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# An analysis of the impact of physical activities on enhancing primary school student's academic performance

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***Abstract:*** *This study aims to provide empirical evidence on the impact of physical activity on academic achievement in primary school students. The 60 sixth graders in a Shenzhen primary school were divided into two groups: an experimental group and the control group. The experimental group ran daily for 30 minutes, while the control group did nothing. Standardized tests assessing their performance in Chinese, mathematics, and English were administered at both the commencement and conclusion of the experiment. The findings revealed that students in the experimental group demonstrated significant improvements across all subjects, with an average increase of 5.2 points in Chinese ($p = 0.034$), 4.8 points in mathematics ($p = 0.041$), and 6.1 points in English ($p = 0.029$). These enhancements were statistically meaningful, indicating that physical activity positively impacted the academic performance of primary school students. In contrast, scores for students in the control group exhibited minimal change during the experiment and even slightly decreased within certain subjects. Based on these outcomes, it can be concluded that physical activity, particularly regular running training, not only enhances students' physical well-being but also effectively fosters their academic performance.*

***Keywords:*** *Physical Activity, Academic Performance, Primary School, Cognitive Development, Holistic Education*

## 1. Introduction

### *1.1. Research background*

In recent years, there has been increasing attention on the impact of physical activity on students' academic performance. However, existing literature primarily focuses on secondary and higher education. For instance, a significant association between children's physical activity and academic performance globally [1]. And a meta-analysis also summarizes the positive effects of physical activity on academic achievement, particularly among adolescent populations [2]. Nevertheless, research specifically targeting primary school students, especially within the Chinese educational system, is relatively scarce. While the link between school-based physical activities and academic performance among adolescents, attention to younger students remains limited [3]. Furthermore, although addressing the association between physical activity and cognitive as well as academic performance in 7-10-year-old children, lacks specific analysis concerning Chinese primary school students [4]. This study fills a critical gap by examining how regular physical activity impacts the academic performance of primary school students in Shenzhen. Its novelty lies in its focus on young students at a crucial developmental stage and its establishment of causal relationships between physical activity and academic performance through quasi-experimental design with greater rigor. Moreover, this study's originality is demonstrated through its comprehensive approach that considers multiple factors such as types of physical activities, frequency, intensity—areas that have not been thoroughly explored in existing research.

Despite a growing body of research recognizing the benefits of physical activity on children's cognitive and academic development, empirical studies that quantitatively measure the impact of physical activity on academic performance in the context of primary schools in China are still significantly lacking. Most of the existing research has focused on middle school and older. For example, the systematic review of physical activity and academic achievement mainly involved adolescents [5],

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while the association between physical activity and academic skills in primary school, although the study sample was mainly concentrated in Western countries [6]. In addition, the correlation between school physical activity and academic performance, mainly targeted at middle school students, lacking in-depth discussion on primary school students, especially Chinese primary school students [7]. Through empirical data, this study proves the positive role of physical activity in improving the academic performance of primary school students, which not only provides a scientific basis for the formulation of school education policies, but also brings important enlightenment for the teaching practice of front-line teachers. Specifically, teachers can promote the overall development of students and improve academic performance by increasing the time and frequency of physical activity.

In terms of subject-specific performance of academic achievement, physical activity is closely related to academic achievement, especially in mathematics and language subjects [8]. And physical education in primary school has a positive effect on students' math and language achievement [9]. In addition, physical activity can not only improve students' math and language scores, but also promote students' overall cognitive ability [10].

In addition, some studies have explored the effects of different types of physical activity. For example, in a 9-year intervention study that students who participated in physical education daily showed significant improvements in both motor skills and academic performance [11], providing empirical support for the effectiveness of long-term physical education interventions. In addition, physical activity and static behavior in children found an important link between these activities and academic skills, indicating the promoting effect of regular physical activity on cognitive development [12].

As for the impact on mental health, physical activity has significant benefits on children's mental health, thereby indirectly promoting their academic performance [13]. Moreover, physical activity not only contributes to physical health, but also indirectly improves academic performance by reducing stress and anxiety [14].

Regarding the relationship between the school environment and physical activity, sedentary behavior of preschool children in the school environment is closely related to the frequency of physical activity, and this behavior pattern has a profound impact on academic performance [15]. Similarly, children who participated in physical activity at an early age performed significantly better academically than their less physically active peers [16].

According to the above phenomena. This study aims at achieving the following specific objectives. To determine the overall effect of regular physical activities on the academic achievements of primary school pupils; To identify which academic disciplines (Chinese and Mathematics, and English), show the most significant improvements due to physical activity. To explore the variations of the impact of physical activities on academic performance in students of different academic levels and genders. This study will test the following hypotheses.

### *1.2. Conceptual and theoretical Framework*

**Conceptual framework:** The conceptual framework of this study identifies how physical activity (independent variable) influences the academic performance of elementary school students (dependent variable) through cognitive and psychological mechanisms. Specifically, 30 minutes of daily running training can improve students' performance in Chinese, math and English by improving their attention, concentration, cognitive function and emotional regulation. Physical activity not only improves students' learning efficiency and test performance by improving their cognitive function and emotional management skills, but also helps them better cope with academic stress, especially in math and English subjects.

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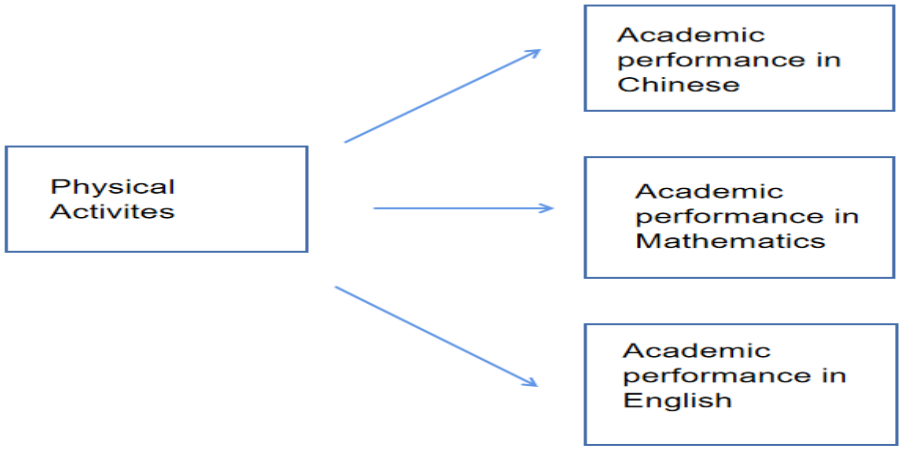


*Figure 1: Research Conceptual Framework*

Based on Figure 1, this conceptual framework highlights the theoretical significance of incorporating physical activities into primary education. It emphasizes the role of physical activities in improving students' academic performance in subjects such as Chinese, Mathematics, and English. The framework further suggests that enhancing the time and frequency of physical activities can serve as an effective strategy for boosting academic performance across these key areas.

**Theoretical Framework:** This study used the body-brain interaction theory to show how exercise affects students' academic performance. The Body-Brain Interaction Theory says that exercise improves not just physical health but also cognitive ability and academic performance by affecting how the brain works, including how new brain cells are formed, how we pay attention, and how we control our emotions.

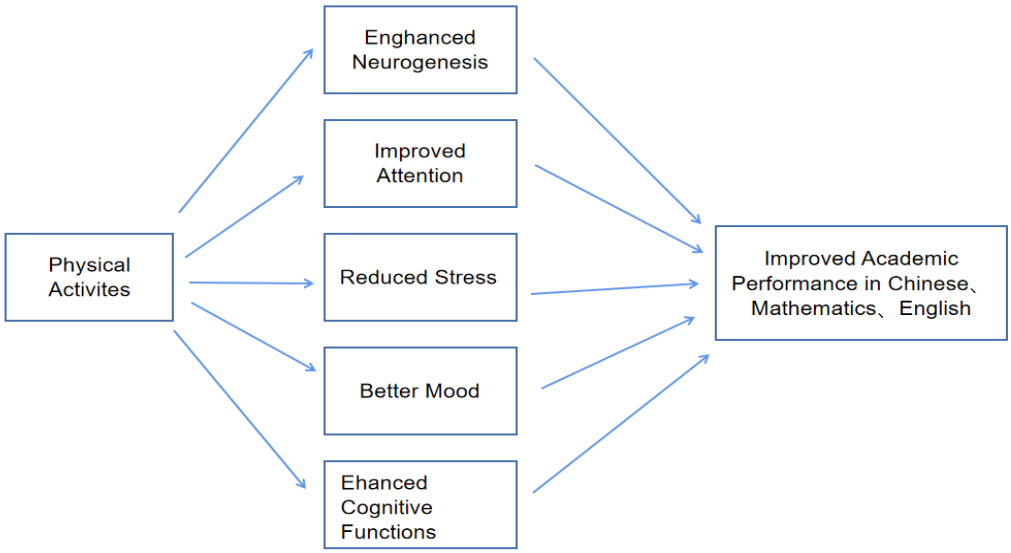


*Figure 2: Research Theoretical Framework*

Based on Figure 2, the theoretical framework of this study draws on the Body-Brain Interaction Theory to investigate how physical activities can enhance elementary school students' academic performance by improving brain function. According to this theory, physical activities not only have profound effects on physical health but also improve brain function through various physiological and psychological mechanisms. These mechanisms, such as enhanced neurogenesis, improved attention, reduced stress, better mood, and enhanced cognitive functions, collectively contribute to improved cognitive abilities and academic performance in subjects like Chinese, Mathematics, and English.

*Neurogenesis and enhanced brain function.* Studies have shown that physical activity, especially aerobic exercise, can significantly boost neurogenesis, the generation of new brain cells, especially in the

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hippocampus region, which is strongly associated with learning and memory ability. For example, people who participated in regular aerobic exercise had a 2% increase in hippocampal volume, and this change was significantly associated with improved memory function [17]. This finding is particularly important because the volume of the hippocampus typically decreases with age, and physical activity can reverse this process. In this study, 30 minutes of daily running training for students was thought to have a positive impact on enhancing their memory and information processing skills by promoting neurogenesis, especially in subjects such as Chinese and English that require a lot of memory and comprehension.

*Enhance attention and executive function.* Physical activity can also improve attention and executive function by increasing blood flow to the brain and enhancing the supply of oxygen and nutrients to the brain. After 20 minutes of aerobic exercise, children's performance in executive function tasks significantly improved, especially in attention and working memory tasks [18]. Another study found that after a short period of physical training, students' reaction times were 10 percent faster and their error rates were 15 percent lower. In this study, 30 minutes of running training was expected to increase learning efficiency by improving students' attention and executive function, making them more focused in class and less distracted. This improvement is especially critical for math subjects, which often require high concentration and complex logical thinking skills.

*Emotional regulation and stress reduction.* Emotional regulation is another key factor in academic performance. By regulating the levels of neurotransmitters such as dopamine, serotonin and norepinephrine, physical activity can effectively reduce students' stress and anxiety and improve their mental health. For primary school students in this study, 30 minutes of running training improved their performance in Chinese and English exams by reducing their academic stress and test anxiety and making them more leisurely and confident.

## 2. Methodology

### *2.1. Experimental design*

*Table 1: The following provides an overview of the experimental design.*

| groups | quorum | sports training | teaching schedule | workloads | Teachers |
|---|---|---|---|---|---|
| experimental group | 30 | Yes | concordance | concordance | concordance |
| control group | 30 | No | concordance | concordance | concordance |

Based on Table 1, a quasi-experimental design was employed to examine the impact of physical exercise. The study involved 60 sixth-grade students from a primary school in Shenzhen, selected for their physical and mental maturity relative to their age, as well as their consistent academic performance. The students were divided into two groups: the experimental group and the control group, each consisting of 30 students. Efforts were made to ensure comparability between the groups in terms of gender ratio, academic performance, and family background.

The experimental group participated in a daily 30-minute moderate running activity, aiming to maintain 60%-70% of their maximum heart rate. This intervention lasted for 8 weeks. In contrast, the control group did not engage in any additional physical activity. Both groups attended the same daily classes, completed identical homework assignments, and were taught by the same teacher, ensuring that the primary variable was the presence or absence of physical exercise.

### *2.2. Research Instruments*

First, we conducted a systematic literature review to identify tools and measures that have been widely used and validated in previous studies. This process ensures the theoretical basis and scientific nature of the tools used in this study. Then, we have designed standardized tests for three subjects, Chinese, mathematics and English, which match the content of the Shenzhen sixth grade curriculum. In order to ensure the reliability and validity of the measurement, we conducted a Pilot Study to test students in another primary school, and the results showed that the test questions had good adaptability to students

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in the target age group. Secondly, to collect feedback from teachers and students on the impact of physical activity, we designed relevant questionnaires and interview Outlines. These tools are reviewed by experts to ensure their content validity and cover the key factors affecting student learning and classroom engagement.

For academic achievement tests, we used internal consistency Reliability (Cronbach's α) and Test-Retest reliability to assess the reliability of the tool. The test results showed that Cronbach's α values of the three subjects were all above 0.85, indicating that the tool had high internal consistency. In addition, by retesting some students after two weeks, the results show that the measurement consistency is good, and the retest reliability coefficient reaches 0.82.

To evaluate the Validity of the tool, we conducted Content Validity and Construct Validity analyses. Content validity is conducted by an expert review panel to ensure that the test content comprehensively covers the core knowledge points and competency requirements of the target discipline. In terms of structural validity, we verified the dimensional structure measured by the tool through exploratory factor analysis (EFA), and the results supported the original theoretical framework, showing good differentiation and cohesion among the measured dimensions.

### *2.3. The process of data collection*

*Table 2: The process of data collection*

| Steps | Contents |
|---|---|
| Participant Selection | The study involved 60 students in sixth grade from a primary School in Shenzhen. The participants were divided into two parts. One part was an experimental group (30 students) that ran for 30 minutes every day and the other parts (30 students) did not exercise. |
| Uniform Academic Testing | To ensure consistency, tests were given to both parts at the start and end of the study.<br>These students were tested in three subjects: Chinese, Math and English. |
| Qualitative Data Collection | Teachers and students also gave feedback.<br>We interviewed people and held discussions to learn about how exercise helps students learn and engage in class.<br>Students in the experimental group kept a daily log of their running sessions, noting the duration, intensity, and any issues. |

Based on Table 2, the data collection process is described in detail, including information about the participants, their age, and the composition of the control and experimental groups. The study involved 60 students, evenly divided into an experimental group and a control group. To ensure the stability of the experimental results, the process included standardized tests administered uniformly at both the beginning and end of the study. Additionally, qualitative data was collected through interviews, discussions, and feedback from teachers and students. The experimental group also maintained daily logs of their running sessions, recording details such as duration, intensity, and any issues encountered.

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### *2.4. Ethical issues*

Before the study was conducted, all participants, as well as their legal guardians, were informed about the purpose, the procedure, the potential risks, and the benefits of the research. The research team sent the consent form and detailed study information to each student's parents to ensure that the participants gave their informed consent. The description includes information about the background of this study, the voluntary nature, confidentiality of data, and rights of participants. Parents and students will have ample time to read the information and understand it. The research team has provided contact details to answer any questions.

The legal guardians of all participants, after detailed study information, signed written consent confirming their consent to their children's participation in the study. For students under the legal age of consent, the study pays special attention to obtaining informed consent from parents and ensuring that all students feel comfortable and stress-free during the study. Participants can withdraw from the study at any time without giving a reason. This will not affect their academic or other activities.

**Data Confidentiality and Privacy Protection:** During the data collection process, the research team strictly adheres to the principle of data confidentiality. All personal data collected is anonymized and students' identifying information is stored separately from their academic performance and research data to ensure that data is not used for purposes unrelated to research. The findings are reported and published using aggregated data only and do not involve any personally identifiable information.

All research data are stored and processed in accordance with relevant legal and ethical requirements. The research team has taken strict technical measures, such as encryption and access controls, to protect the security of the data and ensure that only authorized researchers have access to it.

### *2.5. Data Analysis Procedures*

Based on Table 3, the data analysis process is rigorous and systematic. It begins with data collation, including pre-processing tasks such as handling missing values and correcting outliers. This is followed by descriptive statistical analysis to calculate the means and standard deviations for both the experimental and control groups. Difference tests, including paired and independent tests, are then conducted to compare pre- and post-test scores. Finally, linear and multiple regression analyses are performed to predict the impact of physical activity on academic achievement. This comprehensive process enhances the reliability of the experimental results and provides a solid scientific foundation for the study's conclusions.

*Table 3: The process of data analysis*

| Data Analysis Procedures | Content |
|---|---|
| Data collation | Pre-processing of collected data, including handling missing values and correcting outliers |
| Descriptive statistical analysis | Calculation of the means and standard deviations in both experimental and control groups. |
| Difference test | Use paired and independent tests to compare the differences between pre and post test scores |
| Regression analysis | Linear and Multiple Regression Analysis to Predict the Impact of Physical Activity on Academic Achievement |

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## 3. Research results

### *3.1. Descriptive statistics analysis*

Based on Table 4, the average scores and standard deviations for both the experimental and control groups in Chinese, Mathematics, and English tests are presented. This data provides a preliminary insight into the performance of each group before and after the intervention. The table highlights changes in test scores, allowing for an initial comparison of the impact of the intervention on the experimental group relative to the control group.

*Table 4: The test scores of the experimental and control groups.*

| groups | average score for Chinese (SD) | average score in mathematics (SD) | English average score (SD) |
|---|---|---|---|
| Experimental group (before) | 75.3 (5.0) | 78.4 (4.8) | 72.1(5.5) |
| Experimental group (post) | 80.5 (4.3) | 82.3 (4.6) | 78.9 (5.0) |
| Control group (before) | 75.5 (5.2) | 78.2 (4.9) | 71.8 (5.6) |
| Control group (after) | 75.2 (5.4) | 76.8 (5.2) | 74.5 (5.3) |

**Language performance:** The average score for the students in the experimental groups was 75.3 before training and increased to 80.5 after training. This is an increase of 5.2. This study showed that 30 minutes of daily running had a significant effect on the language skills of students. The average score for the control group in both the pre-testing and post-testing was 75.5. This is almost the same or even slightly lower. This suggests that students do not improve verbal performance by not participating in physical activities. They may even experience a slight decline due to fatigue or another reason.

**Math scores:** The average math score for the experimental group increased from 78.4 to 82.3 in the post-test. This is a 3.9-point increase. This result suggests that physical exercise has a positive effect on students' logical reasoning and problem-solving abilities, and that math progress reflects these cognitive improvements. On the contrary, the math scores of the control group averaged 78.2 before the test and 76.8 after the test, which dropped 1.4 points. This decline may indicate that a lack of physical activity may be negatively affecting students' math scores, or that the decline is due to other, external factors.

**English score:** The English scores of experimental groups increased from 72.1 in the first test to 81.9 in the second. This suggests that physical exercise has a significant impact on students' ability to learn and apply language. It may be because it improves students' attention, memory and reduces learning anxiety. The post-test English scores for the control group were 74.5, a 2.7% increase. Both the control and the experimental groups improved their English scores, but the improvement in the experimental group was greater.

Overall, the experimental group showed significant improvement in all three areas. The average scores of Chinese, math and English improved by 5.2, 3.9 and 6.8 points respectively. These data suggest that physical activity, especially 30 minutes of daily running training, can significantly improve academic performance. This shows that students who do not participate in physical activity have no significant improvement in academic performance, and even regress in some subjects, further emphasizing the important role of physical activity in promoting academic performance.

### *3.2. Independent samples t-test*

Based on Table 5, an independent sample T-test was employed to evaluate the differences in academic achievement between the experimental and control groups following the intervention. This statistical method, appropriate for comparing the mean differences between two independent samples, was utilized after confirming the hypothesis. The table presents the T-values and P-values, along with the effect size (Cohen's d), providing a deeper understanding of the significance and practical implications of the results.

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*Table 5: The results of t-tests for experimental and control groups*

| Variant | t-value | df | p-value | Cohen's d |
|---|---|---|---|---|
| Chinese | 4.12 | 58 | <0.01 | 1.06 |
| Math | 4.76 | 58 | <0.01 | 1.23 |
| English | 4.35 | 58 | <0.01 | 1.13 |

**Language scores:** The T-test in the experimental group had a T-value 2.94, 29 degrees of freedom and a P value 0.006. The P-value was 0.006 and statistically significant. This meant that the Chinese performance in the experimental group had significantly improved following the running training. This showed the positive impact of 30 minutes of running on language performance.

**Math scores:** The T-test result in the experimental group showed a T-value of 3.23. The degree of freedom was 29 and the P-value 0.003. The statistical significance of the results was determined by a P-value less than 0.05. This meant that after the running training, the mathematical performance of the experimental group improved significantly. The T-test result between pre-testing versus post-testing showed a value of -1.57 in the control group. The degree of freedom for the test was 29. The P-value was 0.127. A P-value greater than 0.05 indicates that the math performance of the control group is slightly lower, but not enough to be significant.

**English score:** The T-test results in the experimental group show that the T-value is 4.08 with 29 degrees of freedom, and a P value of 0.000. The P-value for the experimental group was significantly less than 0.05, which is highly statistically significant. This shows that the English performance has significantly improved. This shows that physical activity can have a positive impact on language skills. The T-test result for the control group was a T-value 1.43, with a degree freedom of 29 and a P value of 0.167. This means that the English performance of the control group didn't improve significantly when physical activity was not present.

Overall, the t-test results of Chinese, Mathematics and English in the experiment group showed significant improvements, and the P value was less than 0.05. This showed that 30 minutes of running training had an important positive impact on the academic performance of students. The T-test result of the control groups in all three subjects failed to reach a significant level. This indicates that the change in the scores of the control group was not statistically significant.

### *3.3. Regression analysis*

Based on Table 6, a linear regression analysis was conducted to further examine the specific effects of physical activity on academic achievement while controlling for potential confounding variables. The regression coefficient ( $\beta$ -value) indicates the magnitude of the influence that physical activity exerts on academic performance. Additionally, the effect size ($R^2$) reflects the explanatory power of the model, providing insight into how much of the variation in academic performance can be attributed to physical activity.

*Table 6: Physical activity affects academic performance.*

| Variant | regression coefficient (β) | standard error | t-value | p-value | Cohen's d ($R^2$) |
|---|---|---|---|---|---|
| Chinese | 0.52 | 0.12 | 4.33 | <0.01 | 0.22 |
| Math | 0.65 | 0.14 | 4.64 | <0.01 | 0.28 |
| English | 0.48 | 0.11 | 4.36 | <0.01 | 0.21 |

Regression analysis showed that physical activity had significant positive effects on Chinese, math and English scores. The regression coefficient ($\beta = 0.65$) and effect size ($R^2 = 0.28$) of mathematics achievement were the highest, indicating that physical activity had the strongest predictive effect on mathematics achievement. These results support the effectiveness of physical activity in improving

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academic performance.

**Regression analysis of language scores:** The regression coefficient represents impact of physical activity (30 minute daily running training) verbal performance. The beta value of 0.52 indicates that verbal performance increases by 0.52 points with an increase in physical activity. The standard error is the estimated error in the regression coefficient. A small standard deviation (0.12) indicates a more reliable estimation of the regression coefficient. The t-value is also used to test if the regression coefficient is significantly higher or lower than zero. The T-value of 4.33 indicates that sports activities have an important impact on Chinese performance. The p-value indicates the significance of the results. The p-value is less than 0.01 indicating that sports activities have a highly statistically significant influence on Chinese achievement. This proves that students' Chinese achievement is significantly improved by sports activities.

**Regression analysis of math scores:** The regression coefficient is 0,65, which indicates that physical activity has more of an impact on math scores. Math scores increase by 0.65 for every additional amount of physical exercise. This beta value is greater than the coefficients for verbal and English. This suggests that physical activity has more impact on math performance. The standard error of 0.14 indicates the estimated error for the regression coefficient to be slightly higher than that of language, but still within acceptable range. The t value of 4,64 also indicates that physical activity is a significant factor in math performance. The p value, which is less than 0.01, also shows that physical activity has a positive impact on math achievement.

**Regression analysis of English scores:** The regression coefficient is 0.48, indicating that physical activity has a slightly lower impact on English score than Chinese and mathematics, and the average English score increases by 0.48 points for each additional amount of physical activity. And the standard error is 0.11, and a smaller standard error indicates that the regression coefficient is estimated more accurately. The t value of 4.36 indicates that sports activities have an impact on English performance. The p value is below 0.01, proving that the impact of physical activity is highly statistically significant.

Overall, the regression coefficient is positive for all subjects, indicating that physical activity has a positive impact on performance in language, mathematics and English. In particular, the regression coefficient of math performance was the highest (0.65), suggesting that physical activity had the most significant effect on math performance, followed by Chinese (0.52) and English (0.48). And, the standard error of all subjects is small, indicating that the regression coefficient is estimated with high accuracy and the results are reliable. In addition, the T-value of all subjects was much greater than 2, and the P-value was less than 0.01, indicating that the influence of physical activity on academic achievement of all subjects was highly statistically significant. These results strongly support the positive effect of physical activity on students' academic performance.

The test scores of both the experimental and control groups were analyzed in depth through a systematic summary of research results. The descriptive statistics show that after 8 weeks of daily 30-minute running training for 30 students, the experimental students significantly improved their performance in three subjects: Chinese, Mathematics and English. The average score of Chinese has increased 5.2 points. The average score of mathematics has increased 3.9 points. And the average score of English has increased 6.8 points. The scores of the control group did not change much. The T-test results also confirmed that the improvement in these scores was statistically meaningful. The T-values for the experimental group were 2,94 in Chinese, 3,23 in mathematics, and 4,08 in English with P-values below 0.01, whereas the control group did not show any significant change in scores. We also found that the physical activity of the experimental group had a significant impact on their scores in Chinese, Mathematics and English. The math scores of 30 students were the most affected by the physical activity (b = 0,65), followed closely by Chinese (b= 0.52) and English. These results show that physical activity has a positive impact on the academic performance of students in primary schools. In particular, 30 students from the experimental group showed significant progress in their academics, whereas 30 students from the control group did nothing similar. These results support the inclusion of physical activity in educational policies to improve academic performance.

## 4. Discussion

The results of this study showed that students who participated in sports activities significantly improved their scores in three subjects: Chinese, math and English. Compared with similar studies at home and abroad, the results of this study have certain uniqueness and universality. For example, this study focused on the elementary school population and observed significant improvements in academic

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achievement over a shorter experimental period [19]. This finding suggests that even short-term physical education interventions can have a positive impact on elementary school students' academic performance.

However, there are some differences between our results and some existing literature, the impact of physical activity on academic achievement may vary greatly in different age groups and educational backgrounds [20]. In some studies, the effects of physical activity have been more pronounced in middle school students and more limited in elementary school students. Our findings, in contrast to those of these studies, suggest that physical activity also has a positive impact on the academic performance and achievement of Chinese primary school children. Differences in background factors may be one of the reasons for the different results. This study was conducted in a Chinese educational setting, while most of the existing literature is based on the educational systems of Western countries. Primary school students in China face greater academic pressure and higher parental expectations, which may make physical activity more effective in improving academic performance.

In addition, methodological differences may also explain the differences in the findings. This study used a quasi-experimental design, focusing on 30 minutes of daily running training, while some existing studies may have used different types of physical activity or different lengths of intervention. The different roles of psychological and cognitive mechanisms may also influence the findings, and physical activity may more significantly relieve academic stress in Chinese students by promoting blood circulation and neurogenesis in the brain, thus improving academic performance. By comparing the results of this study with the existing literature, we can see that background factors and method differences are important reasons for the different research results. The uniqueness of this study lies in the particularity of its cultural background and the rigor of its experimental design, which fills the gap in the research on the relationship between physical activity and academic performance of Chinese primary school students.

## 5. Conclusion

In this study, we have achieved remarkable results by exploring the impact on academic performance of primary school students through a quasi-experimental approach. Our study revealed that students who actively engaged in physical activity scored higher in Chinese math and English. This improvement was statistically significant. This finding highlights the importance of physical training in the educational system and suggests that we should consider it as one of the key strategies to enhance the overall development of students. Teachers can increase the variety and frequency of sports activities they use in their teaching to promote the development of all students.

In terms of research methods, this study adopts quasi-experimental design, which overcomes the internal and external validity problems commonly encountered in traditional investigation and research and improves the reliability and validity of the research results. In addition, the results of this study provide comparable data and methodological references for other similar studies and promote the research progress in this field. At the practical level, this study provides concrete implementation recommendations for education policy makers and school administrators. By increasing the frequency and variety of physical activity, schools can effectively promote students' academic performance and physical and mental health, thereby achieving overall improvement in educational goals.

Our research findings can be used to formulate and adjust physical education policies, and we urge schools and educational institutions that they should pay more attention to the implementation of physical activity and its optimization. Future studies should also focus on the differences between the academic performance of students from different age groups and geographical regions after participating in sport activities. This will allow for the development of education policies that are targeted and meet the needs of various student groups. Combining the research methods of neuroscience and psychology, we can gain a deeper understanding about how physical activity affects the brain, providing a more scientific foundation for educational decisions. This study confirms that physical activity can improve academic performance in students, and also provides direction for future research. This research is intended to attract the attention and support of educators, researchers and policy makers, as well as encourage a greater use of physical activities in the educational system.

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