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THE INFLUENCE OF BRAIN GYM (CECILIA KOESTER) ON THE DEVELOPMENT OF FINE MOTORYC IN CHILDREN AGED 4-6 YEARS

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Abstract

Background: The World Health Organization (WHO) reports that 5% to 25% of preschool-aged children worldwide experience minor brain dysfunctions, including fine motor skill disorders. Partial and total motor development disorders are reported in approximately 0.4 million (16%) children in Indonesia. This is supported by a study conducted by 31 children aged 4-6 years at the Talitakum Kudus School and Therapy experienced acceptable motor delays. The impact of delays in fine motor skills can affect a child's development, especially activities and skills that use their hands and fingers, which will be related to daily activities. Proper stimulation can be given to children who experience delays in their fine motor skills by providing brain gym exercises. **Objective**: To determine the effect of a brain gym on fine motor development in children aged 4-6 years. **Method**: This research uses a quasi-experimental research design and a pre- and post-test one-group design research design. The respondents in this study were 31 children using a purposive sampling technique. Brain gym exercises were carried out for four weeks, three times a week, for 30 minutes. The instrument in this study used the Denver Development Screening Test (DDST) to measure aspects of children's fine motor development before and after treatment. **Results**: The Wilcoxon results before and after treatment obtained a p-value of 0.000; this means the p-value < 0.05, which means Ha is acceptable; therefore, the results of the hypothesis test state that there is an effect of giving brain gym before and after treatment. **Conclusion**: The brain gym (Cecilia Koester) influences the fine motor development of children aged 4-6 years

Keywords: ***Brain Gym, Fine Motor, DDST***

INTRODUCTION

The development of children aged 4-6 years is an effective period in human life to develop five aspects: cognition, language, physical motor skills, ethical-religious values, and social-emotional development. Developmental aspects in early childhood are an important foundation for their intelligence, personality, and future abilities; therefore, children's growth and development should be optimally stimulated (Samosir, 2018).

Motor development is a skill that involves smooth muscles or specific body parts influenced by opportunities in the learning and practicing process (Pangaribuan et al., 2022). As fine motor skills develop, children learn to maintain their body's homeostasis by understanding stimuli through touch (Khadijah, 2016). Fine motor skills are necessary for playing, eating, dressing, and especially for writing. These skills involve complex engagement of the brain, nerves, and muscles as part of the motor stimulation process (Dehghan et al., 2017).

The World Health Organization (WHO) reports that 5% to 25% of preschool-aged children worldwide experience small brain dysfunction, one of which is disorders in fine motor skills. Partial and total motor development disorders are reported in about 0.4 million (16%) children in Indonesia. A report from the Indonesian Ministry of Health regarding toddler growth and development shows that 45.7% of children in Indonesia experience growth and development disorders (Mustofa, 2019). Based on health profile data in Central Java in 2021, there were 2,697,000 preschool children screened for development through SDIDTK, and it was found that 8.83% of children experienced delays such as fine motor, gross motor, and emotional delays (Dinkes Central Java, 2021).

Several factors influence delays in children's fine motor skills, including nutrition, genetics or heredity, comorbid conditions during childbirth, premature birth, and lack of environmental stimuli. Children aged 4 to 6 years may experience various delays, including delays in fine motor skills. Children experiencing delays in fine motor skills show an inability to perform tasks in the same way as their peers. The consequences of delays in fine motor skills in children include the inability to develop age-appropriate skills, such as finger play or grasping (Anandhita, 2017).

Children experiencing delays in fine motor skills can be stimulated using brain gym. Brain gym, also known as brain gymnastics, is a series of simple and enjoyable movements that help optimize brain function, including hand-eye coordination, auditory processing, visual processing, and overall body coordination. Brain gym activates all dimensions of the brain that may be closed or underdeveloped, allowing the active dimensions of the brain to be used for all activities (Koester, 2016).

According to Cecilia Koester, brain gym involves movement patterns to stimulate the brain by activating all brain dimensions through core activation towards homologous, homolateral, contralateral, shoulder relaxation, 8 lying down for pelvic movement, eye activation, and lengthening activity on the foot. The goal of these patterns is to educate proprioception, enhance understanding, eye-hand coordination, and spatial context understanding crucial for fine motor development (Koester, 2016).

Brain gym movements stimulate balance through the vestibular labyrinth, which functions to activate and focus the brain, helping improve fine motor skills. Brain gym assists children in enhancing learning concentration, improving motor skills, and strengthening children's memory (Widanti, 2021).

METHODS

This study is quantitative research using a quasi-experimental research design in the form of pre and post-test one group design. The instrument used in this study is the Denver Development Screening Test (DDST) to measure the fine motor development aspect of children, conducted before and after the treatment. The population in this study consisted of 47 children aged 4-6 years old. The sampling technique used was purposive sampling, resulting in 31 samples that met the inclusion criteria. The study was conducted at School and Therapy Talitakum Kudus from February 1 to February 29, 2024.

The data analysis in this study utilized the Statistical Program for Social Science (SPSS). The data analyzed includes:

1. Univariate Analysis: This involves describing the characteristics of each variable being studied. For numerical data, measures such as the mean, median, standard deviation, interquartile range, and minimum and maximum values are used. For categorical data, frequency distribution with percentages is employed to measure proportions. In this study, the characteristics of the variables analyzed include age, gender, height, weight, and BMI.
2. Bivariate Analysis: This analysis aims to identify the influence between two variables, the dependent variable (fine motor skills) and the independent variable (brain gym). During data analysis, the relationship between these two variables can be determined. A normality test using Shapiro-Wilk was performed because the sample size was less than 50. The normality test results showed pre- and post-treatment p-values of 0.000, indicating that the data were not normally distributed. Therefore, the hypothesis was tested using the non-parametric Wilcoxon test.

RESULT AND DISCUSSION

The research was conducted at the School and Therapy Talitakum Kudus for 4 weeks from February 1st to February 29th, 2024. The total population in this study consisted of 47 children aged 4-6 years old. The research sample consisted of 31 children aged 4-6 years who met the inclusion criteria and were able to participate in the study from beginning to end. The instrument used in this research was the Denver Developmental Screening Test (DDST) to measure fine motor development in children before and after treatment. Data analysis was then conducted using SPSS.

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A. Research Results

1. Respondent Characteristics
   a. Respondent Characteristics Based on Age

Table 1. Respondent Characteristics Based on Age

Age (Years)	Research Group (Brain Gym)	
	Number	Percentage
4 Years	15	48,4%
5 Years	14	45,2%
6 Years	2	6,5%
Total	**31**	**100%**

Source: Primary data, 2024.

Based on Table 1, the age characteristics of the respondents in this study are as follows: 15 children (48.4%) are aged 4 years, 14 children (45.2%) are aged 5 years, and 2 children (6.5%) are aged 6 years.

   b. Respondent Characteristics Based on Gender

Table 2. Respondent Characteristics Based on Gender

Gender	Research Group (Brain Gym)	
	Number	Percentage
Male	24	77,4%
Female	7	22,6%
Total	**31**	**100%**

Source: Primary data, 2024.

Based on Table 2, the characteristics of the respondents in this study according to gender are as follows: there were 24 male children (77.4%), while there were 7 female children (22.6%).

   c. Characteristics of Respondents Based on Height

Tabel 3. Characteristics of Respondents Based on Height

Height (cm)	Research Group (Brain Gym)	
	Number	Percentage
85-95	10	32,3%
96-105	16	51,6%
106-115	3	9,7%
116-125	2	6,5%
Total	**31**	**100%**

Source: Primary data, 2024.

Based on Table 3, which details the characteristics of respondents by height, the data shows that there are 10 children (32.3%) with a height of 85-95 cm, 16 children (51.6%) with a height of 96-105 cm, 3 children (9.7%) with a height of 106-115 cm, and 2 children (6.5%) with a height of 116-125 cm.

   d. Characteristics of Respondents Based on Weight

Tabel 4. Characteristics of Respondents Based on Weight

Weight (kg)	Research Group (Brain Gym)	
	Number	Percentage
15-24	28	90,3%
25-34	2	6,5%
35-40	1	3,2%
Total	**31**	**100%**

Source: Primary data, 2024

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Based on Table 4, which presents the characteristics of respondents according to their weight, the data shows that 28 children (90.3%) have a weight of 15-24 kg, 2 children (6.5%) have a weight of 25-34 kg, and 1 child (3.2%) has a weight of 35-40 kg.

e. Respondent Characteristics Based on Body Mass Index

Table 5. Respondent Characteristics Based on Body Mass Index

IMT	Research Group (Brain Gym)	
	Number	Percentage
Normal	11	35,5%
Overweight	1	3,2%
Underweight	19	61,3%
Total	**31**	**100%**

Source: Primary data, 2024

Based on Table 5, the Body Mass Index (BMI) is used to measure the nutritional status of children, obtained from comparing their weight and height. In this study, respondents with normal BMI were 11 children (35.5%), overweight were 1 (3.2%), and underweight were 19 (61.3%).

2. Respondents' Research Data

Table 6. Denver Development Screening Test (DDST) Scores

Scores	***Denver Development Screening Test* (DDST)**		
	Pretest	*Post test*	Deviation
Minimum	2	2	0
Miximum	4	3	1
Mean	3,16	2,45	0,71
SD	0,688	0,506	0,461

Source: Primary data, 2024

Based on Table 6, the Denver Development Screening Test (DDST) is used to assess fine motor development in children, measured before and after treatment. This study shows that the pre-treatment DDST score has a mean of 3.16, a standard deviation of 0.688, and an average difference of 0.71. On the other hand, the post-treatment mean score is 2.45, with a standard deviation of 0.506 and a difference standard deviation of 0.461.

3. Normality Test of Data

Table 7. Normality Test of Data

	Research Group (Brain Gym)		
	Statistic	**df**	**Sig.**
Pre-test	0,798	31	0,000
Post-test	0,635	31	0,000

Source: Primary data, 2024

Table 7 shows the results of normality tests for the pre-test and post-test using the Shapiro-Wilk test. The normality test results for both the pre-test and post-test yielded a p-value of 0.000. This data is not normally distributed because the p-values for both the pre-test and post-test are less than 0.05 ($p < 0.05$), thus falling into the non-parametric statistical category. The statistical test used for hypothesis testing is the Wilcoxon test.

4. Hypothesis Testing

Table 8. Hypothesis Testing

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	Number	*Mean*		*Sig* (2-*tailed*)	Conclusion
		pre	*post*		
DDST	31	3,16	2,45	0,000	Ha accepted

Source: Primary data, 2024

Table 8 Hypothesis testing using non-parametric test to determine the influence between two variables using Wilcoxon. The Wilcoxon results before and after treatment obtained a p-value of 0.000, meaning that the p-value is < 0.05, indicating that the alternative hypothesis (Ha) is accepted. Therefore, the hypothesis test states that there is an influence before and after treatment. From this hypothesis test, it can be concluded that brain gym (Cecilia Koester) has an effect on the fine motor development of 4-6 years old children.

B. Discussion

1. Respondent Characteristics

a. Characteristics Based on Age

Based on the research conducted on respondents, a total of 31 children aged 4-6 years from School and Therapy Talitakum participated. Based on their age characteristics, the results show that children experiencing fine motor disturbances include 15 children aged 4 years (48.4%), 14 children aged 5 years (45.2%), and 2 children aged 6 years (6.5%). Age significantly influences fine motor activities because each child has different motor characteristics. According to Nurjanah's study (2017), motor disorders in preschool-aged children are estimated to be around 3-5%, and about 60% of cases are spontaneously found in children under 5 years old. Fine motor disturbances lead to obstacles in the learning process at school, causing children to be reluctant to write, have less interest in learning, and experience barriers in daily activities involving hand and finger movements.

b. Characteristics Based on Gender

The characteristics of the respondents revealed a total of 31 children, with 24 being male and 7 being female. Based on the gender data of the respondents, it is evident that there are more males than females. This is supported by Bajirani's research (2014) stating that fine motor skills in girls tend to be better than those in boys.

c. Characteristics of Respondents Based on Height

Characteristics of respondents based on height data show that the children's heights range between 85-125 cm. The respondents in this study who have a height of 85-95 cm amount to 10 children (32.3%), those with a height of 96-105 cm amount to 16 children (51.6%), those with a height of 106-115 cm amount to 3 children (9.7%), and those with a height of 116-125 cm amount to 2 children (6.5%). According to Rini (2018), physical development is closely related to children's motor development. Physical development is marked by the growth of bones, muscles, and body tissues, which contributes to increased physical growth. The growth of the legs and arms is proportionally faster than the growth of other body parts, thereby enhancing motor skills involving the hands and feet. If physical development is impaired, motor skills will be hindered (Rudianto, 2016).

d. Characteristics Based on Weight

The respondents' weight data show that children's weight ranges from 15-40 kg. There are 28 children (90.3%) weighing 15-24 kg, 2 children (6.5%) weighing 25-34 kg, and 1 child (3.2%) weighing 35-40 kg. According to Kharisma (2016), a child's weight influenced by malnutrition and obesity affects their organs and body systems. Protein deficiency in malnourished children can lead to muscle atrophy, which causes issues with motor muscle strength.

e. Characteristics Based on Body Mass Index (BMI)

In this study, the characteristics of the respondents show that 11 children (35.5%) have a normal BMI, 1 child (3.2%) is overweight, and 19 children (61.3%) are underweight. Inadequate nutrition can hinder a child's growth and development. The measurement of body mass index is

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used to assess a child's nutritional status, obtained by comparing the child's weight and height (Rini, 2018).

2. Description of Data on the Influence of Brain Gym on Fine Motor Skills

Based on the data description of the study, the assessment of fine motor skills using DDST before and after the study shows changes. The DDST score before the intervention had a mean score of 3.16, a standard deviation of 0.688, and a mean difference of 0.71. Whereas the mean score after the intervention was 2.45, with a standard deviation of 0.506 and a difference standard deviation of 0.461.

The normality test results using the Shapiro-Wilk test, since the sample size is less than 50, yielded a p-value of 0.000 for both before and after the intervention. This data is non-normally distributed as the p-value is less than 0.05 ($p < 0.05$), falling into non-parametric statistics. The statistical test used to test the hypothesis is the Wilcoxon test.

Hypothesis testing using a non-parametric test to determine the influence between two variables using Wilcoxon showed a p-value of 0.000 before and after the intervention, indicating that the p-value is < 0.05, which means the alternative hypothesis (Ha) is accepted. Therefore, the hypothesis test states that there is an effect of providing brain gym before and after the intervention. From this hypothesis test, it can be concluded that brain gym (Cecilia Koester) has an impact on the fine motor development of 4-6 years old children.

A lack of stimulation in the form of physical activity can be one of the factors that hinder the optimal development of a child's fine motor skills. Findings from research conducted by Imelda (2018) indicate that as many as 77.8% of children experiencing this lack of stimulation have fine motor skills that are not in line with their age.

This is supported by Sudiarto's research (2013), which states that fine motor development is influenced by the nervous system in the brain. Providing stimulation can help perfect the nervous system arrangement in the brain. Brain gym exercises will stimulate small muscles and improve blood circulation to the brain, ensuring smooth oxygen supply throughout the body. A sufficient and smooth supply in the body plays a central role in health, physical performance, cognitive function, and body coordination. This is crucial for enhancing fine motor skills (Sudiarto, 2013).

Based on research by Cecilia Koester (2016), the basic human movement structure is embedded in the central nervous system. This structure provides the proper support for activities involving movement. These movement patterns depend on the maturity of the central nervous system; the more mature the central nervous system, the more mature the quality of motor activities. Brain gym movements can mature the central nervous system because brain gym movement patterns can activate three dimensions of the brain: the focus dimension (frontal slice) coordinates the back and front of the body, aiming to build and maintain attention, understanding, and educate the nervous system related to movement patterns such as speaking, writing, or using symbols or signs. The concentration dimension (transversal slice) coordinates the upper and lower body, regulating self-awareness in regulation and increasing self-awareness, thus affecting academic skills. The lateral dimension (lateral slice) coordinates both sides of the body, developing communication skills, the ability to see with both eyes simultaneously, and abstract thinking, which are important for fine motor skills.

In another study by Sulis (2017), Brain Gym can enhance fine motor development. In the preschool age group (4-6 years), the nervous system and brain continue to develop continuously. The intelligence development of preschool-aged children increases from 50% to 80% by stimulating all brain dimensions using brain gym movements (Sulis, 2017). Regular brain gym activities stimulate the brain, improving eye-hand coordination and influencing fine motor development (Sulis, 2017).

CONCLUSION

From the research on the influence of brain gym (Cecilia Koester) on the fine motor development of children aged 4-6 years conducted at the School and Therapy Talitakum Kudus with 31 respondents from

February 1-29, 2024, with a frequency of 3 times a week for 30 minutes each session. The evaluation results of fine motor assessment using DDST before and after the study showed changes, hence it can be concluded that there is an influence of brain gym (Cecilia Koester) on the fine motor development of children aged 4-6 years.

AUTHOR CONTRIBUTION
The writer made a full contribution to this research.

CONFLICT OF INTEREST
This research was conducted without any commercial relationships or sponsorship involvement.

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