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Cross-cultural adaptation of the Victorian institute of sports assessment - Hamstrings (VISA-H) questionnaire for Spanish speaking athletes with proximal hamstring tendinopathy

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A B S T R A C T

Objective: To cross-culturally adapt and validate the Victorian Institute of Sports Assessment – Hamstrings (VISA-H) scale into Spanish.
Design: Clinical measurement study (psychometric analysis).
Setting: Sports clubs and physiotherapy clinics.
Participants: The Spanish version of the VISA-H (VISA-H-Sp) scale was administered to 101 subjects: 50 healthy runners and 51 patients with a clinical diagnosis of PHT.
Main measures: The Victorian Institute of Sports Assessment – Hamstrings.
Results: Cronbach's alpha for the VISA-H-Sp was >0.8. The ICC $_{2,1}$ was 0.993 (95%CI 0.991–0.995). In the exploratory factor analysis, a one-factor solution explained 72.1% of the total variance. Athletes with PHT scored significantly lower in the VISA-H-Sp than healthy subjects ($P < 0.001$). The VISA-H-Sp score results in the PHT group showed significant correlations with SF-36 physical components (Spearman r'>0.6; $P < 0.001$), and low or non-significant association with psychological dimensions. The standard error of measurement was 1.45 whereas the minimal detectable change was 4.02 points. The responsiveness indicators included an effect size of 2.75, and a standardised response mean of 3.1 at discharge.
Conclusion: The VISA-H-Sp shows adequate psychometric properties for assessing the severity of symptoms in Spanish-speaking athletes who suffer from PHT.

1. Introduction

Proximal hamstring tendinopathy (PHT) is an overuse injury at the attachment of the hamstring muscles on the ischial tuberosity (Pietrzak et al., 2018). It usually affects active people, especially long-distance runners (Fredericson et al., 2005). Its onset is usually insidious, and PHT patients often experience a gradual increase in pain or discomfort in the deep gluteal and posterior thigh regions (Chu & Rho, 2016), exacerbated during sports activities that involved flexion and extension hip movement (i.e. lunging) (Degen, 2019).

The histological appearance of PHT is similar to other chronic tendinopathies, with a failed healing response at the hamstring attachment to the ischial tuberosity (Lempainen et al., 2015). Tendon thickening, hypoechoic regions and paratendinous fluid can be seen throught ultrasound imaging (Chu & Rho, 2016). 'Thickening of the tendons and a distal feathery pattern of the proximal tendons associated with peritendinous edema" is as a reliable sign of PHT at magnetic resonance imaging (MRI) (Lempainen et al., 2015). Other common MRI findings such as increased T1 and T2, increased tendon size, or ischial tuberosity edema are not always associated with symptomatic tendinopathy (De Smet et al., 2012).

In tendinopathy patients, the appearance at imaging does not necessarily correlate with the clinical picture (Arumugam, 2017), and the use of scales that capture the patient's point of view is recommended (Davis & Bryan, 2015; Fischer et al., 1999).

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Based on previous patient-reported outcome measures (PROMs) administered to patients with Achilles and patellar tendinopathy, Cacchio et al. (Cacchio et al., 2014) developed a new self-administered questionnaire called Victorian Institute of Sports Assessment – Hamstrings Tendons (VISA-H) questionnaire. It measures pain, function, and sporting activity in patients with PHT by rating symptoms related to different tendon-load situations and assessing its impact on function and sports participation. To the best of the authors' knowledge, the VISA-H has been cross-culturally adapted only to French (Locquet et al., 2019).

Spanish is the second most commonly language spoken in the world (Instituto Cervantes, 2020). Given the increasing number of patients with PHT, we wished to cross -culturally adapt the VISA-H questionnaire into Spanish and assess its psychometric properties on a sample of athletes with PHT.

2. Methods

2.1. Translation and cross-cultural adaptation

The translation and back-translation process was performed as per international recommendations (Fig. 1) (Beaton et al., 2000).

Firstly, a sports physician and an English translation expert independently translated the VISA-H questionnaire from English to Spanish. A meeting was held between the translators and research team to reach a consensus on the Spanish version.

Second, back translation was independently completed by two native English speakers who were fluent in Spanish and were blinded to the original VISA-H questionnaire: a sports physical therapist and a native English teacher without a medical background. Following this, an expert panel including all the involved translators and research team members drafted this pre-final Spanish version, which was preliminarily tested on a sample of 12 runners with PHT (mean age: 36.2 ± 4.6 years, 7 men) to assess its readability and clarity, and the time needed to fill it in. These athletes continued to participate in the study and were included in the final analyses.

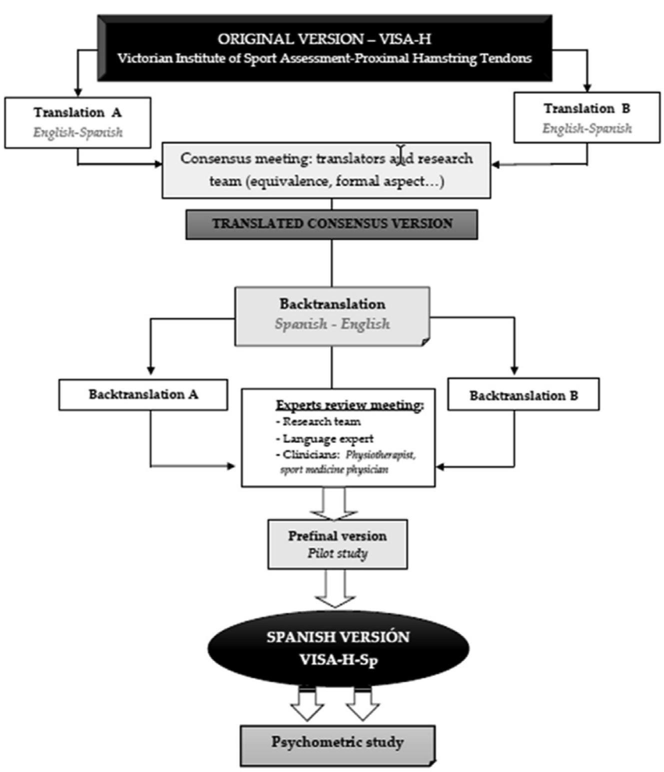

Fig. 1. Flow chart of the VISA-H adaptation process.

Instruments, population, and procedures used in the validation phase are detailed below. The study of the psychometric properties was performed considering the principles of the Consensus-based Standards for the Selection of Health Status Measurement Instruments (COSMIN) recommendations (Mokkink et al., 2016).

2.2. Participants

A convenience sample of 101 physically active subjects comprised of two groups (PHT patients and healthy subjects) was recruited between January 2018 and March 2020.

On the one hand, consecutive patients with a clinical diagnosis of PHT from two physiotherapy clinics specialising in sports injuries were invited to participate in the study. The inclusion criteria were the presence of a clinical diagnosis PHT with tendon changes verified by ultrasound, age over 18 years, and the ability to provide a written informed consent. Patients were diagnosed with PHT when they reported a history of pain in the lower gluteal region for at least three months, tenderness in the ischial tuberosity area, and were positive in at least two of the following pain provocation tests that demonstrate moderate to high validity, sensitivity and specificity for the diagnosis of PHT: Puranen-Orava test, bent-knee stretch test, and modified bent-knee stretch test (Cacchio et al., 2012).

Healthy athletes were recruited from three running clubs in Spain. They practised sport at least three times a week without any symptoms in the lower back, gluteal region back or posterior thigh compatible with the presence of PHT.

Participants were excluded if they had partial hamstring tears, piriformis syndrome, fractures, ischial tuberosity apophysitis, hamstring tendon avulsion, ischioinguinal bursitis, posterior femoral compartment syndrome, referred pain from the low back or lumbar sciatic pain.

2.3. Questionnaires

The VISA-H is a brief disease-specific questionnaire that consists of eight items. Six items rate the pain level on a numeric scale (of 0–10) during different tendon-load conditions. The two final questions ask information about the impairment of the PHT on sports participation using categorical response options. The total score ranges from 0 to 100; the lower scores are associated with more severe symptoms and a worse functional status of the patient with PHT.

Three other questionnaires validated in Spanish were used to assess convergent and divergent validity. The Spanish version of the quality of life short-form 36 questionnaire (SF-36) is a generic measure of health status with 36 items and 8 domains (physical function, physical role, bodily pain, general health, vitality, social function, role emotional, and mental health) and two standardised components (mental and physical) (Alonso et al., 1995). The higher the score, the better the health status. The Lower Limb Functional Index (LLFI) is a lower limb region-specific patient-reported outcome validated in Spanish (Cuesta-Vargas et al., 2014). It comprises a 25-item questionnaire with a 3-point Likert scale of 1 point for "Yes," 0.5 points for "Partly," and 0 points for "No". For scoring, points are added, multiplied by 4, and subtracted from 100 to provide a functional score as a percentage of pre-injury or normal status, from 0% to 100%.

Finally, the Functional Assessment Scale for Acute Hamstring injuries questionnaire (FASH) was applied because is a very similar patient-reported outcome to the VISA-H that consists of 10 items used to assess the functional impact of hamstring muscle tears in athletes (Hernández-Sanchez et al., 2019). Patient's answers are reflected in a 0–10 numerical rating, except for items 2, 9, and 10, which have a categorical rating system with a specific distribution of 10 points. For each item, 10 represents the normal level of physical ability and 0, complete disability. It ranges from 100 to 0 with lower scores indicating greater severity and disability.

2.4. Assessment of psychometric properties

The study protocol was approved by the institutional review board at the Univesity Hospital Virgen Macarena-Virgen del Rocio (12/2018). Before data collection, all the participants read and signed an informed consent form.

Patients with PHT were recruited from two sport physiotherapy clinics specialised in treating running-related injuries. A member of the research team administered the questionnaires at baseline and retest among the healthy group.

2.5. Reliability study

This section discusses the degree of homogeneity in the questionnaire (internal consistency) and the reproducibility of the scores (temporal stability or test-retest reliability). For temporal stability assessment, the VISA-H-Sp questionnaire was re-administered seven days after the baseline assessment to all the participants. In the PHT group, the VISA-H-Sp questionnaire was administered before treatment started to ensure that the clinical status of the patients did not change during this time interval (Stratford, 2004).

Measurement error was also assessed by calculating the standard error of measurement (SEM) and minimum detectable change (MDC) only in the PHT group. The MDC represents the minimal change that a patient has to exhibit on a questionnaire to ensure that the observed changes are real (de Vet et al., 2006). The SEM is an estimate of the expected variation in a set of stable scores, assuming that real change has not occurred. It is a measure of how much measured test scores are spread around a true score. SEM is directly related to questionnaire reliability: the larger the SEM, the lower the test reliability. Both error parameters are meaningful in the validation process because they are in the same units as the target questionnaire.

2.6. Validity study

Construct validity was assessed by studying the factor structure of the VISA-H-Sp questionnaire, using an exploratory approach. To determine the number of factors needed to retain a scree plot, the explained percentage of variance by the factor model, and the pattern of factor loadings were considered (Boateng et al., 2018).

To assess the convergent and divergent validity, correlation coefficients were calculated to check the relationship between the VISA-H-Sp and SF-36 domains and the LLFI and FASH scores at baseline. External validity was tested by comparing VISA-H-Sp scores among groups.

For convergent validity, it was hypothesized a priori that correlations between the scores of the VISA-H-Sp and physical dimensions of the SF-36 (physical functioning, physical role, bodily pain, and standardised physical component) would be higher than those between the VISA-H-Sp score and other domains of the SF-36 (vitality, mental health, emotional, and social role). Further, moderate to high correlations between the VISA-H-Sp scores and LLFI and FASH scores were expected.

2.7. Responsiveness

For the responsiveness assessment, the VISA-H-Sp and the other questionnaires were completed by each participant with PHT at baseline, discharge and at 3-month follow-up to assess changes after physiotherapy intervention. The physiotherapy treatment undertaken by the PHT patients consisted of load management and symptoms reduction techniques. For this relative rest, restriction of the activities or exercises that increase the severity of symptoms, therapeutic exercises (2–3 times per week), and physical therapy sessions including manual therapy, education, and electrotherapeutical analgesic modalities such as percutaneous electrical stimulation, and neuromodulation were carried out (Gómez-Chiguano et al., 2020; Mattiussi & Moreno, 2016; Nasser, 2018). An anchor-based method consisting in a global rating of change (GROC) scale completed by patients was used to assess the perceived change in clinical status at discharge and at 3-month follow-up (Revicki et al., 2008).

2.8. Feasibility

To assess feasibility, the time spent by the subjects in filling out the VISA-H questionnaire was recorded. Ceiling and floor effects were also studied, considering to be present if >15% of the responders achieved the theoretical minimum or maximum possible score (Terwee et al., 2007).

2.9. Statistics

Descriptive statistics were used to describe the characteristics of the participants; means and standard deviation were used for the quantitative variables and frequencies and percentages for the qualitative. The Kolmogorov-Smirnoff test was applied to assess the distribution of VISA-H-Sp scores in the total sample and among the PHT group.

In the reliability study, Cronbach's alpha and type 2,1 intra-class correlation ($ICC_{2,1}$) coefficients with 95% confidence interval (CI) were estimated as indicators of internal consistency and temporal stability (test-retest) respectively. In addition, a Bland and Altman plot was constructed to determine agreement and visualize the potential bias between first and second VISA-H-Sp applications. The mean difference between the first and second measurements with corresponding 95% CI and the 95% limits of agreement is represented.

SEM and MDC were calculated only in the PHT group. The SEM was estimated using the following formula: SD x $\sqrt{(1-R}$, where SD is the standard deviation of the first assessment, and R is the reliability coefficient for the questionnaire. We used the intra-class correlation coefficient ($ICC_{2,1}$ of the PHT group) as recommended by Stradford et al. (Stratford, 2004). The MDC threshold was calculated as 1,96 $\times \sqrt{2} \times$ SEM, where 1.96 is the value associated with the 95% confidence interval and $\sqrt{2}$ accounts the error associated with taking 2 measurements.

For validity, the factor structure of the VISA-H-Sp was studied using an exploratory factor analysis (EFA) approach. Principal component analysis with Varimax rotation was conducted with the participants' baseline VISA-H-Sp scores using maximum likelihood extraction (Williams et al., 2010). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was set at 0.7–1.0 to indicate adequate sampling and the Barlett Test of Sphericity significance level was $p < 0.001$ indicating that the EFA could be used for the data analysis. Three a priori requirements were set for factor extraction: scree plot point of inflection at the second eigenvalue, eigenvalue cutoff >1.0 and $\geq$ 10% variance (Williams et al., 2010).

Between-groups differences in the VISA-H-Sp scores at baseline were analysed using the U-Mann Withney test. One-way repeated-measures ANOVA was conducted to identify differences in the VISA-H-Sp scores between time points. Statistical significance was set at $p < 0.05$. Correlation of the VISA-H-Sp scores with the SF-36 domains, LLFI, and FASH scores at baseline was calculated using Spearman *rho* (r_s).

The effect size (ES) and standardised response mean (SRM) statistics were calculated as distribution-based responsiveness indicators and interpreted using Cohen's thresholds (Cohen, 1988). The ES was calculated as a mean VISA-H-Sp change divided by the standard deviation of the baseline assessment, and standardised response mean (SRM) as the mean VISA-H-Sp change divided by the standard deviation of the change score.

Following the conclusions of the IMMPACT initiative expert panel for interpreting clinical importance of the treatment outcome in chronic pain clinical trials, a 30% improvement in scores, relative to baseline could be considered a clinically meaningful improvement when using a patient reported outcome measure (Dworkin et al., 2008). This percentage from PHT group baseline score was calculated.

For the sample size estimation the reliability study (ICC hypothesis testing) was considered. For an alpha of 0.01, statistical power of 0.80, lower limit $\rho_{(0)} = 0.7$, upper limit $\rho_{(1)} = 0.9$, an expected $ICC_{2,1}$ of 0.90 and 15% drop-out rate, a total sample of 100 subjects was required. All statistical analyses were performed with IBM Statistical Package for the Social Sciences version 25 (Chicago, IL, USA).

3. Results

The characteristics of the participants are presented in Table 1. The mean duration of symptoms in PHT patients was 7.2 ± 4.3 months. The right side was affected in 51% (n = 26) of the patients, and the dominant side in 90% of the participants. In the PHT group, 74.5% (n = 38) were mid and long-distance runners, and 25.5% (n = 13) were triathletes.

3.1. Translation

No difficulties were reported during the translation process. As in the Spanish VISA Achilles and patellar cross-culturally adapted versions, the pain intensity numbered scale was inserted in boxes in increasing order, and the corresponding points out of the response boxes to avoid misinterpretation since in the original presentation the term “strong severe pain” corresponds to the number 0, which was cognitively contradictory for patients in the pilot study. The final version of the VISA-H-Sp can be found as a Supplemental file.

3.2. Reliability

For internal consistency, Cronbach's alpha was 0.88 for the baseline assessment. Calculating Cronbach's alpha by subtracting single items revealed no significant changes in the overall Cronbach's alpha coefficient, indicating no item redundancy. For the test-retest, $ICC_{2,1}$ was 0.995, 95%CI 0.993–0.997, $p < 0.001$. In the individual item analysis, all the calculated ICCs values were between 0.86 and 0.99. Considering only the PHT group, the $ICC_{2,1}$ was 0.993 (95%CI 0.987–0.996, $P < 0.001$). The Bland-Altman plot showed a high level of agreement between the two applications (mean difference, 0.43 points; 95% CI, −0.25 to 1.12) (Fig. 2). The values for SEM and $MDC_{95\%}$ at the patients' individual were 1.45 and 4.02 points respectively.

Table 1
Descriptive characteristics and VISA-H-Sp SCORES in the study population.

	HEALTHY (n = 50)	PTH (n = 51)
Age	38.8 ± 9.2	39.8 ± 9.3
Gender (Men/Women)	27/23	32/19
Body Mass Index (kg/m^2)	22.8 ± 2.5	23.3 ± 1.8
Days training/week	3.3 ± 0.9	3.6 ± 0.5
Hours training/day	2.2 ± 0.5	2.3 ± 0.7
Baseline VISA-H-Sp	96.7 ± 4.7	50.2 ± 14.5
Retest VISA-H-Sp	96.9 ± 3.5	50.8 ± 14.4
SF-36 MCS	40.9 ± 9.8	37.6 ± 7.3
SF-36 PCS	53.7 ± 4.6	46.9 ± 5.7
FASH-Sp (n = 11)	NA	52.2 ± 13.1

3.3. Validity

3.3.1. Factor analysis

The KMO value was 0.892 with a significant Bartlett's sphericity test result ($P < 0.001$). The EFA indicated the existence of a single factor structure, explaining 72.1% of the variance. This was a unique factor, with an Eigen value greater than one. The scree plot shows a clear inflection point from the first factor (Fig. 3). Factor loadings are shown in Table 2.

3.4. Criterion-related

The mean VISA-H scores for each group are shown in Table 1. The VISA-H-Sp scores for the entire sample exhibited asymmetric distribution ($Z_{K\text{-}S} = 0.21$; $p < 0.001$). However, the scores in the PHT group showed a normal distribution ($Z_{K\text{-}S} = 0.11$; $p > 0.05$). The differences between the VISA-H-Sp scores of the PHT and healthy groups was statistically significant (51.02 points; $p < 0.001$).

Convergent and divergent validity were assessed only for the PHT group. A moderate and statistically significant association between the VISA-H-Sp score and the following SF-36 domains was found at baseline: physical function ($r_s = 0.53$; $p < 0.001$), physical role ($r_s = 0.48$; $p < 0.001$), bodily pain ($r_s = 0.53$; $p < 0.001$) and standardised physical component ($r_s = 0.52$; $p < 0.001$). However, the VISA-H-Sp score did not show significant correlation with general health ($r_s = 0.14$; $p > 0.05$), vitality ($r_s = 0.01$; $p > 0.05$), social functioning ($r_s = 0.01$; $p > 0.05$), mental health ($r_s = 0.15$; $P > 0.05$) or the standardised mental component ($r_s = 0.21$; $p > 0.05$). The correlation with role emotional was weak ($r_s = 0.38$; $p < 0.05$). The correlation between the VISA-H-Sp and LLFI scores at baseline was weak ($r_s = 0.35$; $p < 0.05$). Regarding the analysis of the subgroup with the FASH scale, a correlation with FASH-Sp of 0.773 $p < 0.001$ was obtained.

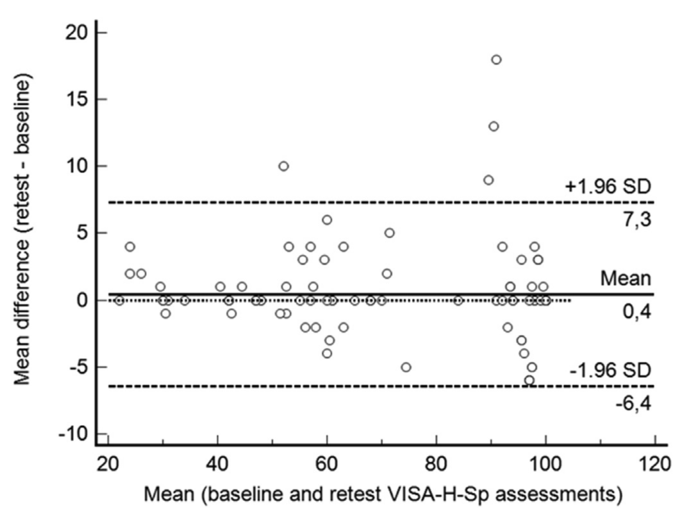

Fig. 2. Bland-Altman plot.

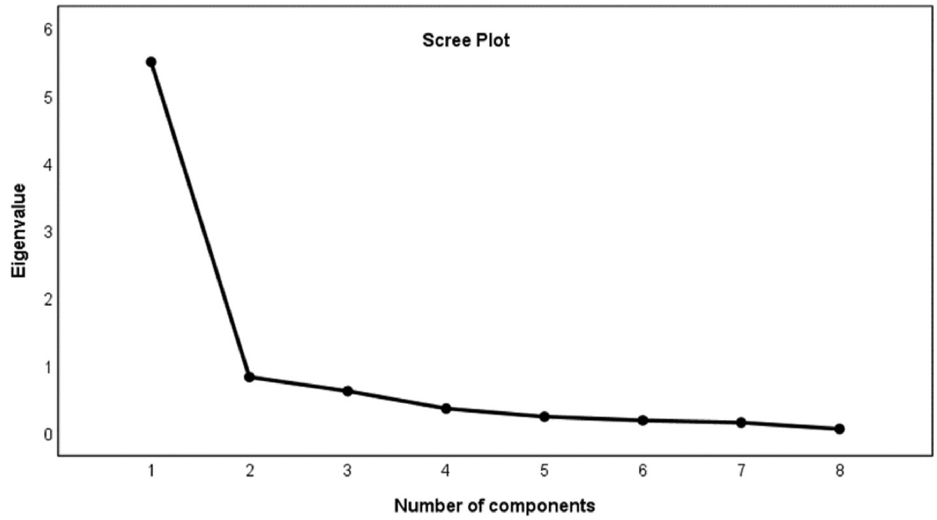

Fig. 3. Scree plot for exploratory factor analysis.

Table 2
Factor loadings for the one-factor solution obtained in the exploratory factor analysis.

VISA-H scale items	Component 1
1. For how many minutes can you sit/can your drive a car pain free?	0.636
2. How much pain do you have during or immediately after stretching your posterior thigh/hamstring (keeping knee straight)?	0.873
3. How much pain do you have during or immediately after normal running?	0.910
4. How much pain do you have during or immediately after sprinting?	0.948
5. How much pain do you have during or immediately after a full weight-bearing lunge?	0.741
6. How much pain do you have during or immediately after lifting an object from the floor (keeping knee straight)?	0.852
7. Are you currently undertaking sport or other physical activity?	0.748
8. For how long can you manage being train/physically active?	0.882

PHT, proximal hamstring tendinopathy; SF-36, general health short form questionarire; FASH, functional assessment scale for hamstring injury; LLFI, lower limb functional index; GROC, global rating of change scale.

3.5. Responsiveness

Outcome scores from the five scales at discharge and 3-month follow-up for the PHT group are shown in Table 3.

The mean change in the VISA-H-Sp score for the PHT group between baseline and at discharge assessments was 39.2 ± 14.8 points ($p < 0.001$; 95% CI: 39.9–43.6). At discharge, ES was 2.75 and SRM 3.1. At 3-month of follow-up, compared to discharge, the mean VISA-H-Sp change was 7.6 ± 5.1 points ($P < 0.001$; 95% CI: 6.2–9.1), with an ES of 1.51 and SRM of 0.59. A 30% change from the baseline VISA-H-Sp score corresponded to 15 points.

At discharge, 30% of the PHT athletes (n = 15) rated ther condition on GROC as ‘moderately better’ (+4) and 23 (46%) as ‘quite a bit better’ (+5). At the 3- month follow-up almost every participant reported a score of 5–6 (22% and 76% respectively) on the GROC scale.

3.6. Feasibility

The participants in the study took less than 5 min to complete the VISA-H-Sp questionnaire. No patient with PHT achieved the highest or lowest possible score on the questionnaire. By item, no patient obtained a maximum or minimum score within more than 75% of the population. Therefore, there was no floor or ceiling effect. No items were missed when answering the questionnaire.

Table 3
SF-36, LLFI, FASH and VISA-H scores for the PHT group at discharge and at 3 months follow-up.

	Discharge	3-month follow-up
VISA-H-Sp	90.1 ± 5.1	97.8 ± 1.9
FASH (n = 11)	85.5 ± 6.5	96.9 ± 3.7
LLFI	1.9 ± 1.1	0.5 ± 0.5
GROC	4.9 ± 0.9	6.7 ± 0.5
SF-36		
Physical functioning	71.4 ± 15.9	98.1 ± 3.5
Body Pain	50.1 ± 18.5	84.4 ± 18.1
Vitality	61.7 ± 24.1	77.8 ± 14.7
Emotional Role	20.5 ± 7.9	23.7 ± 4.6
Physical Role	12.5 ± 10.6	21.2 ± 4.7
Social functioning	87.7 ± 22.6	93.5 ± 11.4
Mental health	68.7 ± 13.1	79.2 ± 16.1
General health	69.8 ± 20.1	77.6 ± 17.2
Physical component summary	41.5 ± 7.0	52.2 ± 3.5
Mental component summary	40.8 ± 9.7	42.5 ± 6.2

4. Discussion

The use of PROMs in clinical practice is considered a relevant element in the analysis of results (Davis & Bryan, 2015). Therefore, the VISA-H was cross-culturally adaptated to Spanish, using the recommended systematic process to ensured the conceptual equivalence of the scale items. The main psychometric properties (validity, reliability and responsiveness) were studied and found to be strong, supporting the use of this new adapted version to assess the functional impact of PHT from the patient's point of view. Its use in combination with new tools that reflects the patient's perceptions and expectations along the recovery process is valuable to complete the athlete subjective assessment related to the status and outcomes after injury and clinical intervention (Piedade et al., 2021).

Regarding the sample of the present study, runners were recruited mainly in the PHT group, given the higher incidence of PHT in this sport (Chu & Rho, 2016). Running places the hamstrings at risk for injury, especially in mountain races (Fredericson et al., 2005). The age of the participants in the current study was significantly higher than that of the PHT patients in the other versions (23.7 and 32 years for the English and French versions, respectively).

Scientific evidence about different therapeutic interventions for PHT is currently unclear (Nasser, 2018; Piedade et al., 2021). The VISA-H scale can contribute to this aspect by monitoring changes in the severity of symptoms and their impact on the athlete's function and sport participation. For example, compressive actions (hip flexion) and energy storage loads place high demands on the proximal hamstring tendon (Schache et al., 2012). In this sense, items 2 to 6 of the VISA-H scale specifically assess the impact of this injury on the ability of the tendon, and on the function of the lower limb to perform a sporting actions.

4.1. Reliability

The indicators of reliability for the VISA-H-Sp scores were high and well supported, matching those reported by the French and English versions. Chronbach's alpha was high, but did not reach the 0.95 threshold, wich is indicative of item redundancy (Copeland et al., 2008).

Measurement error is the systematic and random error of a patient's score which is not attributed to true changes in the measured construct (Stratford, 2004). The SEM threshold for VISA-H-Sp was slightly higher than those reported in the original version for non-surgical patients (1.88 points vs 1.35 points). Using the SEM reported by Cacchio et al. (Cacchio et al., 2014) the $MDC_{95\%}$ threshold for the original VISA-H was calculated, resulting in 4.32 points. For both SEM and MDC the values obtained in the Spanish version are similar to those reported in the original version. These parameters, expressed in the same units as the global score, are necessary to determine the minimal change that a patient should obtain on the scale to ensure that a real change between repeated measurements has occurred and that it is not just a measurement error (de Vet et al., 2006).

4.2. Validity

The factorial validity of the VISA-H-Sp scale was confirmed by the strong support for the 1-factor solution and by the lack of improvement resulting from the 2-factor solution. This unidimensional model explains 72.1% of the variance, meeting all three a priori criteria and supporting its original use as a single summated score. When a patient-reported outcome is used with a single summated score, unidimensionality is critical, and a one-factor solution must support the items which measure the underlying construct (Doward & McKenna, 2004). In this case, the final score of the VISA-H-Sp reflects the construct ‘severity of symptoms’, providing information about the impact of the PHT symptoms on the function and sport participation of patients.

This result differs from that of the original version (Cacchio et al., 2014), in which a two-factor solution using EFA (73.4% of the total variance explanation) was obtained. This is controversial, and differences in the factorial structure of the VISA-H have previously been detected in other studies with VISA scales, such as the VISA-A (Hernández-Sánchez et al., 2018). In the case of two factors, a second factor with only two items seems be examined in detail, since it can compromise the variability of the items within the same factor (Williams et al., 2010). The existence of two subscales in such a case should produce a specific score for each of them, and then a composite score. However, currently, only the VISA-H total score is used. Therefore, the present findings support the presence of construct validity, and that the single score obtained by adding points of each question can be used to rate the severity of symptoms.

Regarding convergent validity, the a priori hypotheses were confirmed, since the VISA-H-Sp scores showed evidence of a statistically significant positive association with the physical components of the SF-36 questionnaire, as in the French version (physical function, body pain and physical role). Evidence of a statistically significant positive association was also found between the VISA-H-Sp score and FASH-Sp, which measure functional impairment of hamstring muscle injury, further confirming the expected convergence: this reinforces the criterion validity.

On the contrary, and again as in the French version, the VISA-H-Sp scores show no evidence of an association with psychological or social dimensions of the SF-36, such as mental health, social function or vitality (r Spearman <0.3, $p > 0.05$), which is an indication of divergent validity. Unlike the original version, we used neither the Nirschl phase rating scale nor the generic tendon grading system proposed by Curwin and Stanish, since there are no Spanish versions of these scales, and because the SF-36 is considered a gold standard for general health assessment (Alonso et al., 1995). The athletes with PHT scored significantly lower than the healthy ones in the VISA-H-Sp, indicating correct discriminant validity.

The known group's validity was also confirmed by verification of the expected differences between the two groups (healthy vs PHT). However, the VISA-H, as the other VISA scales, cannot and should not be considered a diagnostic tool (Cacchio et al., 2014).

4.3. Responsiveness

Distribution-based statistic such a ES and SRM show values of correct sensitivity, very similar to those of the original version. The large effect size (>0.8) indicates that the VISA-H-Sp can detect changes in the severity of symptoms among patients who suffer from PHT at two different moments of the clinical course. These indicators were not reported in the French version.

However, distribution-based statistics do not provide an indicator that is transferable to clinical practice (Dworkin et al., 2008). In the present version, an anchor-based responsiveness analysis using receiver operating characteristic (ROC) curves was not performed because of methodological issues associated to the sample size. An estimated significant clinical change corresponding to 30% of baseline VISA-H-Sp score resulted in 15 points. This was slightly lower than the minimum clinically significant change threshold reported by Cacchio et al. (Cacchio et al., 2014) of 22 points, with an associated sensitivity and specificity of 0.91 (95% CI, 0.61–0.98) and 0.87 (95% CI 0.48–0.96), respectively. These thresholds can provide useful information to assess the efficacy of treatments (de Vet et al., 2006), but future studies with large and different samples are required.

4.4. Feasibility

The VISA-H-Sp was completed by each of the participants in less than 5 min. An instrument that does not require too much time and is simple to score is more likely to be used in clinical practice or research environment (Copeland et al., 2008). Smart phones and electronic tablets have overcame the limitations of the paper format (Schwartzberg, 2016). Given automatic scoring and various options for the analysis, management and storage of data implementation of such technology in administering the VISA-H scale can facilitate its use in clinical and research setting (Teixeira Neto et al., 2018).

4.5. Limitations

Some limitations should be considered when interpreting the results of the present investigation. First, patients schedules for surgery were not included as in the present study, as indeed they were not in the original article. Conservative treatment with therapeutic exercise of the hamstrings and synergist kinetic chain is usually employed (Nasser et al., 2020), with surgery reserved for patients with long standing recalcitrant condition (Degen, 2019). Thus, patients on the waiting list for surgery were not accessed for the present study. Second, dimensionality was assessed using an exploratory approach. Confirmatory factor analysis and a larger sample size should be used in future studies to confirm the hypothesized unidimensionality of the scale and the relationship between the construct and the items (Santor et al., 2011).

5. Conclusion

The Spanish version of the VISA-H showed adequate values for reliability, validity and responsiveness in the psychometric assessment. VISA-H-Sp is an appropriate tool to assess the severity of symptoms and the effectiveness of clinical interventions among athletes with PHT.

The VISA-H-Sp is a user-friendly, easy-to-understand and quick patient-reported outcome measure for evaluating the impact of PHT on the self-perceived functional capacity of the Spanish-speaking runners.

Declaration of interest

The Authors declare that there is no conflict of interest.

Ethical approval

The study protocol was approved by the institutional review board at the Univesity Hospital Virgen Macarena-Virgen del Rocio (12/2018). Before data collection, all the participants read and signed an informed consent form.

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Data availability statement

The authors confirm that the data supporting the findings of this study are available within supplementary materials.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ptsp.2021.06.009.

References

Alonso, J., Prieto, L., & Antó, J. M. (1995). The Spanish version of the SF-36 health survey (the SF-36 health questionnaire): An instrument for measuring clinical results. *Medical Clinics of North America, 104*(20), 771–776.

Arumugam, A. (2017). Clinical versus radiological findings: A paradox in diagnosing minor hamstring injuries. *International Journal of Osteopathic Medicine, 27*, 52–56. https://doi.org/10.1016/j.ijosm.2017.11.004

Beaton, D. E., Bombardier, C., Guillemin, F., et al. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine, 25*(24), 3186–3191. https://doi.org/10.1097/00007632-200012150-00014

Boateng, G. O., Neilands, T. B., Frongillo, E. A., et al. (2018). Best practices for developing and validating scales for health, social, and behavioral research: A primer. *Front Public Health, 6*, 149.

Cacchio, A., Borra, F., Severini, G., et al. (2012). Reliability and validity of three pain provocation tests used for the diagnosis of chronic proximal hamstring tendinopathy. *British Journal of Sports Medicine, 46*(12), 883–887. https://doi.org/10.1136/bjsports-2011-090325

Cacchio, A., De Paulis, F., & Maffulli, N. (2014). Development and validation of a new VISA Questionnaire (VISA-H) for patients with proximal hamstring tendinopathy. *British Journal of Sports Medicine, 48*(6), 448–452.

Instituto Cervantes. (2020). Annual report. Available at https://cvc.cervantes.es/lengua/anuario/anuario_20/. (Accessed 20 December 2020).

Chu, S. K., & Rho, M. E. (2016). Hamstring injuries in the athlete: Diagnosis, treatment, and return to play. *Current Sports Medicine Reports, 15*(3), 184–190. https://doi.org/10.1249/JSR.0000000000000264

Cohen, J. E. (1988). *Statistical power analysis for the behavioral Sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Copeland, J. M., Taylor, W. J., & Dean, S. G. (2008). Factors influencing the use of outcome measures for patients with low back pain: A survey of New Zealand physical therapists. *Physical Therapy, 88*(12), 1492–1505.

Cuesta-Vargas, A. I., Gabel, C. P., & Bennett, P. (2014). Cross cultural adaptation and validation of a Spanish version of the lower limb functional index. *Health and Quality of Life Outcomes, 12*, 75. https://doi.org/10.1186/1477-7525-12-75

Davis, J. C., & Bryan, S. (2015). Patient Reported Outcome Measures (PROMs) have arrived in sports and exercise medicine: Why do they matter? *British Journal of Sports Medicine, 49*, 1545–1546. https://doi.org/10.1136/bjsports-2014-093707

De Smet, A. A., Blankenbaker, D. G., Alsheik, N. H., et al. (2012). MRI appearance of the proximal hamstring tendons in patients with and without symptomatic proximal hamstring tendinopathy. *American Journal of Roentgenology, 198*, 418–422.

Degen, R. M. (2019). Proximal hamstring injuries: Management of tendinopathy and avulsion injuries. *Curr Rev Musculoskelet Med, 12*(2), 138–146. https://doi.org/10.1007/s12178-019-09541-x

Doward, L. C., & McKenna, S. P. (2004). Defining patient-reported outcomes. *Value in Health, 7*(Suppl 1), S4–S8. https://doi.org/10.1111/j.1524-4733.2004.7s102.x

Dworkin, R. H., Turk, D. C., Wyrwich, K. W., et al. (2008). Interpreting the clinical importance of treatment outcomes in chronic pain clinical trials: IMMPACT recommendations. *The Journal of Pain, 9*(2), 105–121. https://doi.org/10.1016/j.jpain.2007.09.005

Fischer, D., Stewart, A. L., Bloch, D. A., et al. (1999). Capturing the patient's view of change as a clinical outcome measure. *Journal of the American Medical Association, 282*, 1157–1162.

Fredericson, M., Moore, W., Guillet, M., et al. (2005). High hamstring tendinopathy in runners: Meeting the challenges of diagnosis, treatment, and rehabilitation. *Phys Sportsmed, 33*(5), 32–43. https://doi.org/10.3810/psm.2005.05.89

Gómez-Chiguano, G. F., Navarro-Santana, M. J., Cleland, J. A., et al. (2020). Effectiveness of ultrasound-guided percutaneous electrolysis for musculoskeletal pain: A systematic review and meta-analysis. *Pain Medicine, 6*, pnaa342. https://doi.org/10.1093/pm/pnaa342

Hernández-Sanchez, S., Korakakis, V., Malliaropoulos, N., et al. (2019). Validation study of the functional assessment scale for Acute hamstring injuries in Spanish professional soccer players. *Clinical Rehabilitation, 33*(4), 711–723. https://doi.org/10.1177/0269215518815540

Hernández-Sánchez, S., Poveda-Pagán, E. J., Alakhdar-Mohmara, Y., et al. (2018). Cross-cultural adaptation of the victorian Institute of sport assessment-achilles (VISA-A) questionnaire for Spanish athletes with Achilles tendinopathy. *Journal of Orthopaedic & Sports Physical Therapy, 48*(2), 111–120. https://doi.org/10.2519/jospt.2018.7402

Lempainen, L., Johansson, K., Banke, I. J., et al. (2015). Expert opinion: Diagnosis and treatment of proximal hamstring tendinopathy. *MTLJ, 5*(1), 23–28.

Locquet, M., Bornheim, S., Colas, L., et al. (2019). French translation of the victorian Institute of sport assessment scale for proximal hamstring tendinopathy (VISA-H). *Journal de Traumatologie du Sport, 36*(4), 217–221.

Mattiussi, G., & Moreno, C. (2016). Treatment of proximal hamstring tendinopathy-related sciatic nerve entrapment: Presentation of an ultrasound-guided intratissue percutaneous electrolysis application. *MLTJ, 6*(2), 248–252. https://doi.org/10.11138/mltj/2016.6.2.248

Mokkink, L. B., Prinsen, C. A., Bouter, L. M., et al. (2016). The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) and how to select an outcome measurement instrument. *Brazilian Journal of Physical Therapy, 20*(2), 105–113. https://doi.org/10.1590/bjpt-rbf.2014.0143

Nasser, A. (2018). Proximal hamstring tendinopathy: A systematic review of interventions. *Journal of Science and Medicine in Sport, 21*, S96–S97. https://doi.org/10.1016/j.jsams.2018.09.219

Nasser, A. M., Pizzari, T., Grimaldi, A., et al. (2020). Proximal hamstring tendinopathy; expert physiotherapists' perspectives on diagnosis, management and prevention. *Physical Therapy in Sport, 48*, 67–75. https://doi.org/10.1016/j.ptsp.2020.12.008

Piedade, S. R., Hutchinson, M. R., Ferreira, D. M., et al. (2021). Validation and implementation of 4-domain patient-reported outcome measures (PROMs) tailored for orthopedic sports medicine. *Int J Sports Med*. https://doi.org/10.1055/a-1327-2970. Online ahead of print.

Pietrzak, J. R., Kayani, B., Tahmassebi, J., et al. (2018). Proximal hamstring tendinopathy: Pathophysiology, diagnosis and treatment. *British Journal of Hospital Medicine, 79*(7), 389–394. https://doi.org/10.12968/hmed.2018.79.7.389

Revicki, D., Hays, R. D., Cella, D., & Sloan, J. (2008). Recommended methods for determining responsiveness and minimally important differences for patient-reported outcomes. *Journal of Clinical Epidemiology, 61*(2), 102–109. https://doi.org/10.1016/j.jclinepi.2007.03.012

Santor, D. A., Haggerty, J. L., Lévesque, J. F., et al. (2011). An overview of confirmatory factor analysis and item response analysis applied to instruments to evaluate primary healthcare. *Health Policy, 7*, 79–92.

Schache, A. G., Dorn, T. W., Blanch, P. D., et al. (2012). Mechanics of the human hamstring muscles during sprinting. *Medicine & Science in Sports & Exercise, 44*(4), 647–658. https://doi.org/10.1249/MSS.0b013e318236a3d2

Schwartzberg, L. (2016). Electronic patient-reported outcomes: The time is ripe for integration into patient care and clinical research. *Am Soc Clin Oncol Educ Book, 35*, e89–e96. https://doi.org/10.1200/EDBK_158749

Stratford, P. W. (2004). Getting more from the literature: Estimating the standard error of measurement from reliability studies. *Physiotherapie Canada, 56*, 27–30.

Teixeira Neto, N. C., Lima, Y. L., Almeida, G. P. L., et al. (2018). Physiotherapy questionnaires app to deliver main musculoskeletal assessment questionnaires: Development and validation study. *JMIR Rehabil Assist Technol, 5*(1), e1.

Terwee, C. B., Bot, S. D., de Boer, M. R., et al. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology, 60*(1), 34–42. https://doi.org/10.1016/j.jclinepi.2006.03.012

de Vet, H. C., Terwee, C. B., Ostelo, R. W., et al. (2006). Minimal changes in health status questionnaires: Distinction between minimally detectable change and minimally important change. *Health and Quality of Life Outcomes, 4*, 54. https://doi.org/10.1186/1477-7525-4-54

Williams, B., Brown, T., & Onsman, A. (2010). Exploratory factor analysis: A five-step guide for novices. *JPHCE, 8*(3), 1–13.