
Psychosocial evaluation of athletes with knee injuries: developmental study of evaluation instrument

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Abstract

Background: Negative psychological aspects are associated with injury in athletes, with knee injuries having the highest prevalence among this population. Objective: To propose a form of psychosocial evaluation and to evaluate measured properties of the proposed instrument as well as others already used. Methods: The Fatores Psicossociais nas Lesões Esportivas (FPLE) instrument was developed. To evaluate measures properties were used this instrument, the Recovery-Stress Questionnaire for Athletes (RESTQ-Sport), and International Knee Documentation Committee (IKDC) of 100 athletes with knee injury, with mean age of 27.7 ($\pm$ 14.5) and 58 (58%) males. Results: The instruments obtained adequate internal consistency (Cronbach's alpha of .43 to .88). The FPLE and IKDC instruments showed substantial reliability (intra-class correlation coefficient [ICC] of .84 and .87) with a good standard error of measurement (SEM) of 5.8% and 8.6% and RESTQ-Sport showed poor-to-moderate reliability in the majority of domains (.01 to .84) with doubtful-to-negative SEM (10.3% to 27%). In the construct validity, the RESTQ-Sport domains had higher correlations ($r > .40$ to .80, $P < .01$). In internal responsiveness, both RESTQ-Sport and IKDC presented high change, whereas FPLE presented a small change and none of the instruments showed correlation in external responsiveness. Conclusion: The instruments were considered valid for use in athletes with knee injuries.

KEYWORDS: Validation Studies, Knee injuries, Athletic Injuries, Psychosocial Impact, Psychology, Sports.

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Avaliação psicossocial de atletas com lesões no joelho: estudo de desenvolvimento de instrumento de avaliação

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Resumo

Introdução: Aspectos psicológicos negativos estão associados a lesão em atletas, sendo a maior prevalência de lesão no joelho nessa população. **Objetivo:** Propor uma forma de avaliação psicossocial e avaliar propriedades de medidas do instrumento proposto e outros já utilizados. **Métodos:** Foi desenvolvido o instrumento Fatores Psicossociais na Lesão Esportiva (FPLE) e avaliado propriedades de medida desse instrumento e do Questionários de Estresse e Recuperação para Atletas (RESTQ-Sport) e International Knee Documentation Committee (IKDC) em 100 atletas com lesão de joelho, com média de idade de 27.7 ($\pm$ 14.5) sendo 58 (58%) do sexo masculino. **Resultados:** Os instrumentos obtiveram consistência interna adequada (alfa de Cronbach de 0,43 a 0,88), o FPLE e o IKDC apresentaram confiabilidade substancial (coeficiente de correlação intraclasse [CCI] de .84 e .87) com erro padrão de medida (EPM) bom (5,8% e 8,6%) e o RESTQ-Sport apresentou confiabilidade ruim a moderada na maioria dos domínios (0,01 a 0,84) com EPM duvidoso a negativo (10,3% a 27%). Na validade do construto, os domínios do RESTQ-Sport apresentaram maiores correlações ($r > 0,40$ a 0,80, $P < 0,01$). Na responsividade interna, o RESTQ-Sport e o IKDC apresentaram grande alteração, enquanto o FPLE apresentou pequena alteração e nenhum instrumento apresentou correlação na responsividade externa. **Conclusão:** Os instrumentos foram considerados válidos para uso em atletas com lesões de joelho.

Palavras-chave: Estudos de validação, Lesões do joelho, Lesões Esportivas, Impacto psicossocial, Psicologia do Esporte.

Evaluación psicossocial de atletas con lesiones en el joelho: estudio de desarrollo de instrumento de evaluación

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Resumen

Introducción: Aspectos psicológicos negativos están asociados a lesión en atletas, siendo la mayor prevalencia de lesión en la rodilla en esa población. **Objetivo:** Proponer una forma de evaluación psicossocial y evaluar propiedades de medidas del instrumento propuesto y otros ya utilizados. **Métodos:** Se desarrolló el instrumento Fatores Psicossociais nas Lesões Esportivas (FPLE) y evaluó propiedades de medida de ese instrumento y del Recovery-Stress Questionnaire for Athletes (RESTQ-Sport) e International Knee Documentation Committee (IKDC) en 100 atletas con lesión de rodilla, con una edad media de 27.7 ($\pm$ 14.5) de los cuales 58 (58%) eran hombres. **Resultados:** Los instrumentos obtuvieron consistencia interna adecuada (alfa de Cronbach de 0,43 a 0,88), el FPLE y el IKDC presentaron confiabilidad sustancial (coeficiente de correlación intraclase [CCI] de .84 y .87) con error estándar de medida (EPOC) bueno (5,8% y 8,6%) y el RESTQ-Sport presentó confiabilidad mala a moderada en la mayoría de los dominios (0,01 a 0,84) con EPM dudoso a negativo (10,3% a 27 %). En la validez del constructo, los dominios del RESTQ-Sport presentaron mayores correlaciones ($r > 0,40$ a 0,80, $P < 0,01$). En la responsividad interna, el RESTQ-Sport y el IKDC presentaron gran alteración, mientras que el FPLE presentó pequeña alteración y ningún instrumento presentó correlación en la responsividad externa. **Conclusión:** Los instrumentos se consideraron válidos para uso en atletas con lesiones de rodilla.

Palabras-clave: Estudios de Validación, Traumatismos de la Rodilla, Impacto psicossocial, Psicología del Deporte.

Introduction

The presence of psychologically negative events is associated with a higher injury rate in athletes (Palmeira, 2007; Li, Moreland, Peek-Asa, Yang, 2017; Kallus and Kellmann, 2000) with the highest prevalence of injury in athletes being in the knee, leading to a lower limb performance decrease (Hootman, Dick, Agel, 2007; Swenson et al., 2005; Stensrud, Risberg, Roos, 2014). A systematic review with meta-analysis evaluated negative psychological responses to injury and also adherence effects to rehabilitation in returns to sport among competitive athletes, and concluded that negative psychological responses of injury had a negative effect on the return to sport, while adherence to treatment had a positive effect (Ivarsson, Tranaeus, Johnson, Stenling, 2017). Moreover, athletes with negative psychological aspects about their injuries have a low adherence to the treatment and higher returning period to sport (Hamson-utley, Martin, Walters, 2008).

Psychological resilience, which consists of the athlete's psychological recovery capacity, is very important in a sport environment, and thus, athletes should use and also optimize some protective factors so they can withstand the pressures to which they are submitted (Sarkar and Fletcher, 2014). Among these protective factors the positive ones perceived by the athlete are personality, motivation, confidence, focus and social support (Sarkar and Fletcher, 2014). Social support is defined as a subjective judgment of the receiver regarding the support provided by friends, teammates and coaches in cases of necessity (Sarkar and Fletcher, 2014).

In the literature, there are instruments that evaluate different psychosocial aspects in athletes (such as burnout, state of humour, competitive anxiety, stress, and power of recovery); however, there are not instruments that specifically evaluate the social support perceived by athletes and correlates these aspects with the presence of musculoskeletal symptoms and disabilities. Therefore, this study aims (1) to propose a psychosocial evaluation instrument, and (2) to evaluate the measurement properties of the proposed instrument and of the already-used instruments, as well as to verify the relationship of social support with the presence of symptoms and disabilities in athletes with knee injuries.

Method

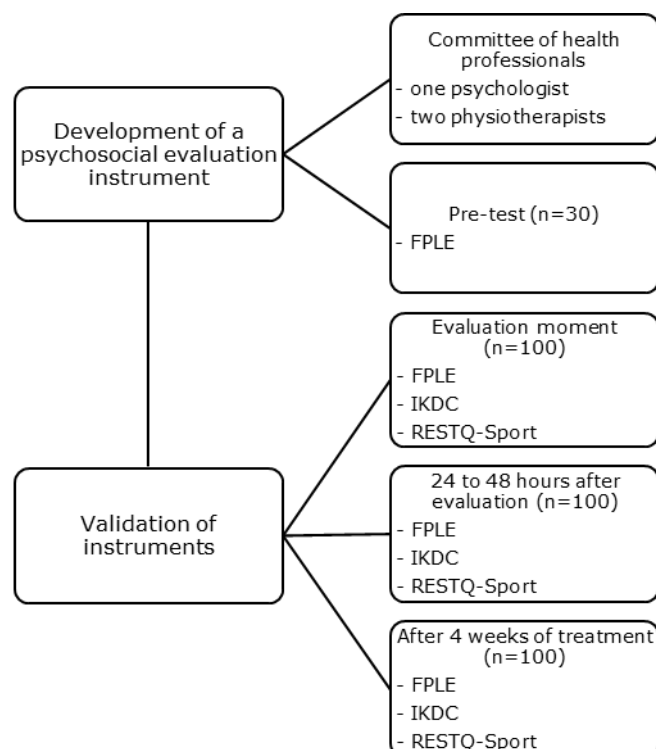
Study design and participants

Study of the development of evaluation's instrument and measurement of clinical measurement properties approved by Ethics and Research Committee (CAAE 70891317.5.0000.5505). Participants over 18 years old who agreed to participate in the study filled in term of free and informed consent and participants under 18 filled the assent term, with due term of free and informed consent filed by their legal guardians.

This study was done in two stages: the development of a psychosocial evaluation instrument, and the evaluation of clinometric properties of this instrument and two other instruments already used in clinical practice and research in athletes with knee injuries.

A health professional's committee (one psychologist and two physiotherapists) developed an instrument to briefly identifying which psychosocial aspects related to social support perceived by the athlete can be related with sport injuries in the knee. The instrument contains 6 self-administered items approached with different psychosocial aspects of athletes at the current moment. These included family relationships, relationship with the trainer/coach, relationship with teammates, relationship with co-workers or classmates, affective/conjugal relationship and financial situation. Data is gathered through a Likert scale of 1 (terrible) to 5 (great), varying from 6 to 30 points, with a higher score indicating better social support as perceived by the athlete. The committee members analysed individually the comprehension, objectivity and relevance of each item and then, a pre-test was conducted on 30 participants. After completing all instrument, the participants were asked about their difficulties in understanding and answering it. In the second stage of the study, a convenience sample was collected of 100 participants who were seeking physical therapy in the sports medicine clinic, with any medical diagnosis of knee injury. Three evaluation instruments were applied at three times: during the physical therapy evaluation, 24 to 48 hours after the evaluation and after 4 weeks of treatment. The interval of 24 to 48 hours was chosen in order to minimize significant changes in athletes' clinical status (Figure 1).

Figure 1. Study flowchart



Evaluation Instruments

Three evaluation instruments were applied: 1) an instrument that was developed through this study to evaluate the psychosocial aspects (social support); 2) the Recovery-Stress Questionnaire for Athletes; 3) International Knee Documentation Committee.

Recovery-Stress Questionnaire for Athletes (RESTQ-Sport)

RESTQ-Sport aims to measure the frequency of current stress state in conjunction with the frequency of associated recovery activities and their subjective consequences in an athlete's profile in the last 3 days/nights (Costa and Samulski, 2005). It was originally created by Kallus and Kellmann in 2000 (Kallus and Kallmann, 2000), and translated into Brazilian Portuguese by Costa and Samulski in 2005 (Costa and Samulski, 2005). The instrument has 77 questions that are divided into 19 scales (12 general and 7 sport-specific scales), with likert scale responses varying from 0 to 6, 0 being "never" and 6 "always" (Costa and Samulski, 2005).

International Knee Documentation Committee (IKDC)

The IKDC instrument aims to evaluate the symptoms and disabilities of patients with complaints of the knee (Metsavaht, Leporace, Riberto, de Mello, Batista, 2010). This instrument was developed by Irrgang et al. in 2001 (Irrgang et al., 2001) and translated and adapted to Brazilian Portuguese by Metsavaht et al. in 2010 (Metsavaht et al., 2010), and it has 18 items that evaluate symptoms (7 items), sports activities (10 items) and function (1 item) scored from 0 to 100 points, with 100 representing the best functional capacity (Metsavaht et al., 2010; Kanakamedala, Anderson, Irrgang, 2016).

Data analysis

Data were analysed using SPSS version 20. The characteristics of the participants were analysed through the use of a descriptive analysis. Continuous variables with normal distribution were summarized by average and standard deviation. Categorical variables were analysed in percentage and frequency (number of participants). For analysis of measurement properties, evaluation instruments were evaluated on five characteristics: internal consistency, reproducibility, construct validity, ceiling and floor effects and responsiveness (internal and external).

Internal consistency indicates the homogeneity level among the items of an instrument, and it was measured by Cronbach alpha test to determine whether the exclusion of each item affects the instrument's consistency (recommended value is between .70 and .95) (da Cunha et al., 2016; Wageck et al; 2013). Reproducibility is the capacity of an instrument to identify variations between two different moments in which the instrument is applied (at evaluation and 24 to 48 hours after). Reproducibility was measured through reliability and agreement (da Cunha et al., 2016; Wageck et al; 2013). Reliability was evaluated using the intra-class correlation coefficient (ICC) (poor <.40; moderate = .40 to .75; substantial = .75 to .90; excellent >.90) (da Cunha et al., 2016; Wageck et al; 2013).

Agreement was evaluated by the standard error of measurement (SEM), which consists of the error of the instrument itself (very good $\leq 5\%$; good $> 5\%$ to $\leq 10\%$; doubtful $> 10\%$ to $\leq 20\%$; negative $> 20\%$) (da Cunha et al., 2016; Wageck et al; 2013).

The validity of the construct refers to whether an evaluated instrument is consistent with the proposed hypothesis. This was evaluated by the Pearson correlation (instruments with equal constructs $\geq .70$ and instruments with similar constructions should vary from $.70$ to $.40$ to be considered moderately correlated). Ceiling and floor effects consist of instrument limitations where by more than 15% of participants should not present a maximum or minimum score (da Cunha et al., 2016; Wageck et al; 2013). Responsiveness was evaluated only with participants who had clinically detectable change exceeding 7 points (Metsavaht et al., 2010) in IKDC. Internal responsiveness measures the sensitivity of an instrument to detect clinical changes in the patient (after 4 weeks of treatment) and was evaluated through the effect size (small change $\leq .20$; moderate change $.20$ to $.50$; large change $\geq .80$). Using a confidence interval (CI) of 84% (due the construct difference between the instruments), the external responsiveness was evaluated by correlation of the difference points of between the third and first applications of each instrument (recommended value is between $.70$ and $.95$) (da Cunha et al., 2016; Wageck et al; 2013).

Results

During the first stage of the study, the *Fatores Psicossociais nas Lesões Esportivas* (FPLE) instrument was developed to briefly identify which psychosocial aspects related to the social support perceived by the athlete might be related to the sports injury. (Figure 2).

Figure 2. *Fatores Psicossociais nas Lesões Esportivas* (FPLE) instrument

Defina como está no momento sua relação/ situação:	Péssima (1)	Ruim (2)	Regular (3)	Boa (4)	Ótima (5)
1. Com seus familiares					
2. Com seu treinador/técnico					
3. Com seus colegas de esporte					
4. Com seus colegas de trabalho/escola					
5. Amorosa					
6. Financeira					

Then, it was the pre-test was conducted with 30 participants, 16 (53.3%) males and 14 (46.7%) females, who had an average age of 30.5 (± 15) years, average height of 1.71 meters (± 8.8), average weight of 73.7 (± 13) kilograms, and 23 (76.7%) participants had right lower limb dominance. Football was the most prevalent sport modality among the participants in the study, being practiced by 9 (30%) participants, followed by 6 (20%) overhead sports, 6 (20%) martial arts and 9 (30%) other modalities. Twenty-five (83.3%) participants were amateurs, 3 (10%) professionals, and 2 (6.7%) at the university level. Among the injuries found in the participants, ligament injuries in the knee joint were highlighted in 9 (30%) participants, 7 (23.3%) presented patellofemoral dysfunction, 3 (10%) had

tendinopathies, 3 (10%) presented meniscal injuries, 3 (10%) displayed patellar instability and 5 (16.7%) subjects were diagnosed with other pathologies. In 13 (43.4%) patients the lesions were in the dominant limb, 10 (33.3%) in the non-dominant limb and 7 (23.3%) had bilateral injuries. The FPLE instrument obtained a mean score of 23.1 ($\pm$ 3.4) points. During the first stage of the study the participants answered the FPLE instrument just one time and they didn't present difficulties in understanding and answering it, therefore there was no need for any type of intervention in the instrument, and then the next stage was followed up.

To evaluate the measurement properties of the instruments in the second stage 100 participants were evaluated. A descriptive analysis of characteristics in this population was made, and it was observed that 58 (58%) participants were males and 42 (42%) females, who had an average age of 27.7 ($\pm$ 14.5) years, average height of 1.70 meters ($\pm$ 9.8), average weight of 70.9 ($\pm$ 13.7) kilograms, and 81 (81%) participants had right lower limb dominance. Football and overhead sports were the most prevalent sports modalities among the participants in the study with 27 (27%) participants each one, followed by 24 (24%) martial arts, 8 (8%) running, 6 (6%) dance, 3 (3%) athletics and 5 (5%) other modalities. Among the categories, 70 (70%) participants were amateurs, 22 (22%) professionals, and 8 (8%) at the university level. Among the injuries found in the participants, ligament injuries in the knee joint were highlighted in 38 (38%) participants, 19 (19%) presented tendinopathies, 12 (12%) meniscal injury, 12 (12%) patellofemoral dysfunction, 8 (8%) presented osteoarthritis, 5 (5%) fracture, 3 (3%) epiphysitis and 3 (3%) patellofemoral instability. In 52 (52%) patients the lesions were in the dominant limb, 31 (31%) in the non-dominant limb and 17 (17%) had bilateral injuries. Besides that 71 (71%) participants were single, 26 (26%) were married and 3 (3%) were divorced. Regarding the financial situation of the studied population, 45 (45%) were without income, 39 (39%) were employed, followed by 12 (12%) who were unemployed, 2 (2%) were sponsored and 2 (2%) were retired. As for the people with whom they lived, 56 (56%) people reported living with their parents, 24 (24%) with their spouses, 11 (11%) lived alone, followed by 6 (6%) living with relatives and 3 (3%) with friends. Among the participants of the study, 19 (19%) participants had family health problems and only 7 (7%) reported ending a relationship in the last three months..

All participants answered the instruments in three different moments. The average of RESTQ-Sport obtained small variation between the moments, being the "self-regulation" the scale with most variation. The FPLE and IKDC instruments had the most average in the last moment (after four weeks of treatment) (Table 1).

Table 1. Mean (SD) of instruments in the three times (n=100)

Instruments	time 1 (evaluation)	time 2 (24 to 48 hours)	time 3 (4 weeks after)
RESTQ-Sport			
General stress	5.6 (±4.8)	5.7 (±4.8)	5.8 (±4.4)
emotional stress	8.0 (±4.6)	7.3 (±4.2)	7.8 (±3.9)
social stress	5.5 (±5.0)	5.7 (±4.8)	6.0 (±4.5)
conflicts/pressure	9.4 (±4.1)	9.0 (±4.2)	9.1 (±3.9)
Fatigue	7.7 (±4.6)	8.2 (±4.9)	8.4 (±4.5)
lack of energy	6.6 (±3.7)	6.8 (±4.3)	7.2 (±4.3)
somatic complaints	8.7 (±4.3)	7.9 (±4.3)	8.2 (±4.0)
Success	13.4 (±4.6)	12.7 (±4.3)	13.5 (±4.1)
social relaxation	15.7 (±4.9)	15.4 (±5.0)	15.6 (±5.2)
somatic relaxation	12.0 (±4.3)	11.9 (±4.4)	11.9 (±4.6)
general well-being	16.4 (±4.8)	16.0 (±4.7)	16.0 (±5.0)
sleep quality	14.1 (±4.9)	14.0 (±4.6)	13.5 (±5.0)
disturbed breaks	8.2 (±5.0)	7.8 (±5.3)	7.8 (±5.1)
burnout/emotional exhaustion	5.4 (±4.5)	5.5 (±4.7)	5.6 (±4.8)
Injury	10.7 (±5.2)	10.3 (±5.3)	10.0 (±5.5)
fitness/being in shape	13.6 (±5.0)	13.2 (±5.2)	12.8 (±5.6)
personal accomplish	12.5 (±6.2)	12.3 (±6.5)	11.9 (±6.2)
self efficacy	13.5 (±5.9)	12.9 (±6.0)	12.7 (±6.2)
self regulation	25.4 (±10.3)	13.2 (±6.7)	13.1 (±6.7)
FPLE	23.4 (±3.4)	23.2 (±3.3)	23.6 (±3.5)
IKDC	53.3 (±18.0)	53.0 (±18.0)	60.9 (±19.2)

Abbreviations: RESTQ-Sports, Recovery Stress Questionnaire for Athletes; FPLE, *Fatores Psicossociais na Lesão Esportiva*; IKDC, International Knee Documentation Committee

Internal consistency

The internal consistency of the RESTQ-Sport instrument ranged from .43 to .88; however, 10 of the 19 instrument domains presented values considered adequate. Cronbach's alpha for the FPLE was .71, and was .87 for the IKDC survey; that is, both instruments presented adequate values and obtained a good internal consistency between the items of the instruments (Table 2).

Reproducibility

The FPLE and IKDC instruments had substantial reliability (ICC2,1 = .84 and .87 respectively) and RESTQ-Sport showed poor-to-moderate reliability in most domains. Regarding the evaluation of standard error of measurement, only the "injuries" domain of the RESTQ-Sport instrument showed low value, with very good percentage (5%), while the other domains obtained doubtful or negative agreement. The FPLE and IKDC instruments obtained low values with good percentages (Table 2).

Table 2. Internal consistency and reproducibility (reliability and agreement) of instruments (n=100)

Instruments	internal consistency (Cronbach alpha)	reliability (CCI _{2,1})	agreement (SEM)
RESTQ-Sport			
general stress	.81	.82	2.6 (11%)
emotional stress	.70	.78	2.6 (10.9%)
social stress	.86	.82	2.7 (11.3%)
conflicts/pressure	.43	.79	2.5 (10.3%)
fatigue	.67	.77	2.9 (12.1%)
lack of energy	.64	.72	2.7 (11.1%)
somatic complaints	.64	.70	2.9 (12.2%)
Success	.65	.78	2.6 (11%)
social relaxation	.75	.76	3.1 (12.8%)
somatic relaxation	.68	.70	3.0 (12.3%)
general well-being	.87	.78	2.9 (11.9%)
sleep quality	.64	.75	3.0 (12.4%)
disturbed breaks	.75	.05	4.0 (16.5%)
burnout/emotional exhaustion	.67	.01	3.4 (14.3%)
Injury	.69	.02	1.2 (5%)
fitness/being in shape	.77	.08	3.7 (15.3%)
Personal accomplish	.82	.73	4.2 (17.4%)
Self efficacy	.88	.84	3.2 (13.2%)
Self regulation	.85	.62	6.5 (27%)
FPLE	.71	.84	1.7 (5.8%)
IKDC	.87	.87	8.6 (8.6%)

Abbreviations: RESTQ-Sports, Recovery Stress Questionnaire for Athletes; FPLE, *Fatores Psicossociais na Lesão Esportiva*; IKDC, International Knee Documentation Committee

Validity of the construct

Only five domains of RESTQ-Sport instrument obtained correlation with recommended values ($r = .72$ to $.80$; $P < .01$). Seven moderate correlations were found among the instruments FPLE and RESTQ-Sport ($r = .40$ to $.49$, $P < .01$), and only a moderate correlation was found between the instruments IKDC and RESTQ-Sport ($r = .44$, $P < .01$). However, no correlation was found between the FPLE and IKDC instruments (Table 3).

Table 3. Pearson correlation of instruments at baseline (n=100)

RESTQ-Sport	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	FPLE	IKDC
1.general stress	1	.72†	.79†	.36†	.32†	.64†	.49†	-.19	-.36†	-.26†	-.55†	-.44†	-.04	.01	-.08	.01	-.12	-.17	-.03	-.47†	-.21*
2.emotional stress		1	.80†	.51†	.31†	.54†	.41†	-.06	-.27†	-.13	-.44†	-.39†	-.05	-.10	-.17	-.12	-.10	-.09	-.07	-.45†	-.19
3.social stress			1	.45†	.29†	.62†	.44†	-.11	-.27†	-.15	-.49†	-.44†	-.07	-.12	-.13	-.03	-.04	-.07	-.03	-.40†	-.16
4.conflicts/pressure				1	.54†	.41†	.45†	.25*	.02	.06	-.05	-.39†	-.09	-.10	-.04	-.08	.10	.12	.13	-.34†	-.09
5.fatigue					1	.40†	.46†	.18	.20*	.11	.08	-.23*	-.13	-.08	-.02	.01	.22*	.19	.20*	-.25*	-.05
6.lack of energy						1	.47†	-.18	-.27†	-.12	-.39†	-.44†	-.07	-.08	-.09	-.08	-.17	-.20*	-.08	-.45†	-.23*
7.somatic complaints							1	-.04	.01	-.39†	-.23*	-.37†	.00	-.13	-.06	-.02	.04	.03	-.02	-.22*	-.44†
8.success								1	.44†	.38†	.52†	.18	.04	-.14	.04	.00	.57†	.58†	.22*	.26†	.07
9.social relaxation									1	.36†	.73†	.43†	.01	-.14	-.03	-.03	.56†	.54†	.26†	.42†	.17
10.somatic relaxation										1	.51†	.44†	-.01	-.06	.01	-.06	.26†	.33†	.04	.22*	.38†
11.general well-being											1	.47†	.08	-.02	.02	-.06	.43†	.43†	.15	.44†	.23*
12.sleep quality												1	.13	-.09	-.08	-.08	.27†	.30†	.12	.49†	.37†
13.disturbed breaks													1	.14	-.06	.07	.10	.04	.00	.10	.08
14.burnout/emotional exhaustion														1	.33†	.25*	-.14	-.08	.29†	-.05	.06
15.injury															1	.64†	.09	-.01	.38†	.08	.01
16.fitness/being in shape																1	.14	-.02	.43†	-.01	.02
17.personal accomplish																	1	.76†	.50†	.21*	.08
18.self efficacy																		1	.39†	.18	.24*
19.self regulation																			1	.01	.13
FPLE																				1	.17
IKDC																					1

†P < .01.

*P < .05.

Abbreviations: RESTQ-Sports, Recovery Stress Questionnaire for Athletes; FPLE, *Fatores Psicossociais na Lesão Esportiva*; IKDC, International Knee Documentation Committee

The correlation among the instruments realized with participants who obtained a clinically detectable change after treatment showed a lower correlation among the instruments FPLE and RESTQ-Sport, in which only one item had a moderate correlation ($r = .51, P < .01$) with a statistically significant difference among the instruments. No correlation was seen among IKDC and RESTQ-Sport. RESTQ-Sport also obtained reduction in the amount of domains that showed correlation and only one domain showed an adequate correlation ($r = 1.0, P < .01$) with statistically significant differences among the instruments (Table 4).

Table 4. Pearson correlation of instruments using the scores obtained in initial assessment and after treatment (n=40)

RESTQ-Sport	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	FPLE	IKDC
1.general stress	1	.55†	.50†	.09	.14	.14	.42†	-.16	-.18	-.08	-.38*	.08	-.25	-.09	-.25	.26	.22	.29	.03	.51†	.10
2.emotional stress		1	.54†	.29	.33*	.33*	.44†	-.03	-.06	.16	-.53†	-.08	.01	-.09	-.24	.09	.28	.26	-.13	.20	.00
3.social stress			1	.25	.05	.05	.47†	-.12	-.26	-.08	-.40†	-.15	.01	-.11	-.04	.18	.23	.33*	-.01	.17	-.16
4.conflicts/pressure				1	.32*	.32*	.43†	.03	.01	.13	-.35*	-.17	-.10	-.14	-.01	-.23	.02	-.01	.03	.15	.22
5.fatigue					1	1†	.16	-.27	-.43†	.17	-.36*	-.44†	.22	.17	.03	.12	.22	-.14	.35*	.08	.23
6.lack of energy						1	.16	-.27	-.43†	.17	-.36*	-.44†	.22	.17	.03	.12	.22	-.14	.35*	.08	.23
7.somatic complaints							1	-.03	-.18	-.40	-.34*	-.27	-.17	.03	.03	-.02	.24	.37*	.09	.25	-.28
8.success								1	.30	.26	.27	.33*	-.08	-.26	-.07	.07	.24	.37*	-.04	.01	.04
9.social relaxation									1	.31	.38*	.37*	-.07	-.00	.04	.19	-.16	-.01	-.25	-.06	-.16
10.somatic relaxation										1	-.04	.25	-.00	.06	-.16	.27	.18	.13	-.01	.15	.18
11.general well-being											1	.38*	-.08	-.08	.10	-.11	-.27	-.33*	-.07	-.29	-.12
12.sleep quality												1	-.15	-.16	-.04	-.00	.05	.08	-.04	.26	-.00
13.disturbed breaks													1	.15	.52†	.23	.11	.03	.28	-.03	-.08
14.burnout/emotional exhaustion														1	.40†	.28	.07	-.04	.43†	.04	-.28
15.injury															1	.18	-.14	-.07	.22	.05	-.11
16.fitness/being in shape																1	.35*	.37*	.32*	.26	-.04
17.personal accomplish																	1	.65†	.43†	.25	-.18
18.self efficacy																		1	.27	.26	-.12
19.self regulation																			1	.10	-.12
FPLE																				1	.10
IKDC																					1

†P < .01.

*P < .05.

Abbreviations: RESTQ-Sports, Recovery Stress Questionnaire for Athletes; FPLE, *Fatores Psicossociais na Lesão Esportiva*; IKDC, International Knee Documentation Committee

Ceiling and floor effect

This analysis was conducted with the initial evaluation score of instruments. Only 6% reached maximum score and 13% obtained the minimum score. Therefore, these effects were not verified in instruments.

Responsiveness

Responsiveness was evaluated in 40 participants, which corresponds to the sample that obtained a clinically significant difference (difference greater than 7 points in IKDC). In internal responsiveness, most domains of RESTQ-Sport [.90 (-.62 to 2.42) to -11.90 (-14.70 to -9.10)] and IKDC [9.20 (2.84 to 15.56)] showed significant changes after 4 weeks of treatment, while the FPLE [.10 (-.98 to 1.18)] presented a small change. In external responsiveness, there was no correlation between the instruments ($r = .00$ to $.28$) after 4 weeks of treatment, as observed in table 5.

Table 5. Internal and external responsiveness of instruments (n=40)*

Instruments	internal responsiveness	external responsiveness
RESTQ-Sport		
general stress	-.50 (-1.99 to .99)	.10
emotional stress	-.20 (-1.58 to 1.18)	.00
social stress	.90 (-.62 to 2.42)	-.16
conflicts/pressure	-.20 (-1.56 to 1.16)	.22
fatigue	-.40 (-1.88 to 1.08)	.23
lack of energy	-.20 (-1.44 to 1.04)	.23
somatic complaints	-1.30 (-2.57 to -.03)	-.28
success	.40 (-.89 to 1.69)	.04
social relaxation	-.10 (-1.67 to 1.47)	-.16
somatic relaxation	.10 (-1.27 to 1.47)	.18
general well-being	-.60 (-2.00 to 0.80)	-.12
sleep quality	.20 (-1.37 to 1.77)	-.00
disturbed breaks	6.70 (5.59 to 7.81)	-.08
burnout/emotional exhaustion	-5.60 (-7.15 to -4.05)	-.28
injury	7.10 (5.77 to 8.43)	-.11
fitness/being in shape	10.00 (8.68 to 11.32)	-.04
personal accomplish	-1.40 (-3.32 to .52)	-.18
self efficacy	-1.90 (-3.86 to .06)	-.12
self regulation	-11.90 (-14.70 to -9.10)	-.12
FPLE	.10 (-.98 to 1.18)	.10
IKDC	9.20 (2.84 to 15.56)	NA

Abbreviations: RESTQ-Sports, Recovery Stress Questionnaire for Athletes; FPLE, *Fatores Psicossociais na Lesão Esportiva*; IKDC, International Knee Documentation Committee; NA, not applied.

*Values calculated only for the participants who obtained a difference ≥ 7 points in the IKDC.

Discussion

This study developed the FPLE instrument and evaluated the clinometric properties of this instrument, as well as RESTQ-Sport and IKDC. The FPLE instrument obtained favourable evaluations by participants during their development stages to evaluate the proposed outcome, and it also

presented positive results regarding their clinical measurement properties. The RESTQ-Sport and IKDC instruments also presented good clinical measurement properties, although RESTQ-Sport obtained values ranging from poor to moderate in respect to reproducibility.

The internal consistency of the FPLE instrument was considered adequate. Most domains of RESTQ-Sport also obtained an internal consistency considered adequate, as observed in another study (Cronbach's alpha of .58 to .85) (Costa and Samulski, 2005). The IKDC instrument scored an adequate internal consistency, as seen previously in original English version (Cronbach's alpha from .92) (Irrgang et al., 2001), Brazilian version (Cronbach's alpha from .92 to .93) (Metsavaht et al., 2010), Chinese version (Cronbach's alpha from .97) (Fu and Chan, 2011), Korean version (Cronbach's alpha from .91) (Kim et al., 2013), Turkish version (Cronbach's alpha from .89) (Çelik et al., 2014), Iranian version (Cronbach's alpha from .84) (Ebrahimzadeh et al., 2014) and Greek version (Cronbach's alpha from .87) (Koumantakis et al., 2015).

To evaluate the reproducibility of the instruments, the first and second measures were used, being that the second measure was done after only 24 to 48 hours to minimize participants' clinical and psychosocial changes. The FPLE instrument obtained an adequate reproducibility, as well as the IKDC, as previously observed in other studies $ICC_{2,1} = .98$ (Metsavaht et al., 2010), $ICC_{2,1} = .87$ (Fu and Chan, 2011), $ICC_{2,1} = .91$ (Çelik et al., 2014) and $ICC_{2,1} = .95$ (Irrgang et al., 2001 and Koumantakis et al., 2015). RESTQ-Sport, on the other hand, did not obtain satisfactory results for reproducibility, because most domains showed poor-to-moderate reliability and doubtful-to-negative agreement; however, it was not possible to correlate this property with other studies for it had not been evaluated previously. It is believed that this occurred due to the instrument outcome (the current stress state and recovery activities associated) having no significant changes in 24 to 48 hours; moreover, the instrument requests that participants remember their last 3 days/nights to answer.

The construct validity analysis indicated that the instruments were satisfactory to evaluate the proposed outcomes. In the first evaluation, the RESTQ-Sport instrument presented a moderate correlation with the FPLE and IKDC instruments. However, there was no correlation between the social support assessed through the FPLE with the self-reported function of the knee measured through the IKDC, and it is implied that this occurred due to the difference in outcomes evaluated by the instruments. It is possible to observe that there is an inversely proportional correlation among the three domains of "stress" of RESTQ-Sport with the FPLE instrument, while the domains of "social relaxation", "general well-being" and "quality sleep" show a positive correlation with psychosocial aspects (social support) evaluated by the FPLE. This is coherent, since the smaller the social support perceived by the athlete, the greater their level of stress will be, and the greater the social support perceived, the greater their powers of social relaxation, general well-being and quality sleep will be. The results found agree with another study that observed a correlation among the RESTQ-Sport with Profile of Mood States instrument ($r > -.20$ to $.70$, $P < .05$) (Costa and Samulski, 2005). The RESTQ-Sport instrument presented a moderate correlation in the "somatic complaints" domain with the IKDC instrument, which makes sense since this

domain approaches the physical complaints of participants, while the IKDC approaches the musculoskeletal symptoms and disabilities of patients with knee pain. The IKDC showed a correlation with the quality-of-life evaluation instrument of quality life Short Form 36 (SF-36) in different languages, being them Portuguese ($r > .51$, $P =$ not reported) (Metsavaht et al., 2010), Chinese ($r = .64$, $P < .05$) (Fu and Chan, 2011) and Greek ($r = .60$, $P < .001$) (Koumantakis et al., 2015). Beyond the SF-36, the IKDC has good correlation with Lysholm knee score and Kujala Anterior Knee Pain Scale ($r = .64$ and 0.89 respectively, $P < .001$) (Çelik et al., 2014).

In construct validity considering the change of the patients over 4 weeks of treatment, only one domain of RESTQ-Sport had correlation with FPLE. We believe that the proposed period of 4 weeks was not enough to change the stress state and psychosocial aspects of the participants in this study, although it has been seen improvement regarding the symptoms, sports activities, and functional capacity of the knee. None of the instruments in this study presented ceiling or floor effects, as previously seen in the IKDC instrument (Irrgang et al., 2001; Fu and Chan, 2011; Kim et al., 2013; Çelik et al., 2014; Koumantakis et al., 2015; Kanakamedala et al., 2016).

The internal responsiveness of the RESTQ-Sport (most domains) and IKDC instruments showed great change. It can be inferred that this great clinical change may happen since most patients in this study have ligament injuries (38%) which most cases had an exaggerated inflammatory phase initially with a clinical outcome that tends to reduce inflammatory processes over time. The FPLE showed a small change after 4 weeks of treatment. It could be that this lessened change occurred because the social support perceived by the athletes (family, coach, sports colleagues, co-workers/classmates, affective/conjugal relationship and financial situation) will rarely change in 4 weeks, whereas normally these are already established relationships in the personal lives of the athletes. A systematic review evaluated the internal responsiveness of IKDC and also observed acceptable values, as effect size = 1.61 to 2.59, CI = not reported (Çelik et al., 2014), effect size = 1.26, CI = not reported (Koumantakis et al., 2015) and effect size = .76 to 2.11, CI = not reported (Kanakamedala et al., 2016); however, studies that evaluated the responsiveness of RESTQ-Sport were not found.

An external responsiveness was not observed among the evaluated instruments. We suggest that this finding was because the instruments evaluate different outcomes: psychosocial aspects (social support), state of stress, and symptoms and disabilities in athletes with knee injuries after 4 weeks of treatment.

A meta-analysis about the psychosocial factors and sport injuries declared that psychological and sociocultural factors have been raised as potential risk factors for injury being that the stress response was the predictor with strongest associations in injury rates (Ivarsson et al., 2017). As a neurophysiological explanation for this relationship, the prolonged stress can generate changes in the functions of the brain's neurological networks, in which the communication between the left and right cerebral hemispheres may decrease (Ivarsson et al., 2017). This

change could lead to decreased information flow between the brain functions that process affect and cognition that might increase the risk of poor decision-making and to increase injury risk (Ivarsson et al., 2017). Moreover, the stress associated with negative events had the strongest associations with injury rates (Ivarsson et al., 2017). One explanation for this is that negative (or threatening) information is processed more thoroughly and has more severe and long-lasting effects on behaviors than positive information (Ivarsson et al., 2017). Increased emotional reactivity is related to decreased activity in the parts of the brain where attention is processed that it might increase the risk for injuries (Ivarsson et al., 2017).

The present study developed an instrument to be used in clinical and scientific practice to evaluate psychosocial aspects in sports injuries, and evaluated the clinical measurement properties of other instruments already used in practice, but did not have all the clinometric measurement properties measured. As for limitations of this study, we can point out that the majority of the sample was composed of amateur athletes, all types of knee injuries were included (which could contribute to a variable clinical evolution), and it was noted lack of similar studies using the same instruments analysed in this study to compare the results. For future studies, we suggest that the participants should be attended for a period of more than 4 weeks, to verify whether there is a change in the psychosocial aspects and in the state of stress and recovery activities in athletes, and, therefore, if those changes may be related with the functional capacity of the knee.

This study contributes to future studies aimed at evaluating the relationship between psychosocial aspects and sports injuries, and especially so that in clinical practice alterations of social support in athletes can be detected and preserved as soon as possible in order to avoid that become contributing factors to future musculoskeletal injuries.

Conclusion

The FPLE instrument was developed to evaluate psychosocial aspects in athletes and presented properties of clinical measures adequate for their clinical and scientific use, besides being considered a low cost instrument, brief, easy applicability and understanding. The IKDC and RESTQ-Sport instruments also presented adequate properties of clinical measures for the outcomes for which they are proposed to be evaluated.

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