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The relationship between leg muscle strength and dynamic balance in skateboard players

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ABSTRACT

Background: Skateboarding is a sport that utilizes a wheeled board as its equipment. As time progresses, skateboarding has evolved into one of the branches of professional sports, even having official competitions. It is popular among a wide range of young people and adults. Skateboarders must have good balance to stabilize their bodies and minimize the risk of falling and injury. It is maintaining balance while skateboarding requires strength in leg muscles, including flexors, extensors, dorsiflexors, plantar flexors, invertors, and evertors, with proper contraction ratios to stay balanced. The researchers aimed to investigate the relationship between leg muscle strength and dynamic balance in skateboard players. Skateboard players with greater leg muscle strength tend to maintain their balance better when performing tricks and maneuvers on the skateboard.
Methods: The research was observational analytics with a cross-sectional approach. Purposive sampling was employed to select participants, resulting in a sample size of 51 skateboarders. Data collection involved measuring leg muscle strength and dynamic balance. Leg muscle strength was measured using a leg dynamometer, while dynamic balance was assessed using the y balance test.
Results: The results showed a relationship between leg muscle strength and dynamic balance in skateboarders. Most samples exhibit muscular leg muscle strength, leading to a favorable dynamic balance.
Conclusion: From the research findings, it can be concluded that there is a strong, significant, and inverse relationship between leg muscle strength and dynamic balance in skateboarders.

Keywords: dynamic balance, leg muscle strength, muscle strength, skateboarding, skateboard players.
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INTRODUCTION

Sports are activities that promote health, physical fitness, and entertainment. They are essential as they encompass the daily movement routines of individuals, constituting a series of regular and planned physical activities to enhance quality of life. Sports serve as a leisure means to train the body for better health and fitness. Engaging in physical activity is critical to improving quality of life, being the most effective and efficient approach. Sports are further divided into several branches that each athlete pursues. One branch of sports that is currently being widely discussed is skateboarding, an extreme sport that has gained traction and evolved within Indonesia.[1,2]

Skateboarding is one of the sports that uses a wheeled board as its equipment. Skateboarding first emerged in the 1950s in California. Since the 1970s, skateboarding has experienced rapid development worldwide, as evidenced by the construction of many skateparks.[3] As time has progressed, skateboarding has become a part of professional sports and has its official competitions. Skateboarding is popular among many young people and adults.[4] Skateboarding in Bali has become widely known, as seen from the increasing number of skateboard communities. Skateboarding in Bali officially entered the realm of sports under the auspices of National Sports Committee of Denpasar in 2008.[5]

Skateboarding is a game that uses a wheeled board and is played by gliding on a specific skateboard arena. The most essential thing required in skateboarding is maintaining body balance to perform a stable game. Skateboarding is quite an extreme sport, as it has the potential to cause injuries. In 2011, it was found that skateboard injuries accounted for more than 78.000 patients from various age groups, including children and adolescents. Upper extremity injuries commonly occur in the shoulder, elbow, wrist, hand, and finger. Another common injury in sports is ankle injuries, with approximately 30,000 cases reported annually.[6,7,8]

Typically, when a skateboarder is on the board, one foot pushes and propels the skateboard while the other remains on the skateboard. Skateboarders playing on steep downhill terrains rely heavily on gravitational force to propel the skateboard's speed.[9] Skateboarders must have good balance to keep their bodies balanced and stable, minimizing the occurrence of falls and injuries. Based on their types, balance is classified into static and dynamic. Skateboarding requires dynamic balance as players must

maintain their body position in balance while on a moving skateboard for optimal performance.[6]

Balance is maintaining equilibrium and not falling when stationary or performing daily activities.[10] Several control components support balance to maintain dynamic balance proficiently for players, including sensory information systems commonly known as the balance center, consisting of visual, vestibular, and somatosensory systems, biomechanics of balance, and muscle strength.[11]

Leg muscle strength combines deploying maximum muscle force with maximum speed rapidly and quickly.[12] Leg muscle strength, which consists of flexor muscles, extensors, dorsiflexors, plantar flexors, inverters, and investors, must have strength with a good contraction ratio to maintain body position in balance. Without good lower extremity muscle strength, skateboard players tend to be unable to keep their balance on the board, leading to undesired events such as injuries.[13] The study by Leng and Shi in 2022 revealed a relationship between dynamic balance ability and lower extremity muscle strength. Lower extremity muscle strength, in particular, is a crucial component in skateboarding as it plays a role in controlling the body on the skateboard, requiring high levels of balance. Skateboarders may need good lower extremity muscle strength to balance on the board.[14]

Research on the relationship between leg muscle strength and dynamic balance is rare. This study provides significant relevance in the context of athletic development and safety in the sport. This is because good balance is a critical factor in preventing injuries in skateboard players and serves as new insights into developing training methods and performance evaluation for skateboard players. Through the background presented above, the researchers aim to investigate whether there is a relationship between leg muscle strength and dynamic balance in skateboard players. Skateboard players with greater leg muscle strength tend to maintain their balance better when performing tricks and maneuvers on the skateboard.

METHODS

The method used in this study was analytical observational with a cross-sectional approach. The research was conducted at Lumintang City Park on May 26, 2023. This study received approval from the Universitas Udayana under registration number 547/UN14.2.2.VII.14/LT/2023. Informed agreement from the respondents to the survey was also provided, which approved the use of sampling. Sampling was done using purposive sampling with a total sample of 51 individuals who met the inclusion and exclusion criteria. This study's subjects must meet the inclusion and exclusion criteria. The inclusion criteria include male skateboard players aged 20-30 years who have actively engaged in skateboarding within the past three months, while the exclusion criteria consist of a history of limb injury such as fractures and being in a training phase.

The data collection was conducted primarily by measuring lower limb muscle strength using a leg dynamometer with three measurements, and the highest result was determined as the final score of lower extremity muscle strength in skateboarders. Dynamic balance was assessed using the y balance test. The y balance test is a simplification of the star excursion test. The y balance test has an interclass coefficient correlation value of 0.88 – 0.99, indicating a nearly perfect interpretation.[15] y balance test, which consists of single-leg squat movements with one foot reaching as far as possible in 3 different directions (anterior, posterolateral, and posteromedial), was repeated three times. The analysis employed included univariate analysis to determine the frequency distribution of each variable and bivariate analysis using *Spearman's Rho* method to determine the relationship between leg muscle strength and dynamic balance in skateboard players.

RESULTS

Table 1 shows that 51 sample data were included in the inclusion criteria, and no one was excluded. The data was analyzed using the bivariate *Spearman Rho* method. Characteristics of subjects in this study were assessed based on age, lower limb muscle strength, and dynamic balance. The distribution of samples by age indicates that the most common age group is 27, comprising nine individuals (17.6%), while the least common age group is 29 years old, with only one individual (2%). Regarding leg muscle strength among skateboard players, most are categorized as 'good,' comprising 17 individuals (33.3%). Out of the total sample size of 51 individuals, 36 samples (70.6%) are deemed to possess good balance, whereas 15 samples (29.4%) are categorized as having poor balance.

Table 2 presents the analysis results, indicating a significance value of 0.000, where $p < 0.05$, suggesting a significant relationship between leg muscle strength and dynamic balance among skateboard players. The analysis also reveals a correlation coefficient value of -0.515. This negative correlation coefficient indicates an inverse relationship between the two variables, implying that leg muscle strength increases among the samples.

DISCUSSION

Dynamic balance involves maintaining body equilibrium by controlling the center of mass or center of gravity about the base of support while in motion. Factors influencing dynamic balance consist of intrinsic and extrinsic factors. Inherent factors affecting dynamic balance include leg muscle strength. This is related to research findings indicating that higher leg muscle strength among samples correlates with better dynamic balance. Dynamic balance requires specific limb control, particularly of the lower extremities, to maintain balance and execute specific movements throughout the game.[16,17,18]

Measurement of dynamic balance is conducted using the y-balance test. Based on the measurement results, 36 samples exhibit good dynamic balance, with most having excellent and reasonable interpretations of leg muscle strength. Among them, 12 samples exhibit excellent leg muscle strength, 16 have good leg muscle strength, and 8 have sufficient leg muscle strength. This aligns with a study by Muehlbauer et al. 2015, which stated that leg muscle strength impacts balance performance. Maintaining good dynamic balance can be achieved by enhancing

Table 1. Characteristics of 51 skateboarders

Variables	Frequency	Percentages (%)
Age		
20	3	5.9
21	3	5.9
22	4	7.8
23	4	7.8
24	6	11.8
25	5	9.8
26	8	15.7
27	9	17.6
28	3	5.9
29	1	2.0
30	5	9.8
Leg muscle strength		
Poor	10	19.6
Below average	3	5.9
Fair	9	17.6
Good	17	33.3
Excellent	12	23.5
Dynamic balance		
Good	36	70.6
Poor	15	29.4

Table 2. The result of correlation between leg muscle strength and dynamic balance among 51 skateboarders

Variables	Correlation	*p-value*
Leg muscle strength and dynamic balance	-0.515	0.000

muscle strength.[13]

The results from the 36 samples exhibiting balance demonstrate proper muscle activation, as these samples maintain balance and stability during the y-balance test measurement. This measurement requires endurance and coordination, which enhances injury prevention sensitivity. Activation of lower limb muscles is needed for each direction of the y balance test path, with samples achieving a composite score below four considered balanced.[19]

Other data indicate that 15 samples are deemed unbalanced. Most of these samples have leg muscle strength interpretations below average and must be revised. Poor dynamic balance signifies dysfunction of factors influencing dynamic balance, including inadequate leg muscle strength, leading to performance decline. These intrinsic muscle strengths are crucial in maintaining stabilization and support during activities.[20]

Skateboard players need to maintain dynamic balance during their actions while skateboarding. Maintaining dynamic balance requires control of leg muscle strength for satisfying gameplay. Research by Wahyuni in 2023 shows a significant correlation between lower extremity muscle strength and dynamic balance in surfing players.[21] Dynamic balance significantly correlates with muscle strength of the hip flexor, hip extensor, hip abductor, knee flexor, and ankle muscle groups. Properly activating these muscle strengths enables players to maintain balance, reducing injury risks.[22]

Skateboard players experiencing lower extremity issues also affect their balance. This is proposed by research conducted by Kamayoga in 2015, indicating that skateboard players with chronic ankle instability experience decreased muscle strength, reduced flexibility, and limited joint range of motion. Chronic ankle instability is closely related to balance control components. Eventually, movement effectiveness and efficiency decrease, leading to disrupted balance. Thus, individuals with a history of injuries or issues, especially in the lower extremities crucial for skateboarding, will affect their balance.[23,24]

The research indicates that the higher the leg muscle strength skateboarders possess, the better their dynamic balance. This implies the importance of maintaining and improving leg muscle strength to ensure the dynamic balance of skateboarders remains intact. The limitation of this study is that the researchers were unable to include the center of balance, which is considered an internal factor affecting dynamic balance, as a variable for investigation because there were no parameters available to serve as a reference for assessing dynamic balance.

CONCLUSION

The research concluded that a solid, significant, and inversely proportional relationship between leg muscle strength and dynamic balance among skateboard players.

ETHICAL CLEARANCE

This study received approval from the Universitas Udayana under registration number 547/UN14.2.2.VII.14/LT/2023. Informed agreement from the respondents to the survey was also provided, which approved the use of sampling.

CONFLICT OF INTEREST

This study has no conflict of interest.

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AUTHOR CONTRIBUTIONS

NAWS developed the study's methodology, gathered the data, wrote the article, edited the draft, and used SPSS to process the data. IDGAK was reviewing and offering constructive feedback on pre-existing drafts of the article. AWI editing grammar, sentence structure, and spelling errors. AANTND reviewed the final version of the paper

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