

Original Article

THE RELATIONSHIP BETWEEN BODY MASS INDEX AND GROSS MOTOR DEVELOPMENT IN TODDLERS AGED (2-5 years)**Mufidatun Nisak^{1*}, Dyah Pitaloka²**¹²Institut Ilmu Kesehatan Nahdlatul Ulama Tuban, Indonesia*Corresponding Author, Email: nisakfida@gmail.com**ABSTRACT**

Introduction. Toddlers with a low Body Mass Index or poor nutrition tend to experience motor delays due to a lack of energy and muscle mass needed for physical activity. On the other hand, toddlers with a high Body Mass Index or obesity often face obstacles in moving due to excessive body weight, which can reduce balance, agility and physical endurance. The aim of this research was to determine the relationship between body mass index and gross motor development in Tegalrejo Village, Merakurak. **Methods.** This research used a correlational analytical method with a cross sectional approach with a population of 206 toddlers aged 2-5 years. The sampling method used simple random sampling technique to obtain a sample of 136 toddler respondents aged 2-5 years. The instruments used were a stature meter, scales and a Denver II observation sheet using the Spearman's rho correlation test. **Results&Analysis.** The results of the research carried out after being analyzed using the Spearman's rho test with a significance level of $\alpha = < 0.05$ obtained a value of $\rho = 0.000 < 0.05$, so H1 was accepted. Based on the results of this data analysis, it can be concluded that there is a significant relationship between body mass index and gross motor development in toddlers aged (2-5 years) in Tegalrejo Village, Merakurak. **Conclusion.** There is a relationship between body mass index and gross motor development in Tegalrejo Merakurak Village. Based on this, the better the body mass index, the more normal gross motor development in toddlers.

Keywords: Body Mass Index, Nutritional Status, Gross Motor Development, Toddlers**INTRODUCTION**

Toddlerhood is the most important period in developing a child's gross motor skills. Gross motor skills enable a person to perform normal activities (Hura, 2024). Suboptimal gross motor skills can lead to decreased creativity in adapting and an inability for children to recognize their environment, making it difficult for children to be accepted in their surroundings (Saparia et al., 2022). Furthermore, the impact of gross motor disorders in children can lead to reduced interest in learning, mental retardation, impaired coordination development, children's inability to carry out activities independently, feelings of inferiority, jealousy and disappointment towards other children, and shame (Usrati et al., 2023). Gross motor skills are movement abilities which involves the strength of large muscles (trunk, arm, and leg muscles) used to perform

movement tasks (standing, sitting, walking, jumping) (Wiyono et al., 2024). Broadly speaking, motor skills in children can be divided into two types: gross and fine motor skills. The development of gross motor skills in children can be identified through locomotor, non-locomotor, and manipulative movements, each of which has fundamental differences in characteristics (Diyono, 2019).

Based on data from the World Health Organization (WHO) in 2018, it was reported that more than 200 million children under 5 years of age worldwide are not fulfilling their developmental potential. Various developmental problems such as motor, language, and behavioral delays, autism, and hyperactivity are increasing. The incidence of developmental delays in children in Thailand is 24%, the United States 12-16%, and Argentina 22%, while in Indonesia the figure is 29.9% (Dewanti, 2021). Based on an initial survey conducted by the World Health Organization

(WHO), A study conducted by researchers at the Tegalrejo Village Integrated Health Post (Posyandu) through direct observation and interviews found that 7 (70%) toddlers experienced delayed motor development, such as not being able to jump or stand independently. Furthermore, 3 (30%) toddlers experienced normal motor development, such as being able to jump and stand independently.

Motor development is strongly influenced by nutrition, health status, and appropriate movement practices for the toddler's developmental stage (Irawati, 2019). Furthermore, impaired gross motor development can also be caused by various factors, including knowledge, parenting styles, and the living environment (Usrati et al., 2023). Children who experience impaired motor development during this period can subsequently experience impaired growth and development (Vita & Latinulu, 2022). Delayed child development indicates an imbalance in the amount of nutritional intake given to the child, thus failing to meet the body's nutritional needs (Maryani, 2023). Meanwhile, excessive nutritional intake can lead to a decreased quality of life in children, one of which is obesity. Nutritional imbalances in children can be measured using body mass index (BMI) guidelines (Amalia & Adriani, 2019).

Body Mass Index (BMI) is one measure for assessing a person's ideal body weight. BMI is also commonly used to determine the risk of health problems (Aprisuandi et al., 2021). Children with a normal BMI can easily perform any movement without experiencing any limitations. Excessive BMI in children occurs due to overnutrition and results in decreased motor skills, while children with low BMIs experience malnutrition and decrease motor skills due to a lack of energy produced by the body, resulting in less than optimal movement (Asmara, 2019).

Therefore, efforts to improve motor development can be carried out through consistent BMI monitoring, providing a healthy diet, and appropriate physical activity. With early intervention, children can grow and develop healthily, actively, and in a balanced manner.

METHOD AND ANALYSIS

The research design used in this study was

quantitative, employing correlational analytics with a cross-sectional time approach. The sample population of this study was 204 toddlers aged 2-5 years in Tegalrejo Merakurak Village. The sampling technique in this study used simple random sampling. The instruments used in this study were a stature meter, scales, and the Denver II test. Analysis was conducted using the Spearman rank correlation test.

RESULTS

1) Age

Table 1. Distribution of respondents based on toddler age in Tegalrejo Merakurak Village

No	Age	Frequency	Percentage (%)
1.	2 years	27	19.9
2.	3 years	50	36.8
3.	4 years	40	29.4
4.	5 years	19	14.0
Jumlah		136	100

From the table above, it can be seen that of the 136 toddler respondents aged (2-5 years), almost half of the respondents were 3 years old, namely 50 (36.8%) respondents.

2) Gender

Table 2. Distribution of respondents based on toddler gender in Tegalrejo Merakurak Village

No.	Gender	Frequency	Percentage (%)
1	Boy	78	57.4
2	Girl	58	42.6
Jumlah		40	100

From the table above, it can be seen that of the 136 toddler respondents aged 2-5 years, the majority of respondents were boy, namely 78 (57.4%) respondents.

3) Weight

Table 3. Distribution of respondents based on toddler weight in Tegalrejo Merakurak Village

No.	Weight	Frequency	Percentage (%)
1	7-9 kg	16	11.8
2	10-20 kg	109	80.1
3	21-25 kg	11	8.1
Jumlah		136	100

From the table above, it can be seen that

of the 136 toddler respondents aged 2-5 years, almost all of them weighed 10-20 kg, namely 109 (80.1%) respondents.

4) Height

Table 4. Distribution of respondents based on toddler height in Tegalrejo Merakurak Village

No.	Height	Frequency	Percentage (%)
1	60-80 cm	21	15.4
2	85-110 cm	110	80.9
3	120-140 cm	5	3.7
Jumlah		136	100

From the table above, it can be seen that of the 136 toddler respondents aged 2-5 years, almost all of the respondents were 85-110 cm tall, namely 110 (80.9%) respondents.

5) Body Mass Index

Table 5. Distribution of respondents based on body mass index in Tegalrejo Merakurak Village

No.	Body Mass Index	Frequency	Percentage (%)
1	Malnutrition	11	8.1
2	Good nutrition	120	88.2
3	Over nutrition	5	3.7
Jumlah		136	100

From the table above, it can be seen that almost all respondents have good nutritional status, namely 120 (88.2%) respondents.

6) Gross Motor Development

Table 6. Distribution of respondents based on gross motor development in Tegalrejo Merakurak Village

No.	Gross Motor Development	Frequency	Percentage (%)
1	Suspect	7	5.1
2	Normal	126	92.6
3	Untestable	3	2.2
Jumlah		136	100

From the table above, it can be seen that almost all respondents have normal gross motor development, namely 126 (92.6%) respondents.

7) Analysis of Body Mass Index and Gross Motor Development

Table 7 shows that the majority of respondents had a good body mass index, with 119 (87.5%) respondents having normal gross motor development. Based on the Spearman Rank Correlation test using SPSS Statistics version 23 for Windows with a significance level of $\alpha = 0.05$, the value of $\alpha = 0.000$ was obtained, where $\alpha = 0.05$. The significance value of Sig. (2-tailed) was 0.000. Since the significance value of $0.000 = 0.05$, it can be concluded that there is a significant relationship between the body mass index variable and gross motor development.

Table 7. Crosstabulation of Body Mass Index and Gross Motor Development in Tegalrejo Merakurak Village

Body Mass Index	Gross Motor Development							
	Suspect		Normal		Untestable		Total	
	f	%	f	%	f	%	f	%
Mal	7	5.1	4	2.9	0	0	11	8.1
Good	0	0	119	87.5	1	0.7	120	88.2
Over	0	0	3	2.2	2	1.5	5	3.7
Total	7	5.1	126	92.6	3	2.2	136	100

DISCUSSION

Identification of Body Mass Index in Toddlers Aged 2-5 Years in Tegalrejo Merakurak Village

Based on the research results in Table 5.4, almost all (88.2%) had good nutritional status, a small proportion (8.1%) of respondents had undernutrition, and a small proportion (3.7%) had overnutrition. Adequate nutritional intake is essential to maintain good nutritional status, preventing problems related to low body mass index.

Body Mass Index (BMI) is an important indicator in assessing the nutritional status of toddlers, which directly affects growth and development. An inappropriate BMI, whether too low (underweight) or too high (overweight/obesity), can impact a child's physical health and motor skills. Toddlers with a low BMI tend to experience energy and nutrient deficits, which can hinder muscle development and motor coordination. This risks delays in motor skills such as walking, jumping, or running (WHO, 2021). Conversely, children with a high BMI often experience difficulties in physical activity because excess weight limits agility and balance (Kelsey et al., 2014).

Several studies have linked optimal nutritional status to better motor development. According to Adolph et al. (2018), children with normal nutritional

status have a better balance between muscle strength, flexibility, and energy, allowing them to be more active and develop at an age-appropriate pace. Therefore, regular BMI monitoring and providing a balanced diet are crucial for supporting optimal child growth and development. Furthermore, the role of parents and healthcare professionals in providing gross motor skills stimulation and healthy lifestyle habits should not be overlooked. Providing opportunities for children to be active, such as playing outdoors and participating in physical activities, can help maintain a balanced body mass index (BMI) (Tucker, 2008).

Field data shows that almost all 120 (88.2%) of toddlers in the study were well-nourished. Meanwhile, a small percentage of 11 (8.1%) respondents were undernourished, and a small percentage of 5 (3.7%) respondents were overnourished. This indicates that toddlers experiencing malnutrition, whether undernourished or overnourished, are at risk of experiencing health problems. Body mass index (BMI) is influenced by the nutritional status provided by parents. At this stage, it is important for parents and caregivers to provide supportive stimulation, such as providing a safe space for movement and engaging in enjoyable physical activities. Children who receive proper nutrition are better able to develop the necessary muscle strength and coordination. However, children who do not receive proper nutrition can experience health problems such as obesity and malnutrition.

In fact, the study found that almost all respondents were well-nourished. However, a small percentage of respondents were undernourished because parents, especially mothers, paid insufficient attention to nutritional intake. Therefore, an unbalanced BMI can hinder growth and gross motor development in toddlers. Therefore, parents play a significant role in ensuring proper nutrition and stimulation so that toddlers can develop optimally.

Identification of Gross Motor Development in Toddlers Aged 2-5 Years in Tegalrejo Merakurak Village

Based on the results of the Denver II test in Table 5.5, 92.6% of respondents had normal gross motor development, 5.1% had suspect gross motor development, and 2.2% had untestable gross motor development.

These results align with Rahmawati's (2018) study, "The Relationship Between Nutritional Status and Gross Motor Development," which showed a relationship between nutritional status and

gross motor skills with a p-value of 0.003. Good nutritional status means that children receive a balanced diet containing carbohydrates, protein, fat, and other nutrients according to their needs.

Gross motor development in toddlers is an important indicator of child growth and development, reflecting a child's ability to control overall body movements. This ability includes activities such as walking, running, jumping, and throwing a ball, which contribute to a child's physical and cognitive development (Gallahue & Ozmun, 2012).

In Hurlock's (1989) developmental theory, physical development, including gross motor skills, serves as the foundation for the development of other aspects. One of the main factors influencing gross motor development is adequate physical stimulation. Children who are active from an early age will more quickly develop balance, coordination, and muscle strength. In addition to stimulation, nutritional status also plays a role in gross motor development. Children with balanced nutrition tend to have sufficient energy to engage in physical activities that support motor development. Conversely, underweight children are at risk of delayed motor development due to a lack of energy for active movement. Meanwhile, overweight children tend to experience difficulty moving because their body weight limits flexibility and agility (Campos et al., 2020).

Data on gross motor development obtained from the field showed that almost all 126 (92.6%) toddlers had normal gross motor development, a small proportion (7 (5.1%)) had suspect gross motor development, and a small proportion (3 (2.2%)) had untestable gross motor development. This indicates that toddlers who experience delays in gross motor development are at risk of experiencing various negative impacts, including lack of self-confidence, limitations in socializing, and potential coordination disorders that can persist into school age.

Factors such as genetics, nutritional intake, environmental stimulation, and parental involvement in children's physical activity play a significant role in this development. Children who lack opportunities for movement and active play are more susceptible to developmental delays than children who are accustomed to physical activity from an early age. Research conducted by Carson et al. (2016) shows that children who engage in more physical activity have better motor development than children who spend more time playing with gadgets. Therefore, parents can limit gadget use and encourage their children to engage in active play outside.

Thus, gross motor development in toddlers is influenced by several factors, including physical activity, nutritional status, and parenting styles. To ensure optimal motor development, adequate

stimulation and a healthy diet are necessary balanced, as well as encouragement from the surrounding environment so that children can grow and develop healthily and have good motor skills.

Analysis of the Relationship Between Body Mass Index and Gross Motor Development in Toddlers Aged 2-5 Years in Tegalrejo Merakurak Village

Table 6 shows that the majority of respondents had a good body mass index (BMI) with normal gross motor development, almost all 126 (92.6%). Toddlers with good nutritional status tend to have optimal gross motor development because they receive sufficient nutrition to support the growth and development of muscles and the nervous system. Body mass index (BMI) influences gross motor development in children. However, parents are often unaware that being underweight or overweight can negatively impact a child's gross motor development.

The data analysis used in this study used the Spearman Rank Correlation test using SPSS Statistics version 23 for Windows software with a significance level of $\alpha = 0.05$. The obtained value of $\alpha = 0.000$, where $\alpha = 0.05$. The significance value obtained was Sig. (2-tailed) of 0.000, because a significance value of $0.000 < 0.05$ means H_1 is accepted, thus concluding that there is a relationship between Body Mass Index and Gross Motor Development in Toddlers (2-5 years old) in Tegalrejo Merakurak Village.

The results of this study align with previous research, such as Nobre's (2023) study, which stated a relationship between BMI and gross motor development. Children with a high BMI have difficulty moving and tend to be less active. Other research also indicates that children with a higher BMI or who are overweight tend to have poor motor coordination (Lima et al., 2017).

Toddlers with a low BMI or those who are malnourished often experience delays in gross motor development. This is due to insufficient nutritional intake necessary to build muscle mass and improve movement coordination. According to research by de Souza et al. (2021), underweight children have lower levels of muscle strength compared to

children with a normal BMI. As a result, children find it more difficult to engage in physical activities, such as running, jumping, or even maintaining balance while standing. Malnutrition also impacts the development of the nervous system, which plays a role in controlling movement. The WHO (2021) emphasizes that malnourished children are often more physically inactive, further slowing the development of their motor skills.

Research findings revealed that a small proportion of toddlers aged 2-5 years in Tegalrejo Merakurak Village had a low body mass index, with 16 (11.8%) children suspected of having delayed gross motor development. This is due to parents' inattention to nutritional intake. Nutritional deficiencies can lead to decreased muscle mass and insufficient energy, making children weak, less active, and more easily fatigued during physical activity. Children with malnutrition tend to experience delays in motor development, such as walking, running, or jumping. Furthermore, deficiencies in essential nutrients such as protein, iron, and vitamin D can impact muscle and bone development.

Based on research results, almost all toddlers aged 2-5 years in Tegalrejo Merakurak Village have a good body mass index (BMI) with normal gross motor development (102 children, 75%). This is due to adequate nutritional intake. Parents play a crucial role in providing nutritional intake to toddlers. Furthermore, the role of parents in providing gross motor development stimulation should not be overlooked, as providing opportunities for toddlers to be active can help maintain a balanced BMI and aid in improving gross motor development.

Therefore, BMI is closely related to gross motor development in toddlers. Both a BMI that is too low and too high can hinder a child's ability to develop motor skills. Children with malnutrition often experience motor delays due to lack of energy and muscle strength, while obese children tend to experience limitations in movement due to excess weight. By maintaining a balance of nutrition and an active lifestyle, children can achieve optimal motor development, which will positively impact their future health and well-being.

CONCLUSION

There is a significant relationship between body mass index and gross motor development of toddlers.

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