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Playing through the pain: The prevalence of perceived shoulder dysfunction in uninjured rugby players using the Rugby Shoulder Score☆

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ABSTRACT

Objective: This study aimed to investigate the prevalence of self-reported shoulder dysfunction using the Rugby Shoulder Score (RSS) reported in arbitrary units (AU) of rugby players available for match selection (uninjured).
Design: Cross-sectional survey.
Methods: Paper survey at the mid-point of the season of uninjured players (n = 86 males (mean age (±SD): 26 ± 6.9y) from 8 squads (professional $n = 34$; amateur; $n = 52$)), using the RSS, subjective impact on rugby performance and previous shoulder injury, analysed using a Mann-Whitney *U* test.
Results: 55% of players reported a level of RSS dysfunction despite being uninjured. Players who also reported their shoulder was impacting on performance had significantly higher median RSS (61, IQR 28AU, p = 0.02) than those who reported no impact on performance (40, IQR 22AU). *Conclusions*: Findings from this study show that over half of players were playing with a level of self-reported shoulder dysfunction. This figure is higher in the professional game, for those with a history of previous injury and for forwards.

1. Introduction

The incidence of injury related to rugby training and matches have been reported in the codes of rugby (Fitzpatrick et al., 2018; Kemp et al., 2017). Injuries in rugby and other collision sports are commonly identified through time lost from matches and training. The time-loss definition reduces errors associated with using different operational injury definitions allowing accurate comparison among studies without medical diagnosis (Fitzpatrick et al., 2018; Fuller et al., 2007). However, not all injuries result in time-loss, which may underestimate the true burden of injury in a particular sport (Bahr, 2009). This may be especially true in sports whereby injury is of insidious onset (Docking et al., 2018). Capturing data on injury or discomfort, which does not result in time loss but does alter a player's perception of function may be the first step to reducing the incidence or severity of future time-loss injuries.

Athletes perceive themselves to be injured when they suffer a performance limitation, not only when they are unable to participate (Bolling et al., 2019). Recording all complaints data is uncommon, especially at sub-elite and amateur levels, where resources are more limited (Brown et al., 2019). Post-match pain and soreness in the limbs are present throughout a professional rugby league season (Fletcher et al., 2016), and prolonged soreness

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may be a precursor to injury identification (Meeuwisse et al., 2007). These challenges suggest a need to develop methods whereby players can independently report their perceived function at multiple time points across a season (Bahr, 2009; Meeuwisse et al., 2007).

Determining the onset of perceived dysfunction in players may prove crucial in preventing or reducing the severity of rugby shoulder injury by allowing for time-sensitive intervention. Relating reported perceived performance to joint function is a novel entity. The shoulder has been reported to be one of the joints most frequently injured in rugby and can be among the most severe injuries based on a time-loss definition (Fitzpatrick et al., 2018; Kemp et al., 2017). The tackle is responsible for the majority of shoulder injuries and those who tackle more often (forwards) suffer more shoulder injuries (Kemp et al., 2017). Identifying risk factors for shoulder injuries in rugby, where single or repeated tackling is the main traumatic event remains a challenge. Electromyographic muscle activation during the tackle (Horsley et al., 2010), isometric (Ashworth et al., 2018), isokinetic shoulder strength and range of motion (McDonough & Funk, 2014) have been investigated as risk factors for injury, but no single objective measure or set of measures has been found to identify the risk of shoulder injuries in rugby players. In the absence of a clear single or multiple set of objective risk factors the subjective prevalence of symptoms warrants further investigation.

The aim of this study was to determine the prevalence of perceived shoulder dysfunction among rugby players. A secondary aim was to determine whether there were differences in perceived shoulder dysfunction between positions and across levels of participation.

2. Methods

Following ethics approval from Leeds Beckett University, gatekeeper permission was sought from Heads of Medicine at clubs and informed consent from players of rugby league (RL) and rugby union (RU) clubs through purposeful sampling to complete the Rugby Shoulder Score (RSS) questionnaire. Eighty-six male players were eligible to be included in this study (mean age (±SD): 26 ± 6.9y) from 8 squads (40% professional (n = 34, RL 2 clubs (European Super league) RU 1 club (English Championship) with n = 25 full international and n = 8 youth international representation), 60% amateur (n = 52) RL 3 clubs, RU 2 clubs). A greater proportion recruited were rugby league players (n = 72) compared to rugby union (n = 14), but an equal split of forwards and backs in each code. To meet the inclusion criteria all players had to be aged over 18 years old and be available for selection (uninjured). Players were excluded if they were not eligible for selection due to an existing injury to a shoulder or other body region injury. Fifty-three players recorded scores for both shoulders and 33 their dominant shoulder only. A total of 139 shoulders of rugby players self-declared as 'fit for selection' were included in the study. The proportion of backs (n = 43) and forwards (n = 43) in the sample were equal and 76% were recorded as right-hand dominant.

Data collection was carried out at the mid-point of respective seasons on the day prior to a match. The RSS (Appendix A) was used for players to report their perception of shoulder function. The RSS is a 20 question Likert scale (20-140AU) used to evaluate a single construct of rugby shoulder function and has been validated for internal consistency (0.96 Cronbach's α) and reliability (0.94 intraclass correlation coefficient) using a cohort of rugby shoulders with chronic stable shoulder dysfunction (Roberts & Funk, 2013). A score of 20 is considered a perfect score and every increase toward 140 is representative of increasing shoulder dysfunction.

In addition to the RSS, each player was asked two extra questions. 1) 'Do you feel that your shoulder impacts your ability to train or play to your full potential?' and 2) 'Have you sustained a shoulder injury in your career to date that has caused you to miss training or matches before?' The first additional question allowed the potential creation of 4 groups (Table 1).

Minimal important difference could be inferred using data from group 3 who reported impact on their rugby. No players recorded answers that could have been used to create a fourth group (a perfect score plus perceived impact). The previous career history of injury question allowed analysis of a sub-group of players that had reported previous injury. Career history was chosen as opposed to past season injury or a shorter time frame, in an attempt to capture ongoing dysfunction that may be present from older injuries.

Data analysis was conducted using SPSS for Windows version 27 (SPSS Inc. Chicago, Illinois) with statistical significance set at $p < 0.05$. Normal distribution of the sample was assessed with Shapiro Wilkes test and based on a non-normally distributed sample a Mann-Whitney *U* test was used with median RSS and interquartile range (IQR) reported.

3. Results

The mean RSS of the entire sample (Table 2) was 35AU ± 20 (range: 20–105). No difference was seen in RSS between the two codes of rugby. Those who had a previous time-loss injury had a higher RSS compared to those without a history of a time loss injury across the sample (48, IQR 41AU *vs*. 20, IQR 13AU, $p < 0.001$). Forty-five percent of the sample recorded a perfect score of 20/140 indicating no perceived dysfunction forming group 1 for analysis. The percentage of each subcategory that scored a perfect score was 34%, 52%, 53%, and 37% for professionals, amateurs, backs and forwards respectively. Thirty-five percent of the sample reported a previous time loss shoulder injury, but only 21% of those players now recorded a perfect score. By comparison, of those with no history of time loss shoulder injury, 56% recorded a perfect score.

Two groups recorded perceived dysfunction scores (groups 2 & 3), with group 3 significantly higher than group 2 (61, IQR 28AU *vs*. 40, IQR 22AU, $p = 0.02$) (Fig. 1). RSS dysfunction was also higher in professionals compared to amateurs (40, IQR 39AU *vs*. 20, IQR 18AU, $p = 0.02$), with positional differences seen between forwards compared to backs (29, IQR 29AU *vs*. 20, IQR 21, $p = 0.036$).

4. Discussion

This study presents new data that shows a high prevalence of perceived shoulder dysfunction in rugby players available for match selection who were not currently receiving medical attention. Fifty-five percent of players reported varying levels of RSS dysfunction. Using time loss injury or medical attention definitions these players would be missed off most injury/performance monitoring programmes. Differences according to playing level, player position, perceived impact on performance and previous injury were also seen.

Reporting the prevalence and incidence of time loss injuries, has become more consistent since the adoption of consensus statement definitions (Ardern et al., 2016; Fuller et al., 2007) and synchronisation of reporting systems (Orchard et al., 2020) across a range of sports and governing bodies. Reporting of overuse, non-time loss injuries, whereby medical attention is sought, is highly recommended but may not occur frequently in situations where players have limited access to medical practitioners (Clarsen et al., 2020). Expert consensus suggests that players frequently return to training for their sport prior to restoration of pre-injury levels of function and pain, typically under bespoke guidance from medical

Table 1
Groups defined by RSS score and perceived impact on rugby performance.

	Perceived impact on rugby	
	No	Yes
RSS = 20 (Perfect score)	Group 1 (n = 62)	Group 4 (n = 0)
RSS >20 (Increasing perceived dysfunction)	Group 2 (n = 60)	Group 3 (n = 17)

Table 2
Differences in RSS scores according to current perceived impact on performance, playing level, position and previous career time loss shoulder injury. RSS scores in AU are displayed as mean ± SD or median (IQR). p-values represent the results ofMann
-Whitney U.

	n	RSS Score
All Shoulders	139	35 ± 20 23 (28)
No performance impact (Group 2)	60	40 (22)
Performance impact (Group 3)	17	61 (28) p = 0.02
Rugby League	125	25 (26)
Rugby Union	14	20 (25) p = 0.41
Professional	58	40 (39)
Amateur	81	20 (18) p = 0.02
Forwards	73	29 (29)
Backs	66	20 (21) p = 0.036
Previous Injury	48	48 (41)
No Previous injury	91	20 (13) p < 0.001

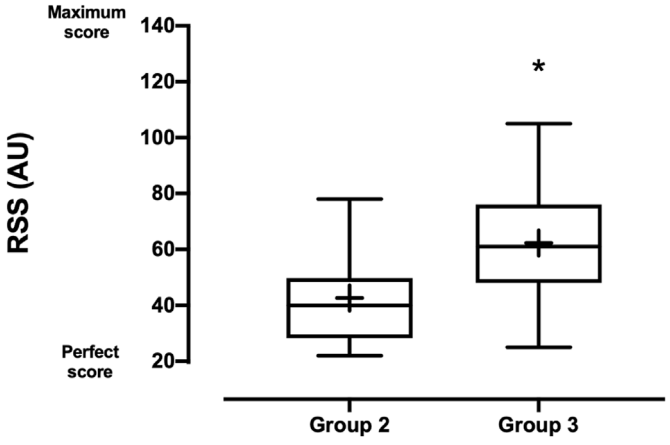

Fig. 1. RSS sub-group analysis. Group 2 (No reported effect on performance) and Group 3 (reduced performance reported) Median score indicated by horizontal line and IQR by the box perimeter. Error bars indicate standard deviation, + = mean RSS in AU * = Significance p < 0.05. Note Group 1 = 20 (i.e., perfect score).

and conditioning teams (Ardern et al., 2016). Furthermore, return to play has also been recommended prior to the restoration of physical function to pre-injury levels (10% deficits in muscle strength and VO_2 max) (Bisciotti et al., 2019). While it has been demonstrated that return to play within these parameters is relatively safe (<2% reoccurrence of muscular injury), it is unclear whether functional deficits of this nature are ever fully resolved. Similarly, when combining imaging to aid the return to play (RTP) decision making, resolution of high Magnetic Resonance Imaging (MRI) and Ultrasound (US) signal often do not occur until 6 months post injury (variable dependant on structure and location) (Bisciotti et al., 2019). Given RTP times of many neuromuscular injures will often occur within 6 months, it has been suggested that 70% of image signal should have returned to normal prior to RTP (Bisciotti et al., 2019). These data make it clear that in many contexts, sports people return to competition prior to the complete resolution of all injury signs, symptoms and functional deficits.

This study showed that professional rugby players reported higher prevalence of perceived shoulder dysfunction and severity compared to amateurs. Whilst this study did not prospectively record injuries or load, given the cross-sectional design, speculative association can be seen between reported RSS dysfunction patterns in this sample and existing rugby shoulder injury data (Fitzpatrick et al., 2018; Kemp et al., 2017; Roberts et al., 2013). There is a proposed theoretical link between increased load exposure and prevalence of shoulder injuries in the professional game compared to amateur (Ross et al., 2015). Epidemiology match data from rugby union demonstrates higher shoulder injury incidence in professionals (3.7/1000h Acromioclavicular Joint) (Kemp et al., 2017) relative to semi professionals and amateurs (2.3/1000h Shoulder) (Roberts et al., 2013). The same pattern of reported dysfunction differences is seen in this sample between professionals and amateur who were eligible for selection. Although professional players might be expected to have greater access to injury prevention and rehabilitation resources, higher prevalence of perceived dysfunction in professionals may be linked to greater demands and higher volume of match and training exposure experienced by professionals (Booth et al., 2018; Ross et al., 2015).

Using a single definition of a career time loss injury in this study, it was clear that the RSS scores of players with a past time loss injury were significantly higher than those with no reported history. Similar impact was seen on Kerlan-Jobe Orthopaedics Clinical Score (KJOC) of elite cricketers (Dutton et al., 2018) and Oslo Sports Trauma Research Centre (OSTRC) Questionnaire score, with semi-professional footballers (Whalan et al., 2019). Collectively, these results suggest that previous injury at any point in an athletes career can result in reduced perceived function years after the index injury, and it is already well documented that previous musculoskeletal injury is the strongest predictor of future musculoskeletal injury across most sports (Toohey et al., 2017). Whilst this study highlights prolonged perceived shoulder dysfunction in those reporting a previous time loss injury, it is not possible to attribute this dysfunction to a particular measurable physical marker or an ongoing post injury psychological construct. In the current study, less than half of the players in this sample had a perfect shoulder score at the mid-point of a season. It is not known whether those players in group 2 and 3 started the season with lower or 'perfect' scores. To assess seasonal carryover of perceived functional deficit, serial monitoring would be required to evaluate the recursive nature of injury and exposure to a rugby competition (Dutton et al., 2018; Meeuwisse et al., 2007).

Pain and soreness felt by rugby league players persists throughout a season (Fletcher et al., 2016) but the impact of pain on performance has not been studied. Performance in team sport is a difficult metric to define (Bishop et al., 2018) and match day and training performance are entirely different entities, however 14 players (17 shoulders) from group 3 reported that their shoulder(s) were impacting on training

and or match performance. A proportion of players were therefore playing or training with perceived deficits. Without prospective evaluation it is not known what the risk of future injury was for these players playing with known impact on match or training performance. The same can be said for players in group 2, however in a typical team environment these would potentially be undetected as they are neither seeking medical attention, absent with injury or report any changes to match or training performance subjectively. The point of medical and conditioning intervention in this group presents its own challenges. Periodic health evaluation, using such tools as RSS, should be promoted as 'performance enhancing' rather than 'risk reducing' which is seen has having a positive impact on performance from an athlete's perspective and thus more likely to have greater player acceptance (Hughes et al., 2018).

This study demonstrates that perceived shoulder dysfunction in rugby exists in players who may not have registered time-loss injury. The severity of reported previous injury cannot be inferred from these data, however compared to those without previous injury, fewer players were playing with a perfect score. It is not known if this represents a failed complete recovery in the absence of serial measures. Longitudinal serial data would allow greater depth of analysis as to whether those players with a previous injury history ever returned to play with a perfect score or an acceptable level of reported dysfunction. Greater understanding of the relationship between reported shoulder dysfunction and injury would enhance the use of this tool for injury screening and RTP.

Positional difference in dysfunction were seen in this study with forwards reporting greater prevalence and severity of dysfunction than backs. Forwards in both codes of rugby complete greater number of tackles than backs(Cummins & Orr, 2015; Hendricks et al., 2014), reporting higher incidence of shoulder injury compared to backs with the main mechanisms of injury occurring during the tackle (Fitzpatrick et al., 2018; Kemp et al., 2017). Tackle determinants on performance (Hendricks et al., 2018) and player attitudes towards the tackle (Hendricks et al., 2015) have been studied, however the presence of a reported dysfunction was not known in these studies. It is unclear if the presence of this type of perceived shoulder dysfunction prior to a game impacts on player performance metrics or injury risk. Different EMG shoulder muscle firing patterns of players performing a simulated tackle (Horsley et al., 2010) with known shoulder labral pathology and altered muscle firing with experimentally induced pain have been demonstrated (Castelein et al., 2017). Given the reported high frequency of players playing with pain throughout a season (Fletcher et al., 2016), it would seem reasonable to surmise that if players are reporting pain and dysfunction and still playing and tacking, they may be exhibiting altered muscle firing during skill performance. The prospective impact of this on performance and potential injury risk remain unknown.

Greater prevalence and severity of perceived shoulder dysfunction was evident in uninjured forwards from this study, this may therefore suggest a link between shoulder dysfunction reported and number of injuries but at the moment, in the absence of data, this is purely a speculative association. Data in this study was collected on match day minus one to try and reduce the effect of previous match day exposure on dysfunction scores, however squads in different competitions may have had different turnaround times between matches and had autonomy to plan their training between fixtures. To date it is not known what the variation in RSS score may be through a short micro cycle of training in-between fixtures. RSS scores could therefore be altered depending on the proximity to a previous training sessions highlighting the importance of serial data in future studies.

Players who acknowledge their own shoulder dysfunction and its impact on their performance is a new category of player reported in this study. The difference in scores between those who perceived their shoulder dysfunction to affect their performance and those who did not, further highlights the continuum towards a time-loss injury. Injury is dependent on the complex dynamic recursive interactions of exposure and training adaptations as well as previous injury (Bahr, 2009; Meeuwisse et al., 2007; Toohey et al., 2017). In this study there is considerable overlap in the range of RSS scores between those who did and did not experience an impact on performance. Some players with minimal perceived shoulder dysfunction reported it to affect their performance and some players with moderate dysfunction reported no impact on performance. An absolute threshold of RSS that may be impacting performance can be inferred from central tendency data from group 3 (~61AU), however this was player reported impact rather than impact seen on physical performance or game metrics. Future studies may wish to evaluate RSS thresholds scores in this region (~61AU) and players may be considered worthy of further medical, conditioning and coaching review. Identifying the prevalence of perceived dysfunction of the shoulder in athletes may be an important step in the prevention of injuries, however there are some limitations when using the RSS that need to be considered.

The RSS is the only validated tool that looks at shoulder function within the codes of rugby (Roberts & Funk, 2013). The RSS was designed for use with players with severe shoulder injuries and therefore may not capture the full range of questions that the sub clinical/lower threshold injuries associate with. The RSS single construct score does not provide practitioners with information regarding the nature of dysfunction that players are experiencing. As such, players with similar RSS scores can have very different limitations which is unhelpful for medical, conditioning and coaching teams aiming to prepare interventions. There are also some questions on the RSS that may inadvertently elevate a score as the similarity of the questions may encourage double counting of the same symptom. An example of this would be where a player has indicated a high score on statement 2 'Pain/discomfort during training or playing' and then indicates a specific aspect of training or playing such as in statements 3–16 of the RSS (Appendix A). To date the original RSS questions have yet to undergo analysis to see if there are indeed any redundant items for a single construct or multicollinearity for questions. Future comparisons of RSS data to performance markers may help with the interpretation of scores. Therefore, caution does need to be given for these reasons when interpreting scores, especially in absence of minimal detectable change values for the RSS.

Given the sample size in this study (n = 72 (125 shoulders) RL, n = 14 (14 shoulders) RU) similarities between codes from data should be viewed with caution. Positional comparison across both codes was not performed due to low numbers (7 forward and backs, n = 14 shoulders − RU, *vs.* 36 forwards and backs, n = 125 shoulders − RL), therefore different RSS scores between a forward or back in RU or RL remain unknown. Future studies may look to recruit enough numbers to allow such comparisons. During data collection one squad of players recorded scores for their dominant shoulder only, as such the true extent of dysfunction may be under or overestimated in this first set of data of this kind in the absence of two scores from those players.

5. Conclusions

This study is the first to report the prevalence of subjective shoulder dysfunction using the RSS in a sample of uninjured players. Data suggest that ~55% of rugby players can expect to have a shoulder dysfunction at the mid-point of the season. The point at which these scores become noticeable to the players in terms of impact on rugby performance has been identified. Previous injury elevated RSS and positional differences appeared to mirror injury prevalence data. The RSS may be useful in the early detection of

players who have perceived shoulder dysfunction related to rugby performance and could be used in combination with other assessments. Given the sample bias towards rugby league players, caution should be taken when applying findings to rugby union players and specific positional differences between codes.

Practical implications

- Periodic health evaluation using self-reported measures may help detect those athletes who present with unreported perceived shoulder dysfunction. Sub-clinical dysfunction may reduce performance and increase injury risk and thus should be actively managed.
- Medical, conditioning and coaching teams can expect that greater than 50% of their playing squads are likely to be playing and training with some level of perceived shoulder dysfunction.
- Players reporting a score of >61AU on the RSS perceive reduced performance capability and may benefit from medical, conditioning and coaching review.

Ethical approval was gained through Leeds Beckett University 18th March 2015 to carry out this research

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ptsp.2022.01.001.

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