while starting the movement, and also during the movement [20]. Therefore, there is a strong link between concentration and balance, which in turn is also linked to academic results. Those who have good concentration want to get better grades and excel at games that require concentration and attention. As a result, if they participate in these types of games, they will display higher levels of self-esteem and will attend more PE classes. Some psychological constructs have been considered multidimensional by researchers, most notably self-concept [21; 22; 23] that has now been conceptualized as multidimensional and hierarchical. Placed highest in the hierarchy is the general or overall concept which indicates how a person views oneself from the perspective of others, commonly referred to as self-concept. Self-concept comprises six domains including the social, academic, and physical domains. The domains are further classified into sub-domains and as children enter into adolescence the differentiation grows deeper [22]. Although the physical domain is inherently associated with physical activity and the respective health benefits deriving from it, research investigating mental well-being needs to take into consideration global self-esteem. In this case, more than one questionnaire would be required to have a better consideration on the Intelligence of those who participate in the testing, such as IQ tests or questionnaires on self-concept and self-esteem [21; 22; 23].

Early research that looked into the possibility of physical activity impairing cognitive performance of young aged-adults found that exercise actually improved rather than debilitated their performance. Gabbard and Barton assessed mathematical skills of 106 sixth grade boys and girls, before and after vigorous physical activity [24]. The accuracy of children's math computations was not harmed by

the exercise, but it was significantly improved. These findings were interpreted as proof of a relaxation state induced by exercise, during which children were able to improve their concentration. McNaughten and Gabbard tested the speed and accuracy in solving mathematical tasks of 120 sixth-grade boys and girls after they went for a 20- to 40-minute paced walk [25]. When the evaluation was done in the afternoon and midday, there was a significant improvement. Caterino and Polak discovered that physical exercises facilitate cognition in children [16]. They compared the effects of 15 minutes of vigorous aerobic exercise versus 15 minutes of stretching exercise on the Woodcock-Johnson Test of Concentration, which requires rapid stimulus identification and matching. Following aerobic exercise, only the fourth-grade students' performance improved significantly. The findings of these studies suggest that children's later academic performance is unaffected by scheduled periods of physical activity; indeed, the evidence, while limited, suggests that exercise may, in some circumstances, improve cognitive performance following periods of vigorous exercise.

Bass evaluated by means of a multiple-baseline design method the effects of 45-minute runs on attention and impulse control in six children from the ages of 8 to 11 [10]. Five out of six children improved their classroom attention and four improved their impulse control as a result of the exercise.

Croce and Horvat demonstrated the ergogenic how acute exercise sessions affect cognition in adolescents with mild intellectual disability in laboratory studies [26]. The authors concluded that the positive results that physical activity brings on children's cognitive performance vary according to exercise intensity and fitness level of the subjects.

According to research, the effects of strenuous physical activity on the ability to concentrate and pay attention vary significantly and are primarily dependent on how intense the exercise is and the time span of the exercise. Most of the evidence that support the health benefits of physical activity

on a child's psychological state are founded on single bouts of physical activity or are gathered from cross-sectional studies in the form of self-report questionnaires. Since the positive impact of regular physical activity on children's development remains still unexplored, studies need to address the relationship between physical activity done on a regular basis and children's well-being [12; 27; 15]. Unfortunately, methods for evaluating physical activity among children have been questioned [28; 29; 13]. Davey studied how physical exertion impacted attention using various intensities of physical activity, concluding that moderate physical exertion improves attention [12]. However, the study is limited in that it fails to determine the level of physical activity that the children engaged in the gym hall. However, the goal was to demonstrate that a typical day in PE class did not reduce children's concentration and attention; rather, they were more concentrated after the PE lesson, implying that PE had no negative impact on their grades; however, those with better grades have even better basic motor abilities, and the speed of movement was not affected by concentration; perhaps it is affected by other factors. With a p value of 0.05, differences between two groups in the balance and concentration results were significant. So, it's possible that their increased attention is the reason for their improved cognitive performance and academic grades, as well as their improved balance, but not their movement speed. Of course, there are some flaws with the tests; for example, the children were classified according to their chronological age rather than their biological age [30], which may have influenced the results; however, the link between attention and concentration and academic average marks and balance was statistically significant, implying that there is a strong link. The academic achievement and the speed test did not have a significant correlation. The relationship between academic achievement and results in balance and concentration was significant ( $r = 0.8$ ), but not so much with speed.

From the revision of the later literature, bouts of physical activity cause transient changes in cognitive processes that control the allocation of attention resources [9]. Skills and associations acquired during physical activity are transferable to learn additional relationships and models. This suggests that rather than the physical effort, the movement itself producing the activity, is important. According to Piaget, an IQ test is required for a more accurate assessment of intelligence development as well as the evaluation of more determinant variables in order to obtain a deeper insight into the effects that these variables have [31]. It is necessary to divide the subjects into groups based on biological rather than chronological age. Finally, the tests are practical and applicable in school situations, in addition to their suitability for survey purposes in large-scale projects. As a result, simple test versions were preferred over more complex ones, without jeopardizing the other validity, reliability, and objectivity criteria. The EUROFIT tests provide useful information about a person's basic motor abilities; however, they are not well suited to assessing or predicting a person's

level of technical sports abilities [32]. Because each test measures a different aspect of motor fitness, it's impossible to create a hierarchy between them. While boys tend to outperform girls in terms of speed, girls may outperform boys in terms of balance.

### **Conclusions**

The literature review that looked into the studies exploring the link between physical activity and children's cognitive ability, show that contrary to the findings of earlier studies, physical activity improved rather than impaired children's academic performance. Improvements in cognitive performance are statistically more significant following periods of vigorous exercise. Based on relevant research, the impact of physical exercises on concentration and attention vary significantly and depend primarily on the intensity and duration of the exercise. The majority of evidence that supports the benefits of physical activity on children's psychological well-being is based on single/acute bouts of physical activity. Consequently, it is necessary to consider the effect of habitual physical activity levels on children's wellbeing.

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