

Quantification of strength of muscles of lower extremity in elite athletes participating in badminton and squash by hand held dynamometer

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Objective: To quantify the strength in various muscle groups of lower extremity in young male athletes of badminton and squash by using hand-held dynamometer.

Methodology: In this cross sectional study, 31 elite athletes were selected through non probability convenience sampling. Strength of 10 muscle groups of lower extremities was measured in short sitting, prone and supine lying. The mean of three measurements was taken as reference value. The mean strength was then used to quantify strength of various muscle groups of lower extremity. The strength between both groups was then compared by independent sample t-test. The data were analyzed by

SPSS version 25.

Results: The flexors and extensors of hip and knee region were among the stronger muscle groups in both badminton and squash players. The muscles of ankle had less strength. The strength difference between various muscles of both groups was insignificant. Both groups showed more strength on dominant side as compared to non-dominant one.

Conclusion: The quantification of strength by hand-held dynamometer in young male players of badminton and squash showed varied range of strength in various muscles of lower extremity.

Keywords: Muscle strength, muscle strength dynamometer, athletes, lower extremity.

INTRODUCTION

Muscle strength is the peak force produced by a muscle group, is a vital constituent of muscle function which ensures mobility, functional independence and participation in various demanding tasks.^{1,2} Hand-held dynamometers are used as conveniently handy instruments, with their validity and reliability studied in comparison with isokinetic dynamometer.³ The dynamometric measurement of strength has been highlighted in competitive sports due to its objective approach over conventional method of measurement of muscle strength.^{4,5} It accommodates the idea of strength variation in healthy population in comparison with subjective approach of manual muscle testing.^{6,7} Various studies have provided with quantitative measurement of strength with age, sex, height, body weight, muscle mass and activity level.^{8,9} Along with jumps, lower extremity movement patterns involve swings and quick footwork required to move shuttle back and forth in the court.¹⁰ The muscle strength therefore, is one of the key components for coordination of movements and maintenance of balance. Agile jumping and overhead strokes do not constitute usual pattern of game in squash. However, it has been found that in comparison with badminton, players of squash

are prone high rate of injury in lower extremities as compared to other areas of body.^{11,12}

The normal muscle strength of athletes and considerable strength differences in both sports therefore, is one of the key factors that needed to be explored regarding the mechanics involved. In existing literature, there are studies that measure the strength of different muscle groups to devise reference data in athletes of different sports especially soccer. Many studies have focused area of hip and knee exploring strength variation in hamstrings and quadriceps and there are comparatively less studies that explore ankle muscles.^{13,14}

METHODOLOGY

This comparative cross sectional study included 31 male athletes of Squash and Badminton in age group of 18-26 years selected by non-probability convenient sampling technique. The study was approved by institutional review board of University Institute of Physical therapy, University of Lahore (IRB number 498-1) and an informed consent was signed by all participants. Those having any comorbid condition, recent injury within last 6 months or were at rest for last 6 months were excluded. The dominant extremity was right side in all athletes, based on the hand used to hold racket.

Hydraulic Hand-Held Pull-Push dynamometer was used to for measurements. The basic protocol of isometric make test to measure the strength of various muscle group of lower extremity was used.^{15,16} Single male therapist measured the strength by taking three readings. To measure the strength of hip, knee and ankle muscles the positions were adopted that showed strong reliability previously (Table 1).¹⁷ The mean value of three measurements is considered as reference value to compare strength of various muscle groups of lower extremity in athletes.

Statistical Analysis: Data were analyzed on SPSS version 21. The independent sample t-test was used to compare the strength differences in squash and Badminton players. $p < 0.05$ was referred to as showing significant difference.

RESULTS

The demographic characteristics of both groups are shown in Table 2. The mean of three measurements of different muscle groups of lower extremity among players of badminton and squash in age group of 18 – 26 years is illustrated in Table 3.

The muscle strength of badminton players was more as compared to the strength of squash players, however the strength did not vary significantly at p value ≤ 0.05 . The hip extensors were the strongest muscle group of lower

extremity. Right side had more strength as compared to left in all muscle groups.

Table 1: Positions for muscle group tested.

Muscle Group	Position of Athlete
Hip flexors	Supine, hip flexed at 90, and knees relaxed
Hip Extensors	Prone, hip flexed at 90, and knees relaxed
Hip Abductors	Supine, hip in neutral, and knees extended
Hip Adductors	Prone, hip in neutral, and knees extended
Knee Flexors	Short sitting, knee and hip joint flexed to 90°
Knee Extensors	Short sitting, knee and hip joint flexed to 90°.
Ankle Dorsi-Flexors	Supine, ankle relaxed, hip and knee extended
Ankle Plantar-Flexors	Supine, ankle relaxed, hip and knee extended

Table 2: Demographic variables of Players.

	Sports Played by Athlete	N	Mean	SD	Std. Error Mean
Age (Years)	Badminton	15	21.27	1.98	0.51
	Squash	16	20.00	2.16	0.54
Height(Ft.)	Badminton	15	5.61	0.45	0.12
	Squash	16	5.56	0.36	0.09
Weight(Kg)	Badminton	15	64.60	4.91	1.27
	Squash	16	64.63	5.67	1.41
BMI	Badminton	15	22.50	4.34	1.12
	Squash	16	22.82	3.87	0.97

DISCUSSION

Previously many studies have been conducted on athletic and non-athletic populations with varying characteristics to quantify and compare strength measured by dynamometers. Bohannon et al studied strength of various muscle groups of upper and lower extremity.¹⁸ Among lower extremity, ankle dorsi-flexors, knee extensors and hip abductors and flexors were studied. In age group of 20 – 29 among

mentioned muscle groups knee extensors were most strong and hip flexors had comparatively less strength in the normal population. The strength of ankle dorsi-flexors was more than hip flexors and abductors. In comparison with present study conducted on athletes the strength of ankle, dorsi-flexors was less among these four muscle groups and knee extensors had more strength. Interestingly hip flexors had considerable strength in both group of athletes which showed least

Table 3: Mean strength of various muscle groups of lower extremity.

Muscle Group	Sports Played	Mean (lbs.)	SD (lbs.)	P-Value
Hip Flexors (Right)	Badminton	49.96	8.22	0.09
	Squash	45.48	6.03	
Hip Flexors (Left)	Badminton	47.07	7.49	0.121
	Squash	43.13	6.24	
Hip Extensors (Right)	Badminton	61.24	10.00	0.480
	Squash	58.71	9.73	
Hip Extensors (Left)	Badminton	61.09	11.09	0.398
	Squash	57.85	9.92	
Hip Abductors (Right)	Badminton	43.89	8.74	0.473
	Squash	41.67	8.27	
Hip Abductors (Left)	Badminton	43.31	8.10	0.190
	Squash	39.56	7.46	
Hip Adductors (Right)	Badminton	50.00	11.27	0.283
	Squash	45.85	9.82	
Hip Adductors (Left)	Badminton	49.78	13.81	0.223
	Squash	44.27	10.69	
Knee Flexors (Right)	Badminton	42.44	8.75	0.195
	Squash	38.63	7.24	
knee Flexors (Left)	Badminton	41.80	7.51	0.312
	Squash	39.00	7.65	
Knee Extensors (Right)	Badminton	54.40	11.42	0.230
	Squash	49.27	11.84	
Knee Extensors (Left)	Badminton	52.49	10.35	0.442
	Squash	49.35	11.90	
Ankle Dorsi-flexors (Right)	Badminton	26.02	5.72	0.346
	Squash	24.25	4.55	
Ankle Dorsi-Flexors (Left)	Badminton	25.69	5.66	0.216
	Squash	23.67	2.88	
Ankle Plantar-Flexors (Right)	Badminton	29.84	5.53	0.459
	Squash	28.46	4.76	
Ankle Plantar-flexors (Left)	Badminton	29.42	5.42	0.450
	Squash	28.00	4.91	

strength in normal population.

The dominant side was stronger which is in complete accordance with the results of this study and many other

studies quantifying muscle strength.^{19,20} In a more recent study by Mentiplay et al assessing the strength of muscles of lower extremity, found that knee extensors

and ankle plantar flexors were the strongest muscles of lower extremity, and hip adductors, abductors and ankle dorsi-flexors, in descending order, were reported to have least strength in 30 healthy young adults in age group of 23 ± 5 years.²¹

In athletes, the comparison of strength among individuals participating in different sports has been addressed in many studies but there is still space available to be explored owing to vast range of mechanics involved in sports. The soccer is well explored and focused game in this context. Hana et al reported stronger hip and knee region as compared to ankle region.²² This comparative study revealed that the strength of badminton players was more as compared to squash. However, there was no significant strength difference among both groups.

Therefore, it can be reasoned that both sports can share mutual strengthening and training plan for lower extremities. However, less strength than non-athletic populations of other countries indicate a need to explore the reasoning as if is the case deconditioning it emphasizes the need of strenuous strengthening. This study is limited to an age group with small sample size; to generalize the results a study with large sample size and different age groups should be focused.

CONCLUSION

The quantitative measurement of strength by hand-held dynamometer in young male players of badminton and squash showed varied range of strength in various muscles of lower extremity. The muscles of ankle region showed less strength as compared to the muscles of knee and hip flexors and extensors.

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