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The Correlation of Core Stability and Muscle Imbalance to Identify Injury Risk Futsal Players Porprov Kendal

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Abstract

Exercise is one of the physical exercises commonly practiced by people to improve physical condition. Every sport has a risk of injury or (sport injury). One of them is futsal sports, sport injury is a type of injury during training or competition that causes injury due to external factors such as tackling, collisions, collisions and internal factors such as poor core stability, muscle weakness, muscle imbalance and excessive use of muscles or ligaments. Knowing the between core stability and muscle imbalance to identify the risk of injury for Kendal porprov futsal players. This type of research uses analytical Observational research design with Cross Section design. The population in this study were all Kendal porprov futsal players with sampling using Total Sampling technique, a sample of 20 respondents. Data analysis in this study used the Kendall tau correlation test. There is a correlation between Core Stability and Injury Risk where the p-value p = 0.000 (p < 0.05). And there is a correlation in muscle imbalance with the risk of injury where the p-value p = 0.009 (p < 0.05). There is a correlation between core stability and muscle imbalance to identify the risk of injury for Kendal porprov futsal players.

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INTRODUCTION

Sport is a form of physical exercise that can improve psychological and physiological quality, one of which is futsal(Tharziansyah, 2021), Futsal is a dynamic sport, where players must always move or move, in playing futsal players must have good techniques and physical conditions, where the elements of physical condition are muscle strength, flexibility, muscle endurance, agility, endurance and speed.(Puspitasari, 2019). Futsal is a sport with a high incidence of injury, Sports injury or sports injury is a type of injury that occurs during training, or during a match or after a match. (Hardyanto & Nirmalasari, 2020). Sports injuries can be caused by collisions, physical stress, technical errors, or physical activities that exceed the training load. Factors that lead to injury consist of two factors, namely external factors (extrinsic factors) in the form of collisions, collisions or tackling while injuries due to internal influences (intrinsic factors) muscle weakness, such as poor posture, unhealthy physique, and excessive use of muscles or ligaments. (Safitri et al., 2021). Factors causing high injury rates in futsal players are due to poor postural muscle strength and muscle imbalance. Poor physical condition will increase the risk of injury. (Tharziansyah, 2021)

The core is the lumbo-pelvic-hip complex. The core area is the position or place of the center of gravity, and is the starting point of all movements. Core efficiency is designed to maintain the correlation of agonist and antagonist muscle function, which will improve the correlation of the two forces in the lumbo-pelvic-hip complex. (Kibler et al., 2006). Core stability affects stability. In its activity, core stability is influenced by superficial (global) and deep (core) muscles whose main function is to maintain posture. The whole muscle is multi-segmental, it is a correlation of external load imposed on the trunk that changes the center of mass of the body.(De Blaiser et al., 2021).

Core stability functions to control the position of the main core muscles, which are the pelvic muscles, transversus abdominis, multifidus, internal obliques, and external obliques. Contraction of the abdominal muscles produces a rigid cylinder that increases the stability of the lumbar spine, rectus abdominis and obliques, activates specific patterns responsible for lower body movement, and provides postural support prior to lower body movement.(Yuliana et al., 2014). Muscle imbalance is an imbalance between the strength, flexibility, or coordination of muscles working together in a muscle group. The strong part of the muscle group will compensate for the weak part, an imbalance can occur when one muscle group becomes stronger, more flexible, or more coordinated than the opposite muscle which can affect posture, movement patterns, and can result in injury risk. (Clark & Lucett, 2011).

Muscle imbalance or muscle imbalance is caused when one of the opposing muscle groups becomes shorter and tighter for reasons such as overdoing certain movements (movements in sports) over a long period of time. Once the muscle becomes underactive or imbalanced, the other muscle group becomes overactive to compensate for the underactive muscle group. This muscle imbalance will create a chain of problems in the musculoskeletal system that will eventually lead to injury (Schlumberger et al., 2006). Functional Movement Screening (FMS) is a method to evaluate a person's functional movement ability. Weaknesses and imbalances in a person's muscles cause FMS movements to be imperfect and cause obstacles. FMS can be used for injury screening and prevention. Muscle weaknesses and imbalances

identified in FMS can be input for injury risk correction. (Cook et al., 2006)

Functional Movement Screening (FMS) examination is performed to detect muscle weakness and muscle imbalance by evaluating the movements performed. FMS consists of 7 movements, namely: deep squats, hurdle steps, inline lunges, shoulder mobility, active straight leg raises, trunk stability push-ups and rotary stability. A score of 3 is given if the respondent is able to perform the movement perfectly, a score of 2 is given if the respondent is able to perform the movement but there is a compensatory movement or uses other auxiliary muscles, a score of 1 is given if the respondent is unable to perform the movement correctly, a score of 0 is given if the respondent feels pain and is unable to complete the movement correctly. (Cook et al., 2014).

METHODS

This research uses an analytic observation method by explaining the correlation between two independent variables and the dependent variable. The research plan used was cross-sectional. First, this study gave consent to respondents, then measured core stability with the Prone bridge test and then screened muscle imbalance and injury risk using functional movement screening (FMS).

Participants

The population of this study were all 20 Kendal porprov futsal players with sampling techniques using total sampling or the number of populations equal to the number of samples.

Sampling Procedures

This study uses an analytic observational research design with a Cross Section design. The population in the study were all Kendal porprov futsal players with sampling using the Total Sampling technique, a sample of 20 respondents.

Materials and Apparatus

1. Core stability is the ability to control the position and motion of the upper pelvic spine to provide optimal production, transfer, and control of force and movement. (Kibler W., 2006).
   a. The prone bridge test is a fitness test to measure the strength of the core muscles, the purpose of this test is to hold or maintain the plank position for as long as possible. The purpose of this test is to hold the position as long as possible through the upper body held by the elbows and forearms, then the body is straight with the legs held by the fingers with the head facing down not looking forward. The test is completed when the subject is unable to hold the back straight and hips down. (Bohannon RW, 2018).

Table 1. Classification Prone Bridge Test

Rating	Time
Excellent	>6 Minutes
Very Good	4-6 Minutes
Above Average	2-4 Minutes
Average	1-2 Minutes
Below Average	30-60 Seconds
Poor	15-30 Seconds
Very Poor	< 15 Seconds

Muscle imbalance is an imbalance in muscle parts that can cause muscle work compensation resulting in unbalanced muscle work on one side, where the opposite muscle group works not optimally or shortens in performing mobilization movements will be disrupted during exercise so that compensation will occur causing active muscle groups to perform frequent movements so that overuse will cause

musculoskeletal problems which will eventually cause injury (Schlumberger, 2006).

a. Classification of Muscle Imbalance

1) The classification of muscle imbalance is categorized into two based on its nature, which can be functional or pathological.
2) The pathological imbalance may or may not be painful but is usually associated with dysfunction and causes functional impairment (A. Schlumberger, 2006).

b. Injury is damage to the structure or function of the body due to physical force or pressure. Factors that lead to injuries include poor posture, incorrect training movements, muscle weakness and overuse of muscles or ligaments. (Safitri, A., Khusniya, I, & Dai, M, 2021).

1) Muscle Imbalance and Injury Risk Assessment using Functional Movement Screening (FMS)
2) Functional Movement Screening (FMS) is a method to assess a person's functional movement ability. FMS can be used as screening and injury prevention. Muscle weaknesses and imbalances found from FMS can be input to the coaching team to make corrections.. (Cook, G, Burton, & Hoogenboom, 2006).
3) FMS examination is performed to identify any muscle weaknesses and muscle imbalances through assessment of the movements performed. FMS consists of 7 movements, namely: (1) Deep Squat, (2) Hurdle Step, (3) Inline Lunges, (4) Shoulder Mobility, (5) Active Straight Leg Raise, (6) Trunk Stability Push-up and (7) Rotary Stability.
4) The examiner will give an assessment of the movements performed by the subject with a value of "0" to "3" with the following criteria (Cook, 2015): A score of 3 is given if the subject is able to perform the fundamental movement perfectly, A score is given if the subject is able to perform the fundamental movement but there is a compensatory movement / using other auxiliary muscles, A score of 1 is given if the subject is unable to perform the movement correctly, A score of 0 is given if the subject complains of pain and is unable to complete the movement. (Cook, 2015).

Procedures

The independent variables in this study are core stability and Muscle Imbalance while the dependent variable in this study is Injury Risk. This research uses an analytic observation method by explaining the correlation between two independent variables and the dependent variable. The research plan used was cross-sectional. First, this study gave consent to respondents, then measured core stability with the Prone bridge test and then screened muscle imbalance and injury risk using functional movement screening (FMS). This study was supported by ethical permits, including informed consent, and confidentiality signed during the research process. The ethical permit for this study was obtained from the Education Installation of the Research Ethics Committee at TK.II 04.05.01 dr. Sodjono Hospital, Magelang, Indonesia, No. 110/EC/V/2023, on May 29, 2023.

Design or Data Analysis

The analysis used in this study is using univariate analysis and bivariate analysis with Kendall Tau correlation test.The research design used is causal correlation. The purpose of the method in this study is to determine whether there is a correlation between core stability and

muscle imbalance in the porprov futsal group of 20 people.

RESULT

1. Sample Characteristics

Tabel 2. Characteristics of Respondents Based on Age

Age	N	%
17-18 years old	6	30
19-20 years old	5	25
21-22 years old	9	45
Total	20	100

Based on Table 2, respondents in the age category 17 to 22 years old in this study. Respondents aged 17 to 18 years totaled 6 people (30%), respondents aged 19 to 20 years totaled 5 people (25%), while in the vulnerable 21 to 22 years totaled 9 respondents (45%).

Table 3. Characteristics based on Body Mass Index

BMI	N	(%)
<20	3	15
20-22	13	65
23-24	3	15
>25	1	5
Total	20	100

In Table 3, the results of BMI <20 (15%) were obtained as many as 3 respondents, who had BMI 20 to 22 as many as 13 respondents (65%), who had BMI 23 to 24 as many as 3 respondents (15%), while 1 respondent (5%) had BMI> 25.

Table 4. Core Stability Measurement Results

Core Stability		N	(%)
> 6 Minutes	Excellent	0	0
4 - 6 Minutes	Very Good	2	10
2 - 4 Minutes	Above Average	4	20
1 - 2 Minutes	Average	14	70
15 - 60 Second	Poor	0	0
<15 Second	Very Poor	0	0
Total		20	100

having very good or excellent core stability amounted to 2 respondents (10%). While those who have core stability above average or above average are 4 respondents (20%), and the remaining 14 respondents (70%) have average core stability.

Table 5. Muscle imbalance measurement results

Muscle Imbalance		N			
		Right	(%)	Left	(%)
5 - 9	Imperfect	0	0	1	5
10 - 14	Less than Perfect	15	75	15	75
15	Perfect	5	25	4	20
	Total	20	20	20	100

Based on Table 5. The results of measuring Muscle Imbalance on the right side of the body on Muscle Imbalance Less Perfect as many as 15 respondents (75%), and perfect muscle imbalance as many as 5 respondents (25%). while the results of measuring Muscle imbalance on the left side obtained results as many as 1 (5%) respondent had imperfect muscle imbalance, as many as 15 respondents (75%) with less perfect muscle imbalance and 4 respondents (20%) with perfect muscle imbalance values.

Table 6. Risk of Injury measurement results

Risk of Injury		N	(%)
<14	High Risk of Injury	2	10
15-18	Moderate Risk of Injury	15	75
19-21	Low Injury Risk	3	15
	Total	20	100

Based on table 6, the results of measuring the risk of injury were obtained where there were 2 respondents (10%) at high risk of injury, 15 respondents (75%) at moderate risk of injury, and 3 respondents (15%) had a low risk of injury.

Bivariate Analysis

Table 7. The relationship between core stability and injury risk

Data	P-Value	Koef
Core Stability Risk of Injury	0,000	0,895**

Based on Table 7, the p-value = 0.000 (p-value < 0.05) was obtained. after the kendall tau test. Then there is a correlation between Core stability and injury risk with a coefficient of determination of 0.895 which means the correlation is very strong.

Table 8. Correlation between Muscle

Data	P-Value		Koef	
	Right	Left	Right	Left
Muscle Imbalance	0,074		0,398	
Injury Risk		0,009		0,575**

The right muscle p-value = 0.074 which means there is no correlation, while in the left muscle the p-value = 0.009 (p-value <=0.05) means there is a correlation in the left muscle with a coefficient of determination of 0.575 which means it has a strong correlation. It can be concluded that the left muscle imbalance has a correlation with the risk of injury.

DISCUSSION

Correlation between Core Stability and Injury Risk

The results of the study were tested using nonparametric statistics Kendal tau obtained p-value = 0.000. So it is concluded that there is a correlation between Core stability and the risk of injury with a determination coefficient of 0.895 which means the correlation is very strong. Core stability plays a role in the strength of body stability which functions to control and maximize functional movements. Limitations in stability, strength and functional movement are risk factors for injury. (Mahdieh et al., 2020). This is in accordance with the opinion of Abdallah et al., 2019 that low core muscle ability increases the risk factor for injury, where players who have a history of injury get a lower core stability value than players who are not injured (Abdallah et al., 2019). In accordance with the research of Rahajeng et al (2016) there is a correlation between core stability and the risk of injury weakness in the paraspinal muscles will change the posture of standing causing forward posture, (Ramadhani et al., 2021). Decreased proprioception of the spine, and decreased quadricep nerve activity (Rahajeng et al., 2016). Muscle weakness increases the risk of injury due to joint loading causing overuse of the knee, hip and lumbar joints. (Blaiser et al., 2018). (Syafrianto & Muchlis, 2021) Core stability is the ability to control posture and body stability, which is influenced by superficial muscles and deep muscles. Core muscles function to maintain posture, control the field of motion from the trunk to the pelvis as a stabilizer of frontal plane activities, quadratus lumborum muscle activity and a combination of flexion, extension and lateral flexion as a support for the spine which functions to stabilize the frontal midwife. (Blaiser et al., 2018). Good core stability means that the strength and postural stability of the individual is good so that it can improve performance during sports activities and can reduce the risk of injury.

Correlation between Muscle Imbalance and Injury Risk

The results of the study found a correlation between muscle imbalance and the risk of injury in futsal players with a p-value = 0.009 and a correlation coefficient value of 0.575, meaning that there is a strong correlation between

muscle imbalance and the risk of injury. This is in accordance with research by (Oktarisa et al., 2023) The imbalance of right and left body muscle strength affects hurdle step, inline lunge, shoulder mobility, active straight leg raise, and rotary stability. The muscle strength of the right body is more dominant than the muscle strength of the left body. Unbalanced strength between the muscles of the right and left sides of the body leads to lower player performance and increases the risk of injury (Mitchell et al., 2016).

Muscle imbalance is an imbalance or asymmetry in strength and flexibility in the muscle group of the dominant side of the body so that it can compensate for the weak side of the body. This opinion is in line with research (Zein & Sudarko, 2020). stated that the cause of high injury in athletes is due to muscle weakness, limited mobility in the upper extremities, pelvis and lower limbs. Weakness and low mobility limitations indicate trunk muscle weakness which affects the risk of injury (Syafei et al., 2020). Imbalances, especially in Rotary Stability and Shoulder Mobility movements, show that there is muscle imbalance in the upper extremities and trunk causing functional impairment and pain resulting in injury to the shoulder due to the influence of the rotator cuff muscles and scapular stability that are imbalanced.

The result of a high FMS value in a player with no history of injury helps the player avoid injury and a player with a history of injury with a low FMS value causes a very high risk of injury or re-injury. FMS is able to correct and identify movement abilities to provide explanations for weaknesses in functional movement patterns, asymmetry and functional movement limitations between right and left, FMS identifies and estimates the risk of injury (Pristianto et al., 2018).

CONCLUSION

The results of the study can be concluded that there is a correlation between core stability and the risk of injury in futsal players with a p-value of 0.000 <0.05 and a correlation coefficient value of 0.895 which means that there is a very strong correlation between core stability and the risk of injury.

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