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Original Article

The impact of core stability training on the dynamic balance of Solok city-based Saiyo FC soccer players

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Abstract:
Soccer is a sport that demands core stability since it is a component of musculoskeletal and neuromuscular control for the body during athletic activity. When playing soccer, core stability regulates how the muscles in the upper and lower extremities move. Dynamic balance is one of the physical components of soccer that is impacted by core stability. Soccer players' ability to maintain dynamic balance affects their ability to sprint, jump, land, and make physical contact with opponents. The focus of this study was to quantify the impact of core stability training on soccer players' dynamic balance. The study design used in this quasi-experimental study consists of a single-group pre-test and post-test. The study involved 16 sessions, three times a week, and 14 soccer players were involved in the testing. The McGill Core Endurance Test was used to measure core stability, and the Star Excursion Balance Test (SEBT) was used to measure dynamic balance in 14 study samples. After receiving core stability training, players' dynamic balance increased, according to the results. A paired t-test was used for statistical analysis, and the mean values of the SEBT pre-test and post-test were 67.50 and 76.29 cm, respectively. The pre-test and post-test differences were 8.79 cm, with a P value of 0.00, p = <0.05. After assessing core stability using the McGill core endurance test, soccer players' increased dynamic balance was consistent with their increased core stability. Soccer players' increased dynamic balance following a 16-session core stability training program was impacted by the reactivation of their stabilizer muscles' movement control system, which runs along their vertebrae and abdominal bones. When a player was moving or battling in a soccer match, their ability to sense their surroundings accurately was affected by their activation of movement control. Based on research findings, soccer players' dynamic balance enhanced by core stability training.
Keywords: Core Stability, Dynamic Balance, Soccer

Introduction

With over 22 million young athletes and 4% of the global population participating, soccer is one of the most popular sports in the world. (Goldblatt D, 2020; Krishna et al., 2020; Moran et al., 2019; Caccese JB et al., 2018). Football performance is comprised of technical, tactical, physiological, psychological, and mental domains (Krishna et al., 2020). Specific physical attributes, such as endurance, strength, flexibility, explosive power, and agility, will significantly impact the game and its outcome. Physical health impacts movement coordination, balance, response time, and execution (Urcanu, 2016).

The function of the physical elements that enable football movement determines one's health; the capacity to play soccer may be supported by effective, efficient, and linked physical elements (Kokstejn, J. et al., 2019). Balance is one of the physical attributes that soccer players need; strong balance will help players avoid falling during ball possession battles or physical contact with opponents (Miller, 2004). In reaction to variations in internal and external circumstances, balance is the result of a complex interplay between the sensory systems (vestibular, ocular, and proprioceptors), the musculoskeletal system, and the brain (motor control, sensory, basal ganglia, cerebellum, and association regions). The capacity to manage the body's center of mass or center of gravity about the fulcrum base of support is another definition of balance (Jeon, W., et al., 2019; Gill, L., et al., 2019; Kisner, C., Colby, L. A., & Borstad, J., 2017). Furthermore, balance is defined as the process by which the body attempts to maintain its position while performing different tasks, including different movements in each body segment supported by the support plane, which enables humans to move effectively and efficiently (Sepdanius, E. et al., 2020).

There are two types of balance: static balance and dynamic balance. In soccer, both types of balance are crucial for a player's ability to perform throughout a game (Jadczak, L., et al., 2019; Pau, M., et al., 2015). The primary topic of discussion in this study was dynamic balance, which is an individual's capacity to regulate their body's posture to maintain stability when in motion (Navarro-Santana et al., 2020; Doherty et al., 2016). Reasonable body control is a supporting element of dynamic balancing ability. As a nerve supply route and the

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component of muscle that makes up the upper extremities, the core is an anatomical feature of the body that aids in controlling the movement of the lower extremities (Rakholiya PA, et al., 2019; Mansell, J., et al., 2005).

According to Malanga et al. (2017) and Raiola et al. (2020), core stability is a crucial body component for limb movement, influences a person's motor motions, and connects to other bodily elements, including nerve tissue. If the core muscles are stable and robust, then movement in the lower limbs will function normally (Shin JW et al., 2017; Frank C et al., 2009).

The four muscles that comprise the core are the diaphragm at the top, the pelvic floor and hip girdle muscles at the bottom, the paraspinal and glute muscles at the rear, and the abdominal muscles at the front. This muscle is crucial to the movement control mechanism in sports because it provides proximal stability, which enables efficient mobility in the distal portion of the body (Akuthota, V. et al., 2008). The starting point for limb movement is core stability, which enhances lower extremity performance and increases body balance maintenance during various dynamic motions (Oliver, G. D., & Adams, 2010).

In addition to being dependent on muscular strength, core stability also depends on the central nervous system receiving accurate sensory information about how the body interacts with its surroundings and on the system continuously delivering feedback that enables the body to modify its movements (Akuthota, V., et al., 2008). Soccer players' dynamic balance control will be influenced by their core stability function (Watson, T., et al., 2017; Bagherian, S.; Ghasempoor, K.; Rahnama, N.; & Wikstrom, 2019). Core stability training is required to achieve optimal muscle function related to core stability.

In order to maintain the spine following symmetrical body lines and become more stable, core stability exercises use the trunk, lumbar spine, hip, and small muscles along the spine. When the spine is solid and stable, it facilitates more effective and efficient movement of the body (Yuliana et al., 2014). One training technique for better dynamic balance is called "core stability," which engages the global and core muscles to preserve postural alignment as effectively as possible. This description serves as the basis for the study's objective: to determine how soccer players' dynamic balance is affected by core stability training.

Research Methods

The research was conducted on the soccer field used by the Solok City Saiyo FC Club, namely the Solok City Merdeka Field. The research described the effect of core stability training on the dynamic balance of soccer players Saiyo Fc Solok City. A purposive sampling technique was used with 14 people who met the criteria. This type of research was a quasi-experiment. According to Sugiyono (2010: 110), The research design employed in this study is a "One Group Pretest-Posttest Design," which involves conducting a pre-test before administering treatment and a post-test after treatment. This design allows for a more accurate assessment of treatment effects by enabling a comparison of the situation before and after the intervention. The instruments used to gather data in this study consist of initial and final tests. The initial test included a dynamic balance assessment (Star Excursion Balance Test - SEBT) and core stability tests (Flexor Endurance Test, Left Side Plank, Right Side Plank, Extensor Endurance Test). After the exercise application was 16 treatments, a final test was conducted as an initial test to determine any improvement after treatment. The data analysis technique used a pre-requisite test of analysis and hypothesis testing.

Results and Discussion

Results

This study's results were described per the objectives of the previously proposed hypothesis. Dynamic balance improvement data was in the form of star excursion balance test (SEBT) data on soccer players Saiyo Fc Solok City. Data were taken before (pre-test) and after (Post-test) treatment. Data were from 14 samples, and this data were processed.

Dynamic Balance Pre-test and Post-Test Data

Balance is one of the essential components of soccer. If they have a good balance, doing sports activities will become more accessible (Khadhiroh, 2018). The Star Excursion Balance Test (SEBT) is an instrument for measuring dynamic balance. This instrument consists of eight directions or lines, where later, the feet of one of the participants must reach all the lines as much as possible and be sequential, starting from the top line.

The implementation is that the participants stand in the center of the grid formed by eight longitudinal lines at an angle of 45º from each other. When measuring, one foot is in the center of the grid with the leg still attached to the floor then the other foot reaches as far as possible along each of the eight lines, then makes a light touch on the line, after which the outstretched foot returns to the center, while maintaining the position of one foot with the other foot in the center of the grid (Gribble, P. A., & Hertel, 2013).

The study results for the pre-test showed that the highest score was 77 cm, the lowest score was 56 cm, the average was 67.50 cm, and the standard deviation was 6.779 cm. In comparison, for the post-test, the highest score was 86 cm, the lowest score was 63 cm, the average was 76.29 cm, and the standard deviation was 6.719 cm. The full results are as follows:

Pre-test and Post-Test Dynamic Balance Data Table

Subject	Pre-test	Post-Test	Difference
1	77	83	6
2	69	77	8
3	74	79	5
4	73	82	9
5	56	63	7
6	73	84	11
7	59	67	8
8	76	86	10
9	63	75	12
10	59	68	9
11	63	73	10
12	70	77	7
13	65	76	11
14	68	78	10
Mean	67.50	76.29	
Sd	6.779	6.719	
Minimum	56	63	
Maximum	77	86	

Pre-test and Post-Test Data on Core Muscle Strength

Using the McGill Test method, measure the core muscle strength of Saiyo FC Solok City soccer players. This test consists of four positions: The flexor endurance test, the Left side plank, the right-side plank, and the Extensor endurance test (Abdelraouf & Abdel- aziem, 2016). The following are the results of the core muscle test implementation test:

1) Flexor Endurance Test

The participant is seated with the body inclined at a sixty-degree angle, hands placed on the chest, and both knees flexed to 90º. Timing begins when the participant assumes the specified position and ceases when the body deviates either forward or backward from the 60º angle.

In terms of the research findings, the pre-test results revealed a maximum score of 79, a minimum score of 50, an average of 60.93, and a standard deviation of 7.691. On the other hand, for the post-test, the highest score recorded was 98, the lowest was 66, the average was 76.29, and the standard deviation was 8.371. The complete results are outlined below.:

Flexor Endurance Test Table

Subject	Pre-test	Post-Test	Difference
1	73	85	12
2	79	98	19
3	63	76	13
4	60	71	11
5	59	74	15
6	65	82	17
7	59	71	12
8	60	74	14
9	52	70	18
10	60	80	20
11	61	80	19
12	53	66	13
13	59	74	15
14	50	67	17
Mean	60.93	76.29	
SD	7.691	8.371	
Minimal	50	66	
Maximum	79	98	

2) Left Side Plank

Participants lying on their left side position their feet one above the other, with the right arm perpendicular to the floor and the elbow resting on the mat. The left arm is positioned above the chest, and the left hand is placed over the right shoulder.

As for the research outcomes, the pre-test results indicated a maximum score of 60, a minimum score of 32, an average of 44.93, and a standard deviation of 8.100. Conversely, in the post-test, the highest score recorded was 74, the lowest was 44, the average was 59.93, and the standard deviation was 8.775. The comprehensive results are provided below:

Left Side Plank Table

Subject	Pre-test	Post-Test	Difference
1	60	74	14
2	40	52	12
3	42	52	10
4	35	50	15
5	40	57	17
6	55	68	13
7	50	70	20
8	39	57	18
9	50	61	11
10	32	44	12
11	52	68	16
12	40	61	21
13	51	68	17
14	43	57	14
Mean	44.93	59.93	
SD	8.100	8.775	
Minimal	32	44	
Maximum	60	74	

3) Right Side Plank

Participants lying on their right side have their feet stacked, with the right arm perpendicular to the floor and the elbow resting on the mat. The left arm is positioned above the chest, and the left hand is placed over the right shoulder.

Regarding the research findings, the pre-test results indicated a maximum score of 64, a minimum score of 36, an average of 51.50, and a standard deviation of 9.493. In contrast, for the post-test, the highest score recorded was 81, the lowest was 51, the average was 69.14, and the standard deviation was 9.662. The complete results are presented below:

Right Side Plank Table

Subject	Pre-test	Post-Test	Difference
1	63	81	18
2	43	64	21
3	64	80	16
4	38	51	13
5	54	77	23
6	61	81	20
7	54	71	17
8	61	76	25
9	60	75	15
10	36	55	19
11	50	64	14
12	45	66	21
13	43	61	18
14	49	66	20
Mean	51.50	69.14	
SD	9.493	9.662	
Minimal	36	51	
Maximum	64	81	

4) Extensor Endurance Test

The assessment of back extensors involves the participant positioning their upper body straightened at the end of the testing bench, with the pelvis, knees, and hips securely stabilized. An assistant is responsible for holding the participant's lower extremities both above and below the knees to ensure stability in the lower body. The timing begins when the participant assumes a horizontal position, removes their hands from the chair, and crosses them over the chest. The timing concludes when the participant either cannot maintain the position or when the upper body descends below the horizontal position.

The results of the pre-test showed the highest score of 75, the lowest number of 33, an average of 52.64, and a standard deviation of 13.921, while the post-test score highest 87, the lowest number of scores of 46, mean of 69.86, and standard deviation was 13.750. The full results are as follows:

Extensor Endurance Test Table

Subject	Pre-test	Post-Test	Difference
1	70	85	15
2	33	51	18
3	75	87	12
4	44	58	14
5	60	79	19
6	63	85	22
7	52	65	13
8	65	82	17
9	39	59	20
10	55	71	16
11	60	81	21
12	35	58	23
13	53	71	18
14	33	46	13
Mean	52.64	69.86	
SD	13.921	13.750	
Minimal	33	46	
Maximum	75	87	

Normality Test Data Analysis

The purpose of the normality test was to ascertain whether the variables in the study exhibit a normal distribution. The One-Sample Kolmogorov-Smirnov Test formula was employed for the calculation of this normality test, and computer assistance was utilized through the SPSS 20 program for data processing. The outcomes were subsequently presented in the table as follows:

Group	(p) Asymp.Sig. (2-tailed)	Sig.	Description
Pre-test Star Excursion Balance Test (SEBT)	0,917	0,05	Normal
Post-Test Star Excursion Balance Test (SEBT)	0,951	0,05	Normal
Flexor Endurance Pretest	0,564	0,05	Normal
Post-Test FlexorEndurance	0,761	0,05	Normal
Left Side Plank Pre-test	0,838	0,05	Normal
Post-Test Left Side Plank	0,765	0,05	Normal
Right Side Plank Pre-test	0,803	0,05	Normal
Post-Test Right Side Plank	0,883	0,05	Normal
Extensor Endurance Pre-test	0,972	0,05	Normal
Post-Test Extensor Endurance	0,781	0,05	Normal

From the table of results above, it can be seen that all data have an Asymp p-value. Sig. (2-tailed) > (Sig.) 0.05, so the variables are normally distributed.

Hypothesis Test Results

The hypothesis in this study was examined using a paired t-test in SPSS 20, and the results of the hypothesis test are as follows: The Paired Sample T-test revealed a significant difference between the pre-test and post-test scores of the five research instrument items, with a two-tailed significance value (p) of 0.00,

which is less than the conventional threshold of 0.05, as shown in the table. In this study, the null hypothesis (H0) was rejected, and the alternative hypothesis (Ha) was accepted, indicating a notable discrepancy between the initial and final assessments.

Then, these results showed that there was a significant difference. Thus, the alternative hypothesis (Ha) reads, "There was a significant effect of core stability training on improving the dynamic balance of s o c c e r players Saiyo FC Solok City." Accepted.

Test	N	Descriptive Statistics	Paired T-Test		
		Mean (Std. D)	T	df	Sig. (2-tailed) (p)
Pre-test Star Excursion Balance Test	14	67.50 (6.779)	-16.076	13	0.00
Post-Test Exclusion Balance Test	14	76.29 (6.719)			
Flexor Pretest Endurance	14	60.93 (7.691)	-19.302	13	0.00
Flexor Post-Test Endurance	14	76.29 (8.371)			
Pre-test lift side plank	14	44.93 (8.100)	-16.863	13	0.00
Post-Test elevator side plank	14	59.93 (8.775)			
Pre-test Right Side Plank	14	51.50 (9.493)	-22.570	13	0.00
Post-Test Right Side Plank	14	69.14 (9.662)			
Pre-test Extensor Endurance	14	52.64 (13.921)	-18.226	13	0.00
Extensor Post-Test Endurance	14	69.86 13.750)			

Discussion

A person's balance depends on information from the vestibular system, the brain-regulated musculoskeletal system, and peripheral receptors in the sensory system (visual, somatosensory, proprioceptive, joints, and skin). The pelvic muscles are among the parts that can regulate balance. The capacity to keep the body under control when moving is known as dynamic balance (Kisner, C., Colby, L. A., & Borstad, J., 2017).

This study focused on dynamic balance as a physical attribute that may be enhanced via core stability training. The Star Excursion Balance Test (SEBT) measures the improvement in dynamic balance in soccer players. According to the research, soccer players from Saiyo FC Solok City have significantly improved their dynamic balance through core stability training.

This is so that optimal motion production may be facilitated. Core stability is an exercise model that can enhance the capacity to regulate the position of trunk motions through the pelvis and legs (Kibler & Sciascia, 2006). In addition to promoting fitness in healthy people and lowering injury rates in athletes, strong core stability enhances movement performance (Jeong, J., Choi, D. H., & Shin, 2021; Dello, Padulo, J., & Ayalon, 2016). Strength and balance are enhanced, upper and lower extremity range of motion is maximized, injury risk is decreased, injury rehabilitation programs are implemented, the spine is stabilized, and athlete performance is improved with core stability training (Hibbs, A. E., Thompson, et al., 2008; Kibler & Sciascia, 2006). The main goal of core stability training is to improve lumbopelvic stability, or the capacity of the abdominal and back muscles to regulate the position and movement of the midsection.

A soccer player must maintain his body while handling the ball, which requires exceptional dynamic balance. Training antagonist and agonist's muscles by the requirements of each body part allows for the execution of muscle-strengthening activities utilizing core stability. As a physical contact sport with high game intensity, football requires players to have strong balance since balance is crucial for dribbling abilities. Apart from dribbling, stability is necessary to avoid collapsing when making physical contact. It typically occurs when a player sprints in one direction and kicks both close and far. Naturally, it will also be preferable if soccer players have solid physical attributes and employ sound skills and strategies.

The central nervous system interprets loading (external load) and postural adjustments as decisions to stabilize the lumbopelvic region. This interpretation is then conveyed to the core muscles (stabilizers), which engage the muscles to produce stabilization and nerve control. This mechanism of stabilization formation of core muscles is caused by the stimulation of extremity movements (proprioceptor activity).

Conclusion

Based on the results of data analysis and discussion of previous problems, core stability training influenced the dynamic balance of soccer players at Saiyo Fc Solok City. The average pre-test value was 67.50, and the average post-test value was 76.29. Based on the pre-test and post-test values, the paired sample test, Sig. (2-tailed) <0.005 n = 14, meaning that core stability training significantly affected the dynamic balance of soccer players at Saiyo Fc Solok City.

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