CORRELATION BETWEEN BODY ASYMMETRY, FLEXIBILITY AND DYNAMIC BALANCE IN RECREATIONAL FOOTBALL PLAYERS: AN OBSERVATIONAL STUDY

by

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Utkal University, Bhubaneswar, Odisha

In partial fulfilment of the

requirements for the degree of

Master of Physiotherapy in Sports

Under the guidance of

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2022 – 2024

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation/thesis entitled **"CORRELATION BETWEEN BODY ASYMMETRY, FLEXIBILITY AND DYNAMIC BALANCE IN RECREATIONAL FOOTBALL PLAYERS : AN OBSERVATIONAL STUDY"** is a bonafide and genuine research work carried out by me under the guidance of **Dr Chinmaya Kumar Patra.**

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Abhishek Kumar Roy

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This is to certify that the dissertation entitled "**CORRELATION BETWEEN BODY ASYMMETRY, FLEXIBILITY AND DYNAMIC BALANCE IN RECREATIONAL FOOTBALL PLAYERS: AN OBSERVATIONAL STUDY"** is a bonafide research work done by **Abhishek Kumar Roy** in partial fulfilment of the requirement for the degree of **MPT – Master of Physiotherapy**.

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LIST OF ABBREVIATION

1. BMI – Body mass index
2. BSS&RT – Back-saver sit & reach test
3. D – Dominant
4. LQ-YBT – Lower quadrant Y balance test
5. ICC – Interclass correlation coefficient
6. ND – Non dominant
7. Postural bench MF system – Postural bench monitoring function system by Technobody
8. T-BED – Technobody bed or postural bench by Technobody

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ABSTRACT

Background: Football is a physically demanding sport requiring strength, flexibility, and balance. Flexibility impacts joint range of motion, influencing injury risk, especially for muscles like quadriceps and hamstrings. Dynamic balance is crucial for maintaining stability during movement, with a strong connection between flexibility, balance, and athletic performance.

METHODS: 56 participants were taken for this study. Body asymmetry was analysed by postural bench by Technobody, made in Italy (T-bed). Lower quadrant Dynamic balance was assessed by lower quadrant Y- balance test (LQ-YBT) and flexibility was assessed by Back-saver sit and reach test (BSS&Rt)

Result: The study found significant positive correlations between the dominant side's lower quadrant Y-Balance test (LQ-YBT), Back-saver sit and reach test (BSS&Rt), and Postural bench monitoring function system (T-Bed), with Pearson coefficients ranging from 0.825 to 0.923. Similarly, the non-dominant side showed significant negative correlations between the same tests, with identical Pearson coefficients. All correlations were highly significant ($p = 0.000$).

Conclusion: This study found a strong relationship between body asymmetry, flexibility, and dynamic balance in recreational football players. Greater flexibility on the non-dominant side negatively affected balance due to muscular imbalances, while flexibility improved dynamic balance on the dominant side. Body asymmetry also negatively impacted non-dominant side balance, highlighting the need for targeted

training. Addressing asymmetry and improving flexibility, particularly on the non-dominant side, can enhance performance and reduce injury risk in football players.

KEYWORDS: football player; muscle tension; body asymmetry; lower quadrant balance test; back-saver sit & reach; dominant; non-dominant.

INTRODUCTION

Playing football demands a great deal of strength and physical conditioning. It's a ninety minute contest, two teams are involved. A minimum of 7 players and a maximum of 11 players per team are allowed. Football is a physically demanding sport that involves a variety of intricate basic actions, including walking, jogging, sprinting, dribbling, shooting, and passing. (1,29,30) A recreational athlete is someone who participates in sports or physical activities three times a week for at least 20 minutes without adhering to a formal training schedule. (3,4)

The entire range of motion of muscles and connective tissues at a joint or set of joints is referred to as flexibility. (6) Tightness in the muscles is often considered an inherent risk factor for the occurrence of a muscle injury. (8) Muscle tension and length are typically negatively correlated in terms of flexibility: lower muscle tension is associated with longer muscle length, whereas higher muscle tension is associated with shorter muscle length. (8,9,34) The range of motion is restricted when there is an increase in muscular tension.(6)

A bodily portion that corresponds in size, form, and relative position on opposing sides of a dividing line or dispersed around a central point or axis is referred to as symmetric. The human body, medicine, and the biomechanics of the locomotor system are all symmetrical, allowing for safe and efficient operation. (31,34) The human body's ability to operate may be compromised by asymmetry, particularly when it comes to the musculoskeletal system. Asymmetry impairs proprioception, joint mobility, adequate muscular strength, balance, and appropriate gait, all of which can lead to pain and abnormal biomechanics. Muscle length affects flexibility. (31,34)

Joints can move through their complete range of motion more freely when muscles are longer and more flexible. Reduced flexibility and a restricted range of motion can result from stiff and shortened muscles. (6,7,23,24) For football players, joint flexibility is another crucial factor to take into account. Important physical traits that affect one's ability to accomplish athletic tasks include joint range of motion (ROM) and resistance to stretching.

These traits can also be linked to an increased risk of muscle strain injuries, particularly during high-intensity exercises. (Witvrouw et al., 2004; Watsford et al., 2010) A football player's statistical risk of suffering a subsequent musculoskeletal injury is higher if they have more strain in their quadriceps or hamstring muscles. (8) Balance has two distinct types, Static and dynamic balance. Maintaining a foundation of support while minimising movement of the centre of gravity in static equilibrium is the role of static balance in performance. The capacity to sustain postural stability and alignment while moving body parts—with the centre of mass above the base of support—is known as dynamic balance. (2) A study by Bulter et al. (2012) male football players at the high school, university, and professional levels possess dynamic balancing ability. They discovered a link between dynamic balance abilities and athletic performance.

The major purposes of dynamic balancing are often, centre of mass maintenance on unstable surfaces or stability during a change from a dynamic to a static state. (5) Football is a fast-paced game that requires players to move constantly, change directions, and engage with opponents. It takes dynamic balance to keep stable while carrying out these tasks. (5) Due to the symbiotic relationship between flexibility and balance, improving one might benefit the other. (10) There was a strong correlation found in a study between bilateral average AROM measurements and bilateral average Y Balance Test outcomes at the ankle and hip. (17)

NEED OF THE STUDY

1. Though it has been proven theoretically the relationship between the muscle tension with the flexibility and balance of an individual but there is no objective quantitative data to relate the muscle tension with flexibility and dynamic balance.

2. By enhancing our knowledge of the various biomechanical and physiological aspects that affect athletic performance, the study advances the discipline of sports science worldwide.

3. Targeted training regimens that maximise athletic performance can result from an understanding of the interactions between muscular tension, flexibility, and dynamic balance.

AIM OF THE STUDY

To find Correlation Between Muscle tension, Flexibility and Dynamic Balance in Recreational Football Players.

OBJECTIVES OF THE STUDY

1. To evaluate muscle tension using postural bench mf system. To evaluate dynamic balance using lower quadrant Y balance test (LQ-YBT).
2. To evaluate flexibility using Back-saver sit and reach test (BSS&Rt).
3. To evaluate muscle tension in terms of percentage using postural bench MF system (T-Bed).
4. To find correlation between muscle tension and dynamic balance.

HYPOTHESIS

Null hypothesis

There will be no significant correlation between muscle tension and dynamic balance and flexibility in recreational football players.

Alternative hypothesis

There will be significant correlation between muscle tension and dynamic balance and flexibility in recreational football players.

Review of the literature

Daniel Bogalho, Ricardo Gomes, Rui Mendes, Gonçalo Dias and Maria António Castro

Applied sciences 2022

The study “Impact of Flexibility on Vertical Jump, Balance and Speed in Amateur Football Players” found the Correlations between flexibility and vertical jump height, balance and speed, with moderate strength associations.

Grant v. overmoyer and Raoul F-Reiser

Journal of Strength and Conditioning Research 2015

In study “Relationship between lower-extremity flexibility, asymmetries and the Y-Balance test” Significant correlations existed between bilateral average AROM measures and bilateral average Y-Balance Test scores at the ankle and hip. Significant correlations between asymmetries in AROM and asymmetries in the Y Balance Test existed only in ankle plantarflexion with Anterior, Posterolateral, and Composite directional scores of the Y Balance Test.

Digpal Ranawat, Manan Vora, Manit Arora and Apoorva Tiwari

Journal of Sports Medicine and Therapy 2018

The study “Analysis of Posterior Chain Muscle Symmetry in Junior Badminton Players of South Asia.” reveals lumbar and pelvic load differences in amateur and professional badminton players, with professional players having more lumbar load and more experienced players having more pelvic load.

Alfonso Calvo Gonell, MsN José Aurelio Pina Romero, MsN Loreto Maciá Soler, PhD

International journal of sports physical therapy 2011

The study “Relationship between the Y-Balance test scores and soft tissue injury incidence in a soccer team.” Examine the YBT should be considered a useful tool in detecting injury susceptible subjects. The YBT could therefore be useful during pre-season testing and when attempting to determine when the player is able to return to sport after an injury.

Pantelis Theo Nikolaïdis

Baltic Journal of Health and Physical Activity 2012

The study “Age-Related Differences of Hamstring Flexibility in Male Soccer Players.” Examine that the Soccer players in lower adolescence have lower flexibility compared to older players, indicating a positive correlation between age and flexibility. Quantifying this pattern could benefit fitness trainers and physiotherapists for sport-related fitness improvement and injury prevention.

Erik Witvrouw, PT, PhD, Lieven Danneels, PT, PhD, and Dirk Cambier, PT, PhD

The American Journal of Sports Medicine 2004

The study “Open versus Closed Kinetic Chain Exercises in Patellofemoral Pain: A 5-Year Prospective Randomized Study” examine that no significant difference between both groups was observed at the 5-year follow-up for the majority of the examined parameters. However, on 3 of the 18 visual analog scales, the open kinetic chain group showed significantly less complaints compared to the closed kinetic chain group.

Mark L. Watsford, PhD, Aron J. Murphy, PhD, and Michael Makdissi, MBBS, PhD

The American Journal of Sports Medicine 2010

The study “A Prospective Study of the Relationship between Lower Body Stiffness and Hamstring Injury in Professional Australian Rules Footballers” examine that a high level of bilateral leg and hamstring stiffness may be associated with an increased risk of hamstring injury. Moreover, injured athletes' comparatively reduced hamstring stiffness in the affected limb seems to be linked to more injuries and could be a result of a weakness. Medical personnel may be able to ascertain each team sport player's hamstring risk level based on the data from the stiffness examination.

METHODOLOGY

STUDY DESIGN

An observational study repeated measures within subject design was implemented within an institutional laboratory setting which was equipped with Postural bench (Technobody, made in Italy), Y-Balance Test Kit and Standard Sit and reach box. The subjects performed the tests in a single session.

The ethics committee of Abhinav Bindra Sports Medicine and Research Institute (ABSMARI Ethics Committee) approved the study protocol (ABS-IEC-2024-PHY-071). Informed consent was obtained from all participants.

SAMPLE SIZE CALCULATION

The formula to calculate sample size for correlation is: n = [(Zα/2+Zβ)^2 / (Effect Size)^2] + 3

Where: Zα/2 is the critical value of the normal distribution for the significance level (for α = 0.05, Zα/2 = 1.96 for a two-tailed test). Zβ is the critical value for the desired power (for 80% power, Zβ = 0.84), and an effect size (d) of 0.30, the sample size of 56 participants were obtained. (15)

SUBJECTS

Fifty six healthy adults with a mean age of 22.28 ± 1.62 years, body height of 169.67 ± 5.37 cm and body mass of 71.48 ± 1.67 kg, volunteered to participate in this study. Participants were recruited through word of mouth. Healthy male individuals between the age of 18 and 24 years with the ability to perform three consecutive repetitions of the LQ-YBT, Back-Saver Sit and Reach Test.

Participants were excluded if

(1) they had any current pain, pathology or trauma;

(2) they were participating in any sports training;

(3) they had any pre-existing conditions such as recent physical injuries, musculoskeletal disorders, cardiovascular and/or respiratory diseases. (15)

OUTCOME MEASURES

The body asymmetry in terms of percentage was obtain using “postural bench by Technobody” (T-Bed), it is a sensorized bed that supports you in the analysis of postural imbalances on the patient lying down, in a decompensated posture. Postural Bench automatically detects the inclinations of the two planes using electronic inclinometers. The data recorded on the PC can be used to build a specific postural re-education plan. (19)

Dynamic balance was recorded using the Y-Balance Test Kit it is the tool used for the Lower Quarter Y-Balance Test (LQ-YBT). The kit includes a stance platform with three PVC pipes attached in the anterior, posteromedial, and posterolateral directions. The LQ-YBT (ICC = 0.88-0.99) is a test that assesses dynamic balance performance in children and adolescents. (11,35) In the test, the participant stands on one leg and reaches out with the other leg in the three directions. The participant repeats the process with the other leg. The maximum reach distance in each direction is recorded, and a composite score is calculated. The composite score is used to predict injury. (32)

Flexibility was recorded using standard Sit and reach box, the tool used for the Back-saver Sit and Reach test (ICC = 0.97) is a Sit and Reach Box, which is a sturdy box with a meter stick attached to the top. (22) To perform the test, the participant sits with one knee flexed against their chest and the other extended. They then try to touch their toes with their fingers. The test is repeated on the other side.

PROCEDURES

Profiling data were gathered following the participants' presentation and explanation of the methods and the subsequent acquisition of their informed permission. Using an electronic scale, the individual with the least amount of clothing on was used to measure body weight. Shoes were taken off in order to measure height with a stadiometer. Body weight was divided by height squared to determine BMI. (18)

Body asymmetry was examined with the Postural bench (or T-Bed), by Technobody made in Italy (figure 1). Two tilting flat surfaces (head and trunk surface A and lower limbs surface B) that pivot on the dock are features of the Postural Bench system. On the bench, the athlete is forced to lie flat. The back muscle structure contracts as you tilt the system from either end, highlighting the rotations and muscular dis-symmetry. The Postural Bench system's evaluation module makes it possible to track the posterior chain's symmetry in real time at three key locations: the scapular, lumbar, and pelvic regions. Following the two-minute test, the report (Figure 2) provides a clear image of the muscle symmetry between the right and left sides. It does this by displaying the load created from the posterior chain in percentage terms. (19)

Figure 1

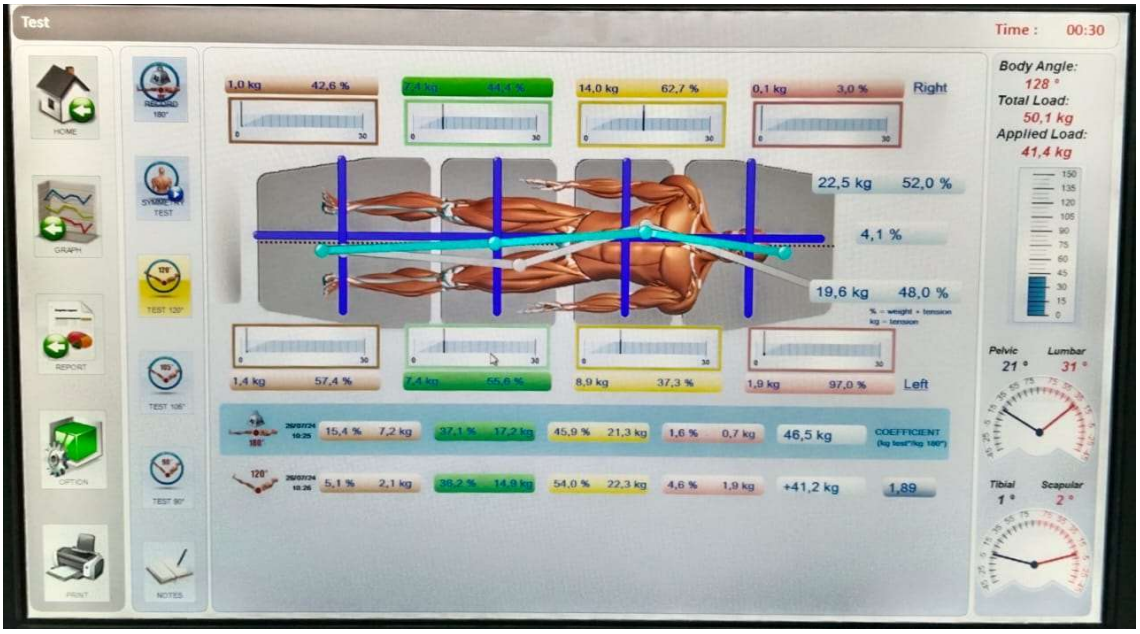


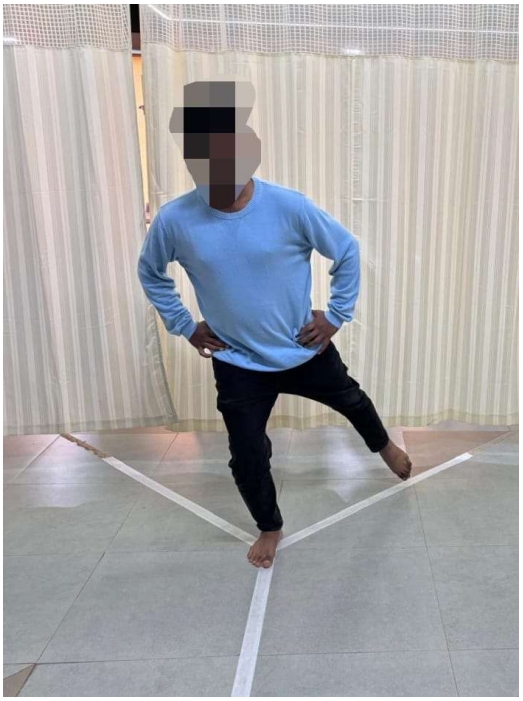
Figure 2

Dynamic balance was evaluated using the Y balance test in accordance with the methodology outlined by Shaffer et al.(11) With their hands resting on their hips and beginning in a unipedal support posture, the participants were instructed to extend their reach as far as they could in the anterior, posterolateral, and posteromedial directions of the test. To reduce the impact of a learning effect, each subject went through six training attempts. The following sequence of steps was used to complete the test: posteromedial with the right lower limb, posterolateral with the left lower limb, anterior with the right lower limb (figure 3), posteromedial with the left lower limb, posterolateral with the right lower limb, anterior with the left lower limb (11) (figure 4). After three successful testing attempts in each reach direction, the average (absolute reach distance in cm) for each lower leg was calculated for each participant. The normalized reach distance was then computed, in percentage terms, for every side and direction (absolute reach distance × actual lower limb length), and finally the composite reach distance for each side, expressed in percentage terms (the product of the three normalized reach distances and three times the lower limb's actual length × 100), with the lower limb's length being measured from the anterosuperior iliac spine (ASIS) to the medial malleolus. Attempts were discarded and repeated if the participant failed to maintain a unilateral stance, failed to maintain range foot contact with the range indicator in the target area while the indicator is in motion (kicking the range indicator to obtain a performance), using the reach indicator for support, or failed to return the reaching foot to the starting position.

Figure 3

(a) Posteromedial

(b) Posterolateral



(c) Anterior

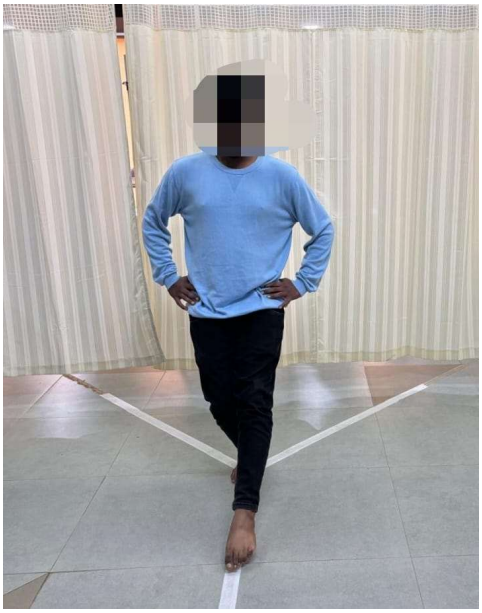


Figure 4

(a) Posteromedial

(b) Posterolateral

(c) Anterior

Flexibility was evaluated using Back-saver sit and reach test. First, participant should take off shoes. With one leg extended straight and the other bent at the knee and the foot flat on the ground, take a seat on the floor as shown in the figure 5. (20,33) The foot that is extended is pressed up against the measurement box. The person carefully stretches forward as far down the measuring line as they can while holding their hands palm down on top of each other. The fourth practice reach is held for at least one second while the distance is recorded, following the first three practice reaches. The best result will be taken after the subject takes the exam three times. (20,21,22)

Figure 5

(a)

(b)

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics 25 software (IBM Corp., Armonk, NY). The Shapiro-Wilk test was used to assess the normality of the data. (34) Pearson correlation coefficient (r) was used to correlate dynamic balance, flexibility and muscle tension. The level of significance was set at $p \leq 0.05$. (34)

RESULTS

All participants successfully completed three tests and were thus included in the data analysis. Table 1 shows the demographic data of the participants enrolled in the study. The sample included 56 adults (Table1), recreational football players, all male (age: 22.28 ± 1.62 years; height: 169 ± 5.37 cm; weight: 71.48 ± 7.9 kg; BMI: 24.15 ± 1.67 kg/m^2). Among the total participants, 48 participants were right dominant (85.714%) whereas 8 participants were left dominant (14.285%). Table 1 shows the data regarding the characterization of the sample.

Table 1 - Demographic data of the participants (n = 15)

	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2
Mean	22.28	169.67	71.48	24.15
Standard deviation	1.62	5.37	7.9	1.67

Descriptive data of the dominant side lower quadrant Y- Balance test (LQ-YBT), Back-saver sit and reach test (BSS&Rt) and Postural bench monitoring function system (T-Bed) are shown in table 2. In the dominant side, we found a significant positive correlation between LQ-YBT and BSS&Rt (Pearson coefficient r = 0.889** & significance value p = 0.000); LQ-YBT and T-Bed (Pearson coefficient r = 0.923** & significance value p = 0.000); BSS&Rt and T-Bed (pearson coefficient r = 0.825 & significance value p = 0.000) as shown in Table 3.

Table - 2

Descriptive Statistics			
	Mean	Std. deviation	N
LQ-YBT (D)	103.6327	8.05251	56
BSS&Rt (D)	29.7679	3.74404	56
T-BED (D)	47.7982	1.19689	56

Table 3

Correlation				
		LQ-YBT (D)	BSS&Rt (D)	T-BED (D)
LQ-YBT (D)	Pearson correlation r	1	0.889	0.923
	Sig. value p		0	0
	N	56	56	56
BSS&Rt (D)	Pearson correlation r	0.889	1	0.825
	Sig. value p	0		0
	N	56	56	56
T-BED (D)	Pearson correlation r	0.923	0.825	1
	Sig. value p	0	0	
	N	56	56	56

Descriptive data of the non-dominant side (ND), the lower quadrant Y- Balance test (LQ-YBT), Back-saver sit and reach test (BSS&Rt) and Postural bench monitoring

function system (T-Bed) are shown in table 4. In non-dominant side (ND) we found a significant negative correlation between LQ-YBT and BSS&Rt (Pearson coefficient r = 0.889** & significance value p = 0.000), LQ-YBT and T-Bed (Pearson coefficient r = 0.923** & significance value p = 0.000), BSS&Rt and T-Bed (Pearson coefficient r = 0.825 & significance value p = 0.000), in table 5.

Table 4

Descriptive statics			
	Mean	Std. deviation	N
LQ-YBT (ND)	105.13	8.1	56
BSS&Rt (ND)	28.81	3.68	56
T-BED (ND)	52.2	1.2	56

Table 5

Correlation				
		LQ-YBT (ND)	BSS&Rt (ND)	T-BED (ND)
LQ-YBT (ND)	Pearson correlation r	1	0.866	-0.918
	Sig. value p		0	0
	N	56	56	56
BSS&Rt (ND)	Pearson correlation r	0.866	1	-0.782
	Sig. value p	0		0
	N	56	56	56
T-BED (ND)	Pearson correlation r	-0.918	-0.782	1
	Sig. value p	0	0	
	N	56	56	56

DISCUSSION

The purpose of the study was to investigate the relationship between recreational football players' body asymmetry, flexibility, and dynamic balance. The results, which particularly highlight the distinctions between the dominant and non-dominant sides, provide insightful information about how these elements interact and affect performance.

The study revealed a significant positive correlation between flexibility, as measured by the Back-Saver Sit and Reach Test (BSS&Rt), and dynamic balance, assessed using the Lower Quadrant Y-Balance Test (LQ-YBT), for the dominant side. The Pearson correlation coefficient was $r = 0.889$ ($p = 0.000$), indicating a strong relationship between these variables. This outcome is consistent with earlier research, including studies by Watsford et al. (2010) and Witvrouw et al. (2004), which showed that increased flexibility contributes to improved dynamic balance during high-intensity movements like those found in football by improving muscle control and range of motion. (8,10)

On the non-dominant side, the correlation, however, showed a different scenario. Flexibility and dynamic balance were shown to be negatively correlated, as indicated by a Pearson coefficient of $r = -0.866$ ($p = 0.000$). This shows that improved balance may not always result from increased flexibility on the non-dominant side, possibly as a result of differences in muscular strength or coordination between the dominant and non-dominant limbs. There are some previous studies which shows that specific training is necessary to correct imbalances because increased flexibility may not be sufficient to guarantee optimal performance on the non-dominant side. (15,16,27,28)

Impact of Body Asymmetry on Balance

The T-Bed's measurement of body asymmetry revealed a strong relationship with dynamic balance as well. On the dominant side, there was a positive connection ($r = 0.923$, $p = 0.000$) between dynamic balance and body asymmetry. This shows that players may maintain effective balance on their dominant side even in situations when there is some asymmetry. This is probably because dominant limbs are used more frequently and have higher neuromuscular control. (15,16)

However, the correlation was negative ($r = -0.918$, $p = 0.000$) on the non-dominant side, suggesting that increased asymmetry is harmful to balance. This result aligns with the research conducted by Calvo Gonell et al. (2011), who proposed that asymmetry may raise the risk of injury by interfering with motor control and balance. In order to improve performance and lower the risk of injury, it is crucial to address asymmetries through strength and balance training, as indicated by the negative correlation on the non-dominant side.

Clinical implications for Training and Injury Prevention

The study's findings have a significant impact on how recreational football players are trained. Given that flexibility and balance on the dominant side are positively correlated, conditioning regimens ought to include flexibility training as a core component. The non-dominant side's negative associations, however, draw attention to the necessity of a more sophisticated training strategy. Strength and coordination

training targeting the non-dominant leg could assist improve balance and lessen the detrimental consequences of asymmetry.

Strategies for preventing injuries should also consider body asymmetry. Asymmetry tests should be a part of routine training and screening procedures since players who have more asymmetry are more susceptible to balance-related problems. To avoid injuries and boost performance overall, exercises that target minimizing asymmetry and improving control of the non-dominant side should be given priority. (25,26,27,28)

Limitations

This study has limitations even if it provides valuable insights. The sample size is relatively small consisting solely of male recreational football players between the ages of 18 and 24, but being sufficient for the statistical procedures employed. This restricts the findings' applicability to other groups, such female athletes or professional football players.

The sample consisted of healthy young adults, which may not represent broader populations.

The study assessed only correlation between body asymmetry, dynamic balance and flexibility.

Future scope in research

More varied samples and an investigation of the long-term impacts of focused therapies to improve flexibility and asymmetry on balance and injury prevention should be the goals of future research.

Conclusion

In recreational football players, this study showed a strong relationship between body asymmetry, flexibility, and dynamic balance. More flexibility on the non-dominant side correlated negatively with balance, most likely because of underlying muscular imbalances, whereas flexibility positively influence dynamic balance on the dominant side. The dynamic balance of the non-dominant side was negatively impacted by body asymmetry as well, emphasizing the necessity for focused training to resolve these disparities. In general, treating asymmetry and increasing flexibility—especially on the non-dominant side—can improve football players' performance and lower their chance of injury.

Summary

The purpose of this study was to look at the relationship between recreational football players' body asymmetry, flexibility, and dynamic balance. Tests for body asymmetry, flexibility, and dynamic balance were performed on fifty-six healthy male participants, ages 18 to 24, utilizing the Postural Bench (T-Bed), the Back-Saver Sit and Reach Test (BSS&Rt), and the Lower Quadrant Y-Balance Test (LQ-YBT). The results demonstrated a significant positive connection on the dominant side between dynamic balance and flexibility, suggesting that enhanced flexibility enhances balance. On the non-dominant side, a negative connection was discovered, indicating that if muscle imbalances are present, flexibility might not be sufficient to improve balance. Furthermore, body asymmetry revealed the negative influence of asymmetry on performance, showing a positive association with balance on the dominant side but a negative correlation on the non-dominant side. These findings highlight the necessity of focused training aimed at strengthening the non-dominant side and reducing asymmetry, which may enhance dynamic balance, maximize performance, and lower the risk of injury.

DATA AVAILABILITY STATEMENT

The datasets generated and analyzed in this study are not available to the public due to privacy and confidentiality issues. However, they can be requested from the corresponding author if needed. The original data, including raw measurements and analysis files, are securely stored and accessible upon request for research and verification purposes.

CONFLICT OF INTEREST

The authors declare that the research was conducted with no commercial or financial relationships that could be perceived as a conflict of interest.

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ANNEXURE – 1

CONSENT FORM Abhinav Bindra Sports Medicine and Reasearch Institute (ABSMARI)

Study Title: CORRELATION BETWEEN BODY ASYMMETRY, FLEXIBILITY AND DYNAMIC BALANCE IN RECREATIONAL FOOTBALL PLAYERS : AN OBSERVATIONAL STUDY

Principal Investigator: Mst. Abhishek Kumar Roy

Contact Information: abhishekroy0926@gmail.com

You are being invited to participate in a research study conducted by Mst. Abhishek Kumar Roy under the guidance of Dr. Chinmaya Kumar Patra (PT), Principal, ABSMARI. The purpose of this study is to find correlation between body asymmetry, dynamic balance and flexibility.

Your participation in this study is entirely voluntary. You may choose not to participate or to withdraw at any time without giving any reason. If you agree to participate in this study, you will be asked to perform three tests, those are T-Bed, LQ-YBT and BSS&Rt . All information collected during this study will be kept strictly confidential. The data will be stored securely and will only be accessible to the research team. Your identity will not be revealed in any reports or publications resulting from this study. If you have any questions about this study, please feel free to contact Mst. Abhishek Kumar Roy at abhishekroy0926@gmail.com. If you have any concerns about your rights as a

research participant, you may contact ABSMARI Ethics Committee at iec@absmari.com. By signing below, you indicate that you have read and understood this consent form, that you voluntarily agree to participate in this study, and that you are at least 18 years of age.

Participant's Name: _____

Participant's Signature: _____

Date: _____

Researcher's Signature: _____

Date: _____

ANNEXURE – 2

ABSMARI ETHICS COMMITTEE APPROVAL LETTER

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2024/071

Date: 22/06/2024

APPROVAL LETTER
APPENDIX- VIII

To,

Abhishek Kumar Roy
ABSMARI
273, PAHAL, BHUBANEWAR-752101

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

Protocol Title: CORRELATION BETWEEN BODY ASYMMETRY, FLEXIBILITY AND DYNAMIC BALANCE IN RECREATIONAL FOOTBALL PLAYERS: AN OBSERVATIONAL STUDY

Protocol ID.: ABS-IEC-2023-PHY-029

Subject: Approval for the conduct of the above referenced study

Dear Mr./Ms./Dr **Abhishek Kumar Roy**
With reference to your Submission letter dated 12/08/2023 the ABSMARI IEC has of the Ethics reviewed and discussed your application for conduct of clinical trial on dated 02/09/2023 (Sat Day).

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	08-08-2023
2	Informed Consent Form	08-08-2023
3	Undertaking form PI	08-08-2023
4	CRF	08-08-2023
5	COI from the Investigators	08-08-2023

The following members were present at meeting held on 02-09-2023

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Satyajit Mohanty	Director-Medcare Hospital, BBSR	Basic Medical Scientist	M	N
3	Dr. Ashok Singh Chouhan	PhD, Pharmacology, Assoc. Prof. Dept. of Pharmacology, Hi-Tech Medical College & Hospital, BBSR	Basic Medical Scientist	M	N

ABSMARI ETHICS COMMITTEE * BHUBANESWAR * Dt.

1

Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2024/071

Date: 22/06/2024

MEMBERS

Dr. Smaraki Mohanty, Clinician

Dr. Satyajit Mohanty, Basic Medical Scientist

Dr. Ashok Singh Chouhan Basic Medical Scientist

Mr. Shib Shankar Mohanty Legal Expert

Ms. Annie Hans, Social Scientist

Ms. Subhashree Samal, Lay Person

Mr. Deepak Ku. Pradhan, Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
4	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
5	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
6	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
7	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work	Social Scientist	F	N
8	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
9	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

This Committee approves the documents and the conduct for the trial in the presented form with necessary recommendation.

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and requests to be provided a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

ABSMARI ETHICS COMMITTEE Dt..... BHUBANESWAR

Yours sincerely,

22/6/24

Mr. Chinmaya Kumar Patra
Member Secretary
ABSMARI Ethics Committee
Pahal, Bhubaneswar

Member Secretary
ABSMARI ETHICS COMMITTEE

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Utkal Signature, Plot No.-273, Ground Floor, Pahal, Bhubaneswar-752101 +91-63707-03654 iec@absmari.com

ANNEXURE – 3

MASTER CHART

SL No.	AGE (years)	HEGHT (cm)	WEIGHT (kg)	BMI (m^2/kg)	Dominance	Back Saver Sit and Reach test (cm)		LQYBT								Body muscle tension	
						Dominant	Non-dominant	Anterior		Postero-lateral		Postero-medial		Comp.score		Dominant	Non-dominant
								Dominant	Non-dominant	Dominant	Non-dominant	Dominant	Non-dominant	Dominant	Non-dominant		
1	25	174	72.4	23.9	R	35.5	36	84	85.5	102	104	99.5	101	109.39	111.3	48.2	51.8
2	24	173	68	22.7	R	33.5	33	80.5	81.5	97.5	98.5	94.5	95.5	105.01	106.17	46.9	53.4
3	23	173.5	74	24.6	R	31.5	30	79	80.5	95	96.5	92	93.5	102.21	103.94	47.6	52.4
4	25	169	70.6	24.7	R	29.5	28.5	77.5	78.5	93.5	95	90.5	92	103.16	104.73	47.5	52.5
5	24	186	85	19.2	R	31	29.5	80.5	81	96	97.5	93.5	94.5	96.77	97.85	47.2	52.8
6	22	165	65.2	23.9	L	33.5	32.5	83.5	84.5	103	104.5	100	101.5	115.76	117.37	49.4	50.6
7	25	171	78	26.7	R	25.5	24	71.5	72.5	88.5	89.5	85.5	86.5	95.71	96.88	46.5	53.5
8	23	172.5	80	26.9	R	30	29.5	77.5	79	93.5	95.5	91.5	92.5	101.45	103.19	46.8	53.2
9	25	174	75.8	25	L	34	33	82	83.5	100.5	101.5	97.5	98.5	107.28	108.62	48.9	51.1
10	23	165	66.2	24	R	26.5	25	75.5	76.5	90.5	91.5	86.5	88.5	102.02	103.64	46.8	53.2
11	24	162.5	68	25.8	R	31	30.5	82	82.5	100.5	102.5	98	99.5	115.08	116.72	49.5	50.5
12	22	169.5	70.6	24.6	R	27.5	26	76.5	77.5	94	94.5	90.5	91.5	103.26	104.25	47.6	52.4
13	25	172.5	72.4	24.3	R	32.5	31.5	80.5	82	100.5	101.5	96.5	98.5	107.25	108.99	48.8	51.2
14	23	173	75	25.1	R	35.5	34	83	84.6	104.5	105.4	100.5	102.4	110.98	112.68	48.4	51.6
15	24	166	70	25.4	L	29.5	27.5	77.5	78.5	93.5	94.5	90	91.5	104.82	106.22	47.9	52.1
16	22	167.5	68.4	24.4	R	30.5	29.5	77.5	79.5	94.5	96	91.5	93	104.88	106.87	48.5	51.5
17	23	168	70.5	25	R	23.5	24.5	65.5	66.5	85	85.5	81	82.5	91.87	93.06	45.2	54.8
18	25	165	66	24.2	R	29.5	28.5	75	75.5	93.5	94.5	90.5	91.5	104.65	105.66	47.8	52.2
19	20	166	68	24.7	R	33.5	32	78.5	79.5	97.5	98.5	94.5	95.5	108.63	109.84	48.9	51.1
20	21	178	85.2	26.9	R	26.5	25.5	68.5	69.5	87.5	88.5	84.5	85.5	90.07	91.2	45.4	54.6
21	22	168	70.1	24.8	R	32	30.5	80	80.5	100.5	101.5	97.5	98.5	110.32	111.31	49.2	50.8
22	25	161	66.5	25.7	L	24.5	23.5	64.5	66	83.5	84.5	80.5	81.5	94.62	96.07	47.5	52.5
23	23	163.5	62	23.2	R	28.5	27	74.5	77.5	94.5	95.5	91.5	92.5	106.22	108.26	48.6	51.4
24	22	162	58.3	22.2	R	35.5	33.5	82.5	83.5	101.5	102.5	98	99.5	116.05	117.49	49.6	50.4
25	24	165.5	62	22.6	R	36	35.5	83.5	85	104.6	105.9	100.5	102.5	116.25	118.19	49.4	50.6
26	25	166.5	68	24.5	L	30.5	29	77.5	78.5	96	97.5	93.5	94.5	106.91	108.31	48.6	51.4
27	22	161.5	60.5	23.2	R	34.5	33	82	83.5	101	102.3	97.5	99	115.79	117.56	49.5	50.5
28	21	170.5	65.2	22.4	R	32.5	32	81	81.5	98.5	99.5	94.5	95.5	107.14	108.11	48.4	51.6
29	20	168.5	67.5	23.8	R	30.5	31.5	78.5	79.5	95	96.5	92	93.5	105.04	106.63	48.2	51.8
30	19	173.5	72.5	24.1	R	27	26.5	74.5	76.5	90.5	91.5	86.5	88	96.64	98.37	47.6	52.4
31	20	172.5	70.2	23.6	R	33.5	32	80.5	81.5	98.5	99.5	94.5	96.5	105.7	107.25	48.3	51.7
32	22	165	67.4	24.8	R	25.5	25	71	72.5	86.5	88	83.5	84.5	97.37	98.99	46.4	53.6
33	21	169.5	66.2	23.3	R	29	28	75.5	76.5	93.5	94.5	89.5	91	101.67	103.05	47.2	52.8
34	19	174.5	70.5	23.2	R	31.5	30	80.5	81.5	99	100.5	95.5	97	105.06	106.59	47.8	52.2
35	20	175	78	25.5	R	23.5	23	64	65.5	80.5	82.5	78	79.5	84.76	86.67	45.4	54.6
36	19	169	65.2	22.8	R	29.5	27.5	77.5	78.2	96.5	97.5	93	94.5	105.33	106.59	48.2	51.8
37	24	165.5	62.4	22.6	R	33	31.5	82.5	85	103.5	104.5	100.5	101.5	115.41	117.22	49.6	50.4
38	25	168.5	69.3	24.4	R	26	25	72.5	74	92.5	93	88.5	90	100.3	101.68	46.5	53.5
39	23	171.5	72.2	24.5	R	29.5	29	77.5	78.5	95.5	96.5	92.5	93.5	103.21	104.37	47.2	52.8
40	22	174.5	78.6	25.8	R	25.5	24.5	71	72.5	90	91.5	87.5	88.5	94.94	96.47	47.2	52.8
41	21	166.5	66.8	24.1	L	27.5	26.5	73.5	75.5	94.5	95.5	91.5	92.5	103.9	105.51	47.8	52.2
42	20	171.5	69.8	23.7	R	32	31.5	82.5	81.8	100	101.5	97.5	98.5	108.84	109.54	48.6	51.4
43	25	173	68.3	22.8	R	31.5	31	80.5	82	100.5	102	97.5	99	107.32	109.06	47.9	52.1
44	24	178.5	88.4	27.2	R	21.5	20.5	61	62.5	80.5	81.5	77.5	78.5	81.79	83.1	45.2	54.8
45	23	163.5	67.2	25.1	L	23.5	23	64.5	66.5	83.5	85.5	81.5	82.5	94.15	96.21	46.4	53.6
46	22	168	68.2	24.2	R	29	28.5	75.5	76.5	95.5	96.5	92.5	93.5	104.56	105.75	47.6	52.4
47	23	171	72.5	24.8	R	28.5	27.5	75.5	77	96	97	93	94	101.93	103.28	47.2	52.8
48	24	165	68.5	25.2	R	25	24	68	69.5	87.5	89.5	85	86.5	97.17	99.19	46.8	53.2
49	25	166.5	65.5	23.6	R	33	32	79.5	81	99.5	101.5	96.5	98.5	110.31	112.51	49.2	50.8
50	23	171.5	70	23.9	L	32.5	31.5	79	81.5	100.5	102	98.5	99	108.07	109.82	48.8	51.2
51	22	168.5	75.6	26.6	R	22.5	22	63.5	64.5	83	84	80.5	81	89.81	90.8	46.6	53.4
52	21	175	71.2	23.2	R	31.5	31	79.5	80.6	98.5	99.5	95	96.5	104	105.37	48.2	51.8
53	20	167	55.3	19.8	R	33.5	32	81.5	83	103.5	104.5	100.5	101.5	113.97	115.37	49.5	50.5
54	19	158	48.6	19.5	R	34	33	80.5	81.5	100.5	101.8	97.5	98.8	117.51	119.03	49.6	50.4
55	20	170.5	69.5	23.9	R	29.5	28.5	75.6	77.5	92.5	94.5	90.5	91.5	101.11	103.03	46.7	53.3
56	19	168.5	71.5	25.2	R	24	23	64.5	65	83.5	84.5	79.5	81.5	90.01	91.39	46.4	53.6