

Influence of Outdoor Nature Play on Children's Physical Activity, Cognitive Performance, and Emotional Well-Being

Maryam Abdoshahi

Associate Professor, Department of Motor Behavior, Faculty of Sport Sciences, Alzahra University, Tehran, Iran. Email: m.abdoshahi@alzahra.ac.ir

Article Info	Abstract
Article type: Research Article Article history: Received 11 March 2026 Received in revised form 10 May 2026 Accepted 24 May 2026 Available online 29 June 2026 Keywords: Child Development, Exercise, Cognition, Emotional Well-Being, Natural Environment.	Introduction: Opportunities for outdoor nature play have declined in contemporary childhood, raising concerns about children's physical activity (PA), cognitive development, and emotional well-being. Emerging evidence suggests that nature-based play environments may support holistic child development; however, experimental studies examining causal effects remain limited. Objective: To examine the influence of outdoor nature play on children's PA, cognitive performance, and emotional well-being. Method: This randomized controlled experimental study investigated the effects of an eight-week outdoor nature play intervention on children aged 6-10 years (N=80). Participants were randomly assigned to an outdoor nature play group (n=40) or a control group engaging in non-nature-based play (n=40). PA was measured using accelerometers, cognitive performance was assessed with standardized executive function tasks, and emotional well-being was evaluated using validated parent-report questionnaires. ANOVA was used for data analysis. Results: Children in the outdoor nature play group demonstrated greater increases in moderate-to-vigorous PA compared to controls ($F(1,78)=36.42, p<0.001, \eta^2=0.32$). Significant improvements were also found in cognitive performance ($F(1,78)=14.88, p<0.001, \eta^2=0.16$) and emotional well-being ($F(1,78)=22.15, p<0.001, \eta^2=0.22$). No significant changes were observed in the control group. Conclusions: Outdoor nature play produces significant benefits for children's PA, cognitive functioning, and emotional well-being. Integrating nature-based play into educational and community settings may support healthier and more balanced child development. Cite this Article: Abdoshahi, M. (2026). Influence of Outdoor Nature Play on Children's Physical Activity, Cognitive Performance, and Emotional Well-Being. <i>Physical Activity in Children</i>, 3(1), 15-22. https://doi.org/10.22034/pach.2026.577351.1084

1. Introduction

Over the past several decades, childhood experiences have undergone profound transformations driven by urbanization, technological advancement, and changing social norms (1). One of the most notable shifts has been a marked decline in children's opportunities to engage in outdoor play, particularly play that occurs in natural environments such as forests, parks, gardens, and open green spaces (2). Instead, many children now spend substantial portions of their daily lives indoors, engaged in sedentary activities mediated by digital devices. This transition has raised growing concern among educators, public health professionals, psychologists, and parents regarding its potential implications for children's physical activity (PA) levels, cognitive development, and emotional well-being. Against this backdrop, outdoor nature play has emerged as a critical area of inquiry, offering a promising avenue for supporting holistic child development.

Outdoor nature play refers to unstructured or semi-structured play activities that take place in natural or semi-natural environments and are often child-directed (3). Unlike traditional playground activities

that rely on fixed equipment, nature play typically involves interaction with natural elements such as trees, rocks, water, soil, and vegetation (4). These environments are inherently variable and open-ended, encouraging exploration, creativity, and physical engagement. Researchers have increasingly argued that such play contexts may offer developmental benefits distinct from those provided by indoor play or highly structured extracurricular activities (3,5,6).

Research on outdoor nature play is supported by several theoretical perspectives that explain how natural environments influence child development. Attention Restoration Theory (ART) proposes that exposure to natural settings helps restore depleted attentional resources, thereby enhancing concentration, cognitive functioning, and mental performance (5,6). Stress Reduction Theory (SRT) suggests that contact with nature promotes psychological recovery and reduces physiological and emotional stress responses, contributing to improved emotional well-being (7). Furthermore, Bronfenbrenner's Ecological Systems Theory emphasizes that children's development is shaped through ongoing interactions with their surrounding environments, highlighting natural play settings as



important developmental contexts. Together, these theoretical frameworks suggest that outdoor nature play may simultaneously influence children's PA, cognitive performance, and emotional well-being, providing a strong conceptual foundation for the present study.

From a physical health perspective, insufficient PA among children has become a global public health concern (7,8). The World Health Organization consistently reports that a large proportion of children fail to meet recommended daily levels of moderate-to-vigorous PA (MVPA) (9). A sedentary lifestyle during childhood has been linked to a greater likelihood of developing obesity, cardiovascular conditions, and metabolic health disorders in later stages of life (10,11). Outdoor nature play may serve as an effective and enjoyable means of increasing children's PA, as natural environments often promote movement through climbing, running, balancing, and other dynamic actions (12-14). Moreover, children tend to engage in longer and more sustained periods of active play outdoors compared to indoor settings, suggesting that nature-based play may be particularly beneficial for fostering habitual PA (6,15,16).

Beyond physical health, childhood is a critical period for cognitive development, during which foundational skills such as attention, memory, executive functioning, and problem-solving are rapidly evolving (17,18). Contemporary educational systems, however, often emphasize structured academic instruction at the expense of play-based learning, sometimes limiting opportunities for experiential engagement with the environment. Emerging evidence suggests that outdoor nature play can support cognitive performance by providing rich sensory input and complex, stimulating contexts that challenge children to plan, adapt, and think creatively (6,12,19). Natural settings may also help restore attentional capacity, as proposed by Attention Restoration Theory, which posits that exposure to natural environments replenishes cognitive resources depleted by sustained directed attention (20,21). As cognitive demands on children increase in both school and home environments, understanding the role of nature play in supporting mental functioning has become increasingly important.

Equally significant is the potential impact of outdoor nature play on children's emotional well-being. Rates of childhood stress, anxiety, and emotional dysregulation have risen in many parts of the world, prompting concern about children's mental health and resilience (22,23). Emotional well-being encompasses a child's ability to experience positive emotions, manage stress, and develop a sense of self-efficacy and emotional security (24). Exposure to natural settings has been associated with lower levels of stress, better mood states, and improved emotional self-regulation among both children and adults (25). For children, outdoor nature play may offer opportunities for autonomy, risk-taking within safe boundaries, and emotional expression, all of which are essential for healthy emotional development (6). Furthermore, natural play settings can foster social interaction and cooperation, contributing to a sense of belonging and social competence that supports emotional health (8).

The present study focuses specifically on PA, cognitive performance, and emotional well-being because these domains represent core and interconnected dimensions of child development. PA is fundamental to healthy growth, motor skill development, and disease prevention. Cognitive performance encompasses essential developmental processes, including attention, memory, executive functioning, and problem-solving, which are critical for learning and academic achievement. Emotional well-being influences children's ability to regulate emotions, cope with challenges, develop resilience, and establish positive social relationships. Since these domains are closely interrelated, examining them together provides a more comprehensive understanding of the developmental significance of outdoor nature play than investigating each outcome independently.

Despite increasing recognition of these potential benefits, children's access to outdoor nature play remains uneven and, in many contexts, limited. Urban environments often lack sufficient green spaces, and safety concerns, academic pressures, and parental time constraints may further restrict outdoor play opportunities (26). Additionally, socioeconomic disparities can influence the availability and quality of natural play environments, potentially exacerbating inequalities in health and developmental outcomes (27). As a result, examining the influence of outdoor nature play is not only a matter of individual child development but also one of broader social and environmental equity.

Research on outdoor nature play spans multiple disciplines, including public health, developmental psychology, education, and environmental studies. While a growing body of literature supports positive associations between nature exposure and various aspects of child development (6-8), findings are sometimes fragmented, and methodological approaches vary widely. Some studies focus primarily on PA outcomes, while others examine cognitive or emotional dimensions in isolation. There remains a need for integrative research that considers the interconnected effects of outdoor nature play on physical, cognitive, and emotional domains simultaneously. Such an approach aligns with contemporary models of child development that emphasize the interdependence of physical health, mental functioning, and emotional well-being.

Current evidence suggests that children who engage more frequently in outdoor activities and experience greater exposure to natural environments generally demonstrate higher levels of PA, improved attention and cognitive functioning, and better emotional outcomes (23,25). Thus, what is already known is that nature exposure appears to support multiple aspects of child development. However, what remains unclear is the extent to which outdoor nature play specifically influences these developmental domains simultaneously and through which mechanisms these benefits occur. Many existing studies employ different definitions of nature play, focus on a single outcome domain, or use diverse methodological approaches, making it difficult to draw integrated conclusions (3,4). Consequently, there is still limited understanding of the interconnected effects of outdoor nature play on PA, cognitive

performance, and emotional well-being within a unified developmental framework.

What is therefore needed is a comprehensive examination of evidence across these three domains to better understand the holistic role of outdoor nature play in child development. Such research is particularly important given ongoing declines in children's opportunities for unstructured outdoor play and increasing concerns regarding sedentary behavior, mental health challenges, and developmental well-being. Without stronger evidence, educators, policymakers, urban planners, and caregivers may lack the information necessary to design environments and interventions that effectively support healthy child development.

This paper seeks to examine the effects of outdoor nature-based play on children's PA, cognitive functioning, and emotional health. It also aims to identify and discuss the underlying mechanisms by which natural play settings may contribute to multiple aspects of child development. By bringing together evidence from physical, cognitive, and emotional domains and addressing gaps in current knowledge, the review provides a broader perspective on the significance of nature play in modern childhood. Furthermore, the findings are intended to offer valuable insights for educators, policymakers, urban designers, and caregivers regarding the benefits of incorporating nature-oriented play experiences into children's everyday environments.

2. Methods

2.1. Study Design

This study employed a randomized controlled experimental design.

2.2. Participants

Participants were children aged 6 to 10 years recruited from local primary schools and community centers. This age range was selected due to its developmental relevance for physical, cognitive, and emotional growth. Inclusion criteria required that children were physically capable of participating in moderate PA and had no diagnosed cognitive, emotional, or neurological disorders that could significantly influence study outcomes. Children with medical conditions restricting PA were excluded. The study cohort consisted of 80 children who were allocated randomly into two distinct groups: an experimental group ($n = 40$) and a control group ($n = 40$). Before enrollment, formal written consent was secured from parents or legal representatives, while the children provided their verbal assent. All procedures were approved by the institutional review board and adhered strictly to the ethical standards for child-centered research.

2.3. Intervention: Outdoor Nature Play Program

The experimental group participated in an outdoor nature play program designed to promote active, child-led interaction with natural environments. Sessions were conducted in local parks and green spaces and took place three times per week for eight weeks, with each session lasting approximately 60 minutes. Activities were largely unstructured and included free play, exploration, climbing, balancing, imaginative

play using natural materials, and cooperative group games. Adult facilitators were present to ensure safety but minimized direct instruction to preserve the child-directed nature of play.

Children in the control group participated in standard play sessions of equal frequency and duration to control for time and social interaction. These sessions took place in indoor or built environments (e.g., classrooms or conventional playgrounds) and involved structured games or free play using manufactured equipment, without exposure to natural elements such as vegetation or uneven terrain.

2.4. Measurements

2.4.1. Physical Activity

PA was assessed using waist-worn accelerometers. Devices were worn during each play session as well as during regular daily activities. Data were analyzed to determine time spent in MVPA. Valid data required a minimum wear time of 10 hours per day on at least four days at each measurement point.

2.4.2. Cognitive Performance

Cognitive performance was evaluated using standardized, age-appropriate neurocognitive tasks administered at baseline and after the intervention period. Measures focused on attention, working memory, and executive functioning. Trained personnel oversaw the administration of all tasks, which were conducted individually in a controlled, noise-free environment, strictly following predefined standardized procedures. Composite cognitive performance scores were calculated by standardizing task outcomes.

2.4.3. Emotional Well-Being

Emotional well-being was assessed using a validated parent-report questionnaire measuring emotional regulation, mood, and psychological functioning. Parents completed the questionnaire at baseline and post-intervention. Higher scores indicated better emotional well-being.

2.5. Procedure

One week before the intervention commenced, baseline data was collected. Participants were then assigned to either the experimental or control condition via a computer-based randomization process. The program was administered over eight weeks, after which post-test evaluations were performed within one week of conclusion, employing identical measures and methodologies as the baseline. Where feasible, researchers who administered the tests remained blinded to the participants' group allocations.

2.6. Data Analysis

Statistical analyses were performed using SPSS software. Initial data screening involved the computation of descriptive statistics for all study variables. To evaluate between-group differences across time points, a repeated-measures ANOVA was employed. In instances where interaction effects reached statistical significance, follow-up post hoc tests were executed. Furthermore, the strength of the intervention's impact was assessed by calculating

effect sizes. A significance threshold of $p < 0.05$ was maintained throughout all analyses.

3. Results

3.1. Participant Demographics

A total of 80 children participated in the study, with 40 assigned to the outdoor nature play intervention

group and 40 to the control group (Table 1). The mean age of participants was 8.1 years ($SD = 1.3$), with no significant age differences between groups. Overall, 41 participants (51.3%) were boys and 39 (48.7%) were girls. Demographic characteristics were comparable across groups, indicating successful randomization.

Table 1. Demographic Characteristics of Participants by Group.

Variable	Outdoor Nature Play (n = 40)	Control Group (n = 40)	p
Age (years), Mean (SD)	8.0 (1.2)	8.2 (1.4)	0.54
Boys, n (%)	21 (52.5)	20 (50.0)	0.82
Girls, n (%)	19 (47.5)	20 (50.0)	
Socioeconomic Status (Low/Medium/High)	12 / 18 / 10	11 / 19 / 10	0.97

3.2. Descriptive Statistics

At baseline, no significant differences were observed between the intervention and control groups across outcome measures (all $p > .05$). Following the

intervention, the outdoor nature play group demonstrated higher mean scores across all outcome variables compared to the control group (Table 2).

Table 2. Descriptive Statistics for Outcome Variables at Baseline and Post-Intervention.

Outcome Measure	Group	Baseline Mean (SD)	Post-Intervention Mean (SD)
MVPA (min/day)	Nature Play	41.3 (9.6)	58.7 (10.2)
	Control	42.1 (10.1)	45.0 (9.8)
Cognitive Performance (z-score)	Nature Play	0.01 (0.89)	0.67 (0.81)
	Control	-0.03 (0.91)	0.08 (0.86)
Emotional Well-Being (score)	Nature Play	62.4 (7.8)	71.6 (6.9)
	Control	63.1 (8.2)	64.5 (7.6)

3.3. Assumption Testing

Prior to inferential analyses, assumptions for repeated-measures ANOVA were examined (Table 3). No significant deviations from normality were detected for any outcome variable ($p > 0.05$). Homogeneity of variances was confirmed using Levene's test at baseline

and post-intervention ($p > 0.05$). Mauchly's test of sphericity was not applicable due to the two-time-point design. Collectively, these diagnostic tests confirmed that the dataset satisfied all prerequisite criteria for parametric analysis.

Table 3. Summary of Assumption Testing.

Assumption	Test	Result
Normality	Shapiro-Wilk	$p > 0.05$ for all variables
Homogeneity of variance	Levene's Test	$p > 0.05$
Sphericity	Not applicable	Two time points

3.4. Effects of Intervention

3.4.1. Physical Activity

Regarding MVPA, a significant group $\times$ time interaction was emerged, $F(1, 78) = 36.42$, $p < 0.001$, $\eta^2 = 0.32$. Subsequent post hoc testing revealed that participants in the outdoor nature play condition experienced a substantial improvement in daily MVPA levels from baseline to post-intervention ($p < 0.001$). In contrast, no statistically significant fluctuations were observed within the control group ($p = 0.09$) (Table 4 and Figure 1).

3.4.2. Cognitive Performance

Regarding cognitive performance, the analysis identified a significant group $\times$ time interaction, $F(1, 78) = 14.88$, $p < 0.001$, $\eta^2 = 0.16$. Follow-up analyses

confirmed that individuals in the outdoor nature play group exhibited a significant increase in composite cognitive scores post-intervention ($p < 0.001$), whereas the control group did not display any statistically significant changes ($p = 0.28$) (Table 4 and Figure 1).

3.4.3. Emotional Well-Being

Regarding emotional well-being, the data showed a significant group $\times$ time interaction, $F(1, 78) = 22.15$, $p < 0.001$, $\eta^2 = 0.22$. Pairwise comparisons indicated that participants in the outdoor nature play group experienced a substantial enhancement in emotional well-being scores from baseline to the post-intervention assessment ($p < 0.001$). Conversely, no meaningful variation was detected in the control group ($p = 0.31$) (Table 4 and Figure 1).

Table 4. Repeated-Measures ANOVA Results for Physical Activity.

Variable	Effect	F	p	Partial η^2
Physical Activity	Time	18.67	< 0.001	0.19
	Group	9.54	0.003	0.11
	Time $\times$ Group	36.42	< 0.001	0.32
Cognitive Performance	Time	7.91	0.006	0.09
	Group	4.38	0.04	0.05
	Time $\times$ Group	14.88	< 0.001	0.16
Emotional Well-Being	Time	12.46	0.001	0.14
	Group	6.72	0.01	0.08
	Time $\times$ Group	22.15	< 0.001	0.22

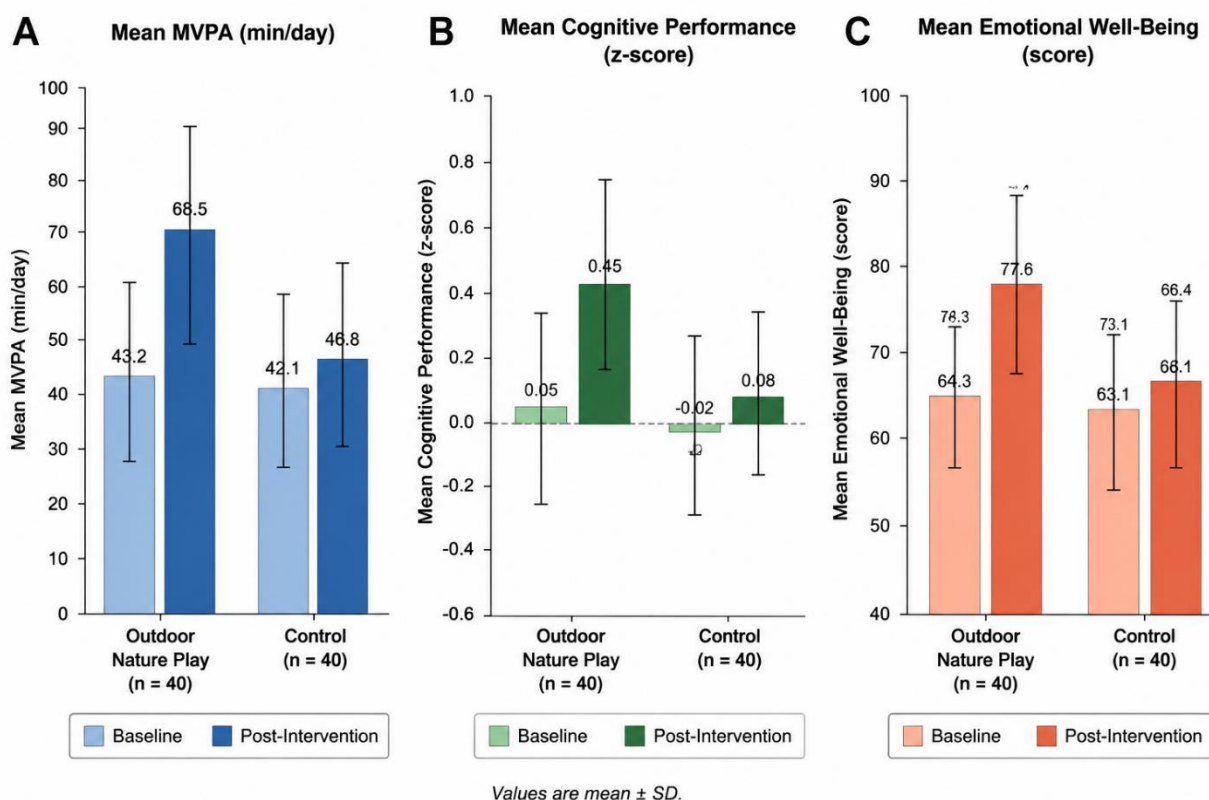


Figure 1. Impact of Outdoor Nature Play Intervention on the Outcome Variables.

4. Discussion

This study investigated the impact of an outdoor nature play intervention on children's PA, cognitive abilities, and emotional health through an experimental framework. The results reveal strong evidence that structured outdoor nature play can lead to significant enhancements in all three areas. Children engaged in the nature-based play program exhibited greater levels of MVPA, improved cognitive performance, and better emotional well-being compared to those in the control group. These findings contribute to the existing literature on the developmental benefits of nature-rich play environments (6-8) and further establish causal relationships through an experimental methodology. Importantly, the present findings position this study within a growing body of research suggesting that outdoor nature play should be viewed as a multidimensional developmental intervention capable of simultaneously supporting physical, cognitive, and emotional outcomes. While previous studies have frequently examined these domains independently, the current findings provide evidence for their interconnected nature within a single experimental framework.

Children participating in the outdoor nature play group demonstrated a significant increase in PA levels after the intervention, supporting the study's hypotheses. This outcome is consistent with ecological models of PA, which emphasize the importance of environmental factors in influencing movement behaviors. Natural settings, with their uneven surfaces, diverse opportunities for play, and expansive areas for exploration, encourage children to engage in a wider

range of PA (6,7). In contrast to conventional playgrounds or indoor environments, nature-based spaces foster spontaneous physical challenges such as climbing, balancing, and running, likely leading to elevated levels of MVPA (3,4). These findings are consistent with previous research reporting that children are generally more physically active in natural environments than in built or indoor settings (6-8). Therefore, the present study strengthens existing evidence by demonstrating similar effects under experimental conditions.

The findings of this study lend support to affordance theory, which posits that environments present action opportunities that individuals perceive and exploit according to their abilities (28). The outdoor nature-play settings likely provided more diverse movement options compared to the control environments, resulting in heightened PA. Notably, the significant effects observed indicate that outdoor nature play could serve as an effective and cost-efficient approach to encourage PA in children, especially given the growing concerns regarding sedentary lifestyles and diminishing physical fitness among youth. The findings therefore support theoretical propositions suggesting that children's behavior is strongly influenced by the opportunities available within their environments. Natural settings appear to offer a richer variety of affordances than conventional play spaces, thereby encouraging greater physical engagement.

The enhancements in cognitive performance observed in children participating in nature play align with Attention Restoration Theory (20,21). This theory posits that natural settings engage involuntary attention in a relaxed and effortless way, facilitating

the recovery of directed attention, which can become fatigued due to prolonged cognitive tasks. By frequently interacting with natural stimuli, children in the outdoor play group likely experienced attentional restoration, leading to improved performance in activities that demand sustained attention, working memory, and executive functioning. This finding is consistent with previous studies that have reported positive associations between exposure to natural environments and improvements in attention, executive functioning, and academic-related cognitive skills (12,19,20). Consequently, the present results extend existing evidence by suggesting that regular participation in outdoor nature play may actively contribute to cognitive development rather than simply producing short-term attentional benefits.

The benefits of outdoor play extend beyond attentional restoration; it also appears to enhance executive functioning through its cognitively engaging aspects. Activities in natural settings often require children to engage in problem-solving, make decisions, and adapt to evolving circumstances as they craft their own play scenarios. From a constructivist learning viewpoint, these interactions facilitate cognitive growth by enabling children to actively build knowledge through their experiences with the environment (12). The evidence indicates that outdoor nature play can serve as a valuable complement to traditional educational methods, offering experiential learning opportunities that nurture cognitive abilities crucial for academic achievement (15). This interpretation is further supported by constructivist theories of learning, which propose that children develop knowledge most effectively through active exploration and interaction with their surroundings. Natural environments may therefore provide unique opportunities for experiential learning that are less common in highly structured educational settings.

The significant improvements in emotional well-being among children participating in outdoor nature play underscore the psychological advantages of nature exposure during formative years. These results align with stress reduction theory, which suggests that natural settings facilitate emotional regulation and alleviate both physiological and psychological stress (29,30). Engaging regularly in outdoor play may assist children in navigating emotional difficulties by offering soothing sensory experiences, avenues for self-expression, and a sense of independence and freedom (2,30). The present findings are also consistent with previous research linking nature exposure to reduced stress, improved mood, and enhanced psychological resilience among children and adolescents (25,29,30).

Nature-based play fosters social interaction, collaboration, and shared imaginative experiences, all of which are vital for emotional growth and social skills (7). According to self-determination theory, engaging in outdoor play meets essential psychological needs for autonomy, competence, and connection (31). In the intervention, children were empowered to lead their own play, tackle physical and cognitive challenges, and engage with peers in a more relaxed setting, potentially boosting their emotional well-being. These insights are particularly significant in light of increasing concerns regarding childhood anxiety, stress, and emotional dysregulation in today's highly structured and technology-oriented

environments. From the perspective of self-determination theory, the emotional benefits observed in this study may have emerged because outdoor nature play satisfies children's basic psychological needs for autonomy, competence, and relatedness. Consequently, the findings provide theoretical support for the proposition that natural play environments promote emotional well-being by fulfilling these fundamental developmental needs.

The findings highlight the intricate connections among physical, cognitive, and emotional development during childhood. Increased PA likely plays a role in enhancing cognitive and emotional outcomes, as movement is known to bolster brain function and aid in emotional regulation. Furthermore, improved emotional health can lead to greater participation in play and learning, fostering beneficial developmental cycles. This comprehensive pattern of results is consistent with bioecological models of development, which focus on the evolving interactions between children and their environments over time. The results therefore suggest that the benefits of outdoor nature play may not operate through isolated pathways. Rather, improvements in one developmental domain may reinforce gains in others, creating synergistic effects that support overall child development. This finding is particularly important because it highlights the value of examining physical, cognitive, and emotional outcomes together rather than separately.

Despite several strengths, including the experimental design and the use of objective measures of PA, this study has a number of limitations that should be considered when interpreting the findings. The relatively small sample, recruited from only a limited number of schools and community settings, may restrict the generalizability of the results. Future studies should therefore include larger and more diverse samples in order to examine whether these findings hold across different cultural, socioeconomic, and geographic contexts. In addition, the brief intervention period raises concerns about the durability of the observed effects, highlighting the need for longitudinal research to determine whether the physical, cognitive, and emotional gains associated with outdoor nature play are sustained over time. The reliance on parent-reported measures for assessing emotional well-being introduces the potential for reporting bias; thus, future studies would benefit from employing multi-informant approaches, including child self-reports and physiological stress indicators. Furthermore, while the study examined overall exposure to outdoor nature play, it did not differentiate between specific types of natural environments or play activities, suggesting that future research should investigate which characteristics of nature play such as biodiversity, risk levels, and social dynamics are most impactful for various developmental outcomes. Lastly, although efforts were made to standardize the intervention delivery, factors like weather variations, seasonal conditions, and individual engagement levels may have influenced the results. Another limitation is that the study did not directly examine the mechanisms underlying the observed developmental benefits. Future research should investigate whether factors such as attentional restoration, stress reduction, social interaction, or

increased autonomy mediate the relationship between outdoor nature play and child development outcomes.

The findings of this study, despite certain limitations, hold significant implications for educators, policymakers, and caregivers. Incorporating outdoor nature play into educational curricula, community initiatives, and urban development can serve as an effective strategy to enhance children's physical health, cognitive abilities, and emotional well-being. As children's lives increasingly revolve around indoor activities and digital technology, ensuring access to nature-based play spaces is crucial for fostering balanced and healthy development. Taken together, the findings suggest that outdoor nature play should be considered not merely a recreational activity but a meaningful developmental resource that can contribute to children's holistic growth and well-being.

4.1. Conclusion

Overall, the findings suggest that outdoor nature play represents a valuable developmental resource with the potential to enhance multiple dimensions of child well-being simultaneously. As opportunities for unstructured outdoor play continue to decline in many societies, preserving and expanding children's access to natural play environments should be considered a priority for educators, policymakers, urban planners, and caregivers. Such efforts may contribute not only to healthier childhood experiences but also to improved developmental outcomes across the lifespan.

Authors' Contribution: The author independently developed the study concept and protocol, organized and implemented the research procedures, collected and analyzed the data, interpreted the results, and prepared the manuscript.

Funding Support: This research was conducted without financial support from governmental, commercial, or private funding sources.

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: In preparing this manuscript, the author employed GapGPT 5.6 for limited language-related assistance, including proofreading, grammatical correction, wording refinement, and enhancement of textual clarity. The technology was not involved in data collection, statistical analysis, interpretation of the results, or development of the study's scientific conclusions. All AI-assisted text was reviewed and revised by the author, who assumes full responsibility for the accuracy, originality, and integrity of the published work.

Ethical Considerations: This research received ethical approval from the relevant institutional ethics committee (Ethics Code: IR.SSRC.REC.1401.079) and was carried out in accordance with the ethical principles of the Declaration of Helsinki. Measures were taken throughout the study to ensure the protection of the children's rights, privacy, safety, dignity, and well-being. Written informed consent was obtained from the parents or legal guardians before the children were enrolled in the study. The children were also provided with age-appropriate information about the research procedures, and their voluntary participation was respected.

Data Availability: The dataset generated and analyzed during the study is available from the corresponding author upon reasonable request, subject to applicable ethical and confidentiality requirements.

Acknowledgments: The author wishes to acknowledge the children and their parents or legal guardians for their participation and cooperation. Appreciation is also extended to the educational settings and staff who supported the implementation of the study. The author is grateful to the anonymous reviewers for their constructive feedback and helpful recommendations, which contributed to strengthening the manuscript.

Conflicts of Interest: The author reports no financial, personal, or professional conflicts of interest associated with this research or its publication.

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