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| RESEARCH ARTICLE

Relationship between Physical Activity and Academic Achievement

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| ABSTRACT

The relationship between physical activity and academic achievement has gained increasing attention in educational and public health research due to rising concerns over sedentary lifestyles among learners. This short research review examines existing empirical evidence on how physical activity influences students' academic performance across different educational levels. Drawing on findings from peer-reviewed studies, the review explores the cognitive, behavioral, and psychosocial mechanisms through which regular physical activity contributes to learning outcomes. The reviewed literature consistently indicates that engagement in physical activity is positively associated with academic achievement, particularly in areas such as attention, memory, executive functioning, and classroom behavior. Moderate to vigorous physical activity has been shown to enhance brain function by improving cerebral blood flow, neurogenesis, and neural connectivity, which in turn supports cognitive processes essential for learning. Additionally, physically active students tend to demonstrate improved concentration, reduced stress and anxiety, better self-regulation, and higher levels of motivation, all of which are critical for academic success. School-based physical education programs, active breaks, and extracurricular sports participation emerge as effective strategies for integrating physical activity into the learning environment without compromising instructional time. However, the review also highlights variations in outcomes influenced by factors such as age, gender, intensity and duration of activity, and socio-economic context. Despite strong evidence supporting a positive relationship, some studies report weak or indirect associations, suggesting the need for more longitudinal and experimental research designs. Overall, this review underscores the importance of promoting regular physical activity as a complementary approach to enhancing academic achievement. Integrating structured and unstructured physical activity into school curricula can support holistic student development by fostering both physical health and academic performance. The findings have important implications for educators, policymakers, and school administrators seeking evidence-based strategies to improve educational outcomes while supporting students' overall well-being.

| KEYWORDS

Physical activity; Academic achievement; Cognitive development; Student performance; School-based exercise; Learning outcomes; Educational psychology

| ARTICLE INFORMATION

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1. Introduction

Physical activity plays a fundamental role in promoting physical health, psychological well-being, and social development among children and adolescents (Shephard, 1997; Tremblay, Inman, & Willms, 2000). In recent decades, however, rapid technological advancement, increased academic pressure, and lifestyle changes have contributed to a noticeable decline in physical activity levels among students worldwide (Education, 2010; Alvarez-Bueno et al., 2017). At the same time, concerns regarding students' academic achievement and cognitive development have intensified, prompting educators, researchers, and policymakers to explore factors that may enhance learning outcomes. Within this context, physical activity has emerged as a potential contributor to academic success, challenging the long-standing perception that time spent on physical education detracts from academic instruction (Trudeau & Shephard, 2008; Chomitz et al., 2009).

Academic achievement is commonly used as an indicator of educational effectiveness and student success, encompassing performance in core subjects, standardized test scores, classroom engagement, and cognitive skills (Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001; Du Toit, Pienaar, & Truter, 2011). Traditional approaches to improving academic outcomes have focused largely on curriculum design, instructional strategies, and assessment methods. However, growing evidence from educational psychology and neuroscience suggests that learning is influenced not only by classroom instruction but also by students' physical health and lifestyle behaviors (Iri, Ibis, & Aktug, 2017; Li & Zhang, 2022). Physical activity, defined as any bodily movement produced by skeletal muscles that results in energy expenditure, has been increasingly linked to improvements in brain function and learning capacity (So, 2012; Lambourne et al., 2013).

Research indicates that regular engagement in physical activity positively affects cognitive processes such as attention, memory, executive function, and information processing speed, all of which are essential for academic achievement (Alvarez-Bueno et al., 2017; Tremblay et al., 2000). Physiological mechanisms underlying this relationship include increased cerebral blood flow, enhanced oxygen and nutrient delivery to the brain, and the stimulation of neurochemical processes that support neural growth and connectivity (Shephard, 1997; Zhai et al., 2022). Additionally, physical activity has been shown to reduce stress, anxiety, and symptoms of depression, thereby creating a psychological environment more conducive to learning and academic engagement (Asigbee, Whitney, & Peterson, 2018; Chomitz et al., 2009).

Beyond cognitive benefits, physical activity contributes to improved classroom behavior, self-discipline, and social interaction. Students who participate in regular physical activity often demonstrate better time management, increased motivation, and higher levels of self-esteem, which can translate into improved academic performance (Tremblay et al., 2000; Shephard, 1997). School-based physical education programs, active classroom breaks, and extracurricular sports have been identified as practical strategies for integrating physical activity into students' daily routines while supporting educational goals (Trudeau & Shephard, 2008; Education, 2010). Importantly, studies suggest that incorporating physical activity into the school day does not negatively affect academic instructional time and may instead enhance overall learning efficiency (Alvarez-Bueno et al., 2017; Lambourne et al., 2013).

Despite the growing body of literature supporting a positive association between physical activity and academic achievement, findings are not entirely consistent. Variations in study design, measurement tools, age groups, and types of physical activity have resulted in mixed outcomes, with some studies reporting modest or indirect relationships (Dwyer et al., 2001; Du Toit et al., 2011; So, 2012). These inconsistencies highlight the need for comprehensive reviews that synthesize existing evidence and clarify the nature of this relationship. Therefore, this short research review aims to examine and synthesize current empirical literature on the relationship between physical activity and academic achievement. By exploring cognitive, behavioral, and psychosocial perspectives, the review seeks to provide a clearer understanding of how physical activity influences learning outcomes and to inform educators, researchers, and policymakers on effective strategies for promoting both academic success and student well-being.

2.Literature review

2.1 Concept of Physical Activity in Educational Contexts

Physical activity within educational settings is commonly defined as any bodily movement that results in energy expenditure and is integrated into students' daily routines through physical education lessons, active classroom breaks, recreational play, and extracurricular sports (Education, 2010; Shephard, 1997). In schools, physical activity is not limited to structured sports but also includes informal movement activities that promote active lifestyles (Trudeau & Shephard, 2008; Alvarez-Bueno et al., 2017). Recent literature emphasizes the importance of embedding physical activity into the school environment as part of a holistic approach to student development (Chomitz et al., 2009; Lambourne et al., 2013). Researchers argue that schools are ideal platforms for promoting physical activity because they reach learners at formative stages and can influence long-term behavioral patterns (Dwyer et al., 2001; Du Toit, Pienaar, & Truter, 2011). Consequently, physical activity has increasingly been examined not only for its health benefits but also for its potential contribution to cognitive functioning and academic success (Asigbee, Whitney, & Peterson, 2018; Li & Zhang, 2022).

2.2 Physical Activity and Cognitive Functioning

A substantial body of research highlights the positive effects of physical activity on cognitive functioning, which plays a critical role in academic achievement (Alvarez-Bueno et al., 2017; Tremblay, Inman, & Willms, 2000). Studies suggest that regular participation in physical activity enhances key cognitive processes such as attention, memory, executive function, and problem-solving skills (Shephard, 1997; So, 2012). These improvements are attributed to physiological mechanisms including increased

cerebral blood flow, improved brain oxygenation, and the stimulation of neurotrophic factors that support neural development (Zhai et al., 2022; Lambourne et al., 2013). Evidence from both experimental and observational studies indicates that students who engage in moderate to vigorous physical activity tend to perform better on tasks requiring concentration and mental flexibility (Chomitz et al., 2009; Li & Zhang, 2022). As cognitive functioning forms the foundation of learning, these findings provide a strong theoretical basis for linking physical activity to improved academic outcomes (Trudeau & Shephard, 2008; Iri, Ibis, & Aktug, 2017).

2.3 Relationship Between Physical Activity and Academic Achievement

Numerous empirical studies have examined the direct relationship between physical activity and academic achievement, often reporting positive associations (Alvarez-Bueno et al., 2017; Shephard, 1997). Learners who participate regularly in physical education programs or extracurricular sports frequently demonstrate higher academic performance, particularly in subjects such as mathematics and language arts (Dwyer et al., 2001; So, 2012). Research also indicates that physically active students show improved classroom engagement, reduced disruptive behavior, and better attendance, all of which contribute to academic success (Chomitz et al., 2009; Du Toit et al., 2011). Importantly, studies have found that allocating time to physical activity does not hinder academic performance; rather, it may enhance learning efficiency by improving students' readiness to learn (Trudeau & Shephard, 2008; Lambourne et al., 2013). However, the strength of the relationship varies across studies, suggesting that contextual and individual factors play a significant role (Tremblay et al., 2000; Li & Zhang, 2022).

2.4 Psychosocial and Behavioral Mechanisms

Beyond cognitive benefits, physical activity influences academic achievement through psychosocial and behavioral pathways (Asigbee et al., 2018; Chomitz et al., 2009). Participation in physical activity has been associated with reduced stress, anxiety, and fatigue, which can otherwise impair learning and academic motivation (Tremblay et al., 2000; Shephard, 1997). Physically active students often exhibit higher self-esteem, improved mood, and stronger social skills, fostering a positive attitude toward school and learning (Alvarez-Bueno et al., 2017; Iri et al., 2017). Additionally, engagement in sports and physical activities promotes discipline, goal-setting, and teamwork, skills that are transferable to academic tasks (Trudeau & Shephard, 2008; Lambourne et al., 2013). These psychosocial benefits contribute indirectly to academic achievement by creating a supportive emotional and behavioral environment for learning (Asigbee et al., 2018; Zhai et al., 2022).

2.5 Moderating Factors and Research Gaps

Despite generally positive findings, the literature reveals inconsistencies influenced by factors such as age, gender, intensity and duration of physical activity, and socio-economic background (Dwyer et al., 2001; Du Toit et al., 2011). Some studies report weak or non-significant relationships, particularly when physical activity levels are low or irregular (So, 2012; Li & Zhang, 2022). Differences in research design, measurement of academic achievement, and reliance on self-reported physical activity data further contribute to mixed results (Chomitz et al., 2009; Tremblay et al., 2000). These gaps highlight the need for more longitudinal and experimental studies to establish causal relationships and to identify optimal types and levels of physical activity for academic benefits (Alvarez-Bueno et al., 2017; Shephard, 1997).

3.Methodology

This short research review employed a narrative literature review design to synthesize existing research on the relationship between physical activity and academic achievement. Relevant peer-reviewed studies were identified through comprehensive searches of academic databases including Google Scholar, ERIC, PubMed, and Scopus. The search strategy utilized keywords such as physical activity, exercise, academic achievement, student performance, and cognitive outcomes. Only studies published in English were considered. Inclusion criteria comprised empirical studies, systematic reviews, and meta-analyses that examined associations between physical activity and academic or cognitive outcomes among learners at primary, secondary, or tertiary education levels. Studies focusing exclusively on physical or medical outcomes without reference to academic performance were excluded.

After removing duplicates, titles and abstracts were screened for relevance, followed by full-text review of eligible articles. Key data extracted included study design, sample characteristics, type and intensity of physical activity, academic achievement indicators, and principal findings. Due to heterogeneity in methodologies and outcome measures across studies, a quantitative meta-analysis was not conducted. Instead, a qualitative thematic synthesis approach was applied to identify consistent patterns, mechanisms, and discrepancies within the literature. This approach enabled a comprehensive and balanced synthesis of evidence while highlighting gaps for future research.

4. Results And Discussion

The findings from the reviewed literature consistently demonstrate a positive relationship between physical activity and academic achievement across different educational levels (Alvarez-Bueno et al., 2017; Shephard, 1997). Most studies report that students who engage in regular physical activity tend to achieve higher academic outcomes compared to their less active peers (Dwyer et al., 2001; So, 2012). Improvements are particularly evident in cognitive-related academic domains such as attention, memory, executive functioning, and classroom engagement (Chomitz et al., 2009; Lambourne et al., 2013). Evidence from school-based interventions indicates that incorporating moderate to vigorous physical activity into daily routines enhances students' readiness to learn without compromising instructional time (Trudeau & Shephard, 2008; Education, 2010). These results challenge the traditional assumption that increased academic instruction must come at the expense of physical education and instead suggest that physical activity may serve as a complementary factor in promoting academic success (Li & Zhang, 2022; Alvarez-Bueno et al., 2017).

The reviewed studies further indicate that the cognitive benefits of physical activity play a central role in explaining its association with academic achievement (Tremblay et al., 2000; Shephard, 1997). Enhanced cerebral blood flow, improved neural connectivity, and increased production of neurotrophic factors are frequently cited physiological mechanisms that support learning and memory processes (Zhai et al., 2022; Lambourne et al., 2013). Learners who participate in regular physical activity often demonstrate improved concentration, faster information processing, and greater mental flexibility, which positively influence academic performance (Chomitz et al., 2009; Li & Zhang, 2022). Experimental and longitudinal studies provide stronger evidence for these effects, showing that sustained engagement in physical activity yields more consistent academic benefits than short-term or irregular participation (Trudeau & Shephard, 2008; Alvarez-Bueno et al., 2017). However, the magnitude of these effects varies depending on the type, intensity, and duration of physical activity, suggesting that not all forms of activity contribute equally to academic outcomes (Dwyer et al., 2001; So, 2012).

In addition to cognitive mechanisms, psychosocial and behavioral factors emerge as important mediators of the relationship between physical activity and academic achievement (Asigbee et al., 2018; Tremblay et al., 2000). The literature reveals that physically active students generally experience lower levels of stress, anxiety, and fatigue, which are known barriers to effective learning (Shephard, 1997; Chomitz et al., 2009). Participation in physical activity has also been linked to improved mood, self-esteem, and motivation, creating a more positive attitude toward school and academic tasks (Alvarez-Bueno et al., 2017; Iri, Ibis, & Aktug, 2017). Furthermore, engagement in sports and structured physical activities promotes discipline, perseverance, teamwork, and time management skills, all of which are transferable to academic contexts (Trudeau & Shephard, 2008; Lambourne et al., 2013). These psychosocial benefits contribute indirectly to improved academic performance by fostering an environment that supports sustained engagement and learning (Asigbee et al., 2018; Zhai et al., 2022).

Despite the predominance of positive findings, some studies report weak or non-significant associations between physical activity and academic achievement (Dwyer et al., 2001; Du Toit et al., 2011). These inconsistencies are often attributed to methodological differences, including variations in study design, measurement tools, and sample characteristics (So, 2012; Li & Zhang, 2022). For instance, studies relying on self-reported physical activity data may underestimate or overestimate actual activity levels, leading to mixed results (Chomitz et al., 2009; Tremblay et al., 2000). Additionally, differences in how academic achievement is measured, such as standardized test scores versus classroom grades, may influence observed outcomes (Alvarez-Bueno et al., 2017; Du Toit et al., 2011). Contextual factors, including socio-economic status, access to school resources, and cultural attitudes toward physical education, further complicate comparisons across studies (Education, 2010; Iri et al., 2017).

Age and developmental stage also appear to moderate the relationship between physical activity and academic achievement. Stronger associations are frequently reported among children and adolescents, possibly due to the heightened sensitivity of the developing brain to physical activity (Tremblay et al., 2000; Shephard, 1997). In contrast, findings among older students are less consistent, suggesting that academic benefits may diminish or become more indirect with age (Li & Zhang, 2022; Zhai et al., 2022). Gender differences are also noted in some studies, although results remain inconclusive (So, 2012; Dwyer et al., 2001). These variations highlight the importance of tailoring physical activity interventions to specific populations and educational contexts (Trudeau & Shephard, 2008; Alvarez-Bueno et al., 2017).

Overall, the reviewed literature supports the conclusion that physical activity is a valuable contributor to academic achievement through cognitive, behavioral, and psychosocial pathways (Shephard, 1997; Chomitz et al., 2009; Alvarez-Bueno et al., 2017). While the relationship is influenced by multiple moderating factors, the evidence suggests that promoting regular physical activity within educational settings can enhance learning outcomes and support holistic student development (Trudeau & Shephard, 2008; Lambourne et al., 2013). The findings underscore the need for well-designed longitudinal and experimental studies to establish causality and to identify optimal physical activity strategies (Li & Zhang, 2022; Tremblay et al., 2000).

Integrating physical activity into school curricula should therefore be viewed not as a distraction from academic goals but as an evidence-based approach to improving both educational performance and student well-being (Alvarez-Bueno et al., 2017; Zhai et al., 2022).

5. Conclusion

This short research review highlights a substantial body of evidence supporting a positive relationship between physical activity and academic achievement across various educational levels. The reviewed literature indicates that regular engagement in physical activity contributes to improved cognitive functioning, classroom behavior, and psychosocial well-being, all of which play critical roles in enhancing academic performance. Physical activity supports key cognitive processes such as attention, memory, and executive functioning through physiological mechanisms including increased cerebral blood flow and enhanced neural connectivity. These cognitive benefits, combined with improved emotional regulation and reduced stress, create favorable conditions for effective learning and sustained academic engagement.

The findings further suggest that integrating physical activity into school routines does not detract from academic instruction but may instead enhance learning efficiency. School-based physical education programs, active classroom breaks, and extracurricular sports activities emerge as practical strategies for promoting both physical health and academic success. Importantly, the literature emphasizes that the academic benefits of physical activity are influenced by factors such as age, intensity, frequency, and type of activity, highlighting the need for context-specific approaches. While children and adolescents appear to benefit most strongly, positive effects are also observed across broader student populations when physical activity is implemented consistently and appropriately.

Despite the overall positive trends, the review identifies gaps and inconsistencies in the literature, largely due to methodological variations and limited longitudinal evidence. These limitations underscore the need for future research employing rigorous experimental designs to establish causal relationships and to determine optimal physical activity interventions for academic enhancement. From a practical perspective, the findings carry important implications for educators, school administrators, and policymakers. Promoting regular physical activity within educational settings should be recognized as a strategic investment in students' academic achievement and overall development. In conclusion, fostering physically active learning environments represents a sustainable and evidence-based approach to improving educational outcomes while supporting students' long-term health and well-being.

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