Relationship between 2 standardized tackling proficiency tests and rugby league match-play tackle performance

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Article Title: Relationship Between Two Standardized Tackling Proficiency Tests and Rugby League Match-Play Tackle Performance

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ABSTRACT

This study investigated the relationship between two different assessments of tackling ability, physical qualities, and match-play performance in semi-professional rugby league players. Eighteen semi-professional rugby league players (mean ± SD age, 23.1 ± 2.0 yrs; mass 98.8 ± 11.8 kg) underwent tests of upper- and lower-body strength and power. Tackling ability was assessed using video analysis under-the-ball and over-the-ball tackle drills. A total of 2,360 tackles were analyzed from match-play. Over-the-ball tackle ability was positively related to the proportion of dominant tackles (r_s = 0.52, 95% CI 0.07 to 0.79, P = 0.03) and average play-the-ball speeds (r_s = 0.50, 95% CI 0.04 to 0.78, P = 0.03), and negatively related to tackles that conceded offloads (r_s = -0.55, 95% CI -0.78 to 0.04, P = 0.04). Under-the-ball tackle ability was significantly related to the proportion of dominant tackles (r_s = 0.57, 95% CI 0.14 to 0.82, P = 0.01) and missed tackles (r_s = -0.48, 95% CI -0.77 to 0.02, P = 0.05). Good over-the-ball tacklers performed proportionally more dominant tackles, allowed significantly fewer offloads, and had longer average play-the-ball speeds. Good under-the-ball tacklers missed proportionately fewer tackles. This study suggests that both the under-the-ball and over-the-ball standardized tackle assessments are associated with varying indicators of match-play tackle performance and justifies the practical utility of these tests to assess and develop both types of tackles.

KEYWORDS: defense, wrestle, contact, collision, strength, power

INTRODUTCTION

The tackle is one of the most crucial elements in the collision sports of rugby league and rugby union.[1, 2] Tackling proficiency, the ability to dominate the tackle contest, and the tolerance of physical impacts is fundamental to success in these sports.[1] It has been shown that winning teams allow fewer meters in defence and are involved in fewer ineffective tackles than losing teams.[2, 3] An increasing body of research has examined tackling ability in rugby league players through the video analysis of a standardized one-on-one tackling drill.[4-6] These studies investigated tackle ability through the assessment of the traditional shoulder tackle, also known as the under-the-ball tackle. The under-the-ball tackle is characterized by the defender making initial contact with their shoulder at the torso region of the ball-carrier.

A 2008 study investigating tackle characteristics in the Australian National Rugby League competition concluded that the majority of tackles were performed at the mid torso of the ball-carrier.[7] However, a more recent study (2015) investigating tackling ability in semi-professional rugby league match-play found that approximately 70% of tackles were executed around the ball-carriers chest and shoulders and fewer than 25% of tackles were made at the torso region.[5] Tackles made at the shoulder and chest region are commonly referred to as "over-the-ball" or "smother tackles". Research investigating the relationships between match-play tackle characteristics and outcomes found that the likelihood of an offload is decreased when the initial contact zone was at the chest and shoulders compared to contact at the torso or legs.[8] Furthermore, it has been found that the smother tackle was as likely to have successful defensive outcomes in both rugby league and rugby union match-play compared to the traditional shoulder tackle.[8, 9] Due to the prevalence and the positive performance outcomes associated with an over-the-ball tackle, from a coach's perspective, it will be useful to examine this type of tackle in a specific drill.

Gabbett and Ryan[4] examined tackle ability in professional players by analyzing a standardized under-the-ball tackling drill, categorizing players as "good" or "poor" tacklers based on a median split. "Good" tacklers were involved in a greater proportion of dominant tackles and missed proportionately fewer tackles than 'poor' tacklers.[4] Similarly, semi-professional players with good under-the-ball tackling ability on a standardized proficiency test were involved in a greater proportion of dominant tackles and missed a smaller proportion of tackles during match-play.[5] These studies have highlighted the association between under-the-ball tackling ability and match-play performance. However, to date no study has investigated the relationship between an over-the-ball tackle ability drill and rugby league match-play tackle performance.

Lower- and upper-body strength, as well as upper-body power have been shown to be significantly related to under-the-ball tackling ability in semi-professional rugby league players.[10, 11] Furthermore, greater lower-body strength and lower-body power have been shown to be significantly associated with the proportion of dominant tackles made during match-play.[5, 12] Previous research has highlighted that muscular strength and power attributes influence tackle performance however, in these studies upper-body strength and power were only measured from pushing movements, namely the bench press and plyometric push up. Previous research has identified that upper-body pulling strength is greater in elite compared with sub-elite players.[13] Gstaniven the amount of grappling and wrestling that can occur during a tackle, where a player's posterior or pulling strength might be contributing to tackling ability.

Research examining tackling in rugby league has focused on the association between physical characteristics and under-the-ball tackling ability on tackle performance outcomes. To date, no research has examined how a standardized over-the-ball tackle ability assessment is related to game specific tackle measures. The primary purpose of this study was to investigate the relationships between two different assessments of tackling ability and match-play

performance in semiprofessional rugby league players. This study also examined the relationship between muscular strength and power, tackling abilities and match tackle performance.

METHODS

Eighteen semi-professional rugby league players (mean ± SD age, 23.1 ± 2.0 yrs; mass 98.8 ± 11.8 kg) participated in this study. Players were categorized into two positional groups, forwards (prop, second row, lock and hooker) (n = 8, 22.9 ± 2.0 yrs, 107.7 ± 11.0 kg) and backs (half-back, five-eighth, centre, winger and fullback) (n = 10, 23.4 ± 2.1 yrs , 91.7 ± 6.4 kg). All players were from one rugby league club competing in a state level competition, which is second tier to the national competition. Players were classified as semi-professional as they received remuneration for playing rugby league but also relied on other forms of income. Players were free from injury and mid-way through a fifteen week preseason training program when they undertook muscular strength and power testing, and a tackling assessment. All players received a detailed explanation of the study, including information on the risks and benefits, and written informed consent was obtained before the start of the study. All procedures were approved by the Australian Catholic University Ethics Committee (2013 01Q) prior to data collection.

The tests were conducted over the course of 2 training sessions. The tackling ability tests were conducted during at the start of the first training session. The power and strength data was collected at the second training session approximately 56 hours after the tackling ability tests. All players were familiar with the testing protocols as they were part of their routine training and testing. The players were instructed to be adequately hydrated prior to the sessions and to refrain from excessive exercise for 48 hours before the testing sessions.

Tackling ability was examined in two tests, an under-the-ball drill and an over-the-ball drill. Both drills were conducted in a 10 meter grid with video cameras (Sony AX100, Sony, Japan) positioned on the left, right and rear of the drills. The protocol for the tackle drills were the same as previous research examining tackle ability in rugby league players.[4, 5, 14] In both drills players performed six consecutive tackles, three on their right side and three on the left side, on another player of similar height and mass. The players were instructed to run directly at each other (the ball carrier was to make no evasive actions) so that the initial contact was made at approximately the five meter mark of the grid. During the under-the-ball tackle assessment the ball-carrier wore a diamond tackle shield (Madison Sport, Brisbane, Australia).The players were instructed to walk back to the start position after each tackle, allowing approximately 30 seconds between each tackle to minimise the effects of fatigue. A randomized-counterbalanced design was used, whereby nine players performed the under-the-ball tackle drill first and then performed the over-the-ball drill following a 30 minute passive break. The other nine players performed the two tackle drills in the reverse order.

The under-the-ball drill was assessed using the same criterion previously used to examine tackling ability through the video analysis of a standardized one-on-one defensive drill. [14-16] The technical criteria for assessing the over-the-ball drill was developed through collaboration of two expert rugby league coaches and were the same cues used during defensive drills at training. The criteria used for the assessment of the two drills are shown in Figure 1a and 1b.

One analyst assessed the tackling ability of both drills using Dartfish video analysis software (Premium version for Windows, Dartfish, Switzerland). Each tackle received a score out of 6. Players were awarded 1 point for each criteria they achieved or 0 points if they failed to meet the criteria while performing a tackle. The players received an aggregate score (arbitrary units) from all 6 tackles in each drill, which was then converted to percentages. The

intraclass correlation coefficient (ICC) for test-retest reliability and typical error of measurement (TEM) for the under-the-ball tackle assessment were 0.88 and 3.9%, and 0.93 and 1.5% for the over-the-ball tackle assessment, respectively.

Under the guidance of a strength and conditioning specialist, a one repetition maximum (1RM) bench press and chin up were used to assess upper-body strength and the back squat to test lower-body strength. For the back squat and bench press, players performed increasingly heavier loads using a standard 20 kg Olympic barbell, with a minimum of 3 minutes rest between sets, until they attempted a load that they could lift only once with appropriate form and technique. For the back squats, players were required to perform the movement to a below parallel thigh position (i.e. they descended to a position where the hip crease passed below the middle of the knee joint) and for the bench press it was essential for the bar to touch the chest before the ascending phase.

The same loading protocols were used for assessment of the 1RM weighted chin-up. The 1RM weighted chin-up was calculated by adding the body mass of the player to the additional mass added to the player via a belt. Players were required to perform a supinated grip chin-up starting with arms fully extended. An attempt was deemed successful if the player was able to pull their body upwards until their chin, with their head in a neutral position, was over the bar. The ICC was 0.98 and 2.8% for the 1RM bench press, 0.98 and 2.7% for the 1RM chin-up and, 0.96 and 3.0% for the 1RM squat. Relative upper- and lower-body strength were calculated by dividing the 1RM of the bench press, chin up and squat by the player's body mass.[17]

A countermovement jump (CMJ) and plyometric push-up (PPU) were performed on a force platform (Kistler 9290AD Force Platform, Kistler, Switzerland) to quantify lower- and upper-body peak power, respectively. The CMJ was performed with hands on hips and the PPU was performed from a standard push up position with arms fully extended. When instructed,

the players descended to a self-selected depth before explosively jumping or pushing as high as possible off the platform. Players had two attempts with approximately 2 minutes recovery between each effort; their highest power output was used for analysis. The ICC and TEM for CMJ peak power were 0.81 and 3.5%, respectively, and for the plyometric push-up were 0.97 and 3.8%, respectively. To minimize the effect of fatigue, the strength and power tests were conducted 56 hours after any previous training sessions and players were instructed to refrain from strenuous exercise prior to the testing session.

Eighteen semi-professional rugby league matches played in the 2016 season were analyzed from video recordings of the matches. A total of 2,360 tackle involvements were examined from the players who undertook the strength power tests and tackling ability assessments. The players competed in an average of 10 games (range: 3 to 17) and were involved in an average of 13 tackle events per match (range: 4 to 26). The outcome data on each of the player's involvement in a tackle contest were recorded. The data recorded on tackle outcomes were if the tackle was dominant or not, if the tackle was a missed tackle, if that tackle conceded an offload, if the tackle caused an error, and duration of the play-the-ball. A tackle was deemed to be dominant if the time from when the ball-carrier's forward momentum had been halted to when the ball touched the foot during the play-the-ball exceeded four seconds or the tackle resulted in an offensive error. A missed tackle was defined as any unsuccessful attempt to complete a tackle where the tackler/defender had made contact with the ball-carrier and broke from the tackle before it was completed. An offload was coded when the ball-carrier was able to pass the ball to a teammate during the tackle. The play-the-ball duration was the time between the ball-carriers cessation of forward momentum and the moment the ball touched the foot during the play-the-ball.

The same analyst who assessed the standardized one-on-one tackling ability test also coded the tackle outcomes for all 18 matches. This ensured consistency with the interpretation

and coding of the game-specific definitions. Although only one analyst was used, it is anticipated that when using a human observer that there is a level of subjectivity.[18] The intra-coder reliability was determined by randomly selecting one match and analysing a second time. Coding for the same match was separated by 21 days. Cohen's Kappa coefficient (κ) was used to evaluate the intra-reliability of the coder.[19] All variables had a kappa statistic of 0.92 or greater. A kappa statistic between 0.81 to 0.99 represents an "almost perfect" agreement between repeated measures.[18, 19]

All data were analyzed using SPSS (version 23 for Windows, SPSS Inc., USA). Spearman's rank order correlation coefficients were used to determine the relationships among muscular strength and power, tackling ability and match-play tackling characteristics and outcomes. Due to the data not being normally distributed, non-parametric tests and magnitude based inferences were used. Data were reported as Spearman's rank correlation coefficients (r_s) and 95% confidence intervals (CI). Players were divided into "good tacklers" and "poor tacklers" for both tackling drills. This was based on a median split of the tackling ability results after controlling for playing position, with each group receiving an equal number of forward and backs.

Mann-Whitney test was used to establish statistical differences in muscular strength and power, tackling ability, and match-play tackling performance between good and poor tacklers. The level of significance was set at $P \leq 0.05$. Differences in physiological variables and tackling ability between the good and poor tacklers were also compared using Cohen's effect size (ES) statistic.[20] Effect sizes of <0.2, 0.2-0.6, 0.61–1.2 1.21-2.0, and >2.0 were considered trivial, small, moderate, large, and very large, respectively.[21]

RESULTS

Table 1 shows the relationships between under-the-ball and over-the-ball tackle abilities and match-play tackle performance. A significant association (r_s = 0.48, 95% CI 0.02

to 0.77, P = 0.05) was found between under-the-ball and over-the-ball tackle abilities. Over-the-ball tackle ability was positively associated with the proportion of dominant tackles (r_s = 0.52, 95% CI 0.07 to 0.79, P = 0.03) and average play-the-ball speeds (r_s = 0.50, 95% CI 0.04 to 0.78, P = 0.03). Furthermore, over-the-ball tackle ability was negatively related to the proportion of tackles that conceded an offload (r_s = -0.55, 95% CI -0.78 to 0.04, P = 0.04). Under-the-ball tackle ability was also significantly related to the proportion of dominant tackles (r_s = 0.57, 95% CI 0.14 to 0.82, P = 0.01) and negatively related to the proportion of missed tackles (r_s = -0.48, 95% CI -0.77 to 0.02, P = 0.05).

Table 2 shows the relationships between tackle abilities and muscular strength and power qualities. Under-the-ball tackle ability was significantly related to 1RM squat (r_s = 0.55, 95% CI 0.11 to 0.81, P = 0.02). Over-the-ball tackle ability was significantly related to 1RM chin up (r_s = 0.56, 95% CI 0.13 to 0.81, P = 0.02). No muscular strength and power qualities were related to match-play tackle performance.

The results of the standardized tackling tests for the first and second grade players are shown in Table 3 and Figure 2. In the under-the-ball tackling ability test, "Good" tacklers more regularly produced leg drive upon contact (*P* = 0.01, ES = 1.04, 95% CI 0.28-2.31) than the "Poor" tacklers. Similarly, in the over-the-ball tackling ability test, In the over-the-ball drill, first grade players more frequently made contact with the chest or shoulder (*P* = 0.01, ES = 1.06, 95% CI 0.39-2.46) and maintained a square and aligned body position (*P* = 0.03, ES = 1.26, 95% CI 0.18-2.19).

Good under-the-ball tacklers were involved in a significantly smaller proportion of missed tackles (P=0.04; ES=-0.98) compared to the poor under-the-ball tacklers. Good over-the-ball tacklers performed proportionally more dominant tackles (P = 0.01; ES = 1.32), conceded significantly fewer offloads (P = 0.02; ES = -1.29), and had slower average play-the-ball speeds (P = 0.03; ES = 1.05) than the poor over-the-ball tacklers. Comparisons of match-

play tackle performance between good and poor tacklers of the over-the-ball and under-the-ball tackle drills are shown in Table 3 and 4, respectively.

DISCUSSION

This was the first study to investigate the relationships between over-the-ball tackle ability and tackle performance of players during rugby league match-play. Similar to the findings of the under-the-ball tackle assessment, over-the-ball tackle ability was significantly related to the proportion of dominant tackles (positive) and missed tackles (negative) performed in match-play. However, unlike under-the-ball tackle ability, over-the-ball tackle ability was negatively related to the proportion of tackles performed that conceded an offload. This finding is consistent with previous rugby league match-play research that found when contact was initiated at the chest and shoulder region the odds of an offload occurring was much lower than if contact was made at the torso or legs.[8] In the present study, over-the-ball tackle ability was also related to greater average play-the-ball speed. The play-the-ball speed is considered a critical element in rugby league defense.[3] Slow play-the-balls provide an advantage to the defensive team, as it allows more time for defenders to recover and prepare for the next attacking play.

Consistent with previous research, results showed that under-the-ball tackle ability was significantly related to the proportion of dominant and missed tackles players made in match-play.[4] Furthermore, this finding is in partial agreement with earlier research in semi-professional rugby league players which found that tackle ability was significantly associated with dominant tackles in match-play.[5] However, the aforementioned study did not find that the proportion of missed tackles in match-play was statistically related to under-the-ball tackle ability.[5] The findings from the current study, along with previous research, confirm the practical utility of the under-the-ball tackle assessment.

Lower body strength, as measured by the 1RM squat, was significantly related to under-the-ball tackle ability. This finding is in partial agreement with previous research that found maximal squat and bench press, squat relative to body mass and upper-body pushing power were all significantly related to under-the-ball tackle ability.[10] Maximal chin up strength was the only muscular strength and power quality that was related to over-the-ball tackle ability. This finding most likely reflects the requirement of defenders to wrap their arms around the ball-carrier to affect the tackle and prevent an offload from occurring. It could be assumed that superior pulling strength would be beneficial when attempting to perform an over-the-ball tackle.

No muscular strength or power qualities were found to be significantly related to match-play tackle performance in this study. In contrast, previous research found that maximal lower-body strength, as measured by a 1RM squat, was significantly associated with the proportion of dominant tackles made during rugby league match-play.[5] The conflicting findings from the two studies might be explained by dissimilar team tactics, playing styles and/or individual playing abilities. Research investigating the relationships between tackle characteristics and tackle outcomes in semi-professional rugby league players found that no specific tackle characteristics (i.e. tackle type, contact zone, direction of tackle) were associated with a dominant tackle outcome.[8] Collectively, the findings from the current study and previous research indicate that the ability and mechanism for players to dominate tackles may vary, possibly influenced by an individual's physical qualities, playing position or playing ability.

Consistent with previous research, "good" under-the-ball tacklers were involved in a smaller proportion of missed tackles during match-play compared to "poor" under-the-ball tacklers.[4, 5, 8] Furthermore, although not statistically significant "good" under-the-ball tacklers performed moderately more dominant tackles and conceded fewer offloads than the "poor" tacklers. This finding is in agreement with previous research examining the relationships

between match-play tackle performance and under-the-ball tackle ability.[4, 5, 8] When tackling ability was assessed from the over-the-ball tackling test, "good" tacklers performed significantly more dominant tackles, allowed significantly fewer offloads and had a significantly greater average play-the-ball speed than the "poor" over-the-ball tackling group. Unlike the under-the-ball tackle assessment, there was only a small, statistically non-significant difference in the proportion of missed tackles in the "good" and "poor" playing groups. The findings from this study indicate that proficiency in the two different tackle ability assessments are related to different match-play tackle outcomes.

The under-the-ball and over-the-ball tackling abilities were found to be moderately correlated. This finding is to be expected given the commonality in the technical criteria assessing the two tackling ability drills, namely maintaining leg drive upon contact, body position square and aligned, and watching the target into contact. Although correlated, figure 2 clearly demonstrates that proficiency in one of the drills does not necessarily translate to proficiency in the other. Furthermore, this study showed that the two tackle ability tests were related to different match-play tackle outcomes. Collectively, the results of this study indicate that the over-the-ball and under-the-ball tackle ability are two different skills and should be assessed, coached and developed accordingly.

PRACTICAL APPLICATIONS

Our findings suggest that both the under-the-ball and over-the-ball standardized tackle assessment tests are related to match-play tackle performance indicators, thus justifying the practical utility of these off-field tests to assess tackling ability. Although correlated, this study showed that the two tackle ability tests were related to different match-play tackle outcomes, indicating that over-the-ball and under-the-ball tackle ability are two different skills and should be assessed and trained accordingly. From the perspective of a rugby league coach, the results

from these standardized tackle assessments can assist in identification of strengths and weaknesses in the tackle technique of individual players. Furthermore, the data from these tests may assist coaches to formulate defensive strategies specific to the abilities of their players.

For the strength and conditioning specialist the findings of this study demonstrate that well-developed muscular strength and power contribute to tackling ability in rugby league players. While a significant correlation does not suggest causation, the results from this research provide insight into the physical characteristics that influence tackling ability. As long as the technical aspects of tackling technique are adequately coached and practiced, it can be assumed that the development of muscular strength and power may serve as foundational components to underpin improvements in tackling ability.

CONCLUSIONS

This is the first study to examine the relationships between over-the-ball and under-the-ball tackling abilities and match-play tackle performance. The findings of this study suggest that proficiency in the over-the-ball or under-the-ball tackling drill is related to different on-field tackle outcomes. Over-the-ball tackle ability was strongly related to the proportion of dominant tackles, average play-the-ball speed and offloads conceded, while under-the-ball tackle ability was associated with fewer missed tackles in match-play. While match-play tackling requires accurate decision-making and sound defensive structures, this study has found that the under-the-ball and over-the-ball standardized one-on-one tackle drills are reliable and valid methods of evaluating tackling ability in rugby league players.

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Figure 1a. Under-the-ball tackle criteria
i) Contact made at the centre of gravity of the ball-carrier; ii) initial contact made with the shoulder; iii) body position square and aligned; iv) leg drive upon contact; v) watch the target onto the shoulder; vi) centre of gravity forward to the base of support

Figure 1b. Over-the-ball tackle criteria
i) Contact made on the ball; ii) initial contact made with the shoulder or chest; iii) body position square and aligned; iv) leg drive upon contact; v)watch the target into contact; vi) actively minimise space between the ball carrier's head, hips and feet

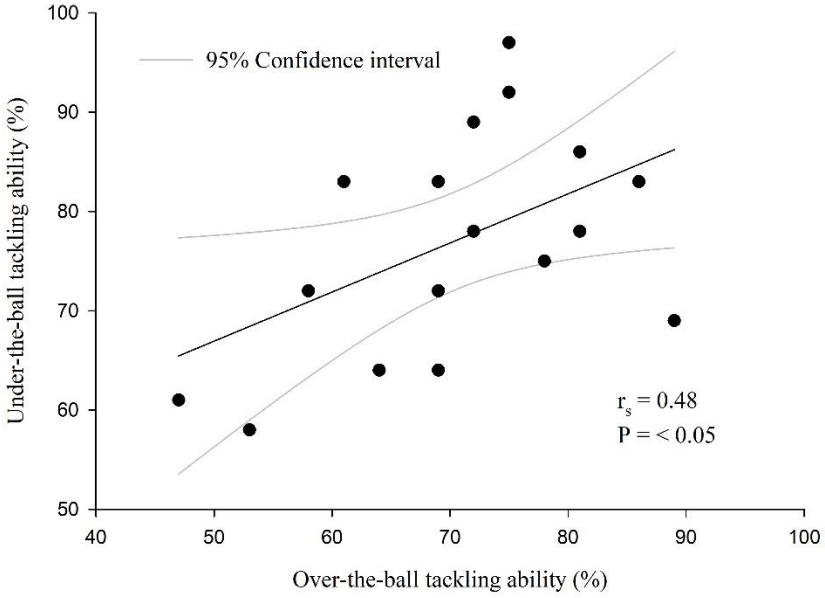

Figure 2: Under-the-ball vs over-the-ball tackling ability.

Table 1: Relationships between tackle ability and match-play tackle outcomes.

	OTB TA	UTB TA	Missed	Offloads	Dominant	Errors	PTB
OTB TA	1.00						
UTB TA	0.48*	1.00					
	(0.02-0.77)						
Missed	-0.11	-0.48*	1.00				
	(-0.55 to 0.38)	-0.77 to -0.02)					
Offloads	-0.50*	-0.32	0.27	1.00			
	(-0.78 to -0.04)	-0.68 to 0.17)	(-0.23 to 0.65)				
Dominant	0.52*	0.57*	-0.16	-0.61**	1.00		
	(0.07 to 0.79)	(0.14 to 0.82)	(-0.58 to 0.33)	(-0.84 to -0.20)			
Errors	0.38	0.07	0.04	-0.20	-0.09	1.00	
	(-0.11 to 0.72)	(-0.41 to 0.52)	(-0.43 to 0.50)	(-0.61 to 0.29)	(-0.53 to 0.39)		
PTB	0.50*	0.23	0.00	-0.45	0.74**	0.02	1.00
	(0.04 to 0.78)	(-0.27 to 0.63)	(-0.47 to 0.47)	(-0.76 to 0.02)	(0.42 to 0.90)	(-0.45 to 0.48)	

Abbreviations: OTB TA, Over-the-ball tackle ability; UTB TA, Under-the-ball tackle ability; Missed, proportion of missed tackles; Offloads Conceded, proportion of off-loads conceded per game; Dominant, proportion of dominant tackles; Errors, the proportion of errors forced each game; PTB, average play-the-ball speed (s).

Note: Data are reported as Spearman's rank order correlation coefficients, r_s and 95% confidence interval (in parentheses).

* Significant at $p<0.05$.

** Significant at $p<0.01$.

Table 2: Relationships between tackle ability and muscular strength and power.

	Over-the-ball TA	Under-the-ball TA
Body Mass	0.03	0.45
	(-0.44 to 0.49)	(-0.02 to 0.76)
1RM Squat	0.15	0.55*
	(-0.34 to 0.58)	(0.11 to 0.81)
1RM Bench Press	-0.07	0.35
	(-0.52 to 0.41)	(-0.14 to 0.70)
1RM Chin up	0.56*	0.43
	(0.13 to 0.81)	(-0.05 to 0.75)
Relative Squat	0.17	0.14
	(-0.32 to 0.59)	(-0.35 to 0.70)
Relative Bench Press	-0.15	-0.05
	(-0.58 to 0.34)	(-0.51 to 0.43)
Relative Chin up	0.19	-0.16
	(-0.30 to 0.60)	(-0.58 to 0.33)
CMJ	-0.16	0.36
	(-0.58 to 0.33)	(-0.13 to 0.71)
PPU	0.05	0.09
	(-0.43 to 0.51)	(-0.39 to 0.53)

Abbreviations: 1RM, 1-repetition maximum; Relative squat, squat relative to body mass; Relative bench, bench press relative to body mass; Relative chin up, chin up relative to body mass; CMJ, countermovement jump peak power; PPU, plyometric push-up peak power.

Note: Data are reported as Spearman's rank order correlation coefficients, r_s and 95% confidence interval (in parentheses).

* Significant at $p<0.05$.

** Significant at $p<0.01$.

Table 3: Standardized tackling ability tests of "Good" and "Poor" players.

	Good Tacklers (n = 9)	Poor Tacklers (n = 9)	Effect Size
Under-the-ball tackling ability (%)	85.1 ± 6.8	69.0 ± 8.1	2.11 (1.01-3.34)
Contact centre of gravity (AU)	5.9 ± 0.3	5.9 ± 0.3	0.00 (-0.93-0.92)
Initial contact with shoulder (AU)	5.9 ± 0.3	5.4 ± 1.3	0.34 (-0.49-1.38)
Square and aligned (AU)	4.2 ± 1.5	2.8 ± 1.3	1.11 (0.01-1.96)
Leg drive upon contact (AU)	5.2 ± 0.8	3.11 ± 2.0	1.04 (0.28-2.31)
Watch target onto shoulder (AU)	3.6 ± 1.6	2.1 ± 1.8	0.82 (-0.14-1.78)
Centre of gravity over base of support (AU)	5.9 ± 0.3	5.6 ± 1.3	0.25 (-0.61-1.25)
Over-the-ball tackling ability (%)	78.8 ± 6.0	62.1 ± 8.1	2.06 (1.05-3.41)
Contact on ball (AU)	6.0 ± 0.0	6.0 ± 0.0	-
Contact with shoulder and chest (AU)	6.0 ± 0.0	5.4 ± 0.5	1.06 (0.39-2.46)
Square and aligned (AU)	4.1 ± 1.5	2.3 ± 1.4	1.26 (0.18-2.19)
Leg drive upon contact (AU)	2.7 ± 2.6	1.8 ± 1.6	0.54 (-0.53-1.34)
Watch target into contact (AU)	5.4 ± 1.1	4.3 ± 1.9	0.57 (-0.28-1.62)
Minimise space between head, hips and feet (AU)	4.1 ± 1.6	2.6 ± 2.1	0.75 (-0.17-1.75)

Individual variable represents a score from a possible score of 6 (i.e. the sum of 6 trials). AU = Arbitrary units

Data are means ± SD. Tackling ability score presented as a percentage. Effect size, <0.2 = trivial; 0.2-0.6 = small; 0.61–1.2 = moderate; 1.21–2.0 = large; >2.0 = very large (95% confidence intervals).

* Significant at $P < 0.05$.

** Significant at $P < 0.01$.

Table 4: Match-play tackling performance of "good" and "poor" over-the-ball tacklers.

	Good (n=9)	Poor (n=9)	Effect Size	Difference
Over-the-ball TA (%)	78.8 ± 6.0**	62.1 ± 8.1	2.38 (1.1 to 3.4)	Very large
Tackles (n)	14.0 ± 6.4	12.1 ± 7.0	0.29 (-0.6 to 1.2)	Small
Missed Tackles (%)	10.1 ± 5.6	11.8 ± 4.7	-0.31 (-1.2 to 0.6)	Small
Offloads Conceded (%)	3.5 ± 1.8*	5.4 ± 1.2	-1.29 (-2.2 to -0.2)	Large
Dominant Tackles (%)	64.5 ± 12.0**	52.0 ± 5.9	1.32 (0.3 to 2.3)	Large
Forced Errors (%)	5.2 ± 5.0	2.4 ± 2.5	0.70 (-0.3 to 1.6)	Moderate
PTB (sec)	4.25 ± 0.17*	4.04 ± 0.23	1.05 (0.1 to 2.0)	Moderate

Note: Data are means ± SD. TA = tackling ability; PTB = play-the-ball. Effect size, <0.2 = trivial; 0.2-0.6 = small; 0.61–1.2 = moderate; 1.21–2.0 = large; >2.0 = very large.

Note: 95% confidence interval (in parentheses).

* Significant at $p<0.05$.

** Significant at $p<0.01$.

Table 5: Match-play tackling performance of "good" and "poor" under-the-ball tacklers.

	Good (n=9)	Poor (n=9)	Effect Size	Difference
Under-the-ball TA (%)	85.1 ± 6.8**	69.0 ± 8.1	2.15 (1.0 to 3.3)	Very Large
Tackles per game	11.2 ± 4.5	14.9 ± 8.0	-0.58 (-1.5 to 0.4)	Small
Missed Tackles (%)	8.7 ± 5.5*	13.2 ± 3.6	-0.98 (-1.9 to 0.1)	Moderate
Offloads Conceded (%)	3.8 ± 1.8	5.1 ± 1.6	-0.76 (-1.7 to 0.2)	Moderate
Dominant Tackles (%)	62.4 ± 11.7	54.1 ± 9.7	0.77 (-0.2 to 1.7)	Moderate
Forced Errors (%)	3.7 ± 4.5	3.9 ± 3.9	-0.04 (-0.6 to 1.3)	Trivial
PTB (sec)	4.19 ± 0.11	4.11 ± 0.29	0.34 (-0.6 to 1.3)	Small

Note: Data are means ± SD. TA = tackling ability; PTB = play-the-ball. Effect size, <0.2 = trivial; 0.2-0.6 = small; 0.61–1.2 = moderate; 1.21–2.0 = large; >2.0 = very large.

Note: 95% confidence interval (in parentheses).

* Significant at $p<0.05$.

** Significant at $p<0.01$.