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RETURN TO PLAY AND PERFORMANCE GUIDELINES IN RUGBY UNION

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ABSTRACT

Models and guidelines on factors associated with the safe return to play (RTP) of an injured athlete have been established, but very limited research has been conducted on components necessary for returning an athlete to their previous level of performance, known as return to performance (RTP_{erf}). The study aimed to establish guidelines applicable to RTP and RTP_{erf} in rugby union. A mixed-methods study design using an e-Delphi survey was conducted to obtain the opinions of medical team members of the Currie Cup rugby unions across South Africa on RTP (Part 1 of the study). In Part 2, medical team members and coaches of the Free State Rugby Union were consulted for RTP_{erf} guidelines. Part 1 of the study comprised a three-step decision-based RTP model used to identify RTP components in rugby. The e-Delphi questionnaire was compiled based on literature analyses and vast experience of the authors. Part 1 involved three steps of integrated guidelines for RTP decision-making in rugby union established by agreement (>80%) (first or second round): Step 1: medical history; Step 2: evaluation of participation risk; and Step 3: decision modifiers. Part 2 focused on components to consider during the RTP_{erf} decision-making process, including psychological readiness, limb symmetry index, acute:chronic training load, external load and internal load. Twelve key performance indicators (KPIs) to measure RTP_{erf} in rugby reached consensus (>80%). The comparison of performance profiles and current KPIs of a rugby player could be used to evaluate the player's performance level and whether they truly achieved RTP_{erf}.

Keywords: Return to play; Return to performance; Key performance indicators; Rugby union; e-Delphi.

INTRODUCTION

Return to play (RTP) is meant, in most of the literature, "in a general sense, to describe the process of diagnosis, treatment, and rehabilitation of a given injury or illness to determine when an athlete is 'healthy' for the purpose of participation in athletic com petition" and forms the epicentre of a team physician's clinical work (Matheson *et al*., 2011; 26). Return to performance (RTP_{erf}) has been described as a continuum on which "the athlete [having] gradually returned to his/her specified sport and is performing at or above his/her preinjury level" (Ardern *et al*., 2016: 854). Various models guiding the RTP decision-making process have been established, of which the most prominent model is Creighton's decision-based RTP model(Creighton *et al*., 2010).

More recently, Buckthorpe *et al*. (2019) stated that traditional RTP decision-making processes are insufficient in a real-world situation. It has been reported that less than ideal numbers of athletes are returning to competitions after injury and that among those who do, RTP poses an increased risk of re-injury. Furthermore, the athlete may not return to pre-injury performance levels or may be unable to achieve the same level of competitive play in the years following the injury (Rebelo-Ma rques *et al*., 2019). It is well known that a history of an injury in sport is a predictor of subsequent injury and that the decisions on when a player should RTP are difficult (Blanch & Gabbett, 2016; Gabbett, 2018).

Taberner *et al*. (2019: 1) stated that practitioners must balance the risk of re-injury and the return to sport (RTS) process, "combining evidence and clinical experience to estimate this risk, then plan and adapt RTS accordingly".

It is therefore difficult for the medical team to find the right balance between returning a player too early and the player suffering a recurrence of the injury or delaying RTP. It is also crucial to consider the RTP process as a continuum with overlapping of the different phases, as well as the roles of each practitioner, especially during the transition between rehabilitation and RTP (Buckthorpe *et al*., 2019). Furthermore, no consensus has been published in the literature of who should make the decision (Blanch & Gabbett, 2016). Within those arguments, a comprehensive checklist of considerations has been developed. Creighton *et al*. (2010) and Matheson *et al*. (2011) developed a three-tiered decision-making process that has recently been clarified in the Strategic Assessment of Risk and Risk Tolerance (SARRT) framework (Matheson *et al*., 2011). However, Bahr (2016: 776) concluded that to date "there is no intervention study providing support for screening for injury risk".

Traditional RTP models focus on guidelines on how to best return a player to their sport, yet do not address the phenomenon of a player not performing in accordance with their pre -injury level of play. It is well known that a notable number of rugby players do not return to competitions after certain types of injury (Lai *et al*., 2018). Additional reasons include that those who do RTP have an increased risk of re-injury (Wiggens *et al*., 2016), may not return to pre-injury performance levels (Myer *et al*., 2011) or may be unable to sustain the same level of competitive play in the subsequent years after the occurrence of the injury (Waldén *et al*., 2016).

In the past, medical staff aimed to understand the link between performance and training loads (Windt & Gabbett, 2017) but recent evidence has concluded that chronic relatively high training loads are not associated with reduced injury risk (Lolli *et al*., 2019; Impellizzeri *et al*., 2020; Wang *et al*., 2020). The acute:chronic workload ratio (ACWR) is commonly used to monitor the training loads of elite athletes. However, it has been considered as an inaccurate system of measurement and difficult to interpret in a practical setting, as no research has been able to determine the causal effects of the ACWR (Lolli *et al*., 2019; Impellizzeri *et al*., 2020; Wang *et al*., 2020). In addition, Bahr (2016) concluded that although predicting future injury risk through screening tests is unrealistic, a pre-participation examination can serve several other purposes, as outlined in the International Olympic Committee (IOC) consensus statement on periodic health evaluation of elite athletes (Bakken *et al*., 2016).

However, to successfully structure rehabilitation and an RTP and RTP_{erf} decision-making process, it is critical to understand the demands of the game (Eaton & George, 2006; Gabbett *et al*., 2016; Buckthorpe *et al*., 2019). Such understanding has recently been advanced by techniques that include video analysis, time-motion analysis and heart rate monitoring during matches and practice (Lacome *et al*., 2014; Gabbett, 2016). Since rugby union is a team sport associated with high velocity impact, high injury rates have been reported on all levels of the sport (Williams *et al*., 2016; Williams *et al*., 2017; Fuller *et al*., 2011).

Measurement of performance is essential when deciding whether a player has reached RTP_{erf} standards. Key performance indicators (KPIs) are a reliable tool used to measure performance that can be defined as "a selection, or combination, of action variables that aims to define some or all aspects of performance" and directly correlates to successful performance in a position-specific and team context (Hughes & Bartlett, 2002: 739; Smart *et al*., 2014; Bunker & Spencer, 2022). The aim of this study was therefore to establish consensus among professionals in a medical team and coaches on which components should be addressed in RTP (Part 1) and RTP_{erf} (Part 2) to identify relevant KPIs to set guidelines for RTP_{erf}.

PURPOSE OF THE RESEARCH

Taking into consideration the evolving role of RTP_{erf} decision-making in sport, the purpose of this article was to integrate literature and practice to develop a framework for guidelines to assist medical personnel and coaches in rugby union in the RTP and RTP_{erf} decision-making process.

METHODOLOGY

Ethical considerations

The study was approved by the Health Sciences Research Ethics Committee (HSREC) of the Faculty of Health Sciences at the University of the Free State (Part 1 – RTP: reference number ECUFS 142/2014) and had written support from the South African (SA) Rugby Union, the Free State Rugby Union and the Delphi panel members before commencement of data collection (Part 2 – RTP_{erf}: reference number UFS-HSD2021/0020/2906).

Research design

An exploratory mixed-methods research design was used primarily applying a quantitative research approach for the e-Delphi survey, supplemented with some qua litative elements. Both Habibi *et al*. (2014) and Jünger *et al*. (2017) supported this design as a promising methodology to explore critical issues when the investigation outcomes require isolated opinions from experts on an explicit subject (Gianarou & Zervas, 2014). This methodology equipped the researchers with information relevant to RTP and RTP_{erf} as the basis for the formulation of guidelines in RTP_{erf} decision-making in rugby union, as presented in this article.

e-Delphi process

It has been suggested that a panel of experts selected for an e-Delphi survey should consist of individuals from heterogeneous educational backgrounds, selected on the basis of their high educational qualifications (Donohoe *et al*., 2012), special expertise (Nworie, 2011) and extensive knowledge of the subject matter (Donohoe *et al*., 2012). We support the suggestion by Fink *et al*. (1984) that an expert should be a representative of their professional group with sufficient expertise not to be disputed or the power required to instigate the findings. Therefore, two independent exercise professionals with eligible academic qualifications and more than 10 years of practical experience in national and international level team management assisted the researchers in compiling the e-Delphi questionnaires.

Data collection

A non-probability, purposeful sampling method was used for the e-Delphi panel. All e-Delphi panel members participated voluntarily and were actively involved as full-time employees in the management and medical team of the 15 Currie Cup Rugby Unions in SA (Part 1) and the Free State Rugby Union (Part 2; see Table 1). All 24 members were qualified in their professions for more than 5 years.

***Table 1*. DEMOGRAPHIC VARIABLES OF THE DELPHI PARTICIPANTS (n=24)**

Variable	n (%)
Gender	
Male	22 (91.7)
Female	2 (8.3)
***Part 1 of the study* (N=14)**	
Profession	
Medical doctor	14 (100)
***Part 2 of the study* (N=10)**	
Profession	
Rugby coaches	2 (20.0)
Physiotherapist	4 (40.0)
Biokineticist	2 (20.0)
Conditioning coaches	2 (20.0)

The primary focus of Part 1 of the e-Delphi survey was to collect the opinions of the selected panel (medical teams of the 15 Currie Cup Rugby Unions in SA) on RTP guidelines by means of a semi-structured questionnaire. Items included in the questionnaire for Round 1 of the survey were based on an extensive literature review (Wall, 2018) and the identified panel of experts (provided by SA Rugby) were invited via email to participate in the study. The email included an information letter about the study, ethical information, the e-Delphi survey itself and information for the completion of the questionnaire. Voluntary completion and return of the questionnaire implied consent to participate in the study. Attrition bias was limited in subsequent rounds by only including experts who responded to the invitation in the first round of the e-Delphi survey. This reply was regarded as an agreement of consent to participate for the full duration of the survey (Slade *et al*., 2014). The questionnaire was sent by email with a set deadline (3 weeks) and a reminder email sent weekly. The completion of the questionnaires took approximately 40 minutes, with the option to complete the questionnaires in their own time within the 3-week period. The questionnaires for Rounds 1 and 2 consisted of items that had to be evaluated on a three-point Likert scale (agree/partially agree/disagree) and served as the quantitative component. This was followed by an open-ended question at the end of each section, providing the qualitative component whereby additional comments or suggestions could be proposed. The questionnaire included three sections: (1) evaluation of health status; (2) evaluation of participation risk; and (3) decision modifiers (Creighton *et al.*, 2010).

The e-Delphi questionnaire for Part 2 of the study consisted of RTP_{erf} components and KPIs (used for the measurement of RTP_{erf}) that had to be ranked on a five-point Likert scale (1 = must not be considered; 2 = should not be considered; 3 = can be considered; 4 = should be considered; 5 = must be considered). The e-Delphi panel members had to elaborate through comments on components scored 3 or less and could provide additional feedback in an open-ended question. Data were recorded into a Microsoft Excel spreadsheet in which percentage consensus and the mode (the value that appeared most frequently on the Likert scale) were calculated. Eighty per cent (80%) agreement had to be reached to achieve consensus. Therefore, 8 out of the 10 participants had to provide a score of 4 or 5 on the Likert scale. If consensus was not reached, the component was included in Round 2 and if consensus in Round 1 was below 40%, the component was disregarded.

In Round 2, the components not achieving 80% consensus were disregarded from the RTP_{erf} guidelines. The results of Round 1 were used for the development of the questionnaire for Round 2. Round 2 questionnaires had the same structure and main sections as the first questionnaire. Questions on which consensus had been reached were indicated as such in the questionnaire. If consensus had not been reached, the question was included in the following round for further consideration. In some cases, slight adaptations were made based on the feedback received from the e-Delphi panel, such as making questions more specific. After completion of these two rounds of the e-Delphi survey, the results were used to compile guidelines for RTP. These guidelines indicated consensus, partial agreement or disagreement percentages (quantitative elements) on components included in the guidelines.

Validity of the e-Delphi survey

The validity of the e-Delphi survey intrinsically relied on the panel of experts who were part of the medical teams in SA Rugby Union. The eligibility of members to be included on the panel of experts required suitable competence and knowledge of the research subject. Flexibility also enhanced the validity of the captured data through the substantial time between rounds, which the experts could use when considering their responses to the questions.

Analysis of data

The responses from the experts on the questionnaires used in Round s 1 and 2 were quantitatively analysed in Microsoft Excel and descriptive statistics were calculated. For the first round of the questionnaire, participants had to indicate their responses as follows:

Fully agree:	Must be considered in the RTP decision-making process (a weight of 2 was allocated in the analysis of the data).
Partially agree:	Can be considered in the RTP decision-making process (a weight of 1 was allocated in the analysis of the data).
Disagree:	Should not be considered in the RTP decision-making process (a weight of 0 was allocated in the analysis of the data).

The participants were encouraged to comment on each of the statements if they felt it necessary. In the second round of the e-Delphi, participants were instructed to indicate their level of agreement only as agree or disagree. This was done in order to encourage decision -making among the participants. Group consensus for each question was defined as a total cumulative agreement of ≥80% and was considered indicative of overall agreement. Feedback on the components and guidelines for RTP and RTP_{erf} was analysed and included in the final guidelines for RTP and RTP_{erf} presented in this article.

RESULTS

In Part 1 of the study, a total of 15 questionnaires were sent out for both rounds of the e-Delphi questionnaires. With each round, 14 questionnaires were returned, resulting in a 93.3% response rate (see Tables 2 and 3). The Delphi panel indicated in the first round that they preferred the use of the word "guidelines" rather than a "model" for musculoskeletal injuries in rugby union.

Part 1: Return to play results

Part 1 of the study comprised three separate steps. The first step in the RTP decision-making process was the evaluation of health status where all components achieved consensus (>80%). Step 2 included the evaluation of participation risk where all components achieved consensus, except the ability to protect, which received 68% consensus in Round 1, with qualitative data stating: "It depends on the anatomical area ", and 100% consensus in Round 2. All components reached consensus for Step 3, decision modification, except for "masking of injury". In Round 1, the component received only 54% of support, with qualitative data stating: "depending on the type of injury, risk for further injury, and if the joint is weight-bearing or not", and ultimately in Round 2 with 86% consensus, with qualitative data stating: "It is seldom used and it probably works to get a player through a game, but in an ideal setup it should not be used ", "It is not really allowed" and "It is unethical and illegal".

Table 2. **PART ONE: e-DELPHI FIRST ROUND RESULTS ON RETURN TO PLAY (n=14)**

Aspect	Agree	Partially agree	Disagree	Responses	% Agreement
Response to Step 1: Consensus reached					
Pain	2	1	0	2 2 2 2 2 2 2 2 1 2 2 2 2 2 2 1	93
Personal medical history	2	1	0	2 2 1 1 0 2 2 2 2 2 2 2 2 2 2	86
Functional tests	2	1	0	2 2 2 2 2 2 2 2 2 2 2 2 1 2 2	96
Psychological state	2	1	0	2 1 2 2 2 2 2 2 1 2 2 1 2 2 2	89
Potential seriousness	2	1	0	2 2 2 2 2 2 2 2 2 2 1 2 1 2 2	93
Instability	2	1	0	2 2 1 2 2 2 2 0 2 2 1 2 1 2	82
Strength	2	1	0	2 1 2 2 1 1 1 2 2 2 2 2 2 2 1	82
Range of motion	2	1	0	2 2 1 2 1 1 2 2 2 2 2 0 2 2	82
Consensus NOT reached					
Patient demographics	2	1	0	1 0 1 0 0 0 2 1 2 1 1 1 2 2	46
Swelling	2	1	0	1 1 1 2 1 1 1 1 2 1 1 1 2 1	61
Laboratory tests	2	1	0	1 0 1 1 1 2 2 1 1 1 1 2 1 1	57
Surgeon's opinion	2	1	0	1 2 2 1 1 2 1 1 2 2 1 2 1 2	75
Response to Step 2: Consensus reached					
Position played	2	1	0	2 2 2 1 1 2 2 2 2 2 2 2 2 2	93
Consensus NOT reached					
Limb dominance	2	1	0	2 1 1 1 0 1 1 1 1 2 2 2 2 2	68
Competitive level	2	1	0	1 1 2 0 0 2 2 2 2 2 1 2 2 2	68
Ability to protect	2	1	0	0 0 1 2 1 1 1 2 2 2 2 2 1 2	68
Response to Step 3: Consensus NOT reached					
Timing and season	2	1	0	2 2 1 1 1 2 1 1 2 2 1 1 1 1	68
Pressure from player	2	1	0	1 1 1 1 0 1 1 1 2 0 1 1 1 2	50
External pressure	2	1	0	2 1 1 1 0 1 1 2 2 0 0 2 0 2	54
Masking of injury	2	1	0	2 1 1 1 0 1 1 2 2 0 0 2 0 2	54
Conflict of interest	2	1	0	0 1 2 2 0 1 2 2 2 1 2 1 0 2	64
Fear of litigation	2	1	0	2 1 1 1 1 2 2 1 2 1 2 0 1 2	68
Response to the importance of the research: Consensus NOT reached					
A standardised RTP model for musculoskeletal injuries in rugby union is relevant	2	1	0	0 2 2 0 0 0 1 1 2 2 2 2 1 0	61
A standardised RTP model for musculoskeletal injuries in rugby union could potentially reduce the prevalence of re-injuries	2	1	0	2 0 2 2 1 1 1 1 2 2 2 2 1 0	68

Part 2: Return to performance results

In the second part of the study on RTP_{erf}, the response rate was 100% (n=10) for both Rounds 1 and 2 of the e-Delphi process that included the Free State Cheetahs medical team and coaches. After conducting two consecutive rounds of the e-Delphi questionnaire during June and July 2021, full consensus was reached on the components necessary for RTP_{erf}.

Table 3. **PART ONE: e-DELPHI SECOND ROUND RESULTS ON RETURN TO PLAY (n=14)**

Aspect	Agree	Disagree	Responses	% Agreement
Response to Step 1: Consensus reached				
Orthopaedic surgeon's opinion	1	0	1 1 1 1 1 1 0 1 1 0 1 1 1 1	86
Consensus NOT reached				
Swelling*	1	0	0 0 1 1 1 1 0 1 1 1 1 1 1 1	73
Laboratory tests*	1	0	1 0 1 1 0 0 1 1 0 1 1 1 1 0	60
Response to Step 2: Consensus reached				
Type of Sport	1	0	1 1 1 1 1 1 1 1 1 1 1 1 1 1	100
Competitive level	1	0	1 1 1 1 1 1 1 1 1 1 1 1 1 1	100
Ability to protect	1	0	1 1 1 1 1 1 1 1 1 1 1 1 1 1	100
Consensus not reached				
Limb dominance*	1	0	0 0 0 1 0 0 1 1 0 1 0 1 1 1	50
Response to Step 3: Consensus reached				
Timing and season	1	0	1 1 1 1 1 1 1 1 1 1 1 1 1 1	100
Masking of injury	1	0	1 1 1 1 0 1 1 1 1 1 1 1 1 0	86
Conflict of interest	1	0	1 1 1 1 1 0 1 1 1 1 1 1 1 1	93
Fear of litigation	1	0	1 1 1 1 1 1 1 1 1 1 1 1 1 1	100
Consensus NOT reached				
Pressure from player*	1	0	0 0 1 1 0 0 1 1 1 1 1 1 1 1	71
External pressure*	1	0	0 1 1 1 0 0 1 1 1 1 1 1 1 1	79
Response to the importance of the reached: Consensus reached				
Standardised RTP guidelines for musculoskeletal injuries in rugby union is relevant	1	0	0 1 1 1 1 1 1 1 1 1 1 1 1 1	93
Standardised RTP guidelines for musculoskeletal injuries in rugby union could potentially reduce the prevalence of re-injuries	1	0	0 1 1 1 1 1 1 1 1 1 1 1 1 1	93

*No consensus

Table 4 lists the components identified for RTP_{erf}. Psychological state reached consensus in Round 1 with 100% agreement and a mode of 5 on the Likert scale. Limb symmetry index (LSI), as measured through functional testing, reached 90% agreement and a mode of 5 on the

Likert scale. The third component involved training load, with all subcomponents reaching consensus after Round 1. Training load included the ACWR with scenarios of acute > chronic and/or chronic > acute (due to physical fatigue, mental fatigue, cumulative microtrauma and/or external and internal load management).

***Table 4*. PART TWO: RETURN TO PERFORMANCE COMPONENTS IN RUGBY UNION: SUMMARY OF e-DELPHI PARTICIPANTS' FEEDBACK (n=10)**

Component	Response
Psychological state	
Component: psychological readiness	
Mode	5
Consensus (% agreement)	100%
Functional testing	
Component: limb symmetry index	
Mode	5
Consensus (% agreement)	90%
Training load	
Component: acute > chronic workload ratio	
Mode	5
Consensus (% agreement)	100%
Component: chronic > acute (physical fatigue)	
Mode	5
Consensus (% agreement)	80%
Component: chronic > acute (mental fatigue)	
Mode	5
Consensus (% agreement)	90%
Component: chronic > acute (cumulative)	
Mode	5
Consensus (% agreement)	90%
Component: external load	
Mode	5
Consensus (% agreement)	100%
Component: internal load	
Mode	5
Consensus (% agreement)	100%

Likert scale options: 1 = must not be considered; 2 = should not be considered; 3 = can be considered; 4 = should be considered; 5 = must be considered.

The measurement of performance through KPIs identified to measure effort is shown in Table 5. The KPIs identified after Round 1 included both attacking and defensive KPIs applicable to individual position-specific performance. These KPIs included effective attacking ruck, tackles made, attacking first three and defensive first three. Furthermore, after Round 2, total possession, passes and carries were identified as KPIs evaluating measures of effort for individua l playing positions. However, total possession should only be used in combination with other actions and does not always reflect a player's fitness as it is a specific measure of the team's ability to retain the ball during attacking play. Passes and carries provide further insight into a player's movement during the game, regardless of a player's specific playing position.

Table 5. **PART TWO: KEY PERFORMANCE INDICATORS AS A MEASUREMENT OF RETURN TO PERFORMANCE IN RUGBY UNION: SUMMARY OF e-DELPHI PARTICIPANTS' FEEDBACK (n=10)**

Component	Response	
Clean break		
Mode	4	–
Consensus (% agreement)	80%	–
Tackle success (%)		
Mode	4	–
Consensus (% agreement)	100%	–
Carries over gain line (%)		
Mode	4	–
Consensus (% agreement)	80%	–
Dominant collisions (%)		
Mode	4	–
Consensus (% agreement)	100%	–
Effective attacking ruck (%)		
Mode	4	–
Consensus (% agreement)	80%	–
Turnovers		
Mode	4 (Round 1)	1 (Round 2)
Consensus (% agreement)	60% (Round 1)	100% (Round 2)
Offloads		
Mode	4 (Round 1)	1 (Round 2)
Consensus (% agreement)	60%	62.5%
Half break		
Mode	5 (Round 1)	1 (Round 2)
Consensus (% agreement)	70%	0%
Tries scored		
Mode	4 (Round 1)	0 (Round 2)
Consensus (% agreement)	40%	12.5

Likert scale options: 1 = must not be considered; 2 = should not be considered; 3 = can be considered; 4 = should be considered; 5 = must be considered.

In Table 6, the KPIs identified to measure optimal performance as part of RTP_{erf} are summarised. The KPIs identified after Round 1 included clean breaks, tackle success percentage, carries over gain line percentage, dominant collisions and effective attacking ruck percentage. These mentioned KPIs have proven to be fundamental in measu ring performance for most playing positions in rugby union (Smart *et al*., 2014; Bunker & Spencer, 2022). Furthermore, turnovers were identified after Round 2, but should only be used in combination with other actions, as turnovers do not always point to a player's fitness or readiness, but mostly to the ineffectiveness of the attacking team to retain their own ball.

***Table 6*. PART TWO: KEY PERFORMANCE INDICATORS OF OPTIMAL PERFORMANCE AS A MEASUREMENT OF RETURN TO PERFORMANCE IN RUGBY UNION: SUMMARY OF e-DELPHI PARTICIPANTS' FEEDBACK (n=10)**

Component	Response	
Effective attacking ruck		
Mode	5	–
Consensus (% agreement)	90%	–
Tackles		
Mode	4	–
Consensus (% agreement)	80%	–
Attacking first three		
Mode	5	–
Consensus (% agreement)	90%	–
Defensive first three		
Mode	4	–
Consensus (% agreement)	80%	–
Total possession		
Mode	4 (Round 1)	1 (Round 2)
Consensus (% agreement)	40%	100%
Passes		
Mode	2	–
Consensus (% agreement)	33%	–
Carries		
Mode	5 (Round 1)	1 (Round 2)
Consensus (% agreement)	70%	100%

Likert scale options: 1 = must not be considered; 2 = should not be considered; 3 = can be considered; 4 = should be considered; 5 = must be considered.

DISCUSSION

Each factor included in the guidelines for RTP decision-making in rugby union is discussed, regarding both the literature and the e-Delphi findings of the study. The results for Part 1 of the study quantified three central aspects and are based on the decision trees described previously (Creighton *et al*., 2010; Shrier *et al*., 2010; Matheson *et al*., 2011; Blanch & Gabbett, 2016). The three aspects addressed in Part 1 of the study were the following:

- evaluation of health status;
- evaluation of participation risk; and
- decision modifiers.

Part 1: Step 1 – evaluation of health status

Medical history

A condition-specific medical history is an integral part of evaluating an injured player, as prior injury vastly influences the probability of re-injuries. Furthermore, re-injuries are often more severe than the initial injury, highlighting the importance of obtaining a personal medical history in the RTP decision-making process (Creighton *et al*., 2010; Fuller *et al*., 2013). The literature corroborates the finding of the e-Delphi results in which 86% of participants supported the inclusion of medical history. This step has to be taken first as it is the cornerstone of the guidelines.

Pain

Pain is an essential indicator of presumed incomplete healing (Creighton *et al*., 2010). However, it is well known that sportsmen tend to play even when in pain (Liston *et al*., 2006). Furthermore, pain, and the fear of pain, can also influence a player's RTP (Tjong *et al*., 2014). Pain was indicated by the participants in the e-Delphi study (93%) as an important consideration in RTP decision-making. Participants noted that pain is a message from the injured area to the brain to indicate incomplete healing. The panel also indicated that the use of numeric pain scales would be useful to determine the level of pain. The International Rugby Board (IRB) advocates the best advice as "if it hurts, don't play" (Rugby Ready, 2011).

Instability

Dynamic stability during functional tasks should be seen as an important factor in RTP decision-making (Wikstrom *et al*., 2006; Creighton *et al*., 2010). This view was reinforced by the findings in this study (82% agreement), where participants noted that if functio nal performance was efficient, a certain degree of instability could be allowed. Furthermore, it has been reported that when a degree of laxity was present, improved neuromuscular control should be emphasised. Participants indicated that when instability is observed, the risk of re-injury and/or early onset of osteoarthritis were dramatically increased. Dynamic methods are therefore advocated to ensure more challenging and possibly more effective tests when assessing joint stability for RTP (Wikstrom *et al*., 2006).

Strength

Objective strength testing is a prominent factor in the RTP decision-making process. These tests include isokinetic strength testing that can reveal strength deficits as small as 5%–10% between the injured and uninjured limbs. A satisfactory outcome has been defined as having at least 85% strength of the contralateral leg (Sousa *et al*., 2017). Baseline strength values should have been regained at the time of RTP (Creighton *et al*., 2010; Tol *et al*., 2014). The importance of strength in RTP was emphasised by the findings of the e-Delphi panel (82%). However, chronic neuropraxia could be acceptable on return with 80% of strength regained, depending on the playing position or role. Finally, a strength discrepancy could lead to underperformance, re-injury or overuse of other parts of the kinetic chain (Tol *et al*., 2014).

Range of motion

Unrestricted or free range of movement (ROM) has been advised for most injury types and sites. Baseline flexibility should be considered when assessing ROM for RTP (Creighton *et al*., 2010; Petersen & Zantop, 2013). Limited ROM was indicated by some of the participants (7/14; 50.0%) as a possible contributing factor for underperformance, re-injury and/or overuse of other structures. However, it was summarised that some reduction in ROM should be allowed as full ROM is not always possible after surgery such as anterior cruciate ligament (ACL) reconstruction (Petersen & Zantop, 2013). Similar to this study (82% agreement), Webster *et al*. (2019) identified the LSI, measured in ROM, strength, neuromuscular control and plyometric modalities, as a predictor of RTP_{erf}. LSI is determined by functional testing, such as the single-leg hop for distance, and correlates with the functional testing component in Creighton's decision-based RTP model.

Functional tests

It is evident from both the literature and this study's findings that functional tests are extremely important for RTP decision-making. Functional tests combine muscular strength, ROM, endurance, confidence and proprioception to evaluate both player and injury against the demands of the sport in general and the position-specific demands on the player (Tol *et al*., 2014). These tests must not exceed the tolerance levels of the player (Wikstrom *et al*., 2006; Creighton *et al*., 2010; Tol *et al*., 2014). Participants in the e-Delphi (96%) commented that functional testing should be considered the best predictor of RTP readiness. However, according to Sousa *et al*. (2017), a satisfactory functional test requires performance of at least 90% of the contralateral leg.

Psychological state

Like any aspect of decision-making in practice, understanding the player's psychological readiness for RTP should be based on accurate, repeatable outcome measurement (89% agreement). Measures to quantify the player's mental readiness to RTP can promote monitoring the player's progress during rehabilitation and assessing the mental readiness when the player is evaluated as physically ready to RTP (Waldén & Ardern, 2018). Murphy and Sheehan (2021) concluded that individual burden experienced by rugby players throughout injury could affect recovery and rehabilitation outcomes, potentially extending the injury process and thus unavailability for the team. This has important implications for injury management and facilitation of RTP_{erf}, in the sense that reducing burden needs to consider any injury-related burden that players experience, as well as the burden experienced by the team. Therefore, the design and implementation of injury intervention programmes should also focus on supporting players to effectively cope with stressors experienced during injury. However, psychologica l readiness does not always coincide with physical readiness. As noted by some of the participants in the e-Delphi, psychological inability can be as detrimental to a player as physical inability (Creighton *et al*., 2010; Tjong *et al*., 2014). The Injury-Psychological Readiness to Return to Sport (I-PRRS) scale has been developed to monitor psychological readiness for RTP. It should be used for the duration of the physical rehabilitation process to assure the athlete's complete readiness (Glazer, 2009). Furthermore, burnout was found to be associated with injury, non-selection, rugby experience and team environment, with more injuries leading to greater feelings of exhaustion or devaluation (Quarrie *et al*., 2017). Players attributed burnout to competition transitions, pressure to comply with demands, heavy training and playing load, injury, the competitive rugby environment, an "anti-rest culture", pressure to perform and media or public pressure and expectation (Cresswell *et al*., 2007).

Potential seriousness

Players and staff need to be guided and educated on recovery and the risk of permanent disability and chronic injuries associated with a lack of full recovery (Wikstrom *et al*., 2006;). A team's medical staff has the responsibility to provide guidance to players and other members of the team management (Gabbett & Whiteley, 2017) about permanent disability and chronic injuries that could result from insufficient recovery (Murphy & Sheehan, 2021). However, Hulin *et al*. (2016: 1008) stated that "contrary to the philosophy that high workloads and shorter recovery equate to increased injury risk, our data suggest that high and very -high chronic workloads may protect against match injury following shorter between-match recovery periods". This view is supported by the researchers of the study reported in this article, with 93% agreement.

Orthopaedic surgeon's opinion

Orthopaedic surgeons provide medical staff with guidelines on the recovery after specific orthopaedic procedures have been performed. However, orthopaedic surgeons should not be involved in RTP decision-making as they do not incorporate factors such as strength, muscle function and proprioception in their decisions (Tjong *et al*., 2014). Participants in the study noted that orthopaedic surgeons should guide them in the RTP decision -making process whenever grafting and other procedures had been performed by the particular surgeon. Based on the literature and the findings of this study, an orthopaedic surgeon's opinion or guidelines should be considered as a factor contributing to the rehabilitation process rather than the RTP process. It was interesting to note that agreement (86%) on the orthopaedic surgeon's opinion was only reached in Round 2. An orthopaedic surgeon's advice to relinquish sport after ACL reconstruction has been cited as a less common contributor in RTP decision-making (Tjong *et al*., 2014). However, by addressing both physical and psychosocial factors during the reha bilitation process, clinicians may be better equipped to assist players in their transition back to sport or even to life after sport (Burland *et al.*, 2018). It must be noted that the clinician and the coachingstaff are both responsible for the athlete's welfare (Creighton *et al*., 2010).

Part 1: Step 2 – evaluation of participation risk

RTP decision-making should be approached with a thorough understanding of the inherent demands of the activity returning to, as the likelihood of an identical recurrent trauma is high (Gabbett, 2016).

Position played

Different physical attributes and anthropometrical profiles are required for the different player positions in rugby union. Consequently, the differences between the playing positions will occur with respect to the nature and prevalence of injuries (Fuller *et al*., 2007; Fuller *et al*., 2013). Lazarus *et al*. (2017) concluded that coaching and performance staff should avoid prescribing substantially high weekly load and sustained increases in load during the competitive period of the season. Furthermore, positional differences should be taken into account when planning and prescribing training loads over an entire season. This factor was highlighted through the findings of the e-Delphi questionnaire (93% agreement).

Competitive level

The prevalence of injuries in rugby union has increased significantly since the onset of playing professionally, with the incidence of re-injuries also being higher. The higher prevalence of injuries is not only reported at the professional level, but also at amateur and ev en schoolplayer level (Brooks *et al*. 2005). The professional era is associated with greater financial and other competitive pressures, potentially resulting in irresponsible decisions about RTP. However, the Delphi panel reached agreement only in the second round.

Ability to protect

The effectiveness of taping, bracing, splinting and padding has not been fully proven. Limited evidence is available to support claims that taping, mouthguards, padded headgear and support sleeves prevent injuries (Marshall *et al*., 2005; Cusimano *et al*., 2010). The controversy surrounding the topic is evident in the results of this study. The e-Delphi panel indicated that the ability to protect should not influence RTP decision-making (only 68% agreement in the first round), but could assist in the process of RTP.

Part 1: Step 3 – decision modifiers

Timing and season

Financial or performance-related advantages during a certain time of the season could outweigh the potential disadvantages of RTP (Creighton *et al*., 2010). However, the coach often makes decisions with the team's best interest in mind, risking a player prematurely (Orchard, 2014). The e-Delphi panel noted that timing and season present a risk-versus-reward type of situation. The respondents acknowledged that although they did not like to admit it, timing and season do play a role in the RTP decision-making process (only 67% agreement in Round 1). The literature supports this observation that decisions are often made in the team 's best interest rather than the player's best interest. Likewise, staff can rationalise that a player be side-lined for another week during the pre-season, but should be allowed to play if an important final match is to be played (Orchard, 2014; Tol *et al*., 2014).

Masking of the injury

Local anaesthetics are often used in sports medicine to mask an injury, allowing the player to continue playing despite an existing injury (Creighton *et al*. 2010; Herring *et al*., 2012). This study found that local anaesthetics are useful in RTP decision-making and if the player fully comprehends the risks involved, they should be allowed to play. The collective view of the group was that there is a role in RTP for the masking of the injury. However, the panel mentioned after the first round (54%) that this practice is both unethical and illegal, but reached agreement (86%) in the second round. The findings on this matter again illustrate that masking of the injury could potentially modify decisions about RTP in rugby union (Fuller *et al*., 2013).

Conflict of interest

A unique ethical challenge faced by medical teams involved in high performance sports is the fact that they have an obligation towards both the team and the player (Poulis, 2012). The results of this study (64% agreement in the first round) highlight this situation as a dilemma. Respondents indicated that the player should always be put first. This conflict of interest emphasises that this particular factor could be regarded as a decision modifier. It is thus advocated that an open and honest approach to the player and the management team be taken (Murthy *et al*., 2012). Transparency remains the best policy (Creighton *et al*., 2010).

Fear of litigation

Fear of litigation should be seen as a special form of conflict of interest that involves both the clinician and the athlete's welfare (Creighton *et al*., 2010). Respondents reached consensus only after the second round of the e-Delphi. Comments included the view that if medical staff disagreed with the player and/or coaching staff on readiness to RTP, a document should be signed by the player and/or staff to protect the medical team. RTP should, however, only be allowed once all the risks are well understood by both the player and coaching staff.

Part 2: return to performance (RTP_{erf})

The aim of these general guidelines for RTP_{erf} of rugby players is based on a better synergy in support staff approaches. The authors agree with Blanch and Gabbett (2016), who believe a critical aspect that has been excluded from the RTP decision relates to the amount of training the athlete has completed over the time of recuperation, in order to be adequately prepared for the demands of the game.

Psychological readiness

This study emphasised the importance of psychological readiness in the RTP_{erf} process, which was in agreement with Webster *et al*. (2019), who concluded that psychological readiness, measured by using questionnaires such as the Anterior Cruciate Ligament Return to Sport After Injury scale, should be a component in RTP_{erf}. They correctly identified 87% of the patients who returned to their pre-injury level of play with an overall correct group identification of 63%. The findings of this study were similar to those reported by Webster *et al*. (2019) and identified multiple psychological components, including fear and confidence (Burland *et al*., 2018; Alswat *et al*., 2020).

Workload

It is important to determine the re-injury risk of a player. Impellizzeri *et al*. (2020) reported that the re-injury risk remains high regardless of the training load. Therefore, manipulating the training load will not contribute to changing the re-injury risk. It has been suggested that the ACWR can be used to plan training with the aim that players train at an acceptable ACWR; however, the acceptable ACWR is unknown (Impellizzeri *et al*., 2020). Equally important is a thorough understanding of all the associated risk modifiers (Creighton *et al*., 2010; Matheson *et al*., 2011) as discussed above, which are equally crucial when making a final decision regarding loading for optimal performance (Soligard *et al*., 2016; Gabbett *et al*., 2017; Gabbett & Whiteley, 2017).

The results from this study proved the importance of monitoring and adjusting the player's ACWR for establishing RTP_{erf} and were in agreement with Gabbett (2016) and Quarrie *et al*. (2017). In contrast, Blanch and Gabbett (2016) reported that the ACWR should be included in the RTP criteria , whereas this study found that the ACWR should be considered in the RTP_{erf} process. However, recently reported research is not in support of using the ACWR for RTP/RTP_{erf} (Lolli *et al*., 2019; Impellizzeri *et al*., 2020; Wang *et al*., 2020).

External training load is an objective measure of the "physical work" performed by an athlete, which, in professional sport, is regularly measured through the use of a global positioning system (Gabbett, 2016). Quarrie *et al*. (2017) and Blanch and Gabbett (2016) considered external load as part of player monitoring and injury prevention. This study reported similar results where external load should be monitored and considered in RTP_{erf}.

Internal load is considered a subjective evaluation of the response to tra ining (Gabbett, 2016). Quarrie *et al*. (2017) regarded internal workload as a more sensitive predictor of injury and to identify changes in physical load (external workload). Blanch and Gabbett (2016) reiterated that internal load should be monitored in conjunction with external load. The results of this study showed that internal load should be monitored and considered in RTP_{erf}, with qualitative feedback suggesting that players' personal problems and environment have a notable effect on their performance.

In conclusion, Impellizzeri *et al*. (2020) reported that it is difficult to use the ACWR in workload management systems because it is not related to re-injury risk, it is an inaccurate measurement, and it lacks evidence to support its contributing effects.

Key performance indicators

Cunningham *et al*. (2018) compiled a series of rugby-specific KPIs that were similarly identified as applicable measurements of performance in this study, with 4 out of the 16 identified KPIs being disregarded. KPIs are preferred by coaching and medical staff, as they provide a quantifiable indication of an individual's contribution to specific areas of match-play that are linked to successful performance of the team and the individual p layer concerned (Cunningham *et al*., 2018). Qualitative feedback provided the researchers with a different method of measuring KPIs, namely through seconds per action, which measures the amount of time occurring between relevant "actions" such as cleans or line breaks, with the desirable time being less than 60 seconds. KPIs particularly applicable to position-specific performance include two major categories, namely technical KPIs and physiological KPIs (Smart *et al*., 2014; Greef, 2021; Upcott, 2022). Technical KPIs evaluate the technical skills of the player involved in match-play such as passes and tackles made, while physiological KPIs analyse the functioning of a player's body in the context of match-play, such as distance covered, maximal velocity achieved and heart rate behaviour (Smart *et al*., 2014; Hendricks *et al*., 2020; Greef, 2021; Bunker & Spencer, 2022; Upcott, 2022). Performance measurements should include different "actions" and KPIs specific to a player's position, as also proposed by Hughes *et al*. (2012) and Cunningham *et al*. (2018).

Based on the results from this e-Delphi survey and the integration of these results with existing literature, guidelines for RTP_{erf} were developed and are presented in Figure 1. It must be emphasised that these guidelines for RTP_{erf} are only applicable to rugby union. Additional measures of sporting performance should be recorded and monitored when needed. Lastly, an interdisciplinary approach and shared decision-making are still the key requirements for success to optimal RTP_{erf}.

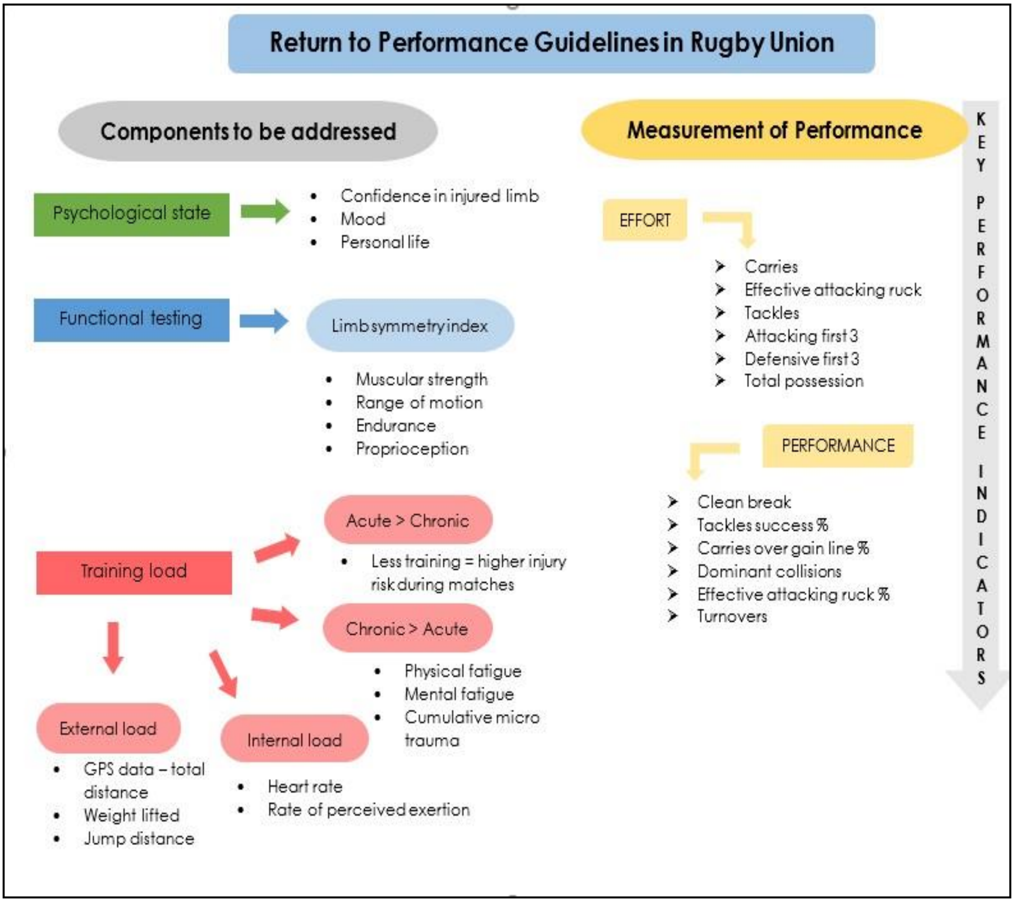

Figure 1. **RTP$_{ERF}$ GUIDELINES FOR RUGBY UNION.**

Limitations and recommendations

A limitation of the research was that the second part of the study was only based on one rugby union. Furthermore, it would be beneficial to expand and identify the RTP$_{erf}$ criteria to more unions and other sport codes. This study is one of a few that has been conducted on RTP$_{erf}$ criteria in sport, and it can therefore be used as a starting point for future research. A further limitation of the study was that KPIs were assessed in the context of competitive play only . Future studies could broaden the scope of the assessment of KPIs for RTP$_{erf}$ to include training sessions.

CONCLUSION

This research is of important value as it presents a unique and collated perspective of a professional rugby management team regarding RTP and RTP$_{erf}$ guidelines in rugby union. The outcomes of this research suggest that the measurement of RTP$_{erf}$ in rugby has subcomponents classified under psychological state, functional testing and training load. The findings revealed that rugby-specific KPIs must be used to measure whether a player has reached their pre-injury performance level.

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Conflict of interest

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