Original Article

Comparison of Isokinetic Strength Parameters of Quadriceps in Athletes and Non-Athletes

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ABSTRACT

OBJECTIVE: To compare the quadriceps isokinetic strength parameters of athletes and non-athletes.
METHODOLOGY: The cross-sectional study was conducted from July to December 2019 at the Pakistan Sports Board, Islamabad. The sample size was 81, selected through a non-probability convenience sampling technique and calculated by the Rao Soft tool. The 41 participants were in the athletes' group, and 40 were in the non-athletes' group. Individuals with a history of sprain, strain, or fracture in the lower limbs within the last six months were excluded. The self-structured questionnaire includes demographic data, waist-to-hip ratio, thigh circumference, peak torque values and agility t-test score. The isokinetic strength of the right lower limb (RLL) was measured via Biodex system Pro 3. Data was analyzed through SPSS 22, and an independent t-test was applied for analysis between groups. Pearson test was used for the correlation coefficient.
RESULTS: Athletes had significantly higher quadriceps muscle strength than non-athletes (p<0.001), indicating the positive impact of regular sports participation and physical training. Quadriceps peak torque positively correlated with thigh circumference (r=0.60, p<0.001), consistent with previous studies. Surprisingly, athletes exhibited a weak to moderate negative correlation between quadriceps peak torque and agility (r=-0.35, p<0.05), suggesting a potential trade-off between muscle mass and agility performance. Increased muscle bulk may compromise speed and flexibility.
CONCLUSION: Athletes demonstrated superior quadriceps muscle strength, emphasizing the positive influence of sports involvement and physical training; thigh circumference positively correlated with Quadriceps peak torque, and Agility negatively correlated with quadriceps peak torque.

KEYWORDS: Athletes and Non-athletes, Correlation, Isokinetic, Peak torque

INTRODUCTION

Quadriceps performance, the strength and power generated by the muscles in the front of the thigh, is a crucial aspect of human movement. Whether a professional athlete or a healthy person enjoys an everyday life, the health and function of the quadriceps play a pivotal role in everyday activities[1]. The quadriceps, a group of four muscles located in the front of the thigh, is responsible for extending the knee and is involved in various movements such as walking, running, jumping, and cycling. In athletes, these muscles are especially vital, as they are essential for sports performance. Whether it's a sprinter exploding off the starting line, a basketball player making a jump shot, or a soccer player executing a powerful kick, strong and responsive quadriceps are indispensable[2]. Athletes and their performance depend on many intrinsic and extrinsic factors. Intrinsic factors refer to physiological attributes that include cardiovascular fitness, muscle strength and flexibility[3]. These attributes are crucial for enhancing athletic performance and overall physical capacity[4]. On the other hand, extrinsic factors comprise various elements such as training methods, coaching techniques, nutrition, and psychological factors like motivation and mental resilience[5]. These outside factors are vital in optimizing performance and supporting athletes' physical and mental well-being[6].
Performance parameters in athletes are diverse and reflect the specific demands of each sport or activity. These parameters typically include strength, speed endurance, Agility, power, and skill proficiency[7]. By assessing these parameters, coaches, researchers, and sports scientists can evaluate athletic performance, track progress, and compare individuals within a specific sport or across different sports[8]. Dynamometers are frequently employed when assessing muscular strength and power. Isokinetic

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dynamometers, for example, offer precise muscle strength measurements through the evaluation of joint torque and velocity during controlled movements[9]. These measurements are particularly relevant for assessing knee extensors and flexors, critical muscle groups for athletic performance[10]. Quadriceps weakness creates a muscular strength imbalance in females' knees. The study demonstrated that men's and women's Quadriceps/Hamstrings peak torque ratios were not different at low isokinetic angular velocities. In contrast, significant differences were observed between the sexes at high isokinetic angular velocities. It should be noted that some of these data were obtained from recreational athletes or non-athletes, disregarding the effects of sport-specific training on the development of muscle strength[11].

The literature determines that quadriceps' peak torque can affect strength, power, Agility, and speed. These parameters are essential for good athletic performance. As it is well established in athletes that high peak torque is achieved at low angular velocity, this phenomenon was not previously documented in non-athletes. Suppose we can determine that the same scientifically-proven effect also occurs in non-athletes. In that case, it enhances strength and other fitness components in non-athletes using similar approaches. In previous studies, it is concluded that the strength of the quadriceps depends on the quadriceps torque, while as per our information, there is no study conducted yet that compares the quadriceps torque of athletes with no athletics, so this study aims to determine the comparison of isokinetic strength parameters of quadriceps in athletes and non -athletes

METHODOLOGY

A comparative cross-sectional study was conducted from July to December 2019 at the medical centre of Pakistan Sports Board Complex, Islamabad. The study included a total sample of 81 individuals, with 40 athletes and 41 non-athletes, selected using non-probability convenience sampling. Encompassed individuals of both genders, aged 18-35 years, engaged in sports participation or gym training for a maximum of three times and one time per week for athletes included. The exclusion criterion comprised a lower limb sprain, strain, or fracture history within the last six months.

The participants completed a self-structured questionnaire to gather relevant information. The isokinetic strength of the participants' right lower limb (RLL) was measured using the Biodex System Pro 3 [12]. The isokinetic testing procedure was performed with the participants seated, and their trunks, thighs, and tibias were secured to prevent extraneous joint movement. The knee was positioned at 90 degrees of flexion, aligning the dynamometer arm with the outer femoral condyle. Participants were instructed to extend and flex the lower limb as rigidly and quickly as possible, within a full range of motion. Verbal encouragement was provided during each trial, emphasizing maximum effort in one direction of movement. Participants were also instructed to keep their arms crossed over their chest to isolate knee joint flexion and extension[13]. Repetitions were performed at speeds of 60 degrees/sec and 210 degrees/sec. To assess Agility, the T-test was employed as a fitness test[14,15].

Approval for the study was obtained from the institutional Research Ethics Committee (REC) of Riphah College of Rehabilitation Sciences (RIPHAH/ RCRS/REC/Letter-0399). Informed consent was also obtained from all participants involved in the study. The data was analyzed using SPSS for Windows software version 22, with a statistical significance level set at p=0.05. The Shapiro-Wilk test usually distributed and assessed the data, so independent t-tests were applied for between-group analysis. The correlation coefficient was evaluated using the Pearson correlation test.

RESULTS

The demographic data of athletes and non-athletes showed no significant difference (p>0.05) between groups based demographic data. In terms of sports type, the athlete group included most participants in cricket (55%), tennis (32.5%), gymnastics (7.5%), and football (5%), while the non-athlete group did not participate in any specific sports. The mean BMI of the athlete group was 24.91±5.45 kg/m2, and the mean BMI of the non-athlete group was 24.79±5.145 kg/m2. (**Table I**)

Table II showed the quadriceps peak value at a rate of 60°/s, 210°/s, agility T-test fitness measure, and thigh circumference was significantly higher in athletes compared to non-athletes (p-value<0.001).

In Non-athletes, a correlation between PTQ at 60 degrees with Agility was weak positive (r= 0.177, p=0.267), with BMI moderate positive (r= 0.498, p=0.001), and thigh circumference strongly positive (r= 0.620, p=0.001). The correlation between PTQ at 210degree with Agility was weak positive (r= 0.395, p=0.011), with BMI moderate positive (r= 0.411, p= 0.165), and thigh circumference was strongly positive (r= 0.605, p=0.144) **Graph I.**

In athletes, a correlation between PTQ at 60 degrees with Agility was moderate negative (r= -0.468, p=0.002), BMI was weak negative (r= -0.190, p= 0.291), and thigh circumference was weak positive (r= 0.314, p=0.048). The Correlation between PTQ at 210 degrees with Agility was weak negative (r= -0.292, p= 0.68), with BMI was weak negative (r= -0.310, p=0.165), and with thigh circumference was weak positive (r= 0.235, p= 0.144) **Graph I**.

Table I: Shows Demographic Values of Athletes and Non-Athletes

Group		Athlete (n=40)	Non-Athlete (n=41)	P value
Age of Participants	18-22y	27(67.5%)	31(75.6%)	0.31
	23-28y	11(27.5%)	10(24.4%)	
	29-35y	2(5.0%)	0	
Gender	Male	30(75%)	25(61%)	0.17
	Female	10(25%)	16(39%)	
Type of Sports	Cricket	22		
	Tennis	13		
	Gymnastic	03		
	Football	02		
Height (Mean±SD)		5.47 ± 0.491	5.33 ±0.51	0.21
Weight (Mean±SD)		65.63 ± 12.07	62.56 ± 14.65	0.31
BMI (Mean±SD)		24.91 ± 5.45	24.79 ± 5.145	0.91

Table II: Comparison Mean ± Standard Deviation Values of Athletes and Non-Athletes

	Athletes Mean±SD	Non-athletes Mean±SD	P-value
Quadriceps Peak Value at RLL 60°/s	50.94±12.16	28.76±7.01	0.001
Quadriceps Peak Value at RLL 210°/s	24.90±12.6	15.076±7.01	0.001
Agility T-test	12.66±0.94	13.82±1.58	0.001
Thigh Circumference	19.78±1.34	19.12±1.89	0.050

DISCUSSION

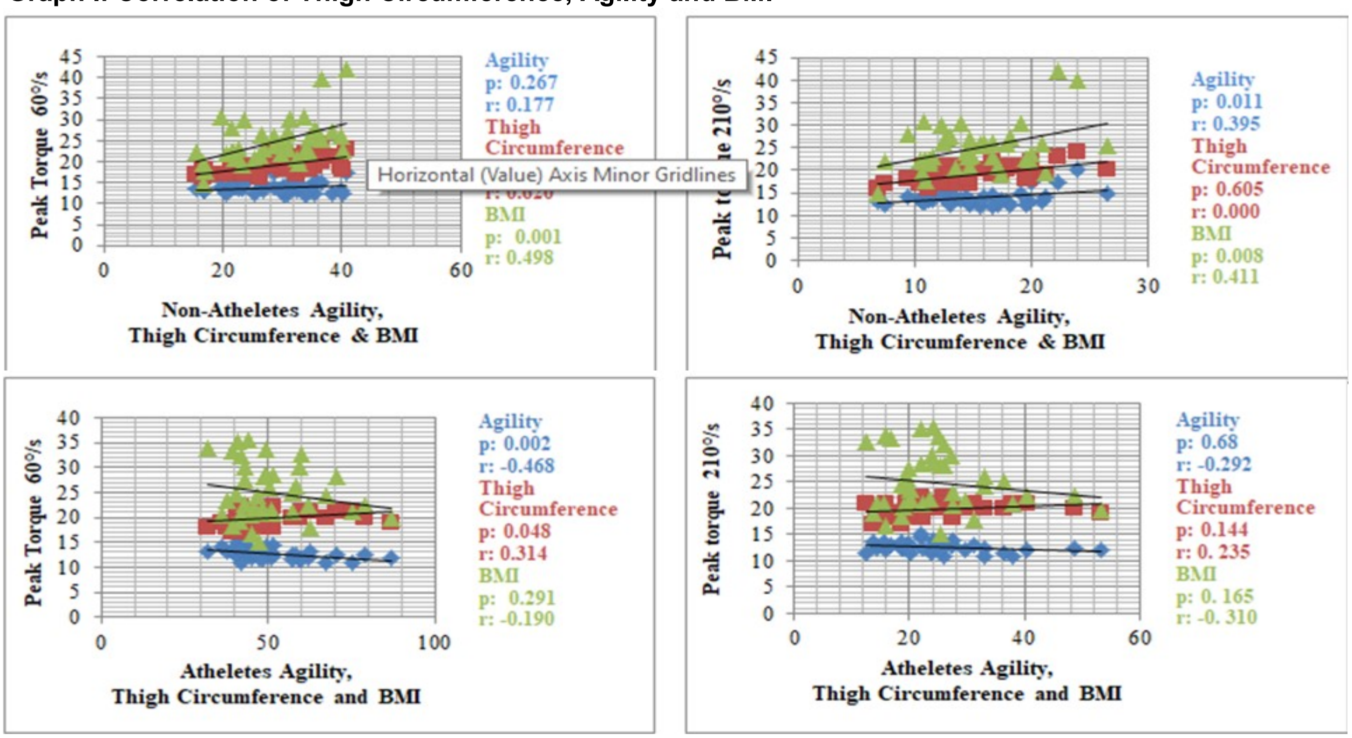
The study analyzed the differences in quadriceps peak torque, Agility, and thigh circumference between athletes and non-athletes. The results indicated significant differences between the two groups in all the variables studied. The athletes had higher quadriceps peak torque, Agility, and thigh circumference values than the non-athletes. The correlation analysis showed a weak to moderate negative correlation between quadriceps peak torque and Agility and a weak to moderate positive correlation between quadriceps peak torque and thigh circumference in athletes and non-athletes.

The findings of this study are consistent with previous research that has reported a positive association between muscle strength and athletic performance. Studies have shown that athletes generally have higher muscle strength levels than non-athletes, likely contributing to their superior athletic performance[16,17]. The correlation between quadriceps peak torque and thigh circumference is also consistent with previous studies that have suggested a positive association between muscle size and strength[18].

However, the weak to moderate negative correlation between quadriceps peak torque and Agility in athletes is somewhat surprising, as one would expect higher muscle strength to be associated with better agility performance[19]. One possible explanation for this finding is that excessive muscle mass can sometimes hinder agility performance by reducing speed and flexibility[20].

The pathophysiology underlying the findings in this

Graph I: Correlation of Thigh Circumference, Agility and BMI



study is likely related to the adaptations that occur in response to regular physical activity and training. For example, regular exercise can increase muscle fibre size (hypertrophy) and improve neuromuscular recruitment and coordination[21,22]. These adaptations can increase muscle strength, power, endurance, Agility and speed improvements. Biomechanically, the differences observed in this study may be explained by the principles of force production and force absorption[23]. Athletes are exposed to repetitive and high-intensity loading that requires their muscles to quickly generate large amounts of force, whereas non-athletes are less exposed to these demands. As a result, athletes may have a greater capacity for force production and absorption, leading to increased muscle size and strength[24]. Additionally, the muscle size and strength of the quadriceps may contribute to agility performance by improving stability, balance, and control during directional changes and rapid movements[25]. Overall, the pathophysiological and biomechanical mechanisms underlying the findings in this study are complex and multifactorial and likely involve a combination of physiological and mechanical adaptations in response to physical activity and training.

CONCLUSION

The present study reveals that the quadriceps attained their maximum PTQ value at the lowest velocity, whereas lower PTQ values were observed at the highest velocity. In non-athletes, PTQ at the lowest angular velocity showed weak positive correlations with Agility and moderate positive correlations with BMI. In contrast, a strong positive correlation was observed with thigh circumference. In athletes, PTQ at low velocity exhibited a moderate negative correlation with Agility and weak positive correlations with thigh circumference. PTQ at high angular velocity showed weak negative correlations with Agility and BMI.

Ethical permission: Riphah College of Rehabilitation Sciences, Riphah International University, Islamabad, Pakistan REC letter No. RIPHAH/RCRS/REC/Letter-0399.

Conflict of Interest: The authors have no conflict of interest to declare

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AUTHOR CONTRIBUTIONS

Memon AG: Conception and design, drafting of article, final approval
Afzal MF: Critical revision for the important intellectual content
Khan MMH: Analysis and interpretation of data
Bansari SK: Assembly of data
Saeed A: Data collection, Assembly of data
Sanaullah M: Data collection

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