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Journal of Sports Sciences

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rjsp20

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To cite this article: Gordon Dunlop, Andreas Ivarsson, Thor Einar Andersen, Susan Brown, Gary O'Driscoll, Colin Lewin, Gregory Dupont, Clare L. Ardern, Barthelemy Delecroix, Leslie Podlog & Alan McCall (25 Jan 2024): Examination of the validity of the Injury-Psychological Readiness to Return to Sport (I-PRRS) scale in male professional football players: A worldwide study of 29 professional teams, Journal of Sports Sciences, DOI: 10.1080/02640414.2024.2307764

To link to this article: https://doi.org/10.1080/02640414.2024.2307764

JOURNAL OF SPORTS SCIENCES
https://doi.org/10.1080/02640414.2024.2307764

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SPORT AND EXERCISE PSYCHOLOGY

Examination of the validity of the Injury-Psychological Readiness to Return to Sport (I-PRRS) scale in male professional football players: A worldwide study of 29 professional teams

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ABSTRACT

Perceived confidence is an important dimension of an athlete's psychological readiness to return-to-play. However, there is no established and validated tool to evaluate confidence in professional football. This study aimed to provide preliminary evaluation of the internal structure of the Injury-Psychological Readiness to Return-to-Sport scale (I-PRRS) in a cohort of injured male professional footballers. Over an 18-month period, 29 teams from 17 leagues participated. Players sustaining injuries eliciting $\geq$ 3 weeks' time-loss were recruited. Cross culturally adapted to 4 further languages, the I-PRRS was administered on two occasions: 1) day before returning-to-training and 2) day before returning-to-match-play. In total, 113 injuries were recorded with 96 completed I-PRRS data sets collected. Confirmatory factor analysis indicated the I-PRRS was a unidimensional scale, with all items measuring the same construct. The scale demonstrated good internal consistency ($\omega = .88$). When examining longitudinal invariance of the I-PRRS across administration time-points, indices of model fit supported scalar invariance. There was preliminary evidence of good internal structure for the I-PRRS in professional male footballers. However, before further research involving the I-PRRS can be endorsed, efforts to confirm or refute empirical developments pertaining to psychological readiness are necessary.

ARTICLE HISTORY
Received 3 August 2023
Accepted 12 January 2024

KEYWORDS
Return to play; rehabilitation; football; psychological readiness

Introduction

To facilitate a safe and successful return-to-play (RTP), it is widely accepted that players must be both physically and psychologically prepared, with the assessment of psychological readiness gaining increased attention as an integral component of the decision-making process over the past decade (Ardern et al., 2016; Paton et al., 2023). While different conceptualisations of what it means to be psychologically ready to RTP have been presented, confidence consistently emerges as a central component of this desired state (Podlog et al., 2022) and specifically within football players (van der Horst et al., 2017; Zambaldi et al., 2017). This is probably not surprising given confidence has been related to self-belief in athletes' perceived ability to remain injury-free, perform at high-level, or achieve appropriate levels of physical-fitness and skill-execution (Conti, diFronso, Pivetti, et al., 2019; Podlog et al., 2015).

Across sport, patient-reported-outcome-measures (PROMs) and psychometric instruments are commonly used to evaluate psychological constructs and can be adopted to monitor progress over time, evaluate treatment effectiveness and help to facilitate treatment modifications in athletes (Snyder et al., 2012). Despite this, there is no well-established and validated PROM to measure confidence of injured football players. While a number of measures to assess confidence to RTP after injury exist (e.g., the Knee-Self-Efficacy Scale and the Anterior Cruciate Ligament Return to Sport After Injury scale (ACL-RSI), their application within football is limited by their injury-specific focus (Thomeé et al., 2006; Webster et al., 2008).

One PROM that purports to measure confidence in athlete populations (e.g., NCAA collegiate athletes, recreational and competitive-level individual and team-sport athletes) with some preliminary validation – albeit not sport-specific (Conti, diFronso, Robazza, et al., 2019; Naghdi et al., 2016; Vereijken et al., 2019), is the Injury-Psychological-Readiness-to-Return-to-Sport scale (I-PRRS) (Glazer, 2009). However, preliminary validity alone is insufficient to recommend widespread uptake of a PROM in either research or practice. First, validity and reliability must be established in the target population (Impellizzeri & Marcora, 2009; Mokkink et al., 2010).

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Supplemental data for this article can be accessed online https://doi.org/10.1080/02640414.2024.2307764

Indeed, critical appraisal of Glazer's (2009) work highlights a number of limitations in the original development and validation of the I-PRRS. For example, the instrument was not theoretically or conceptually grounded, and despite claiming to have established content validity, no attempt was made to consider the perspectives of athletes when developing scale items. In line with COnsensus-based Standards for the selection of health Measurement Instruments (COSMIN), the sample of athletes used ($n = 22$) was inadequate for validating a psychometric instrument (Terwee et al., 2007). Despite its limitations, the I-PRRS is routinely referenced as a tool to assess psychological readiness and monitor athlete confidence following injury (Ardern et al., 2016; Paton et al., 2023; Schwank et al., 2022), with its application equally being endorsed within professional football (Bisciotti et al., 2019; Zambaldi et al., 2017).

To ensure that scientific rigour is upheld, and practitioners are best supported when making inferences about a players' psychological readiness to RTP, greater scrutiny of the I-PRRS is required before its use within the rehabilitation practices of professional football is recommended. To our knowledge, despite the I-PRRS being used in professional football (Forsdyke et al., 2022; Mccall et al., 2017), the measurement properties of this instrument have not yet been evaluated in this population.

The objective of this study was to evaluate the internal structure of the I-PRRS by assessing its' (i) structural validity, (ii) internal consistency, and (iii) longitudinal measurement invariance in a population of injured male professional footballers.

Materials and methods

Participants

One-hundred-and-three professional football teams from 22 leagues (20 countries) were invited to participate. Reflecting a convenience sample, teams were primarily recruited based on participation in a previous survey (Dunlop et al., 2019), wherein an interest and willingness to participate in future research investigations aligned to RTS was registered. The invitation was emailed to the Head of Medicine/Sport Science of each team outlining the purpose of the study. Institutional ethics review board approval was granted by Edinburgh Napier University (SAS/00014). Confidentiality and anonymity were detailed to clubs before agreeing to participate. Male professional players meeting the study inclusion criteria were invited to take part in the study and written informed consent was collected.

The study period lasted 18 months with injury data collected across 2017/2018 and 2018/2019 seasons. Prior to data collection, participating teams completed a one-month familiarisation period (January 2018) to become accustomed to the protocol. Officially, data collection began on the 1st of February 2018 and concluded on the 1st of June 2019, covering pre and in-season periods. To maximise reliability of data, teams were provided with an instruction manual containing definitions and detailed protocol to record data (Appendix A). Teams were required to appoint a contact person from medical/sport-science staff who was responsible for collecting and submitting relevant data to the research group. There was monthly communication between the contact person and the principal researcher (GD) throughout the study.

Player inclusion criteria

A player was eligible to participate if they incurred a contact or non-contact injury with a prognosis time-loss ≥3 weeks. In cases where injured players returned earlier than originally anticipated (i.e., < 3 weeks) data were not collected. Informed by the collective knowledge and experience of the research group (inclusive of medical, science and psychology experts), as well as some of the early work in this area (e.g., Johnston & Carroll, 1998), this time-loss duration was selected on the premise that injuries of a more severe nature may lead to more marked changes in perceived confidence across rehabilitation and subsequently effect performance, a finding which has more recently been supported, albeit in collegiate Gaelic games athletes (O'Connor et al., 2021). Pragmatically, we also anticipated this inclusion criterion would present less burden to participating teams and minimise dropout.

Diagnoses and prognoses were made by the medical doctor of each team. Where a player(s) joined a participating team during the study period, they were included from the date of arrival. Conversely, for any player(s) leaving a participating team during in-season or off-season (e.g., transferred to another club, contract expiry), all injury data were included until their departure date. If a player(s) went on loan and then returned to their parent team before the end of the study period, they were admitted back in. Any player(s) who sustained an end-of-season injury that was eligible for inclusion were followed over the off-season period. As detailed (Appendix A) in instances where re-injury was experienced, teams were requested to follow the same data collection protocol as all other injuries if inclusion criteria was met. Conversely, where a re-injury occurred but did not elicit a time-loss of ≥3 weeks, teams were still required to inform the research team of this injury event but were not required to subsequently collected questionnaire data.

Injury definition

Injury definitions followed the UEFA guidelines and aligned with consensus for football injury surveillance (Fuller et al., 2006; Hägglund et al., 2005). Adopting a time-loss definition, injury was defined as any physical complaint sustained by a player resulting from training or match-play that caused unavailability for future training or match-play. Players were considered to be injured until cleared by medical staff to participate in full unrestricted training and deemed available for match selection. A re-injury was defined as an injury of the same type and location as the index injury that occurred after the player's return to full participation from the index injury. Contusions, lacerations and concussions were not recorded as injury recurrences.

A standardised injury report form was completed after injury occurrence to minimise reporting inaccuracies associated with recording information retrospectively. Data were sent to the principal researcher to establish prospective timelines regarding players' return-to-training and competition respectively. This procedure allowed email reminders to be sent to club contact personnel to ensure timelines were met.

Injury-psychological readiness to return to sport scale (I-PRRS)

The Injury-Psychological Readiness to Return to Sport scale (I-PRRS) (Glazer, 2009) was used to assess player confidence to return-to-training and match-play following injury. To calculate a total score for confidence, the scores from the six items of the I-PRRS were summed and then divided by 10 (Glazer, 2009). The maximum score was 60. Consistent with thresholds adopted by the original author, a score of 60 implied that the player had utmost confidence to return-to-training or match-play at that time; 40, the player exhibited moderate confidence to return; and ≤20, the player demonstrated low overall confidence (Glazer, 2009). The I-PRRS was administered on two separate occasions, the day before a player was medically cleared to return to full unrestricted training and again, a day prior to clearance to return to match-play (i.e., selection in the squad for a match). It was requested that questionnaires be completed by the player, alone in a quiet room, free from the influence of teammates or any other personnel. The purpose of the I-PRRS questionnaire and how it was to be used within the RTP process was explained to participating players by the elected club contact.

Cross-cultural adaptation of I-PRRS questionnaire

The I-PRRS questionnaire was translated and cross-culturally adapted to French, Spanish, Italian, Portuguese, and Brazilian-Portuguese (Appendix B). In accordance with WHO guidelines (World Health Organisation, 2017), this procedure was underpinned by five steps and involved the conduct of the forward translation, translation synthesis, backward translation, committee review and pre-testing of I-PRRS translated versions. The goal of the translation procedure was to achieve different language versions of the original English instrument that were conceptually equivalent in the target countries/cultures (i.e., equally natural, acceptable and perform practically in the same way). This process and its specific steps are fully detailed in Appendix C. Players were allowed to complete the I-PRRS in the language they felt most comfortable.

Statistical analysis

IBM Statistical Package for the Social Sciences Version 25 (SPSS V-25) software for Windows were used to calculate descriptive statistics for player injury characteristics and where appropriate, were presented as means and standard deviations (IBM Corp,2017). Appraisal of the internal structure of the I-PRRS was performed using Bayesian structural equation modelling (BSEM) in Mplus (version 8.3; Muthén & Muthén 1998–2019).

BSEM is a specific application of Bayesian statistical analysis and is used when undertaking factor analysis and structural equation modelling (Muthén & Asparouhov, 2012). Presenting several theoretical and practical advantages over traditional frequentist statistical approaches (e.g., maximum likelihood), the adoption of BSEM in sport and exercise is increasing (Stenling et al., 2015). In the context of the present study, a particular advantage of Bayesian analysis is the higher likelihood of producing reliable estimates even with small sample sizes due to less restrictive distributional assumptions (Song & Lee, 2012; Yuan & MacKinnon, 2009).

Regarding our analysis, Markov Chain Monte Carlo (MCMC) simulation procedures with a Gibbs sampler was used to generate credible parameter values for all path analyses. All models were run using 100,000 iterations (50,000 burn-in by default). In line with previous recommendations, a potential scale reduction factor of around 1.0 was considered evidence of convergence (Kaplan & Depaoli, 2012). To evaluate model fit, the posterior predictive *p* value (PP*p*) was used in combination with its 95% credibility interval (CI). The PP*p* denotes the proportion of post burn-in iterations with a set of parameters that reflects the data poorly. A PP*p* value close to 0.50 and a symmetrical 95% credibility interval centring on zero is considered an indication of good model fit (Muthén & Asparouhov, 2012; Song & Lee, 2012). A 95% credibility interval (CI) was estimated for each parameter specified in the analyses. The CI indicates the probability that, given the observed data, the value of the specified parameter lies between the upper and lower bound (Zyphur & Oswald, 2015). If the 95% CI around the parameter estimate did not include zero, we considered it to be a credible parameter estimate (i.e., reject the null hypothesis of no effect) (Zyphur & Oswald, 2015).

The model testing procedure was conducted in the following steps:

Step 1. Structural validity

To test the dimensionality of the I-PRRS, confirmatory factor analyses (CFA) were conducted. More specifically, an a priori factor structure for the I-PRRS (1-factor solution) was specified and tested. Factor loadings were calculated to give a representation of the relationship of each item to the underlying factor (i.e., construct) of the scale. The factor loading is the correlation between the observed score and the latent score. For all estimated models, the factors loadings were given an informative prior of 0.70 with a variance of 0.02. For all cross-loadings, zero mean accompanied with small variance priors (0.02) was specified. Zero mean and small informative variance priors were specified (0.01; inverse-Wishart [IW] distribution) for the residual correlations.

Step 2. Internal consistency (reliability)

Internal consistency was used as an index of scale reliability and assessed with McDonalds Omega (ω) (Mcdonald, 1999). A threshold of between 0.70 and 0.95 is desirable when assessing the internal consistency of items in health status questionnaires, however a reliability coefficient of $\geq$ 0.70 is accepted as being satisfactory for each unidimensional scale or subscale (Terwee et al., 2007).

Step 3. Longitudinal measurement invariance

Ensuring appropriate and proper comparison of psychological outcomes over time within the same population is dependent on first confirming equivalence (or invariance) of meaning in the construct(s) under investigation (i.e., is the construct of interest being interpreted in a conceptually similar way across repeated measurements) (Dimitrov, 2010; Gregorich, 2006; Luo et al., 2020; Millsap & Cham, 2012; Putnick & Bornstein, 2016). Without establishing measurement invariance, observed differences over time may not be valid, reflecting differences related to the scale itself (e.g., item interpretation) rather than any meaningful change in the construct(s) intended to be measured (Shi et al., 2019) and thus, providing no basis for interpreting observed differences.

To evaluate measurement invariance of the I-PRRS between administration time-points, CFA was conducted. Tested sequentially, from configural to scalar invariance, establishing measurement invariance (across all three steps) allows one to assume that differences observed over time (i.e., between repeated measurements) are due to changes in the latent variable (i.e., construct of interest) rather than differences in scale properties (e.g., discrepancy in item functioning – how items are being interpreted and scored). Specifically, ascertaining scalar invariance enables valid inferences of latent factor mean differences between groups or across repeated measurements (Dimitrov, 2010).

To establish which model of invariance (i.e., configural, metric or scalar) showed best fit to the data, the deviance information criterion (DIC) and Bayesian information criterion (BIC) were inspected. Lower values on these two metrics are indicative of better model fit (van de Schoot et al., 2012). For the model parameters the same priors as used in step 1 were specified.

Results

Study participants

In total, 29 professional football teams (28% of teams invited) from 17 leagues, representing 15 different countries participated in the study (Figure 1, Table 1). While 36 (35%) teams had initially agreed to participate, 7 were withdrawn due to non-correspondence during the data collection period, despite repeated contact attempts.

Recorded injuries

One-hundred and thirteen injuries (involving 108 players) satisfied inclusion criteria. At timepoint 1 (return-to-training) the I-PRRS was collected for all injury cases ($n = 113$) while 96 players completed the I-PRRS questionnaire at return-to-play. In total, 96 completed I-PRRS data sets were collected. Despite being partially completed (i.e., collected at return-to-training only), the remaining 17 data sets of injured players were not excluded from analysis and were used where appropriate to address specific study aims. Partially completed data sets were

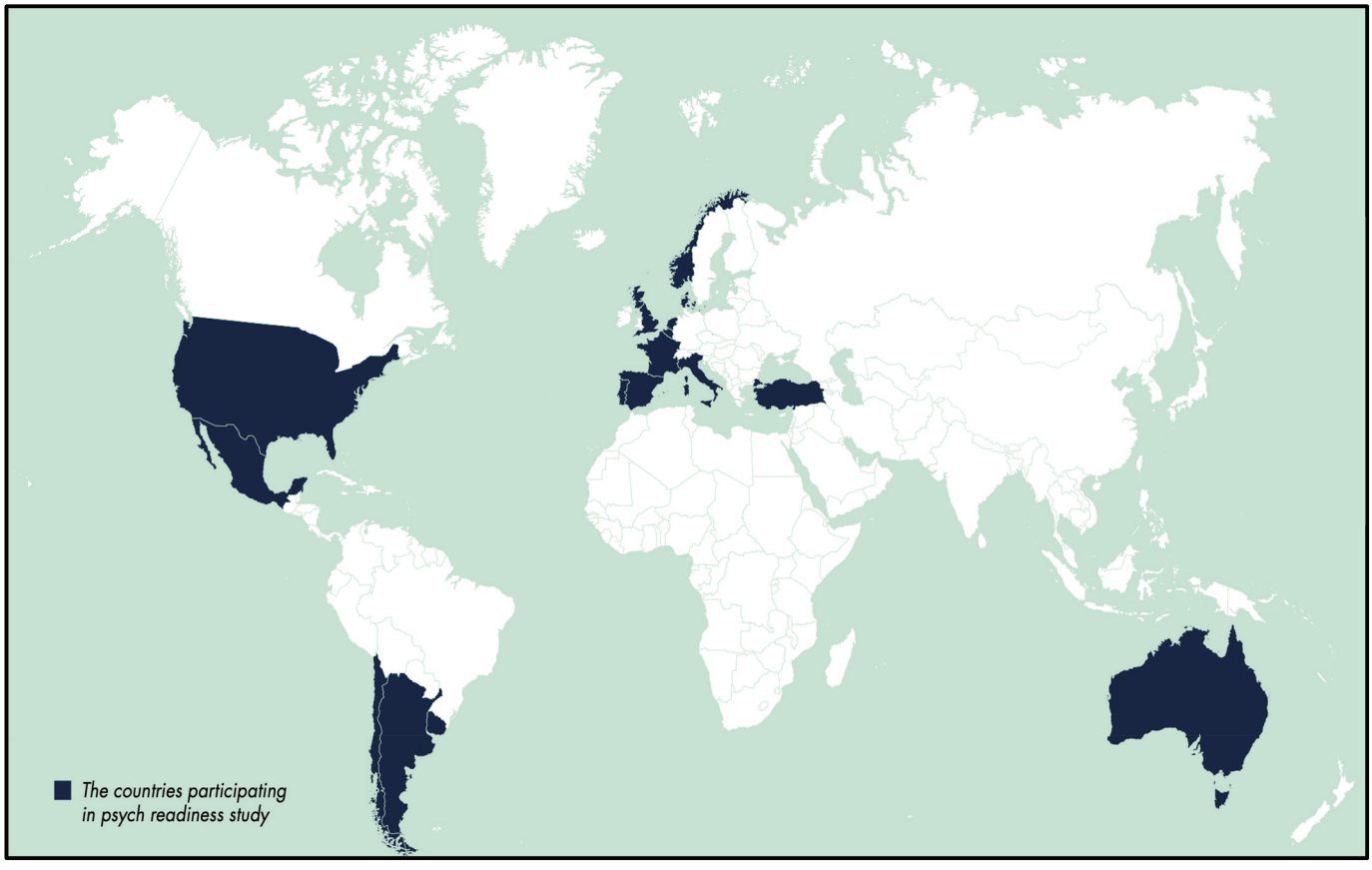

Figure 1. World map representing the countries of teams who participated in the psychological readiness to return to sport study.

Table 1. Details of participating teams by confederation and country.

Football Confederation	Union of European Football Associations (UEFA)	Asian Football Confederation (AFC)	South American Football Confederation (CONMEBOL)	Confederation of North, Central American and Caribbean Association Football (CONCACAF)
Confederation Representation	(23)	(1)	(4)	(1)
Associated Country of Participating Teams	Belgium (1) Denmark (1) England (5) France (1) Holland (2) Italy (5) Norway (1) Portugal (1) Scotland (4) Spain (2)	Australia (1)	Argentina (1) Chile (1) Uruguay (2)	America (1)

attributed to the following reasons: transfer or contract expiry of injured players ($n = 5$), club contacts leaving position ($n = 5$), injured players lost to follow-up (i.e., unable to collect data at specified time-point(s) ($n = 6$) and players experiencing a new injury (or re-injury) before all data could be collected for the index injury ($n = 1$).

During data collection, 10 (9%) re-injuries were reported. Injury characteristics are presented in Table 2. The English I-PRRS was most commonly used ($n = 141$;68%) followed by Spanish ($n = 42$;20%), Portuguese ($n = 14$;7%), French ($n = 9$;4%) and then Italian ($n = 3$;1%). No data were received for the Brazilian-Portuguese I-PRRS.

Structural validity

Data from 113 players were collated and used to examine the structural validity and internal consistency of the I-PRRS questionnaire. The one-factor model showed good fit to data (PP$p = 0.41$, 95% Confidence Interval = [−20.22, 22.99]). All six-factor loadings were credible and ranged from 0.59 to 0.60. The item correlations ranged between 0.27 and 0.72.

Internal consistency

The McDonald Omega coefficient of the six-item I-PRRS questionnaire was 0.88, indicating good internal consistency and higher than that of the proposed criterion of >0.70 (Terwee et al., 2007).

Longitudinal measurement invariance

All completed I-PRRS scales at return-to-training (n = 113) and at return-to-competition (n = 96) were included for analysis. All three models (i.e., configural, metric, scalar) fit the data well. Comparison of DIC and BIC values for the different models showed that the scalar model had the best fit to the data (Table 3). The scalar model showed good fit to the data (PPp = 0.54, 95% CI = [−0.42, 0.37]). All factor loadings were credible and ranged between 0.44 and 0.76. The cross loadings between items ranged between −0.004 and 0.46. The correlation between the two latent variables was credible and strong (r = 0.80, 95% Credible Interval = [0.54, 0.90]).

Discussion

This global multi-club study revealed that the I-PRRS measured a unidimensional state and that it possesses good structural validity, internal consistency, and longitudinal measurement invariance in a sample of professional male football players returning-to-play after injury.

Structural validity

Indices of model fit demonstrated that structural validity of the I-PRRS is upheld in this sample of injured professional male footballers with a time-loss ≥3 weeks. In agreement with the unidimensional factor structure proposed by Glazer (2009), CFA verified a 1-factor solution fit the data well. These results therefore imply that all 6-items of the I-PRRS load into the same underlying factor and are measuring the same purported construct (i.e., confidence).

Our findings are consistent with the Dutch version of the I-PRRS (Slagers et al., 2019). However, evidence for the factor structure of the I-PRRS is not unequivocal. Factor analysis of both Persian (Naghdi et al., 2016) and Italian (Conti, diFronso, Robazza, et al., 2019) adaptations of the I-PRRS have challenged this unidimensional nature, instead presenting a two-factor solution where "confidence to perform" and "confidence in recovery" following injury were suggested to reflect the dimensions of confidence being assessed. Notably however, latent constructs composed of fewer than three items, as observed in both Persian and Italian I-PRRS versions, are typically considered weak and unstable and indicative of the fact that a larger sample is warranted to achieve a stable solution (Costello & Osborne, 2005). It has been recommended, particularly when working with small data sets, that a stable factor should be comprised of at least five strongly loading items (i.e., 0.50 or better) (Costello & Osborne, 2005). This would indicate, as the original study by Glazer (2009) intended, that the I-PRRS for male professional football players is potentially more appropriate to be considered as a unidimensional scale.

The failure of other studies to confirm the unidimensional structure of the I-PRRS should not however be entirely dismissed. Rather, it serves to reinforce the fact that a high degree of uncertainty currently exists within the field as to what psychological readiness actually is and how it should best be defined (Podlog et al., 2022).

Table 2. Injury characteristics and mean (SD; range) time to return to full unrestricted training and competition.

	Injury Count	Injury Occurrence		Injury Nature		Re-Injury	Return to Training (days)	Return to Competition (days)	Difference (days)
Injury Type/Injury Location	(n)	Training	Match-Play	Contact	Non-Contact	(n)	Mean ± SD (Range)	Mean ± SD (Range)	Mean ± SD (Range)
Muscle and Tendon	**55**	**16**	**39**	**4**	**51**	**5**	**50.76 ± 40.43(21 − 237)**	**60.73 ± 45.33(22 − 259)**	**10.33 ± 10.01(1 − 43)**
Thigh: Anterior	12	5	7	1	11	2	58.25 ± 46.26(27 − 199)	70.25±48.68(29 − 212)	12.00±7.59(1 − 25)
Thigh: Posterior	22	4	18	0	22	2	38.14 ± 19.62(21 − 103)	43.05 ± 18.44(22 − 95)	7.90 ± 9.05(1 − 43)
Lower Leg/Achilles tendon	7	1	6	0	7	0	82.86 ± 77.47(26 − 237)	90.43 ± 83.85(27 − 259)	7.57 ± 6.85(1 − 43)
Hip/Groin	11	6	5	2	9	1	49.36 ± 27.00(23 − 102)	61.00 ± 36.39(30 − 141)	12.70 ± 14.41(2 − 40)
Knee	2	0	2	1	1	0	26.50 ± 0.71(26 − 27)	42.00 ± 0.00	15.00 ± 0.00
Ankle	1	0	1	0	1	0	78.00	108.00	30.00
Joint and Ligament	**36**	**9**	**27**	**23**	**13**	**2**	**82.97 ± 71.62(21 − 343)**	**95.39 ± 78.68(27 − 355)**	12.85 ± 10.86(2 − 43)
Ankle	13	6	7	10	3	1	53.92 ± 30.76(25 − 138)	56.00 ± 22.57(27 − 103)	8.36 ± 6.31(2 − 20)
Knee	22	3	19	12	10	1	97.68 ± 84.38(21 − 343)	113.86 ± 91.29(28 − 355)	15.62 ± 12.07(2 − 43)
Shoulder/Clavicula	1	0	1	1	0	0	137.00	141.00	4.00
Fracture and Bone Stress	**17**	**5**	**11**	**8**	**9**	**2**	**65.65 ± 43.03(26 − 185)**	**79.19 ± 45.07(35 − 196)**	**12.75 ± 9.66(1 − 35)**
Ankle	3	0	3	3	0	0	49.33 ± 21.73(26 − 69)	58.00 ± 32.53(35 − 81)	10.50 ± 2.12(9 − 12)
Foot/Toe	5	4	1	1	4	0	63.80 ± 39.06(27 − 129)	84.80 ± 45.97(46 − 164)	21.00 ± 11.64(10 − 35)
Hip/Groin	2	0	2	0	2	1	93.00 ± 4.24(90 − 96)	105.00 ± 0.00	12.00 ± 4.24 (9 − 15)
Knee	3	0	3	1	2	0	94.00 ± 79.79(36 − 185)	101.67 ± 83.55(37 − 196)	7.67 ± 5.77(1 − 11)
Elbow	1	1	0	1	0	0	29.00	50.00	21.00
Forearm	1	0	1	1	0	0	37.00	42.00	5.00
Hand	1	0	1	1	0	0	50.00	52.00	2.00
Lower Back/Pelvis/ Sacrum*	1	0	0	0	1	1	65.00	68.00	3.00
Nervous system	**2**	**1**	**1**	**2**	**0**	**1**	**43.00 ± 11.31(35 − 51)**	**51.50 ± 13.44(42 − 61)**	**8.50 ± 2.12 (7 − 10)**
Head/Face	2	1	1	2	0	1	43.00 ± 11.31(35 − 51)	51.50 ± 13.44(42 − 61)	8.50 ± 2.12(7 − 10)
Other	**1**	**1**	**0**	**1**	**0**	**0**	**34.00**	**38.00**	**4.00**
Lower Leg/Achilles Tendon	1	1	0	1	0	0	34.00	38.00	4.00
Not Reported* #	2								
Total §	113	32	78	38	73	10	62.20 ± 53.87(21 − 343)	74.30 ± 59.27(22 − 355)	11.42 ± 10.10(1 − 43)

*Site of injury occurrence not determined; **#** Mechanism of injury not determined; **§** 3 injuries with missing injury information; SD, standard deviation.

Table 3. Summary of model fit indices for measurement invariance testing of the injury-psychological readiness to return to sport (I-PRRS).

Model	PP*p*	DIC	BIC
Configural	0.48	9321	9675
Metric	0.48	9321	9648
Scalar	0.54	9307	9638

PP*p*, Posterior Predictive *p* value; DIC, Deviance Information Criterion; BIC, Bayesian Information Criterion.

Without this clarity, valid measurement and appraisal of this desired state to support RTP decision-making and comprehensively profile rehabilitating players remains essentially unknown and represents a key challenge for practitioners and researchers.

Internal consistency

The I-PRRS demonstrated good internal consistency (ω = 0.88) signifying a high degree of interrelatedness (correlation) among scale items which means that items intended to measure the same underlying construct, yield similar scores (Terwee et al., 2007). Internal consistency is particularly important for PROMs that are intended to measure a single construct by adopting multiple items (Terwee et al., 2007). Although not directly comparable, our results appear consistent with existing reliability estimates presented for the I-PRRS (0.78–0.94), albeit in other athletic populations (Glazer, 2009), across translated versions (e.g., Dutch I-PRRS) (Slagers et al., 2019; Vereijken et al., 2019) or used to assess specific injury types (e.g., ACL injury) (Slagers et al., 2019).

Longitudinal measurement invariance

Longitudinal measurement invariance assesses whether the same constructs are measured equally at different timepoints (Dimitrov, 2010; Luo et al., 2020; Putnick & Bornstein, 2016). Failure to demonstrate measurement invariance indicates test scores may not be able to be reliably compared nor attributed to changes in the construct(s) being measured because differences may be confounded by irregularities in the psychometric properties of the instrument between administrations. In the present study, invariance testing revealed that scalar invariance of the I-PRRS was supported and demonstrated best fit to the data (Table 3). The observed variance in I-PRRS scores (within this sample) from the first time-point of returning-to-training to the second time-point of returning to unrestricted match-play were attributable to change at a construct level, suggesting that administering the I-PRRS throughout rehabilitation (i.e., the RTP continuum) may be

appropriate within male professional football populations. A PROM capable of tracking changes in psychological status across key RTP milestones is clearly important given that the recovery profile of psychological readiness may not be linear (Morrey et al., 1999), nor necessarily coincide with the restoration of physical function (Ardern et al., 2014). In recognition of the preliminary nature of our finding, further research is required to evaluate the responsiveness of the I-PRRS and determine its ability to detect changes over time in this population (Impellizzeri & Marcora, 2009).

Limitations

Firstly, face validity of the I-PRRS was assumed (i.e., on the face of it, the PROM appears to assess the desired construct). It is however important to remember that this criterion typically represents a subjective judgement and is not based on any empirical approach (Jenkinson et al., 1996; Streiner et al., 2015). Nevertheless, the degree to which the I-PRRS is accepted as a measure of confidence to RTP requires further empirical scrutiny in this population. Secondly, only injuries with a time-loss of ≥3 weeks were included. As such, the impact of injuries <3 weeks on confidence to RTP is not known and may vary not only according to the injury but also the individual player (e.g., previous injury history) and specific contexts (e.g., accelerated RTP for upcoming key fixtures). Third, data pertaining to multiple language versions of the I-PRRS were collectively analysed and not assessed independently. In an effort to minimise any impact to our analyses, the I-PRRS was cross-culturally adapted to achieve versions of the original instrument that were conceptually equivalent in all other languages and cultures. However, owing to this approach, the validity of translated instruments (i.e., for use at an individual level) remains the subject of further investigation. Consequently, it is important to acknowledge that their current application should be confined to research whereby aggregated data is examined. Whilst correctly viewed as a potential disadvantage, the desire to account for the multi-lingual/cultural make-up of modern-day professional football squads and subsequently enhance the applicability of this study to more players, justified this decision.

It should also be acknowledged that the findings of this study pertain to male professional footballers only. In this respect, how the I-PRRS functions and performs in other football populations (e.g., female, youth or recreational) remains to be established. Lastly, owing to their subjective nature, social desirability represents a potential source of bias commonly associated with PROMs (Chang et al., 2019). Given their strong intent to re-integrate into training and match-play, it is feasible that some players may not have been entirely honest when answering items owing to a perception that undesirable responses (e.g., low confidence) may impede their return. However, the phenomenon of player honesty or dishonesty is complex and recently has been shown to be highly dependent on the relationship between the player and the practitioner(s) asking the questions (McCall et al., 2023). Therefore, although possible, player dishonesty should not be implicitly assumed.

Considerations for future research

Whilst this study has sought to advance existing knowledge pertaining to the I-PRRS, its application within male professional football at this stage should still be done cautiously. Continued research involving this instrument is necessary to further establish its validity and reliability in order to endorse its suitability for use. As part of this approach, it might be beneficial to test the I-PRRS using other analytical frameworks such as item response theory. This approach may offer further insight to the weighting specific items hold in respect to predicting player confidence to RTT and RTC following injury.

Consideration of empirical developments relating to psychological readiness and confidence is also equally warranted. For example, in view of the proposed multi-dimensional nature of confidence to RTP, reservations exist regarding how well the I-PRRS actually reflects the entirety of this construct. Indeed, having confidence across several areas of rehabilitation (e.g., the program and progress being made, the expertise of support staff, a belief in performance capabilities as well as a negligible fear or re-injury) may be important in supporting one's RTP following injury (Podlog et al., 2015). The absence of items (or sufficient breadth of items) pertaining to these potentially relevant components of confidence indicates the I-PRRS may not fully capture all aspects of this construct and thus lacks content validity.

Since the inception of the I-PRRS, conceptual clarity around what it means to be "psychologically ready" to RTP has also evolved (Podlog et al., 2022). Accordingly, while confidence appears central to this psychological state, the unidimensional characterisation of psychological readiness as originally presented by Glazer (2009) is now contested. Preliminary findings indicate that to comprehensively screen a player's psychological readiness to RTP, consideration of their motivation to regain previous performance standards and love for the game as well as ensuring they possess realistic expectations of their sporting capabilities, may also be important (Kunnen et al., 2020; Podlog et al., 2015). In this respect, the label ascribed to this PROM as a measure of psychological readiness is perhaps misleading in the sense that adopting the I-PRRS in isolation may be insufficient to provide a complete and accurate representation of this posited higher-order construct (i.e., psychological readiness).

In future, researchers should explore in greater depth the psychological readiness phenomenon to elucidate what dimensions and precursors actually underpin it. Such findings may help to alleviate the conceptual ambiguity which presently encompasses the I-PRRS as evidenced by the wide range of conceptually different reference measurements (often without clear rationale) used to establish construct validity (Conti, diFronso, Robazza, et al., 2019; Naghdi et al., 2016; Slagers et al., 2019). Finally, examination of the predictive validity of the I-PRRS alongside other relevant psychological constructs (e.g., motivation, expectations) for salient RTS outcomes (e.g., re-injury) would be instructive in future research.

Conclusion

The I-PRRS showed good internal structure in professional male footballers. Specifically, the I-PRRS measured a unidimensional state, indicative of good structural validity and internal consistency and exhibited good longitudinal measurement invariance, signifying potential utility for implementation prior to returning to full training and competition following injuries of ≥3 weeks' time-loss.

Despite this study advancing knowledge and representing a basis from which to progress research into the I-PRRS within male professional football players and investigate other important measurement properties, it is imperative to acknowledge that issues surrounding the content and construct validity of this PROM remain. To support RTP decision-making, the proposed multidimensional nature of psychological readiness and specifically confidence should be the subject of further empirical scrutiny to establish greater conceptual clarity.

Acknowledgments

The authors would like to thank the medical and science staff and contact persons responsible for the collection of injury and psychological data, as well as all players for their participation in the study. We acknowledge and thank the following people: Dr Abd-esbasset Abaidia, Dr Alex Moreira, Dr Maurizio Franchini, Samuele Melotto, Dr Ricard Pruna, Dr Daniel Medina, Dr Mario Bizzini, Dr Joao Brito, Renato Andrade, Dr Josean Lekue and Dr Alex Rebelo Marques for contributing to the translation process for each psychological instrument.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This research was part of a PhD funded by Edinburgh Napier University and PUMA who are in a partnership with Arsenal FC. Specifically, Arsenal FC were involved in the study design, data analysis and data interpretation of the report.

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