ISOKINETIC STRENGTH CHARACTERISTICS OF FOUR DIFFERENT EVENT ATHLETES

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INTRODUCTION

Research on characteristics of isokinetic strength in different sport events has been drawn more and more attentions. However, it is difficult to make comparisons of isokinetic measurements between previous studies since different kinds of isokinetic dynamometers were employed and methodologies of measurements were not consistent with each other. Peak torque of extensors and flexors of knee joint has been always given first priority in the study of isokinetics since it has been considered as an index of the absolute strength of knee extensor and flexor. Among some of the previous studies, Poulmedis (1985) presented the isokinetic measurements from the elite soccer players, peak torques of 180 deg/s were 94.9 and 68.6 lbs respectively for knee extensor and flexor while Appen (1986) studied a group of college track athletes and concluded that peak torques of 60 deg/s were 149.0 and 92.2 lbs, 94.0 and 73.0 lbs for 180 deg/s, 67.0 and 57.0 lbs for 300 deg/s respectively. Ghena (1991) found that the peak torques were 191.4 and 104.9 lbs for 60 deg/s, 161.7 and 92.7 lbs for 180 deg/s, 107.5 and 65.2 lbs for 300 deg/s and 83.4 and 67.6 lbs for 450 deg/s among athletes. Ratio of extensors and flexors is another important index which is most often used in discussing the isokinetic characteristics.Alexander (1990) found that elite sprinters had 0.77 for 180 deg/s,Appen (1986) calculated that the ratios of track athletes were 0.64 for 60 deg/s, 0.79 for 180 deg/s, 0.84 for 300 deg/s. Worrell (1991) showed that the 0.64 for 60 deg/s, and 0.71 for 180 in testing athletes. Stafford (1984) found that soccer players had 0.73 for 180 deg/s 0.82 for 300 deg/s. It can be seen that the trend is that the ratio increased as the velocities of movement increased. The purpose of this study was to analysize and compare characteristics of isokinetic strength measurement of knee joint among the athletes from diferent sport events and to study the factors of the isokinetic measurements of knee joint which have most profound influences on separating the athletes from diferent events.

METHODS

Sixty one college male students served as subjects in this study The subjects were divided into four groups according to their sport events. Prior to the beginning of the tests, the weight, height, leg lengths were measured.The anthropometric characteristics are given in table 1.An isokinetic dynamometer (Cybex II 6000, Lumex, Inc.) was employed to measure strength of both extensors (quadriceps) and flexors (hamstrings) at the knee joint of dominant side at angular velocities of 60, 180, 300, 400 and 500 deg/sec for concentric contraction.The Digitest 1000 (Ergojump Bosco System) were used to test Squad jump- Standing Vertical Jump (SJ) and Counter Movement Vertical Jump (CMJ). ANOVA following by Tukey-HSD post-hoc test, Pearson

Product-moment Correlation, and DiscriminantAnalysis were employed for the statistical analysis. A probability value of 0.05 or less was accepted at significant level.

Table 1: Anthropometric data of the subjects. Mean+SD

Group	N	Age(yrs)	Height(cm)	Weight(lb)
1 Football players	19	26.78+5.73	171.84+9.21	132.89+32.03
2 Karate players	18	22.61+6.43	165.33+8.87	133.16+28.58
3 Water Sport	12	26.50+6.00	169.75+4.47	137.16+15.46
4 Track and Field	12	20.50+6.27	170.50+4.68	132.41+18.21

RESULTS AND DISCUSSION

The ANOVA results of PTEBW and PTFBW of four group players have been shown in table 2. Tukey's honestly significant difference (HSD) test with significance level 0.05 was applied to determine the location of group differences after a significant F has been found.

Table 2: Comparisons of means of four group players' PTEBW and PTFBW and HSD

	PTEBW					PTEBW				
group	60	180	300	400	500	60	180	300	400	500
Fball	102.5	68.47	54.31	47.94	39.26	64.52	50.36	40.73	34.94	29.10
1	2±9.8	±7.44	±5.62	±5.55	±5.26	±10.3	±6.31	±6.25	±5.64	±6.61
Kara	94.83	65.33	51.05	43.38	35.22	56.00	42.72	34.50	29.77	24.61
2	±14.4	±12.0	±9.77	±9.40	±8.82	±11.5	±8.96	±7.24	±7.11	±8.95
WS	114.2	76.83	59.00	51.33	43.00	60.00	45.83	36.91	32.16	26.16
3	5±9.0	±6.82	±4.86	±5.75	±5.34	±3.54	±8.26	±4.66	±4.68	±4.74
T & F	117.2	81.50	64.41	58.08	50.58	74.25	59.33	49.50	42.33	34.25
4	±12.5	±6.77	±6.72	±7.19	±5.16	±8.37	±7.78	±6.96	±5.58	±5.91
F	11.47 **	10.12 **	9.30 **	10.40 **	14.14 **	9.47 **	11.64 **	14.04 **	11.34 **	5.02 **
HSD	1□3x 4 2□3x 4	1□4 2□3x 4	1□4 2□3x 4	1□4 2□3x 4	1□4 2□3x 4 3□4	1□2 4□1x 2x3	1□2 4□1x 2x3	1□2 4□1x 2x3	4□1x 2x3	4□2x 3

Note: *P<0.05, **P<0.01. Symbol "□" means between, for instance, 4□1x2x3 means that there are significant differences between group 4 and group 1, between group 4 and group 2, and between group 4 and group 3.

PTBW- peak torque of body weight % in this study shows a trend that the strength of knee extensors and flexors decrease obviously as the velocities of movement (shortening velocity of the muscles) increase.There exist significant differences (P<0.01) of PTEBWs-peak torques of extensor of body weight %, and PTFBWs-peak torques of flexor of body weight % between four groups. In PTEBWs, track and field group has the highest percentages in all different velocities from 60 to 500 deg/s, which indicates that athletes of this group have the strongest relative extensor strength comparing with other three groups. Water sport group places on the second

following by soccer group and karate group respectively Nevertheless, the decreasing percentages of PTBWs among four groups are different from each other. It is believed that the less decreasing percentage represents better ability of knee extensors and flexors to perform larger forces while the velocity of muscular contraction increases. There is the smallest decreasing percentage in athletes group 45. 06% in PTEBW when the velocity increases from 60 to 300 deg/s, the decreasing rates of other three groups are larger than that of track and field group, 46.16% for karate, 47.02% for soccer and 48.35% for water sport. In PTFBW, even though there are no significant difference ($P<0.05$) of decreasing percentages of knee flexors between the groups, the smallest decrease of tension 33.33% still appears in track and field group when the velocity increases from 60 to 300 deg/s. It is concluded that track and field group has the best performance of knee extensors as speed of movement increases among four group players.

Peak torque ratio of flexors/extensors (H/Q) or PTR represents the equilibrium between hamstrings and quadriceps. Which has been studied in numerous studies because of the important role of both muscle groups in the knee stability The imbalance of H/Q ratio not only influences the athletic ability but also may lead to muscular injuries. (Westing 1989, Baratta 1988, Burnie 1987, Solomonow 1987, Bohannon 1986, Osterning 1986, Vesgo 1985, Grace 1984, Murray 1984, Knutsso 1982, Davies 1981, Scudder 1980, Goslin 1979). It is inferred, in this study, that athletes of track and field and soccer players have stronger hamstrings (knee flexors) comparing to other two group players, because the PTRs of athletes and soccer players are significantly larger than those of karate and water sport groups when the velocities of movements are set to middle level. It is concluded that track and field and soccer groups maintain a better balance between knee flexors and extensors than other two groups. On the other hand, correlation analysis shows there are significant correlation between the performance of these two field tests and isokinetic variables. Significant differences of two field test variables SJ- standing vertical jump and CMJ- counter movement vertical jump among the groups were found, Fs are 7.33 and 9.30, $P<0.01$. This trend also exists in most of isokinetic measurements in this study. That is, track and field group in this study demonstrated better performance not only in performance of field tests but also in isokinetic measurements. Further correlation analysis shows there are significant correlation between the performance of these two field tests and isokinetic variables, correlation coefficients are 0.56, 0.61 and 0.64 respectively, $P<0.01$, between SJ and PTEBW60, PTEBW400, and PTFBW60. High correlation also were found between CMJ and PTEBW60, PTEBW300, PTEBW500, Rs are 0.69, 0.62, and 0.71 respectively, $P<0.01$. Which indicates that high correlation exists between isokinetic variables and the performance of field tests.

In this study, multiple discriminant analysis was applied to determine how many of the ninety dependent variables were needed to separate (predict) the four groups of the subjects, and which dependent variable contributes the most to separation of the groups. The result of discriminant analysis in this study shows that PTEBW500-peak torque of body weight % at 500 deg/s and PTR180-peak torque ratio of flexors/extensors at 180 deg/s are the two most important isokinetic variables in separating the four groups. Even though significant difference $P<0.05$ exist in fifty eight isokinetic variables between four groups according to the results of ANOVA, only PTEBW500

and PTR180 were choosen to be kept in the discriminant functions.This means that the characteristics underlying performance in these two isokinetic variables included are the same characteristics underlying performance in those not included in the discriminant functions.

Two significant canonical discriminant fuctions ($P<0.01$) were derived based on F-ratios and Wilks' Lambda 0.412 and 0.80 in this study as shown in table 6.That is an estimation of the percent variance accounted for by canonical discriminant functions as seen in table 6, there are 79.06% by the first funtion which has a high correlation 0.696 with the group membership, and 20.94% by the second function which has lower correlation 0.446 with the group memberships. It is concluded that the first funtion plays the more important role in separating the groups than the second function does. X^2 test is employed in testing the effects of discriminant function, there are significant X^2s for function 1 and function 2, X^2 are 50.51 and 12.69 respectively, $X^2 > X^2 0.01(6)$, $X^2 > X^2 00.1(2)$, $P<0.01$. Which indicates that there exists a significant difference of discriminant function of four groups at the level of $\alpha = 0.05$. Therefore, it can be said that discriminant effects of the established discriminant functions are satisfactory. On the other hand, The results of centroids also indicates that the discriminating effects of the established discriminant functions are very promising. which is also shown by the percentage of correct prediction, and the percentage of "grouped" cases correctly classified is 65.57% according to classification results.

Table 3: Canonical Discriminant Functions

Fcn	Eigenvalue	Pct of Variance	Cum Pct	Canonical Corr		After Fcn	Wilks' Lambda	Chi-square	df	Sig
					:	0	.412	50.516	6	.0000
1*	.941	79.06	79.06	.696	:	1	.800	12.695	2	.0018
2*	.249	20.94	100.00	.446	:					

* Marks the 2 canonical discriminant functions remaining in the analysis.

CONCLUSIONS

Track and field group has the best performance of knee extensors as the speed of movement increases among four group players. Both track and field and soccer groups maintain a better balance between knee flexors and extensors than water sport and karate groups. It is also concluded that high correlation exists between isokinetic variables and the performance of field tests. Multiple discriminant analysis shows that PTEBW500 and PTR180 are the two most important isokinetic variables in separating the four group players. The characteristics underlying performance in these two isokinetic variables included are the same characteristics underlying performance in those isokinetic variables not included in discriminant functions.