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Effect of video-based fine motor stimulation education on maternal independence in supporting child development: A quasi-experimental study

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ABSTRACT

Introduction: Fine motor developmental delays among children under five remain a public health concern in Indonesia, including in Tangerang Regency. Adequate caregiver stimulation plays an important role in supporting optimal child development; however, many mothers still have limited independence in implementing appropriate stimulation activities. This study aimed to examine the association between video-based fine motor stimulation education and maternal independence in supporting early childhood development.

Methods: A quasi-experimental pretest–posttest control group study involved 42 mothers of toddlers (21 intervention; 21 control) recruited from a community health post in Tangerang Regency, Indonesia. The intervention consisted of video-based education demonstrating age-appropriate fine motor stimulation activities. Maternal independence was assessed using an observation checklist adapted from Denver II developmental indicators. Observer training and inter-rater agreement procedures were conducted to ensure measurement reliability. Data were analyzed using the Wilcoxon signed-rank test and Mann–Whitney U test.

Results: Maternal independence scores increased significantly in the intervention group ($Z = -3.845$; $p < 0.001$; $r = 0.84$, large effect). The control group showed a non-significant trend toward change ($Z = -1.633$; $p = 0.102$). Between-group comparison demonstrated a significant difference in change scores ($U = 24.000$; $p < 0.001$).

Conclusions: Video-based educational interventions were associated with improvements in maternal independence in providing fine motor stimulation and may support community-based early childhood development programs.

Keywords: early childhood development, fine motor stimulation, maternal independence, parenting education, community health programs

Introduction

Developmental delays in early childhood remain a major global health concern, particularly in low- and middle-income countries (LMICs). The World Health Organization estimates that more than 250 million children under five years of age in LMICs are at risk of not achieving their developmental potential due to poverty, malnutrition, and inadequate stimulation (Widiatmika, 2015). Similarly, global reports indicate that early childhood development outcomes remain unequal, with children from disadvantaged households experiencing higher rates of delays in fine motor, gross motor, and socio-cognitive development (UNICEF, 2023). These developmental disparities may negatively affect children's long-term educational attainment, productivity, and health.

In Indonesia, developmental delays have also been reported in children under the age of five. A descriptive study found that approximately 16% of Indonesian children under five years of age experience developmental delays, including delays in fine motor skills (Sari, 2025). Therefore, early identification and intervention are essential because fine motor abilities, such as grasping, manipulating small objects, drawing, and tool use, form the basis for daily functioning and later academic readiness (Gunardi *et al.*, 2019). Regional health monitoring data also suggest that developmental stimulation practices among caregivers remain

inconsistent in several districts of Banten Province, including Tangerang Regency, where community-based child health services (*posyandu*) report varying levels of caregiver engagement in early childhood developmental activities.These conditions highlight the need for practical and accessible strategies to strengthen caregivers' ability to provide effective developmental stimulation in community settings.

Mothers play a central role in providing developmental stimulation because they are typically the primary caregivers who interact most frequently with their children during early childhood (Provenzi *et al.*, 2020). Through daily caregiving activities, mothers provide opportunities for their children to practice motor coordination, object manipulation, and other developmental skills that are essential for fine motor development. However, several studies suggest that many mothers still have limited knowledge and practical skills in providing appropriate developmental stimulation at home. Limited access to parenting education, lack of exposure to structured stimulation techniques, and low confidence in implementing developmental activities often hinder mothers from effectively supporting their children's fine motor development (Alijanzadeh *et al.*, 2024; Jatnika *et al.*, 2024). These challenges suggest that strengthening maternal capability in providing developmental stimulation is essential for improving early childhood development outcomes.

Video-based educational interventions represent a promising approach for delivering practical parenting education. Video demonstrations allow caregivers to directly observe stimulation techniques, repeat learning materials multiple times, and apply the activities within the home environment. Previous studies have shown that digital or video-assisted parenting education can improve parental knowledge, caregiving practices, and engagement in child development activities (Linhares *et al.*, 2022; Romano, Abarca and Baehman, 2025). Despite these promising findings, evidence regarding whether video-based educational strategies specifically enhance maternal independence in implementing fine motor stimulation activities is limited (Metin and Baltacı, 2024; Tryphonopoulos *et al.*, 2025). Therefore, this study aimed to evaluate the association between video-based fine motor stimulation education and maternal independence in supporting fine motor development in children under five years of age.

Materials and Methods

Study Design

This study adopted a quantitative, quasi-experimental design with a pretest–posttest control group to evaluate the effect of video-based fine motor stimulation education on maternal independence. Two parallel groups were formed, each receiving pre- and post-test assessments: the intervention group was provided with structured educational videos demonstrating fine motor stimulation activities, whereas the control group did not receive the intervention until after the final assessment. This design provides preliminary evidence by comparing pre–post changes between groups; however, causal inference remains limited due to non-random allocation and potential confounding factors.

Study Setting and Time

The study was conducted at a selected community health post (*posyandu*) in Tangerang Regency, Indonesia. The intervention and observation periods were from June 26 to July 26, 2025. Routine *posyandu* services in the study area were conducted monthly, and the initial educational session for the intervention group was delivered during a scheduled *posyandu* meeting. The educational session and subsequent monitoring were facilitated by a research team consisting of pediatric nursing researchers and trained research assistants.

Variables

The independent variable was the provision of video-based education on fine motor stimulation tailored to the developmental stages of children aged 0–6 years. The dependent variable was maternal independence in stimulating fine motor development, which was measured as the ability to consistently and autonomously apply age-appropriate stimulation activities. Background characteristics, such as maternal age, education, employment status, number of children, and child age category, were also recorded as potential confounders.

Population, Sample Size, and Sampling

The target population consisted of all mothers with children aged 0–6 years, including newborns, infants, toddlers, and preschool-aged children, who were registered at the *posyandu*, totalling 87 individuals. This age range represents the early childhood developmental period, during which caregiver stimulation plays a crucial role in supporting optimal motor development.. This age range represents the early childhood developmental period, during which caregiver stimulation plays a crucial role in supporting optimal motor development.

From this population, a total sample of 42 mothers was selected, comprising 21 participants in the intervention group and 21 in the control group. The sample size was calculated assuming a moderate effect size (d = 0.7), alpha level of 0.05, and statistical power of 80% for two-group comparisons. The calculation indicated a minimum requirement of 19 participants per group for the study. Considering an anticipated attrition rate of approximately 10%, the final sample size was set to 21 participants per group. Participants were recruited through purposive sampling based on the predefined eligibility criteria. The inclusion criteria were mothers

who (i) had a child aged 0–6 years, (ii) resided within the study area, (iii) were able to communicate effectively and participate in the educational sessions, and (iv) had access to a smartphone to view the educational video intervention. Written informed consent was obtained from all participants prior to enrollment, in accordance with the approved ethical procedures.

The exclusion criteria included mothers who had previously received structured training on fine motor stimulation and children who were undergoing medical treatment or therapeutic interventions at health facilities that could potentially influence motor development, as reported by the parents based on available medical records. Participants who were unwilling or unable to complete the intervention and observation procedures were also excluded from the study. Participants were equally allocated to the intervention and control groups to enhance group comparability and minimize potential selection bias. Baseline maternal independence was assessed before the intervention to determine the initial comparability of the groups. Following recruitment, the participants were assigned sequentially to the intervention and control groups based on their order of registration during *posyandu* attendance, with equal numbers allocated to each group.

Baseline (pretest) assessments of maternal independence were conducted before the intervention. Baseline comparability between groups was assessed using independent statistical comparisons, which indicated no statistically significant differences in maternal independence scores between the intervention group (mean = 46.3, SD = 8.7) and the control group (mean = 45.8, SD = 9.1; $p > 0.05$), suggesting similar initial conditions before the intervention.

Although purposive sampling was used to recruit participants who met the predefined eligibility criteria, baseline (pretest) analysis demonstrated no statistically significant differences in maternal independence scores between the intervention and control groups, indicating comparable initial conditions prior to the implementation of the intervention.

Instruments

Maternal independence was assessed using an observation checklist adapted from the Denver II developmental screening tool, focusing on age-specific, fine motor stimulation indicators. The checklist consisted of 10 items for children aged 0–6 months, three items for 6–12 months, four items for 1–2 years, seven items for 2–4 years, and three items for 4–6 years. Maternal performance was observed over 30-day period, and the scores were expressed as percentages. Maternal independence was categorized as not independent (0–49%), moderately independent (50–74%), or independent (75–100%).

The observation checklist was administered at baseline and after the intervention to mothers in both the intervention and control groups. The Denver II instrument has demonstrated established international validity and reliability internationally (Frankenburg *et al.*, 1992). Reliability testing of the adapted checklist in this study demonstrated acceptable internal consistency, with Cronbach's alpha coefficients exceeding the recommended threshold for reliability (Cronbach, 1951).

To enhance the measurement accuracy, trained observers conducted direct observations during the assessment process. Inter-rater reliability was evaluated by comparing the assessments of two trained observers, and the results indicated a high level of agreement, suggesting consistency in the evaluation of maternal stimulation practices (McHugh, 2012).

Intervention

The intervention was delivered through a structured educational video package designed to demonstrate age-appropriate fine motor stimulation practices in young children. The video content was developed based on established early childhood development guidelines, including fine motor stimulation recommendations derived from the Denver Developmental Screening Test II (Denver II) and the WHO Nurturing Care Framework for Early Childhood Development (WHO 2018). These frameworks emphasize responsive caregiving and stimulation as key components in promoting optimal developmental outcomes in early childhood.

The development of the educational videos involved several stages, including the identification of relevant stimulation activities, storyboard preparation, video production, and expert validation. The initial content was developed through a review of the scientific literature and early childhood stimulation guidelines. Subsequently, the video materials were evaluated by experts in pediatric nursing and child development to assess the accuracy, clarity, and suitability of the stimulation activities. The content validity of the video materials was assessed using the Content Validity Index (CVI), which is widely used to evaluate the relevance and clarity of educational materials (Polit and Beck, 2006). Expert evaluation indicated an acceptable level of content validity, with CVI values exceeding the recommended threshold. Feedback from experts was incorporated to refine the final version of the educational videos before implementation.

The videos were structured according to children's developmental stages, with durations of approximately 5 min for children aged 0–6 months, 3 min for 6–12 months, 4 min for 1–2 years, 4 min for 2–4 years, and 4 min for 4–6 years. Each video demonstrated practical and culturally appropriate stimulation activities, including grasping objects, drawing, stacking blocks, folding paper, cutting with scissors, and assembling puzzles. These activities were selected to promote hand–eye coordination, object manipulation, and fine motor control.

Prior to the main study, the educational videos were pilot tested with 10 mothers from the same community. A

pilot test was conducted to evaluate the clarity of the instructions, usability of the video format, and participants' comprehension of the demonstrated stimulation activities. The feedback obtained during this stage was used to refine the video materials to ensure clarity and practicality before implementation.

The videos were delivered through smartphones to ensure accessibility and flexibility for the participants. This delivery approach enabled mothers to repeatedly access educational content and independently practice the demonstrated stimulation activities within their home environment.

Data Collection and Monitoring

At baseline, eligible mothers were invited to participate in routine posyandu activities. An orientation session was conducted by the research team to explain the study objectives, procedures, and participant responsibilities prior to obtaining written, informed consent. Following the orientation, a baseline (pretest) assessment of maternal independence in providing fine motor stimulation was performed for both the intervention and control groups using the same observation checklists. The baseline assessment indicated comparable maternal independence scores between the intervention group (mean = 46.3, SD = 8.7) and the control group (mean = 45.8, SD = 9.1), with no statistically significant difference observed prior to the intervention ($p > 0.05$), indicating similar initial conditions between the groups.

After completing the baseline assessment, the mothers in the intervention group attended a structured educational session facilitated directly by the researchers, conducted at the posyandu meeting area, and lasting approximately 30 minutes. During this session, the researchers explained the importance of early stimulation for fine motor development, demonstrated the use of the educational video, and provided guidance on selecting stimulation activities based on the child's developmental stage.

Following the session, participants in the intervention group received individual access to the educational videos via smartphone and were instructed to watch and practice the stimulation activities with their children at home for 30 days. To ensure intervention fidelity, the research team conducted weekly monitoring through home visits and follow-up communication via a WhatsApp group to support adherence and address any challenges encountered during the intervention period.

Because both groups were recruited from the same posyandu setting, specific measures were implemented to minimize contamination between groups. The video materials were distributed individually through private messaging links that were accessible only to participants in the intervention group. The participants were advised not to share the videos with other mothers during the study period. Nevertheless, as both groups were recruited from the same posyandu and community context, this measure may not have fully prevented contamination between the groups.

Participants in the control group continued to receive routine posyandu services without additional educational materials during the intervention period. To ensure ethical fairness, an educational video package was provided to the control group after the posttest data collection was completed.

At the end of the 30-day intervention period, both groups underwent posttest assessment using the same observation checklist to evaluate changes in maternal independence in providing fine motor stimulation.

Data Analysis

Data were processed using the SPSS version 27. Data editing, coding, entry, and cleaning were performed to ensure data quality. Descriptive statistics were used to summarize the respondent characteristics. The Shapiro–Wilk test was used to assess the normality of the data. As the maternal independence scores were not normally distributed, non-parametric analyses were performed. The Wilcoxon signed-rank test was used to assess within-group pretest-and posttest differences, whereas the Mann–Whitney U test was used to compare change scores between the intervention and control groups. Statistical significance was set at $p < 0.05$. Effect sizes were calculated using $r = Z/\sqrt{N}$ to estimate the magnitude of within-group and between-group differences, with N defined according to the specific test applied.

Ethical Considerations

Ethical approval was obtained from the Health Research Ethics Committee of the Universitas Yatsi Madani (No. 262/LPPM-UYM/VI/2025). Participation was voluntary, and all respondents provided written informed consent after receiving an explanation of the study objectives, procedures, and potential benefits. Privacy and confidentiality were maintained by de-identifying the data and storing personal information separately. To ensure fairness, the control group was given access to the educational video package after the completion of data collection. This study followed the ethical principles of the Declaration of Helsinki, emphasizing respect for human dignity, privacy, justice, and proportionality between benefits and risks.

Results

Baseline Characteristics of Mothers and Children by Study Group

A total of 42 mothers participated in this study, with 21 in the intervention group and 21 in the control group. Baseline characteristics of mothers and children, including maternal age, education level, employment status, number of children, and child age category, were

Table 1. Baseline Characteristics of Mothers and Children by Study Group

Variable	Intervention n (%)	Control n (%)	p-value
Maternal age			
20–35 years	18 (85.7)	18 (85.7)	1.000
>35 years	3 (14.3)	3 (14.3)	
Education level			
Primary school	4 (19.0)	3 (14.3)	0.742
Junior high school	3 (14.3)	3 (14.3)	
Senior high school	9 (42.9)	9 (42.9)	
Diploma/Bachelor's	5 (23.8)	6 (28.6)	
Employment status			
Employed	7 (33.3)	6 (28.6)	0.735
Unemployed	14 (66.7)	15 (71.4)	
Number of children			
One child	13 (61.9)	12 (57.1)	0.755
More than one child	8 (38.1)	9 (42.9)	
Child Age Categories			
0–6 months	3 (14.3)	4 (19.0)	0.991
6–12 months	4 (19.0)	3 (14.3)	
1–2 years	5 (23.8)	5 (23.8)	
2–4 years	6 (28.6)	6 (28.6)	
4–6 years	3 (14.3)	3 (14.3)	

Remarks: Chi-square or Fisher's exact test.

analyzed to evaluate the comparability between groups prior to the intervention.

As shown in Table 1, the intervention and control groups demonstrated comparable baseline characteristics for mothers and children. No statistically significant differences were observed in maternal age, education level, employment status, number of children, or child age category ($p > 0.05$), indicating that the groups were broadly comparable before the intervention.

Changes in Maternal Independence Categories

Maternal independence was categorized as not independent (0–49%), moderately independent (50–74%), and independent (75–100%) based on the proportion of correctly demonstrated stimulation activities.

The distribution of maternal independence categories differed between the pre-test and post-test groups. At the pre-test, all mothers in the intervention group were categorized as not independent, whereas 33.3% of mothers in the control group were already categorized as moderately independent. This finding indicates a meaningful categorical imbalance at baseline, although score-based comparisons did not reveal statistically significant differences. Therefore, the findings should be interpreted cautiously. At post-test, 57.2% of mothers in the intervention group were categorized as independent, whereas no mothers in the control group reached the independent category.

Maternal Independence Scores and Within-Group Changes

Continuous maternal independence scores were also analyzed to quantify the magnitude of change.

Continuous maternal independence scores were analyzed to assess the changes within each group. The intervention group showed a substantial increase in median maternal independence scores from 45 (IQR: 40–50) in the pre-test to 80 (IQR: 70–90) in the post-test. The Wilcoxon signed-rank test indicated that this improvement was statistically significant ($Z = -3.845$; $p < 0.001$), with a large effect size ($r = 0.84$). In contrast, the control group showed only a slight increase in median scores from 46 (IQR: 41–52) to 47 (IQR: 42–55), representing a non-significant trend toward change ($Z = -1.633$; $p = 0.102$).

Between-Group Comparison of Maternal Independence Change Scores

Change scores were calculated by subtracting the pre-test scores from the post-test scores. A higher change score indicates greater improvement in maternal independence after the intervention. The Mann–Whitney U test was used to compare the maternal independence change scores between the intervention and control groups.

The intervention group had a higher mean rank for maternal independence change scores than the control group, indicating greater improvement in maternal

Table 2. Distribution of Maternal Independence Categories in the Intervention and Control Groups (Pre-test and Post-test)

Maternal Independence	Intervention n (%)	Control n (%)	P Value
Pre-test			0.009
Not independent	21 (100.0)	14 (66.7)	
Moderately independent	0 (0.0)	7 (33.3)	
Independent	0 (0.0)	0 (0.0)	
Post-test			<0.001
Not independent	4 (19.0)	16 (76.2)	
Moderately independent	5 (23.8)	5 (23.8)	
Independent	12 (57.2)	0 (0.0)	0 (0.0)

Note: Values are presented as n (%). P-values were obtained using the Fisher–Freeman–Halton exact test because of the small cell counts. This table presents categorical distributions; score-based pre–post and between-group statistical comparisons are reported separately.

Table 3. Maternal Independence Scores and Within-Group Changes

Group	Pre-test Median (IQR)	Post-test Median (IQR)	Z Value	p-value	Effect size (f)
Intervention	45 (40–50)	80 (70–90)	-3.845	<0.001	0.84
Control	46 (41–52)	47 (42–55)	-1.633	0.102	

Remarks: Values are presented as median (IQR). Within-group comparisons were performed using the Wilcoxon signed-rank test. The effect size was calculated using r = Z/√N.

Table 4. Between-Group Comparison of Maternal Independence Change Scores

Variable	Group	Mean Rank	Sum of Ranks	U	Z	p-value	Effect size (r)
Maternal Independence Change Scores	Intervention	30.86	648.00	24.000	-5.247	<0.001	0.81
Control	Control	12.14	255.00				

Remarks: The change score was calculated as the post-test score minus the pre-test score. Higher change scores indicate greater improvement in maternal self-care independence. Between-group comparisons were analyzed using the Mann–Whitney U test. The effect size was calculated using r = Z/√N.

independence after receiving video-based fine motor stimulation education than the control group. The between-group difference in change scores was statistically significant (U = 24.000; Z = −5.247; p < 0.001), with a large effect size (r = 0.81). This finding suggests that the intervention was associated with a greater increase in maternal independence than the control condition.

Discussions

The present study indicates that a multi-component educational intervention consisting of video-based learning, weekly visits, and WhatsApp monitoring is associated with improved maternal independence in supporting children's fine motor development (Provenzi *et al.*, 2020; Hasher, 2021; Vilaseca *et al.*, 2025). Prior to the intervention, all mothers in the intervention group were categorized as dependent. After receiving the intervention, more than half of the participants achieved independence, and an additional proportion were categorized as moderately independent, whereas the control group demonstrated minimal change. These findings suggest that structured and technology-supported educational approaches may help translate theoretical knowledge into practical caregiving behaviors and increase caregivers' ability to independently perform developmental stimulation activities (Provenzi *et al.*, 2020; de Oliveira *et al.*, 2024; Romano, Abarca and Baehman, 2025). In this study, maternal independence referred to the caregiver's ability to initiate, perform, and sustain developmental stimulation practices without continuous professional supervision.

The observed improvements can be explained by several complementary mechanisms. Video demonstrations allow mothers to observe and understand correct stimulation techniques, thereby facilitating observational learning and behavioral modeling. Repeated access to video materials also enables mothers to review the stimulation steps multiple times, reducing forgetting and supporting routine home practice. In addition, weekly visits and WhatsApp monitoring may have provided reminders, accountability, and social support, which encouraged consistent engagement in stimulating activities. Together, these elements may contribute to gradual increases in caregiver competence, confidence, and autonomy in supporting their children's development.

These findings are consistent with a growing body of international research highlighting the potential benefits of digital and video-assisted interventions for strengthening parental competence and caregiving practices. Several randomized controlled trials (RCTs) have reported that digital parenting support programs can enhance parental self-efficacy and engagement in early childhood developmental activities (Boe Danbjørg *et al.*, 2015; Outhwaite, 2023). Similarly, other RCT-based studies have demonstrated that video-assisted parental education may improve caregiver participation in infant motor stimulation and promote positive developmental outcomes (Boonzaaijer *et al.*, 2019; Lima *et al.*, 2022). The PLAY trial also reported that parents who implemented structured motor skill activities delivered through digital platforms showed greater consistency in supporting child development (Staiano *et al.*, 2025). Although the present study employed a quasi-experimental design, the observed improvements in maternal independence appear consistent with the patterns reported in these RCT-based studies, suggesting that video-based educational approaches may represent a promising strategy for supporting caregiver engagement (Linhares *et al.*, 2022; Suir *et al.*, 2022).

Conversely, the absence of improvement in the control group aligns with the findings of studies in which parents did not receive structured educational support. A recent scoping review of digital parenting interventions in low- and middle-income countries reported that parents who accessed structured digital modules generally demonstrated improved parenting practices and caregiving confidence, whereas parents without access to such interventions showed limited changes (Altafim *et al.*, 2024). This pattern suggests that structured educational support may play an important role in strengthening maternal independence in providing developmental stimulation to their children.

The improvements observed in the intervention group can also be interpreted from the perspective of empowerment and self-efficacy theories. According to Bandura's social cognitive theory, observational learning, guided practice, and repeated exposure to modeled behaviors can enhance individuals' perceived competence and confidence in performing specific tasks

(Bandura 1997). This theoretical alignment is further substantiated by (Wittkowski *et al.*, 2017)whose umbrella review concluded that educational programs integrating skill development with supportive delivery mechanisms, whether digital or face-to-face, consistently enhanced parental self-efficacy across diverse contexts (Wittkowski *et al.*, 2017; Poojari *et al.*, 2023). Moreover, higher levels of family empowerment are associated with superior fine motor, gross motor, and cognitive development among children with cerebral palsy, underscoring that caregiver competence is a decisive determinant of child developmental outcomes (Wittkowski *et al.*, 2017; Poojari *et al.*, 2023; Al-Otaibi *et al.*, 2024).

Collectively, these findings highlight the dual theoretical and practical significance of video-based interventions for fine motor stimulation. From a theoretical perspective, this study reinforces the growing body of evidence that empowerment-oriented educational strategies can be effective across diverse cultural and socioeconomic contexts. From a practical standpoint, video modules offer a scalable, affordable, and contextually adaptable medium for enhancing maternal competencies, particularly in resource-limited settings. In the Indonesian context, embedding such digital learning tools into community health platforms, including *Posyandu*, or aligning them with national digital health infrastructures such as e-PPGBM, has the potential to strengthen maternal roles in fostering early childhood development and advancing stunting prevention initiatives (Damayanti, Saputri and Darwitri, 2025; Istiqomah *et al.*, 2025). Future investigations should focus on examining the long-term sustainability of these approaches, extending evaluations across broader population groups, and undertaking cost-effectiveness analyses to provide robust evidence for their integration into national public health strategies and policy frameworks.

This study had several limitations that should be considered when interpreting the findings. First, the quasi-experimental design without random allocation limits causal inference and may introduce a methodological bias. Although baseline score comparisons showed no statistically significant difference between groups, the categorical distribution of maternal independence in the pre-test was imbalanced, which may have affected group comparability. Second, both groups were recruited from the same *posyandu* and community setting; therefore, contamination through informal communication between participants could not be completely excluded. Third, the intervention was delivered as a multi-component package consisting of video-based education, weekly visits, and WhatsApp monitoring. Consequently, the observed improvement cannot be attributed solely to the video component, as monitoring and social support may also have contributed to these outcomes. Fourth, the relatively small sample size from a single community health setting may limit the generalizability of the findings. Finally, the study assessed only short-term outcomes; therefore, the sustainability of maternal independence over time remains uncertain.

Conclusion

The findings of this study suggest that video-based education on fine motor stimulation is associated with improved maternal independence in supporting early childhood development. Mothers in the intervention group demonstrated greater improvement in independence scores than those in the control group after the educational program. These findings indicate that structured video-based educational materials may support mothers in implementing fine-motor stimulation activities for their children.

For practice, video-based education may be integrated into community-based maternal and child health services as a supportive tool for strengthening caregiver skills in developmental stimulation. Health workers and *posyandu* cadres can use short, age-appropriate educational videos to guide mothers in practicing fine motor stimulation at home. Future studies should use randomized controlled trial designs, include larger samples from multiple community settings, and assess long-term outcomes to determine the sustainability of maternal independence and child developmental benefits.

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Declaration Of Generative Artificial Intelligence (AI) Use

The authors used generative artificial intelligence tools only to support language editing, grammar checking, and improvement of manuscript clarity. These tools were not used to generate research data, conduct statistical analysis, interpret the findings, or replace the authors’ scientific judgment

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Availability of data and materials

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Authors' contributions

RSS contributed to the conceptualization of the study, design of the methodology, coordination of the research process, data analysis, drafting of the initial manuscript, and final revision of the paper. FH contributed to field data collection and assisted in the validation of research instruments. She was also involved in statistical analysis, data interpretation, and preparation of visual data representations. All authors have read and approved the final version of the manuscript.

Declaration of Interest

The authors declare no conflicts of interest related to this study.

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