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ORIGINAL ARTICLE

Balance bike activity is better at optimizing motor components compared to bicycle and tricycle in early childhood

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ARTICLE INFORMATION	ABSTRACT
<p>Article history Received May 17, 2024 Revised Jun 25, 2024 Accepted July 09, 2024</p> <p>Keywords Push-bike, Bicycle, Tricycle.</p>	<p>Introduction: Riding a bicycle has become a common way for preschoolers to practice their motor skills. The purpose of this study is to evaluate how well push bikes and two- and three-wheeled pedal bicycles improve preschoolers' motor skills, including balance, agility, and leg muscle strength. Objective: To determine how different push bikes and pedal bicycles—both two- and three-wheeled—affect preschoolers' ability to develop their motor skills. Methods: Preschoolers who participated in this study were split into three groups according to the kind of bicycle they rode: push bikes, two-wheeled pedal bicycles, and three-wheeled pedal bicycles. The study used an observational method. For a predetermined amount of time, each group used their individual bicycles for activities. Direct observations, balance, agility, and leg muscle strength assessments were all used to gather data. Results: Compared to children who rode two- and three-wheeled pedal bicycles, children who rode push bikes exhibited significantly improved balance, agility, and leg muscular strength. It has been demonstrated that push bikes are more successful in helping preschoolers develop their motor skills. Conclusion: Push bikes are more effective at improving motor components (balance, agility, and leg muscle strength) in preschool children bicycle and tricycle. As a result, push bikes are a superior option for helping preschoolers develop their motor skills.</p>

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1. Introduction

The early years of a child's life are vital for motor development, greatly influencing their capacity to carry out everyday tasks and participate in physical play. Fine and gross motor skills are critical for children's comprehensive growth and their future success in academics and athletics (Gabbard, 2018). Physical activity plays a crucial role in the motor development of preschool-aged children. During this stage, children start to acquire fundamental motor skills such as balance, agility, and muscle strength, which form the foundation for more advanced motor abilities later on.

Children's motor development can be categorized into two types: fine motor skills and gross motor skills. Gross motor skills involve activities that engage the larger muscles, such as crawling, lying on their stomachs, lifting their necks, sitting, and walking. Kids love to play, explore, and enhance their mobility. This instinctive drive transitions them from sitting and lying down to walking and running. Various games can help boost children's gross motor skills, including playing soccer, running, throwing and catching a ball, jumping rope, roller skating, cycling, and more (Sujarwo, & Widi, 2015).

Cycling is an enjoyable activity for kids as it allows them to engage with their surroundings and gain new experiences. Beyond just playing, children also benefit from these activities; for example, they develop an appreciation for their belongings and a desire to care for them. In terms of physical development, cycling helps children enhance their gross and fine motor skills by incorporating elements that develop locomotor, non-locomotor, and manipulative movements (Brantasari, 2020; Sujarwo, & Widi, 2015).

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Bicycles come in a wide range of designs and styles. Some of the different types of bicycles you can find today include unicycles, standard two-wheel bicycles, BMX bikes, hybrid bikes, balance bikes, and more (Suyuthie, 2017). Bicycles are a basic form of transport that don't require an engine. They move through human power, specifically by pedaling. Cycling is an activity that consumes a significant amount of energy, making it an effective way for children to expend their surplus energy. Additionally, it helps strengthen the heart muscle, enhancing endurance and reducing fatigue (Mahendra & Dharmastiti, 2020). A push bike or balance bike is a small, pedal-free bicycle designed for young children as a precursor to pedal bicycles. Instead of pedals, children use their feet to propel the bike forward. These bikes are excellent for developing balance and strengthening the lower leg muscles during early childhood. The act of pushing the bike helps optimize leg function and muscle strength during this critical growth period. On the other hand, a tricycle is a three-wheeled bike meant for children around the age of four or those who haven't yet mastered riding a two-wheeler. Tricycles come in various wheel sizes, such as 12", 14", and 16" (Casman et al., 2021; Mranani & Lastianti, 2022; Suyuthie, 2017)".

In early childhood, the development of balance, agility, and lower limb strength is essential for supporting a child's physical and motor growth. Balance aids children in performing fundamental motor activities such as walking and running with stability, while agility allows for coordinated movement. On the other hand, lower limb strength is crucial for activities like jumping and running, which are integral to gross motor development. The significant impact of these basic motor skills on both physical and cognitive development in young children. Proper interventions and well-designed exercises are vital to fostering these components and enhancing overall motor development in children.

Achieving balance is essential for independent living. It refers to the control of body posture to prevent falls and is commonly associated with maintaining equilibrium between opposing forces. This concept is crucial for almost every movement and is often termed postural control, which involves sustaining gravitational balance by managing the body's center of weight. Balance encompasses the ability to keep the body's central projection aligned on a support surface while standing, sitting, transitioning, or walking. It is necessary for maintaining stability when shifting from one position to another and for responding quickly and effectively to ensure stability during and after movement, as well as in reaction to external disturbances. Balance relies on the dynamic interplay of internal and external factors, including environmental influences. There are two primary types of balance: static balance, which maintains a stationary position, and dynamic balance, which involves managing the body's movement through space (Supriyono, 2015). Enhancing balance in young children is a key element of their motor development. Balance, which is the capacity to keep the body steady both when stationary and in motion, plays a vital role in performing everyday tasks. During the preschool years, significant progress in balance is observed as the child's central nervous system and postural muscles mature. Studies indicate that this progress is shaped by genetic influences, environmental factors, and daily physical activity (Haga & Sigmundsson, 2021; Logan et al., 2018; Smith & Lloyd, 2020; Ulrich et al., 2019).

Muscle strength in the lower legs of children aged 4-6 years refers to the capacity of the quadriceps, hamstrings, gastrocnemius, and soleus muscles to generate peak force during physical activities. This stage of rapid motor development makes muscle strength crucial for supporting activities like walking, running, jumping, and various forms of play (Gallahue & Donnelly, 2006). Muscle strength in the lower limbs is crucial for children between 4 and 6 years old for several key reasons. Firstly, it supports motor development, enabling the acquisition of gross motor skills like running, jumping, and kicking, which are essential for everyday activities and play (Haywood & Getchell, 2009). b) Injury Prevention: Robust muscles play a crucial role in safeguarding joints and bones from harm. For instance, well-developed quadriceps muscles can provide support to the knee joint, reducing the risk of issues like knee pain. c) Muscle strength plays a crucial role in helping children achieve proper balance and coordination, which is essential for performing physical activities safely and effectively (Aagaard et al., 2010).

Agility refers to the capacity of an individual to alter their body position swiftly and accurately, often while in motion, evading obstacles, or adapting to changes in their surroundings. For children between the ages of 4 and 6, agility is crucial for motor development as this stage is

vital for acquiring fundamental motor skills like running, jumping, and catching (Gallahue & Donnelly, 2006). The significance of dexterity in children's motor development includes, (1) Fundamental Motor Skills: Dexterity aids children in developing essential motor skills such as hand-eye coordination, balance, and body control, which are foundational for various physical activities and sports in the future; (2) Health and Physical Fitness: Children with good agility are generally more physically active, which promotes cardiovascular health, muscle strength, and flexibility. Engaging in regular physical activity also helps prevent obesity and other chronic health issues (Strong et al., 2005); Cognitive Development: Activities that involve dexterity often necessitate quick thinking and decision-making, thereby enhancing cognitive skills such as problem-solving and attention (Diamond, 2000).

While numerous studies have examined the benefits of bicycles and tricycles, there is a notable paucity of research focusing on balance bikes. Specifically, comparative studies assessing the effectiveness of balance bikes versus traditional bicycles and tricycles in enhancing motor components are limited. Additionally, existing research often lacks longitudinal data to ascertain the long-term benefits of balance bike activities on motor development (Becker et al., 2014; L. Sayers et al., 2019). To fill these gaps, this research will perform a comparative analysis of motor skill development results linked to balance bikes, bicycles, and tricycles. By utilizing a mix of observational studies and standardized motor skill evaluations, this study aims to offer empirical data on the effectiveness of these tools in promoting motor development during early childhood.

This study is driven by the necessity to discover the most efficient techniques for enhancing motor development in young children. With the growing popularity of balance bikes, it is crucial to validate their claimed advantages through solid scientific research. Identifying the best tools for supporting motor development will help parents, educators, and policymakers make well-informed choices about physical activity resources for children (Duncan et al., 2018).

The main goal of this research is to analyse and contrast the effects of balance bikes, regular bicycles, and tricycles on the motor skills of young children. The specific objectives are as follows; (1) Examining how balance and coordination develop in children using balance bikes in comparison to those using bicycles and tricycles, (2) Investigating the enhancement of gross motor skills include balance, agility, and leg muscle strength.

The results of this study will greatly enhance our understanding of motor development in early childhood. By presenting solid evidence on the advantages of balance bikes, this research has the potential to shape early childhood education methods and inform parental decisions. Furthermore, it will emphasize the critical role of choosing suitable tools for developing motor skills, which could lead to better developmental progress for young children (Gabbard, 2018; L. Sayers et al., 2019).

2. Methods

The study will employ an Observational Analytical research design, involving observation alone without any intervention or training from the researcher. It will use a Cross Sectional Study approach to assess the impact of different types of bicycles—push bikes, two-wheeled crank bikes, and three-wheeled crank bikes—on young children's motor skills. Measurements will be taken of the children's leg muscle strength, balance, and agility while using these bicycles. The collected data on these motor components will be analyzed and compared to determine which type of bicycle most effectively enhances motor strength in young children. The research overview is illustrated in the chart below.

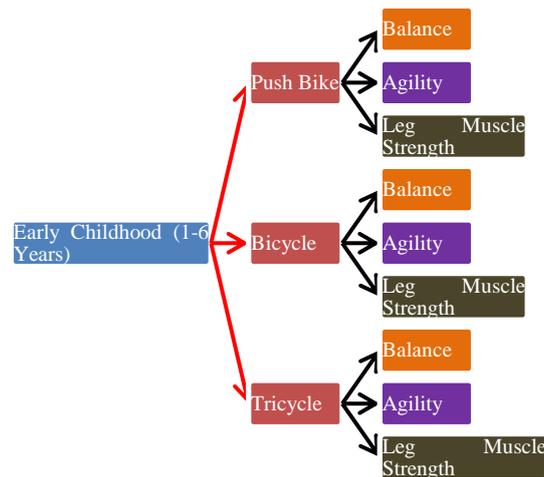


Figure 1. The research overview Balance bike activity is better at optimizing motor components compared to bicycle and tricycle in early childhood

The participants in this study included children who engaged with push bikes, tricycles, and bicycles in Malang City. The research sample comprised children from the push bike community and kindergartens aged 1-6 years who consented to participate. The study was conducted in these communities and kindergartens in Malang City due to the high number of children meeting the research criteria available for participation.

3. Results and Discussion

The characteristics of the respondents in this study are depicted in table 1 below, as follows:

Table 1 Respondent Characteristics

Variabel	N	p
Age		
4 Years Old	5	11 %
5 Years Old	25	53 %
6 Years Old	17	6 %
Gender		
Man	25	54 %
Woman	22	46 %
Bicycle Type		
Push Bike	17	38 %
Bicycle	15	31 %
Tricycle	15	31 %

Based on the data presented in Table 1, it was observed that most of the participants in this study were 5 years old, totalling 25 individuals (53%). This was followed by 5 participants aged 4 years (11%) and 17 participants aged 6 years (36%). The study also revealed that there were more male participants (25 individuals, or 54%) compared to female participants (22 individuals, or 46%). Regarding the types of bicycles used, 17 participants (38%) utilized push bikes, while 15 participants (31%) used both two-wheeled bicycles and tricycles, with each type being used by an equal number of individuals (15 people or 31% each).

3.1 The typical level of skills observed in children

The table below illustrates the variations in average balance scores, leg muscle strength scores, and agility scores among users of pushbikes, two-wheeled crank bikes, and three-wheeled crank bikes. This information is shown in Table 2 of the study.

Table 2 Table of Average Ability Scores for Children 4-6 Years

Variabel	N	Push Bike	Bicycle Type Bicycle	Tricycle
Balance (One Leg Stance Test)		33,85	15,37	21,47
Leg Muscle Strength (Vertical Jump Test)	47	167,6	164,2	154,6
Agility (Shuttle Run Test)		11,53	19,26	20,86
		17	15	15

According to Table 2, the highest agility scores were observed in users of push bikes, averaging 33.8, followed by 2-wheel crank bike users with an average of 15.37, and 3-wheel crank bike users with an average of 21.47. In terms of leg muscle strength, push bike users achieved the highest score of 167.7, with 2-wheel crank bike users at 164.3, and 3-wheel crank bike users at 154.6. Additionally, for agility abilities, push bike users had the top score of 11.53, while 2-wheel crank bike users scored 19.29, and 3-wheel crank bike users scored 20.86.

3.2 Normality Test

The Normality Test in this study is depicted in table 3 below, as follows:

Table 3 Table of Normality Test

Variabel	P		
	Push Bike	Bicycle	Tricycle
Balance	0,054	0,015	0,098
Leg Muscle Strength	0,129	0,136	0,117
Agility	0,401	0,119	0,895
N	17	15	15

Based on Table 3, the Shapiro-Wilk test (appropriate for samples of 47 respondents or fewer) revealed that the muscle strength data was normally distributed, as indicated by a P value greater than 0.50. Conversely, the balance and agility data did not follow a normal distribution. Consequently, for analyzing muscle strength, which showed normal distribution, ANOVA was utilized for hypothesis testing. In contrast, for balance and agility, which did not meet the normality assumption, the Kruskal-Wallis test was employed to assess differences in effectiveness among push bikes, two-wheeled bicycles, and three-wheeled bicycles.

3.3 Comparison Test

Hypothesis testing in this research is depicted in table 4 below, as follows:

Table 4 Table of Comparison Test

Variabel	N	Hypothesis Testing	Comparison Of Push Bicycles, Bicycle, And Tricycle
Balance		Kruskal Wallis	0,00
Leg Muscle Strength	47	Anova	0,00
Agility		Kruskal Wallis	0,00

Based on Table 4, the results from both the ANOVA and Kruskal-Wallis tests revealed significant differences in balance values across the three types of bicycles (push bikes, two-wheeled bicycles, and three-wheeled bicycles), with a p-value of 0.00 (<0.05). Additionally, differences in agility scores among the three bicycle types were noted, also with a significant p-value of 0.00 (<0.05). Furthermore, variations in muscle strength effectiveness were observed, again with a p-value of 0.00 (<0.05).

Conclusion

Balance refers to the capability to keep the body stable, whether stationary or moving. During early childhood, balance is a crucial fundamental motor skill that needs to be nurtured. The growth of balance is shaped by the daily experiences and physical activities of children (Gallahue & Donnelly, 2006). Children who use push bikes exhibit superior balance compared to those who use two-wheeled or three-wheeled bicycles. Since push bikes lack pedals, children must use their legs to propel and stabilize themselves, which enhances their balance more efficiently. Push bikes promote faster development of balance skills because they require children to manage their body balance independently, without stabilizers (M. G. L. Sayers & Goodwin, 2012). Riders of two-wheeled bicycles exhibit notable progress in their balance skills. The need to balance while in motion on these bicycles prompts children to consistently practice and improve their stability. Studies suggest that children who use two-wheeled bicycles generally enhance their dynamic balance, as they must stay balanced while moving and prevent falls (Ulrich, 2020). Children riding tricycles generally exhibit lower balance scores when compared to those using push bikes or two-wheeled bicycles. Tricycles offer enhanced stability with their three contact points on the ground, reducing the need for children to balance on their own. This stability can result in insufficient development of balance skills. Additionally, research indicates that children on tricycles experience slower progress in balance development because the reduced balancing challenge limits their ability to develop these skills (Rivara et al., 1991).

Agility refers to the ability to swiftly and accurately change the direction of one's body. In young children, specifically those aged 4-6 years, agility progresses alongside the development of motor skills and coordination. This period of motor development is heavily influenced by physical activities that involve a variety of complex movements. Research suggests that children who use push bikes tend to exhibit better agility compared to those using two-wheeled or three-wheeled bicycles. Push bikes, or balance bikes, facilitate the development of balance and coordination early on without the complication of pedals. According to Brown, using a push bike can enhance gross motor skills as it encourages children to balance independently (Gallahue & Donnelly, 2006). Children riding two-wheeled bicycles also demonstrate relatively high agility, though not to the same extent as those using push bikes. Riding two-wheeled bicycles demands advanced balance and coordination skills, and the intensive balance training involved can lead to improved agility. Sanders notes that while this training is beneficial, children in this age group might still need support or a balance wheel, which can affect their overall agility (Brown et al., 2013; Sanders, 2002). On the other hand, children using tricycles generally score lower in agility. The added stability of tricycles minimizes the need for self-balancing. Payne & Isaacs observe that while tricycles can boost a child's confidence in cycling, they are less effective at fostering balance and coordination compared to push bikes or bicycles (Payne & Isaacs, 2008).

The development of leg muscle strength plays a crucial role in children's motor skills. Between the ages of 4 and 6, children undergo significant physical development, which includes enhancements in muscle strength and gross motor coordination. Push bikes are commonly used by children to enhance their balance and coordination. Without pedals, children rely on their feet to propel and balance themselves. Studies indicate that riding a push bike can boost leg muscle strength because children continuously engage their muscles to push and stabilize their bodies while moving. This method often leads to greater leg muscle development compared to children who do not use push bikes (Mika, 2019). Similarly, riding two-wheeled bicycles has been associated with notable improvements in leg muscle strength. This type of cycling demands superior balance and regular pedaling, which helps to build lower leg muscles. Research by Johnson supports the idea that cycling enhances muscle strength, coordination, and balance in children (Johnson, L., Taylor & Patterson, 2020). In contrast, tricycles generally offer more stability than push bikes or two-wheeled bicycles. While tricycles can contribute to leg muscle strength through pedaling, the enhancement might not be as significant as with two-wheeled bicycles or push bikes, as balance is less of a factor. According to Smith's research, tricycle use emphasizes pedaling skills more than balance and dynamic leg muscle strength (Smith, 2018).

Based on analysis of various studies, it was concluded that push bikes are most effective in improving balance, leg muscle strength and coordination in children. Two-wheeled bicycles excel in improving leg muscle strength and agility due to the need to pedal and maintain balance while moving. Tricycles are better suited for younger children to develop basic skills before they are ready to move on to two-wheeled bicycles. Push bikes have been proven to be very effective in improving balance, leg muscle strength and coordination in children. Children who use push bikes can develop balance skills more quickly than those who use tricycles. This is due to the focus on balance without the distraction of pedals, allowing the child to concentrate on these basic skills before moving on to a two-wheeled bicycle (Froböse, 2017; Jana, 2018).

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