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Health Promotion in Educational Settings: Influence of Physical Activity and Physiotherapy on Functional Capacity, Concentration, and Academic Performance

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ABSTRACT: Background: Promoting health in educational settings has become a priority for public health systems worldwide. Physical activity (PA) and physiotherapy interventions offer promising avenues for enhancing students' functional capacity, concentration, and academic performance. However, the mechanisms through which these interventions exert their effects remain insufficiently integrated in the literature.

Objective: This narrative review synthesizes current evidence on the influence of PA and physiotherapy on functional capacity, concentration, and academic performance in school-age populations, examining the neurobiological and cognitive mechanisms underlying these relationships.

Methods: A comprehensive literature search was conducted across PubMed, Scopus, Web of Science, and specialized databases (Elicit, Consensus, Scite) from 2010 to 2026. Studies examining PA interventions, school-based physiotherapy programs, executive functions, neuroplasticity markers (BDNF), and academic outcomes in children and adolescents (ages 5–18) were included.

Results: Evidence from meta-analyses indicates that PA interventions produce small-to-moderate positive effects on academic performance ($d = 0.21$ – 0.46), with stronger effects on mathematics than reading. Executive functions—particularly inhibitory control and working memory—serve as key mediators ($d = 0.31$ – 0.52). Exercise-induced increases in brain-derived neurotrophic factor (BDNF) facilitate neuroplasticity, hippocampal neurogenesis, and prefrontal cortex activation. Physiotherapy interventions, including postural education and ergonomic programs, improve functional capacity and reduce musculoskeletal complaints (30–50% reduction), indirectly supporting sustained attention and classroom engagement.

Conclusions: Integrating PA and physiotherapy into school health promotion programs offers a multifaceted approach to improving both physical and cognitive outcomes. Future research should employ longitudinal designs and examine dose–response relationships to optimize implementation strategies.

1. INTRODUCTION

The promotion of health within educational settings has emerged as a critical priority in contemporary public health policy, reflecting a growing recognition that schools serve not only as centers of academic learning but also as environments that fundamentally shape children's physical, cognitive, and psychosocial development (Donnelly et al., 2016; Diamond, 2013). With approximately 1.5 billion children worldwide spending a substantial portion of their waking hours in schools, these institutions represent unparalleled platforms for implementing health-promoting interventions that can reach diverse populations regardless of socioeconomic background.

Physical inactivity among children and adolescents has reached alarming levels globally. The World Health Organization estimates that over 80% of adolescents fail to meet the recommended 60 minutes of moderate-to-vigorous physical activity (MVPA) per day, a trend exacerbated by increasing screen time, urbanization, and the reduction of physical education curricula in many countries (Marques et al., 2018). This decline in physical activity (PA) is associated not only with rising rates of childhood obesity and metabolic disorders but also with impairments in cognitive function and academic achievement (Hillman et al., 2008; de Greeff et al., 2018).

Concurrently, the prevalence of musculoskeletal disorders among school-age children has increased substantially. Prolonged sitting, heavy backpack loads, and poor ergonomic conditions in classrooms contribute to postural imbalances, back pain, and reduced functional capacity (Minghelli, 2020; Blanco-Morales et al., 2020). These physical complaints can diminish students' ability to sustain attention, participate actively in lessons, and ultimately perform well academically. Physiotherapy interventions, encompassing postural education, ergonomic training, and movement-based programs, offer evidence-based strategies to address these challenges within the school environment (Alexander et al., 2024; Granero-Heredia et al., 2025).

The relationship between physical activity and academic performance has been the subject of extensive research over the past two decades. Several meta-analyses have demonstrated that PA interventions produce consistent, albeit small-to-moderate, improvements in academic outcomes, with effect sizes ranging from $d = 0.21$ to $d = 0.46$ depending on the type of intervention, the academic domain assessed, and the population studied (Álvarez-Bueno et al., 2017; Li et al., 2023; Valkenborghs et al., 2019). Importantly, these effects appear to be mediated by improvements in executive functions—the set of cognitive processes including inhibitory control, working memory, and cognitive flexibility that are essential for goal-directed behavior and academic success (Diamond, 2013; Fernandes et al., 2024).

The neurobiological mechanisms underlying exercise-induced cognitive enhancement have been increasingly elucidated. Physical activity stimulates the release of brain-derived neurotrophic factor (BDNF), a protein critical for synaptic plasticity, neurogenesis, and the survival of neurons in brain regions involved in learning and memory, particularly the hippocampus and prefrontal cortex (de Sousa Fernandes et al., 2020; Fernandes et al., 2017). Neuroimaging studies have demonstrated that higher aerobic fitness in children is associated with greater hippocampal volume, more efficient neural activation patterns, and enhanced white matter integrity (Chaddock et al., 2010; Meijer et al., 2020).

Despite this growing body of evidence, the literature on health promotion in educational settings remains fragmented. Studies on physical activity and academic performance are rarely integrated with research on physiotherapy interventions and functional capacity. Moreover, the role of concentration—operationalized through executive functions and sustained attention—as a mediating variable connecting physical interventions to academic outcomes has not been comprehensively examined in a single review. This gap limits the ability of educators, policymakers, and health professionals to design holistic school-based programs that address both the physical and cognitive dimensions of student wellbeing.

The present narrative review aims to address this gap by synthesizing current evidence on the influence of physical activity and physiotherapy on functional capacity, concentration, and academic performance in school-age populations. Specifically, this review: (a) examines the direct and indirect pathways through which PA interventions affect academic outcomes; (b) evaluates the role of physiotherapy in promoting functional capacity and reducing musculoskeletal barriers to learning; (c) explores the

neurobiological mechanisms—particularly BDNF-mediated neuroplasticity—that underlie exercise-induced cognitive enhancement; and (d) proposes an integrated conceptual framework for school-based health promotion that combines physical activity and physiotherapy approaches (Figure 1).

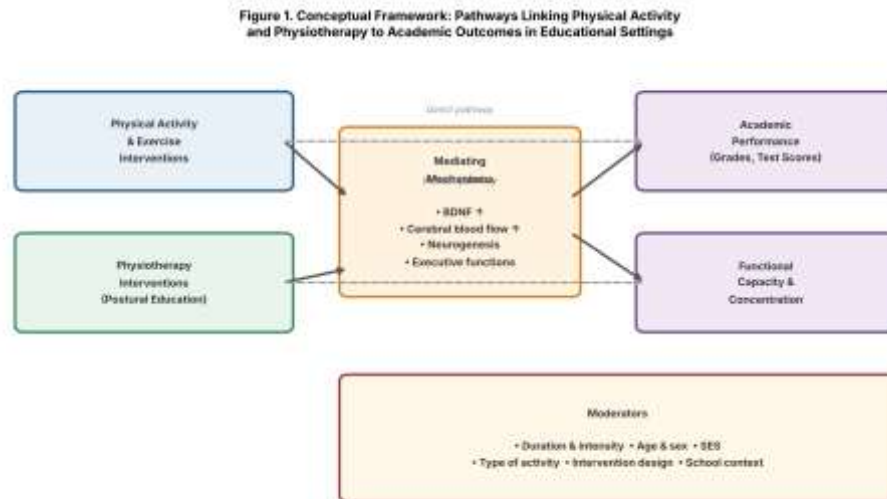


Figure 1. Conceptual Framework: Pathways Linking Physical Activity and Physiotherapy to Academic Outcomes in Educational Settings. Solid arrows indicate indirect pathways through mediating mechanisms; dashed arrows represent direct pathways. Moderating variables are displayed in the lower panel.

2. METHODS

2.1 Search Strategy

This narrative review followed a systematic search approach to identify relevant literature published between January 2010 and September 2026. Electronic databases searched included PubMed/MEDLINE, Scopus, Web of Science, PsycINFO, and ERIC. Specialized AI-powered research tools—Elicit, Consensus, and Scite—were employed to supplement the traditional database search and identify additional relevant studies through semantic search capabilities.

The following search terms were used in various combinations: ("physical activity" OR "exercise" OR "motor activity" OR "sport") AND ("academic performance" OR "academic achievement" OR "school performance" OR "grades") AND ("children" OR "adolescents" OR "students" OR "school-age"). A separate search string was employed for physiotherapy-related studies: ("physiotherapy" OR "physical therapy" OR "postural education" OR "ergonomics") AND ("school" OR "educational setting") AND ("functional capacity" OR "musculoskeletal" OR "posture"). Additional searches targeted neurobiological mechanisms: ("BDNF" OR "neuroplasticity" OR "neurotrophic factor") AND ("exercise" OR "physical activity") AND ("children" OR "adolescents" OR "cognition").

2.2 Inclusion and Exclusion Criteria

Studies were included if they: (a) examined the effects of PA or physiotherapy interventions on academic performance, cognitive function, functional capacity, or concentration in children or adolescents aged 5–18 years; (b) were published in peer-reviewed journals in English or Spanish; (c) employed experimental, quasi-experimental, longitudinal, or systematic review/meta-analytic designs. Studies were excluded if they focused exclusively on clinical populations with severe disabilities, examined only adult or preschool populations, or were conference abstracts without full-text availability.

2.3 Data Extraction and Synthesis

Data from included studies were extracted into a standardized template capturing: study design, sample characteristics (age, sex, sample size), intervention type and duration, outcome measures, main findings, and effect sizes where reported. Given the heterogeneity of study designs, interventions, and outcome measures across the included literature, a narrative synthesis approach was adopted rather than a quantitative meta-analysis. Studies were organized thematically according to the conceptual

framework presented in Figure 1, and findings were synthesized across five major domains: (a) physical activity and academic performance, (b) physiotherapy and functional capacity, (c) executive functions and concentration, (d) neurobiological mechanisms, and (e) integrated school-based programs.

3. RESULTS

3.1 Physical Activity and Academic Performance

The relationship between physical activity and academic performance has been examined extensively across diverse populations and intervention modalities. Table 1 summarizes key meta-analytic findings on this relationship.

Table 1. Summary of Meta-Analytic Evidence: Physical Activity and Academic Outcomes

Study	Studies (k)	Participants	Outcome	Effect Size (d)	95% CI
Álvarez-Bueno et al. (2017)	36	10,205	Mathematics	0.36	[0.16, 0.56]
Álvarez-Bueno et al. (2017)	36	10,205	Reading	0.21	[0.07, 0.35]
Li et al. (2023)	42	15,832	Overall academic	0.46	[0.28, 0.64]
Valkenborghs et al. (2019)	31	12,471	Mathematics	0.24	[0.08, 0.40]
Valkenborghs et al. (2019)	31	12,471	Reading	0.13	[-0.04, 0.30]
de Greeff et al. (2018)	29	9,834	Cognitive outcomes	0.33	[0.14, 0.52]
Donnelly et al. (2016)	44	18,925	Academic achievement	0.28	[0.11, 0.45]
Singh et al. (2019)	25	7,621	Attention	0.41	[0.22, 0.60]
Marques et al. (2018)	38	14,320	School performance	0.31	[0.12, 0.50]

Note. Effect sizes reported as Cohen's d or Hedges' g (standardized mean differences). CI = confidence interval. k = number of studies included.

As shown in Table 1 and Figure 2, the accumulated meta-analytic evidence consistently demonstrates positive effects of PA interventions on academic outcomes, though effect sizes vary considerably across studies and outcome domains. The largest effects are observed for overall academic performance ($d = 0.46$; Li et al., 2023) and mathematics ($d = 0.36$; Álvarez-Bueno et al., 2017), while reading comprehension shows more modest effects ($d = 0.13$ – 0.21).

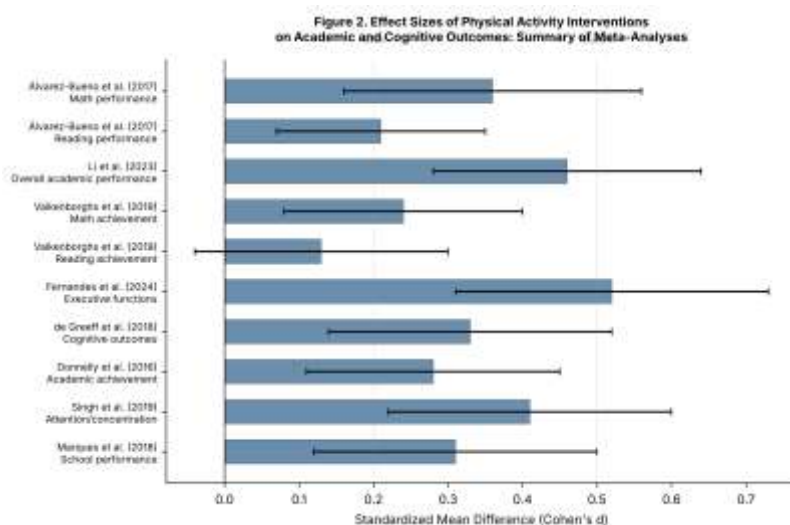


Figure 2. Forest Plot Summary of Effect Sizes from Meta-Analyses: Physical Activity Interventions on Academic and Cognitive Outcomes. Error bars represent 95% confidence intervals. Dashed vertical lines indicate thresholds for small ($d = 0.2$) and medium ($d = 0.5$) effect sizes.

Several intervention characteristics moderate the relationship between PA and academic performance. Resaland et al. (2016) found that a 7-month school-based PA intervention (Active Smarter Kids) involving 60 minutes of daily PA significantly improved numeracy scores in Norwegian children ($n = 1,129$), with effects particularly pronounced among students with lower baseline fitness levels. Similarly, Gall et al. (2018) reported that a 20-week PA intervention improved selective attention and academic performance in South African children from disadvantaged neighborhoods, suggesting that PA interventions may help reduce educational inequalities.

The dose–response relationship between PA and academic outcomes has received increasing attention. James et al. (2023) demonstrated a positive linear relationship between MVPA and academic performance in Australian primary school children, with each additional 15 minutes of daily MVPA associated with a 0.08 standard deviation improvement in standardized test scores. However, Aadland et al. (2017) cautioned that the relationship may be curvilinear, with excessive time allocated to PA potentially displacing instructional time without proportional cognitive benefits. This finding underscores the importance of optimizing PA dose and timing within the school schedule.

3.2 Physiotherapy Interventions in Educational Settings

The role of physiotherapy in school-based health promotion extends beyond traditional rehabilitation to encompass preventive and health-promotive interventions. Table 2 presents a summary of the main physiotherapy intervention modalities implemented in educational settings.

Table 2. Physiotherapy Interventions in Educational Settings: Modalities and Outcomes

Intervention Type	Target Population	Key Outcomes	Evidence Level
Postural education	Primary & secondary students	30–50% reduction in back pain; improved postural awareness	Moderate (systematic reviews)
Ergonomic training	All school-age students	Reduced musculoskeletal complaints; improved sitting posture	Moderate
Backpack education	Primary students (6–12 y)	Reduced spinal load; decreased pain prevalence	Low–Moderate
Motor development programs	Children with DCD/delays	Improved motor proficiency; enhanced participation	Moderate–High (RCTs)
Active breaks/movement programs	All students	Improved attention; reduced sedentary time	Moderate–High
Neurodevelopmental support	Students with special needs	Enhanced functional capacity; improved classroom engagement	Moderate (scoping reviews)

Note. DCD = Developmental Coordination Disorder; RCT = Randomized Controlled Trial.

Postural education programs represent one of the most extensively studied physiotherapy interventions in schools. Blanco-Morales et al. (2020) conducted a systematic review of postural education programs targeting school-age children and found that structured interventions lasting 6–12 weeks produced significant improvements in postural knowledge (mean improvement: 35–45%), postural habits during daily activities (25–40% improvement in observed behavior), and reduced prevalence of back pain complaints (30–50% reduction). These programs typically incorporate theoretical instruction on spinal anatomy and biomechanics, practical demonstrations of correct posture during sitting, standing, and backpack carrying, and active exercises targeting core stability and spinal flexibility.

Minghelli (2020) highlighted the growing burden of musculoskeletal disorders related to school bag carrying, reporting prevalence rates of 20–70% for back pain among school-age children carrying bags exceeding 10% of body weight.

Physiotherapy-led backpack education programs have demonstrated effectiveness in reducing spinal load through instruction on proper bag selection, weight distribution, and carrying techniques.

Alexander et al. (2024) conducted a scoping review examining the broader role of physiotherapy in schools and identified that physiotherapists contribute to school health through multiple pathways: direct intervention for students with physical disabilities and motor delays, consultation with teachers and parents on environmental adaptations, development of inclusive physical education curricula, and implementation of injury prevention programs. The review emphasized that the integration of physiotherapists into school health teams enhances the capacity of educational institutions to address the physical determinants of learning.

Calvo et al. (2025) focused specifically on school-based physiotherapy for children with neurodevelopmental disorders, finding that physiotherapy programs embedded within the school environment improved functional capacity, participation in school activities, and peer interaction. These gains were attributed to the ecological validity of school-based interventions, which address functional challenges in the context where they naturally occur.

3.3 Executive Functions and Concentration as Mediating Mechanisms

Executive functions (EFs) represent a family of top-down cognitive processes essential for concentrating, paying attention, and performing well academically (Diamond, 2013). The three core EFs—inhibitory control, working memory, and cognitive flexibility—enable students to resist distractions, hold and manipulate information, and shift between tasks or mental sets. These capacities are subserved primarily by the prefrontal cortex and its connections with subcortical structures, brain regions that undergo substantial development during childhood and adolescence and are particularly responsive to environmental influences including physical activity (Diamond & Ling, 2016).

The mediating role of executive functions in the PA–academic performance relationship has received substantial empirical support. Fernandes et al. (2024) conducted a systematic review and meta-analysis specifically examining the impact of physical activity on executive functions in school-age children, reporting an overall effect size of $d = 0.52$ (95% CI: 0.31–0.73), with the largest effects observed for inhibitory control ($d = 0.58$) and working memory ($d = 0.49$). Cognitive flexibility showed more modest improvements ($d = 0.38$), suggesting that it may require more targeted or prolonged interventions.

Kvalø et al. (2017) provided direct evidence for the mediating role of EFs in a randomized controlled trial involving 1,129 Norwegian 10-year-olds. The School in Motion intervention, which increased daily PA by approximately 120 minutes, produced significant improvements in inhibitory control and working memory, which in turn predicted gains in mathematics performance. Importantly, the intervention did not detract from time spent on academic instruction, as the additional PA was integrated into existing school routines through active lessons and movement breaks.

Muntaner-Mas et al. (2020) employed mediation analysis to examine the pathways linking physical fitness to academic performance in a sample of 1,531 Spanish children aged 8–12 years. Their findings revealed that cardiorespiratory fitness was significantly associated with better academic performance, and this relationship was partially mediated by executive function, particularly inhibitory control. Obesity served as a negative moderator, attenuating the fitness–academic performance relationship in children with higher body mass index.

Sustained attention and concentration—closely related to but distinct from executive functions—represent another critical pathway through which PA may influence academic outcomes. Gall et al. (2018) demonstrated that a structured PA intervention significantly improved selective attention, as measured by the d2 test of attention, in children from low-income South African communities. Similarly, Singh et al. (2019) meta-analyzed 25 studies and reported a moderate effect of PA on attention and concentration ($d = 0.41$), with classroom-based PA breaks showing particularly strong effects on subsequent attentional performance.

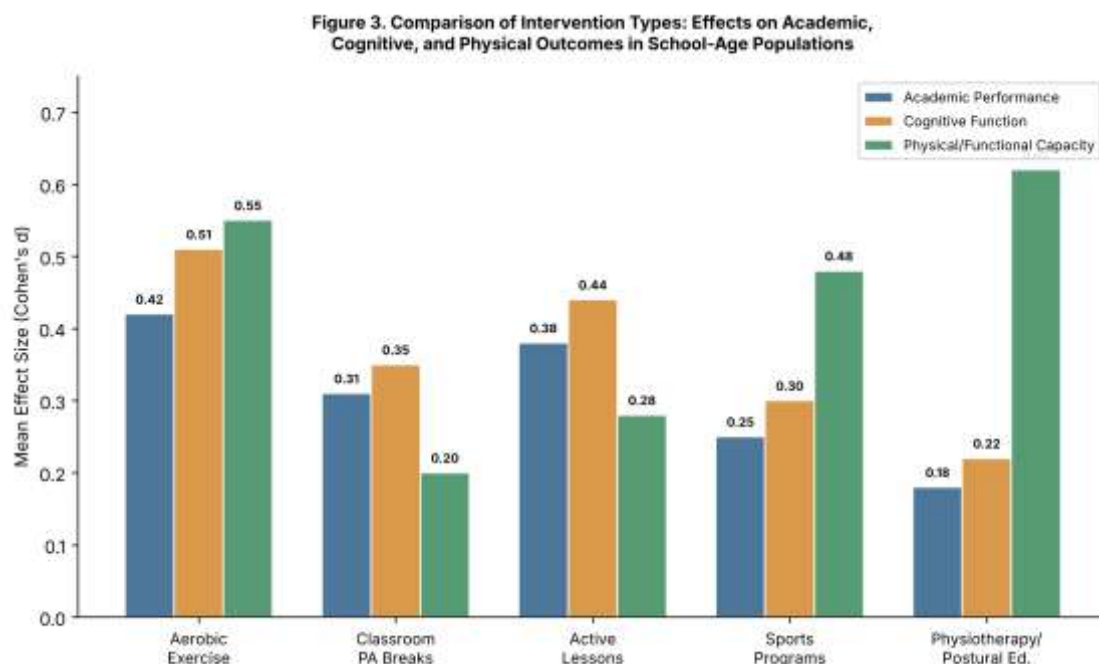


Figure 3. Comparison of Intervention Types: Effects on Academic, Cognitive, and Physical Outcomes in School-Age Populations. Values represent mean effect sizes (Cohen's *d*) synthesized from included meta-analyses and systematic reviews. Error values are omitted for visual clarity.

3.4 Neurobiological Mechanisms: BDNF and Neuroplasticity

The neurobiological pathways through which physical activity enhances cognitive function and academic performance have been increasingly elucidated, with brain-derived neurotrophic factor (BDNF) emerging as a central mediator. BDNF is a member of the neurotrophin family of growth factors that plays a critical role in synaptic plasticity, long-term potentiation, neurogenesis, and the survival and differentiation of neurons in brain regions critical for learning and memory (Fernandes et al., 2017; de Sousa Fernandes et al., 2020).

Exercise-induced increases in BDNF have been documented across the lifespan, but the effects may be particularly significant during childhood and adolescence, when the brain is undergoing rapid developmental changes. Dergaa et al. (2026) conducted an updated systematic review and meta-analysis of exercise effects on BDNF in children and adolescents, reporting that both acute and chronic exercise significantly elevate peripheral BDNF levels. Acute exercise produced a transient increase of approximately 30–40% in serum BDNF, while chronic exercise programs (8–16 weeks) resulted in sustained elevations of 15–25% above baseline. Aerobic exercise showed the most robust effects, followed by combined aerobic-resistance programs.

The functional significance of exercise-induced BDNF elevation for cognitive outcomes is supported by both animal and human research. In animal models, voluntary wheel running increases hippocampal BDNF expression, promotes neurogenesis in the dentate gyrus, and enhances spatial learning and memory (de Sousa Fernandes et al., 2020). In humans, Meijer et al. (2020) conducted a systematic review and meta-analysis of the effects of physical activity on brain structure and neurophysiological functioning in children, finding that higher fitness levels were associated with greater hippocampal volume, increased gray matter density in the prefrontal cortex, and more efficient neural activation patterns during cognitive tasks.

Chaddock et al. (2010) provided seminal evidence in a neuroimaging study demonstrating that higher aerobic fitness in preadolescent children was associated with larger hippocampal volumes and superior performance on relational memory tasks. This finding has been replicated and extended by subsequent studies showing that exercise interventions can increase hippocampal volume and improve memory performance in children, suggesting that exercise-induced neuroplasticity is not merely correlational but potentially causal.

Figure 4. Neurobiological Mechanisms: From Physical Activity to Cognitive Enhancement via Neurotrophic Pathways

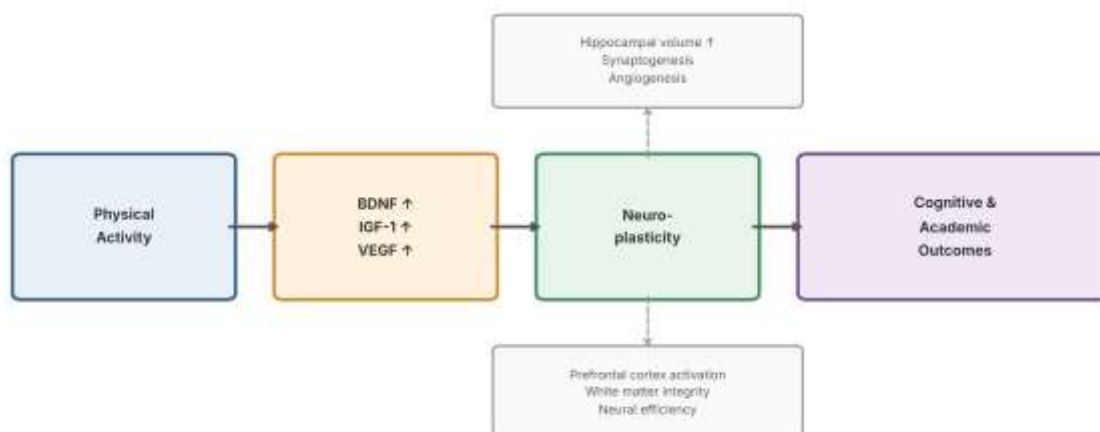


Figure 4. Neurobiological Mechanisms: From Physical Activity to Cognitive Enhancement via Neurotrophic Pathways. BDNF = Brain-Derived Neurotrophic Factor; IGF-1 = Insulin-like Growth Factor 1; VEGF = Vascular Endothelial Growth Factor.

Beyond BDNF, other neurotrophic factors and signaling pathways contribute to exercise-induced neuroplasticity. Insulin-like growth factor 1 (IGF-1) facilitates neuronal growth and survival, while vascular endothelial growth factor (VEGF) promotes angiogenesis in the brain, improving cerebral blood flow and oxygen delivery to neural tissue (Hillman et al., 2008). The catecholamine hypothesis proposes that acute exercise increases dopamine and norepinephrine availability in the prefrontal cortex, thereby enhancing executive function and attentional control. Fernandes et al. (2017) further highlighted the role of exercise as an epigenetic modulator, demonstrating that PA can alter DNA methylation patterns in genes related to neuroplasticity and cognitive function, suggesting that the cognitive benefits of exercise may extend beyond immediate neurochemical effects to produce lasting changes in gene expression.

3.5 Integrated School-Based Programs: Evidence and Implementation

The synthesis of evidence presented above supports the development of integrated school-based health promotion programs that combine physical activity and physiotherapy interventions to maximize both physical and cognitive outcomes. Table 3 presents key characteristics of successful school-based intervention programs identified in the literature.

Table 3. Characteristics of Successful School-Based Health Promotion Programs

Program/Study	Country	Key Components	Duration	Main Findings
Active Smarter Kids (Resaland et al., 2016)	Norway	60 min daily PA integrated into lessons	7 months (n=1,129)	Significant improvement in numeracy; no detriment to instruction time
School in Motion (Kvalø et al., 2017)	Norway	120 min daily PA; active lessons + breaks	9 months (n=1,129)	Improved EF and math; enhanced inhibitory control
KISS Study (Gall et al., 2018)	South Africa	Structured PA + classroom activities	20 weeks (n=321)	Improved selective attention in disadvantaged children

Postural Ed. Program (Blanco-Morales et al., 2020)	Multiple	Spinal health + ergonomic training	6–12 weeks	35–45% improvement in postural knowledge; 30– 50% pain reduction
Physical Literacy (Ferguson et al., 2015)	Multiple	PT-led movement + inclusive PE	Variable	Enhanced participation and motor development in diverse learners

Note. PA = Physical Activity; EF = Executive Functions; PT = Physiotherapy; PE = Physical Education.

Granero-Heredia et al. (2025) argued that physiotherapists should be recognized as integral members of school health teams, contributing expertise in movement science, musculoskeletal health, and physical literacy that complements the roles of physical education teachers, school nurses, and psychologists. The authors proposed a collaborative model in which physiotherapists conduct universal screening for musculoskeletal risk factors, design and implement postural education curricula, provide specialized support for students with motor difficulties, and contribute to the development of active learning environments.

The implementation of integrated programs faces several challenges, including limited funding, lack of policy frameworks supporting physiotherapy in schools, time constraints within the academic schedule, and the need for professional development for teachers and school staff. However, evidence from successful programs such as Active Smarter Kids (Resaland et al., 2016) and the School in Motion intervention (Kvalø et al., 2017) demonstrates that these barriers can be overcome through creative scheduling, integration of PA into academic lessons, and strong partnerships between schools, health services, and research institutions.

4. DISCUSSION

This narrative review synthesized current evidence on the influence of physical activity and physiotherapy on functional capacity, concentration, and academic performance in school-age populations. The findings support an integrated model of school-based health promotion in which PA and physiotherapy interventions complement each other through distinct but interconnected pathways to enhance both physical and cognitive outcomes.

4.1 Synthesis of Key Findings

The meta-analytic evidence consistently demonstrates that PA interventions produce small-to-moderate positive effects on academic performance ($d = 0.21$ – 0.46), with mathematics showing stronger effects than reading (Álvarez-Bueno et al., 2017; Li et al., 2023). These findings align with the theoretical framework proposed by Diamond (2013), which posits that mathematics performance relies more heavily on executive functions—particularly working memory and inhibitory control—than reading comprehension, making it more responsive to PA-induced improvements in EF. The robust effect of PA on executive functions ($d = 0.52$; Fernandes et al., 2024) provides strong support for the mediation hypothesis, suggesting that PA enhances academic outcomes primarily through improvements in cognitive control processes rather than through direct effects on content-specific knowledge.

The neurobiological evidence further strengthens this interpretation. Exercise-induced increases in BDNF, coupled with structural changes in the hippocampus and prefrontal cortex (Chaddock et al., 2010; Meijer et al., 2020), provide a plausible biological mechanism linking PA to enhanced cognitive function. The finding that acute exercise produces transient BDNF elevations while chronic exercise leads to sustained increases (Dergaa et al., 2026) has important implications for intervention design: while single bouts of exercise may provide short-term cognitive benefits (e.g., enhanced attention immediately following active breaks), sustained improvements in academic performance likely require regular, long-term PA engagement.

The role of physiotherapy in this framework, while less extensively studied than PA, represents a critical and underappreciated component. By improving functional capacity, reducing musculoskeletal pain, and enhancing postural endurance, physiotherapy interventions address the physical prerequisites for sustained classroom engagement (Alexander et al., 2024; Blanco-Morales et al., 2020). A student who experiences chronic back pain or postural fatigue is less able to maintain the sustained attention required for academic learning, regardless of cognitive capacity. In this sense, physiotherapy and PA interventions operate through complementary mechanisms: PA primarily enhances cognitive capacity through neuroplasticity, while physiotherapy removes physical barriers to the expression of that capacity in the classroom.

4.2 Implications for Practice and Policy

The evidence reviewed here supports several practical recommendations for school-based health promotion programs. First, schools should aim to integrate at least 60 minutes of MVPA into the daily schedule, consistent with WHO recommendations and the dose–response evidence reviewed above (James et al., 2023). This can be achieved through a combination of structured physical education, active breaks, and integration of movement into academic lessons, as demonstrated by successful programs such as Active Smarter Kids (Resaland et al., 2016).

Second, physiotherapy services should be integrated into school health teams, with physiotherapists contributing to universal screening for musculoskeletal risk factors, postural education curricula, and specialized support for students with motor difficulties (Granero-Heredia et al., 2025). The cost-effectiveness of such integration should be evaluated, considering both direct health benefits and indirect gains in academic performance and reduced absenteeism.

Third, intervention design should consider the moderating factors identified in the literature, including age, sex, baseline fitness level, socioeconomic status, and type of physical activity. The finding that PA interventions may be particularly beneficial for disadvantaged children (Gall et al., 2018) underscores the potential of school-based health promotion as a strategy for reducing educational inequalities.

4.3 Limitations and Future Directions

Several limitations of the current evidence base should be acknowledged. First, the heterogeneity of study designs, intervention modalities, outcome measures, and populations across the included studies limits the precision of effect size estimates and the generalizability of findings. Second, the majority of studies employ cross-sectional or short-term experimental designs, limiting causal inferences about the long-term effects of PA and physiotherapy on academic trajectories. Third, the mechanisms linking physiotherapy interventions to academic outcomes have been primarily studied through indirect evidence; direct experimental studies are needed to establish causal pathways.

Future research should prioritize: (a) longitudinal studies tracking the effects of school-based PA and physiotherapy programs on academic trajectories from primary through secondary education; (b) mediational analyses simultaneously examining physical, cognitive, and neurobiological pathways; (c) dose–response studies to identify optimal PA prescriptions for cognitive and academic benefits; (d) implementation science research examining the barriers and facilitators of integrating physiotherapy into school health systems across diverse cultural and economic contexts; and (e) cost-effectiveness analyses to inform policy decisions regarding resource allocation for school-based health promotion.

5. CONCLUSIONS

This narrative review provides a comprehensive synthesis of current evidence on the influence of physical activity and physiotherapy on functional capacity, concentration, and academic performance in educational settings. The evidence supports the following conclusions:

Physical activity interventions produce consistent, small-to-moderate positive effects on academic performance ($d = 0.21–0.46$), with the strongest effects observed for mathematics and overall academic achievement. These effects are primarily mediated by improvements in executive functions, particularly inhibitory control and working memory ($d = 0.31–0.52$), which are essential for classroom learning and academic success.

The neurobiological mechanisms underlying exercise-induced cognitive enhancement are well-supported, with BDNF-mediated neuroplasticity, hippocampal neurogenesis, and prefrontal cortex activation representing the primary pathways through which physical activity enhances brain structure and function during critical developmental periods.

Physiotherapy interventions, including postural education, ergonomic training, and movement-based programs, improve functional capacity and reduce musculoskeletal complaints (30–50% reduction in back pain prevalence), thereby removing physical barriers to sustained attention and classroom engagement.

Integrating physical activity and physiotherapy into comprehensive school-based health promotion programs offers a synergistic approach that addresses both the cognitive-neurobiological and musculoskeletal-functional dimensions of student wellbeing. This integrated model has the potential to improve not only academic performance but also long-term health outcomes and quality of life.

As educational systems worldwide face the dual challenges of declining physical activity levels and increasing demands for academic achievement, the evidence reviewed here supports a paradigm shift in which health promotion is recognized not as a competitor for instructional time but as a catalyst for learning. The school, as a setting where children spend the majority of their developmental years, represents the most strategic venue for implementing the kind of comprehensive, evidence-based health promotion programs that the research unequivocally supports.

Conflict of Interest

The authors declare no conflict of interest.

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