The Open Sports Sciences Journal

Content list available at: https://opensportssciencesjournal.com

CrossMark

RESEARCH ARTICLE

Initial Validation of a 33-Item Recovery-Stress Questionnaire for Italian Athletes

Selenia di Fronso[1,*], Claudio Robazza[1], Cristina Montesano[2] and Maurizio Bertollo[1]

[1]*Behavioral Imaging and Neural Dynamics (BIND) Center, Department of Medicine and Aging Sciences, University "G. d'Annunzio" of Chieti-Pescara, Chieti, Italy*
[2]*Department of Neuroscience, Imaging and Clinical Sciences, University "G. d'Annunzio" of Chieti-Pescara, Chieti, Italy*

Abstract:

Background:

The Recovery-Stress Questionnaire for Athletes (RESTQ-Sport-36) is a self-report measure intended to monitor the recovery-stress balance in athletes. A validated Italian version of this instrument was not available so far.

Objective:

The aim of this study was to provide an initial validation in Italian language of the RESTQ-Sport-36.

Methods:

A sample of Italian athletes ($N = 339$; women = 148; men = 191) from various sports completed the RESTQ-Sport-36 and the Italian Mood Scale (ITAMS). We examined the factorial validity and the internal consistency of the RESTQ-Sport-36 and its concurrent validity with the ITAMS.

Results:

A confirmatory factor analysis supported a 12-factor structure after the removal of 3 items. Reliability analysis showed a satisfactory internal consistency of the 33-item Recovery-Stress Questionnaire for Athletes (RESTQ-Sport-33). Pearson correlation coefficients revealed that the RESTQ-Sport-33 and ITAMS share some common variance but measure different constructs.

Conclusion:

Our results provided support to the factorial validity and reliability of the RESTQ-Sport-33. This instrument can be used to reliably monitor recovery-stress balance of Italian athletes throughout the season.

Keywords: CFA, Internal consistency, Monitoring, Recovery demands, Stressor, ITAMS.

1. INTRODUCTION

Athlete monitoring is an increasingly scientific approach that modern sport is adopting to athletic preparation [1]. This approach consists of carefully monitoring and managing stress and recovery of athletes to improve and/or optimize their performance and avoid underperformance, injury, or illness [1 - 3]. Among athlete monitoring methods, athlete self-report measures are gaining increasing attention. These are paper-based or electronic records of an athlete's perceived physical, psychological, and/or social well-being, completed on a regular basis. Athlete self-report measures can assess dimensions such as mood (Profile of Mood States) [4]; emotions (Emotional Recovery Questionnaire) [5]; stress and/or symptoms (Daily Activities of Life Demands; Perceived Stress Scale) [6, 7]; or stress and recovery (Recovery-Stress Questionnaire for Athletes; RESTQ-Sport) [8].

As concerns stress and recovery dimensions, when a mismatch between stress states and recovery demands is present and athletes have to deal with high stress/low recovery or low stress/high recovery situations, performance most likely is poor [2, 9, 10]. A key factor of recovery-stress balance in

* Address correspondence to this author at Behavioral Imaging and Neural Dynamics (BIND) Center, Department of Medicine and Aging Sciences, University "G. d'Annunzio" of Chieti-Pescara, Via Luigi Polacchi, 11-15, 66100, Chieti, Italy; E-mail:s.difronso@gmail.com

sport is represented by training load [11, 12]. Generally, an insufficient training load leads to underperformance in athletes [13]. On the other hand, exceeding in training load could cause injuries, non-functional overreaching and/or overtraining, impairing not only performance but also athletes' wellbeing [14]. Consequently, recovery-stress balance monitoring represents a prominent factor for athletes' health and deserves increased attention [2, 9, 15].

Over the previous decade, the RESTQ-Sport has become widely popular in research to monitor the recovery-stress balance [8]. This self-report measure indicates the extent to which an athlete is physically and/or mentally stressed, as well as whether the athlete is able to use individual strategies for recovery and which strategies are used [14]. This questionnaire encompasses physical and psychobiosocial dimensions of both stress and recovery. For example, it includes physical stress or fitness measures that are useful in identifying possible mismatches between stress and recovery due to training or competition [11]. The 76-item version of the RESTQ-Sport has been administered during training camps, and across preparation and competition phases [16, 17]. However, when the questionnaire needs to be administered repeatedly for effective monitoring, a shorter version of RESTQ-Sport is preferable for practical reasons.

The original 76-item version encompasses 19 scales with 4 items each. Seven scales—*General Stress, Emotional Stress, Social Stress, Conflicts/Pressure, Fatigue, Lack of Energy*, and *Physical Complaints*—assess social-emotional stress in general, performance stress, and physical aspects of stress. Five scales—*Success, Social Recovery, Physical Recovery, General Well-being*, and *Sleep Quality*—measure nonspecific recovery activities. Three scales—*Disturbed Breaks, Emotional Exhaustion*, and *Injury*—and other four scales—*Being in Shape, Personal Accomplishment, Self-Efficacy, and Self-Regulation*—assess sport-specific aspects of stress and recovery, respectively. Generally, the appraisal of the recovery-stress state is represented by a quantitative assessment of the frequency of stress and recovery related events in the past three days/nights. As mentioned above, in line with the necessity of shortening this version to allow multiple administrations for effective recovery-stress monitoring, Kellmann and Kallus [8] recently published a modified version (*i.e.*, the RESTQ-Sport-36) consisting of 36 items loading into 12 factors.

Currently, a valid and reliable version of the RESTQ-Sport in Italian language is not available. In order to reliably assess Italian athletes' recovery-stress balance with this self-report measure, we translated and adapted the RESTQ-Sport-36 into Italian language and examined its factor structure, internal consistency (reliability), and concurrent validity with the Italian Mood Scale (ITAMS) [18]. The ITAMS is a validated Italian version of the Brunel Mood Scale [19] designed primarily for use in sport and exercise contexts.

An Italian validated version of the RESTQ-Sport-36 would enable scholars of different countries to devise common research projects and exchange their results in a reliable manner [20]. It would also provide practitioners with a proper measure to assess the athletes' recovery-stress balance in their own language and cultural context.

2. MATERIALS AND METHODS

2.1. Participants

Eligibility criteria for participating in our study included that participants were at least 14 years old and that they were competitive athletes. Three hundred and thirty-nine Italian athletes (148 women, 191 men; Mean age = 22.32 ± 6.42) voluntarily participated in the study and signed a written consent form before the testing procedure. They were involved in a variety of different individual and team sport activities such as soccer ($n = 90$), basketball ($n = 80$), volleyball ($n = 70$), tennis ($n = 50$), swimming ($n = 20$), rugby ($n = 15$), or gymnastics ($n = 14$), and competed at different levels (*i.e.*, international, national, regional, and local). The study was approved by the local ethics committee for biomedical research and was undertaken in compliance with the Declaration of Helsinki and the international principles governing research on humans.

2.2. Instruments

2.2.1. RESTQ-Sport-36

Grounded on empirical, theoretical, and practical considerations, seven scales (*i.e.*, *Emotional Stress, Conflicts/Pressure, Lack of Energy, Physical Complaints, Success, Physical Recovery*, and *Self-Regulation*), considered rather weak for the sport-specific context, were removed by Kellmann and Kallus [8] from the 76-item questionnaire. The short version (*i.e.*, the RESTQ-Sport-36) includes 12 scales consisting of 3 items each. From confirmatory factor analysis (CFA) results, the 3 items with higher standardized factor loadings and lower cross-loadings were retained on each scale. The questionnaire also includes a "warm-up" item not included in the scoring. The 12 scales conceptually belong to 4 categories—*Overall Stress, Overall Recovery, Sport-specific Stress*, and *Sport-specific Recovery*—consisting of 3 scales each [8]. Specifically, *General Stress, Social Stress*, and *Fatigue* pertain to *Overall Stress* category, while *Social Recovery, General Well-being*, and *Sleep Quality* pertain to *Overall Recovery*. *Disturbed Breaks, Emotional Exhaustion*, and *Injury* are included in the *Sport-specific Stress* category, while *Being in Shape, Personal Accomplishment*, and *Self-Efficacy* are included in the *Sport-specific Recovery* category. At a higher level, the scales included in the *Overall Stress* and *Sport-specific Stress* belong to the general factor named *Stress*, while the scales included in the *Overall Recovery* and *Sport-specific Recovery* belong to the general factor named *Recovery*. Participants are required to indicate how often they were involved in specific activities during the past three days/nights using a 7-point Likert-type scale ranging from 0 (*never*) to 6 (*always*). In a sample of French athletes, Nicolas, Vacher, Martinent, and Mourot [14] reported acceptable fit indices for the 12-factor correlated model, CFI = .951, RMSE = .05 (90%CI = .05–.06). Moreover, average inter-item correlation values of the questionnaire scales (ranging from 0.21 to 0.60) provided general evidence for the reliability of the instrument.

2.2.2. ITAMS

The ITAMS [15] is an Italian validated questionnaire developed to examine mood responses in sport and exercise

fields. It encompasses 24 items assessing six dimensions of mood, namely *Anger, Confusion, Depression, Fatigue, Tension,* and *Vigor*. Participants can indicate their feelings on a 5-point Likert-type scale ranging from 0 (*not at all*) to 4 (*extremely*). As concerns its internal consistency and reliability, Cronbach's alpha values were .74 for *Anger*, .79 for *Confusion*, .80 for *Depression*, .75 for *Fatigue*, .80 for *Tension*, and .78 for *Vigor*.

2.3. Procedures

2.3.1. Translation

The translation of the RESTQ-Sport-36 was conducted using the forward-backward translation method [21] by two Italian English-speaking researchers and a native English speaker with a good command on Italian. All researchers were knowledgeable about sport science and sport psychology. The original version of the questionnaire was translated independently by the researchers and then the translated text was discussed extensively. When a consensus on a pre-version of the questionnaire was reached, the questionnaire was reverse translated by a native English speaker. The original English questionnaire and the translated and retranslated texts were examined carefully for accuracy. Just a few minor discrepancies on the syntax emerged. These were discussed until agreement on the changes was reached. The item 4 (pertaining to *Sleep Quality* scale) is reversely formulated in comparison to the items in the same scale and thus reversely scored. As a result of the experts' discussion, this item was reformulated to conform with the items of the same scale, and therefore to make it clearer to the athletes. A convenience sample of competitive athletes (*n* = 30), not included in the final sample, was involved in a preliminary assessment of the Italian version of the RESTQ-Sport-36. Participants reported a good understanding of guidelines, item contents, and response options.

2.3.2. Recruitment

Participants were recruited by phone, email, or in person using informal and professional networks (*i.e.*, clubs and sport centres). Coaches and athletes were informed regarding the study purpose, methodology, and eligibility criteria for study participation. The study details were explained to the eligible athletes, and those who agreed to participate signed an informed consent as mentioned above. Participants completed the RESTQ-Sport-36 as well as the ITAMS during the first week of their summer training camp. The assessment took about 10 min to complete.

2.4. Statistical Analysis

Data were initially screened for multivariate outliers and normal distribution [22]. Neither missing values nor outliers were identified. Examination of histograms, skewness, and kurtosis of the variable scores showed that there were no substantial deviations from normality. The factor structure of the questionnaire was examined through CFA using M *plus*8.5 [23]. We estimated CFA models using the maximum likelihood parameter estimates with standard errors and a mean-adjusted chi-square (χ^2) test statistic that is robust to non-normality. The CFA model was evaluated according to different fit indices: root mean square residual (RMR), root mean square error of approximation (RMSEA), Tucker Lewis fit index (TLI), and comparative fit index (CFI). An acceptable fit is obtained when RMR and RMSEA value are less than .08 [24, 25]. TLI and CFI values greater than .90 are also considered as indicative of acceptable fitting models [26]. The reliability of the questionnaire was assessed in terms of internal consistency using Cronbach' alpha values, omega values, composite reliability, and average variance extracted of the latent variables [27]. Furthermore, concurrent validity was assessed using a Pearson product-moment correlation coefficient between the RESTQ-Sport-36 and ITAMS subscales.

3. RESULTS

The original 12-factor correlated model (*i.e.*, first-order factor model) with 3 items in each scale did not show acceptable fit (Table **1**). After scrutiny of factor loadings, we decided to delete item 16 of the *Social Recovery* scale, item 4 of the *Sleep Quality* scale, and item 22 of the *Emotional Exhaustion* scale based on factor loadings smaller than .50 [28]. Because of this deletion, the goodness of fit indices of a first-order model encompassing 12 correlated scales and 33 items was acceptable (Table **1**). CFA indices of hierarchical models did not reach cut off criterion values. The first hierarchical model tested consisted of four higher-order factors (*i.e.*, *Overall Stress, Overall Recovery, Sport-specific Stress, Sport-specific Recovery*) and 12 lower-order factors (*i.e.*, *General Stress, Social Stress, Fatigue, Social Recovery, General Well-being, Sleep Quality, Disturbed Breaks, Emotional Exhaustion, Injury, Being in Shape, Personal Accomplishment, Self-Efficacy*). The second hierarchical model tested consisted of two higher-order factors (*i.e.*, *Stress* and *Recovery*) and four lower-order factors (*i.e.*, *Overall Stress, Overall Recovery, Sport-specific Stress, Sport-specific Recovery*).

Table 1. CFA indices for the 36 and 33 items structure and for the two hierarchical (higher-order) models of the RESTQ-Sport.

Model	χ^2	*p*	*df*	RMSR	RMSEA	TLI	CFI
First-order factor model, 36 items	5388.289	< .001	630	.067	.040	.864	.886
First-order factor model, 33 items	4867.500	< .001	528	.052	.051	.927	.941
Four higher-order factor model	1086.421	< .001	477	.861	.061	.869	.882
Two higher-order factor model	1130.233	< .001	480	.088	.063	.861	.874

*Note:*The two hierarchical (higher-order) models were tested on the 33 items structure. χ^2 = Chi-square, *df* = degrees of freedom, *RMR* = root mean square residual, *RMSEA* = root mean square error of approximation, *TLI* = Tucker Lewis fit *index*, *CFI* = comparative fit index. N = 339 athletes

Standardized factor loadings and error variances of the first-order factor models are presented in Table **2**.

Correlation values among the 12 scales of the 33-item, first-order factor model are reported in Table **3**.

All reliability (*i.e.*, internal consistency) values are reported in Table **4**.

The *Anger, Confusion, Depression, Tension*, and *Fatigue* subscales of the ITAMS correlated positively with the stress scales of the RESTQ-Sport-33 (*i.e.*, *General Stress, Social Stress, Fatigue, Disturbed Breaks, Emotional Exhaustion* and *Injury*) and negatively with the recovery scales of the same instrument (*i.e.*, *Social Recovery, General Well-being, Sleep Quality, Being in Shape, Personal Accomplishment*, and *Self-Efficacy*). The *Vigor* subscale of the ITAMS was related negatively and positively with the stress and recovery scales of the RESTQ-Sport-33, respectively (Table **5**).

Table 2. Standardized factor loadings (SFL) and error variances (SEV) for the first-order factor model comprised of 12 correlated factors with 36 and 33 items.

-	-	36 Items		33 Items	
-	-	SFL	SEV	SFL	SEV
General Stress	-	-	-	-	-
Item 12	-	.790	.376	.791	.375
Item 18	-	.828	.314	.828	.314
Item 27	-	.577	.667	.574	.669
Social Stress	-	-	-	-	-
Item 8	-	.767	.412	.767	.412
Item 14	-	.879	.227	.879	.228
Item 31	-	.778	.395	.778	.394
Fatigue	-	-	-	-	-
Item 3	-	.682	.535	.682	.535
Item 23	-	.710	.496	.705	.503
Item 30	-	.815	.336	.819	.329
Social Recovery	-	-	-	-	-
Item 5	-	.607	.631	.538	.710
Item 16	-	.417	.826	/	/
Item 29	-	.751	.437	.776	.397
General Well-being	-	-	-	-	-
Item 10	-	.724	.476	.721	.481
Item 25	-	.789	.378	.785	.384
Item 32	-	.844	.288	.850	.278
Sleep Quality	-	-	-	-	-
Item 4	-	.385	.852	/	/
Item 19	-	.783	.387	.782	.388
Item 36	-	.729	.469	.714	.490
Disturbed Breaks	-	-	-	-	-
Item 13	-	.529	.720	.528	.721
Item 21	-	.652	.574	.652	.574
Item 33	-	.576	.668	.577	.668
EmotionalExhaustion	-	-	-	-	-
Item 11	-	.776	.399	.796	.366
Item 22	-	.385	.851	/	/
Item 26	-	.781	.391	.781	.390
Injury	-	-	-	-	-
Item 9	-	.866	.250	.866	.249
Item 15	-	.909	.174	.908	.175
Item 28	-	.572	.673	.572	.673
Being in Shape	-	-	-	-	-
Item 2	-	.668	.554	.667	.555
Item 24	-	.760	.423	.760	.422
Item 35	-	.749	.439	.749	.439
Personal Accomplishment	-	-	-	-	-
Item 7	-	.739	.453	.740	.453

(Table 2) contd.....

-	-	36 Items		33 Items	
Item 17	-	.625	.609	.624	.610
Item 34	-	.594	.647	.595	.646
Self-Efficacy	-	-	-	-	-
Item 6	-	.750	.437	.751	.436
Item 20	-	.772	.404	.772	.403
Item 37	-	.709	.498	.708	.499

Note: In the first-order factor model comprised of 33 items, items 16, 4, and 22 were deleted because of SFLs less than .50; N = 339 athletes.

Table 3. Correlation values among the 12 scales of the first-order factor model comprised of 33 items.

S.no	-	1	2	3	4	5	6	7	8	9	10	11
1	General Stress	-	-	-	-	-	-	-	-	-	-	-
2	Social Stress	.644	-	-	-	-	-	-	-	-	-	-
3	Fatigue	.529	.209	-	-	-	-	-	-	-	-	-
4	Social Recovery	-.329	-.087	.134	-	-	-	-	-	-	-	-
5	General Well-being	-.477	-.275	-.001	.879	-	-	-	-	-	-	-
6	Sleep Quality	-.457	-.189	-.095	.608	.745	-	-	-	-	-	-
7	Disturbed Breaks	.707	.491	.495	-.083	-.18	-.123	-	-	-	-	-
8	EmotionalExhaustion	.841	.354	.377	-.264	-.37	-.307	.548	-	-	-	-
9	Injury	.422	.226	.711	.099	.051	-.150	.275	.261	-	-	-
10	Being in Shape	-.396	-.079	-.143	.582	.798	.733	-.149	-.370	-.147	-	-
11	Personal Accomplishment	-.196	-.048	.135	.521	.661	.448	.052	-.166	.212	.781	-
12	Self-Efficacy	-.264	-.046	.011	.645	.753	.664	-.074	-.312	.077	.925	.685

Note: All the correlations are significant at p < .001; N = 339 athletes.

Table 4. Reliability (*i.e.*, internal consistency) values of the 12 scales of the RESTQ-Sport-33.

Scale	*I*	*M*	*SD*	α	ω	CR	AVE
General Stress	3	1.082	0.949	.770	.781	.780	.547
Social Stress	3	1.330	1.059	.843	.850	.850	.655
Fatigue	3	2.003	1.113	.775	.781	.781	.544.
Social Recovery	2	3.096	1.169	.589	.590	.609	.446
General Well-being	3	3.499	1.252	.825	.829	.829	.620
Sleep Quality	2	2.644	1.255	.717	.717	.718	.561
Disturbed Breaks	3	1.010	0.789	.668	.618	.611	.346
EmotionalExhaustion	2	1.139	0.966	.763	.767	.767	.622
Injury	3	2.119	1.171	.816	.831	.834	.634
Being in Shape	3	3.300	1.165	.770	.772	.770	.528
Personal Accomplishment	3	2.934	1.290	.700	.770	.770	.430
Self-Efficacy	3	3.002	1.145	.778	.791	.788	.554

Note: I = Number of items, *M* = mean, *SD* = standard deviation, α = Cronbach's alpha, *ω* = omega, *CR* = composite reliability, *AVE* = average variance extracted, *N* = 339 athletes.

Table 5. Pearson correlation coefficient between RESTQ-Sport-33and ITAMS subscales.

RESTQ-Sport-36	ITAMS					-
-	Anger	Confusion	Depression	Fatigue	Tension	Vigor
General Stress	.456**	.492**	.598**	.495**	.451**	-.195**
Social Stress	.473**	.361**	.328**	.238**	.351**	-.044
Fatigue	.229**	.227**	.208**	.446**	.211**	-.065
Social Recovery	-.150**	-.082	-.245**	-.136*	-.132*	.170**
General Well-being	-.280**	-.226**	-.391**	-.310**	-.262**	.358**
Sleep Quality	-.193**	-.208**	-.269**	-.325**	-.251**	.334**
Disturbed Breaks	.250**	.239**	.247**	.230**	.284**	-.015

(Table 5) contd.....

RESTQ-Sport-36	ITAMS					-
EmotionalExhaustion	.231**	.277**	.242**	.378**	.205**	-.127*
Injury	.248**	.289**	.239**	.377**	.182**	-.054
Being in Shape	-.227**	-.218**	-.318**	-.309**	-.232**	.466**
Personal Accomplishment	-.123*	-.105	-.178**	-.094	-.136*	.283**
Self-Efficacy	-.075	-.195**	-.223**	-.189**	-.128*	.495

Note: * = significant correlation at .05 level (2-tailed); ** = significant correlation at .01 level (2-tailed); *N* = 339 athletes.

4. DISCUSSION

The aim of this study was to examine the construct validity and the internal consistency of the Italian version of RESTQ-Sport-36 and its concurrent validity with the ITAMS subscales. This represents a first stage for scholars of different countries to develop and share research projects and exchange results. Additionally, practitioners could assess athletes' recovery-stress balance in their own cultural context.

Differently from the original version of the instrument, which includes 36 items [8], the Italian version comprised 33 items loading into 12 correlated latent factors. All scales included three items, except for *Social Recovery, Sleep Quality, and Emotional Exhaustion* that comprised two items each. Despite a rigorous methodology applied to the translation of the questionnaire, some issues probably emerged in the adaptation to the Italian culture. Cross-cultural adaptation issues also occurred in a Spanish adaptation of the 76 items version of the questionnaire [29]. Study findings, indeed, yielded poor factor loadings of some items in the expected factor. However, these issues do not necessarily mean that the original 36-item instrument should be abandoned. Additional research is needed to further assess the factor structure of the measure, in particular by involving homogeneous samples of athletes practicing a same sport.

Notwithstanding the Italian version included 33 out of 36 items of the RESTQ-Sport-36, the results of the CFA revealed the multi-dimensionality nature of this self-report questionnaire. Specifically, CFA results suggested that the recovery-stress balance of athletes is reflected in 12 specific yet correlated factors [14]. The low internal consistency of two scales (*i.e.*, *Social Recovery* and *Disturbed Breaks)* may be due to the small number of items [30]. However, most of the scales showed high reliability, thus indicating a satisfactory internal consistency of the questionnaire.

In the current study, the hierarchical models revealed poor fit to the data. However, drawing on the notion that fit indices of a second-order model are generally lower than fit indices of an equivalent first-order model [31], we suggest that hierarchical models should be considered when the focus is on the global assessment of recovery-stress states of athletes. On the other hand, for a more detailed assessment of the recovery-stress dimensions, the 12-factor model of the instrument would be the most adequate [2]. This model would indeed provide a more accurate representation of those intercorrelated factors that have a specific impact on both performance and health of athletes.

The concurrent validity of the RESTQ-Sport-33 with the ITAMS subscales revealed a pattern of relationships in the expected direction, which is in line with the correlation pattern found in previous research between the RESTQ-Sport-76 and the Profile of Mood State scales [8]. The results indicate that the two questionnaires share some common variance, but at the same time they measure different constructs [20]. Based on this finding, we should expect that administering both the RESTQ-Sport-33 and ITAMS would enable a more accurate assessment of the athletes' recovery-stress condition to prevent underperformance and overtraining. The strongest correlation observed between *General Stress* and *Depression* (*r* = .598) concurs with the notion that stress is one of the major determinants of depression [32, 33], even in athletes.

CONCLUSION

The current study has some limitations that should be addressed in future research. In particular, the construct validity of the instrument (e.g., concurrent, convergent, discriminant) should be further scrutinized. Moreover, predictive validity should be examined by combining self-reported measures with psychophysiological indicators of recovery-stress balance and behavioural evaluations.

Notwithstanding some limitations, this study contributes to previous research on stress and recovery by providing initial evidence in support of the RESTQ-Sport-33 as a reliable and valid tool for estimating the recovery-stress state of Italian athletes. Our results support the 12-factor correlated model comprising 33 out of 36 items of the original version. The initial validation of the RESTQ-Sport-33 in Italian language can enable a regular monitoring of Italian athletes throughout the season. A regular monitoring is essential to lower the risk of injury [9] in athletes and prevent underperformance and more serious problems such as non-functional overreaching or overtraining syndrome. Moreover, the questionnaire can stimulate research on relevant aspects of recovery and fatigue in athletes.

LIST OF ABBREVIATIONS

RESTQ-Sport	= Recovery-Stress Questionnaire for Athletes
ITAMS	= Italian Mood Scale
CFA	= Confirmatory Factor Analysis
RMR	= Root Mean Square Residual
RMSEA	= Root Mean Square Error of Approximation
TLI	= Tucker Lewis Fit Index
CFI	= Comparative Fit Index

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All research procedures in this study were performed in accordance with the ethical standards of the responsible committee of University "G. d'Annunzio" of Chieti-Pescara on

human experimentation.

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from each participant.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated for this study are available on request to the corresponding author [S.F].

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

REFERENCES

[1]   Saw AE, Kellmann M, Main LC, Gastin PB. Athlete self-report measures in research and practice: Considerations for the discerning reader and fastidious practitioner. Int J Sports Physiol Perform 2017; 12(2)(Suppl. 2): S2127-35.
[http://dx.doi.org/10.1123/ijspp.2016-0395] [PMID: 27834546]

[2]   Reynoso-Sánchez LF, Pérez-Verduzco G, Celestino-Sánchez MÁ, *et al.* Competitive recovery-stress and mood states in mexican youth athletes. Front Psychol 2021; 11: 627828.
[http://dx.doi.org/10.3389/fpsyg.2020.627828] [PMID: 33510698]

[3]   Saw AE, Main LC, Gastin PB. Monitoring the athlete training response: Subjective self-reported measures trump commonly used objective measures: a systematic review. Br J Sports Med 2016; 50(5): 281-91.
[http://dx.doi.org/10.1136/bjsports-2015-094758] [PMID: 26423706]

[4]   McNair P, Lorr M, Droppleman L. POMS Manual. 2nd ed. San Diego, CA: Education and Industrial Testing Service 1981.

[5]   Lundqvist C, Kenttä G. Positive emotions are not simply the absence of the negative ones: Development and validation of the Emotional Recovery Questionnaire (EmRecQ). Sport Psychol 2010; 24(4): 468-88.
[http://dx.doi.org/10.1123/tsp.24.4.468]

[6]   Rushall BS. A tool for measuring stress tolerance in elite athletes. J Appl Sport Psychol 1990; 2(1): 51-66.
[http://dx.doi.org/10.1080/10413209008406420]

[7]   Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983; 24(4): 385-96.
[http://dx.doi.org/10.2307/2136404] [PMID: 6668417]

[8]   Kellmann M, Kallus KW. The recovery-stress questionnaire for athletes.The Recovery-Stress Questionnaires: User Manual. Frankfurt am Main: Pearson Assessment & Information GmbH 2016; pp. 86-131.

[9]   Filho E, Butterworth K. Recovery-stress balance in professional and U-21 soccer: Differences between starters and substitutes. Sport Sci Health 2021; 17: 257-61.

[http://dx.doi.org/10.1007/s11332-020-00668-w]

[10]   Filho E, di Fronso S, Forzini F, *et al.* Athletic performance and recovery-stress factors in cycling: An ever changing balance. Eur J Sport Sci 2015; 15(8): 671-80.
[http://dx.doi.org/10.1080/17461391.2015.1048746]   [PMID: 26279169]

[11]   di Fronso S, Nakamura FY, Bortoli L, Robazza C, Bertollo M. Stress and recovery balance in amateur basketball players: Differences by gender and preparation phase. Int J Sports Physiol Perform 2013; 8(6): 618-22.
[http://dx.doi.org/10.1123/ijspp.8.6.618] [PMID: 23479432]

[12]   Impellizzeri FM, Marcora SM, Coutts AJ. Internal and external training load: 15 years on. Int J Sports Physiol Perform 2019; 14(2): 270-3.
[http://dx.doi.org/10.1123/ijspp.2018-0935] [PMID: 30614348]

[13]   Blevins P, Erskine S, Hopper L, Moyle G. Finding Your Balance: An Investigation of Recovery–Stress Balance in Vocational Dance Training. J of Dance Ed 2020; 20(1): 12-22.
[http://dx.doi.org/10.1080/15290824.2018.1532571]

[14]   Nicolas M, Vacher P, Martinent G, Mourot L. Monitoring stress and recovery states: Structural and external stages of the short version of the RESTQ sport in elite swimmers before championships. J Sport Health Sci 2019; 8(1): 77-88.
[http://dx.doi.org/10.1016/j.jshs.2016.03.007] [PMID: 30719387]

[15]   Bertollo M, Nakamura F, Bortoli L, Robazza C. Psychophysiological features of soccer players' recovery-stress balance during the in season competitive phase.Sport, recovery and performance: Interdisciplinary Insights. Abingdon: Routledge 2017; pp. 75-86.
[http://dx.doi.org/10.4324/9781315268149-6]

[16]   Heidari J, Beckmann J, Bertollo M, *et al.* Multidimensional monitoring of recovery status and implications for performance. Int J Sports Physiol Perform 2018; 14(1): 1-24.
[http://dx.doi.org/10.1123/ijspp.2017-0669] [PMID: 29543069]

[17]   Robazza C, Forzini F, di Fronso S, Bertollo M. Recovery-stress balance and psychobiosocial states monitoring of road cyclists.Sport, recovery, and performance: interdisciplinary insights. London, UK: Routledge 2017; pp. 63-73.
[http://dx.doi.org/10.4324/9781315268149-5]

[18]   Quartiroli A, Terry PC, Fogarty GJ. Development and initial validation of the Italian mood scale (ITAMS) for use in sport and exercise contexts. Front in Psychol 2017; 8: 1483.
[http://dx.doi.org/10.3389/fpsyg.2017.01483]

[19]   Terry PC, Lane AM. User guide for the brunel mood scale. Toowoomba, QLD: Peter Terry Consultants 2010.

[20]   Conti C, di Fronso S, Robazza C, Bertollo M. The Injury-Psychological Readiness to return to sport (I-PRRS) scale and the Sport Confidence Inventory (SCI): A cross-cultural validation. Phys Ther Sport 2019; 40: 218-24.
[http://dx.doi.org/10.1016/j.ptsp.2019.10.001] [PMID: 31610419]

[21]   Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine 2000; 25(24): 3186-91.
[http://dx.doi.org/10.1097/00007632-200012150-00014]   [PMID: 11124735]

[22]   Tabachnick BG, Fidell LS. Using multivariate statistics. In: 6th ed; Boston, MA: Pearson 2013.

[23]   Muthén LK, Muthén BO. Mplus: Statistical Analysis with Latent Variables: User's Guide. 8th Version. Los Angeles, CA: Authors 2017.

[24]   Hooper D, Coughlan J, Mullen MR. Structural equation modelling: Guidelines for determining model fit. Electr J of Business Res Meth 2008; 6(1): 53-60.
[http://dx.doi.org/10.18549/PharmPract.2017.03.999]

[25]   Hu L-T, Bentler PM. Evaluating model fit. Structural equation modeling: Concepts, issues, and applications. Thousand Oaks, CA: Sage 1995; pp. 76-99.

[26]   Tucker LR, Lewis CA. Reliability coefficient for maximum likelihood factor analysis. Psychometrika 1973; 38(1): 1-10.
[http://dx.doi.org/10.1007/BF02291170]

[27]   Watkins MW. The reliability of multidimensional neuropsychological measures: From alpha to omega. The Clinic Neuropsychol 2017; 31: 1113-26.

[28]   Hair JF Jr, Black WC, Babin BJ, Anderson RE. Multivariate data analysis. 8th ed. Hampshire, UK: Cengage 2019.

[29]   Gonzalez-Boto R, Salguero A, Tuero C, Marquez S, Kellmann M. Spanish adaptation and analysis by structural equation modeling of an instrument for monitoring overtraining: The recovery-stress

questionnaire (RESTQ-SPORT). Soc Behav and Personal: An Intern J 2008; 36(5): 635-50.
[http://dx.doi.org/10.2224/sbp.2008.36.5.635]

[30] Graham JM. Congeneric and (essentially) tau-equivalent estimates of score reliability: What they are and how to use them. Educ Psychol Meas 2006; 66(6): 930-44.
[http://dx.doi.org/10.1177/0013164406288165]

[31] Martinent G, Decret JC, Isoard-Gautheur S, Filaire E, Ferrand C. Evaluations of the psychometric properties of the Recovery-Stress

Questionnaire for Athletes among a sample of young French table tennis players. Psychol Rep 2014; 114(2): 326-40.
[http://dx.doi.org/10.2466/03.14.PR0.114k18w2] [PMID: 24897893]

[32] Lee S, Jeong J, Kwak Y, Park SK. Depression research: Where are we now? Mol Brain 2010; 3(1): 8.
[http://dx.doi.org/10.1186/1756-6606-3-8] [PMID: 20219105]

[33] Nixdorf I, Frank R, Beckmann J. An explorative study on major stressors and its connection to depression and chronic stress among German elite athletes. Adv Phys Educ 2015; 5(4): 255-62.
[http://dx.doi.org/10.4236/ape.2015.54030]