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Origami activities are effective in improving the fine motor skills of stunted children

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Abstract

Purpose: This study aimed to evaluate the effectiveness of origami activities on fine motor development in stunted children aged 3–5 years. **Methods:** A quasi-experimental study with a pretest–posttest control group design was conducted at the Babakan Community Health Center, Cirebon District. A total of 60 stunted children were recruited and equally assigned to intervention and control groups (n = 30 each group). The intervention group participated in three origami activity sessions, while the control group did not receive the intervention. Fine motor skills were assessed before and after the intervention using the KPSP questionnaire. Group differences were analyzed using the Mann–Whitney test. **Results:** Children in the intervention group showed significantly greater improvement in fine motor skills compared with the control group (p = 0.014). **Conclusion:** Origami activities are effective in enhancing fine motor development among stunted children and may serve as a simple, low-cost intervention in community health settings.

Keywords: children; fine motor skills; origami; stunting

INTRODUCTION

Stunting is a condition of impaired growth characterized by a child's height being significantly below the standard for their age. This condition results from chronic malnutrition that often occurs during the critical first 1,000 days of life, from conception to the age of two years. Beyond physical growth retardation, stunting also has profound impacts on brain development, including structural and functional alterations caused by delayed cerebellar neuronal differentiation and shortening of apical dendrites. In Indonesia, stunted growth remains a significant public health challenge [1,2].

The national basic health research (Riset Kesehatan Dasar; Riskesdas) in 2018 reported that 21.6% of Indonesian children are stunted. A nutrition survey, Survei Status Gizi Indonesia (SSGI), in 2022, revealed a stunting prevalence of 20.2% in West Java province. Additionally, stunting incidence in Cirebon city in 2021 was reported to be 17.0% [3,4]. Risk factors for stunting include poor parenting, inadequate health services, limited access to diverse food sources, and inadequate access to clean water and sanitation. Stunting management should involve not only the control of these risk factors to prevent new cases, but also measures to improve the growth and development of stunted preschool children. They also require improvement in both gross and fine motor skills, which are essential for overall development [5-7].

Children aged 1 to 6 years are in a critical period of development during which they are highly responsive to various forms of stimulation. At this stage, they naturally exhibit intense curiosity and eagerness to explore their environment, which makes it essential to provide adequate support for their motor development. Motor development is generally categorized into gross motor skills and fine motor skills. The optimal development of fine motor skills during early childhood is particularly critical, as it lays the

foundation for later learning, independence in daily activities, and overall functional abilities [5,6].

One common issue faced by children with stunting, besides impaired physical growth, is reduced brain function, which affects motor skills, attention, memory, and cognitive abilities. Studies have shown that stunted children experience delays in both gross and fine motor development. These developmental delays limit their ability to be independent and engage in activities, including playing, which can further impact brain, physical, communication, and social development. Therefore, early and adequate interventions are essential to prevent potential losses and support their overall growth and development [5,7-9].

Various strategies have been developed to stimulate fine motor skills in early childhood. Origami, the traditional Japanese art of paper folding, is one such activity that requires hand–eye coordination, concentration, patience, and accuracy. Several studies have demonstrated that origami can enhance fine motor skills, imagination, and spatial abilities in preschool children. Nevertheless, the evidence regarding its effectiveness specifically for stunted children is still limited, particularly in community-based health settings such as posyandu (integrated health posts). This gap highlights the need for empirical studies to investigate the potential of origami as a simple, affordable, and practical intervention for enhancing fine motor development in children with stunted growth in Indonesia [7-10].

Therefore, this study aims to assess the effectiveness of origami activities in improving fine motor skills among stunted children aged 3–5 years in the working area of Babakan Community Health Center, Cirebon. The findings are expected to contribute to the scientific evidence based on developmental stimulation for stunted children and to offer practical implications for incorporating origami-based activities into routine posyandu programs as a complementary strategy to reduce stunting.

METHODS

This is a quasi-experimental study with a pre- and posttest control group design. The research protocol was approved by the Ethics Committee of the Faculty of Medicine at Universitas Swadaya Gunung Jati (No. 86/EC/FKUGJ/VI/2023). The study population consisted of children aged 3 to 5 years who attended the Posyandu held by the Babakan Community Health Center from June to July 2023.

A total of 60 stunted children were equally assigned to intervention and control groups (n = 30 per group). Due to the limited number of eligible participants, random allocation was not feasible. To minimize potential bias, matching was conducted based on gender and age when selecting participants for the control group. Family-related information, including maternal education, occupation, and household income, was collected; however, only maternal occupation was used as a matching variable because of time and data constraints. Other potential confounders, such as maternal education, socioeconomic status, and home-based stimulation, were not included in the analysis, which may have influenced the study outcomes.

The sample size was calculated using the standard estimation formula for experimental research, ensuring that the study achieved sufficient statistical power (80%) to detect an actual effect. A standard deviation of 1.195 was applied, and an additional 10% was included to account for potential dropouts. This approach provided adequate sensitivity to minimize both type I and type II errors, thereby strengthening the validity and reliability of the findings. The inclusion criteria were stunted children confirmed through on-site height measurements, while children with congenital disabilities or illnesses at the time of data collection were excluded.

The intervention group participated in origami activities once a week for two hours, for a total of three sessions. Height was measured using a microtoise, and fine motor skills were assessed before and after the intervention using the KPSP questionnaire. The assessors who evaluated fine motor skills were not informed about the children's group assignments or stunting status. However, since stunted children generally have noticeable differences in body size, complete blinding could not be guaranteed. Written informed consent was obtained from the parents of all participating children.

To maintain the consistency of the origami intervention, a structured protocol was created for each session to guide the ordering and type of origami activities provided to participants. Initially, all facilitators had been trained to ensure uniform instruction and interaction. Instruction sessions emphasized uniform procedures, step-by-step demonstrations, and equal practice opportunities for all participants. Furthermore, the research team monitored the implementation of each session to ensure fidelity and minimize variation in intervention delivery.

Data were analyzed using statistical software. Univariate analysis was conducted to describe the characteristics of the study participants and to calculate the mean changes in fine motor skills in both the intervention and control groups. Bivariate analysis

was then performed to assess the effect of origami activities on fine motor skill development among stunted children, using the Mann–Whitney test.

RESULTS

Table 1 summarizes the demographic characteristics of participants. The intervention and control groups showed comparable distributions in child gender, age, and maternal occupation. Most children were aged 52–60 months, with a predominance of stunting in the intervention group, while all children in the control group were classified as short. Mothers in both groups were mainly housewives, with education levels ranging from elementary to senior high school. Family income was mostly within the Rp 1,510,000–2,000,000 range across both groups.

Table 1. Characteristics of respondents (n=60)

Characteristics of children	Intervention group n = 30	Control group n = 30
	n (%)	n (%)
Gender		
Female	15 (50.0)	13 (43.3)
Male	15 (50.0)	17 (56.7)
Age (months)		
36-41	5 (16.7)	6 (20.0)
42-47	8 (26.7)	7 (23.3)
48-51	3 (10.0)	3 (10.0)
52-60	14 (46.7)	14 (46.7)
Stunting category		
Short	16 (53.3)	30 (100)
Very short	14 (46.7)	0 (0)
Characteristics of maternal	**Intervention group n = 30**	**Control group n = 30**
	n (%)	**n (%)**
Education		
No formal education	1 (3.3)	0 (0)
Elementary school	13 (43.3)	3 (10.0)
Junior high school	9 (30.0)	19 (63.3)
Senior high school	7 (23.3)	6 (20.0)
Bachelor degree	0 (0)	2 (6.7)
Occupation		
Housewife	23 (76.7)	23 (76.7)
Laborer/Farmer	2 (6.7)	2 (6.7)
Kiosk owner	5 (16.6)	5 (16.6)
Family income (Rp)		
< 1,000,000	2 (6.7)	0 (0)
1,000,000 – 1,500,000	10 (33.3)	7 (2.3)
1,510,000 – 2,000,000	15 (50.0)	19 (63.3)
> 2,000,000	3 (10.0)	4 (13.4)

Table 2 shows the mean of changes in fine motor skills among children in each study group. The table indicates that children in the intervention group showed greater improvement in motor skills after the origami activities compared to the control group. This finding suggests that origami activities can enhance fine motor skills among stunted children. In addition, the cadres have been trained to implement origami activities. This approach aims to enable continued implementation of origami-based activities as part of routine posyandu, thereby supporting long-term behavioral and developmental outcomes in children.

Table 2. Mean of fine motor skills change

Group	Fine motor skills		
	Pre-test mean	Post-test mean	Difference
Intervention	1.60 (SD±0.49)	2.00 (SD±0.0)	0.400 (SD±0.49)
Non-intervention	1.87 (SD±0.30)	2.00 (SD±0.0)	0.133 (SD±0.30)

Note: p (p-value); SD (Standard Deviation)

Table 3 presents the effectiveness of origami activities in enhancing fine motor skills in children with stunted growth, as analyzed using the Mann-Whitney test. Children in the intervention group experienced a significant improvement in fine motor skills after participating in origami activities over three sessions.

Table 3. The effectiveness of origami activities in improving fine motor skills in stunted children

Fine motor skills	Group				p
	Intervention		Control		
	Pre n (%)	Post n (%)	Pre n (%)	Post n (%)	
Appropriate	18 (60)	30 (100)	26 (86.7)	30 (100)	
Not appropriate	12 (40)	-	4 (13.3)	-	0.014
Total	30 (100)	30 (100)	30 (100)	30 (100)	

Note: p (p-value)

DISCUSSION

The most important finding of this study is that origami activities significantly improved fine motor skills among stunted children aged 3–5 years compared with the control group. This demonstrates that even a simple, low-cost, and culturally adaptable intervention can have measurable benefits in stimulating developmental outcomes for children with growth restrictions. For families and communities with limited resources, this kind of intervention is particularly valuable because it is inexpensive, easy to apply, and can be integrated into children's daily routines [11-15].

Origami can enhance fine motor skills because it requires precise finger movements, grip control, and bimanual coordination, all of which strengthen the small muscles of the hands. At the same time, children must integrate visual perception with motor actions, translating two-dimensional patterns into spatial folds, which supports visual–motor integration and cognitive processing. Repeated practice during origami sessions also facilitates motor learning, while the playful and engaging nature of the activity keeps children

motivated to continue practicing for longer. Prior studies confirm that origami improves dexterity, concentration, and visual–motor integration in pre-schoolers and may serve as a low-cost developmental stimulation for children with stunting, who are at a higher risk of motor delays [5,12,16].

From a practical perspective, these findings carry important implications for community health programs. Integrating origami-based activities into posyandu or early childhood education initiatives can provide an affordable, sustainable, and engaging method to support child development alongside existing nutritional interventions. This approach not only stimulates fine motor skills but also encourages creativity, focus, and social interaction—essential components for school readiness. Policymakers and local health authorities should implement this model into standard programs of child development surveillance and intervention in countries with a high prevalence of stunting [17–18].

The present study highlights the need for future investigations to evaluate the long-term effects of origami interventions and their scalability when implemented by trained community health workers or teachers. Future studies should also integrate more comprehensive family and environmental variables, such as parental education, socioeconomic conditions, and home-based stimulation, to better capture the contextual determinants of developmental outcomes. Additionally, expanding the intervention duration and incorporating follow-up assessments will be essential to determine the sustainability of the observed benefits.

The limitations of this study should be acknowledged. Randomization was not feasible due to the limited number of eligible participants; however, matching was applied based on maternal occupation, gender, and age to minimize group differences. In addition, while assessors were not formally informed about the children's stunting status or group assignment, complete blinding could not be ensured because stunted children are often physically recognizable. Moreover, although maternal occupation was considered for matching, other potential confounders, such as maternal education, household income, and home stimulation, were not fully accounted for, which may have influenced the outcomes. These constraints should be carefully considered when interpreting the findings.

CONCLUSION

Fine motor skills are crucial for child development, and children with developmental delays often require additional support to foster improvement in this area. There are various methods to enhance fine motor skills, and origami activities are one such practical approach. In this study, the intervention group showed significant improvement in fine motor skills compared to the control group after three sessions of origami activities. These findings should be integrated into the daily activities of stunted children, including those at school and at home.

Achieving this requires collaboration among the government, parents, and healthcare workers. Further studies are necessary to minimize potential bias by matching the characteristics of subjects in both the intervention and non-intervention groups, as well as by considering a broader range of factors that contribute to stunting. Health institutions, through community-health-center cadres (posyandu), should regularly implement origami activities for children with stunted growth to help address growth and developmental delays.

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