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RELIABILITY OF JUMP AND PERFORMANCE MEASURES IN RUGBY UNION PLAYERS

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The current study examined the reliability of countermovement (CMJ), squat (SJ), and rebound jumps (RBJ) to sprint and estimated 1RM back squat (SQ) of sub-elite Rugby Union players drawn from two teams of similar competitive level. Comparisons of mean performance on all tests were made via Student t-tests. The three trial reliability of jump height for the SJ, CMJ, RBJ, contact time (CT) and Reactive Strength Index for the RBJ, T-Test agility run (TA-Test), 30 and 36.58 m (40 yd) sprint times were estimated via ICC and ReANOVA. All variables displayed Average measures ICC ≥ .900; and except for the TA-Test, the three trials did not differ from each other. The performance of the two teams was found to be similar on all tests except the 30 m and 40 yd sprint tests. All the studied performance measures could be reliably assessed with one trial, except the TA-test.

KEYWORDS: reactive strength index, fitness tests, agility, sprinting, stretch shortening cycle

INTRODUCTION: Agility, as well as, leg strength, power and speed are believed to be important physical components necessary for successful performance in many sports and recreational activities (Paoule et al. 2000). Rugby players need to exhibit explosive starts and changes of direction that can be translated to speed and maintained for both short (10m) and extended (30m) bursts. Performance of Squat jump (SJ) has been related to the explosive action of sprint starts due to the importance of rapid force development and starting strength that is common in both activities (Young et al., 1995). Countermovement jump (CMJ) heights have been linked to short duration speed (Baker & Nance, 1999) and this is most likely due to the importance of the long stretch shortening (i.e. contact times > 200 ms) which occur in short distance sprints. Similarly, performance of rebound jump (RBJ) is often associated with speed maintenance since the RBJ and maximum speed running are both characterized by cyclical movement (periodic) short stretch shortening cycles where increasing leg spring stiffness is associated with increased cadence or jumping frequency (Flanagan & Harrison, 2007). Stretch shortening cycle describes an individual's ability to change quickly from an eccentric to concentric muscular contraction and expresses an athlete's explosive capabilities in dynamic jumping activity (Flanagan et al., 2008). It has also been suggested to be related to sprint running performance (Holm et al., 2008).
Fitness and performance in Rugby have often been assessed using field tests that include: timed sprints of up to 40m, agility tests that involve rapid starts/stops and changes of direction, vertical jumps for height, and measures of muscular strength and endurance (Baker & Nance, 1999; Cronin & Hansen, 2005; Gabbett et al. 2007). In order to be effective, these tests need to demonstrate an acceptable level of reliability as well as being biomechanically similar to the sport of interest. Therefore, the purpose of the current research study was to investigate the reliability of jump height for the SJ, CMJ, RBJ, contact time and RSI for the RBJ, TA-Test agility run, 30 and 36.58 m (40 yd) sprint times across three trials performed by sub-elite Rugby Union players.

METHODS: Approval by the institution's Ethics Board was obtained prior to the beginning of the study. Twenty-one sub-elite Rugby Union players (Mean ± SD: Age = 19.5 ± 2.1 y; Height = 1.84 ± 0.06 m; Mass = 94.0 ± 11.5 kg) from two teams competing at similar level, volunteered to participate in the study, (Team A, n=11; Team B, n=10). Subjects signed an informed consent form and completed a Physical Activity Readiness-Questionnaire prior to

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participating. All testing took place on a single day during the preseason training period. Subjects were asked to refrain from training for 24 hours prior to testing.

Subjects performed three 40 m sprint trials from a standing start with at least three minutes between trials. Time was recorded for 30 m and 40 yd (36.58 m). Sprint time was assessed with optical timing gates (Browner Timing Systems, Model: T-C System, Salt Lake City, Utah, USA) and timed to the nearest millisecond.

To measure agility, each subject performed three trials of a T-Test agility Run (TA-Test) according to methods of Paoule et al. (2000). Three cones were arranged in a line so that they were separated by 5 yd (4.57 m) between each; a fourth cone was set 10 yd (9.14 m) away from middle cone making the shape of the letter T. The subject sprinted forward to the middle cone and touched the base with their right hand. They then shuffled to the left cone and touched its base. They then shuffled to the right cone and touched its base. They next shuffled back to the middle cone, touching its base and then ran backward past the starting point to finish the test. When shuffling, the subject faced forward and did not cross their feet. Following a practice trial at sub-maximal speed, each subject completed three trials for time, separated by a minimum of three minutes of rest. Time was assessed with the Browner timing gates and timed to the nearest millisecond.

In a random order subjects performed three repetitions each of a CMJ, a SJ and a jump following a drop from 30 cm (RBJ). In all cases they were asked to jump as high as possible. For the counter movement jump they lowered their hands and arms, then jumped vertically, without a preparatory or stutter step, swinging their arms upward as they jumped. For the squat jump they performed the movement the same as the counter movement jump, except they paused at the bottom of the counter movement for three seconds. For the drop jump they stepped off the platform and dropped to the floor proceeding directly into a counter movement jump. Subjects were instructed to minimize the time spent in contact with the ground during the RBJ while still jumping as high as possible. A minimum of two minutes rest took place between each trial. Flight time (FT) and contact time (CT) from the RBJ were assessed with an Opto-jump Next system (Microgate, Bolzano, Italy). Jump height was determined from FT using the formula $(9.81 * FT^2)/8$. Reactive strength index (RSI) was calculated as JH/CT. To prepare for 1RM squat estimation subjects warmed up with 3-5 repetitions of 10-20% of their estimated three repetition max load. They then rested for two minutes followed by 3-5 repetitions of 40-50% of the estimated 3 RM load and after another two minutes performed 2-4 repetitions of 70-80% of the estimated 3 RM load. Following an additional two minutes rest subjects completed as many repetitions as possible in 30 seconds. For the full squat, the athlete descended until the top of the thigh was below parallel with the floor. This depth was visually assessed by a Certified Strength and Conditioning Specialist. Estimated 1RM for the back squat was determined according to Adams (1994) where 1RM = squat load/((100-(reps*2))/100).

Reliability was estimated using a two-way mixed Intra-Class Correlation and Repeated Measures ANOVA to test differences between trials. Significance was set at $p \leq 0.05$ and if differences were found between trials follow-up pair-wise comparisons were performed with Bonferroni's correction. Coefficient of Variation (CV) was also calculated and equal to (Standard deviation of the trials/Mean of the trials) * 100.

Comparisons of the tests' means were also made between the two teams using Student independent t-tests.

RESULTS: Tables 1 and 2 show the mean scores $\pm$ SD for all the test scores. The results of the Student t-tests comparing means scores showed statistically significant differences between Teams A and B for 30 m sprint and 40 yd sprint times. As illustrated in Table 3, all variables displayed high Intra-Class Correlation coefficients (Average measures ICC ≥ .900), low Coefficient of Variation (CV < 10.5%), and except for the TA-Test agility measure, the three trials did not differ from each other ($p > 0.05$). For the TA-Test all three trials (Mean ± SD: trial1 = 12.51 ± 1.03 s; trial2 = 12.26 ± 0.94 s; trial3 = 12.11 ± 0.94 s) differed from each other ($p < 0.05$).

Table 1
Mean and SD of DJ, SJ and CMJ performances of Rugby Union players by team ($n_{Team\ A}$ =11; $n_{Team\ B}$ = 10).

		DJ CT (s)	DJ FT (s)	DJ Ht (cm)	CMJ FT (s)	CM Ht (cm)	SJ FT (s)	SJ Ht (cm)
Team A	Mean	0.293	0.472	27.40	0.503	31.3	0.479	28.4
	SD	0.043	0.033	3.76	0.053	6.4	0.045	4.9
Team B	Mean	0.334	0.465	26.69	0.477	28.0	0.447	24.7
	SD	0.076	0.040	4.54	0.037	4.4	0.039	4.3

Table 2
Mean and SD of Sprints, T test and strength tests of rugby players by team ($n_{Team\ A}$ =11; $n_{Team\ B}$ = 10).

		Time 30m (s)[a]	Time 40y (s)[a]	Time TA-Test (s)	Est. 3RM (kg)	Squat (kg)	Squat (reps)
Team A	mean	4.37	5.22	11.98	95.09	73.18	16.2
	SD	0.14	0.27	0.65	15.23	10.55	2.3
Team B	Mean	4.68	5.56	12.63	103.00	78.00	16.4
	SD	0.29	0.36	1.12	22.14	17.35	4.0

[a] indicates significant difference between Team A and Team B ($p < 0.05$)

Table 3
Reliability estimates for three trials of 30 and 35.68 m sprint times, TA-Test agility run, contact time and RSI of RBJ, and SJ, CMJ and RBJ flight time and jump height (n = 21).

	Average Measures (ICC: 95% CI)	Single Measure (ICC: 95% CI)	Difference between trials (p)	Coefficient of variance (%)
RBJ FT (ms)	.926 .846 - .968	.806 .647 - .908	0.686	3.0
RBJ Ht (m)	926 .847 - .968	.807 .649 - .909	0.672	6.0
CT (ms)	.900 .792 - .956	.749 .560 - .879	0.934	9.3
CMJ FT (ms)	.966 .930 -.985	.905 .817 -.957	0.537	2.6
CMJ Ht (m	.966 .930 -.985	.905 .817 -.957	0.523	5.1
SJ FT (ms)	.977 .952 - .990	.933 .867 - .970	0.090	2.3
SJ Ht (m)	.975 .945 - .989	.929 .860 - .968	0.083	4.6
Sprint 30m (s)	.965 .928 - .985	.903 .812 -.956	0.361	1.2
Sprint 40yd (s)	.991 .982 - .996	.974 .948 - .989	0.281	0.8
TA-Test [a] (s)	.975 .948 - .989	.929 .858 - .969	< 0.001	2.2
RSI (m/ms)	.913 .820 - .962	.778 .603 .894	0.798	10.1

[a] All three trials significantly different from one another ($p < 0.05$)

DISCUSSION: The comparison of mean scores with respect to team membership showed that team A was significantly faster than team B on the 30 m and 40 yd sprints. This could be explained by the fact that team A consisted of a greater proportion of backs than forwards compared to team B. The high degree of reliability found for the current variables indicates that their use in assessing Rugby Union players can be recommended. The decreasing times found for the trials of the TA-Test agility run were likely due to a learning effect. The majority of the current subjects had not performed this test prior to this testing session and the single familiarity practice trial did not appear to be enough to afford stable performance. Paoule et al. (2000) stated that due to a high ICC (> .93) that a single trial of the TA-Test agility run was reliable for college aged men and women with varying sporting backgrounds. However, they did not report the CV or if there were differences between trials. Furthermore they did not specifically study Rugby players. The differences between the three trials in the current study suggest additional practice would be recommended before this test is used with Rugby Union players.

CONCLUSIONS: The variables examined in the current study were found to have high reliability as evidenced by high ICC, low CV, and except for the TA-Test agility run, no differences among the three trials. The improving times exhibited across the TA-Test agility run suggest that more practice of this test be done before it is used with Rugby Union players.

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