# Healthy sports physical activity and relationship to cognitive performance and physical fitness among secondary school students In Algeria

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**Abstract**

*Background:This study addresses the importance of sports participation in improving both physical fitness and cognitive performance among adolescents. Previous research suggests that regular physical activity can positively influence academic performance, but few studies focus on secondary school students in Algeria. Objective:The aim of this study was to explore the relationship between healthy sports participation, physical fitness, and cognitive performance in secondary school students in Guelma, Algeria. Methods:The research involved 30 secondary school students from Guelma, divided into two groups: one group practicing regular physical activity and another group not participating in any physical activity. Four tests were used: the 5-minute Brixie endurance test and the 2 kg medicine ball throw test to assess physical fitness, and mathematics and physics science tests to assess cognitive performance. Data collection took place in April and May 2024. Statistical analysis was carried out using SPSS version 25, with arithmetic mean, standard deviation, and independent sample t-test ($p < 0.05$). Results:The results showed that students who engaged in physical activity scored significantly higher in both physical fitness and cognitive performance. Specifically, those who participated in physical activity had higher endurance scores ($M = 1452.76$, $SD = 117.78$) and strength scores ($M = 9.43$, $SD = 6.50$). In terms of cognitive performance, students who practiced sports scored better in both mathematics ($M = 13.50$, $SD = 1.29$) and physics ($M = 13.97$, $SD = 1.94$), with statistically significant differences ($p < 0.05$). Conclusions:The findings of this study suggest that regular participation in physical activity has a positive effect on both physical fitness and cognitive performance. Adolescents who engage in sports not only exhibit superior physical health but also show enhanced academic performance. Thus, promoting healthy sports programs in schools is crucial for fostering overall well-being and academic achievement.*

**Keywords:** *health, sports physical activity, cognitive performance, physical fitness, secondary school.*

## 1. Introduction

Health and well-being have long been associated with exercising sports. adolescents who lead active, healthy lifestyles develop a strong musculoskeletal system, lower their chance of contracting chronic illnesses, sharpen their cognitive abilities, and boost their sense of self. It is well acknowledged that physical activity has positive effects on children's and teenagers' cognitive development, brain health, and, ultimately, academic success, in addition to its well-known health benefits, Physical exercise may have a direct and indirect impact on academic achievement across a number of physiological, cognitive, emotional, and learning variables, according to this evidence. After all, young people who participate in the most physical exercise have the chance to improve their mental and physical well-being as

well as to strengthen their sense of self-worth and self-efficacy, which will ultimately help (Latino & Tafuri, 2023).

Physical activity plays a vital role in promoting both the physical and psychological well-being of adolescents. During adolescence, which represents a critical developmental stage, regular participation in physical exercise supports healthy growth, improves fitness levels, and contributes to the prevention of various health problems such as obesity, cardiovascular disease, and anxiety (Janssen & LeBlanc, 2010). Furthermore, engaging in structured physical activities has been associated with improved self-esteem, emotional stability, and stress management among high school students (Biddle, Ciaccioni, Thomas, & Vergeer, 2019). As such, schools are increasingly encouraged to integrate sports and physical education programs as an essential component of holistic adolescent development (World Health Organization [WHO], 2020).

In addition to physical health, several studies have highlighted the positive impact of physical activity on cognitive functions, including memory, attention, and information processing speed. Exercise enhances cerebral blood flow, increases neuroplasticity, and stimulates the release of neurotrophic factors that facilitate learning and cognitive development (Hillman, Erickson, & Kramer, 2008). Evidence suggests that adolescents who engage in regular physical activity tend to perform better academically, especially in subjects that require problem-solving and critical thinking, such as mathematics and science (Donnelly et al., 2016). These findings emphasize that physical education should not be viewed merely as recreation, but as a core contributor to intellectual performance.

Moreover, sports participation fosters cognitive engagement through coordination, concentration, and decision-making processes inherent in athletic activities. For instance, team sports often require strategic thinking, anticipation, and communication, which strengthen executive functions related to academic success (Voss, Kramer, Basak, Prakash, & Roberts, 2010). Physical exercise also enhances brain function by stimulating the hippocampus and prefrontal cortex, areas responsible for learning and memory (Esteban-Cornejo et al., 2015). Consequently, physically active students are better equipped to handle complex academic tasks, leading to improved scholastic outcomes.

Although the precise processes via which exercise improves cognitive function are not entirely understood, it is known that aerobic exercise raises the synthesis of chemicals such brain-derived neurotrophic factor, which are thought to be important for cognitive function (Barnett, 2011).When automatic reactions are not suitable, cognitive control refers to a collection of top-down cognitive processes, sometimes referred to as executive functions, that enable the management of attention and behavior. Core cognitive control functions include cognitive flexibility, working memory, and inhibitory control. Even when IQ is taken into account, individual differences in cognitive control are linked to academic success in preschool and throughout the school years. Therefore, efforts have been made to find therapies that can consistently improve cognitive control abilities and demonstrate a positive correlation with academic results. The investigation of whether exercise may enhance cognitive functions is one field of inquiry that has expanded recently (Vasilopoulos et al., 2023).

Physical activity is crucial for children's mental and physical health, as well as their cognitive and physical development and psychological well-being. Indeed, an increasing number of studies have demonstrated that academic achievement is linked to aerobic fitness, a pertinent indicator of children's cardiovascular health, and that PA and its physiological aftereffects, including aerobic fitness, are the cause of individual differences in cognitive function and academic achievement. The association between children's physical fitness indicators (such as aerobic fitness, motor ability, and muscular fitness) and academic success is interestingly mediated by executive skills, according to a few recent research (Yangüez et al., 2024). Therefore, the public health agenda's promotion of physical exercise to enhance children's and teenagers' physical, mental, and cognitive health has compelling justification. Over the past twenty years, there has been a surge in research investigating the impact of both acute and chronic physical exercise on children's and teenagers' academic performance. (Muntaner-Mas et al., 2024).

Despite these well-documented benefits, the relationship between physical activity and cognitive performance among Algerian adolescents has received limited empirical attention. Understanding how sports participation affects both physical fitness and academic performance in this population is essential for developing evidence-based educational and health policies. Therefore, the current study aims to examine the link between healthy sports participation, physical fitness, and cognitive performance among secondary school students in Guelma, Algeria. By comparing students who regularly engage in physical exercise with those who do not, the study seeks to provide a scientific basis for promoting physical education as a means to enhance academic achievement and overall well-being (Singh et al., 2019).

## 2. Materials and methods

### Study participants

30 secondary school students from the Guelma province of Algeria participated in the study; 15 of them engaged in physical exercise, while the remaining 15 did not. They were chosen at random.

### Study design

To differentiate between exercisers and non-exercisers in the study variables, the research sample was subjected to the following four tests:

- Physical fitness (endurance test, strength test).
- Cognitive performance (mathematics test, physics science test).

The following phases comprised the research, which was carried out in April and May of 2024 :

- In April 2024, the endurance test was administered and assessed between April 23 and April 26.
- From April 27, 2024, to April 29, 2024, the strength test was carried out and assessed.
- From May 3 to May 6, 2024, the mathematics test was assessed.
- The evaluation period for the Physics Sciences exam was May 07–May 09, 2024.

**Measurements**

Among the field tests used in the study are the following ones:

**endurance Test**

The 5-Minute Brixie Test

The test aims to measure the maximum oxygen consumption as well as the effectiveness of the respiratory and circulatory systems.

Test Description: During the allotted five minutes, the most distance must be covered.

Procedure for recording grades: The total distance covered throughout the test time is computed.

**Strength test**

Test of medicine ball throwing:

The test's objective is to measure arm muscular strength.

Equipment: a measuring tape and a 2 kilogram medicine ball.

In order to conduct the test, the tester stands behind the starting line, holding the ball in both hands. He then swings his arms and throws the ball as far away as he can while keeping his back to the throwing area or measuring tape.

grades for the method record: The best of the tester's three efforts is counted, and the distance is measured to the closest 5 cm.

- Evaluation of cognitive performance test grades in mathematics and Physics sciences.

**Statistical analysis**

- The statistical analysis of the research was conducted using SPSS version 25 software.

- Both the standard deviation (SD) and the arithmetic mean.

- For independent samples, use the T test.

- The research's significance criterion was set at a 95% confidence interval, or ($p < 0.05$).

## 3. Results

**Table. 1.** Statistical analysis of the results for the Brixie 5min Test.

| **Endurance: Brixie 5min Test** | | |
|---|---|---|
| test grade | Practice variable | |
| | practitioners | non-practitioners |
| N | 15 | 15 |
| M | 1452,76 | 1051,57 |
| SD | 117,78 | 105,88 |
| T test | 9,810 | |
| df | 28 | |
| Significance level | ($p < 0.05$) | |
| Sig | 0,00 | |
| Statistical estimate | significant | |

*Source*. Present research

In the endurance test (Brixie 5-minute test) for the Physical fitness variable, the arithmetic mean of students who practiced sports physical activity was 1452.76 with a standard deviation of 117.78, which is higher than the arithmetic mean of non-participants, which was 1051.57 with a standard deviation of 105.88, as shown in Table (1). After then, we look at the outcomes of the next test (t) to see if this difference is statistically significant. The table indicates that the value of (t) computed at degree of freedom (28) equals (9.810). The differences between practitioners and non-practitioners in terms of the endurance test are statistically significant and in favor of practitioners given the variable of engaging in healthy sports physical activity because the degree of significant probability (sig=0.00) is lower than the significance level ($p < 0.05$).

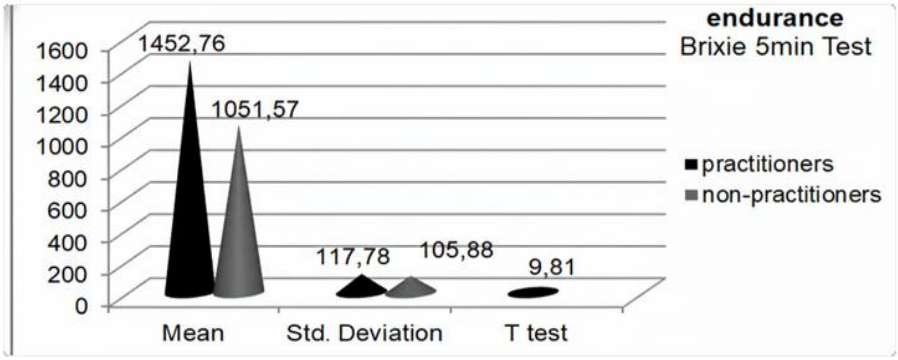


**Figure. 1** . Graph of the Mean and std Deviation of the Brixie 5min Test.

**Table. 2.** Statistical analysis of the results for 2 kg medicine ball throw test.

| **Strength: 2 kg medicine ball throw test** | | |
|---|---|---|
| test grade | Practice variable | |
| | practitioners | non-practitioners |
| N | 15 | 15 |
| M | 9,43 | 6,50 |
| SD | 0, 86 | 1,47 |
| T test | 6,644 | |
| df | 28 | |
| Significance level | ($p < 0.05$) | |
| Sig | 0,00 | |
| Statistical estimate | significant | |

*Source*. Present research

In the strength test (2kg medicine ball throw test) for the Physical fitness variable, the arithmetic mean of athletic participants was 9.43 with a standard deviation of 6.50, higher than the arithmetic mean of non-participants, which was 0.86 with a standard deviation of 1.47, as shown in Table (1). After then, we look at the outcomes of the next test (t) to see if this difference is statistically significant.

The table indicates that the value of (t) computed at degree of freedom (28) equals (6.644). Given the variable of engaging in healthy physical sports, the strength test results of practitioners and non-practitioners differ statistically significantly, favoring practitioners because the degree of significant probability (sig=0.00) is lower than the significance level ($p < 0.05$).

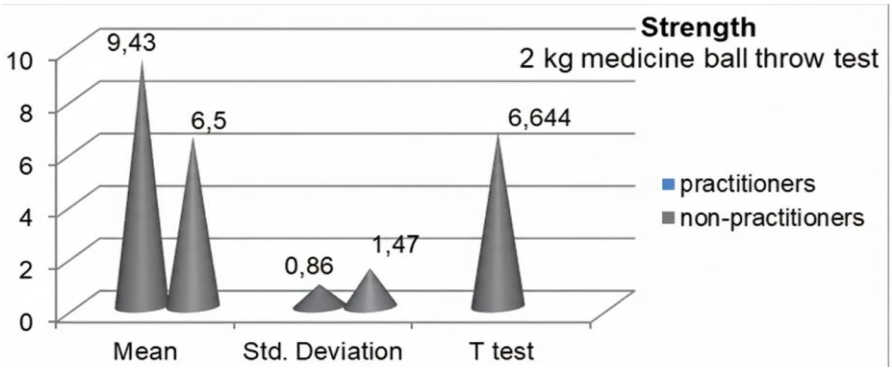


**Figure .2**. Graph of the Mean and std Deviation of the medicine ball throw test

**Table.3.** Statistical analysis of the results for the mathematics test.

| **mathematics Test** | | |
|---|---|---|
| test grade | Practice variable | |
| | practitioners | non-practitioners |
| N | 15 | 15 |
| M | 13,50 | 9,43 |
| SD | 1,29 | 2,47 |
| T test | 5,646 | |
| df | 28 | |
| Significance level | ($p < 0.05$) | |
| Sig | 0,00 | |
| Statistical estimate | significant | |

*Source*. Present research

In assessing the grades on the mathematics test for the cognitive performance variable, the arithmetic mean of those who participate in physical sports was 13.50 with a standard deviation of 1.29, higher than the arithmetic mean of those who did not, which was 9.43 with a standard deviation of 2.47, as shown in Table (1). To ascertain whether or not this difference is statistically significant, we next look at the outcomes of the next test (t). The value of (t) computed at the degree of freedom (28) is equal to (5.646), as can be seen from the table. Because the degree of significant probability (sig=0.00) is lower than the significance level ($p < 0.05$), the

differences between practitioners and non-practitioners in terms of the mathematics test are statistically significant and in favor of practitioners given the variable of engaging in healthy physical sports activity.

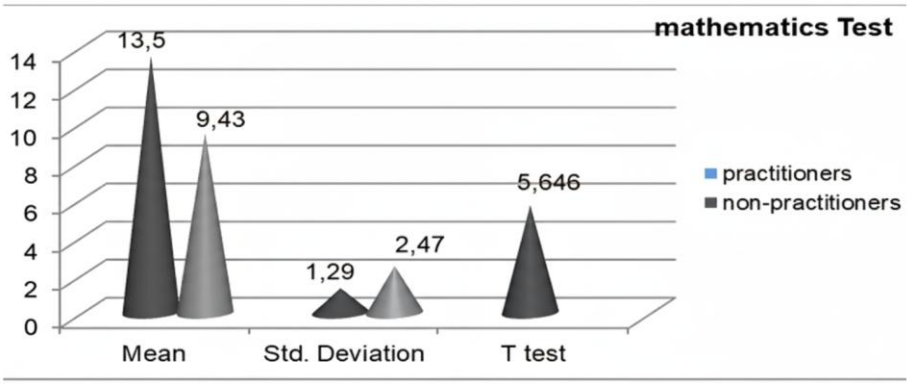


**Figure 3.** Graph of the Mean and std Deviation of the mathematics test.

**Table .4.** Statistical analysis of the results for the physics sciences test.

| **Physics sciences test** | | |
|---|---|---|
| test grade | Practice variable | |
| | practitioners | non-practitioners |
| N | 15 | 15 |
| M | 13,97 | 1,94 |
| SD | 9,80 | 1,68 |
| T test | 6,267 | |
| df | 28 | |
| Significance level | (p < 0.05) | |
| Sig | 0,00 | |
| Statistical estimate | significant | |

*Source*. Present research

In assessing the grades on the physics sciences test for the cognitive performance variable, the arithmetic mean of students who engage in physical activity was 13.97 with a standard deviation of 9.80, which is higher than the arithmetic mean of non-participants, who scored 1.94 with a standard deviation of 1.68, according to the data in Table (1). After then, we look at the outcomes of the next test (t) to see if this difference is statistically significant. The table indicates that the value of (t) computed at degree of freedom (28) equals (6.267). Given the variable of engaging in healthy physical sports, the physics sciences test results show statistically significant differences between practitioners and non-practitioners that favor practitioners because the degree of significant probability (sig=0.00) is lower than the significance level (p < 0.05).

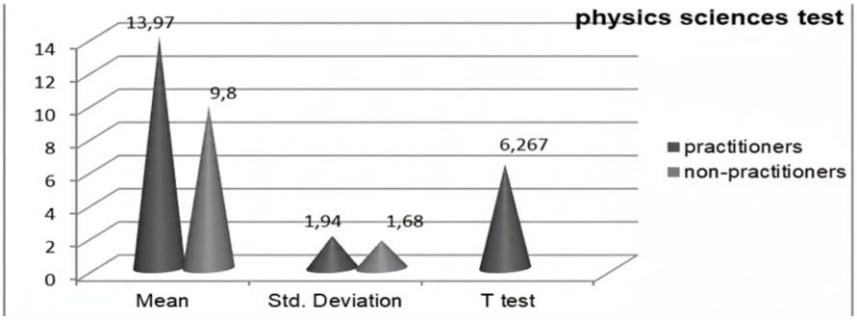


**Figure .4.** Graph of the Mean and std Deviation of the physics sciences test.

## 4. Discussion

The results of the current study demonstrate that playing sports improves physical health and, consequently, cognitive performance in various academic subjects for practicing students, whether in physical education classes or during leisure time. This leads to preference in academic achievement, concentration, and cognitive awareness, and ultimately to good results in the academic path. This is because we found that there is a difference in the evaluation of test results between practitioners and non-practitioners of physical sports activity, favoring practicing students who obtained high scores in the cognitive performance variable for mathematics and physical science tests. This study helps us understand how good sports practices affect physical health and improve cognitive performance among secondary school students. However, we also analyzed the results of the physical fitness variable tests regarding the endurance test and the muscular strength test, and we found that there is a large difference in the level of physical fitness (endurance, strength) between practitioners and non-practitioners of sports exercises, which is in favor of practicing students to varying degrees. This indicates that practicing students have good physical health and good cognitive performance in their academic achievement in various scientific subjects, and this is due to the variable of healthy sports practice among them. and here we find many studies that agree with Our current study on the role of healthy sports practice in improving physical fitness and cognitive performance for different educational stages.

The research thoroughly examines the ways in which physical exercise improves children's academic performance and cognitive function. By highlighting the physiological, emotional, and social elements that mediate these gains, it underlines how important active lifestyles are for improved academic achievement and cognitive growth (Latino & Tafuri, 2023).

Activity is associated with improved cognitive performance in schoolchildren; research shows that both short bursts of activity and long-term exercise can improve academic performance and intelligence, especially in executive functioning processes (Barnett, 2011). Basic cognitive abilities like memory and more advanced ones like thinking and decision-making are both improved by exercise. More intellect, more academic achievement, and enhanced

social relationships—especially in kids and teenagers can result from this development (Zarzecka, 2014).

The discovery that physical exercise treatments have a favorable impact on children's cognitive function and academic success, including improving their working memory, creativity, on-task behavior, and fluid intelligence, with significant advantages for language and math results (Vasilopoulos et al., 2023). the connection between children's academic success and aerobic fitness, stressing the indirect contributions of intellect and executive processes, and underlining the importance of cognitive flexibility in relating aerobic fitness to arithmetic proficiency (Yangüez et al., 2024)

The effect of fitness and physical exercise on academic achievement, examining conflicting findings in previous research. It seeks to examine these impacts as well as how teacher abilities contribute to the implementation of successful interventions for kids and teenagers (Sember & Premelč, 2024). Cardiorespiratory fitness, in particular, has a significant impact on children's academic performance and psychological well-being. It also highlights distinct trajectories for boys and girls and emphasizes the need of regular physical exercise over screen time restriction (Jaekel, 2024).

Children in school benefit academically from physical exercise; sessions should last between thirty and sixty minutes, and moderate to intense intensity is linked to better academic results and cognitive function (James et al., 2023). the immediate impacts of physical exercise on academic results in school-aged children, discovering that a single physical activity session may significantly enhance behavior modification strategies and academic achievement, especially in language and arithmetic (Muntaner-Mas et al., 2024).

That playing sports has a favorable effect on young people's cognitive abilities, especially their inhibitory control. It does point out, though, that academic achievement and cognitive ability do not strongly correspond, indicating that variables other than fitness and physical exercise affect educational outcomes (Campos et al., 2024). As demonstrated by improved diastolic function, greater left ventricular muscle mass, and decreased resting heart rate, moderate exercise dramatically increases cardiac fitness. These gains are especially noticeable in sedentary people, promoting long-lasting behavioral shifts in favor of physical exercise (Pavlik et al., 2018). Teenagers who engage in high-intensity exercise training see notable improvements in their muscular fitness, cardiovascular health, and body composition. In order to maximize students' physical fitness results, the evaluation recommends that schools give high-intensity sports priority in their physical education curricula (Zhou et al., 2024).

Interventions including physical exercise greatly increase teenagers' cardiopulmonary fitness, especially in obese people. Greater advantages in blood pressure and maximum oxygen consumption are obtained from high-intensity exercise, highlighting the significance of exercise frequency and type for successful fitness gains (Wang et al., 2023). Teenagers who are physically active have far better muscular fitness the best results are obtained from short-duration, high-intensity, low-frequency workouts. For this age group, resistance training also yields significant advantages for improving muscular fitness (Wu et al., 2021).

Demonstrated giving teenage females supervised combined aerobic and strength training instead of traditional physical education greatly increased their muscular and cardiorespiratory fitness (Cohen et al., 2021). that maintaining physical fitness in teenagers, especially underweight females, requires engaging in health-promoting activity. It draws attention to a lack of engagement in physical activity and the necessity of customized programs to enhance body weight and physical health (Andrieieva et al., 2020). Adolescents who exercise regularly through aerobic, resistance, and flexibility training have better health-related fitness. Evidence suggests that teenagers recover more effectively from resistance training, which makes structured exercise regimens crucial (Smith et al., 2020). Adolescents who engage in more physical activity, especially those who meet the World Health Organization's recommendation of 300 minutes per week of moderate-vigorous activity, have much better cardiorespiratory fitness, which is essential for preventing overweight and obesity and improving general health in this age group (López et al., 2021). Teenagers might potentially avoid cardiovascular problems later in life by improving their cardiorespiratory fitness and decreasing body fatness, which can assist decrease exercise blood pressure and related cardiovascular risk (Huang et al., 2024).

Teenagers who engage in resistance training see a considerable improvement in their physical fitness, including improved lung capacity and running ability. A good physical intervention program fosters socializing and athletic enthusiasm, which in turn helps students do better academically (Hui., 2022). Because combining resistance and plyometric training greatly boosts adolescents' fitness performance by increasing their lower limb speed and explosive strength, two qualities that are essential for young people's overall athletic development and health-promoting lifestyles (Fischetti et al., 2019).

Improved cognitive performance, such as selective attention, focus, and processing speed, as well as improved psychosocial outcomes, such as self-efficacy, self-rated health, and life satisfaction, are associated with adolescents who exercise and become more fit (Reigal et al., 2020). Participating in organized sports greatly improves the muscular and cardiorespiratory fitness of teenagers. Higher levels of fitness are attained by consistent engagement, but the advantages of dropout are lessened. To encourage fitness in individuals who never participated or drop out, low-cost leisure activities are advised (Kolunsarka et al., 2023).

## 5. Conclusions

Secondary school students who participate in healthy physical education programs or in their leisure time have good physical health, according to the study's findings. Based on all the data gathered and analyzed from the assessment of the tests, this is clear from the physical fitness variable that compares the performance of practitioners and non-practitioners in the endurance test (5-minute brixie test) and the strength test (2 kg medicine ball throwing test). Consequently, the endurance test provided practitioners with an arithmetic mean (1452.76) and a standard deviation (117.78). For the strength test, practitioners received an arithmetic mean of (9.43) and a standard deviation of, (0.86) whereas non-practitioner students received an arithmetic mean of (1051.57) and a standard deviation of 105.88. While practitioners' scores on cognitive performance tests for

mathematics and physical science revealed that, when we analyzed the mathematics test, the arithmetic mean for practitioners was (13.50) with a standard deviation of,( 1.29) non-practicing students' scores on the same test were (6.50)with a standard deviation of (1.47). Conversely, non-practicing students who completed the same test had an arithmetic mean of (9.43)and a standard deviation of. (2.47) The physical science exam results, on the other hand, were also assessed since the practitioners' arithmetic mean was (13.97) with a standard deviation of (1.94). In comparison, the identical exam had an arithmetic mean of (9.80) and a standard deviation of (1.68) for students who did not practice. Based on these field-analyzed data, we conclude that there is a statistically significant difference between those who participate in physical sports and those who do not, favoring practitioners in all research variables, including physical fitness and cognitive performance.

We may draw the conclusion that kids who engage in physical exercise and healthy sports have better physical health and do better cognitively in their academic endeavors than their peers who do not, based on the facts presented. Students who engaged in physical sports activities outperformed those who did not, as seen by their improved exam scores.

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