

# Contributors to negative biopsychosocial health or performance outcomes in rugby players (CoNBO): a systematic review and Delphi study protocol

Sam McCormack,<sup>1,2</sup> Kevin Till,<sup>1,3</sup> Jessica Wenlock,<sup>1,3</sup> Sarah Whitehead,<sup>1</sup> Keith A Stokes,<sup>4,5</sup> Mark Bitcon,<sup>5</sup> James Brown ,<sup>1,6</sup> Matt Cross,<sup>7</sup> Phil Davies,<sup>8</sup> Éanna C Falvey ,<sup>8,9</sup> Sharron Flahive,<sup>10</sup> Andrew Gardner,<sup>1,11</sup> Sharief Hendricks ,<sup>1,12</sup> Rich Johnston,<sup>1,13</sup> Stephen D Mellalieu ,<sup>14</sup> James Parmley,<sup>1</sup> Gemma Phillips,<sup>1,2,15</sup> Carlos Ramirez ,<sup>1,16</sup> Joshua Stein,<sup>10</sup> Sean Scantlebury,<sup>1,2</sup> Stephen W West ,<sup>4,17</sup> Ben Jones ,<sup>1,2,3,12,18</sup>

**To cite:** McCormack S, Till K, Wenlock J, *et al.* Contributors to negative biopsychosocial health or performance outcomes in rugby players (CoNBO): a systematic review and Delphi study protocol. *BMJ Open Sport & Exercise Medicine* 2022;**8**:e001440. doi:10.1136/bmjsem-2022-001440

Accepted 17 September 2022

## ABSTRACT

The importance of contributors that can result in negative player outcomes in sport and the feasibility and barriers to modifying these to optimise player health and well-being have yet to be established. Within rugby codes (rugby league, rugby union and rugby sevens), within male and female cohorts across playing levels (full-time senior, part-time senior, age grade), this project aims to develop a consensus on contributors to negative biopsychosocial outcomes in rugby players (known as the CoNBO study) and establish stakeholder perceived importance of the identified contributors and barriers to their management. This project will consist of three parts; part 1: a systematic review, part 2: a three-round expert Delphi study and part 3: stakeholder rating of feasibility and barriers to management. Within part 1, systematic searches of electronic databases (PubMed, Scopus, MEDLINE, SPORTDiscus, CINAHL) will be performed. The systematic review protocol is registered with PROSPERO. Studies will be searched to identify physical, psychological and/or social factors resulting in negative player outcomes in rugby. Part 2 will consist of a three-round expert Delphi consensus study to establish additional physical, psychological and/or social factors that result in negative player outcomes in rugby and their importance. In part 3, stakeholders (eg, coaches, chief executive officers and players) will provide perceptions of the feasibility and barriers to modifying the identified factors within their setting. On completion, several manuscripts will be submitted for publication in peer-reviewed journals. The findings of this project have worldwide relevance for stakeholders in the rugby codes. PROSPERO registration number CRD42022346751.

## INTRODUCTION

Sports participation positively influences biopsychosocial factors, primarily through

### WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Multiple contributors can result in a negative biopsychosocial health or performance player outcomes in the rugby codes.
- ⇒ Stakeholder participation and engagement are important to inform policy and practice and improve player health and well-being.

### WHAT THIS STUDY ADDS

- ⇒ The systematic review will establish the contributors that result in negative health or performance player outcomes in rugby players.
- ⇒ The Delphi offers a rigorous technique to establish an evidence base beyond the published literature for all and specific cohorts (eg, men, women, professionals, age grade).
- ⇒ This study will include several important stakeholders and experts from rugby codes to identify contributors and prioritise player health and well-being.

### HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ The findings from this study can inform governing body policies and guidance on the factors that can result in negative biopsychosocial health or performance outcomes to inform worldwide policy and practice within rugby codes, which can then be implemented to improve player health and well-being.

increased physical activity.<sup>1</sup> This results in improved well-being, quality of life and self-confidence and reduces symptoms of anxiety, depression, social anxiety and shyness.<sup>2-4</sup> In addition to the associated benefits of sport participation, there are potentially unintended associated negative biopsychosocial outcomes that some players may experience.



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

## Correspondence to

Professor Ben Jones;  
b.jones@leedsbeckett.ac.uk



In this study, a negative biopsychosocial health or performance player outcome is defined as *any negative change in a player's physical, psychological, social or health that does not return to baseline in the short term (eg, within approximately 1 week) once the affecting contributor is removed*. These outcomes include decreased mental health,<sup>5 6</sup> an injury and/or illness event<sup>7–10</sup> and player burnout.<sup>11</sup> Negative biopsychosocial player outcomes have been attributed to the cumulative stressors and demands associated with sport,<sup>12</sup> influenced by several factors, including the tradition of the sport, rules, competition and scheduling, club environment and culture or commercial decisions. Such negative player outcomes are likely to remain for a number of weeks, months or years depending on each specific context. For example, research suggests that athletes exposed to both minimal and maximal training and match play demands are more susceptible to such outcomes (ie, physical and mental fatigue, injury)<sup>12</sup> while a U-shaped relationship has been found between 4-week cumulative load and subsequent injury risk among professional male rugby union players.<sup>13</sup> For example, injury is a clear negative player outcome, with a significant body of research calling for wider stakeholder engagement when developing prevention strategies.<sup>14–16</sup> Furthermore, involving those directly influenced by the outcomes of specific innovation strategies (ie, persons required to authorise behaviour change) is a key component of the research process.<sup>17</sup>

The rugby codes (rugby union, rugby league and rugby sevens, hereafter referred to as 'rugby') are played worldwide by men and women, from youth to senior ages, and amateur to international.<sup>18 19</sup> Rugby is a skill-based collision sport characterised by frequent intermittent actions of high-speed running and contact events (eg, tackling, scrummaging), alongside periods of lower intensity work and rest.<sup>20–22</sup> The demands of match play are typically specific to the respective playing level, positional groups and codes.<sup>18 20 23</sup> The collision demands (eg, the tackle) are similar across codes, with players involved in multiple collision events throughout a match.<sup>24 25</sup> However, these demands differ significantly in volume, intensity and type (eg, rucks, mauls unique to rugby union), though the tackle is somewhat similar across codes.<sup>24–26</sup> The tackle is the most injurious event in a rugby match<sup>27</sup> and poses a risk of musculoskeletal and neurological injuries for both the ball carrier and the tackler.<sup>28 29</sup>

In addition to the physical demands of rugby, depending on playing level, players undertake other rugby (eg, media, contract negotiation) and non-rugby (eg, work outside of rugby, socialising) activities, which contribute to the overall psychological load players' experience. This can impact their health and well-being and potentially increase the risk of injury, illness<sup>7 12</sup> and risk-taking behaviours.<sup>6</sup> These psychological demands are often more challenging to measure and quantify.<sup>30</sup> Moreover, periods of high competition typically tend to occur during the ages associated with the onset of mental disorders.<sup>31</sup> Some physical factors associated

with injury and illness are modifiable (eg, training load). However, others are non-modifiable (eg, sex, age, structural physiology).<sup>32</sup> Regardless of the type of biopsychosocial contributor that players are exposed to, there is an initial stress response,<sup>33</sup> leading to a positive (eg, increase in physical fitness) or negative (eg, injury, illness) outcome. Players' short-term, medium-term and long-term health, well-being and performance should be a primary concern for all stakeholders.<sup>14 18</sup> How collective biopsychosocial factors may positively or negatively influence player outcomes is unknown. No study has investigated the biopsychosocial factors, which result in negative health and/or performance player outcomes in the rugby codes. Establishing all potential biopsychosocial contributors that result in health or performance player outcomes can increase the impact of the research, allowing stakeholders to manage and mitigate identified risk factors appropriately. Additionally, the involvement of key stakeholders within the research process increases the alignment of research objectives and the needs of stakeholders from practice, increasing the adoption of outcomes in real-world settings.<sup>34–36</sup>

Stakeholders have become increasingly concerned with the potential negative health and performance effects of biopsychosocial contributors on players.<sup>12</sup> There is a focus on the potential 'excessive' demands placed on players.<sup>10</sup> Several studies have described the physical,<sup>14 20 36–38</sup> psychological<sup>37–40</sup> and social loads players experience.<sup>41 42</sup> Professional rugby union players involved in fewer than 15 or more than 35 matches over the previous 12 months were at a greater risk of injury.<sup>10</sup> Rugby union stakeholders adopted this research finding in England to create a new governing body policy. Moreover, training, travel<sup>43</sup> and psychological<sup>44</sup> demands could further contribute to negative player health and performance outcomes. A challenge when establishing contributors which result in negative biopsychosocial player outcomes is where the evidence does not exist. The Delphi method provides a solution to this problem as it can generate ideas, establish consensus<sup>45</sup> and critically appraise the current scientific literature (ie, systematic review). Delphi methods have been undertaken in sport science and medicine research,<sup>46 47</sup> and involving stakeholders in research has been advocated to increase the adoption of research findings into practice.<sup>36</sup> This is consistent with intervention mapping to support the implementation of injury prevention interventions in sports.<sup>48</sup> To the authors' knowledge, no study has reviewed the contributors, which result in negative biopsychosocial player outcomes within the rugby codes. This information can provide evidence to inform governing body policy worldwide (eg, match scheduling, contact exposure, off-season duration, squad size and player contract duration).

Contributors to negative biopsychosocial health or performance player outcomes may be homogeneous between rugby cohorts. Equally, there may be differences between ages (eg, youth vs senior), sex (male vs female) and playing level (eg, full-time vs part-time professional),

which warrant consideration, and the perceived feasibility and barriers to subsequently modifying these contributors may differ. Therefore, code-specific, sex-specific and age-specific information is required to support governing bodies in any policy change decisions. Finally, before any strategies to manage the identified contributors can be implemented, the broader stakeholder perceived importance, alongside the barriers and facilitators to modifying these, must be considered. A key stakeholder group to determine general and specific barriers and subsequent mitigation strategies to identify contributors resulting in negative biopsychosocial player outcomes would be advantageous.<sup>16 34</sup>

Therefore, the contributors to negative biopsychosocial health or performance outcomes in rugby players (CoNBO) project will include three parts. Part 1 will conduct a systematic review of the literature detailing the physical, psychological and social factors that result in negative health or performance player outcomes in the rugby codes. Part 2 will use a Delphi method to establish other contributors that were not identified from the systematic review and obtain experts' perceptions of the importance of the identified contributors from the systematic review. Finally, Part 3 will determine the feasibility and barriers to managing the contributors within each specific code and context based on stakeholder perceptions. Together, the CoNBO study aims to develop a consensus on the contributors, which result in negative biopsychosocial player health and performance outcomes and establish stakeholder perceived importance of the identified contributors, alongside the context-specific feasibility and barriers to their management, providing governing bodies with information to improve player welfare.

## METHODS

The CoNBO project will be undertaken in three parts; part 1: a systematic review, part 2: a three-round Delphi consensus method and part 3: establishing the perceived feasibility and barriers to managing the contributors associated with negative health and performance player outcomes. All parts will include general and cohort-specific contributors, feasibility and barriers.

This protocol has been reviewed and approved by a broad range of relevant stakeholders to ensure that they have an opportunity to contribute to this research's design, conduct, reporting or dissemination plans. Stakeholders are listed (where consent was provided) in the Acknowledgements section.

### Part 1: systematic review

The Preferred Reporting Items for Systematic Reviews and Meta-analyses for Protocols (PRISMA-P) have been followed to report the protocol. The completed PRISMA-P checklist is provided in online supplemental file 1. The protocol is registered with the PROSPERO international prospective register for systematic review. The

final review will be reported according to the PRISMA statement.<sup>49</sup>

### Search strategy

A systematic search of five electronic databases (PubMed, Scopus, MEDLINE, SPORTDiscus and CHINAL) will be performed from the earliest record available until the search is complete. Using previously published applied sport science reviews as a guide<sup>12 50 51</sup>, search terms will be placed into terms related to (1) rugby, (2) physical, (3) psychological and (4) social contributors. Primary terms will be combined using the AND function. Secondary terms pertaining to rugby ('rugby', 'rugby league', 'rugby union', 'rugby sevens'), physical ('physical', 'training', 'competition', 'match', 'training practices', 'training load', 'training impulse', 'TRIMP', 'external load', 'internal load', 'duration', 'exposure', 'RPE', 'rating of perceived exertion', 'summated-heart-rate-zone', 'SHRZ', 'PlayerLoad', 'BodyLoad', 'contact load', 'global positioning system', 'GPS', 'accelerometer', 'frequency', 'intensity', 'time', 'volume', 'type'), psychological ('well-being', 'well-being', 'wellness', 'mental-state', 'mental health', 'mental performance', 'resilience', 'psychological strain', 'sport psychiatry', 'sport psychology' 'state of mind', 'mood', 'emotion', 'anxiety', 'fear', 'distress', 'performance anxiety', 'self-image', 'confidence', 'self-esteem', 'self-efficacy', 'motivation', 'amotivation', 'amotivated', 'apathy', 'depression', 'stress', 'health', 'psychological', 'tension', 'feeling', 'physical state', 'physical functioning', 'perceived recovery', 'perceived strength', 'soreness', 'quality of life', 'readiness', 'vitality', 'vigor', 'vigour', 'sleepiness', 'sleep quality', 'fatigue', 'tiredness', 'alertness', 'distress', 'appetite', 'overtrain', 'overreach', 'burnout', 'ill-being', 'mental illness', 'affect', 'feeling states', 'perfectionism'), and social load ('social', 'sociology', 'social health', 'social capital', 'social relation', 'social connect', 'social network', 'social function', 'social inclusion', 'interpersonal relation') will be combined by the OR function. Searches will be performed in the title and abstract fields. All searches will be limited to the English language. Reference lists of selected studies will be manually searched for additional eligible papers.

### Inclusion criteria

- ▶ Articles from any geographical location.
- ▶ All playing levels and ages.
- ▶ Male and female rugby league, rugby union or rugby sevens investigations.
- ▶ Studies that investigate physical factors, which result in a negative player health or performance outcome.
- ▶ Studies that investigate psychological factors, which result in a negative health or performance player outcome.
- ▶ Studies that investigate social factors, which result in a negative health or performance player outcome.
- ▶ Peer-reviewed original research studies.

### Exclusion criteria

- ▶ Non-English language studies.
- ▶ Review articles, conference proceedings, editorials, case studies, theses and grey literature.
- ▶ Studies that do not differentiate outcome measures between rugby and other sports.
- ▶ Studies that do not differentiate outcome measures (ie, positive or negative) between physical/psychological/social factors and other factors.
- ▶ Studies that do not identify a negative player health or performance outcome.

### Study selection

Records will be managed in EndNote throughout the review process. Titles and abstracts identified will be screened independently by two researchers (JP and SW) against the eligibility criteria. Any disagreement between the two reviewers will be solved by a third reviewer (BJ). Full-text articles will be retrieved and reviewed for final inclusion by the same researchers (JP, SW and BJ). Following PRISMA guidelines,<sup>49</sup> a flow diagram will be developed to visualise the selection process.

### Data extraction and synthesis

Two reviewers (JP and SW) will independently extract data from selected studies into a predesigned template. Authors will be contacted if data are needed to be obtained or confirmed, and WebPlotDigitizer (V.4.5) will be used to extract data from figures where needed. Data extracted will cover the following points: study details (eg, authors, publication details), study design (eg, type of study, duration), sample (eg, size, rugby codes, age grade, playing level, sex), independent (ie, the physical, psychological and social factors) and dependent variables (ie, health and/or performance outcomes), results (eg, descriptive statistics, effect sizes, p values) and the key outcome and findings will be extracted. Given the expected heterogeneous nature of the study designs, no summary measure, data exploration or additional analysis will exist.

### Risk of bias

Two reviewers will perform a critical appraisal of individual articles independently (JP and SW) using the modified version of the Downs and Black checklist<sup>52</sup> as used in previous sport and exercise science reviews.<sup>20</sup> Only criteria that logically apply will be included (numbers 1–3, 6, 7, 10–12, 16, 18, 20). Question 10 will be modified to include the reporting of effect sizes. A score of '0' for 'absent or insufficient information provided' or '1' for 'item is explicitly described' will be assigned to the criteria, and the data will be summarised in the data synthesis.

## Part 2: Delphi technique

### Participants

This project will recruit a group of expert practitioners from across the rugby cohorts to identify additional general and cohort-specific contributors associated

with negative player outcomes that were not identified in the systematic review (part 1). To achieve reliable results, a Delphi panel should contain >10 experts.<sup>53</sup> Participants will be required to meet one or more of the following criteria; (a) have a minimum of 3 years of experience working in professional/elite rugby, (b) published research regarding physical, psychological or social factors in rugby or (c) minimum of an MSc qualification in a relevant field. A large sample (>50 participants) will be contacted and asked to participate in this study. However, a sample size of 11–25 is deemed typical for the final round of a Delphi study<sup>54</sup> and may be deemed sufficient based on the potential for dropouts and non-responders. Identified experts will also be asked to recommend other suitable participants that meet the criteria and could contribute valuable knowledge to the Delphi process.

All participants will be recruited using a purposeful sampling technique, which involves selecting participants based on the abovementioned criteria.<sup>55</sup>

### Round 1

In round 1 of the Delphi, the expert panel will be provided with the main findings from part 1 (systematic review). The participants will be asked to read the findings and provide any additional contributors they believe result in negative health or performance player outcomes. Next, the steering group will group the results from round 1 via thematic analysis to identify themes and subthemes.<sup>56</sup> Duplicate responses will be removed until a unique list of contributors is identified. Data will be obtained using the online software Qualtrics (Qualtrics, Provo).

Experts will be given 2 weeks from the date of the initial invitation to complete the online form. A reminder follow-up email will be sent after 12 days if the participant is yet to complete the questionnaire. If the participant does not complete the questionnaire following the 2-week deadline, they will be deemed unwilling to participate.

### Round 2

Following the analysis of round 1 responses (~1 week after the end of round 1), a full list of contributors that result in negative health or performance player outcomes will be listed next to a five-point Likert scale ranging from 1—*strongly disagree*, 2—*disagree*, 3—*neither agree nor disagree*, 4—*agree*, 5—*strongly agree*.<sup>57 58</sup> Participants will be asked to indicate their level of agreement on whether they perceived the contributor increased the likelihood of a negative health or performance player outcome. Consensus will be reached for each factor if >70% agreement is achieved between the expert panel.<sup>59 60</sup> Participants will be asked to complete the online form within 2 weeks. Twelve days after the initial email, a follow-up email will be sent.

### Round 3

Contributors to negative health or performance player outcomes that did not reach consensus in round 2 will

be listed in round 3 alongside the same five-point Likert scale used in round 2. The mean rating of agreement from round 2 will be listed next to each contributor to negative health or performance player outcomes to allow experts the opportunity to reflect on their initial rating. Following round 3, the contributors to negative health or performance player outcomes that do not achieve  $\geq 70\%$  agreement will be deemed to have not reached consensus and will be discarded.

During round 3, experts will also be asked to rate the priority of the identified contributor on a 5-point Likert scale ranging from 1—*very low*, 2—*low*, 3—*neither low nor high*, 4—*high* and 5—*very high*. The responses will be combined (ie, very low and low priority and high and very high priority will be grouped). Participants will be asked to complete the online form within 2 weeks. Twelve days after the initial email, a follow-up email will be sent.

### Part 3: feasibility and barriers

Stakeholders (ie, head coaches, chief executive officer and former players) from across the different cohorts (eg, male and female) and rugby codes will be provided with the findings from parts 1 and 2. This will include a consensus of the general and cohort-specific contributors associated with negative player outcomes across rugby codes. Each stakeholder will detail the perceived feasibility and barriers to modifying the identified contributors within their context. Stakeholders will be grouped according to their role (ie, on-field staff, administration and former players). The target sample size for each stakeholder group will be 10 participants from each cohort (ie, male and female) and rugby code (rugby union, rugby league, rugby sevens).

The stakeholders will be asked to rate the feasibility (ie, the feasibility that the contributor can be managed and reduced) of all contributors, which achieved consensus on a 5-point Likert scale (1—*strongly disagree*, 2—*disagree*, 3—*neither agree nor disagree*, 4—*agree*, 5—*strongly agree*). Next, the stakeholders will be asked to list the perceived barriers in preventing and modifying the contributors that result in negative player health or performance outcomes within their setting. Participants will be asked to complete the questionnaire within 2 weeks. Twelve days after the initial email, a follow-up email will be sent.

On completion of the questionnaire, all contributors that result in negative health and performance player outcomes will have a rating for feasibility and a list of any barriers preventing their modification.

## DISCUSSION

To the authors' knowledge, this will be the first systematic review and Delphi study examining the factors that result in negative player biopsychosocial, health or performance outcomes in rugby codes. The review will provide an overview of the available literature, establish the importance of contributors that result in negative health and performance player outcomes and identify the facilitators and barriers to modifying such factors specific

to each rugby code, their specific playing level and according to sex. The CoNBO project has also involved stakeholders in the study design to increase the adoption of the study findings. The findings of the CoNBO project will have significant relevance for stakeholders within rugby, including governing bodies, policymakers and those in managerial positions.

### Author affiliations

- <sup>1</sup>Carnegie Applied Rugby Research (CARR) centre, Leeds Beckett University, Leeds, UK
- <sup>2</sup>England Performance Unit, Rugby Football League, Manchester, UK
- <sup>3</sup>Leeds Rhinos Rugby League club, Leeds, UK
- <sup>4</sup>Department for Health, University of Bath, Bath, UK
- <sup>5</sup>Rugby Football Union, Twickenham, UK
- <sup>6</sup>Institute of Sport and Exercise Medicine, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa
- <sup>7</sup>Premiership Rugby, Twickenham, UK
- <sup>8</sup>World Rugby Limited, Dublin, Ireland
- <sup>9</sup>College of Medicine and Health, University College Cork, Cork, Ireland
- <sup>10</sup>National Rugby League, Sydney, New South Wales, Australia
- <sup>11</sup>Sydney School of Health Sciences, University of Sydney, Sydney, New South Wales, Australia
- <sup>12</sup>Division of Physiological Sciences, Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Rondebosch, South Africa
- <sup>13</sup>School of Behavioural and Health Sciences, Australia Catholic University, Brisbane, Queensland, Australia
- <sup>14</sup>Cardiff School of Sport and Health Sciences, Cardiff Metropolitan University—Cyncoed Campus, Cardiff, UK
- <sup>15</sup>Hull Kingston Rovers Rugby League club, Hull, UK
- <sup>16</sup>Scottish Rugby Union, Edinburgh, UK
- <sup>17</sup>Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Alberta, Canada
- <sup>18</sup>School of Science and Technology, University of New England, Armidale, New South Wales, Australia

**Twitter** Sharief Hendricks @Sharief\_H, Stephen D Mellalieu @stevemellalieu, Stephen W West @westy160991 and Ben Jones @23benjones

**Contributors** BJ conceptualised the project. SMcC and JW developed the initial search terms for the systematic review. All authors critically reviewed the protocol and refined the search terms. SMcC drafted the initial manuscript. All authors critically reviewed and edited the manuscript prior to submission.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** SMcC, SS research fellowships are part-funded by the Rugby Football League. KT and BJ are employed by Leeds Rhinos Rugby League club in a consultancy capacity. JW PhD is part-funded by Leeds Rhinos Rugby League club. KS and MB are employed by Rugby Football Union. MC is employed by Premiership Rugby. JB research fellowship is funded by World Rugby. PD and EF are employed by World Rugby. SF and JS are employed by the National Rugby League. JP PhD is part-funded by the Rugby Football League. BJ and GP are employed by the Rugby Football League in a consultancy capacity. CR research fellowship is part-funded by Scottish Rugby Union. AG concussion consultant to RugbyAU.

**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not applicable.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Open access** This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

## ORCID iDs

James Brown <http://orcid.org/0000-0002-7778-7783>

Éanna C Falvey <http://orcid.org/0000-0003-3961-1805>

Sharief Hendricks <http://orcid.org/0000-0002-3416-6266>

Stephen D Mellalieu <http://orcid.org/0000-0003-2868-3328>

Carlos Ramirez <http://orcid.org/0000-0003-1605-3484>

Stephen W West <http://orcid.org/0000-0001-5800-7000>

Ben Jones <http://orcid.org/0000-0002-4274-6236>

## REFERENCES

- Malm C, Jakobsson J, Isaksson A. Physical activity and Sports-Real health benefits: a review with insight into the public health of Sweden. *Sports* 2019;7:127.
- Eime RM, Young JA, Harvey JT, et al. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act* 2013;10:98.
- Rosenbaum S, Tiedemann A, Ward PB, et al. Physical activity interventions: an essential component in recovery from mental illness. *Br J Sports Med* 2015;49:1544–5.
- McMahon EM, Corcoran P, O'Regan G, et al. Physical activity in European adolescents and associations with anxiety, depression and well-being. *Eur Child Adolesc Psychiatry* 2017;26:111–22.
- Joy E, Kussman A, Nattiv A. 2016 update on eating disorders in athletes: a comprehensive narrative review with a focus on clinical assessment and management. *Br J Sports Med* 2016;50:154–62.
- Rice SM, Purcell R, De Silva S, et al. The mental health of elite athletes: a narrative systematic review. *Sports Med* 2016;46:1333–53.
- Chesson L, Whitehead S, Flanagan K, et al. Illness and infection in elite full-contact football-code sports: a systematic review. *J Sci Med Sport* 2021;24:435–40.
- Chesson L, Deighton K, Whitehead S, et al. Incidence, prevalence and consequences of illness in Academy rugby League players. *J Sci Med Sport* 2020;23:1016–20.
- Schwellnus M, Soligard T, Alonso J-M, et al. How much is too much? (Part 2) International Olympic Committee consensus statement on load in sport and risk of illness. *Br J Sports Med* 2016;50:1043–52.
- Williams S, Trewartha G, Kemp SPT, et al. How much rugby is too much? A Seven-Season prospective cohort study of match exposure and injury risk in professional rugby union players. *Sports Medicine* 2017;47:2395–402.
- Brenner JS. American Academy of pediatrics Council on sports medicine and fitness. overuse injuries, overtraining, and burnout in child and adolescent athletes. *Pediatrics* 2007;119:1242–5.
- Quarrie KL, Raftery M, Blackie J, et al. Managing player load in professional rugby Union: a review of current knowledge and practices. *Br J Sports Med* 2017;51:421–7.
- Cross MJ, Williams S, Trewartha G, et al. The influence of In-Season training loads on injury risk in professional rugby Union. *Int J Sports Physiol Perform* 2016;11:350–5.
- West SW, Starling L, Kemp S, et al. Trends in match injury risk in professional male rugby Union: a 16-season review of 10 851 match injuries in the English Premiership (2002–2019): the professional rugby injury surveillance project. *Br J Sports Med* 2021;55:676–82.
- West SW, Williams S, Cazzola D, et al. Training load and injury risk in elite rugby Union: the largest investigation to date. *Int J Sports Med* 2021;42:731–9.
- Hendricks S. Rethinking innovation and the role of stakeholder engagement in sport and exercise medicine. *BMJ Open Sport Exerc Med* 2021;7:e001009.
- Bowen DJ, Hyams T, Goodman M, et al. Systematic review of quantitative measures of Stakeholder engagement. *Clin Transl Sci* 2017;10:314–36.
- Till K, Weakley J, Read DB, et al. Applied sport science for male Age-Grade rugby union in England. *Sports Med Open* 2020;6:14.
- Johnston RD, Gabbett TJ, Jenkins DG. Applied sport science of rugby League. *Sports Medicine* 2014;44:1087–100.
- Whitehead S, Till K, Weaving D, et al. The use of Microtechnology to quantify the peak match demands of the football codes: a systematic review. *Sports Med* 2018;48:2549–75.
- Johnston RD, Weaving D, Hulin BT, et al. Peak movement and collision demands of professional rugby League competition. *J Sports Sci* 2019;37:2144–51.
- Rennie G, Hart B, Dalton-Barron N, et al. Longitudinal changes in super League match locomotor and event characteristics: a league-wide investigation over three seasons in rugby League. *PLoS One* 2021;16:e0260711.
- Hausler J, Halaki M, Orr R. Application of global positioning system and microsensor technology in competitive rugby League Match-Play: a systematic review and meta-analysis. *Sports Med* 2016;46:559–88.
- Naughton M, Jones B, Hendricks S. Quantifying the collision dose in rugby League: a systematic review, meta-analysis, and critical analysis. *Sports Med - Open* 2020;6:6.
- Paul L, Naughton M, Jones B, et al. Quantifying collision frequency and intensity in rugby Union and rugby Sevens: a systematic review. *Sports Med Open* 2022;8:12.
- Hollander SD, Ponce C, Lambert M, et al. Tackle and ruck technical proficiency in rugby Union and rugby League: a systematic scoping review. *Int J Sports Sci Coach* 2021;16:421–34.
- Schwellnus MP, Jordaan E, Janse van Rensburg C, et al. Match injury incidence during the super rugby tournament is high: a prospective cohort study over five seasons involving 93 641 player-hours. *Br J Sports Med* 2019;53:620–7.
- Williams S, Robertson C, Starling L, et al. Injuries in Elite Men's Rugby Union: An Updated (2012–2020) Meta-Analysis of 11,620 Match and Training Injuries. *Sports Medicine* 2022;52:1127–40.
- Tee JC, Till K, Jones B. Incidence and characteristics of injury in under-19 Academy level rugby League match play: a single season prospective cohort study. *J Sports Sci* 2019;37:1181–8.
- Mellalieu S, Jones C, Wagstaff C, et al. Measuring psychological load in sport. *Int J Sports Med* 2021;42:782–8.
- Gulliver A, Griffiths KM, Christensen H. Barriers and facilitators to mental health help-seeking for young elite athletes: a qualitative study. *BMC Psychiatry* 2012;12:157.
- von Rosen P, Frohm A, Kottorp A, et al. Multiple factors explain injury risk in adolescent elite athletes: applying a biopsychosocial perspective. *Scand J Med Sci Sports* 2017;27:2059–69.
- McEwen BS. Physiology and neurobiology of stress and adaptation: central role of the brain. *Physiol Rev* 2007;87:873–904.
- Verhagen E, Voogt N, Bruinsma A, et al. A knowledge transfer scheme to bridge the gap between science and practice: an integration of existing research frameworks into a tool for practice. *Br J Sports Med* 2014;48:698–701.
- Finch CF, Talpey S, Bradshaw A, et al. Research priorities of international sporting federations and the IOC research centres. *BMJ Open Sport Exerc Med* 2016;2:e000168.
- Jones B, Till K, Emmonds S, et al. Accessing off-field brains in sport: an applied research model to develop practice. *Br J Sports Med* 2019;53:791–3.
- Cresswell SL, Klund RC. The nature of player burnout in rugby: key characteristics and Attributions. *J Appl Sport Psychol* 2006;18:219–39.
- Hodge K, Lonsdale C, Ng JYY. Burnout in elite rugby: relationships with basic psychological needs fulfilment. *J Sports Sci* 2008;26:835–44.
- Kruyt N, Grobbelaar H. Psychological demands of international rugby Sevens and well-being needs of elite South African players. *Front Psychol* 2019;10:676.
- McAuliffe J, Lavallee D, Campbell MJ. A narrative review of the role of psychological skills and characteristics in Navigating the pathway to professional rugby Union. *Int J Sport Exerc Psychol* 2021;22:1–23.
- Hartwig TB, Naughton G, Searl J. Load, stress, and recovery in adolescent rugby union players during a competitive season. *J Sports Sci* 2009;27:1087–94.
- Cupples B, O'Connor D, Copley S. Facilitating transition into a high-performance environment: the effect of a stressor-coping intervention program on elite youth rugby League players. *Psychol Sport Exerc* 2021;56:101973.
- Schwellnus MP, Derman WE, Jordaan E, et al. Elite athletes travelling to international destinations >5 time zone differences from their home country have a 2-3-fold increased risk of illness. *Br J Sports Med* 2012;46:816–21.
- Ivarsson A, Johnson U, Podlog L. Psychological predictors of injury occurrence: a prospective investigation of professional Swedish soccer players. *J Sport Rehabil* 2013;22:19–26.
- McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm* 2016;38:655–62.
- Heyward O, Emmonds S, Roe G, et al. Applied sport science and medicine of women's rugby codes: a systematic-scoping review and consensus on future research priorities protocol. *BMJ Open Sport Exerc Med* 2021;7:e001108.
- Hendricks S, Till K, den Hollander S, et al. Consensus on a video analysis framework of descriptors and definitions by the rugby Union video analysis consensus group. *Br J Sports Med* 2020;54:566–72.
- Ageberg E, Bunke S, Lucander K, et al. Facilitators to support the implementation of injury prevention training in youth

- handball: a concept mapping approach. *Scand J Med Sci Sports* 2019;29:275–85.
- 49 Page MJ, McKenzie JE, Bossuyt PM, *et al.* The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
- 50 Li C, Wang CKJ, Pyun DY, *et al.* Burnout and its relations with basic psychological needs and motivation among athletes: a systematic review and meta-analysis. *Psychol Sport Exerc* 2013;14:692–700.
- 51 Eckard TG, Padua DA, Hearn DW, *et al.* The relationship between training load and injury in athletes: a systematic review. *Sports Medicine* 2018;48:1929–61.
- 52 Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *J Epidemiol Community Health* 1998;52:377–84.
- 53 Vergouw D, Heymans MW, de Vet HCW, *et al.* Prediction of persistent shoulder pain in general practice: comparing clinical consensus from a Delphi procedure with a statistical scoring system. *BMC Fam Pract* 2011;12:63.
- 54 Diamond IR, Grant RC, Feldman BM, *et al.* Defining consensus: a systematic review recommends methodologic criteria for reporting of Delphi studies. *J Clin Epidemiol* 2014;67:401–9.
- 55 Palinkas LA, Horwitz SM, Green CA, *et al.* Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm Policy Ment Health* 2015;42:533–44.
- 56 Crowe M, Inder M, Porter R. Conducting qualitative research in mental health: thematic and content analyses. *Aust N Z J Psychiatry* 2015;49:616–23.
- 57 Robertson S, Kremer P, Aisbett B, *et al.* Consensus on measurement properties and feasibility of performance tests for the exercise and sport sciences: a Delphi study. *Sports Med Open* 2017;3:2.
- 58 Zambaldi M, Beasley I, Rushton A. Return to play criteria after hamstring muscle injury in professional football: a Delphi consensus study. *Br J Sports Med* 2017;51:1221–6.
- 59 Verhagen AP, de Vet HC, de Bie RA, *et al.* The Delphi list: a criteria list for quality assessment of randomized clinical trials for conducting systematic reviews developed by Delphi consensus. *J Clin Epidemiol* 1998;51:1235–41.
- 60 van der Horst N, Backx F, Goedhart EA, *et al.* Return to play after hamstring injuries in football (soccer): a worldwide Delphi procedure regarding definition, medical criteria and decision-making. *Br J Sports Med* 2017;51:1583–91.