The Effect of Ball Carrying on the Sprinting Speed of International Rugby Union Players

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ABSTRACT

Speed is considered to be a highly valuable ability in rugby union. One unique aspect of rugby is that players need to be effective at sprinting while carrying a rugby ball. Previous research reported that amateur club players were slower while sprinting with the ball, than without. The purpose of the current research was to examine how sprinting while carrying a ball affected the sprinting speed of international rugby players. Twenty-six international players performed 6 x 40 m sprints under three conditions: Ball One Hand (B1H), Ball Two Hands (B2H) and No Ball (NB). Timing gates were placed at the 0 m, 10 m, 30 m and the 40m mark of the sprint. The 0-10m was used to examine initial acceleration; 30-40 m was used to examine maximal velocity and the 10-30 m section to analyze the acceleration up to maximal velocity. Comparisons were also made between backs and forwards. Backs were found to be faster than forwards at each of the splits for the NB, B1H and B2H conditions (0.04 – 0.08 s, $p<0.0001$ – $p=0.015$, $d=0.88$ – 1.35). The results of the study showed only trivial and small differences (1-2%) between the B1H and B2H conditions with the NB condition. The decrements in speed from the B2H conditions were much less for the international players when compared with previously reported data from amateur club players. Coaches working with rugby players should regularly incorporate sessions focused on speed development, as well as including B1H and B2H as part of a speed testing battery.

Key words: Acceleration, Maximal Sprinting Velocity, Rugby Football, Speed Testing, Strength and Conditioning

INTRODUCTION

Speed is considered to be a highly valuable ability in rugby union and a key component of a team's success [1]. There are several aspects of sprinting that are unique and specific to rugby players. One key difference in sprinting performances between a track and field

sprinter and a rugby union player is the requirement of rugby players to run fast, while also carrying a rugby ball. Ball carrying is an essential skill for rugby players because tackle breaks are a key element of game play that discriminates winning and losing teams [2, 3]. An important aspect of producing tackle breaks in rugby is the speed in which ball carriers carry the ball towards the defensive line [3, 4]; players must be fast while carrying a ball. Being proficient at carrying the ball in one hand is important because it allows a player to adopt fending strategies during contact which greatly contribute to the potential of a tackle break [5]. Another important aspect of tackle breaks is the fact that the vast majority occur in a one-on-one situation, so creating situations where only a single defender attempts to tackle a ball carrier is ideal. Carrying the ball in two hands likely contributes to creating a one-on-one tackling situation as defenders need to stay covering other players because the ball carrier could potentially pass to them. If a player puts the ball in one hand, it is highly unlikely that he will pass the ball so other defenders could then commit to tackling the ball carrier and create a mismatch that favours the defensive team. For these reasons, elite rugby players need to be proficient at carrying the ball in both one and two hands.

Previous research has shown that amateur rugby players are slower while carrying a rugby ball when compared to sprinting without a ball [6, 7] and this difference was more pronounced in university players who had just recently taken up the sport [6]. Sprinting with a rugby ball is a unique skill because the normal movement that the arms make while sprinting, to counterbalance the rotation of the hips, is most likely affected by the ball [6, 7]. It may be a trainable skill and elite rugby players, who presumably are accustomed to this skill, might show minimal performance decrements while sprinting with a ball. If this was the case, then performing sprint training while carrying a ball may need to be a key focus of training in sub-elite players. To date, no study has examined the influence of carrying a rugby ball on sprinting speed in elite rugby players. The purpose of the current study was to understand how carrying a rugby ball might influence the sprinting speed of elite rugby players. It was hypothesized that international level rugby players would show lower decrements in sprinting performance with a ball when compared with previous research examining lower level amateur players.

METHOD

PARTICIPANTS

Twenty-six international rugby union players (14 forwards, 12 backs) took part in the study (age = 26.2 ± 3.2 years, body mass = 101.6 ± 11.9 kg, height = 1.84 ± 0.1 m). All participants were members of the same national team (typically 11^{th} - 15^{th} place in the International Rugby Board world rankings) and had played in International Rugby Board (IRB) test matches against other national teams. While not involved in national team duty, all of the players either played for European professional clubs or were part of a national team academy with a daily training schedule similar to that of a professional club. All of the participants consented to have their testing results used and the study had Institutional Review Board approval.

TESTING

The players performed 6 x 40 m sprints total, with two repetitions each of the three different conditions: sprinting with a ball in one hand (B1H), sprinting with a ball in two hands (B2H) and sprinting without a ball (NB). Each of the sprints with the ball was performed with an IRB approved [8] Gilbert match ball. The sprint testing was performed on a firm dry pitch with short cut grass on a warm clear day with no wind. The sprints were tested using a

Brower TC timing system (Brower, Utah) with gates set on 1 m tripods at 0 m, 10 m, 30 m, and 40 m. The participants were instructed to begin with their front foot beside a marker that was placed 0.75m in front of the first gate. The gates were set at this height because gates set higher than hip height have lower typical error [9].

The order of the trials was randomized for each subject to balance the possible effects of fatigue. Each subject completed at least one trial of each condition before their second round where they completed trials in the same order. A rest time of four to five minutes was given between each trial. The 0-10 m, 10-30 m and 30-40 m splits from the trial that had the fastest 40 m time, under each condition, was kept for analysis. The 0-10 m split is representative of acceleration ability, the 10-30 m split is a transition to maximal velocity, and maximal velocity is achieved between 30 m and 40 m in international rugby players [10]. Velocities were also calculated for each split by dividing the distance of the split by the time taken to complete it.

STATISTICAL ANALYSIS

The trial with the fastest 40 m time under each of the three different ball carrying conditions was kept and compared using a two way (Position x Ball Carrying Condition) ANOVA. The level of significance was set at $p \leq 0.05$. If a significant F value was found, then a Tukey's post hoc test was used to determine the source of these differences. In order to characterize the differences between groups, Cohen's *d* effect sizes were calculated with the following classification system used to determine the magnitude of effect [11]. Effect sizes (Cohen's *d)* of <0.2, ≥0.2 to <0.6, ≥0.6 to <1.2, ≥1.2 to <2.0, and >2.0 were considered trivial, small, moderate, large, and very large, respectively. The Typical Error of Measurement (TEM) and Intraclass Correlations (ICC) were calculated to determine reliability. All statistical analyses were conducted with XLSTAT (New York, USA) software.

RESULTS

The reliability of the different splits was found to be high with low TEMs (0.02-0.04s) and high ICCs for the NB (0.87), B1H (0.85) and B2H (0.77) conditions of the 0-10 m split, the NB (0.77), B1H (0.79) and B2H (0.78) conditions of the 10-30 m split and the NB (0.86), B1H (0.90) and B2H (0.89) conditions of 30-40 m split. No differences were found between the NB carrying condition with the B1H condition over the 0-10 m split ($p=0.95$, $d=0.08$), 10-30 m split ($p=0.69$, $d=0.25$) and 30-40 m split ($p=0.99$, $d=0.01$). Trivial to small differences were found between the B2H Condition for the 0-10m ($p=0.93$, $d=0.11$), 10-30 m ($p=0.85$, $d=0.17$), and 30-40 m splits ($p=0.65$, $d=0.25$) with the NB conditions. While there were no significant differences between the 3 conditions, 38% of the players in the maximal velocity phase had decrements in speed greater than the TEM but no players had speed decrements greater than the TEM in the acceleration phase. The forwards were found to be slower than the backs for the 0-10 m phase under the NB ($p=0.015$, $d=0.93$), B1H ($p<0.006$, $d=1.04$), and B2H ($p=0.021$, $d=0.88$) conditions. They were also found to be slower for NB ($p<0.0001$, $d=0.88$), B1H ($p=0.022$, $d=0.88$), B2H ($p=0.001$, $d=1.23$) for the 10-30 m split as well as the NB ($p<0.0001$, $d=1.29$), B1H ($p<0.0001$, $d=1.35$), and B2H ($p=0.002$, $d=1.15$) conditions of the 30-40 m split.

DISCUSSION

As hypothesised, international rugby players displayed superior sprinting speed (Table 1, Figure 1) when compared with studies that have previously examined this topic with amateur club players [6, 7]. A key finding of this study is the trivial differences between the B2H

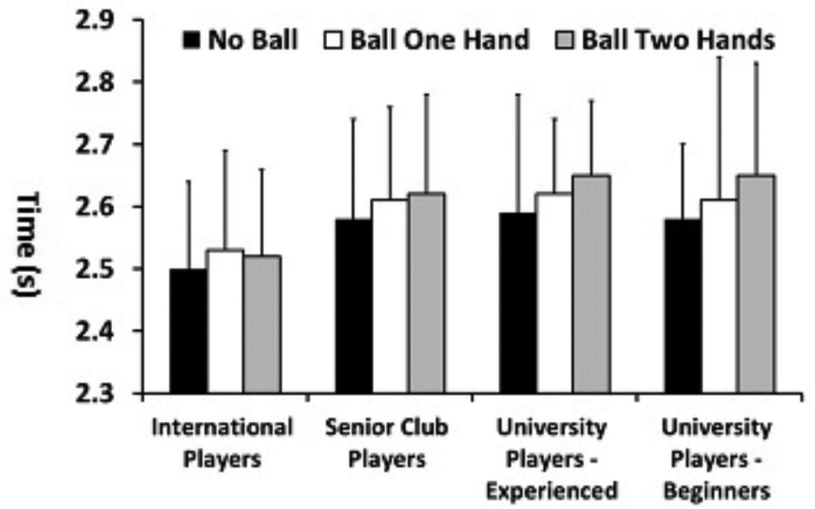

Figure 1. Comparison between the current study (n=26) and previous studies [6, 7] examining club (n=48), inexperienced university (n=12) and experienced university (n=22) players on the time taken to cover between the 10 m mark and the 30 m mark of a sprint.
The no ball conditions are in black, the ball in one hand conditions is in white, and the ball in two hands conditions is in grey.

Table 1. Comparison between sprinting speeds in each of the ball carrying conditions for the group.
Differences between the no ball condition and one hand carry condition and no ball condition and two hand carry condition are listed below the mean scores of each condition. *p* values and effect size differences are listed in parentheses.

	0-10m (s)		10-30m (s)		30-40m (s)	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
No Ball	1.82	0.08	2.50	0.14	1.18	0.08
Ball One Hand	1.81	0.09	2.53	0.16	1.18	0.09
difference from No Ball condition	*(p=0.95, d=0.08)*		*(p=0.69, d=0.21)*		*(p=0.99, d=0.01)*	
Ball Two Hands	1.81	0.09	2.52	0.14	1.2	0.09
difference from No Ball condition	*(p=0.93, d=0.10)*		*(p=0.85, d=0.10)*		*(p=0.65, d=0.25)*	

condition and NB condition in the 10 – 30 m split (Figure 1, Table 1). The small difference in the 10-30 m split between the NB condition and the B1H (0.03 s, p=0.69) condition was similar to the differences (0.03 s) previously reported in male club players [6, 7]. The trivial difference (0.02 s, p=0.93, d=0.11) in this study between the B2H and NB conditions was, on the other hand, less than previously reported in university club players who had recently taken up the game (0.07 s), experienced university age club players (0.06 s), and senior men's club players (0.04 s) [6, 7]. The differences between the current study and the other

studies that have examined ball carrying speed would suggest that carrying a rugby ball in two hands is a trainable skill, or at very least the sprinting speed of international rugby players is more resistant to decrements when carrying a ball in one and two hands. In the current study, forwards were found to be slower (Table 2) than backs and this is consistent with other research [1]. It might be expected that because backs spend more time performing ball carrying drills that they might be superior at sprinting while carrying a ball but both groups were similarly unaffected by sprinting with a rugby ball. Through frequent ball carrying and passing drills in training sessions, elite players likely develop the ability to compensate for the effect that carrying a ball has on their arms while sprinting.

The arms are considered to be important for balancing the angular momentum produced by the legs [12,13] so an athlete carrying an object in their hands could potentially affect sprinting speed by disrupting arm movement. The mass of the ball (0.45 kg) though would not seem to affect sprinting speed given that previous research showed that sprinting with a 0.44 kg weight in either hand did not affect sprinting velocity [14]. The trivial differences between the NB and B1H condition for the 0-10 m split (p=0.9, d=0.08) and the 30-40m split (p=0.99, d=0.01) suggest that elite rugby players can adequately use their arms for balance while holding a ball and sprinting. Peak velocity occurs between 30-40 m in elite rugby players [10] so it would be expected if the players were to struggle while carrying a ball in two hands, it would likely happen over this distance. There was a small and non-significant difference between the NB condition and B2H condition (p=0.65, d=0.25), but individual results showed that there were 10 individuals whose B2H velocities were slower and outside the TEM of the No Ball conditions (Figure 2). This would suggest that some players were unable to effectively use their arms for balance while holding a ball in two hands. This is relevant because most elite players typically hit maximal velocity during games [1].

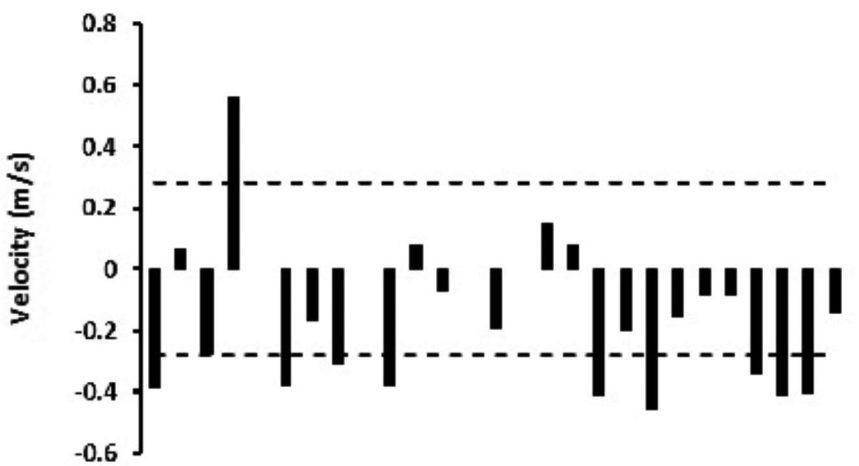

Figure 2. Individual velocity differences between the no ball condition and the ball two hands condition for maximal sprinting velocity (30-40 m split) Bars represent individual scores with positive scores meaning the athlete was faster with the ball in two hands and negative scores indicating they were slower in the ball two hands condition compared to the no ball condition. Dashed bars indicate the typical error of measurement for the no ball condition.

Table 2. Comparison between forwards and backs for sprinting speeds in each of the ball carrying conditions. Differences between the forwards and backs for each of the conditions are listed below with the *p* value from the Tukey's post-hoc analysis and the effect sizes listed on the bottom.

		0-10 m (s)			10-30 m (s)			30-40 m (s)		
		No Ball	**Ball One Hand**	**Ball Two Hands**	**No Ball**	**Ball One Hand**	**Ball Two Hands**	**No Ball**	**Ball One Hand**	**Ball Two Hands**
Forwards	mean	1.85	1.86	1.85	2.58	2.60	2.60	1.23	1.24	1.25
	SD	0.08	0.09	0.09	0.12	0.13	0.14	0.09	0.08	0.08
Backs	mean	1.78	1.76	1.77	2.40	2.45	2.42	1.12	1.12	1.15
	SD	0.06	0.06	0.06	0.08	0.17	0.08	0.05	0.04	0.05
Difference between forwards and backs		0.07 s	0.05 s	0.04 s	0.08 s	0.07 s	0.08 s	0.05 s	0.06 s	0.05 s
		p=0.015	p=0.006	p=0.021	p<0.0001	p=0.022	p=0.001	p<0.0001	p<0.0001	p=0.002
		d=0.93	d=1.04	d=0.88	d=1.33	d=0.88	d=1.23	d=1.29	d=1.35	d=1.15

While sprinting, athletes typically move their arms forward and backward in the sagittal plane to counterbalance the rotation of the hips generated by the angular momentum of their legs [12, 13]. The normal movement patterns that the arms use to counterbalance this rotation, is undoubtedly affected by sprinting with the ball in two hands. Another sport that is required to compensate for the effect of a reduced role of the arms while sprinting is pole vault as pole vaulters face a similar problem in trying to sprint without the normal use of their arms. Sprinting while carrying a pole negatively affects sprinting velocity by decreasing the maximal hip flexion during the swing phase [15]. The lower hip and knee flexion causes a higher braking phase, which both results in a lower stride length and a lower sprinting velocity [15]. The mass and shape of a pole likely make it impossible to balance the torques produced by the legs, but a rugby ball is much lighter and smaller so there may be a specific technique for sprinting with the ball in two hands that allows players to counter-balance the rotation of the hips [12] and minimize the loss of speed from sprinting with a ball. It is common to see elite players shift the ball side to side while carrying the ball. This likely helps balance the rotation of the hips from the angular momentum produced by the legs so that it does not affect the hip and knee flexion during the swing phase and reduce stride length [15].

Mastering the ability to carry the ball in two hands is an important skill for rugby players; not only do players require the ability to maximize their sprinting speed while carrying a ball, but they also create uncertainty with defenders if they are able to carry the ball in two hands while moving at speed. For instance, if a player struggles while carrying a ball they may be more likely to make a passing error after catching a ball while sprinting at a near maximal velocity. Professional players frequently sprint at or near their maximal velocity in games [1, 16]. Some positions, such as fly-half and scrum-half may touch the ball over 40 and 70 times each per game, respectively [17] so ball carrying ability is a highly important skill for those positions. Even positions such as prop, who handle the ball the least of any position

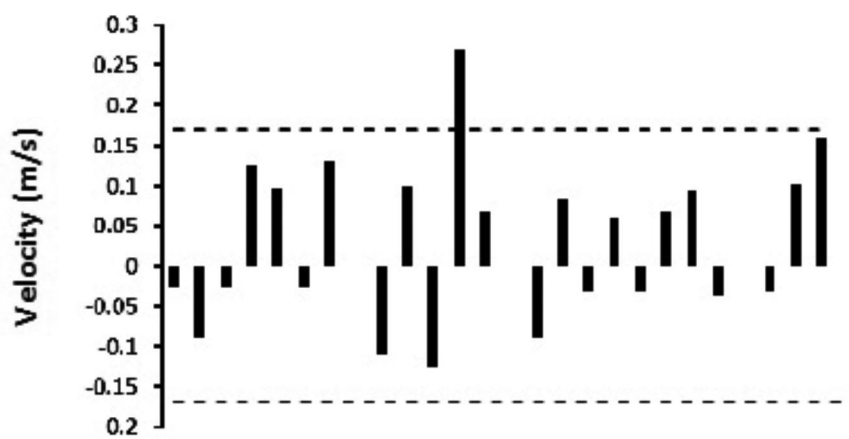

Figure 3. Individual differences between the no ball condition and the ball two hands condition for acceleration (0-10 m split)
Bars represent individual scores with positive scores meaning the athlete was faster with the ball in two hands and negative scores indicating they were slower in the ball two hands condition compared to the no ball condition. Dashed bars indicate the typical error of measurement for the no ball condition.

in international rugby, may touch the ball as many as 10 times per game [17]. Further research is required to determine if players who struggle sprinting with the ball in two hands make more passing errors while sprinting with the ball in two hands.

Sprint training sessions with rugby players should regularly incorporate ball carrying drills so that players can develop the ability to sprint with a ball at maximal velocities. Given the importance of ball carrying ability, we also suggest that coaches working with rugby teams include sprinting with a ball in their testing batteries. This would allow for the identification of players whose performance is limited while sprinting with a ball (similar to the individual response shown in Figures 2 and 3). An individualized approach could then be taken so that ball carrying drills can be built into sprint training sessions to develop areas of weakness. Speed training for rugby players could then have a periodized approach where blocks of training can shift back and forth from sprinting without a ball to sprinting with a ball. This would allow players to improve sprinting speed with traditional speed training methods and then ensure that the speed increases are transferred to improvements in ball carrying ability. This periodized approach is particularly relevant for sub-elite player transitioning into professional and international rugby, and for 'second tier' rugby nations developing their elite squads through talent transfer programs (e.g., gridiron football players converting to Olympic rugby sevens and to rugby union World Cup programs).

CONCLUSION

Ball carrying ability should be a key consideration for strength and conditioning coaches evaluating the sprinting ability of rugby players. The findings of the current study would suggest that carrying a rugby ball in two hands does not negatively affect the sprinting speed of elite rugby players to the same extent that has previously been reported in sub-elite players. It is suggested that coaches working with rugby players should consider implementing a testing protocol that utilizes both sprints with and without a rugby ball. If a player has deficiency in ball carrying ability, it is likely that they will benefit from additional ball carrying drills during speed sessions. Long term training plans for players transitioning from sub-elite to elite rugby should focus on teaching players to sprint with a rugby ball in two hands.

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