Comparison Of Asymmetry Between Shoulder Flexor And Shoulder Extensor Among Handball And Basketball Players

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Abstract

This research explored the differences in shoulder flexor and extensor muscle strength between male handball and basketball players to identify sport-specific muscle imbalances that could impact performance and injury risk. In overhead sports like handball and basketball, the shoulder muscles are vital because repetitive movements such as throwing and shooting are common. When there is an imbalance in strength between opposing muscle groups—known as muscular asymmetry—it can result in inefficient movement patterns and a higher likelihood of injuries, especially in the shoulder, which is naturally less stable than other joints. The study included 30 male athletes (15 from handball and 15 from basketball), aged 17 to 24, from the Lakshmibai National Institute of Physical Education (LNIPE), NERC Guwahati. Their shoulder flexor and extensor strength was measured using the HUMAC NORM Isokinetic Dynamometer at a peak torque of 60°/sec, which is considered an optimal angle for assessing muscle strength. A randomized control design was used, and independent T-tests were applied to analyze the data and determine the extent of asymmetry in each group. Results showed a significant difference in muscle asymmetry between the two groups ($p < 0.05$). Handball players had lower asymmetry scores (Mean = 9.80, SD = 3.96) than basketball players (Mean = 17.46, SD = 13.45). This indicates that handball players, who regularly use both muscle groups during overhead throws, have better muscle balance compared to basketball players, who tend to use their shoulder extensors more during shooting. The statistical analysis confirmed that these differences were significant and not due to chance.These findings highlight the importance of sport-specific training and injury prevention. Coaches and trainers should implement balanced strength programs targeting both the shoulder flexors and extensors, especially for basketball players who may be more susceptible to muscle imbalances. Regular isokinetic testing can help track muscle symmetry and guide personalized training plans to boost performance and reduce the risk of injuries.

Keywords

Shoulder muscle strength, shoulder flexor, shoulder extensor, isokinetic dynamometry, muscular asymmetry, handball players, basketball players, sport-specific training, injury prevention, HUMAC NORM, upper limb biomechanics.

INTRODUCTION

Today, sports are an integral part of our social lives and have secured a top position in human culture because of their challenging, competitive, and progressive nature. As we continue to seek ways to improve human physical, motor, and physiological abilities, we are reaching the limits of what can be achieved through traditional knowledge. Finding new ways to enhance performance remains a significant challenge for sports professionals. As a result, they have turned to psychology, identifying various mental factors that can impact athletic performance.

Sports are activities that engage millions of people worldwide, whether they are directly involved as players or indirectly as spectators. The media plays a significant role in engaging those who watch rather than participate. Sports are a major social phenomenon that blend both competition and teamwork. Factors such as the drive to achieve, dedication, and societal expectations all shape how people get involved and perform in sports. Sports are not just physical activities—they also have important psychological and social aspects, along with physical, physiological, and technical elements. In today's highly competitive environment, preparing athletes mentally is just as crucial as teaching them the technical skills of the game. Teams are trained not only to participate but to win, and achieving victory depends not just on skill, but also on the mindset and determination with which athletes approach the competition.

When we look at the psychological side of physical education and sports, we focus on things like motor skills, how people learn movements, and how they acquire new abilities. Recently, there has been a noticeable shift toward a more flexible and experience-based approach in sports psychology, with greater attention being paid to the behaviors of participants rather than just their outcomes. As a result, when we analyze sports from a behavioral perspective, we see that an individual's psychological, social, and emotional factors all play important roles within the context of physical activity and athletics.

Psychology helps teachers, coaches, and sports psychologists understand that while people may share some similarities, each individual is unique in terms of personality, abilities, and both natural and learned traits. Everyone reacts to situations and challenges in their own distinct ways, so it's not effective to treat all athletes the same. The foundation of athletic coaching is based on recognizing these individual differences, as every person is a unique product of nature and should be treated accordingly. In physical education and sports, psychology is not just a subject taught in classrooms; it is actively used by coaches and athletes on the field. They apply psychological techniques and coping strategies, such as visualization, concentration, and focus, to help athletes perform at their best.

Literature Review

I. **Dragana Golik-Peric1 (2011**) A study was carried out titled "Short-Term Isokinetic Training versus Isotonic Training: Effects on Asymmetry in Strength of Thigh Muscles." The purpose of this research was to compare how two different training methods affect the isokinetic performance of athletes. The study involved 38 athletes, with an average age of 23.3 years (± 3.6), all of whom competed in national-level sports leagues and had an initial concentric hamstring-to-quadriceps (conH/Q) torque ratio below 0.5. During the sports season, knee extensor and flexor strength was measured using isokinetic testing at a speed of 60°/s. The participants were split into two groups: one group of 19 athletes followed an isokinetic training program (IT), while the other 19 athletes completed an isotonic training program (RT). Both training programs lasted for four weeks. After finishing the training, both groups participated in a final isokinetic assessment.

II. **Gaël Guilhema, b. (2017)** The goal of this study was to standardize isotonic (IT) and isokinetic (IK) eccentric exercises by matching both the amount of work done and the angular velocity at two different intensity levels, in order to accurately compare how each exercise type affects the neuromuscular system. Fourteen participants took part in three testing sessions, each involving two sets of IT and two sets of IK exercises using a specially designed isokinetic dynamometer. For the IT sets, participants performed eight

eccentric knee extensor contractions at 120% of their one-repetition maximum (1RM) during the first two sessions, and at 100% 1RM in the third session. The IK sets were carried out at the same average angular velocity as the IT sets and were stopped once the total work matched that of the IT sets.

III. **Dragana Golik-Peric1 (2011)** The purpose of this study was to examine how two different training methods affect the isokinetic performance of athletes. The research involved 38 athletes, with an average age of 23.3 years (± 3.6), all of whom competed in various national sports leagues and initially had a concentric hamstring-to-quadriceps (conH/Q) torque ratio below 0.5. During the sports season, their knee extensor and flexor strength was measured isokinetically at a speed of 60º/s. The athletes were split into two groups: one group of 19 followed an isokinetic training program (IT), while the other 19 completed an isotonic training program (RT). Both training programs lasted for four weeks. After the training period, both groups were tested again using isokinetic measurements. The results showed that both groups experienced significant improvements in peak torque for both the extensor and flexor muscles after training ($p < 0.05$)

IV. **T.L. Wang1(2014)** The objective of this study was to review existing research on the effectiveness of isokinetic training for patients with shoulder impingement syndrome (SIS). To do this, studies published up to March 2011 were identified using databases such as Plumed, Scopus, Lilacs, the Physiotherapy Evidence Database, and the Cochrane Library, with the keywords “isokinetic,” “shoulder,” and “impingement.” References from these studies were also examined. Studies were included if isokinetic training was used as part of the treatment for shoulder impingement or other shoulder conditions causing impingement-related pain. All selected studies provided information on the level of evidence, patient details, treatment methods, outcome assessments, results, any complications, and return-to-work rates. In total, two randomized controlled trials (RCTs) and four studies with level 4 evidence met the inclusion criteria.

V. **C. Tourny (2000)** The purpose of our study was to compare the isokinetic concentric (at speeds of 60°, 120°, and 240° per second) and eccentric (at 60° and 120° per second) knee muscle strength on both sides of soccer players, considering their positions on the field. We measured the hamstring and quadriceps strength of 21 soccer players using a Kin-Com R (Kinetic Communicator) isokinetic dynamometer. Overall, we did not find a significant difference in muscle strength between the dominant and non-dominant legs, except for the hamstrings during concentric contractions at a speed of 240° per second. Additionally, both concentric and eccentric strengths of the knee flexors and extensors decreased as the angular speed increased.

VI. **Mohammad Faiz Abdul Rahim (2017)** The shoulder joint is considered the most vulnerable part of the kinetic chain in weightlifting. This study aimed to compare the impact of adding isokinetic versus isotonic shoulder training—and then stopping that training—on two-dimensional movement patterns and barbell speed during a one-repetition maximum power clean and power snatch in advanced adolescent weightlifters. Nineteen participants were assigned to either the isokinetic or isotonic training group. All athletes were selected from the same group of advanced weightlifters who were already following a required training program under their coach.

VII. **MI-Kyoung Kim, J. H. (2015)**[1] A study titled "Effects of Different Types of Exercise on Muscle Activity and Balance Control" was conducted to examine how isotonic, isokinetic, and isometric exercises for the ankle joint muscles influence muscle activity in the lower limbs and balance control. The research involved 30 healthy adults, who were randomly divided into three groups of 10, each group performing a different type of exercise. Using multivariate analysis of variance, the study found that the type of exercise significantly affected muscle activity in the non-dominant tibialis anterior, gastrocnemius, and peroneus longus muscles during weight-bearing on the non-dominant side. When the dominant side was weight-bearing, significant differences in muscle activity were observed in the dominant gastrocnemius and peroneus longus. Additionally, both the non-dominant and dominant sides showed notable differences in balance control based on how long support was maintained in the tested area. Muscle fatigue resulting from all three exercise types led to reduced muscle activity and impaired balance control, and interestingly, even the side that did not perform the exercises was affected due to pre-exercise fatigue.

VIII. **Balakrishnan, J. P. (2014)** Strengthening exercises are commonly prescribed for people with orthopedic conditions and for athletes to boost muscle force and help prevent muscle imbalances or joint injuries. Research has shown that isometric contractions can quickly enhance quadriceps strength. The main goal of this study was to assess how isometric strengthening exercises affect quadriceps strength at 45 and 90 degrees of knee flexion, and to compare the effects at different knee angles between a control group and an experimental group. This comparative experimental study involved forty healthy female participants from the physiotherapy department at KPJ Healthcare University College, Malaysia. The results showed a significant increase in quadriceps strength at 45 degrees of knee flexion ($P<0.01$). The study concluded that isometric strengthening exercises improve quadriceps strength at both 45 and 90 degrees, with a greater improvement observed at 90 degrees compared to 45 degrees.

Methodology

Methodology refers to the approach and methods used in a research study. It plays a crucial role in any type of research. In this chapter, the steps taken for choosing participants, selecting variables, determining measurement criteria, ensuring data reliability, designing the experiment, collecting data, administering tests, and the statistical methods used for data analysis are all explained.

1. Selection of Subjects

For this study, 15 handball players and 15 basketball players will be randomly chosen from the student body at LNIPE, NERC Guwahati. To test the strength of the shoulder extensors and flexors, the participants will be divided into three groups: one experimental group focusing on shoulder extensors, another experimental group focusing on shoulder flexors, and a control group.

2. Selection of Variables

The variables chosen for this study were selected based on a review of existing literature, consultations with experts, and the researcher's own knowledge and insights.

a) Independent Variables

Asymmetry between strength of shoulder flexor muscle and shoulder extensor muscle.

b) Dependent variables

The asymmetry was depending on the sports from where they belong i.e. Handball and Basketball.

3. Criterion measures

S. NO.	ITEM	EQUIPMENT	UNIT
1	Strength of Deltoid muscle	HUMAC NORM ISOKINETIC DYNAMOMETRY	Nm
2	Strength of Bicep muscle	HUMAC NORM ISOKINETIC DYNAMOMETRY	Nm
3	Strength of triceps muscle	HUMAC NORM ISOKINETIC DYNAMOMETRY	Nm

The scores achieved by the subjects in the strength of Shoulder flexor and shoulder extensor were considered as the Criterion measure for symmetry between strength of shoulder flexor and Shoulder extensor muscle among handball and basketball players.

- The Maximum strength of the muscle at peak torque was measured at 60% sec. protocol.
- The weight of the subjects was recorded in kilograms with the standard weighting machine.
- The height of the subjects was recorded in centimeters.

4. Research Design

Following methods and procedures were used in data collection and analyzing measure of variables specified below:

5. Selection of Tests

The Humac Norm dynamometer was used to assess the strength of the shoulder flexor and extensor muscles in the players. This HUMAC NORM ISOKINETIC DYNAMOMETRY device is considered one of the best tools globally for measuring muscle strength asymmetry at peak torque, specifically at 60 degrees per second, which is regarded as the optimal angle for evaluating muscle strength.

Procedure for Collection of Data

The 30 students selected from LNIPE NERC, Guwahati were split into three groups of equal size. Each participant was contacted and informed about the study's objectives. All subjects received clear instructions on the testing procedures in the Sports Training Lab. Their shoulder muscle strength was measured using the HUMAC NORM ISOKINETIC DYNAMOMETRY device. Both the experimental and control groups underwent strength testing of the shoulder muscles at 60% per second using the isokinetic protocol, and peak torque values (in Nm) were recorded for each participant. The collected data was then analyzed using suitable statistical methods.

Results of the study

This study was designed to evaluate the asymmetry between the shoulder flexor and extensor muscles in handball and basketball players. Thirty male students from LNIPE, NERC Guwahati, aged 17 to 24 years, participated in the research. They were evenly divided into two groups: one for handball players and one for basketball players.

The research followed a true random group design, with 15 participants in each group, all within the age range of 17 to 24 years. To assess muscle asymmetry, the Humac Norm Isokinetic Dynamometry system by CSMi was used to measure peak torque at 60% per second for both groups. The collected data was analyzed using SPSS software, employing descriptive statistics and independent T-tests to determine if there were significant differences at the 0.05 level of confidence.

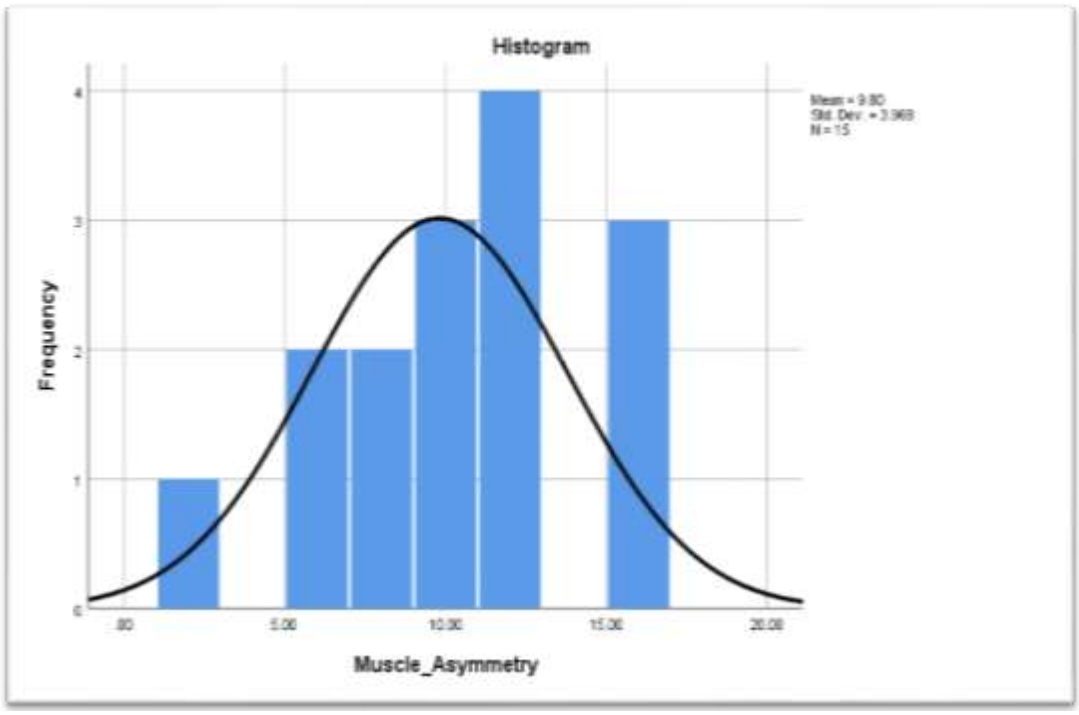

Figure- 1

Figure 1- Shows test of Normality and Shows the Normal Curve of Handball Players.

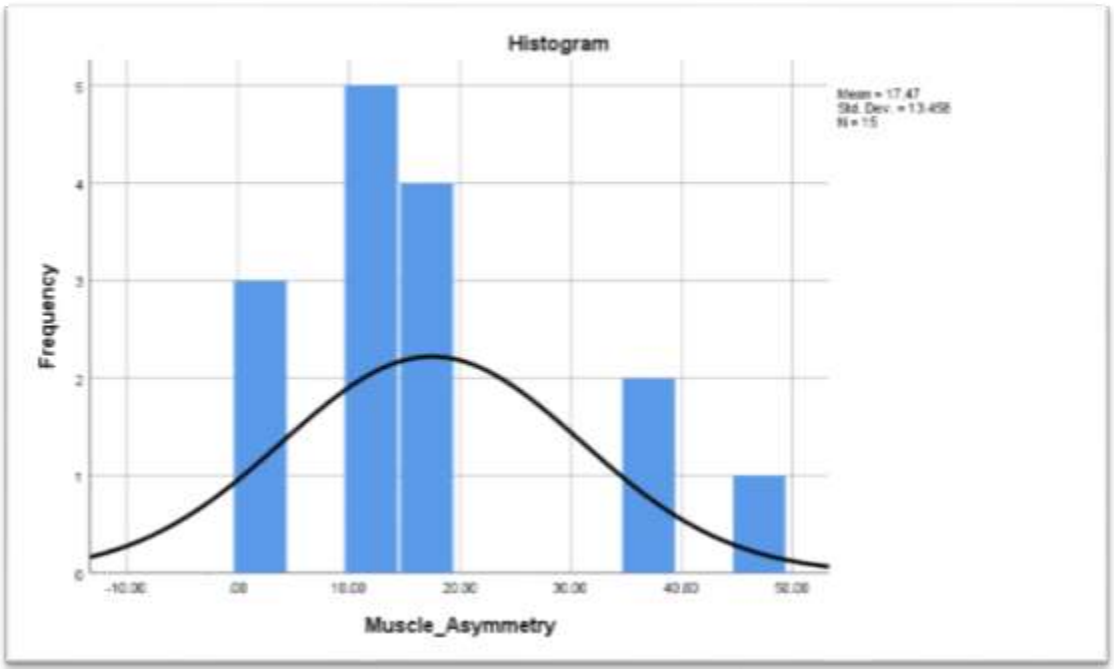

Figure - 2

Figure 2- Shows test of Normality and Shows the Normal Curve of Basketball Players

Hence, the criteria of normality were satisfied for both the Handball and Basketball groups.

Tests of Normality							
		Kolmogorov-Smirnov			Shapiro-Wilk		
	Sports	Statistic	df	Sig.	Statistic	df	Sig.
Muscle Asymmetry	Handball	.105	15	.200*	.972	15	.892
	Basketball	.255	15	.010	.876	15	.041
*. This is a lower bound of the true significance.							

Table 1- Test of Normality

The Kolmogorov-Smirnov (K-S) test results showed that the asymmetry scores for handball players, D(15) = 0.105, p = 0.20, and for basketball players, D(15) = 0.255, p = 0.010, were both evaluated for normality. According to the K-S test, a p-value greater than 0.05 indicates that the data are normally distributed. In this case, the handball players' p-value (0.20) is above 0.05, confirming normal distribution for this group. However, the basketball players' p-value (0.010) is below 0.05, which actually suggests that their scores are **not** normally distributed. Therefore, only the handball players' scores can be considered normally distributed based on these K-S test results, while the basketball players' scores do not meet the normality assumption.

Descriptive					
	Sports			Statistic	Std. Error
Muscle Asymmetry	Handball	Mean		9.8000	1.02446
		95% Confidence Interval for Mean	Lower Bound	7.6027	
			Upper Bound	11.9973	
		5% Trimmed Mean		9.8889	
		Median		10.0000	
		Variance		15.743	
		Std. Deviation		3.96773	
		Minimum		2.00	
		Maximum		16.00	
		Range		14.00	
		Interquartile Range		5.00	
		Skewness		-.186	.580
		Kurtosis		-.419	1.121
	Basketball	Mean		17.4667	3.47490
		95% Confidence Interval for Mean	Lower Bound	10.0138	
			Upper Bound	24.9196	
		5% Trimmed Mean		16.6296	
		Median		13.0000	
		Variance		181.124	
		Std. Deviation		13.45822	
		Minimum		2.00	
		Maximum		48.00	
		Range		46.00	
		Interquartile Range		9.00	
		Skewness		1.115	.580

Table-2 Descriptive statistics

This descriptive statistics shows that less muscle asymmetry in the Handball players, M=9.80, 95% CI [7.60, 11.99], SD= 3.96, than Basketball players, M= 17.46, 95% CI [10.01, 24.91], SD= 13.45.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Muscle Asymmetry	Equal variances assumed	7.792	.009	-2.116	28	.043	-7.66667	3.62277	-15.08757	-.24576
	Equal variances not assumed			-2.116	16.415	.050	-7.66667	3.62277	-15.33082	-.00251

***Significant at 0.05 level**

Table 5- Independent Samples Test

This table showed the Levene's test is non-significant $p > .05$, (because $p > .009$, which is greater than .05), so the test statistics in the row equal variances assumed, $t(28) = -2.116$, p is .043, which is less than .05 and it can be concluded that there was a notable difference in the average muscle asymmetry between handball players and basketball players.

Handball Players had less asymmetry (M= 9.80, SE= 1.04) than Basketball Players (M= 17.46, SE= 3.29). This difference, 7.66, BCa 95% CI [-15.25439, -.94995], was significant $t(28) = -2.116$, $p < .043$.

Thus, it may be concluded that Handball Players has less asymmetry between shoulder flexor and shoulder extensor than Basketball Players.

Hence, it may be inferred that Handball Players has using both the muscles almost equally in shooting as compare to Basketball Players because in Basketball they usually use shoulder extensor muscle more in shooting.

Discussion of Finding

This study compared shoulder flexor and extensor muscle asymmetry between handball and basketball players. The findings showed that there was a meaningful difference in muscle balance between the two groups. Basketball players exhibited greater asymmetry, predominantly relying on shoulder extensor muscles during shooting actions. In contrast, handball players engaged both shoulder flexor and extensor muscles more equally during throwing motions. The study's statistical analysis indicated that the asymmetry scores for handball players ($D(15) = 0.105$, $p = 0.20$) were lower and more normally distributed compared to basketball players ($D(15) = 0.255$, $p = 0.01$). These results indicate that muscle imbalances in basketball players could raise their chances of shoulder injuries. This highlights the importance of implementing balanced training routines that strengthen both muscle groups, which can help improve performance and lower the risk of injury

Summary

The aim of this study was to evaluate the difference in strength between the shoulder flexor and extensor muscles in handball and basketball players. Participants, aged 17 to 24 years, were chosen from the Lakshmibai National Institute of Physical Education. For the study, they were divided into two groups: one consisting of

handball players and the other of basketball players. For the assessment of strength of shoulder flexor and shoulder extensor muscles Humac Norm Isokinetic Machine was used at peak torque of 60 % which is the best angle to measure strength. 15 students from each group were there for the study. There was no treatment or motivational technique used in the study. The research selected one Independence variable that is asymmetry of the muscle. To analyze the data collected from the isokinetic machine, the researcher applied various statistical tests using the SPSS software package, version 20. Handball players had less asymmetry between shoulder flexor and shoulder extensor than Basketball players. Hence, it may be inferred that Handball players has using muscles almost equally as compared to basketball players. To analyze the data the researcher employed Descriptive statistics and T-test between both the groups as a statistical technique the level of significance was 0.05. The findings of the study show that there is a notable difference in the asymmetry between the shoulder flexor and extensor muscles when comparing handball players to basketball players. Additionally, the comparison of the average values between the two groups also reveals a significant difference.

Conclusions

Jorge et al. pointed out in their research that muscle strength imbalances can be detrimental to elite athletes, as significant asymmetries may increase the risk of muscle injuries and negatively impact athletic performance. Therefore, it is important to monitor how these imbalances develop in athletes from sports such as handball, basketball, soccer, and volleyball. The purpose of their study was to determine whether isokinetic muscle imbalances exist among professional athletes in different sports and to explore how these imbalances relate to their specific athletic activities.

The study used an observational, analytical, and cross-sectional design, evaluating 86 athletes (14 handball, 27 basketball, 25 football, and 20 volleyball players) with a Biodex Medical System isokinetic dynamometer. The main measurements included bilateral differences and the hamstring-to-quadriceps ratio at angular velocities of 60°/sec (4 repetitions) and 180°/sec (6 repetitions). The results showed that while the unique movements required by each sport do not necessarily lead to significant muscle imbalances, every sport does demand a distinct isokinetic muscle profile.

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