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The Influence of Play-Based Learning on the Cognitive Development of Early Childhood in Kindergarten

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Abstract

Purpose – This study examined whether structured play-based learning improved the cognitive development of kindergarten children.

Methodology – A cluster-based quasi-experimental pretest-posttest control-group design was used. The illustrative dataset comprised 116 children from 12 Group B classes in Surabaya, Indonesia. Six classes received an eight-week play-based intervention, while six classes followed regular instruction. Cognitive development was assessed through 24 performance tasks, and the data were analyzed using a linear mixed-effects model with classroom as a random intercept.

Findings – The illustrative analysis showed that the experimental group achieved a significantly higher adjusted posttest score than the control group after baseline performance and classroom clustering were controlled. The largest descriptive gains occurred in problem-solving, logical reasoning, and spatial understanding.

Implications – Kindergarten teachers should integrate guided construction, puzzles, classification, symbolic play, numeracy games, and rule-based movement into regular instruction while preserving children's agency.

Originality – The study treats play-based learning as a multidimensional pedagogy and models broad cognitive development while accounting for the classroom clustering of participants.

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Introduction

Early childhood is a major developmental period in which children establish the cognitive capacities required for later learning. During the kindergarten years, attention, memory, language, classification, symbolic representation, reasoning, and problem-solving become increasingly organized. Executive functions are particularly important because they allow children to retain instructions, inhibit immediate responses, and change strategies when task demands shift. These functions are closely associated with preschool children's linguistic, emotional, and general cognitive competencies (Spataro et al., 2024). Kindergarten education therefore needs to provide developmentally appropriate experiences that prepare children for formal schooling without replacing exploration with premature academic pressure.

Play-based learning offers an educational environment in which children acquire knowledge through participation, experimentation, and interaction. Within playful activities, children

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manipulate materials, communicate with peers, make decisions, and observe the consequences of their actions. Play can integrate academic, personal, and social learning within meaningful experiences. A systematic review found that play-based pedagogies supported school readiness across academic, social, and personal dimensions (Kalinde et al., 2024). This evidence positions play as an intentional pedagogical context rather than a recreational activity separated from learning.

International evidence supports the cognitive value of guided and structured play. Guided play combines a learning objective established by an adult with meaningful choices controlled by the child. A systematic review and meta-analysis reported that guided play produced stronger outcomes than direct instruction for early mathematics, shape knowledge, and task switching (Skene et al., 2022). A separate meta-analysis identified moderate to large effects of game-based learning on cognitive, motivational, and engagement outcomes in early childhood education (Alotaibi, 2024). These findings indicate that children can benefit when teachers provide purposeful guidance without removing autonomy.

Different forms of play engage different cognitive processes. Social pretend play requires children to maintain roles, follow imaginary rules, and coordinate a shared narrative. Naturalistic evidence indicates that sustained engagement in social pretend play predicts growth in inhibitory control across the preschool year (White et al., 2021). Cognitively demanding physical play similarly requires children to remember signals, inhibit inappropriate movements, and switch between rules. A cluster-randomized intervention found that group play at moderate-to-vigorous intensity improved executive function and motor skills among preschool children (Bai et al., 2022).

Constructive and spatial play also provide measurable cognitive benefits. When children build, rotate objects, assemble puzzles, or compare positions, they use spatial working memory and part-to-whole reasoning. A randomized intervention involving three-year-old children showed that concrete and digital spatial activities improved trained spatial assembly skills and selected transfer outcomes (Bower et al., 2025). Large-scale experimental evidence has also shown that spatial-cognition training can strengthen mathematical learning (Judd & Klingberg, 2021). These studies suggest that spatial play may support both domain-specific understanding and broader reasoning.

Indonesian studies demonstrate that playful learning is relevant to local kindergarten practice. Educational block media improved logical-thinking performance among preschool children (Kurniawati et al., 2024). A numeracy game integrated with a STEAM approach also improved the numerical abilities of children aged five to six years in Surabaya (Fauziyah & Rakhmawati, 2023). Counting-board activities have generated significant pretest-posttest improvements in early cognitive performance (Arumsari et al., 2024). Digital educational games have likewise been used to support problem-solving and cognitive engagement in Indonesian early childhood settings (Humaida & Suyadi, 2021).

Despite this positive evidence, the effects of play are not automatic or uniform. A realistic pretend-play intervention improved self-regulation within training sessions but produced limited transfer to broader cognitive control (Adam et al., 2022). A systematic review of preschool interventions also found that effect sizes depended on cognitive challenge, duration, implementation fidelity, and the outcome assessed (Muir et al., 2023). Recent meta-analytic evidence identified only small average effects for some executive-function outcomes (Trujillo-Trujillo et al., 2026). The present study therefore examined whether an eight-week multidimensional play-based program influenced overall cognitive development among kindergarten children in Surabaya. It addressed the research question of whether children receiving structured play-based learning would achieve higher cognitive-development scores than children following regular instruction.

Literature Review

Play-Based Learning

Play-based learning refers to a pedagogical approach in which children develop knowledge and skills through activities characterized by enjoyment, exploration, participation, and meaningful choice. It does not remove instructional objectives but embeds them within experiences that require children to manipulate materials, communicate, decide, and respond to challenges. Active playful learning is particularly effective when activities involve active engagement, meaningful content, social interaction, iteration, and agency (Fletcher et al., 2024). These characteristics distinguish educational play from passive entertainment or activities that appear attractive but provide little cognitive demand.

Free play, guided play, and structured play differ according to the distribution of control between children and adults. Free play is initiated and directed by children, whereas guided play combines child agency with an adult-defined learning goal. Structured games use clearer procedures and rules but continue to require active responses. Play-based numeracy becomes more effective when teachers provide differentiated support, sufficient resources, and assessment strategies that capture learning during activity (Ugalde et al., 2024). The teacher therefore facilitates thinking by asking open questions and offering prompts rather than completing the task for the child.

Pretend play is cognitively important because it requires symbolic transformation. Children may use one object to represent another, adopt fictional roles, and maintain events that differ from immediate reality. Structured and free pretend play provide complementary opportunities for language, symbolic thought, and self-regulation (Mohan et al., 2022). Block play and pretend play can also contribute jointly to cognitive, linguistic, social, and emotional development (Lyu, 2023). Their educational value increases when teachers encourage children to explain plans, negotiate roles, and consider alternative solutions.

Play-based learning can also support language as a cognitive tool. Children use language to remember rules, describe relationships, organize a narrative, and justify decisions. Research on playful learning environments has shown positive contributions to listening, speaking, reading, and writing when games are aligned with explicit language goals (Tekman & Yeniasır, 2023). Quantitative evidence from preschool educators similarly indicates that purposeful play is associated with improvements in attention, memory, language, and problem-solving (Lazăr, 2025).

Cognitive Development in Early Childhood

Cognitive development refers to changes in children's capacity to acquire, organize, retain, process, and apply information. It includes attention and memory as well as higher-order processes such as reasoning, planning, and problem-solving. During kindergarten, children become increasingly able to follow multi-step instructions, identify patterns, classify objects, compare quantities, and explain simple causes. These abilities should be assessed through observable tasks rather than inferred only from classroom participation.

Executive functions form a central component of early cognition. Working memory enables children to retain information while completing a task, inhibitory control allows them to resist an immediate but inappropriate response, and cognitive flexibility supports switching between rules or perspectives. A critical review argued that interventions need explicit theories of change when executive functions are expected to support early mathematics (Scerif et al., 2023). This position is important because improvement in a trained cognitive process does not necessarily transfer automatically to every academic outcome.

Physical activity contributes to cognition when it combines movement with decision-making and coordination. A controlled trial found that diverse exercise supported cognitive and mental-health outcomes among children aged five to six years (Jia et al., 2021). Pom cheerleading also improved preschool executive function, with speed and agility acting as partial mechanisms (Wang et al., 2022). These findings indicate that movement becomes cognitively valuable when children must remember sequences, respond to signals, and regulate timing.

Early cognition also includes numerical and spatial understanding. Numerical cognition involves counting, quantity comparison, number recognition, and relational reasoning, whereas spatial cognition involves shape, direction, orientation, distance, and part-to-whole relationships. A nationally representative randomized trial found that play-based spatial learning improved preschool spatial reasoning and transferred to numeracy (Resnick & Lowrie, 2023). The integration of spatial tools into authentic preschool activities may therefore support mathematical understanding without relying on abstract instruction alone.

Theoretical Foundations

Constructivist theory explains that children build knowledge through interaction with objects, people, and events. They form an expectation, test it through action, and revise it when the result conflicts with their initial idea. Open-ended materials are especially suitable because they allow children to create several solutions from the same resources. A review of loose-parts play concluded that exploratory, symbolic, and constructive activities can reinforce reasoning, problem-solving, divergent thinking, and cognitive self-regulation (Cankaya et al., 2023).

Sociocultural theory complements constructivism by emphasizing language, shared activity, and scaffolding. Teachers can extend children's current ability through questions, modelling, reminders, or partial assistance while preserving responsibility for the task. Forest-school research demonstrates that exploratory environments may provide psychological and developmental benefits when children cooperate and respond to authentic challenges (Sella et al., 2023). The educational effect nevertheless depends on planning, safety, and purposeful adult support.

Embodied cognition provides a further explanation because young children often understand concepts through coordinated perception and action. Manipulating objects can make shape, sequence, and quantity visible, while gestures can represent spatial transformation. Developmentally appropriate technologies may support similar reasoning when children actively sequence and control actions. A systematic review found that digital and tangible technologies can introduce preschool children to sequencing, repetition, and conditional logic (Bakala et al., 2022).

Empirical Evidence

Intervention studies generally support the potential of structured play to strengthen executive function. A six-week preschool program using block building, pretend play, freeze games, and response-inhibition activities improved executive, language, and motor outcomes (Gibb et al., 2021). A systematic review of curricular motor-play programs similarly identified positive effects on working memory, inhibitory control, cognitive flexibility, and planning (Bedoya Salazar et al., 2022). Both findings suggest that play is most effective when its cognitive demands are explicit and repeatedly practiced.

Classroom intervention research also supports the use of thematic and constructive play. A quasi-experiment found that theme-based block play facilitated preschool language development by creating repeated opportunities for description, negotiation, and symbolic representation (Cai et al., 2022). A broader Indonesian review concluded that imaginative, constructive, and interactive games contribute differently to memory, critical thinking, language, and problem-solving (Misrahayu, 2024). Together, these studies justify evaluating play-based learning as a multidimensional approach rather than as one isolated game.

The empirical literature nevertheless shows substantial heterogeneity. Effects vary according to participant age, intervention intensity, teacher preparation, measurement quality, and the similarity between training and outcome tasks. This variability supports the use of an integrated cognitive assessment and an analysis that accounts for the classroom context in which the intervention is delivered.

Hypothesis Development

The Influence of Play-Based Learning on Cognitive Development

Play-based learning is expected to influence cognitive development because it places children in situations that require active information processing. Children observe materials, recall rules, classify objects, recognize patterns, select strategies, and evaluate outcomes. Repeated engagement in these processes can strengthen attention, memory, logical reasoning, symbolic thinking, early numeracy, spatial understanding, and problem-solving.

Constructivist theory predicts a positive relationship because children form cognitive structures through exploration and revision. A failed construction or an incorrect classification creates feedback that encourages the child to reconsider the original strategy. Guided play can increase the value of this process by directing attention toward a learning objective while preserving choice. The meta-analytic advantage of guided play over direct instruction for selected cognitive outcomes supports this mechanism (Skene et al., 2022).

Sociocultural theory provides a second basis for the expected relationship. Teacher questions, demonstrations, and prompts can support children in tasks that exceed their independent performance. Peer interaction also exposes children to alternative strategies and requires them to communicate their reasoning. The effectiveness of mediated play depends on appropriate cognitive challenge, dosage, and implementation fidelity (Muir et al., 2023).

The expected relationship is also supported across several forms of play. Constructive activities stimulate spatial and logical reasoning, pretend play exercises symbolic representation and inhibitory control, and number games connect quantities with concrete actions. Reviews of early childhood cognition consistently identify problem-solving and self-regulation as central mechanisms through which playful exploration contributes to learning (Cankaya et al., 2023).

The effect is not assumed to occur through every activity labelled as play. Effective play requires developmental relevance, sufficient duration, cognitive challenge, and opportunities for reflection. Based on the theoretical mechanisms and empirical evidence, the study proposed the following hypothesis:

H1: Play-based learning has a positive and significant influence on the cognitive development of early childhood in kindergarten.

Research Methods

This study used a quantitative quasi-experimental design with a cluster-based nonequivalent pretest-posttest control group. The research was conducted in 12 accredited kindergartens in Surabaya, East Java, Indonesia, from October to December 2025. Six Group B classes received structured play-based learning, while six classes continued the regular classroom program. Both conditions completed cognitive-development assessments before and after the intervention. The program was delivered for eight consecutive weeks through three 35-minute sessions each week. Activities included guided block construction, puzzles, object classification, symbolic role play, number games, spatial tasks, open-ended problem-solving, and rule-based movement games. Structured classroom play has been used successfully to develop preschool executive and linguistic abilities (Gibb et al., 2021). Teachers followed a standardized implementation guide, and trained observers completed a fidelity checklist after each session.

The target population consisted of Group B kindergarten children aged five to six years who were enrolled in accredited public and private kindergartens in Surabaya during the 2025/2026 academic year. A stratified cluster-sampling procedure represented public and private institutional settings. Twelve kindergartens were selected, and one Group B class was included from each institution. The classes were randomly allocated at a 1:1 ratio to the experimental or control condition. Individual randomization was not applied because instruction was delivered at classroom level and could have produced contamination between children. An a priori power analysis considered a medium effect, $\alpha = .05$, power = .80, classroom clustering, and expected attrition. Sample-size justification was based on the planned statistical model rather than a general numerical convention (Lakens, 2022). A total of 120 children entered the baseline assessment.

Cognitive development was measured with a 24-item Early Childhood Cognitive Development Assessment covering attention, working memory, classification, logical reasoning, symbolic thinking, problem-solving, early numeracy, and spatial understanding. Each dimension contained three performance tasks scored from 0, indicating inability to perform the task, to 3, indicating independent and consistent performance. The total score ranged from 0 to 72. Five experts evaluated item relevance, clarity, developmental suitability, and representativeness, and items were retained when the item-level content-validity index reached .78. The revised instrument was piloted with 30 children outside the main sample. Corrected item-total correlations above .30 were required. Cronbach's alpha and McDonald's omega were used because reliability estimates can differ according to item properties and factor loadings (Edwards et al., 2021). Coefficients of at least .70 indicated acceptable internal consistency, while an intraclass correlation coefficient of at least .75 indicated adequate inter-rater reliability. Reporting omega alongside alpha provided complementary reliability evidence (Zakariya, 2022).

Data screening and descriptive analysis were conducted in IBM SPSS Statistics 29, and the primary hypothesis was tested in R 4.4.1. Preliminary procedures examined missing values, data-entry errors, univariate outliers, score distributions, and baseline comparability. Frequencies, percentages, means, standard deviations, minimum values, and maximum values summarized participant characteristics and cognitive scores. Paired-samples t tests described within-condition change but were treated as supplementary analyses. The primary linear mixed-effects model specified posttest cognitive development as the dependent variable, learning condition and pretest score as fixed effects, and classroom as a random intercept. Restricted maximum likelihood estimation and the Kenward-Roger correction were applied. Results were reported through coefficients, standard errors, t values, p values, 95% confidence intervals, intraclass correlations, and Cohen's d. The hypothesis was supported when the adjusted intervention coefficient was positive and significant at $\alpha = .05$. Parents provided written informed consent, children gave verbal assent, and participant identities were replaced with numerical codes.

Results and Discussion

Results

The numerical results in this section constitute an illustrative simulated scenario developed to demonstrate the intended analysis and reporting format. They must be replaced with verified participant data and reproducible software output before the manuscript is submitted for publication.

A total of 120 children from 12 Group B classes completed the baseline assessment. Four children did not complete the posttest because of prolonged absence or relocation, resulting in a final analytic sample of 116 children. The experimental group consisted of 58 children from six classes, and the control group included 58 children from six classes. The participants had a mean age of 5.52 years, and the gender distribution comprised 59 boys and 57 girls. No meaningful baseline differences appeared in age, gender, or cognitive-development performance.

The cognitive-development instrument showed strong illustrative reliability, with Cronbach's alpha of .90 and McDonald's omega of .91. The inter-rater intraclass correlation coefficient was .87. Mean implementation fidelity reached 92.8%, indicating that teachers delivered most intervention components according to the activity guide. The baseline cognitive scores of the experimental and control groups were statistically comparable, $t(114) = 0.33$, $p = .744$.

Table 1. Descriptive Statistics of Cognitive-Development Scores

Group	n	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD	Mean Gain	Gain SD
Experimental	58	41.28	6.07	53.10	5.72	11.82	6.20
Control	58	40.91	6.12	45.62	5.89	4.71	5.80

Source: *Authors' calculations based on illustrative simulated study data, 2025.*

Table 1 shows that the experimental group increased from a pretest mean of 41.28 to a posttest mean of 53.10, producing an average gain of 11.82 points. The control group increased from 40.91 to 45.62, producing an average gain of 4.71 points. The experimental group showed a significant within-group increase, $t(57) = 14.52$, $p < .001$, Cohen's $d = 1.91$. The control group also improved, $t(57) = 6.19$, $p < .001$, Cohen's $d = 0.81$. These paired comparisons describe change but do not constitute the primary evidence of intervention effectiveness.

The unconditional mixed model produced an intraclass correlation of .071, indicating that 7.1% of the posttest variance occurred between classrooms. The clustered structure therefore needed to be retained in the primary analysis. After baseline scores and classroom clustering were controlled, the experimental condition predicted a 6.84-point higher posttest score, $B = 6.84$, $SE = 1.12$, $t(9.40) = 6.11$, $p < .001$. The 95% confidence interval ranged from 4.31 to 9.37, and the standardized difference was large, Cohen's $d = 1.18$. H1 was therefore supported within the illustrative analysis.

Table 2. Linear Mixed-Effects Model Predicting Posttest Cognitive Development

Model Component	Estimate	SE	t	p	95% CI
Pretest cognitive score	0.61	0.07	8.71	< .001	[0.47, 0.75]
Learning condition	6.84	1.12	6.11	< .001	[4.31, 9.37]
Class-level variance	2.34				
Residual variance	30.77				
Intraclass correlation	0.071				

Note. *The control group was the reference category. Classroom was entered as a random intercept, and the Kenward-Roger correction was applied.*
Source: *Authors' calculations based on illustrative simulated study data, 2025.*

Descriptive analysis across the eight cognitive dimensions showed positive gains in both groups, but the experimental group recorded consistently larger improvements. The largest gain differences appeared in problem-solving, logical reasoning, and spatial understanding. Attention and working memory showed smaller differences. These dimension-level patterns were interpreted descriptively because the primary hypothesis concerned the total cognitive-development score and separate inferential tests would have increased the risk of type I error.

Table 3. Descriptive Mean Gains across Cognitive-Development Dimensions

Cognitive Dimension	Experimental Group	Control Group	Gain Difference
Attention	1.18	0.48	0.70
Working memory	1.05	0.40	0.65
Classification	1.54	0.63	0.91
Logical reasoning	1.70	0.60	1.10
Symbolic thinking	1.26	0.50	0.76
Problem-solving	1.79	0.64	1.15
Early numeracy	1.59	0.73	0.86
Spatial understanding	1.71	0.73	0.98
Total gain	11.82	4.71	7.11

Source: *Authors' calculations based on illustrative simulated study data, 2025.*

Discussion

The illustrative findings indicate that structured play-based learning produced stronger cognitive-development gains than the regular kindergarten program. The significant mixed-model coefficient remained after baseline ability and classroom variation were controlled. This pattern supports the conclusion that active exploration, purposeful materials, social interaction, and repeated problem-solving can provide cognitive stimulation beyond routine classroom instruction. The result is consistent with the moderate-to-large cognitive effects identified in a meta-analysis of game-based learning (Alotaibi, 2024).

The intervention combined child agency with explicit instructional objectives. Teachers prepared cognitive challenges but used questions and prompts instead of giving complete solutions. This design reflects guided play, in which adult support focuses attention without eliminating exploration. The advantage observed in the illustrative analysis is compatible with evidence that guided play can outperform direct instruction for selected mathematics, shape, and task-switching outcomes (Skene et al., 2022).

Problem-solving displayed the largest descriptive gain. Children encountered incomplete patterns, unstable structures, classification tasks, puzzles, and open-ended challenges. These situations required them to identify a problem, test an initial response, observe the result, and revise the strategy. Loose-parts play supports this sequence because the same materials can produce multiple solutions (Cankaya et al., 2023). The absence of one predetermined route may have encouraged persistence and comparison.

Logical reasoning also improved substantially. Block construction and sequencing required children to compare characteristics and identify relationships among objects. Indonesian experimental evidence has shown that educational block media can improve preschool logical thinking (Kurniawati et al., 2024). The present intervention extended that principle by combining block activities with classification, pattern completion, balance, and causal reasoning.

Spatial understanding showed another notable gain. Children rotated objects, arranged shapes, completed puzzles, and constructed models from visual examples. These tasks required coordination of position, orientation, distance, and part-to-whole relationships. A large randomized trial demonstrated that play-based spatial learning improved spatial reasoning and transferred to preschool numeracy (Resnick & Lowrie, 2023). The current descriptive pattern is also compatible with evidence that concrete and digital spatial activities strengthen assembly and shape-identification skills (Bower et al., 2025).

Early numeracy developed more strongly in the experimental condition. The activities connected number symbols with visible quantities, grouping, comparison, and movement. A Surabaya-based quasi-experiment found that a STEAM-oriented numeracy game improved the numerical abilities of children aged five to six years (Fauziyah & Rakhmawati, 2023). Concrete and playful representations may reduce dependence on memorization because numerical relationships become observable within an activity.

Attention and working memory showed smaller gains than reasoning and problem-solving. These abilities require sustained concentration, retention of information, and control of distraction. A preschool program using rule-switching, inhibition games, and block activities improved executive-function performance after repeated implementation (Gibb et al., 2021). The systematic review evidence nevertheless indicates that dosage and implementation quality strongly influence executive outcomes (Muir et al., 2023). A longer intervention might therefore produce larger gains in attention and working memory.

The control group also improved from pretest to posttest. This increase was expected because the children continued to receive regular instruction and experienced normal developmental change. Within-group improvement does not establish effectiveness, which is why the mixed-effects comparison provided the primary test. Caution remains necessary because preschool cognitive interventions can produce small or domain-specific average effects (Trujillo-Trujillo et al., 2026).

The findings have practical implications for kindergarten instruction. Teachers can integrate guided block construction, puzzles, classification, role play, numeracy games, and rule-based movement into daily learning. Each activity should contain a clear cognitive objective while preserving opportunities for children to decide, explain, and revise. Schools should also provide professional development in scaffolding and monitor implementation fidelity because excessive adult control can weaken exploration, whereas insufficient guidance can obscure the intended concept.

Several limitations restrict interpretation. The study setting was one Indonesian city, the number of classroom clusters remained modest, and the intervention lasted eight weeks without a delayed posttest. The assessment focused on structured performance tasks and did not directly measure transfer to everyday behaviour. Future research should involve more schools, use longer follow-up periods, and examine whether teacher competence, child engagement, socioeconomic background, or baseline cognitive ability moderates the effectiveness of play-based learning.

Conclusion

This study concludes that structured play-based learning can strengthen kindergarten children's cognitive development when activities combine clear objectives, appropriate challenge, teacher scaffolding, and child agency. After baseline performance and classroom-level variation were controlled, the experimental condition achieved a higher illustrative posttest score than regular instruction. The largest descriptive improvements appeared in problem-solving, logical reasoning, and spatial understanding, while positive gains also occurred in attention, working memory, classification, symbolic thinking, and early numeracy.

The study contributes to early childhood education by treating play-based learning as a multidimensional pedagogy and by accounting for the clustering of children within classrooms. Kindergarten teachers should integrate construction, puzzles, classification, symbolic play, numeracy activities, and rule-based movement into regular instruction rather than treating play only as recreation. Future studies should include larger numbers of schools, delayed posttests, and verified measures of transfer to everyday learning. Because the present numerical findings are illustrative simulations, all statistical values must be replaced with results derived from the actual study dataset before submission.

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Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

"During the preparation of this manuscript, the authors used OpenAI's ChatGPT to assist with the initial drafting, organization, language refinement, and improvement of the clarity and readability of the manuscript. Grammarly was used to improve grammatical accuracy, sentence structure, and the readability of the English text, while DeepL was used to support translation and linguistic refinement. The authors subsequently reviewed, revised, and verified all AI-assisted and machine-translated content, including the arguments, terminology, citations, references, tables, and interpretation of the findings. These tools were not used to generate or manipulate research data, perform the statistical analysis, or make final scholarly judgments. The authors take full responsibility for the accuracy, integrity, originality, and final content of the manuscript."

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