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Observation of stunting status with the motor skills of toddler children
Observación del estado de retraso en el crecimiento con las habilidades motoras de niños pequeños

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Abstract. Background: Stunting is a condition of child growth caused by chronic malnutrition that lasts for a long period of time. This condition can cause slowed physical growth and delays in the development of fine motor skills, gross motor skills, language and personal social skills in children. Good motor skills enable children to carry out daily activities and have a big impact on the child's future. This study aims to evaluate the motor skills of children diagnosed with stunting. Method: This research applies a descriptive quantitative approach with a cross-sectional research design, with a sample consisting of two groups of children (boys/girls) with a total sample of 31 children with criteria aged 3 to 5 years: the group diagnosed with male stunting (N =12) and female stunting group (N=19). Children's motor skills were measured using the TGMD-2 (Test of Gross Motor Development-2) motor skills test which has been tested for validity and reliability. The Shapiro-Wilkoxon test was used to check normal data distribution. Results: The results of the study showed that there was a significant difference between male and female children diagnosed with stunting (P<0.05). Children diagnosed with female stunting have lower motor skills with an average Gross Motor Quontient x̄87, while boys diagnosed with stunting have a Gross Motor Quontient of x̄85.9. In male stunting children, the highest performance was in the kick movement skill with a value of ±4.25, while the lowest performance was in the gallop skill with a value of ±2.00. For girls with stunting, the highest performance was in the object control skill Stricking a stationary ball with a value of ±3.53, while the lowest performance was in the gallop skill with a value of ±1.32. In terms of motor skills, normal boys performed better than girls in jumping, hopping, and sliding (P<0.05). In terms of motor skills, male stunted children performed better than female stunted children (P<0.05). Conclusion:In this study, children with the same nutritional status and different genders (boys/girls) showed certain characteristics in basic motor skills (FMS), indicating that they were influenced by nutritional status and gender. Boys and girls with stunting status tend to have lower abilities in carrying out some process characteristics of some skills than others, but may perform better in other skills. This suggests that certain population groups may require a special focus on interventions to improve their basic motor skill levels. Further research will provide greater clarity for improving interventions targeted at basic motor skills.
Keywords: Locomotor skills; Object control skills; Basic motor skills; Children; Development; Nutritional status.

Resumen. Antecedentes: El estornudo es una condición del crecimiento del niño causada por la malnutrición crónica que dura durante un largo período de tiempo. Esta condición puede causar un crecimiento físico retrasado y retrasos en el desarrollo de habilidades motrices finas, habilidades motoras brutas, lenguaje y habilidades sociales personales en los niños. Las buenas habilidades motoras permiten a los niños realizar actividades diarias y tienen un gran impacto en el futuro del niño. Este estudio tiene como objetivo evaluar las habilidades motrices de los niños diagnosticados con estancamiento. Método: Esta investigación aplica un enfoque cuantitativo descriptivo con un diseño de investigación transversal, con una muestra compuesta de dos grupos de niños (hijos/hijas) con un total de 31 niños con criterios de edad de 3 a 5 años: el grupo diagnosticado con estuntamiento masculino (N =12) y el grupo de estuntamientos femeninos (N=19). Las habilidades motrices de los niños se medieron utilizando el test de habilidades motoras TGMD-2 (Test of Gross Motor Development-2), que se ha probado para la validez y fiabilidad. Se utilizó la prueba Shapiro-Wilkoxon para comprobar la distribución normal de los datos. Resultados: Los resultados del estudio mostraron que había una diferencia significativa entre los niños varones y las mujeres diagnosticados con estuntamiento (P<0.05). Los niños diagnosticados con estornudo femenino tienen habilidades motrices más bajas con un promedio de cuantitativo motor bruto de x̄87, mientras que los niños con un diagnóstico de quintitativo tienen un cuantum motorbruto de X̄85.9. En los niños del sexo masculino, el mayor rendimiento fue en la habilidad de movimiento de golpes con un valor de ±4,25, mientras que el menor rendimiento se produjo en el galope con un valore de 2,00. Para las niñas con estancamiento, el mayor rendimiento fue en la habilidad de control de objetos golpeando una bola estacionaria con un valor de ±3.53, mientras que el rendimiento más bajo fue en el galope de habilidad con un valore de ≤1.32. En términos de habilidades motoras, los niños normales realizan mejores resultados que las niñas en saltos, saltos y deslizamientos (P<0.05). En lo que respecta a las habilidades motoras, los niños con trastornos de movimiento masculino obtuvieron mejores resultados que las mujeres (P<0.05). Conclusión:En este estudio, los niños con el mismo estado nutricional y diferentes géneros (hijos/hijas) mostraron ciertas características en las habilidades motrices básicas (FMS), lo que indica que estaban influenciados por el estado nutritivo y el género. Los niños y las niñas con estado de estancamiento tienden a tener habilidades inferiores en la realización de algunas características de procesos de algunas habilidades que otras, pero pueden desempeñar mejor en otras habilidades. Esto sugiere que ciertos grupos de población pueden requerir un enfoque especial en las intervenciones para mejorar sus niveles básicos de habilidad motora. La investigación adicional proporcionará mayor claridad para mejorar las intervenciones dirigidas a las habilidades motrices básicas.
Palabras clave: Habilidades locomotoras; Habilidades de control de objetos; Habilidades motrices básicas; Niño; Desarrollo; Estado nutricional.

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Introduction

Indonesia faces nutritional problems that have a serious impact on human resources, namely stunting. Stunting has now been designated as one of the national priority issues in the National Medium Term Development Plan (RPJMN) with a target of a stunting prevalence rate of 14% in 2024(Anastasia et al., 2024). Toddlers are children aged 0-59 months(Fufa, 2022), this period is characterized by a process of very rapid growth and development and is accompanied by changes that require nutrients in greater quantities and of higher quality.(Corrêa et al., 2023; Kofinti et al., 2022; Sah et al., 2022).

The first five years of a child's life is a crucial phase that determines the quality of human life in the future, requiring good attention and support for nutrition(Soofi et al., 2022), special stimulus (Wardoyo, Nurjazuli, & Darundiati, 2022), and intervention(Antunes Moura et al., 2022). The age period of one to three years also has an important role in determining the quality of life in the future. Lack of adequate nutritional support can cause stunting. In terms of nutritional intake, growth disorders indicate the cumulative effects of a long-term deficiency or inadequate intake of energy, macronutrients or micronutrients.(Fonseka et al., 2022; Sadler et al., 2022; Stunting Children - Search | ScienceDirect.Com, nd).

*Stunting*is a growth problem(Konyole et al., 2023; Singh, Chiero, Kriina, Alee, & Chauhan, 2022)which occurs in children due to chronic nutrition over a long period of time(Águila Soto & José López Vargas, 2019; Soofi et al., 2022).According to WHO, stunting can result in a slowdown in a child's physical growth as well as delays in development processes such as fine motor skills, gross motor skills, language and personal social skills. Fine motor development includes body movements that involve the coordination of certain body parts and are carried out by small muscles, while gross motor development is related to body movements and postures carried out by large muscles.(Corrêa et al., 2023; Fufa, 2022; Oktavia et al., 2019).

The development of gross motor skills involves the use of the large muscles in the legs, arms, and chest. These gross motor skills are very important for carrying out daily physical tasks such as running, walking, lifting, kicking, throwing, and so on. Good gross motor skills enable children to carry out daily activities, such as running, walking and playing, including skills such as climbing and various sports activities such as catching, throwing or using a racket to play badminton, and so on. Well-developed gross motor skills help improve balance, muscle strength, endurance, and coordination in children(Bangelesa et al., 2023; Tamir, Techane, Dessie, & Atalell, 2022). By improving children's motor skills, we can prolong their long-term health and encourage strong physical literacy. Assessment of motor skills can help in identifying possible early delays that may affect other aspects of development, including cognitive and affective.

The Gross Motor Development Test Second Edition (TGMD-2) is a test tool designed to evaluate and identify gross motor development in children aged 3-10 years. This test is useful for a variety of professionals, including kinesiologists, general and special educators, psychologists, and physical therapists (Ulrich, 2000). TGMD-2 consists of two subtests, namely locomotor control and object control. Locomotor control includes six skills, including running, sprinting, jumping, hopping on one leg, and sliding. Meanwhile, object control includes six skills, such as hitting a stationary ball, dribbling a stationary ball, rolling under the hand, kicking, throwing over the hand, and catching.(Ihsan, Tri Mario, & Mardesia, 2023; Yendrizal et al., 2023).

Materials & Methods

This research applies a descriptive quantitative approach with a cross-sectional research design, which collects data at one particular point in time. The focus of this research is on phenomena observed during the data collection period to explain the relationship and description between two related parameters. A Cross-Sectional approach was used to ensure the validity and reliability of data through appropriate data collection techniques(Komaini & Mardela, 2018). The motor skills assessment involved a total of 12 items divided into two main categories: locomotor movements and object control. Locomotor movements include running, galloping, jumping, horizontal jumping, and gliding. Meanwhile, object control involves hitting the ball, dribbling the ball, catching, kicking, throwing and rolling the ball. The test procedure uses the Basic Movement Skills Test-2 (TGMD-2)(Udjaja, Rumagit, Gazali, & Deni, 2021). The participants involved in this research were 31 children aged 3-5 years in the category diagnosed with stunting according to the age eligibility criteria for carrying out the TGMD-2 motor test (Ulrich, DA, 2000).

Participants' gross motor development was measured using the Gross Motor Development Test (TGMD-2) developed by (Ulrich 2000). This test consists of two main subtests: locomotor and object control subtests. The locomotor subtest includes running, gallop, hop, leap, horizontal jump, slide. Meanwhile, the object control subtest includes Stricking a stationary ball, stationary dribble, catch, kick, overhand throw, underhand roll. Each skill is evaluated twice, with a sequence of locomotor subtests followed by object control. After a short break, the test was administered once again for both subtests.

Data was collected over a period of time from September to October 2023. Information regarding the age, weight and height of each child was obtained from the Posyandu concerned and measured directly by researchers. Basic motor skills (FMS) were measured using the Gross Motor Skills Development Test (TGMD-2), which has been validated for the Indonesian population. This research has been approved by Padang State University. Each child who

was the subject of this research participated with the consent of their parents.

The researchers have undergone training and obtained test qualification permits from the Padang State University Sports Science Study Program, which is the TGMD-2 testing authority. Each testing session involved a test group consisting of 2 children, 2 testers, and 1 photographer. Subjects were directed to repeat each test twice after observing action demonstrations from the examiners. Scores are obtained from each skill measured and then added together to calculate a locomotor skills score (consisting of 6 skills with a maximum score of 46) and an object control skills score (also consisting of 6 skills with a maximum score of 46). The total TGMD-2 score is obtained by adding the locomotor skills score and the object control skills score (with the maximum possible score being 92).

TGMD-2 data were analyzed using SPSS version 23.0 for Windows software. Descriptive statistics were used to calculate levels of mastery, locomotor skills, and object control, presented as mean ± SD. Bivariate correlation analysis was used to evaluate the relationship between body mass index (BMI) and raw skill scores, using Pearson correlation coefficient (r) to determine correlation. Children were divided into two groups based on the diagnosis of stunting and normal conditions, and the effect on children's motor skills was evaluated. For variables with interaction effects, simple effects analysis was used to compare differences between groups. If there was no interaction effect, main effects analysis was performed. Statistical significance was set at a p value <0.05.

Results

The age range of respondents in this study ranged from 3 to 5 years. The age breakdown of respondents in this age group is as follows: 10% are children aged 3 years 0-5 months, 23% are children aged 3 years 6-11 months, 32% are children aged 4 years 0-5 months, 32% are children aged 4 years 6-11 months, and 3% aged 5 years 0-5 months.

Table 1.

Category	Gender	N	Age	Height(Cm)	Weight(Kg)	BMI
Stunting	man	12	4.03	92.9	12.00	13.92
	Woman	12	4.19	93.6	14.53	16.56

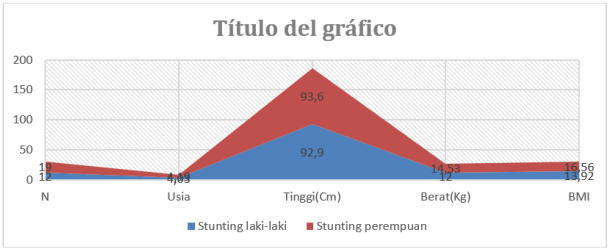

Figure 1. Characteristics of Toddler Respondents by Gender

Gender of Respondents: In the 3-5 year age group, girls are more widely distributed, namely 61%, while the remaining 39% are boys. The table provides a comparison between anthropometric data for boys and girls in the stunting group. Boys have an average height of 92.9 cm, while girls have an average height of 93.6 cm. This shows that in general, girls in the stunting group tend to have a slightly taller height than boys. The average body weight of boys is 12.00 kg, while girls have an average body weight of 14.53 kg. This shows that girls tend to have a higher body weight compared to boys in the stunting group. The average Body Mass Index (BMI) value for boys is 13.92, while girls have an average BMI value of 16.56. This showed that girls in the stunting group had higher BMI values than boys, indicating a possible higher proportion of body fat. From this comparison, it can be seen that there are significant differences between men and women in the stunting group, especially in terms of height, weight and BMI values.

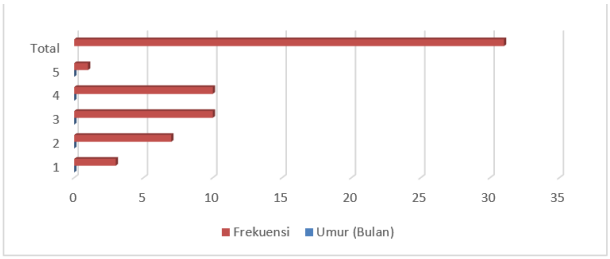

Figure 2. Characteristics of Toddler Respondents Based on Age Classification of TGMD Test 2

The age range of respondents in this study ranged from 3 to 5 years. The age breakdown of respondents in this age group is as follows: 10% are children aged 3 years 0-5 months, 23% are children aged 3 years 6-11 months, 32% are children aged 4 years 0-5 months, 32% are children aged 4 years 6-11 months, and 3% aged 5 years 0-5 months with an average age of 4.11 months.

Table 2.
Description of skills of stunted children based on gender with TGMD2

Skills	stunting		MEANS
	lk	pr	
Run	3.92	3.32	3.62
Gallop	2.00	1.32	1.66
Hops	3.08	3.37	3.23
Leap	3.58	2.53	3.05
Horizontal jump	3.33	3.37	3.35
Slides	3.17	2.63	2.90
MEANS	3.18	2.75	2.97
Stricking a stationary ball	3.92	3.53	3.72
Stationary dribble	2.25	2.37	2.31
Cath	3.25	3.11	3.18
Kick	4.25	2.68	3.47
Overhand throw	3.25	2.84	3.05
Underhand Roll	3.00	2.53	2.76
MEANS	3.3	2.8	3.1

Locomotor movement is the ability to move the body from one location to another. Based on test results using TGMD-2, boys who are stunted show variations in scores in various types of locomotor movements. The average score for all movements was 3.18, with the highest score for the leap movement (3.58) and the lowest for the gallop movement (2.00). Girls with stunting also showed variations in locomotor abilities, the average score was

2.75. The highest scores for girls were in the hop and horizontal jump movements, each with a value of 3.37, while the lowest score was in the gallop movement (1.32). Comparison between the two groups shows that boys tend to have higher scores in running, hop, leap, horizontal jump and slide movements compared to girls who experience stunting. Nevertheless, girls showed higher scores in the gallop movement. These results indicate significant variations in locomotor abilities between the two groups.

The object of control is the assessment of manipulative movements involving a medium in the form of a ball and a bat. The abilities of this control object are divided into two, namely male control objects and female control objects. There are differences in manipulative movement abilities between boys and girls who are stunted. Stunted boys tend to have higher scores in all types of control object movements compared to stunted girls. However, there is variation in the rate of improvement between each movement. For example, in the "Kick" movement, stunted boys have a much higher score compared to stunted girls. However, in some other movements such as "Stationary dribble" and "Over hand throw", the difference in scores is not that significant.

These two results state that the locomotor and object control abilities of male stunted children outperform the abilities of female stunted children with a fairly high score difference. A very obvious factor in obtaining grades is the understanding ability that is possessed. Women tend to be shy and reluctant to do something and think first to avoid mistakes, men tend to be quick and do it directly. There are also students who are not confident in their abilities, which gives them a feeling of imitating the friend next to them.

In some types of motor movements, such as running, boys tend to have higher scores than girls. However, for other movements such as the galop, girls seem to have lower scores compared to boys. However, there is no consistent pattern across all types of movement. For example, in jumping movements, girls show a higher average score than stunted boys. These findings highlight the importance of considering gender differences in the analysis of motor skills of stunted children. Other factors such as physical development and individual preferences may also influence the results.

Further analysis of specific problems found several interesting findings related to the mastery of motor skills in children experiencing stunting. It was found that the highest percentage of mastery in the four running parameters was located in the second point, namely "a short period where both feet do not touch the ground", reaching 95%. This shows that children who experience stunting tend to have good abilities in certain aspects of running movements. Meanwhile, in the slide aspect, the highest percentage of mastery was found in the movements "slide to the right continuously 4 times" and "slide to the left continuously 4 times", with each reaching 78% and 79%. This shows that children in the stunting group have quite good abilities in performing continuous slide movements. However, in the gallop skill, it was found that the percentage of bad possession on specific three points was always low. For example, only about 25% of children successfully demonstrate the skill of positioning the hand in front of the body with the elbow bent. This indicates difficulty in gaining mastery in some aspects of the gallop movement. In TH's five hitting points, the highest percentage of poor possession was found at the point "this ball sends it straight forward," where approximately 33% of children failed to complete the task completely. This suggests that children in the stunting group may have difficulty performing TH strokes correctly.

Table 3.
Kolmogorov-Smirnov Tests of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
New_standardscore	,168	25	,068	,902	25	,020

a. Lilliefors Significance Correction

The results of the Kolmogorov-Smirnov test show statistical and significance values (Sig.) for each group, while the results of the Shapiro-Wilk test provide statistics and significance which can provide a further picture of the normality of the data distribution. In general, if the significance value (Sig.) is greater than 0.05, it can be considered that the data distribution is not significantly different from the normal distribution. Conversely, a significance value smaller than 0.05 indicates evidence that the data distribution is not normal.

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From the table results, it can be concluded that the "male motor" group shows significant data distribution and normal distribution, both according to the Kolmogorov-Smirnov and Shapiro-Wilk tests. The "male stunting motor" group showed a value less than 0.05 in the Kolmogorov-Smirnov test, indicating a significant distribution of normal distribution, although the results of the Shapiro-Wilk test did not provide the same significance, the "female normal motor" group showed that data distribution was significantly from the normal distribution according to both test methods, the group "female motor stunting" showed similar results, where the data distribution was significantly from the normal distribution according to both tests.

Discussion

The main findings of this study indicate that children who are stunted have a significantly lower level of motor

skills compared to children who are not stunted. These results are consistent with previous research findings showing a negative relationship between physical growth and motor development in childhood (Arruda et al., 2022). This study involved 48 preschool children aged 3–6 years from various preschools in South Solok, showing that body mass index (BMI) and nutritional status had minimal influence on basic motor skills (FMS). Correlation analysis confirmed that the association between BMI and FMS was relatively weak, consistent with previous findings (Niemistö, Finni, Haapala, Cantell, & Sääkslahti, 2019).

Linear growth failure, or stunting, serves as a marker for a variety of pathological disorders associated with increased morbidity (disease) and mortality (death). This condition can cause loss of optimal physical growth potential, reduce neurodevelopment and cognitive function, and increase the risk of developing chronic diseases in adulthood(López-Valenciano, Ayala, De Ste Croix, Barbado, & Vera-Garcia, 2019; Phytanza, Burhaein, & Pavlovic, 2021).The severe irreversible physical and neurocognitive damage associated with stunted growth represents a serious threat to human development. Awareness of the high prevalence of stunting and its devastating impacts has led to it being considered a top priority in global health. This has become the focus of international attention at the highest level, with global targets set to tackle stunting by 2025 and beyond.(Griffiths, Toovey, Morgan, & Spittle, 2018; Luengo et al., 2019).

Stunting has become a major contributor to morbidity (disease) and mortality (death) in children. Therefore, providing evidence to support more effective policies and programs to prevent child malnutrition, as well as preventing associated lifelong disabilities, is critical. This is important in achieving the global nutrition targets for 2025 adopted by the World Health Assembly. Stunting has been proposed as a key indicator for the post-2019 development agenda(Akombi et al., 2017). The early period of a child's life is a critical time to encourage physical activity. Although the health benefits of vigorous physical activity at an early age have not been fully confirmed, it is recommended that physical activity be encouraged in young children. This is because physical activity can help in the development of their motor skills which are very important at that stage of development(McCoy et al., 2020; Oktavia et al., 2019).

Several studies have shown gender differences in gross motor skills (FMS) proficiency, with boys tending to score higher than girls.(Bala, G., & Katić, nd; Soofi et al., 2022; Wardoyo et al., 2022).However, evidence regarding gender differences in locomotor skills is inconsistent, with some studies reporting superiority in girls (Zhou et al., 2023). While other studies support the current findings that there are no significant differences between boys and girls(Fonseka et al., 2022; Oberer et al., 2017).

Study(Arini, Mayasari, & Rustam, 2019)shows that there is a relationship between the degree of stunting and impaired cognitive and motor development in children. Research result(Mastuti & Indahwati, 2021)shows that children who experience stunting have lower personal social, language, gross motor and fine motor development scores compared to children who do not experience stunting. Research results (Susiani, 2019) show that the percentage of stunted toddlers with fine motor development status in the suspect category is higher (71.7%) compared to non-stunting toddlers (47.4%). Likewise, the percentage of stunted toddlers with gross motor development status in the suspect category is higher (60.4%) than non-stunting toddlers (35.1%). There is a significant difference in fine motor and gross motor development between stunting and non-stunting toddlers, with a p-value of 0.016 and 0.014 respectively.

One theory is that between the ages of 3 and 6, boys and girls have significant biological similarities, but gender roles and social perceptions may influence how they engage in competitive activities. This may result in differences in the performance of certain motor skills.(Konyole et al., 2023; Lewis, Friis, Mupere, Wells, & Grenov, 2023). In this study, girls showed significantly better performance in locomotor skills, such as jumping, running, and sliding, compared with boys. Therefore, in analyzing the influence of environment and ethnicity on FMS, research subjects were divided into groups of boys and girls. Low motor skills, if left unchecked, can have a negative impact on a child's physical, cognitive, social development and active lifestyle(Michel & Molitor, 2022; Sah et al., 2022).

Motor skills refer to a person's ability to carry out movements or physical activities that require coordination between muscles, nerves and sensory systems. There are two main categories of motor skills, namely gross motor skills and fine motor skills. Gross motor skills involve large movements that use the large muscles in the body, such as walking, running, jumping, and throwing. Meanwhile, fine motor skills involve fine movements that require detailed coordination between hands and eyes, such as writing, drawing, holding small objects, and using tools with precision.(Lopes et al., 2022; Pranoto, Ma'mun, Mulyana, & Kusmaedi, 2021)

Data on basic motor skills in children, both preschool and elementary school children, in Indonesia is still limited due to a lack of understanding of this discipline(Bakhtiar, 2014).Lack of physical activity can cause various problems, especially related to cardiovascular disease, obesity and difficulty in solving problems. Physical activity programs that aim to increase endurance and body strength can increase life satisfaction for children who are obese, and can even increase satisfaction with aspects of school.(Chaeroni, Komaini, Pranoto, & Antoni, 2022).Under normal conditions, children, especially kindergarten ones, acquire and apply these motor skills in the school environment(Pranoto, Chaeroni, Rifki, Ilham, & Susanto, 2023). Handling stunting in the form of providing nutritious food and accompanied by physical activity in the form of traditional games for school children is very necessary(Welis, Darni, Khairuddin, Rifki, & Chaeroni,

2022).Basic motor skills are needed as a basis for developing motor skills in the future(Pranoto, Sibomana, et al., 2023).Basic motor skills are children's basic movements that should be mastered in childhood(Harris, Alnedral, Taufan, Aulia, & Gusril, 2023).

In this study, children's motor performance varied between genders. The FMS scores of children in this area are lower than in other areas. These findings are consistent with research from other countries(Aye et al., 2018; Engel et al., 2022). Research shows that children from low economic backgrounds in rural areas show better performance in motor skills compared with children from high economic backgrounds in urban areas and children from low economic backgrounds in urban areas (P=0.028 and P =0.009, respectively). Other research that considers socioeconomic and family factors finds that children living below the poverty line tend to have better gross motor skills, and that girls have better locomotor skills compared to boys.(Leroy & Frongillo, 2019; Zeng et al., 2017).

Children from rural areas have the potential to spend more time outdoors, while children from metropolitan areas tend to be more involved in organized sports(Yuan et al., 2023). It is unclear whether ethnicity influences the development of basic motor skills (FMS) in young children, with previous results varying. A 3-year longitudinal study of 313 kindergartners showed that Hispanic children demonstrated greater increases in sedentary behavior and lower moderate-to-vigorous physical activity (MVPA) than non-Hispanic children. Studies investigating FMS in catching, balancing, and jumping in 4- to 12-year-old Euro-American children (N=103) and Mexican–American children (N=104) found no significant differences between the two groups on these tasks(Dapp, Gashaj, & Roebers, 2021; Saidmamatov, Nascimento, Cerqueira, Rodrigues, & Vasconcelos, 2022). The authors concluded that they found no ethnic differences because many activities were similar during the early years of childhood(Ghadiri, Bahmani, Paulson, & Sadeghi, 2022; Henrique et al., 2023; Opie, Pourmajidian, Ziemann, & Semmler, 2020). In contrast, in Eyre's study, in the white and South Asian groups, at baseline, there were significant differences between ethnicities in running, stationary dribbling, throwing, tumbling, 7-skill scores, and medicine ball throwing. The majority of South Asian children were categorized as those with poorer motor performance on the skill component and/or White children with higher levels of mastery of the motor component.

Conclusion

Overall, the results showed that children with different nutritional status and different genders showed significant variations in basic motor skills. It was found that children with stunting status tend to face challenges in some aspects of motor skills, while they may show better abilities in other skills. These findings emphasize the need for more focused interventions to improve basic motor skills in at-risk population groups.

References

Águila Soto, C., & José López Vargas, J. (2019). Cuerpo, corporeidad y educación: una mirada reflexiva desde la Educación Física Body, corporeality and education: a reflective look from Physical Education (Vol. 35). Retrieved from www.retos.org

Akombi, B.J., Agho, KE, Hall, J.J., Merom, D., Astell-Burt, T., & Renzaho, A.M.N. (2017). Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. BMC Pediatrics, 17(1), 1–16. https://doi.org/10.1186/s12887-016-0770-z

Anastasia, A., Anggraini, N., Yusril, A., Bastyan, I., Herfizal, LN, & Hardjati, S. (2024). CHILDREN'S PARENTING AS A STUNTING PREVENTION MEASURE THROUGH THE GREAT PARENTS SCHOOL PROGRAM. 6(2020), 2492–2501.

Antunes Moura, RT, Bueno, NB, Silva-Neto, LGR, Pureza, IR de OM, Silva, MGV da, Cabral, MJ, & Florêncio, TM de MT (2022). Red propolis supplementation does not decrease acute respiratory events in stunted preschool children: A paired nonrandomized clinical trial. ESPEN Clinical Nutrition, 50, 264–269. https://doi.org/10.1016/j.clnesp.2022.05.005

Arini, D., Mayasari, AC, & Rustam, MZA (2019). Motor and Cognitive Development Disorders in Toodler Children with Stunting in the Coastal Area of Surabaya. Journal of Health Science and Prevention, 3(2), 122–128.

Arruda, RCBF de, Tassitano, RM, da Silva Brito, AL, de Sousa Martins, OS, Cabral, PC, & de Castro Antunes, MM (2022). Physical activity, sedentary time and nutritional status in Brazilian children with cerebral palsy. Jornal de Pediatria, 98(3), 303–309. https://doi.org/10.1016/j.jped.2021.07.005

Aye, T., Kuramoto-Ahuja, T., Sato, T., Sadakiyo, K., Watanabe, M., & Maruyama, H. (2018). Gross motor skill development of kindergarten children in Japan. Journal of Physical Therapy Science, 30(5), 711–715. https://doi.org/10.1589/jpts.30.711

Bakhtiar, S. (2014). Fundamental motorbike skills among 6-year-old children in Padang, West Sumatra, Indonesia. Asian Social Science, 10(5), 155–158. https://doi.org/10.5539/ass.v10n5p155

Bangelesa, F., Hatløy, A., Mbunga, BK, Mutombo, PB, Matina, MK, Akilimali, PZ, … Mapatano, MA (2023). Is stunting in children under five associated with the state of vegetation in the Democratic Republic of the Congo? Secondary analysis of Demographic Health Survey data and the satellite-derived leaf area index. Heliyon, 9(2). https://doi.org/10.1016/j.heliyon.2023.e13453

Chaeroni, A., Komaini, A., Pranoto, NW, & Antoni, D. (2022). The Effect of Physical Activity Programs and

School Environments on Movement Activities and Mental Health. International Journal of Human Movement and Sports Sciences, 10(2), 131–137. https://doi.org/10.13189/saj.2022.100201

Corrêa, E.M., Gallo, C. de O., Antunes, J.L.F., & Jaime, P.C. (2023). The tendency of stunting among children under five in the Northern Region of Brazil, according to the Food and Nutrition Surveillance System, 2008-2017. Jornal de Pediatria, 99(2), 120–126. https://doi.org/10.1016/j.jped.2022.07.006

Dapp, L. C., Gashaj, V., & Roebers, C. M. (2021). Physical activity and motor skills in children: A differentiated approach. Psychology of Sport and Exercise, 54(February), 101916. https://doi.org/10.1016/j.psychsport.2021.101916

Engel, A., Hardy, L., Broderick, C., van Doorn, N., Ward, R., Kwai, N., & Parmenter, B. (2022). Effect of a Fundamental Motor Skills Intervention on Fundamental Motor Skills and Physical Activity in a Preschool Setting: A Cluster Randomized Controlled Trial. Pediatric Exercise Science, 34(2), 57–66. https://doi.org/10.1123/PES.2021-0021

Fonseka, R.W., McDougal, L., Raj, A., Reed, E., Lundgren, R., Urada, L., & Silverman, J.G. (2022). Measuring the impacts of maternal child marriage and maternal intimate partner violence and the moderating effects of proximity to conflict on stunting among children under 5 in post-conflict Sri Lanka. SSM - Population Health, 18. https://doi.org/10.1016/j.ssmph.2022.101074

Fufa, D. A. (2022). Determinants of stunting in children under five years in dibate district of Ethiopia: A case-control study. Human Nutrition and Metabolism, 30. https://doi.org/10.1016/j.hnm.2022.200162

Ghadiri, F., Bahmani, M., Paulson, S., & Sadeghi, H. (2022). Effects of fundamental movement skills based dual-task and dance training on single- and dual-task walking performance in older women with dementia. Geriatric Nursing, 45, 85–92. https://doi.org/10.1016/j.gerinurse.2022.03.003

Griffiths, A., Toovey, R., Morgan, P. E., & Spittle, A. J. (2018). Psychometric properties of gross motor assessment tools for children: A systematic review. BMJ Open, 8(10), 1–14. https://doi.org/10.1136/bmjopen-2018-021734

Haris, F., Alnedral, Taufan, J., Aulia, F., & Gusril. (2023). The effect of Motor Coordination Learning (MCL) based on a combination of e-book and QR-Code media with sign language to improve Basic Movement Skills (BMS) in deaf children: An inclusion education research. Journal of Physical Education and Sport, 23(12), 3349–3355. https://doi.org/10.7752/jpes.2023.12383

Henrique, PPB, Perez, F.M.P., Dorneles, G., Peres, A., Korb, A., Elsner, V., & De Marchi, A.C.B. (2023). Exergame and/or conventional training-induced neuroplasticity and cognitive improvement by engaging epigenetic and inflammatory modulation in elderly women: A randomized clinical trial. Physiology and Behavior, 258. https://doi.org/10.1016/j.physbeh.2022.113996

Ihsan, N., Tri Mario, D., & Mardesia, P. (2023). The effect of learning methods and motor skills on the learning outcomes of basic techniques in volleyball. Journal of Physical Education and Sport ® (JPES), 23(9), 2453–2460. https://doi.org/10.7752/jpes.2023.09282

Kofinti, R.E., Koomson, I., Paintsil, J.A., & Ameyaw, E.K. (2022). Reducing children's malnutrition by increasing mothers' health insurance coverage: A focus on stunting and underweight across 32 sub-Saharan African countries. Economic Modelling, 117. https://doi.org/10.1016/j.econmod.2022.106049

Komaini, A., & Mardela, R. (2018). Differences of Fundamental Motor Skills Stunting and Non Stunting Preschool Children in Kindergarten in North Padang. IOP Conference Series: Materials Science and Engineering, 335(1). https://doi.org/10.1088/1757-899X/335/1/012131

Konyole, SO, Omollo, SA, Kinyuru, JN, Owuor, BO, Estambale, BB, Ritz, C., … Grenov, B. (2023). Associations between Stunting, Wasting and Body Composition: A Longitudinal Study in 6- to 15-Month-Old Kenyan Children. Journal of Nutrition, 153(4), 970–978. https://doi.org/10.1016/j.tjnut.2023.02.014

Leroy, J. L., & Frongillo, E. A. (2019). Perspective: What Does Stunting Really Mean? A Critical Review of the Evidence. Advances in Nutrition, 10(2), 196–204. https://doi.org/10.1093/advances/nmy101

Lewis, J.I., Friis, H., Mupere, E., Wells, J.C., & Grenov, B. (2023). Calibration of Bioelectrical Impedance Analysis Against Deuterium Dilution for Body Composition Assessment in Stunted Ugandan Children. Journal of Nutrition, 153(2), 426–434. https://doi.org/10.1016/j.tjnut.2022.12.028

Lopes, V.P., Martins, S.R., Gonçalves, C., Cossio-Bolaños, M.A., Gómez-Campos, R., & Rodrigues, L.P. (2022). Motor competence predicts self-esteem during childhood in typical developing children. Psychology of Sport and Exercise, 63. https://doi.org/10.1016/j.psychsport.2022.102256

López-Valenciano, A., Ayala, F., De Ste Croix, M., Barbado, D., & Vera-Garcia, F.J. (2019). Different neuromuscular parameters influence dynamic balance in male and female football players. Knee Surgery, Sports Traumatology, Arthroscopy, 27(3), 962–970. https://doi.org/10.1007/s00167-018-5088-y

Luengo, M.H., Álvarez-Bueno, C., Pozuelo-Carrascosa, D.P., Berlanga-Macías, C., Martínez-Vizcaíno, V., & Notario-Pacheco, B. (2019). Relationship between breast feeding and motor development in children: Protocol for a systematic review and meta-analysis. BMJ Open, 9(9). https://doi.org/10.1136/bmjopen-

2019-029063

Mastuti, NLPH, & Indahwati, L. (2021). The Effect of Stunting on the Development of Fine Motor, Gross Motor, Language and Social Personality in Toddlers Aged 2-5 Years in Madiredo Village, Pujon District, Malang Regency. Journal of Issues In Midwifery, 5(3), 111–120. https://doi.org/10.21776/ub.joim.2021.005.03.2

McCoy, S. W., Palisano, R., Avery, L., Jeffries, L., Laforme Fiss, A., Chiarello, L., & Hanna, S. (2020). Physical, occupational, and speech therapy for children with cerebral palsy. Developmental Medicine and Child Neurology, 62(1), 140–146. https://doi.org/10.1111/dmcn.14325

Michel, E., & Molitor, S. (2022). Fine motor skill automatization and working memory in children with and without potential fine motor impairments: An exploratory study. Human Movement Science, 84. https://doi.org/10.1016/j.humov.2022.102968

Niemistö, D., Finni, T., Haapala, E.A., Cantell, M., & Sääkslahti, A. (2019). Environmental correlates of motor skills in children – the Skilled Kids Study. International Journal of Environmental Research and Public Health, 16, 1–17.

Oberer, N., Gashaj, V., & Roebers, C. M. (2017). Motor skills in kindergarten: Internal structure, cognitive correlates and relationships to background variables. Human Movement Science, 52, 170–180. https://doi.org/10.1016/j.humov.2017.02.002

Oktavia, D., Bali, M., Rahman, H., Umar, U., Syakroni, A., & Widat, F. (2019). Exploration of Fine Motor Skills through the Application of Paint. https://doi.org/10.4108/eai.8-12-2018.2284038

Opie, G.M., Pourmajidian, M., Ziemann, U., & Semmler, J.G. (2020). Investigating the influence of paired-associative stimulation on multi-session skill acquisition and retention in older adults. Clinical Neurophysiology, 131(7), 1497–1507. https://doi.org/10.1016/j.clinph.2020.04.010

Phytanza, D.T.P., Burhaein, E., & Pavlovic, R. (2021). Gross motor skills levels in children with autism spectrum disorder during the covid-19 pandemic. International Journal of Human Movement and Sports Sciences, 9(4), 738–745. https://doi.org/10.13189/saj.2021.090418

Pranoto, NW, Chaeroni, A., Rifki, MS, Ilham, & Susanto, N. (2023). The Effects of Inactivity During the COVID-19 Pandemic on the Psychomotor Skills of Kindergarten Students. Annals of Applied Sport Science, 11(2). https://doi.org/10.52547/aassjournal.1162

Pranoto, NW, Ma'mun, A., Mulyana, M., & Kusmaedi, N. (2021). The effect of fundamental motor skills intervention program on kindergarten students. International Journal of Human Movement and Sports Sciences, 9(3), 583–589. https://doi.org/10.13189/saj.2021.090326

Pranoto, NW, Sibomana, A., Ndayisenga, J., Chaeroni, A., Fauziah, V., Susanto, N., … Rayendra, R. (2023). Development of a disaster mitigation learning program for kindergarten students through physical fun games. Journal of Physical Education and Sport, 23(12), 3228–3234. https://doi.org/10.7752/jpes.2023.12369

Sadler, K., James, P.T., Bhutta, Z.A., Briend, A., Isanaka, S., Mertens, A., … Wells, J.C. (2022). How Can Nutrition Research Better Reflect the Relationship Between Wasting and Stunting in Children? Learnings from the Wasting and Stunting Project. Journal of Nutrition, 152(12), 2645–2651. https://doi.org/10.1093/jn/nxac091

Sah, O., Maguire, A., & Zohoori, F. V. (2022). Fractional urinary fluoride excretion and nail fluoride concentrations in normal, wasted and stunted 4–5 year-old children in Nepal. Journal of Trace Elements in Medicine and Biology, 69. https://doi.org/10.1016/j.jtemb.2021.126876

Saidmamatov, O.A., Nascimento, M.M., Cerqueira, J.C., Rodrigues, P., & Vasconcelos, O. (2022). Motor skills training programs for children with developmental coordination disorder: Does gender matter? Neuropsychiatrie de l'Enfance et de l'Adolescence, 70(4), 183–194. https://doi.org/10.1016/j.neurenf.2022.03.001

Singh, K.J., Chiero, V., Kriina, M., Alee, N.T., & Chauhan, K. (2022). Identifying the trend of persistent cluster of stunting, wasting, and underweight among children under five years in northeastern states of India. Clinical Epidemiology and Global Health, 18. https://doi.org/10.1016/j.cegh.2022.101158

Soofi, SB, Ariff, S., Khan, G.N., Habib, A., Kureishy, S., Ihtesham, Y., … Bhutta, Z.A. (2022). Effectiveness of unconditional cash transfers combined with lipid-based nutrient supplement and/or behavior change communication to prevent stunting among children in Pakistan: a cluster randomized controlled trial. American Journal of Clinical Nutrition, 115(2), 492–502. https://doi.org/10.1093/ajcn/nqab341

stunting children - Search | ScienceDirect.com. (nd). Retrieved February 6, 2024, from https://www.sciencedirect.com/search?qs=stunting%20children

Taib, WRW, & Ismail, I. (2021). Evidence of stunting genes in Asian countries: A review. Meta Gene, 30. https://doi.org/10.1016/j.mgene.2021.100970

Tamir, TT, Techane, MA, Dessie, MT, & Atalell, KA (2022). Applied nutritional investigation spatial variation and determinants of stunting among children aged less than 5 years in Ethiopia: A spatial and multilevel analysis of Ethiopian Demographic and Health Survey 2019. Nutrition, 103–104. https://doi.org/10.1016/j.nut.2022.111786

Udjaja, Y., Rumagit, RY, Gazali, W., & Deni, J. (2021). Healthy Elder: Brain Stimulation Game for the Elderly to Reduce the Risk of Dementia. Procedia Computer

Science, 179, 95–102. https://doi.org/10.1016/j.procs.2020.12.013

Wardoyo, S., Nurjazuli, N., & Darundiati, YH (2022). Lead exposure and stunting incidents in children aged 3–5 years in Pontianak City, West Kalimantan, Indonesia. Toxicologie Analytique et Clinique, 34(2), 111–116. https://doi.org/10.1016/j.toxac.2022.02.006

Welis, W., Darni, Khairuddin, Rifki, MS, & Chaeroni, A. (2022). Effect of Stunting Handling and Physical Activity on Motor Ability and Concentration of School Children. International Journal of Human Movement and Sports Sciences, 10(5), 1040–1046. https://doi.org/10.13189/saj.2022.100522

Yendrizal, Kiram, Y., Yenes, R., Komaini, A., Ihsan, N., & Mario, D.T. (2023). Effect of weight training and motor skills on muscle strength: A factorial experimental design. Journal of Physical Education and Sport, 23(6), 1416–1424. https://doi.org/10.7752/jpes.2023.06173

Yuan, X., Zhong, X., Wang, C., Dai, Y., Yang, Y., & Jiang, C. (2023). Temporo-Parietal cortex activation during motor imagery in older adults: A case study of Baduanjin. Brain and Cognition, 173(November), 1–8. https://doi.org/10.1016/j.bandc.2023.106103

Zeng, N., Ayyub, M., Sun, H., Wen, X., Xiang, P., & Gao, Z. (2017). Effects of physical activity on motor skills and cognitive development in early childhood: A systematic review. BioMed Research International, 2017. https://doi.org/10.1155/2017/2760716

Zhou, L., Liang, W., He, Y., Duan, Y., Rhodes, R.E., Lippke, S., … Liu, Q. (2023). A school-family blended multi-component physical activity program for Fundamental Motor Skills Promotion Program for Obese Children (FMSPPOC): protocol for a cluster randomized controlled trial. BMC Public Health, 23(1), 369. https://doi.org/10.1186/S12889-023-15210-Z

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