

Effectiveness of a Caregiver–Promoting Play Program on Fine Motor and Cognitive Development among Preschool Children from Skipped–Generation Families: A Cluster Randomized Controlled Trial

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Abstract: Fine motor and cognitive skills are vital for early learning; however, children from skipped-generation families may face developmental risks due to limited caregiver stimulation. This cluster-randomized controlled trial evaluated the effectiveness of the Caregiver-Promoting Play Program in Thailand, organizing play activities to enhance fine motor and cognitive development in preschool children from skipped-generation families. Two community clusters were randomly assigned to the experimental and control groups, and 50 caregiver–child pairs were recruited from selected sites. Data were collected using the Caregiver Competency Questionnaire and the Developmental Surveillance and Promotion Manual (DSPM). Statistical analyses comprised descriptive statistics and generalized estimating equations to account for correlated pre–post measurements.

The study found that at the post-intervention assessment, children in the experimental group achieved greater gains in fine motor and cognitive development than those in the control group. Caregivers in the experimental group also demonstrated significantly higher caregiving competency in organizing play activities after completing the program. These findings indicated the effectiveness of the Caregiver-Promoting Play Program in strengthening caregiver capacity and improving developmental outcomes among preschool children in skipped-generation families. The findings suggest that nurses and community health personnel can implement the program to support early childhood development in vulnerable family contexts. However, further study with longer follow-up periods is recommended to examine the sustainability of program effects.

Keywords: Caregivers, Cluster randomized controlled trial, Families, Fine motor and cognitive development, Preschool children, Promoting play, Skipped generations

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Introduction

The preschool years represent a critical developmental window for the acquisition of fine motor and cognitive skills—competencies that form the foundation for school readiness, academic performance, and adaptive functioning in daily life. Delays in these domains during early childhood constitute a significant public health concern, as early developmental difficulties are strongly associated

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with long-term educational underachievement and psychosocial maladjustment.¹ Globally, around 250 million children younger than five years in low- and middle-income countries may not achieve their full developmental potential because of poverty and related adversity.² In Thailand, the 2021 national

survey on early childhood development reported that 70.3% of children demonstrated age-appropriate development across all domains, which remains below the national target of 85%.³ This highlights the need for continued monitoring and interventions to promote optimal child development.

As Thailand's population ages and working-age adults migrate for employment, family arrangements are shifting, with many grandparents taking primary responsibility for childcare in skipped-generation households.⁴ Many assume this role without adequate preparation or resources to support children's developmental needs fully.⁵⁻⁷ Children living in these households are more vulnerable to developmental delays because opportunities for structured learning may be limited, caregiving practices often follow traditional patterns, and some grandparents who provide care experience health-related constraints.⁸ Grandparents raising grandchildren in these households are less likely to adopt authoritative parenting approaches and may organize structured family activities less frequently.^{9,10} Longitudinal evidence further shows that children in skipped-generation households may experience suspected developmental delay, suggesting that caregiving capacity within these contexts can shape children's developmental opportunities.¹¹

Despite Thailand's national developmental surveillance guidelines, routine practice largely emphasizes screening rather than structured caregiver training to promote child development.^{12,13} The Developmental Surveillance and Promotion Manual (DSPM) provides standardized tools for monitoring developmental milestones and guiding referrals when developmental delays are suspected. However, the DSPM primarily focuses on surveillance and risk identification rather than equipping caregivers with practical strategies to stimulate children's development at home.¹⁴ Consequently, caregiver understanding of developmental guidance and consistent follow-up engagement may remain limited.¹² Several program-based interventions and community health initiatives have sought to encourage caregiver participation in developmental promotion activities and to support

caregiver well-being.^{7,15,16} Nevertheless, many interventions have focused on parents or general caregivers rather than grandparents.¹⁵

There remains a critical gap in rigorously evaluated programs that focus on helping grandparents to support children's fine motor and cognitive development through play. Without such targeted strategies, developmental disparities among children in skipped-generation families may persist or widen over time. Therefore, systematic evaluation of a structured caregiver-promoting play program is essential to determine its effectiveness in improving developmental outcomes and reducing preventable inequities during early childhood.

Literature Review and Conceptual Framework

Early childhood development depends strongly on caregiver interaction and environmental stimulation. Supportive caregiving environments that provide opportunities for guided play and learning are essential for promoting children's developmental progress.^{1,2,17}

The Caregiver-Promoting Play Program is a previously developed theory-based intervention study,⁷ based on Orem's Self-Care Deficit Theory of Nursing (SCDT),¹⁸ the Theory of Cognitive Development,¹⁹ and evidence-based literature on early childhood development and caregiver involvement.^{2,15,20} These theoretical and empirical foundations emphasize the importance of caregiver engagement and developmentally appropriate activities in promoting children's development.

According to Orem, self-care refers to actions an individual carries out to maintain his/ her life and well-being.¹⁸ However, children are unable to perform some activities to meet their self-care needs; thus, it is important to enhance caregivers' capabilities to effectively meet these needs by organizing play activities to enhance fine motor and cognitive development of their grandchildren through three phases of self-care: the estimative, transitive, and productive stages.

The estimative phase focuses on identifying children's developmental needs and potential risks, such as fine motor delays, limited attention, or inadequate opportunities for guided play. The transitive phase focuses on setting goals and selecting developmentally appropriate play activities, while the productive phase entails implementing, monitoring, and adapting these activities within daily routines. Applying this framework to the interventions enables caregivers to organize and sustain developmentally appropriate play activities within daily routines.

Piaget's Theory of Cognitive Development also informed the program design. Piaget proposed that preschool-aged children learn through active interaction with their environment and by manipulating concrete objects.¹⁹ Based on this principle, the program incorporates hands-on play activities that allow children to explore materials and engage in simple problem-solving. While Orem's theory emphasizes caregivers' roles in organizing and sustaining development-promoting activities, Piaget's perspective explains how children learn through these play experiences. Together, these perspectives underscore the importance of caregiver-guided play in supporting developmental learning.

Structured play represents an appropriate strategy that promotes both physical and intellectual health. Empirical evidence highlights the benefit of structured and interactive activities in early childhood. A growing body of research indicates that structured motor and play-based activities can enhance children's fine motor coordination and early cognitive abilities.^{17,21} Structured physical activity programs may also support the development of motor competence.¹⁷ In addition, fine motor skills have been linked with early numerical competencies.²² These findings suggest that play activities requiring manipulation, tracing, pattern construction, drawing, and object classification may support coordinated fine motor and cognitive development when implemented consistently.^{23,24}

The family environment also has a significant influence on children's developmental trajectories. A substantial body of research shows that supportive

and stimulating home environments are strongly associated with improved developmental outcomes in early childhood.^{11,25,26} In skipped-generation families, the quality of caregiving and developmental stimulation within the home environment becomes especially critical. Structured support programs may help strengthen grandparents' caregiving capacity in these households.^{16,27} Evidence from randomized controlled trials indicates that such interventions may reduce grandparents' psychological distress, improve parenting practices, and decrease internalizing and externalizing difficulties among grandchildren.²⁷ Community- and home-based participation models also suggested that when caregivers are actively involved in activities that support children's development, they may become more engaged and develop greater competence in supporting children's growth and learning.^{15,26} These findings highlight caregiver capacity as a key leverage point for improving developmental outcomes among children living in skipped-generation households. Strengthening caregivers' knowledge, skills, and confidence, therefore, provides the rationale for the present caregiver-promoting play intervention.²⁸

Drawing on these theoretical and empirical perspectives, the Caregiver–Promoting Play Program trains caregivers to use stage-appropriate play activities to support children's development. By strengthening caregivers' knowledge, confidence, and skills, the program is expected to increase the quality and frequency of developmentally appropriate play interactions at home. Increased caregiver engagement may provide enriched stimulation that supports children's fine motor coordination and cognitive development. More confident caregivers are more likely to provide guided play, responsive interaction, and consistent developmental stimulation in daily routines, creating enriched opportunities for children's exploration, practice, and cognitive engagement. Accordingly, caregiver competency is conceptualized as the key mechanism linking the caregiver-promoting play program to improved developmental outcomes among preschool children in skipped-generation families.

Aim and Hypotheses

This study aimed to examine the effects of a Caregiver-Promoting Play Program on fine motor and cognitive development in preschool children from skipped-generation families by organizing play activities to promote these domains. It was hypothesized that: 1) the experimental group of preschool children would demonstrate greater improvement in age-appropriate fine motor and cognitive development from pre- to post intervention compared with the control group, and 2) the experimental group of caregivers would have a higher mean score of developmental promotion ability than before the intervention and higher than the control group.

Methods

Study Design: This study employed a cluster randomized controlled trial (cluster RCT) design, reported in accordance with the CONSORT Statement: Extension for Cluster Randomized Trials.²⁹ The trial evaluated the effectiveness of the Caregiver-Promoting Play Program of the Grandparents' Care Competency Program, a caregiver-promoting play program, previously developed and validated by Mad-a-dam and Komjakraphan,⁷ on the fine motor and cognitive development of preschool children living in skipped-generation families. Clusters, rather than individual caregivers or children, served as the unit of randomization to minimize contamination among participants within the same community.

Sample and Setting: The project was implemented in a single province in southern Thailand. Districts were first selected as the sampling frame. Sub-districts within these districts served as the unit of randomization and were randomly assigned to either the experimental or control group, ensuring comparable representation of the target population in both groups. The intervention was conducted over a defined timeframe, following a specific process to maintain the internal validity while remaining feasible in community settings.

The target population of the study consisted of grandparents, both biological and non-biological, from

skipped-generation type families in the province, who were the primary caregivers of preschool-aged children. The grandparents who were enrolled as caregivers had to have primary caregiving and parental duties (e.g., feeding, taking to school, supervising) and no indication of dementia, as determined by the Mini-Mental State Examination (MMSE), for people aged 60 or older. They also had to be able to communicate in Thai and be willing to fully commit to the duration of the program. The preschool children chosen to participate in this study had to be between 3 and 6 years old. Children who were diagnosed with an intellectual disability or a profound developmental delay, as well as children with specific medical conditions that inhibited their participation in play-based activities, were not included in the study. The sample size was determined using the power analysis table from Polit and Beck,³⁰ based on effect sizes previously reported in studies on family capacity-building programs and integrated activity interventions. The sample size calculation did not account for the intracluster correlation coefficient (ICC) or associated design effect, which may have reduced the effective sample size; this is acknowledged as a methodological limitation.

A cluster randomized controlled trial design was employed. From the 16 districts in the study province, six were selected using simple random sampling to define the sampling frame. Within each selected district, all sub-districts were listed, and one sub-district was randomly selected using a random number generator, yielding six clusters for randomization. These clusters were then assigned to either the experimental group (three clusters) or the control group (three clusters).

After allocation, a list of preschool service sites within each selected sub-district was obtained from local administrative offices. In each sub-district, where more than one eligible site was available, two sites were purposively selected—one school and one child development center—to represent different preschool settings. Site selection followed predefined criteria, including the provision of services for preschool-aged children, accessibility, and willingness to participate, and sites were chosen from official lists provided by

local authorities. This resulted in 6 sites in each group. Eligible caregiver–child pairs were then recruited from these sites until the target sample size was reached,

yielding 25 pairs per group. The flow of clusters, sites, and participants through each stage of the trial is presented in **Figure 1**.

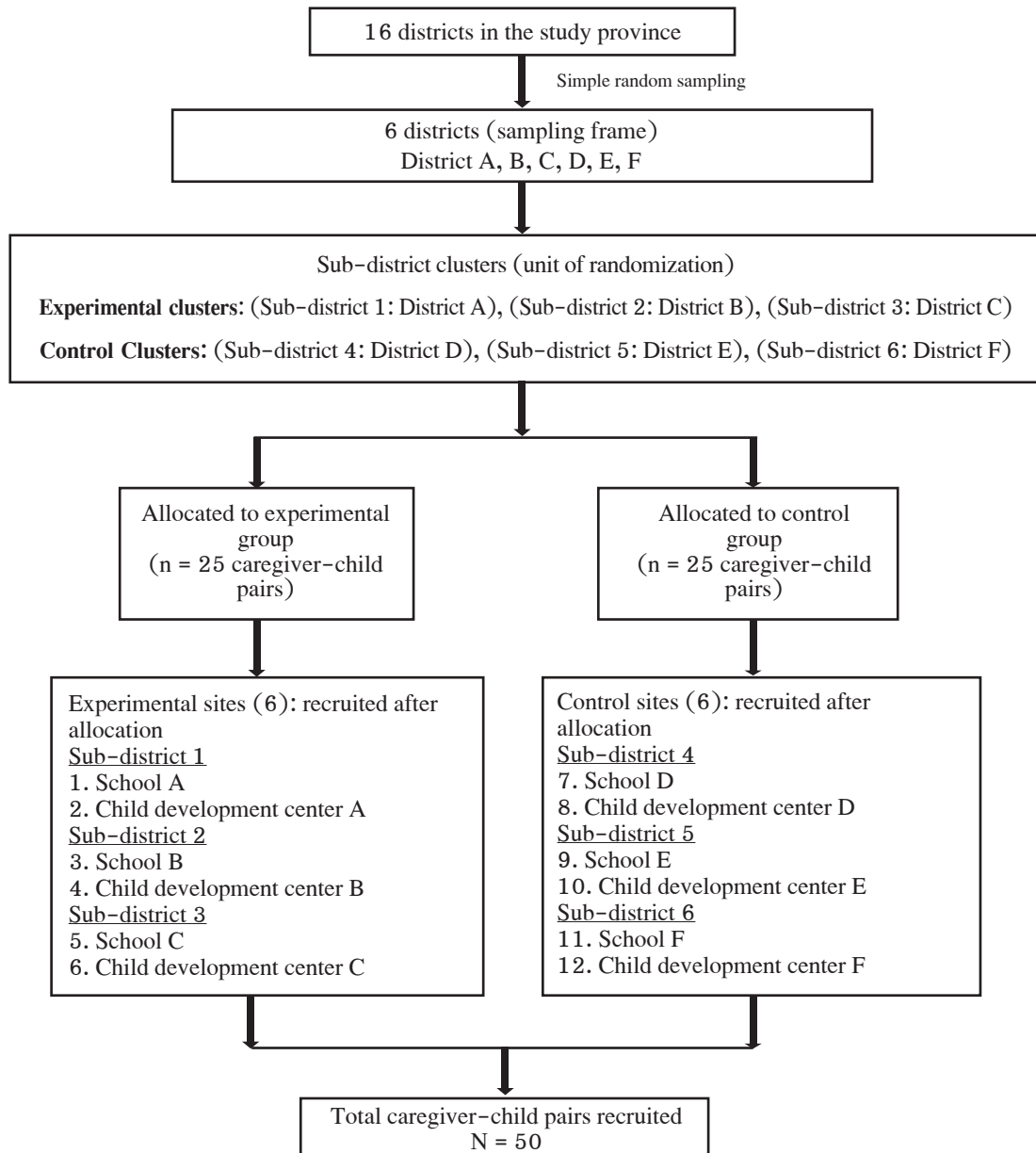


Figure 1. Flowchart of the multi-stage cluster randomized controlled trial

Ethical Considerations: This study received approval from the Human Research Ethics Committee, Social and Behavioral Sciences Division, Prince of Songkla University (Approval Code: PSU IRB 2022-St-Nur-038 [Internal], valid from December 13, 2022, to December 13, 2027). Following approval, permission was obtained from the schools and leaders of local administrative organizations to conduct the research. The rights of all participants were protected by providing detailed information about the study, including its purpose, procedures, rights, and potential risks and benefits of participation. Written informed consent was obtained from all caregivers on behalf of the participating children. Given the children's preschool age, written consent was not required; however, their comfort and willingness to participate were continuously monitored throughout the study. They were also told that they could withdraw from the study at any time without any penalty.

Instruments: Three instruments were used for data collection: the Demographic Data Form, the Developmental Surveillance and Promotion Manual, and the Caregiver Competency Questionnaire.

The Demographic Data Form consists of two parts: 1) Caregiver demographic data, including gender, marital status, education level, underlying medical conditions, occupation, family income, perceived income sufficiency, and support received from the child's parents. 2) Child demographic data, including gender, age, school enrollment, weight, height, parents' marital status, number of caregivers, and current living arrangements.

The Developmental Surveillance and Promotion Manual (DSPM). Children's fine motor and cognitive development were assessed using the DSPM developed by Sirithongthaworn¹⁴ under the Thai Ministry of Public Health. Examples of screening tasks include sorting geometric shapes, assembling a simple picture puzzle, and drawing a circle according to a model at 42 months, and copying a square and drawing a human figure with six body parts at 60 months. In this study, age-specific items for 30, 42, and 60 months were used for children aged 3–5 years. According to DSPM guidelines,

children who passed all items were classified as having age-appropriate development, while failure on one or more items indicated suspected developmental delay. The DSPM has demonstrated acceptable validity (accuracy 75%, sensitivity 96.04%, specificity 64.67%), with inter-rater reliability greater than 0.80 and test-retest reliability around 0.95.¹⁴ Click or tap here to enter text. In the present study, test-retest reliability was assessed in a sample of 10 children over a two-week interval, yielding a correlation value of 0.95.

The Caregiver Competency Questionnaire was used to measure caregivers' competency. This questionnaire was created by the research team based on Orem's Self-Care Nursing Theory (i.e., how a caregiver makes decisions and plans for, implements, and guides a child's play activities). The questionnaire includes 25 self-administered items scored on a 4-point Likert scale (1 = never practice to 4 = always practice). Total scores range from 25–100, with higher scores indicating greater competency. An example item from the productive phase of Orem's self-care process is: "I design play activities to help my grandchild improve fine motor skills, such as drawing lines, coloring, or cutting paper." Content validity was evaluated by three experts, comprising a pediatric nurse educator, a psychiatric nurse specialist, and a gerontological nurse educator, and provided a consensus content validity index (CVI) of 0.92. The questionnaire was pilot-tested with 20 caregivers and showed high reliability (Cronbach's alpha = 0.94). In the main study, the instrument maintained high internal consistency (Cronbach's alpha = 0.94).

The caregiver-promoting play program evaluated in this study was the *Grandparents' Care Competency Program*, which was previously developed and validated, with additional background available in Mad-a-dam and Komjakraphan.⁷ The program was delivered over 7 weeks and included multiple components designed to strengthen caregivers' ability to organize play activities that support children's development. It consisted of three main elements: 1) education and skill development through instruction and demonstration, 2) guided planning and adaptation

of individualized play activities, and 3) home-based implementation with ongoing support, including follow-up telephone contacts at weeks 1, 3, and 6. The intervention is presented below, following the

Template for Intervention Description and Replication (TIDieR) checklist.³¹ A summary of the intervention components is presented in **Table 1**.

Table 1. Summary of the Caregiver–Promoting Play Program (TIDieR-informed)³¹

TIDieR item	Summary description
Intervention name	Grandparents' Care Competency Program
Rationale	To enhance caregivers' competency in organizing play activities that promote fine motor and cognitive development in preschool children from skipped-generation families
Core components	Assessment of caregiver competency; education and demonstration; individualized play-activity planning; home-based practice; follow-up and evaluation
Materials	Educational leaflets, activity plans, caregiver worksheets, DSPM materials, and developmentally appropriate play materials
Who provided	Trained nurse researchers with expertise in child development
Mode of delivery	Face-to-face, group-based sessions with home-based implementation and telephone follow-up
Setting	Schools and community child development centers; home for caregiver-led play activities
Dose and duration	Week 2: two group sessions (2 hours/session); Weeks 3–6: home play activities (30 minutes/session, 3 times/week, total 12 sessions); follow-up telephone contacts (3 times)
Tailoring	Play activities individualized according to child age and developmental level
Fidelity strategies	Standardized manuals, caregiver activity records, facilitator checklists, and follow-up monitoring
Modifications	None
Fidelity assessment	Adherence monitored via caregiver records and facilitator follow-up

Note. TIDieR = Template for intervention description and replication, DSPM = Developmental surveillance and promotion manual

Data Collection: After obtaining Institutional Review Board approval and permission from preschool administrators, eligible caregivers were invited to participate, and written informed consent was obtained. A trained research assistant (RA) collected demographic information and administered the Caregiver Competency Questionnaire at baseline and one week after completion of the 7-week intervention. The RA remained blinded to participants' group allocation throughout the data collection process. Caregivers completed the questionnaires independently; when necessary, the RA assisted by reading the questions aloud and recording responses.

Children's fine motor and cognitive development were assessed by the primary investigator (PI) using the DSPM at baseline and post-intervention. Because the PI delivered the intervention, blinding to group

allocation was not feasible; however, standardized assessment procedures were followed, including adherence to the DSPM manual, consistent scoring criteria, and, where possible, verification of scoring to minimize potential bias.

The Caregiver–Promoting Play Program was delivered by the PI to caregivers in the experimental group, along with routine developmental guidance provided through the Well–Child Clinic using the DSPM, whereas caregivers in the control group received only routine developmental guidance.

Data Analysis: Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the demographic characteristics of caregivers and children. Baseline comparisons between the experimental and control groups were conducted using chi-square or Fisher's

exact tests for categorical variables to confirm group comparability prior to the intervention. Intervention effects were analyzed using generalized estimating equations (GEE) to appropriately account for the correlated pre-post measurements within participants. For the continuous outcome of caregiver competency, GEE with a normal distribution and identity link function was applied. For the binary child developmental outcome (DSPM classification: age-appropriate vs. suspected delay), GEE logistic regression with a binomial distribution and logit link was used. In both models, participant ID was specified as the subject variable, Time (pre-post) as the within-subject factor, and an exchangeable working correlation structure with robust (sandwich) standard errors was applied. The primary focus of the analyses was to determine whether changes from baseline to one week after completion of the intervention differed significantly between the experimental and control groups, indicating an intervention effect. Effect sizes, 95% confidence intervals, and p-values are reported for all primary outcomes. Statistical analyses were performed using SPSS version 26, and statistical significance was set at $p < 0.05$.

Results

Fifty caregiver-child pairs were recruited for the study, with 25 in each group: experimental ($n = 25$)

and control ($n = 25$). Caregiver and child characteristics were matched as closely as possible across the two groups. The majority of caregivers in both groups (96%) were female, and just over half were less than 60 years old. The majority of the children attended schools operated by local government organizations. Married caregivers comprised a large proportion of both the experimental and control groups. Most caregivers had low education levels; most reported “less than high school.” Most monthly household incomes fell within the range of 5,000–10,000 Thai baht per month (approximately USD 140–285; 1 USD $\approx$ 35 THB), which caregivers commonly reported as insufficient to meet daily living expenses. Financial support received from the children’s parents was also characterized as being insufficient by most caregivers. Under these circumstances, the majority of caregivers remained employed and attempted to manage paid work and caregiving simultaneously. The majority of children in the experimental group and the majority in the control group lived only with their grandparents, meaning their daily lives revolved solely around them. Statistical analyses using Pearson’s chi-square and Fisher’s exact tests indicated no statistically significant differences in demographics between the two groups, suggesting they are comparable and appropriate for outcome analysis. Characteristics of caregivers and children are presented in **Table 2**.

Table 2. Characteristics of caregivers and children in the experimental and control groups ($N = 50$)

Characteristics	Experimental ($n = 25$) n (%)	Control ($n = 25$) n (%)	p-value
Caregivers			
Age ≥ 60 years	11 (44.0)	11 (44.0)	1.00
Female	24 (96.0)	24 (96.0)	1.00
Married	19 (76.0)	15 (60.0)	0.225
Secondary education or higher	8 (32.0)	12 (48.0)	0.248
Children			
Age group (months)			0.183
36–48	7 (28.0)	2 (8.0)	
49–60	8 (32.0)	12 (48.0)	
61–71	10 (40.0)	11 (44.0)	
Age (months), Mean (SD)	56.20 (10.15)	57.88 (8.15)	–
Male	13 (52.0)	15 (60.0)	
Normal weight-for-age	21 (84.0)	21 (84.0)	

At baseline, the mean caregiver competency scores were 2.92 (SD = 0.53) in the experimental group and 3.12 (SD = 0.49) in the control group. After the intervention, the mean scores increased to 3.49 (SD = 0.34) in the experimental group and 3.19 (SD = 0.38) in the control group. Caregiver competency scores were analyzed using GEEs to account for the repeated pre–post measurements within participants. A significant difference in baseline–post–intervention scores was observed between groups ($\beta = -0.502$,

SE = 0.128, 95% CI –0.754 to –0.251, $p < 0.001$), indicating that caregivers in the experimental group demonstrated significantly greater improvement than those in the control group. These findings confirm that participation in the caregiver–promoting program led to meaningful improvements in caregivers’ ability to support child development.

The detailed results of the cluster–adjusted GEE analysis for caregiver competency are presented in **Table 3**.

Table 3. Effects of the intervention on caregiver competency scores

Predictor	β	SE	95% CI	p-value
Intercept	2.96	0.11	2.75 to 3.17	< 0.001
Group (Experimental vs Control)	0.30	0.10	0.10 to 0.50	0.003
Time (Pre vs Post)	–0.07	0.07	–0.21 to 0.07	0.358
Group $\times$ Time	–0.50	0.13	–0.75 to –0.25	< 0.001

Note. SE = Standard error, CI = Confidence interval

Children’s developmental outcomes were assessed using DSPM screening classifications and analyzed using GEE logistic regression. At baseline, in both the experimental and control groups, 14 children (56%) were classified as having age–appropriate development and 11 (44%) as having suspected developmental delay. After the intervention, the number of children with age–appropriate development in the experimental group increased to 24 (96%), while those with suspected developmental delay decreased to 1 (4%). In contrast, no change was observed in the control group, where 14 children (56%) remained classified as having age–appropriate development and 11 (44%) as having suspected developmental delay. Within–group analysis using McNemar’s test showed a significant improvement in the experimental group

($p = 0.002$), whereas no significant change was found in the control group ($p = 1.000$).

Further analysis using GEE logistic regression demonstrated a significant group–by–time interaction between baseline and post–intervention measurements ($B = -2.94$, SE = 1.03, $p = 0.004$). This interaction corresponds to an odds ratio of 0.053 (95% CI, 0.007–0.402), indicating that children in the experimental group were significantly more likely to progress from suspected developmental delay to age–appropriate development than children receiving standard care. These findings indicate that the caregiver–promoting program produced substantial improvements in children’s fine motor and cognitive development beyond those observed with routine care. The detailed GEE results for DSPM outcomes are presented in **Table 4**.

Table 4. Effects of the intervention on children’s fine motor and cognitive development (DSPM outcomes)

Predictor	β	SE	p-value	Odds ratio	95% CI for OR
Intercept	–0.24	0.52	0.640	0.79	0.29 to 2.16
Group (Experimental vs Control)	0.00	0.63	1.000	1.00	0.29 to 3.42
Time (Pre vs Post)	–2.94	0.89	0.001	0.05	0.01 to 0.30
Group $\times$ Time	–2.94	1.03	0.004	0.053	0.007 to 0.402

Note. DSPM = Developmental surveillance and promotion manual, SE = Standard error, CI = Confidence interval

Discussion

This study's findings demonstrated that the Caregiver-Promoting Play Program enhanced caregiver competence and promoted preschool children's fine motor and cognitive development among children living in skipped-generation families. Caregiver capacity, therefore, plays an important role in linking family context with children's developmental outcomes. This finding is consistent with previous research showing that caregiver capacity is associated with child developmental outcomes.²⁸ When caregivers receive appropriate guidance and support, they may be better able to provide developmentally stimulating interactions even in resource-constrained environments.¹⁵ This challenge is particularly evident in skipped-generation families, where grandparents often take responsibilities for childcare while coping with physical limitations, financial pressure, and gaps in caregiving knowledge.^{5,6,32}

This program was developed based on Orem's Self-Care Deficit Theory, a framework that emphasizes the role of awareness, decision-making, and implementation of caregiving behaviors.¹⁸ During the estimative phase, caregivers became more aware of children's developmental milestones and opportunities for developmental stimulation in daily routines. Previous studies have suggested that caregiver awareness and understanding of child development play an important role in shaping responsive caregiving behaviors, as they enable caregivers to better interpret and respond to children's needs.²⁸

In the transitive phase, caregivers translated their increased awareness into actions by selecting play activities that matched children's developmental abilities. This approach is consistent with Piaget's theory of cognitive development, which suggests that young children construct knowledge through active interaction with their environment.¹⁹ Accordingly, play activities involving object manipulation, exploration, and simple problem solving may support early cognitive

processes such as reasoning and emerging numeracy skills.^{22,23}

During the productive phase, caregivers engaged in play activities with their grandchildren while receiving guidance from the researcher. This process may have strengthened caregiver confidence and caregiving competence, leading to more frequent developmental interactions. Previous intervention studies have shown that caregiver training programs may enhance parenting skills and support children's developmental outcomes,^{17,34} consistent with and supporting the present study. Similarly, structured play and motor-skill interventions have been associated with improvements in young children's fine motor development.^{17,23,24}

The strength of this Caregiver-Promoting Play Program was its use of low-cost, locally available materials, allowing caregivers to implement play activities using everyday household resources. Such approaches may enhance the feasibility and sustainability of developmental promotion in low-income households.^{15,35} Previous studies indicate that simple play-based interactions, particularly those involving manipulation and exploration, can support children's development without requiring specialized toys.^{36,37} Evidence also highlights the importance of caregiver sensitivity and responsiveness, which have been consistently linked to more favorable developmental outcomes in early childhood.²⁸ Together, these findings point to caregiver capacity as a key factor in shaping children's development. These findings align with the present study and suggest that improvements in caregiver competency were associated with better fine motor and cognitive development in children. This may be because caregivers spent more time interacting with children during play and were more responsive to their needs. As caregivers became more confident, they were more likely to guide play, encourage practice, and support children's learning, which in turn may have contributed to improvements in both fine motor and cognitive skills.

However, several implementation challenges were identified. Some caregivers reported limited time due to work and household responsibilities, while older caregivers experienced fatigue or physical limitations. These challenges have also been reported among grandparents raising grandchildren in skipped-generation families.^{5,35,38} In addition, safety concerns sometimes led caregivers to restrict children's play activities. Previous studies indicate that excessive safety concerns may limit opportunities for exploratory play, which support motor and cognitive development.³⁹

Overall, the findings suggest that strengthening caregivers' knowledge, confidence, and practical caregiving skills represents a feasible strategy for supporting early childhood development in skipped-generation families. Interventions that combine caregiver education with guided play activities may help create developmentally stimulating home environments even in contexts with limited resources. Future interventions may also consider alternative delivery approaches, such as digital health platforms, which have been reported to support caregiver engagement and improve follow-up in early childhood development programs.⁴⁰ In resource-limited settings, these approaches may offer a practical way to extend caregiver support beyond routine services.

Limitations of the Study

Despite the encouraging results, several limitations should be considered. The study involved a relatively small sample and was conducted across a limited number of clusters, which limits how far the findings can be generalized beyond the study setting. Cluster randomization was used to minimize contamination between intervention groups, but variation between districts and schools may have existed at baseline and could have influenced the results. Another limitation of this study is that activity implementation was reported by caregivers themselves. Such self-reported information may be influenced by social desirability bias. Home practice could not be

directly monitored; activities may have differed between households in both frequency and quality. In addition, the DSPM is a screening instrument rather than a diagnostic tool. Consequently, the outcome reflects a suspected developmental delay rather than a confirmed diagnosis. Finally, outcome assessors were aware of group allocation, which may have led to detection bias. Future studies should consider larger multi-site trials, objective measures of caregiver implementation, and longer follow-up periods to evaluate the sustainability of developmental gains.

Conclusion and Implications for Nursing Practice

Overall, the findings underscore the value of caregiver-focused interventions in promoting early childhood development in disadvantaged family contexts. By strengthening caregivers' capacity to support development within their everyday environments, such programs may help improve children's readiness for future learning and social participation. The research findings underscore the important role that community health nurses play in assessing caregivers' abilities, providing relevant educational materials tailored to their circumstances, and teaching caregivers simple play activities that promote the developmental needs of young children, using common household items. By incorporating caregiver support within established child health care programs (such as well-child clinics, preschool outreach/education programs, or direct home visits), early indicators of a young child's suspected delay will be more readily identified and addressed.

Author Contributions

Conceptualization, Method and design: W.M., P.K., K.B.
Data collection, Drafting the manuscript: W.M., P.K.

Data analysis and interpretation: W.M., P.K.
Editing the manuscript: P.K.
Revising the manuscript: P.K., K.B.
Final approval of the manuscript: W.M.,
P.K., K.B.

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ประสิทธิผลของโปรแกรมส่งเสริมการเล่นโดยผู้ดูแลต่อการพัฒนาการด้านกล้ามเนื้อ มัดเล็กและสติปัญญาของเด็กปฐมวัยในครอบครัวข้ามรุ่น : การศึกษาวิจัย เชิงทดลองแบบสุ่มเป็นกลุ่ม

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บทคัดย่อ: ทักษะด้านกล้ามเนื้อมัดเล็กและสติปัญญามีความสำคัญต่อการเรียนรู้ในช่วงวัยเริ่มต้น
ของชีวิต อย่างไรก็ตาม เด็กที่เติบโตในครอบครัวข้ามรุ่นอาจมีความเสี่ยงด้านพัฒนาการเนื่องจากมี
ข้อจำกัดในการได้รับการกระตุ้นและการส่งเสริมพัฒนาการจากผู้ดูแล การศึกษาวิจัยเชิงทดลอง
มีกลุ่มเปรียบเทียบและสุ่มเป็นกลุ่มนี้ มีวัตถุประสงค์เพื่อประเมินประสิทธิผลของโปรแกรมส่งเสริม
การเล่นโดยผู้ดูแลในประเทศไทย โดยจัดกิจกรรมการเล่นเพื่อเสริมสร้างพัฒนาการด้านกล้ามเนื้อมัดเล็ก
และสติปัญญาในเด็กปฐมวัยจากครอบครัวข้ามรุ่น ชุมชนสองแห่งได้รับการสุ่มให้เป็นกลุ่มทดลอง
และกลุ่มควบคุม โดยคัดเลือกผู้ดูแลและเด็ก จำนวน 50 คู่จากพื้นที่ที่กำหนด เก็บรวบรวมข้อมูล
ด้วยแบบสอบถามสมรรถนะผู้ดูแล และคู่มือเฝ้าระวังและส่งเสริมพัฒนาการเด็กปฐมวัย วิเคราะห์ข้อมูล
โดยใช้สถิติเชิงพรรณนาและสมการประมาณค่าทั่วไป (generalized estimating equations)

ผลการศึกษาพบว่า ภายหลังการทดลอง เด็กในกลุ่มทดลองมีพัฒนาการด้านกล้ามเนื้อมัดเล็ก
และสติปัญญาเพิ่มสูงขึ้นกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ ขณะเดียวกัน ผู้ดูแลในกลุ่มทดลอง
มีสมรรถนะในการจัดกิจกรรมการเล่นเพิ่มขึ้นอย่างมีนัยสำคัญหลังเข้าร่วมโปรแกรม ผลลัพธ์ดังกล่าว
สะท้อนให้เห็นถึงประสิทธิผลของโปรแกรมส่งเสริมการเล่นโดยผู้ดูแลในการเสริมสร้างศักยภาพ
ผู้ดูแล ควบคู่กับการพัฒนาผลลัพธ์ด้านพัฒนาการของเด็กปฐมวัยในครอบครัวข้ามรุ่น ผลการศึกษา
ชี้ให้เห็นว่าพยาบาลและผู้ปฏิบัติงานสาธารณสุขระดับชุมชนสามารถนำโปรแกรمدังกล่าวไป
ประยุกต์ใช้เพื่อสนับสนุนพัฒนาการเด็กปฐมวัยในบริบทครอบครัวที่มีความเปราะบาง อย่างไรก็ตาม
ควรมีการศึกษาติดตามผลในระยะยาวเพิ่มเติมเพื่อประเมินความยั่งยืนของผลลัพธ์ที่เกิดจาก
โปรแกรمدังกล่าวต่อไป

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คำสำคัญ: ผู้ดูแล การทดลองแบบสุ่มเป็นกลุ่ม ครอบครัว พัฒนาการด้านกล้ามเนื้อมัดเล็ก
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