ASSESSING MUSCULAR ENDURANCE OF MAJOR SPINE STABILIZING MUSCLES: AN INVESTIGATION AMONG RACQUET SPORTS MALE ATHLETES

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Abstract
The aim of the study was to assess muscular endurance of major spine stabilizing muscles (MSSM) among racquet sports male athletes. Eighty five male athletes (table tennis=19, tennis=23, badminton=26, and squash=17), age (Mean ± S.D., Age: 20.31 ± 1.34 years, BMI: 19.248 ± 1.3) were selected as participants. Right and left Side Bridge Endurance Test was used to measure muscular endurance of right and left obliques and quadratus lumborum muscles respectively. Trunk Flexor Endurance Test was used to measure muscular endurance of trunk flexors muscles and Sorensen Test was used to measure muscular endurance of trunk extensors muscles. All these tests were measured in seconds through stopwatch. Descriptive Statistics and One Way Analysis of Variance were used as the statistical techniques. The results indicated that there was a significant difference between badminton and table tennis ($p < 0.05$) and; tennis and table tennis ($p < 0.05$) in muscular endurance of left obliques and quadratus lumborum muscles. It might be due to the nature of sport and use of left obliques and quadratus lumborum muscles in particular sport.

Keywords: Major Spine Stabilizing Muscles, Tennis, Badminton, Squash and Table Tennis.

Introduction

Major Spine Stabilizing Muscles (MSSM) play eminent role in any sporting activity. A large number of muscles cross the spine, and all contribute to the modulation of lumbar stability and movement to some extent (Bergmark, 1989). However, MSSM includes Right and Left Obliques and Quadratus Lumborum Muscles, Trunk Flexors and Back Extensors Muscles. Major spine stabilizing muscles (MSSM) are greatly required for racquet sports because these sports require constant rotation of the torso to hit the ball or shuttle harder and to quickly change the direction. The major racquet sports are tennis, badminton, table tennis and squash; which basically vary with each other in many extents such as the scientific disciplines of sports physiology and nutrition, notational analysis, sports biomechanics, sports medicine, sports engineering, sports psychology and, motor skills are briefly considered in turn (Lees, 2003). A research by Everett et al., (2008) was done to identify the differences among unilateral (UL) and bilateral sports (BL), which requires more MSSM, and found no differences in left:right extensor EMG ratios across any of the test protocols. However, the UL group had higher left:right flexor EMG ratios than the BL group during pre-fatigue and post-fatigue isometric flexion. Hence, to find out and critically evaluate this research gap, the researchers had selected this research study to identify that which unilateral racquet sports require more muscular endurance of MSSM.

Methods

Eighty five male athletes (table tennis=19, tennis=23, badminton=26, and squash=17) who studied in Lakshmibai National Institute of Physical Education, Gwalior, (M.P.), India, age ranging between 17 to 23 years (Mean ± S.D., Age 20.31 ± 1.34 years, BMI 19.248 ± 1.3) were selected for the study. They all voluntarily participated in data collection and provided informed consent prior to participation.

Materials: For the purpose of the data collection, right and left Side Bridge Endurance Test was used to measure muscular endurance of right and left obliques and quadratus lumborum muscles, measured in seconds through stopwatch. To test the muscular endurance of right sided muscles, the subject lied on his right side on the ground. The upper body was supported off the ground by the right elbow and forearm. The legs were straight, with the left foot in front of the right foot. The right hip was lifted off the floor while the right elbow and feet supported the body, creating a straight line from head to toe. The left hand was placed on the supporting shoulder. As soon as the subject was in correct position, the stopwatch was started. The test was over when the subject was unable to hold the back straight and the hip was lowered. After 5-7 minutes rest, left side was tested similarly.

Trunk Flexor Endurance Test was used to measure muscular endurance of trunk flexors muscles, measured in seconds through stopwatch. The subject lied on a cushioned and flat surface with hips and knees flexed, both at 90 degrees with the arms crossed over the chest. The subject was asked to raise the trunk in a smooth motion, keeping the position as much as possible. The duration for which the trunk was held statically in proper position was measured in seconds.

Sorensen Test was used to measure muscular endurance of trunk extensors muscles, measured in seconds through stopwatch. The subject lied in the prone position on the examining table with the upper edge of the iliac crests positioned on the upper edge of the table. The pelvis, knees, and ankles were fixed to the table by three straps and arms were bent. The subject was asked to isometrically maintain the upper body in a horizontal position. A chair was placed in front of the subject to support him by holding it with hands in case of inability to keep the position.

Statistics: The data were analyzed and compared with the help of statistical procedure in which Descriptive Statistics like Mean and Standard Deviation were used, and Comparative Statistics as One Way Analysis of Variance was used at 0.05 level of significance. To find out the significant differences among the groups, post hoc Scheffe Test was employed.

Results

The data collected were analyzed statistically with the software package SPSS 18 and the outcome generated is given below.

TABLE 1
DESCRIPTIVE STATISTICS OF VARIOUS VARIABLES FOR ASSESSING MUSCULAR ENDURANCE OF MSSM AMONG RACQUET SPORTS MALE ATHLETES

VARIABLES	TABLE TENNIS	TENNIS	BADMINTON	SQUASH
	M ± S.D	M ± S.D	M ± S.D	M ± S.D
Muscular Endurance of Left Obliques and Quadratus Lumborum Muscles	90.58 ± 12.59	104.47 ± 15.28	108.84 ± 10.39	101.59 ± 12.69
Muscular Endurance of Right Obliques and Quadratus Lumborum Muscles	89.63 ± 11.05	94.6 ± 12.08	92.8 ± 11.45	89.59 ± 9.81
Muscular Endurance of Trunk Flexors Muscles	135.89 ± 16.61	144.56 ± 9.96	145.88 ± 18.88	145.76 ± 12.26
Muscular Endurance of Trunk Extensors Muscles	161.58 ± 16.96	165.43 ± 8.59	166.46 ± 20.06	162.29 ± 9.08

The comparison of mean scores of all variables among racquet sports is shown below.

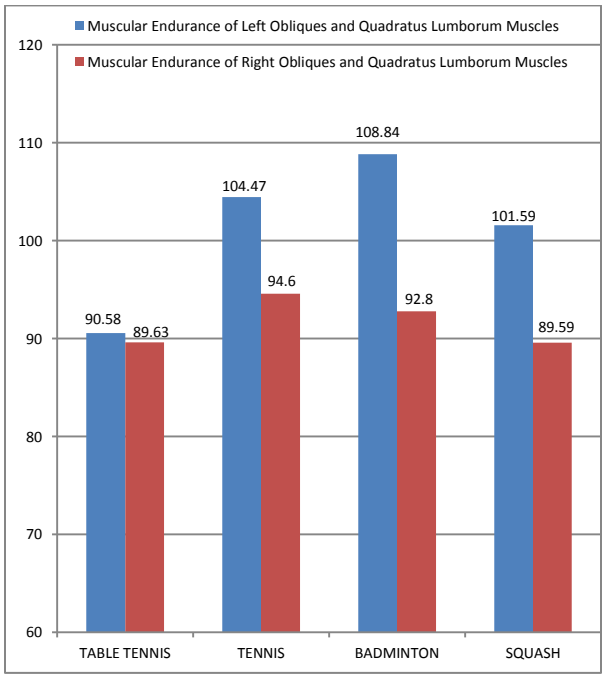

Figure 1: Mean Comparison of Muscular Endurance of Left and Right Obliques and Quadratus Lumborum Muscles among Racquet Sports

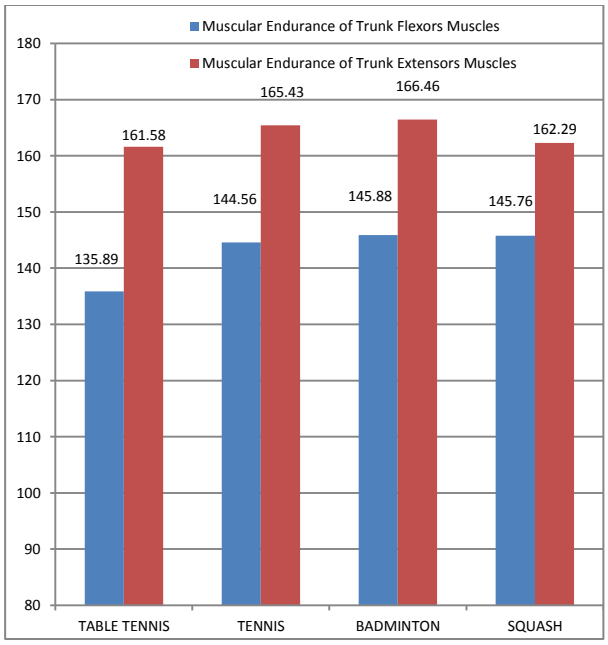

Figure 2: Mean Comparison of Muscular Endurance of Trunk Flexors Muscles and Trunk Extensors Muscles among Racquet Sports

Table 1, and figures 1 and 2 above clearly indicate that mean scores of muscular endurance of left Obliques and Quadratus Lumborum muscles was more in badminton followed by tennis, squash and table tennis: and muscular endurance of right Obliques and Quadratus Lumborum muscles was more in tennis followed by badminton, table tennis and squash. The muscular endurance of Trunk Flexors muscles was more in badminton followed by squash, tennis and table tennis. The muscular endurance of Trunk Extensors muscles was more in badminton followed by tennis, squash and table tennis.

One Way Analysis of Variance of various Variables for assessing muscular endurance of MSSM among racquet sports is shown below in table 2.

TABLE – 2
ONE WAY ANALYSIS OF VARIANCE OF VARIOUS VARIABLES FOR ASSESSING MUSCULAR ENDURANCE OF MSSM AMONG RACQUET SPORTS MALE ATHLETES

Variables		SS	df	MSS	F	p-value
Muscular Endurance of Left Obliques and Quadratus Lumborum Muscles	BG	3839.70	3	1279.90	7.809 *	.000
	WG	13275.87	81	163.90		
Muscular Endurance of Right Obliques and Quadratus Lumborum Muscles	BG	378.65	3	126.21	1.000	.397
	WG	10224.05	81	126.22		
Muscular Endurance of Trunk Flexors Muscles	BG	1355.62	3	451.87	1.982	.123
	WG	18469.15	81	228.01		
Muscular Endurance of Trunk Extensors Muscles	BG	360.03	3	120.01	.534	.660
	WG	18194.27	81	224.62		

*significant at 0.05 level of significance

Table 2 above indicates that muscular endurance of right Obliques and Quadratus Lumborum muscles, muscular endurance of Trunk Flexors muscles and muscular endurance of Trunk Extensors muscles were found insignificant ($p > 0.05$),whereas muscular endurance of left Obliques and Quadratus Lumborum muscles was found significant ($p < 0.05$).

To further analyze as which racquet sports have more muscular endurance of left obliques and quadratus lumborum muscles, Pairwise Mean Comparison analysis was done by using Scheffe Test shown below in table 3.

TABLE 3
MULTIPLE COMPARISONS OF MUSCULAR ENDURANCE OF LEFT OBLIQUES AND QUADRATUS LUMBORUM MUSCLES AMONG RACQUET SPORTS

Variables	(I)	(J)	Mean Difference (I-J)	Std. Error	p value/sig.
Muscular Endurance of Left Obliques and Quadratus Lumborum Muscles	Badminton	Table Tennis	18.26*	3.86	.000
		Tennis	4.36	3.66	.702
		Squash	7.25	3.99	.354
	Tennis	Table Tennis	13.89*	3.96	.009
		Squash	2.89	4.09	.919
	Squash	Table Tennis	11.00	4.27	.093

*significant at 0.05 level of significance

From table 3 above, it is evident that there was significant difference between badminton and table tennis ($p < 0.05$), and tennis and table tennis ($p < 0.05$) in muscular endurance of left Obliques and Quadratus Lumborum muscles.

Discussion

The purpose of the study was to assess muscular endurance of major spine stabilizing muscles (MSSM) among racquet sports. The study reveals that there was significant difference between badminton and table tennis ($p < 0.05$) and; tennis and table tennis ($p < 0.05$) in muscular endurance of left Obliques and Quadratus Lumborum muscles. This result may be attributed to the nature of sport, as badminton at the elite level requires a combination of the aerobic and anaerobic systems and the involvement of these systems depends on the nature of the rally (short or long) and the duration of the game (short set or long match) (Dewney and Brodie, 1980); and most no. of strokes are played above the head to get points where swing ends at the non racquet side of the body, and the use of left obliques muscles enhances to generate power, as well as tennis is a physically demanding sport (Chandler, 1995) as the match can last anywhere from 30 minutes to several hours. Here the use of trunk rotation is more in one direction than in another direction (i.e., a muscle imbalance) because in modern tennis, use of forehand and service is more; almost to 75% than other strokes, due to which players who are right handed require to use more forcefully trunk rotation to the left to generate power, speed and spin on the ball due to which more strength develops on the left side compared to the right side (Roetert and Ellenbecker, 1998). On the other hand, squash is a moderate to high intensity sport which demands specific fitness. Squash at any level places a high demand on the aerobic system for energy delivery during play and recovery. In addition, this sport requires bursts of intense, anaerobic physical activity involving the lactic anaerobic energy system. The squash players must possess appropriate levels of local muscular endurance, strength, power, flexibility and speed, combined with agility, balance and co-ordination (Locke et al. 1997). In squash, the high incidence of shots played from the back left of the court (37.2%), in comparison to the back right (17.3%), suggested a strategy used by the players (Grehaigne and Godbout, 1995). This was evident in the higher incidence of crosscourt drives played from the forehand (right) side of the court seemingly to apply pressure on the backhand side, concurring with the findings of Hong et al., 1996, and Murray and Hughes, 2001; due to which left and right obliques and quadratus muscles develop equally in squah, as well as the table tennis is also a sport where muscular endurance is required less as compared to other racquet sports due to which muscular endurance is equal in both right and left obliques and quadrates lumborum muscles. Hence, tennis and badminton are the sports where left obliques and quadratus lumborum muscles develop more in comparison to squash and table tennis.

References:

Bergmark, A. (1989). Stability of the Lumbar Spine: A Study in Mechanical Engineering. Acta Orthopaedica Scandinavica. Supplementum. 230:1–54.

Chandler, T.J. (1995). Exercise Training for Tennis. Clinics in Sports Medicine. USA: 14(1):33-46.

Dewney, J. and Brodie, D. (1980). Get Fit for Badminton. London: Pelham Books.

Everett, R., Strutton, P.H. and McGregor, A.H. (2008). Do Asymmetries exist in the Trunk Muscles and is this influenced by sporting task?. The Journal of Bone and Joint Surgery. vol. 90-Bno. SUPP III 486.

Grehaigne J.K, Godbout P. (1995) Tactical Knowledge in team sports from a constructivist and cognitivist perspective. Quest 47, 490 – 505.

Hong, Y., Robinson, P.D., Chan W.K., Clark, C.R., and Choi T. (1996). Notational Analysis on game strategy used by the World's top male squash players in International Competition. The Australian Journal of Science and Medicine in Sport. 28, 18-23 [PubMed].

Lees, Adrian (2003). Science and the Major Racquet Sports: A Review Journal of Sports Sciences, 21, 707–732.

Locke, S.; Colquhoun, D.; Briner, M.; Ellis, L.; O'Brien, M.; Wollstein, J. and Allen, G. (1997). Squash Racquets. A Review of Physiology and Medicine. Sports Medicine, 23(2):130-8.

Murray S. and Hughes M. (2001). Tactical Performance Profiling in elite level Senior Squash. In:Pass.com: Computer Science and Sport III and Performance Analysis of Sport. V. CPA UWIC: Cardiff; 185-194.

Roetert, E. Paul and Ellenbecker, Todds. (2007). Complete Conditioning for Tennis. Human Kinetics: USA: 1-2.