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Validity and Reliability of the Modified Persian Version of the iHOT-12 Questionnaire in Iranian Professional Soccer Players with Chronic Groin Pain

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Abstract

Background: The iHOT-12 questionnaire is designed to evaluate pelvic pain in various populations. This study aimed to translate and validate the Persian version of the iHOT-12 questionnaire for assessing chronic groin pain in Iranian professional soccer players, while also evaluating its validity and reliability.

Methods: This study was conducted on 809 Iranian professional soccer players who were referred to the Iranian National Football Center (IFMARC) between April 2022 and April 2024. The measurement error was assessed by calculating the Smallest Detectable Change (SDC), which helps determine the smallest amount of change that can be reliably detected by the questionnaire. Reliability was evaluated using the Intraclass Correlation Coefficient (ICC) through the test-retest analysis conducted two weeks apart in 86 athletes, and internal consistency was measured using Cronbach's alpha. Structural validity was assessed using a principal factor analysis.

Results: The ICC, calculated using Cronbach's alpha, was 0.7 (95% CI). Repeatability was excellent, with a score of 0.99. The standard error of measurement was 0.83 (8.9%), and the SDC was 2.3 (24.8%). Factor analysis confirmed the structural validity of the questionnaire.

Conclusion: The modified Persian version of the iHOT-12 questionnaire demonstrated acceptable validity and reliability for assessing chronic groin pain in professional soccer players.

Keywords: Factor analysis, Groin, Humans, Iran, Pelvic pain, Reproducibility of results, Soccer, Surveys and questionnaires, Statistical

Introduction

Groin pain is a prevalent issue in multidirectional team sports such as football, ice hockey, and rugby (1), accounting for 8 to 18% of all injuries in soccer players (2). This condition can significantly impair an athlete's professional career, disrupt their performance in both athletic and daily activities, and lead to financial losses for both the athlete and their club (3). The pain typically arises from injuries to the muscles and other structures in the groin area. However, the lack of clear and uniform terminology to classify underlying pathologies (4), combined with the complexity of identifying the exact source of pain, makes groin pain a challenging and ambiguous issue to address (5).

Given the importance of timely diagnosis, various questionnaires have been developed worldwide as tools for the rapid screening of groin pain among both the general and athletic populations (6). Some of these questionnaires, such as the iHOT-33 (International Hip Outcome Tool 33-questionnaire) and HAGOS (The Copenhagen Hip and Groin Outcome Score), have been evaluated for their reliability and validity (7). These tools aim to diagnose chronic groin pain and predict the recurrence of injuries during the sport-specific training and team competitions.

A study published in the Journal of Patient-Reported Outcomes by Stasi *et al* evaluated 124 patients using the iHOT-12 (International Hip Outcome Tool 12-questionnaire). The study concluded that the iHOT-12 is a reliable and valid tool for assessing groin pain and can also be effectively applied to other single-joint evaluations (8). The iHOT-12 has also been validated in Turkey, demonstrating its reliability and validity for assessing outcomes related to hip and groin pain (9).

In Iran, only the HAGOS questionnaire has been validated for assessing groin pain, showing high reliability and validity (10). The iHOT-12, compared to the iHOT-33, reduces the number of questions while maintaining a similar completion process. The questionnaire addresses the presence of groin pain, its exacerbation due to mechanical activities, sports, and lifting objects, as well as athletes' concerns about the impact of pain on their lives and their awareness of their hip health status. Each item is rated on a Visual Analog Scale (VAS) ranging from 0 (least) to 10 (most).

Given the high prevalence of groin pain among Iranian soccer players and the regular pre-season examinations conducted annually, there is a need for a valid and reliable tool for rapid diagnosis. The crowded examination settings, limited time allocated for groin assessments, and the need for athlete cooperation in completing forms were the primary reasons for evaluating a shorter version of a questionnaire in terms of reliability and validity. The iHOT-12 was selected for this purpose, as it is a concise and valuable version of the iHOT-33. This study aims to evaluate the reliability and validity of the iHOT-12 among professional soccer players in Iran, providing a suitable and rapid solution for diagnosing chronic groin pain during periodic pre-season examinations. Additionally, the study seeks to identify potential predictors for an increased risk of re-injury during the season, with the goal of minimizing the negative impact on players, their families, and their teams.

Materials and Methods

This research was a cross-sectional study conducted on male professional soccer players in Iran who are Persian-speaking. The study took place at the Iranian National Football Center (IFMARC) from April 2022 to April 2024, focusing on players undergoing periodic pre-season examinations. Ethical approval was obtained from the Ethics Committee of the Research Vice Presidency at Iran University of Medical Sciences, with the ethics ID IR.IUMS.FMD.REC.1401.308.

Inclusion criteria

Maximum age of 35 years.

Participation in professional training (at least three specialized training sessions per week for a minimum of three months).

Exclusion criteria

History of intra-articular or soft tissue injections in the groin on the same side within the past six months.

Any history of groin, femur, acetabulum, or lumbosacral vertebrae surgery on the same side within the past six months.

Lack of consent from the athlete to continue participation in the study after completing the

questionnaires. Failure to respond to all the questions in the questionnaire.

Sample size

The required sample size was determined to be a minimum of 100 participants based on previous research and formula ($n=\frac{(z1-\alpha/2)^2\delta^2}{d^2}$). A total of 809 individuals who completed the informed consent form were enrolled in the study.

Data collection tools

The primary data collection tool was the International Hip Outcome Tool (iHOT-12), a shortened version of the iHOT-33 questionnaire. The iHOT-12 consists of 12 items that assess: The presence of groin pain. Exacerbation of pain due to mechanical activities, sports, and lifting objects. Athletes' concerns about the impact of pain on their lives. Awareness of hip health status. Importance placed on fitness and overall well-being. Each item is rated on a VAS ranging from 0 (no pain or disability) to 10 (maximum pain or disability).Translation and Validation Process

Ethical approval and translation

Permission for translation was obtained from the original author (Damian R. Griffin MD) of the iHOT-12. The Persian version of the questionnaire was developed following the BITEN protocol.

Face and content validity

The translated Persian version was reviewed by a panel of experts, including:
Five sports medicine specialists.
One soccer coach.
One exercise physiologist.
One orthopedic specialist.
Two experienced sports physiotherapists with expertise in groin-related issues. Four additional questions were added based on the expert consensus.
Cognitive debriefing: The forward translation version was provided to 20 players to suggest alternative words for better comprehension.
Content validity: The Lawshe method was used to calculate the Content Validity Ratio (CVR) and Content Validity Index (CVI). The experts rated each item based on the relevance, clarity, and simplicity using a four-point Likert scale (11).
Structural validity: A two-stage factor analysis was conducted:
Exploratory factor analysis (EFA): Principal Component Analysis (PCA) with Oblimin rotation was used to extract factors (12,13).
Convergent validity (reproducibility): The test-retest method was employed to assess the reproducibility (11). The iHOT-12 questionnaire was administered online to 86 participants after a two-week interval to ensure the participants forgot their initial responses and no interventions affected their chronic groin pain.

Reliability

Internal consistency: Assessed using Cronbach's alpha, indicating acceptable reliability.
Test-retest reliability: Evaluated using the Intraclass Correlation Coefficient (ICC), showing excellent stability over time.
Pearson correlation coefficient: Strong correlation between test and retest scores, confirming the reproducibility.
Bland-altman plot: Minimal systematic bias observed, supporting reliability.
Measurement error: SEM and SDC calculated, confirming the tool's precision in detecting real changes.

Validity

Content validity: Confirmed through expert reviews, with CVR and CVI meeting required thresholds.
Structural validity: EFA revealed a four-factor structure, supported by KMO and Bartlett's test.
Convergent validity: Strong consistency between test and retest administrations.
Floor and ceiling effects: Absence confirmed, indicating the tool's ability to capture a wide range of symptom severity.
Correlation matrix: Most items showed correlations above 0.3, supporting structural validity.
Data analysis was performed using SPSS 24 (IBM Corp., Armonk, NY, USA).

Ethical considerations

Participation in the study was voluntary, and all the

participants provided the informed consent. Athletes were fully informed about the study and assured that their personal information would remain confidential. The participants could withdraw from the study at any time without affecting their medical treatment or inclusion in the next sports season. No additional costs were incurred by the athletes for participating in the study.

Summary

This study aimed to evaluate the reliability and validity of the Persian version of the iHOT-12 questionnaire among male professional soccer players in Iran. The rigorous translation, validation, and ethical processes ensure that the tool is suitable for rapid diagnosis of the chronic groin pain during pre-season examinations. The findings will help identify predictors of re-injury and minimize the negative impact of groin pain on athletes and their teams.

Results

Participants' demographics and characteristics

Total participants: 809 male professional soccer players. Average Age: 25.74 (± 4.34) *yr.*

Position distribution

Goalkeepers: 98 (12.1%)
Defenders: 254 (31.4%)
Midfielders: 256 (31.6%)
Forwards: 201 (24.8%)

Foot dominance

Right-footed: 614 (75.9%)
Left-footed: 158 (19.5%)
Ambidextrous (two-footed): 37 (4.6%)

Surgical history: 28 athletes (3.5%) had a history of surgery on the hip, back, or groin, with an average recovery time of 3 months.

Previous injuries: 217 athletes (26.8%) reported previous injuries to the hip, back, or groin, with an average time away from play of 2.5 months.

Test-retest reliability

Second-Round Participants: 86 athletes (10.6%) completed the second-round questionnaires (test-retest) after two weeks.

Face and content validity: Content Validity Ratio (CVR):

CVR = 1 for all the questions except questions 10 and 11, which had a CVR of 0.8.

Content Validity Index (CVI): CVI = 1 for all the questions, except question 10 (0.9) and question 11 (0.8).

Supplementary questions: Four additional questions (13-16) were added based on the expert consensus. These addressed:

Pain in the anal and buttock regions.

Back pain after activity.

Groin pain during side-foot passing, long shots, zigzag movements, jumping, running, and morning stiffness in the groin area (Table 1).

Reliability and measurement error

Cronbach's Alpha: 0.7 (acceptable) for the 809 players who completed the final version of the questionnaire (Table 2).

Intraclass correlation coefficient (ICC): ICC =0.994 (excellent) with a 95% Confidence Interval (CI) (Table 2).

Mean total scores: 9.27 (first administration) and 8.96 (retest).

Standard Error of Measurement (SEM): SEM= 0.83 (8.9%) (Table 2).

Smallest Detectable Change (SDC): SDC= 2.3 (24.8%). This indicates that a change of more than 24.8% in the iHOT-12 score reflects a real improvement in hip pain rather than measurement

Table 1. Results of content validity ratio (CVR) and content validity index (CVI) for iHOT12 questionnaire items

Question	CVI	CVR
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	0.9	0.8
11	0.8	0.8
12	1	1

Table 2. Results of test-retest reliability and standard error of measurement for iHOT12 Questionnaire Items

	Test Mean±SD	Retest Mean±SD	Test SEM	Retest SEM	ICC (CI95%)
Total questions	9.27±7.69	8.96±7.24	0.83 (8.9%)	0.78 (8.7%)	0.994

SD: Standard Deviation; CI: Confidence Interval.

error (SDC= 1.96* 2 ½ * SEM)

Pearson correlation coefficient: Correlation coefficient (r)= 0.99, indicating excellent reliability ($p<0.05$).

Bland-altman plot : The mean difference between test and retest measurements was close to zero, indicating minimal accidental error (14) (Figure 1).

Structural validity

Correlation matrix: Most questions exhibited correlation coefficients above 0.3, confirming interrelation and suitability for factor analysis.

Kaiser-Meyer-Olkin (KMO) and Bartlett's Test: KMO value = 0.826 (exceeds the threshold of 0.6). Bartlett's test $p<0.05$, indicating adequate correlation among variables (8,12).

Factor analysis

Four factors had eigenvalues greater than 1, collectively accounting for 71.162% of the variance (Table 3). Scree plot showed significant changes for factors 1 and 2, particularly factor 1 (Figure 2).

Second-order factor analysis

In the first stage of exploratory factor analysis, four factors were retained. Subsequently, a factor analysis was conducted based on this retention.

Pattern matrix: This Table is used to determine the extent to which each item loads on the factors. Items that load on one factor should generally not load on other factors (13).

Factor 1: Items 1, 3, 6, 7, and 15 had the highest loadings.

Factor 2: Items 5, 8, and 14 had the highest loadings.

Factor 3: Items 4, 9, 12, and 16 had the highest loadings.

Factor 4: Items 10 and 11 had the highest loadings.

Structure matrix: Consistent with the Pattern Matrix, items correlated strongly with their respective factors (13).

Component matrix: This Table indicates the

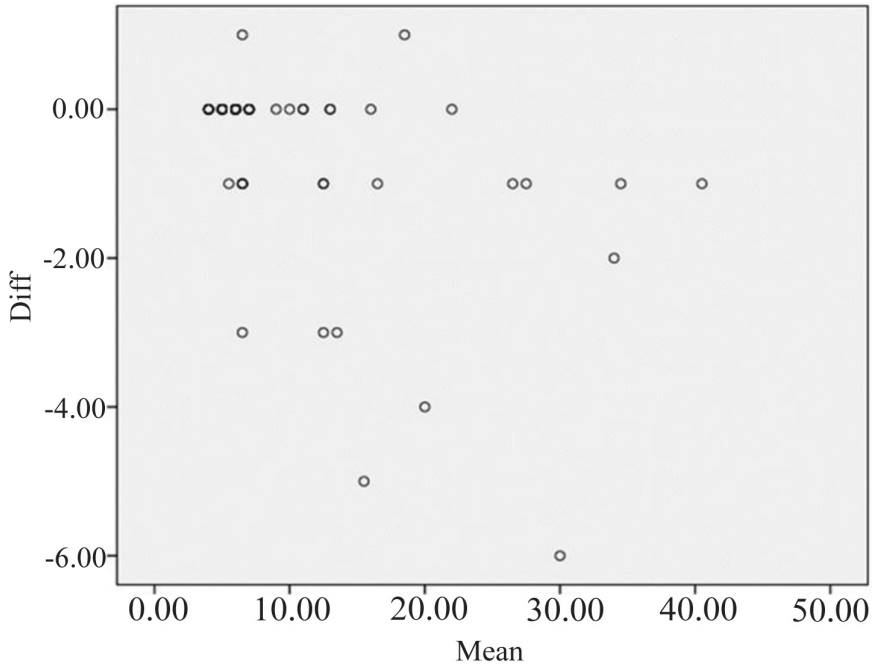

Figure 1. Bland-Altman plot results for test-retest measurement differences of the iHOT12 questionnaire.

Table 3. Results for total variance of questions in the iHOT12 questionnaire

Component	Total	% of Variance	Cumulative %
1	6.580	41.127	41.127
2	1.832	11.447	52.574
3	1.665	10.404	62.977
4	1.309	8.184	71.162

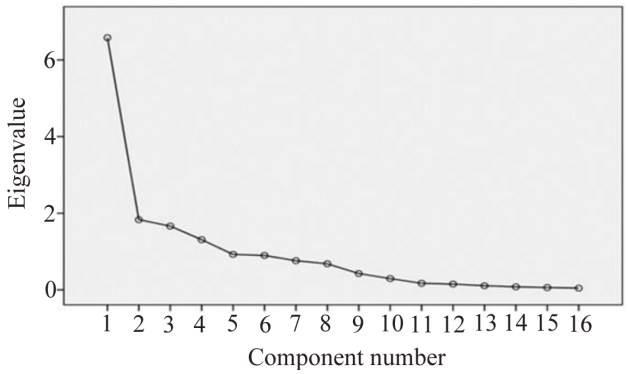

Figure 2. Results of the significant changes in the factors of the iHOT12 questionnaire items.

amount of variance explained for each item based on the factors (12).

Factor 1 explained the highest variance for items 1, 3, 5, 8, 12, 14, and 15.

Factor 3 explained the highest variance for items 4, 9, and 16.

Factor 4 explained the highest variance for items 10 and 11.

Correlation between factors

All the correlation coefficients between factors were below 0.3 (12,13), indicating no significant overlap (Table 4).

Floor and ceiling effects

No ceiling or floor effects were observed in the total score or subgroup scores, as less than 15% [17] of the participants achieved the maximum or minimum scores.

Summary of the key findings

Reliability: The Persian version of the iHOT-12 demonstrated excellent reliability, with an ICC of 0.994 and a Pearson correlation coefficient of 0.99. Cronbach's alpha of 0.7 confirmed acceptable internal consistency.

Validity: Face and content validity were confirmed, with CVR and CVI scores meeting acceptable thresholds. Structural validity was supported by factor analysis, with four factors explaining 71.162% of the variance.

Measurement error: SEM and SDC values indicated that the tool is sensitive to real changes in hip pain.

No floor or ceiling effects: The absence of floor and ceiling effects confirms the tool's ability to capture a wide range of symptom severity. These results demonstrate that the Persian version of the iHOT-12 is a reliable and valid tool for assessing chronic groin pain in male professional soccer players

Table 4. Results of the inter-factor correlation matrix for the iHOT12 questionnaire items

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1	0.421	0.204	-0.143
Factor 2	0.291	1	0.204	0.007
Factor 3	0.421	0.204	1	0.13
Factor 4	-0.143	0.007	-0.13	1

in Iran. Its use in clinical and research settings can facilitate rapid diagnosis and monitoring of groin pain, ultimately improving outcomes for athletes.

Discussion

This cross-sectional study evaluated the Persian version of the iHOT-12 questionnaire as a diagnostic tool for chronic groin pain among professional Iranian soccer players. The study aimed to provide a rapid, reliable, and valid method for assessing groin pain, facilitating timely diagnosis and treatment, which is critical for reducing the psychological and financial burdens on athletes and their teams. Below, the key findings and their implications are discussed.

Face and content validity

The face and content validity of the Persian iHOT-12 were confirmed through evaluations by a panel of 10 experts, including sports medicine specialists, physiotherapists, and coaches.

Content Validity Ratio (CVR): All the questions had a CVR above 0.62 (14), the minimum threshold for a panel of 10 experts, indicating that all the items were deemed necessary.

Content Validity Index (CVI): All the questions had a CVI above 0.79 (14), exceeding the acceptable threshold of 0.7. This confirms the relevance and clarity of the questions. Four supplementary questions were added based on expert consensus, addressing specific symptoms such as pain in the anal and buttock regions, back pain after activity, and groin pain during specific movements (*e.g.*, side-foot passing, long shots, and jumping).

These results demonstrate that the Persian iHOT-12 has strong face and content validity, making it suitable for use in the target population.

Reliability

Internal Consistency: Cronbach's alpha was 0.73 in the pilot group (n=20) and 0.7 in the main sample (n=809), indicating acceptable internal consistency. A Cronbach's alpha above 0.7 is considered satisfactory for reliability (15).

Test-retest reliability: The Intraclass Correlation Coefficient (ICC) was 0.994, indicating excellent reliability. This is consistent with ICC values reported in other translations of the iHOT-12, such as Japanese (0.89), Turkish (0.91), German (0.94), and Dutch (0.93) (9,16-18) (Table 5).

Pearson correlation coefficient: The correlation between test and retest scores was 0.99 ($p<0.05$), demonstrating excellent reproducibility.

Smallest Detectable Change (SDC): The SDC was 2.3 (24.8%), meaning that a change of more than 24.8% in the total score reflects a real improvement in hip pain rather than measurement error. This is comparable to SDC values reported in other studies (average SDC=2.73).

The high reliability of the Persian iHOT-12 suggests that it is a stable and consistent tool for assessing groin pain in Iranian soccer players.

Structural validity

Correlation matrix: Most questions exhibited correlation coefficients above 0.3, indicating strong interrelationships among the items and suitability for factor analysis.

Kaiser-Meyer-Olkin (KMO) and bartlett's test: The KMO value was 0.826 (exceeding the threshold of 0.6), and Bartlett's test was significant ($p<0.05$), confirming the adequacy of the sample size for factor analysis.

Factor analysis: Principal Component Analysis (PCA) extracted four factors with eigenvalues greater

Table 5. Results of the correlation test between test-retest in other studies

Translation	N	Mean± SD	SEM	SDC	Pearson correlation coefficient
Japanese	72	75.6±24.2	1.15	3.19	>0.5
Turkish	120	37.2±98.3	0.85	2.37	-
German	83	55.8±27	1	2.76	0.48
Dutch	117	83.4±35.5	0.93	2.6	0.65

SEM: Standard Error of Measurement. SDC: Smallest Detectable Change.

than 1, collectively explaining 71.162% of the variance. These factors were:

Factor 1: Items 1, 3, 6, 7, and 15 (*e.g.*, pain during mechanical activities and sports).

Factor 2: Items 5, 8, and 14 (*e.g.,* pain during lifting objects and specific movements).

Factor 3: Items 4, 9, 12, and 16 (*e.g.*, pain in the anal and buttock regions, back pain after activity).

Factor 4: Items 10 and 11 (*e.g.*, morning stiffness and awareness of hip health).

Pattern and structure matrices: The results of both matrices were consistent, confirming the structural validity of the questionnaire.

Inter-factor correlations: All the correlation coefficients between factors were below 0.3, indicating that the factors are distinct and not overlapping. The structural validity of the Persian iHOT-12 was confirmed, demonstrating that the questionnaire effectively captures the multidimensional nature of chronic groin pain.

Measurement error

Standard Error of Measurement (SEM): The SEM was 0.83 (8.9%), indicating low measurement error.

Bland-altman plot: The mean difference between test and retest scores was close to zero, with most values clustered around zero, further confirming minimal measurement error.

These findings suggest that the Persian iHOT-12 is a precise tool for assessing groin pain.

Floor and ceiling effects

No floor or ceiling effects were observed, as less than 15% of the participants achieved the minimum or maximum scores. This indicates that the questionnaire is sensitive to a wide range of symptom severity and is suitable for detecting changes in pain levels over time.

Comparison with other studies

The reliability and validity of the Persian iHOT-12 are consistent with findings from other translations, such as Japanese, Turkish, German, and Dutch versions (9,16-18) (Table 5).

The higher Pearson correlation coefficient (0.99) in this study may be attributed to the controlled environment in which the questionnaire was administered, the presence of an evaluator, and the use of an online platform for the retest, which provided a calm and comfortable setting for the participants.

Conclusion

The study highlighted the successful validation of the Persian version of the iHOT-12 questionnaire for assessing chronic groin pain in Iranian professional soccer players. The accessibility of athletes during pre-season assessments was a key strength, as it allowed for efficient data collection in a centralized setting. However, the study also identified areas for improvement and future research directions.

Key findings

Validity and reliability: The Persian iHOT-12 demonstrated adequate validity and reliability, making it a suitable tool for evaluating chronic groin pain in Persian-speaking athletes.

Strengths: The study benefited from the ability to gather the participants during pre-season assessments, ensuring a concentrated and efficient data collection process.

Recommendations for future research

Responsiveness of tools: Future studies should focus on evaluating the responsiveness of various assessment tools for chronic groin pain. This would allow for practical comparisons between instruments in both clinical settings and clinical trials.

Communication pathways: Establishing clear communication channels between coaches, team physicians, and the research team is crucial. This collaboration can help address logistical challenges and ensure smoother implementation of research protocols.

Athlete reassurance: Ensuring that medical team members reassure athletes about the importance of their cooperation in completing questionnaires can improve participation rates and data quality, thereby reducing research limitations.

Practical implications:

Clinical applications: The validated Persian iHOT-12 can be used in clinical settings to assess and monitor chronic groin pain in Persian-speaking athletes.

Research collaboration: Enhanced communication between sports professionals and researchers can facilitate more robust and comprehensive studies in the future.

By addressing these recommendations, future research can further refine the assessment and management of chronic groin pain in athletes, ultimately improving outcomes for this population.

Limitations

The study focused exclusively on male professional soccer players, limiting generalizability to other populations (*e.g.*, female athletes or non-professional players). The test-retest interval was two weeks, which may not fully capture long-term stability. The study relied on self-reported data, which may be subject to recall bias.

Despite these limitations, the Persian iHOT-12 is a valuable tool for assessing chronic groin pain in Iranian soccer players and can serve as a foundation for future research in this area.

Conflict of Interest

Authors declare no conflict of interest.

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