

The Impact of Parental Knowledge on Fine Motor Skills in Early Childhood Education in Peguyangan: Cross-Sectional Study

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Abstract

Introduction: The development of fine motor skills in early childhood is significantly influenced by environmental stimulation, particularly from parents and early childhood education (PAUD). Insufficient stimulation may result in developmental delays or lasting disorders. Parents need adequate knowledge to provide age-appropriate stimulation. In addition, early childhood educators can facilitate development through structured learning activities and media.

Methods: This study used a cross-sectional observational design with purposive sampling involving 51 participants. Parental knowledge of play stimulation was assessed using a structured questionnaire completed by the parents. Children's fine motor skills were evaluated using the Denver Developmental Screening Test (DDST).

Results: Analysis using Spearman's rho demonstrated a significant relationship between parental knowledge of play stimulation and children's fine motor development ($p = 0.029$; $r = 0.306$), indicating a low to moderate positive correlation. Furthermore, early childhood education was significantly associated with fine motor skills ($p = 0.015$; $r = 0.339$), suggesting that structured educational environments play a role in supporting motor development.

Conclusion: The study found a significant relationship between parental knowledge of play stimulation and early childhood education with fine motor skill development in Peguyangan Village, Denpasar. These results highlight the importance of enhancing parental understanding of child development and the value of quality early education programs. Educated parents can provide effective play-based stimulation, while PAUD institutions can deliver structured developmental support. These findings support the integration of parental education and PAUD programs into community health center initiatives aimed at improving early childhood development.

Keywords: knowledge, parents, stimulation, early childhood education, fine motor skills, children

Introduction

A child's future is filled with promise and possibilities from the moment they are born.¹ The growth and development of children during their golden years (ages 0-6) occur rapidly. Children need age-appropriate developmental stimulation and support to reach their full potential and avoid developmental delays. Stimulation is used to hone their foundational skills to ensure children aged 0 to 6 have the best opportunities to grow and develop healthily.² Insufficient stimulation can lead to developmental deviations or persistent disorders.³ Play is an excellent way to provide the necessary stimulation regularly.⁴ From an early age, all children require consistent and regular stimulation. Parents, as the closest individuals to the child, are responsible for providing an environment that stimulates the child's development. Therefore, parents need to understand what their children need at specific ages regarding development.⁵

One interrelated aspect of a child's maturation process is their motor skills. This development can be categorized into two types: gross motor skills and fine motor skills.⁶ Coordination and synchronization between the eyes and hands are necessary for children to develop fine motor skills, which include skilled use of fingers and hands.⁷ Factors affecting child development include age, gender, race, chromosomes, diet, and genetics. Economic and social contexts and stimulation are examples of extrinsic variables that influence children's development and growth.⁸ According to the World Health Organization, between five and ten percent of children worldwide experience developmental delays.⁹ According to UNICEF, approximately 27.5%, or around 3 million children, had issues in 2019, particularly with motor development.¹⁰ Delays in children's growth and development have become more common recently. Cases in the U.S. vary between 12% and 16%, while in Thailand, it is 24%, Argentina 22%, and Indonesia 13% to 18%.¹¹

A child's fine motor skills will progress with supportive stimulation. Stimulation can be provided by parents and teachers in preschool and early childhood education (PAUD).² According to data from the Central Statistics Agency, only a quarter of children were enrolled in PAUD in 2021 (26.57 percent). Based on the Health and Nutrition Family Data

from the Bali Health Office in 2022, the number of toddlers in Bali Province reached 319,690. From early childhood education data, only 67,757 children were enrolled in PAUD between 2021 and 2022.¹² This means that only 21.3% of children in Bali Province participated in PAUD.¹² PAUD plays a crucial role in child growth and development, allowing children to play and channel their energy through various physical activities, music, or crafts that support their development.¹ Children who attend PAUD receive more targeted stimulation, which can positively impact their growth and development.¹³ This explanation shows that parental stimulation and PAUD are essential for child development and excellent motor skills.

Among various environments in Denpasar, the North Denpasar III Community Health Center was chosen because its child healthcare services are the highest in the city. The North Denpasar III Community Health Center covers four areas, with the Peguyangan Village having the highest incidence of developmental disorders compared to the other three regions. Observations indicated that the two places offer comprehensive early childhood education programs, including playgroups and kindergartens. Although previous studies have examined the relationship between PAUD and child development, there is still limited research explicitly exploring the relationship between parents' knowledge of play stimulation and PAUD education with children's fine motor skills, particularly in Bali. This study aims to determine the relationship between parents' knowledge of play stimulation, PAUD education, and children's fine motor skills, hypothesizing that both factors significantly relate to children's fine motor skills in Peguyangan Village.

Methods

With approval number 0617/UN14.2.2.VII.14/LT/2024, the Research Ethics Committee of the Faculty of Medicine, Udayana University, approved the observational cross-sectional study. This design involves data collection at a single point in time, without additional evaluations or repeated observations, for efficiency in time and cost. This cross-sectional study examines the relationship between fine motor skills and parents' knowledge regarding play stimulation and early childhood education (PAUD). Initial observations were conducted in January 2024. Permission requests, socialization, and measurements of children's fine motor skills and parents' knowledge regarding play stimulation were carried out in March 2024 at Candra Kasih PAUD and Angsa PAUD, which offer comprehensive programs, including playgroups and kindergartens.

The accessible population consists of children attending PAUD in Peguyangan Village, North Denpasar, who meet the inclusion and exclusion criteria and are between three and six years old. The research population includes children in that age range attending PAUD in Peguyangan Village, North Denpasar. The reachable population comprises children aged 3-6 years attending PAUD in Peguyangan Village who meet the study's inclusion, exclusion, and dropout criteria.

This study employs purposive sampling to select subjects according to the research objectives, time availability, and resource limitations. The purposive sampling method ensures the relevance and accuracy of the data obtained by specifically selecting individuals from the target population within the research area. However, subject selection based on specific criteria may limit the representation of actual diversity within the population, thereby reducing the generalizability of the research findings to a broader population.

To ensure the relevance and accuracy of the data in line with the research objectives, the researchers established inclusion criteria: children aged 3-6 years attending PAUD in Peguyangan Village. For data generalization, the inclusion criteria for parents include those over 22 years of age with at least a high school education—additionally, parents of subjects provided consent by signing an informed consent form. Children with health disorders such as Down syndrome and parents with literacy limitations were not included as subjects. If it is found that children or their parents would have difficulty answering questions, they will not be included in the study.

Based on the formula for correlational analytical research with a correlation coefficient from previous studies of 0.554, 24 children were needed for this study. However, the researcher added 25% to the calculated result to ensure an adequate sample size. Therefore, 30 children aged 3-6 years attending PAUD in Peguyangan Village, North Denpasar, were required. The PAUD institutions Candra Kasih and Angsa provided information regarding children who met the inclusion and exclusion criteria. Parents were then explained data measurements and asked to complete the consent form.

The measurement and classification of children's fine motor skills were conducted using the Denver Developmental Screening Test (DDST), the standard instrument for assessing child development carried out by the research team and nurses, with interpretations categorized as abnormal, suspect, and usual. A child is considered normal if there is no delay or at most one "caution," abnormal if there are two or more delays, and suspect if there are two or more "cautions" and one or more delays. Parents' knowledge regarding play stimulation was assessed using a questionnaire, and to ensure the questionnaire's accuracy, reliability testing was conducted with a Cronbach's alpha value of 0.781, according to the established procedures for interpreting good, fair, and poor results. The questionnaire was completed in a comfortable, pressure-free environment to allow parents to provide honest and reflective answers. Statistical analysis was performed on a laptop using SPSS 27.0.

One data analysis method was univariate analysis using data on the ages of the children and parents, children's gender, children's fine motor skills, parents' education, and parents' knowledge level regarding play stimulation—univariate analysis aimed to provide a basic overview of the study participants. Percentage graphs and frequency distribution tables offered a general overview of the topic. This study illustrates the relationship between parents' knowledge of play stimulation and early childhood education and children's fine motor skills. To verify that a correlation exists between the two variables, the study utilized bivariate analysis using the Spearman rho test. At a significance level of 95% ($\alpha = 0.05$), the correlation between parents' knowledge regarding play stimulation and

children's fine motor skills and the relationship between early childhood education and children's fine motor skills is assessed with $p < \alpha$.

Results

Participants in this study were preschool children in Peguyangan Village, aged three to six years. The total population of children enrolled in preschool was 64, of which 63 met the inclusion criteria. Twelve children were categorized as dropouts because they could not complete the questionnaire and tests adequately. Sampling was conducted using purposive sampling, resulting in 51 participants with no missing data. As shown in Figure 1, the research subjects were identified.

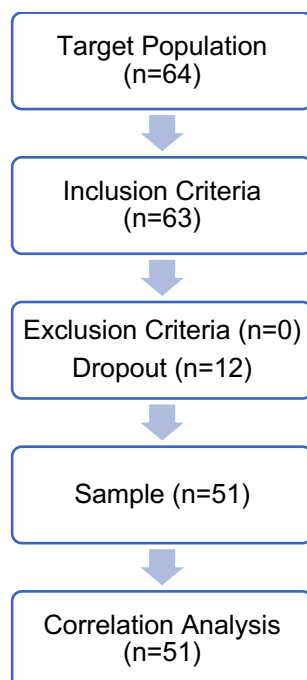


Figure 1. Diagram of Research Sampling Stages

The sample size of 51 was determined to be sufficient based on the data presented in Figure 1. Table 1 displays the demographics of the study participants.

Table 1. Frequency Distribution of Subject Characteristics

Characteristic	Frequency (n)	Percentage (%)
Age of Children		
3	7	13.7
4	26	51
5	18	35.3
Gender of Children		
Male	24	47
Female	27	53
Fine Motor Skills		
Abnormal	1	2
Suspected	7	13.7
Normal	43	84.3
Age of Parents		
22-30	8	15.7
31-40	35	68.6
41-50	8	15.7
Education Level of Parents		
High School	6	11.7
Associate's Degree (D3)	11	21.5
Bachelor's Degree (S1)	28	55
Master's Degree (S2)	5	9.8
Doctorate (S3)	1	2
Parents' Knowledge Level		
Poor	0	0
Fair	21	41.2
Good	30	58.8
Total	51	100

Based on Table 1, the age range of children according to the inclusion criteria is 3-5 years. The dominant age group among the subjects was four years, with 26 children (51%). Among the study subjects were 27 girls (53%) and 24 boys (47%). Of the total 51 subjects, the majority, 43 children (84.3%), demonstrated fine motor skills in the normal category. Regarding parental characteristics, the majority were aged 31-40, totaling 35 individuals (68.6%). Regarding parents' educational level, most were educated to a bachelor's degree (S1), accounting for 28 individuals (55%) of the total. Concerning play stimulation and children's fine motor skills, the results of the cross-tabulation and analysis tests can be seen in Tables 2 and 3.

Table 2. Cross-tabulation of Parents' Knowledge about Play Stimulation and Children's Fine Motor Skills

Parents' Knowledge about Play Stimulation	Children's Fine Motor Skills						Total		p
	Abnormal		Suspected		Normal		n	%	
	n	%	n	%	n	%			
Poor	0	0	0	0	0	0	0	0	0.029
Fair	1	2	5	9.8	15	29.4	21	41.2	
Good	0	0	2	3.9	28	54.9	30	58.8	
Total	1	2	7	13.7	43	84.3	51	100	

Based on Table 2, among parents with fair knowledge of play stimulation, one child was categorized as abnormal, five as suspected, and 15 as usual. In contrast, among parents with a good understanding of play stimulation, 28 children were categorized as usual, two as alleged, and none as abnormal. Parents with a good knowledge of play stimulation tend to have children with better fine motor development. Most children have everyday fine motor skills, and parents' knowledge about play stimulation in the good category indicates that parental expertise and provision of play stimulation are practical in supporting children's development.

Table 3. Relationship between Parents' Knowledge about Play Stimulation and Children's Fine Motor Skills

Variable Correlation	Correlation Coefficient	p
Parents' Knowledge about Play Stimulation and Children's Fine Motor Skills	0.306	0.029

Based on the results of Spearman's rho correlation test (Table 3), with a p-value of 0.029 ($p < 0.05$), there is a significant relationship between children's fine motor skills in Peguyangan Village and parents' knowledge about play stimulation. The correlation coefficient of 0.306, obtained from this analysis, falls within the low strength category (0.2 to 0.4). This positive correlation indicates that as parents' knowledge about play stimulation increases, children's fine motor skills also improve. The low correlation strength suggests that other factors, such as parenting styles and the environment, which provide support, encouragement, and engagement opportunities, may have a more significant impact. Bivariate analysis determined the relationship between early childhood education and children's fine motor skills. The results of the cross-tabulation and analysis can be seen in Tables 4 and 5.

Table 4. Cross-tabulation of Early Childhood Education and Children's Fine Motor Skills

Table 4. Cross tabulation of Early Childhood Education and Children's Fine Motor Skills									
Age of Participation in Preschool	Children's Fine Motor Skills						Total		p
	Abnormal		Suspected		Normal		n	%	
	n	%	n	%	n	%			
3 Years	1	2	1	2	5	9.8	7	13.8	0.015
4 Years	0	0	6	11.8	20	39.2	26	51	
5 Years	0	0	0	0	18	35.2	18	35.2	
Total	1	2	7	13.8	43	84.2	51	100	

According to Table 4, among children aged 3 years participating in preschool, one child was categorized as abnormal, one as suspected, and five as usual. Among children aged 4 years in preschool, there were no children in the abnormal category, 6 in the alleged category, and 20 in the normal category. For children aged 5 years in preschool, no children were categorized as abnormal or suspected, with 18 categorized as usual. This indicates that the older the child is when they participate in preschool, the better their fine motor development.

Table 5. Relationship between Early Childhood Education and Children's Fine Motor Skills

Variable Correlation	Correlation Coefficient	P Value
Early Childhood Education and Children's Fine Motor Skills	0.339	0.015

There is a significant relationship between early childhood education and fine motor skills in children in Peguyangan Village, as shown in Table 5, which presents the results of Spearman's rho correlation test. The obtained p-value is 0.015 ($p < 0.05$). Furthermore, since the correlation coefficient of 0.339 falls within the range of 0.2 to 0.4, this relationship is considered low in strength according to correlation strength interpretation. The low correlation strength indicates that other factors, such as stimulation provided at home, where children spend a significant amount of time, and physical activities, may have a more substantial influence.

Discussion

Characteristics of the Research Subjects

The research subjects, aged 3-6 years and attending early childhood education (PAUD), were predominantly 4 years old, comprising 26 children (51%). Additionally, there were 18 children (35.3%) aged 5 years, seven children (13.7%) aged 3 years, and no children aged 6 years. During early childhood, a child's brain develops rapidly, reaching approximately 80% of its growth by age six.¹⁴ In total, 51 children participated in this study, 27 (53%) female and 24 (47%) male. The assessment of fine motor skills indicated that 43 children (84.3%) of the research subjects fell into the standard category. Seven children (13.7%) were categorized as suspect, and one child (2%) was classified as abnormal. To prepare children for school, they need to develop their fine motor skills, which involve using their hands and fingers to control and master fine muscle movements accurately and quickly. Stimulation is a strategy to enhance children's basic fine motor skills to facilitate optimal development.¹⁵

The characteristics of the subjects were recorded based on the parents' education level and their knowledge of play stimulation, in addition to the age, gender, and fine motor skills of the children. According to the data, most parents were between 31 and 40 years old, comprising 35 individuals (68.6%). To be effective parents, they need to understand how children grow and develop. Personal characteristics, such as age and education level, influence an individual's level of knowledge.¹⁶ Regarding parental education, most parents had a bachelor's degree, totaling 28 individuals (55%) of the overall subjects. A person's capacity to absorb information is a function of their education level. This means that the higher an individual's education level, the easier it is to receive and understand information. Therefore, education level is an essential factor to consider.¹⁷

In this study, the majority of parents' knowledge regarding play stimulation was categorized as good, with 30 individuals (58.8%), while 21 individuals (41.2%) fell into the sufficient category, and none were classified as lacking (0%). Parents play a crucial role in monitoring their children's growth. The development of children is greatly facilitated by the interaction between parents and their children. It is, therefore, important for parents to recognize signs of fine motor skill development early on and to encourage it appropriately.¹⁸ Having adequate understanding as parents is vital, as it supports the provision of suitable stimulation for their child's development. Parents can significantly support their children's optimal growth and development with good knowledge. This includes the ability to recognize and meet developmental needs, as well as providing appropriate stimulation according to developmental stages.¹⁹

Parental Knowledge of Play Stimulation and Children's Fine Motor Skills

Statistical analysis using Spearman's rho yielded a p-value of 0.029 ($p < 0.05$) with a correlation coefficient 0.306. This result indicates a significant relationship between parental knowledge of play stimulation and children's fine motor skills in Peguyangan Village, Denpasar, with a correlation coefficient categorized as low. In other words, as parental knowledge of play stimulation improves, so do the children's fine motor skills, and vice versa. Each child has a unique developmental pace. Fine motor development is influenced by parental knowledge and other factors, such as the child's biological development, genetic factors, and individual readiness.

Additionally, parents' quality and frequency of stimulation, or early childhood education (PAUD), can vary significantly. High knowledge does not always equate to optimal practice; it is possible that, despite understanding the importance of play stimulation, parents do not consistently implement it in their daily lives. The urban location of the study influences knowledge, parenting styles, and children's development in various ways. Access to information in urban areas is broader due to educational institutions and health facilities providing support.

Child development is affected by the amount of attention received from parents. When parents and children engage in positive interactions, this significantly impacts the child's overall development.¹⁸ Therefore, good parental knowledge can be a key factor in effectively supporting child development stimulation. Parents play a crucial role as primary caregivers for their children; they are entrusted with supervising, guiding, and accompanying their children as they grow and develop into adults.¹⁹ Given their significant influence, parents must understand the stages of child development, especially concerning the maturation of fine motor skills.³

A significant relationship between maternal knowledge of child growth and development and children's fine motor skills was demonstrated in a 2020 study by Puspita and Umar, which utilized SPSS for analysis and reported $p < 0.05$. A mother's knowledge of her child's growth and development and the influencing factors should be comprehensive due to her role as the primary caregiver. Mothers must invest time in educating themselves about child development, as this can help them connect with their children in ways that support their growth and development.²⁰

These findings align with research conducted in 2020 by Faridah et al., which identified a correlation between maternal education level and their children's proficiency in fine motor skills during early childhood. Mothers with knowledge of child development are more likely to create an environment that supports their children's skills. Given their primary role in their children's lives, mothers must deeply understand how and what influences growth and development. When mothers possess adequate information, they are better equipped to foster an environment conducive to their children's skill development.⁶

Research conducted in 2020 by Endarwati and Darmayanti found that when parents have a solid understanding of stimulation, their children's fine motor skills develop generally between three and five years old. Parents should encourage children to play and explore in age-appropriate ways to reach their full potential. As a reinforcing factor, stimulation also benefits children's growth and development. Children can experience more rapid progress in their development when exposed to various forms of stimulation, including visual, verbal, auditory, and tactile. Given their central role as primary caregivers—supervising, directing, and accompanying children—parental knowledge of child development and contributing factors to healthy growth is crucial.¹⁹

Regarding their dexterity in using pencils, most children in this study scored within the normal range. Evidence suggests that this is influenced by parental knowledge, with most parents categorized as having good knowledge. Consistent with findings from several previous studies, parental involvement is critical for each child's maturation. Children can grow and develop their potential energy through play.

Early Childhood Education and Children's Fine Motor Skills

The statistical analysis results using Spearman's rho showed a p-value of 0.015 ($p < 0.05$) with a correlation coefficient of 0.339. This finding indicates a significant relationship with a low correlation level between early childhood education (PAUD) and children's fine motor skills in Peguyangan Village, Denpasar. This means that the more a child participates in PAUD, the better their fine motor development. Children between the ages of three and six develop fine motor skills that allow them to perform various activities, such as precisely imitating shapes, drawing based on ideas, using different media to create unique works, and correctly holding and using writing instruments. Education in PAUD provides stimulation that supports this development through structured play and learning activities appropriate for the child's developmental stage. Children become more aware of their environment by around six years of age, particularly in writing.²¹ However, the low correlation indicates that the quality and frequency of stimulation PAUD provides can vary significantly. Not all PAUD institutions have facilities or programs that adequately support children's fine motor development, which means the effectiveness of PAUD education can also vary.

Chi-square test results indicate that a child's age is the factor most significantly associated with motor skills, with a p-value less than 0.05, according to research by Suryaputri et al. in 2014. As the body matures and muscle functions develop, children's motor skills progress with age. In addition to chronological age, environmental stimulation is crucial for appropriate growth and development. More stimulation, including from parents, classmates, and classes, enters children's sensory environments between the ages of three and five. Furthermore, some children begin attending school, either at home or through programs known as Early Childhood Education (PAUD), which helps them refine their motor skills.²²

In 2016, Septiani et al. found that children whose parents participated in PAUD had significantly higher developmental levels than those whose parents did not, with a p-value less than 0.05. This study confirms that PAUD is an effective tool for stimulating preschool children. In this environment, children are free to pursue their interests. At the same time, educators facilitate their personal growth according to these interests while fostering basic social skills such as empathy and independence through play. Other factors, such as the child's age, level of independence, quality of PAUD teachers, and parenting styles used, also affect developmental success in PAUD institutions.²³

Consistent with previous research, this study found that children's self-care abilities, emotional maturity, cognitive capacity, communication skills, and social competence are all aspects that influence their readiness to engage in early childhood education, according to a study by Sha et al. in 2019. Children's ability to care for themselves and be independent depends on their age. Early signs of non-academic readiness, such as willingness to learn and compliance with classroom rules, are observable in children as young as three. Children also become more open to trying new things and developing their sense of autonomy as they mature. As they grow, children become more capable of concentrating and working independently, making it easier to accept new ideas. Since PAUD encourages children to be independent, it provides ample opportunities for growth and development.²⁴

By age three, children's fine motor skills have developed significantly; for example, they can imitate the correct way to hold a pencil while keeping their fingers away from the tip. Around age four, children begin to experiment with holding and using colored pencils or crayons for drawing.²⁵ Early learning should be age-appropriate, meaning it must engage children's interests, involve achievable skills, and offer challenging and age-suitable activities. Providing fine motor stimulation through PAUD also contributes to developing children's skills and independence as they grow older.²⁶

This study has several limitations that should be considered. The researcher could not closely monitor how parents completed the questionnaire due to inconsistencies in the research location and timing. Furthermore, there may have been instances where some respondents required additional time to complete the questionnaire. This study could only examine one aspect of child development due to financial constraints. Several subject factors could not be controlled, representing the research's limitations. The quality of teaching in PAUD, including teaching methods, educator qualifications, and the availability of facilities and play tools that support fine motor stimulation, can significantly influence the results. If the quality of teaching in PAUD varies, then the development of children's fine motor skills will also vary. It is essential to consider other factors, such as parenting styles, affecting children's knowledge and fine motor skills across different demographics. To better understand how parental knowledge of play stimulation affects children's fine motor skills, further research could account for parental and environmental factors and utilize more robust and representative designs, such as experimental and control designs.

Despite its limitations, this study contributes to understanding how parental knowledge about play stimulation affects children's fine motor skills. The findings have important clinical implications for understanding how parents can optimally support their children's fine motor development by being informed about effective practices at home. The results can be applied in PAUD education or parental training through programs designed by the community health center in Peguyangan Village to enhance parental involvement, such as training on stimulation through play. The findings may also be applicable more broadly.

Conclusion

This study highlights the significant relationship between parental knowledge of play stimulation and children's fine motor skills among Peguyangan Village and Denpasar preschoolers. The findings indicate that better parental understanding of effective play strategies correlates with improved fine motor development in children. However,

variations in the quality of early childhood education (PAUD), parental involvement, and other environmental factors also play crucial roles in shaping children's motor skills. The results underscore the importance of educating parents about play stimulation, as this knowledge can enhance their ability to support their children's development. Despite the study's limitations, it offers valuable insights for PAUD programs and parental training initiatives to foster children's fine motor skills through informed and engaged parenting practices. Future research should explore additional factors influencing children's development and consider employing more comprehensive study designs to deepen our understanding of this relationship

Author Contribution

Ida Ayu Agung Tri Ananda Sundaram: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.

Ni Luh Putu Gita Karunia Saraswati: Supervision, guidance on research design, and critical review of the manuscript.

Agung Wiwiek Indrayani: Supervision, validation, and manuscript editing.

Agung Gede Eka Septiawan Utama: Supervision, methodological consultation, and final manuscript review.

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Conflict of Interest Statement

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

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Ethics Statement

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Udayana (Approval No. 0617/UN14.2.2.VII.14/LT/2024). All participants provided informed consent prior to data collection.

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