# Cross-Cultural Adaptation and Validation of the Oslo Sports Trauma Research Center Questionnaires on Overuse Injury and Health Problems (2nd Version) in Spanish Youth Sports

Javier Bailón-Cerezo,*† PhD, Benjamin Clarsen,‡ PhD, Beatriz Sánchez-Sánchez,*§ PhD, and María Torres-Lacomba,* PhD

*Investigation performed at the Physiotherapy Department, Faculty of Medicine and Health Sciences, University of Alcalá, Alcalá de Henares, Madrid, Spain*

**Background:** The Oslo Sports Trauma Research Center Questionnaires on Health Problems (OSTRC-H) and Overuse Injury (OSTRC-O) have shown a greater ability to identify athletes with health problems and to estimate the severity of those problems compared with traditional surveillance methods. Despite the numerous language adaptations of these questionnaires and their extended use, some of their measurement properties remain unknown. Moreover, these questionnaires are not available for Spanish-speaking athletes, and the validity and reliability of these questionnaires in youth athletes are unknown.

**Purpose:** To cross-culturally adapt and investigate the measurement properties of the second version of the OSTRC-H (OSTRC-H2) and OSTRC-O (OSTRC-O2) questionnaires in Spanish youth athletes.

**Study Design:** Cohort study (diagnosis); Level of evidence, 2.

**Methods:** Following international guidelines, we developed Spanish cross-cultural adaptations of the questionnaires, including a comprehensibility analysis with 30 participants from the target population. In the second phase, 73 athletes (age range, 12-18 years) were invited to participate in an 11-week prospective study. The reliability (internal consistency and test-retest reliability) of both questionnaires was assessed through use of Consensus-Based Standards for the Selection of Health Measurement Instruments recommendations. The construct validity and responsiveness of the OSTRC-H2 were evaluated using the convergence of the OSTRC-H2 severity score and the number of days of time loss. The response rate after 11 weeks was calculated as a feasibility indicator.

**Results:** Equivalent Spanish versions were developed. A total of 63 athletes (age range, 12-17 years) participated in the prospective study. The Cronbach alpha was 0.93 (95% CI, 0.92-0.94) for OSTRC-H2 and 0.88 (95% CI, 0.86-0.90) for OSTRC-O2. The intraclass correlation coefficient was 0.87 (95% CI, 0.79-0.92) and 0.85 (95% CI, 0.81-0.89), and the Cohen kappa was 0.80 (95% CI, 0.71-0.89) and 0.87 (95% CI, 0.78-0.96), respectively, for OSTRC-H2 and OSTRC-02. Correlations between the severity score and time loss (Spearman rho = 0.61) and between the changes in both scores over time (Spearman rho = 0.78) were within our expected range. The response rate was 95.5% for the OSTRC-O2 and 99.6% for the OSTRC-H2.

**Conclusion:** These results present equivalent, reliable, and feasible Spanish versions of both questionnaires as well as evidence of the validity and responsiveness of the OSTRC-H2.

**Keywords:** patient-reported outcome measures; epidemiology; athlete monitoring; injury prevention; adolescent

Reducing the risk of injury and health problems related to sports participation is one of the greatest challenges for people involved in athlete care.[26] In youth sports, this topic is of special interest because of the increasing training and competition demands in this population. This situation can lead to potential detrimental effects on the growth, health status, and career development of young athletes.[4]

The first step in developing comprehensive injury prevention programs is to understand the extent of the problem.[11,31] In some sports, such as swimming, running, or cycling, overuse injuries are the most common type of injury[8] and seem to occur very frequently among youth

The Orthopaedic Journal of Sports Medicine, 8(12), 2325967120968552
DOI: 10.1177/2325967120968552

athletes.[20,23] However, traditional injury surveillance systems lack the ability to detect a majority of these problems. Medical consultations or a time loss are needed to register an injury using these approaches. Because athletes with overuse symptoms or injuries often continue to participate in their sport, knowledge about overuse injuries is limited.[2,7,8]

The Oslo Sports Trauma Research Center Questionnaire on Health Problems (OSTRC-H) and the Oslo Sports Trauma Research Center Overuse Injury Questionnaire (OSTRC-O) were developed to prospectively monitor athletes' health status.[7,8] These questionnaires are used to identify athletes with health complaints (discriminative purpose) and to quantify the effect of these problems on the sport (evaluative purpose). Several language adaptations have been published,[10,13,14] and numerous studies and institutions have started to use these questionnaires for research and clinical practice. This situation suggests a shift in the method of sports epidemiology, relying first on a patient-reported outcome measure and assuming a definition of injury as "all complaints" instead of a time-loss approach based on an external observer. After athletes with health complaints are identified, medical staff can plan their actions.[1,5,12,19,21,22,32] These questionnaires, validated in adults,[7,8] were administered to youths in previous studies,[15,19,20,23] but no data are available regarding the validity and reliability of the questionnaires in this population.

To use the OSTRC questionnaires in a Spanish youth population, it is necessary to follow a process that guarantees content, conceptual, and semantic equivalence with the original versions as well as comprehensibility among the youth population. We must also explore the measurement properties of the questionnaires.[3,27,33] The main objectives of this study were to translate and adapt the latest versions of the OSTRC-O and OSTRC-H; to estimate their validity, reliability, and responsiveness; and to assess the feasibility and interpretability of both instruments for use in Spanish youth sports. We hypothesized that Spanish versions of the questionnaires would show good reliability and that the OSTRC-H score would be moderately correlated with the number of days of time loss as a measure of construct validity and responsiveness.

## METHODS

This study received ethics committee approval and conformed to the current Declaration of Helsinki guidelines. Informed consent was obtained from the athletes and from legal guardians for those athletes younger than 18 years.

This cross-cultural adaptation and validation study was developed after 2 phases: (1) a cross-cultural adaptation of the questionnaires and (2) testing of their measurement properties. The first author of the original questionnaires (B.C.) was involved in this study. For the purposes of this study, youth athletes were defined as those aged between 12 and 18 years.

### The Questionnaires

The OSTRC-O and OSTRC-H contain 4 key items on the presence of physical or health complaints during the past 7 days, their effect on sports activity (volume and performance), and the intensity of symptoms. The OSTRC-O is focused on injury complaints in predetermined areas (eg, the shoulder, lower back, or knee), whereas the OSTRC-H is designed to capture any health complaints, including illnesses and injuries in any anatomic region.[7,8]

There are 4 key items covering 2 objectives: (1) to detect the presence of physical or health complaints and (2) to evaluate the severity of the problem using a score between 0 and 100, with 0 representing no impact and 100 representing the maximum impact on sports activity. Version 2 of each English-language questionnaire (OSTRC-O2 and OSTRC-H2) was used.[6] This update uses the expression "the past 7 days" instead of "the past week" in all questions and includes slight changes in the score. Item 1, consisting of 4 response options, was scored as 0, 8, 17, and 100. Items 2, 3, and 4, with 4 response options, were scored 0, 8, 17, and 25. Athletes scoring 100 in item 1 ("Could not participate due to a health problem") did not answer items 2, 3, and 4.[6] Those who selected the third or fourth response option in either item 2 or 3 or the fourth option in item 1 were considered to have substantial problems.[7]

For athletes reporting any problem, the OSTRC-H2 asks about the type of complaint (injury or illness), the area (in case of injury), or symptoms (in case of disease). Finally, every athlete reporting a problem completes a set of project-specific questions. At the end of the questionnaire, athletes with >1 health problem can choose to start a new questionnaire. In this way, they complete 1 questionnaire for every health problem, starting with the most severe. In this study, injury area and project-specific questions related to time loss from activities were developed based on the recommendations of the Fédération Internationale de Natation.[21]

§Address correspondence to Beatriz Sánchez-Sánchez, PhD, Ctra. Madrid-Barcelona Km 33,600, Alcalá de Henares, Madrid 28871, Spain (email: beatriz.sanchez@uah.es).

*Physiotherapy in Women's Health Research Group, Physiotherapy Department, Faculty of Medicine and Health Sciences, University of Alcalá, Alcalá de Henares, Madrid, Spain.

†Department of Physical Therapy, Centro Superior de Estudios Universitarios de La Salle, Universidad Autónoma de Madrid, Madrid, Spain.

‡Oslo Sports Trauma Research Center, Norwegian School of Sport Sciences, Oslo, Norway.

Final revision submitted April 16, 2020; accepted May 26, 2020.

The authors declared that there are no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from Hospital Clínico San Carlos (study ID: 17/185-E).

## Phase 1: Cross-Cultural Adaptation

The OSTRC-H2 and OSTRC-O2 (shoulder, lower back, and knee) were cross-culturally adapted according to the recommendations of the "Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures"[3] and the International Society for Pharmacoeconomics and Outcomes Research[33] through the following steps:

1. Translation: 3 independent translators, whose native language was Spanish and who had English-language competence, translated the questionnaires. The first and second translators (T1, T2) were physiotherapists residing in Spain and were familiar with the health- and sports-related concepts included in the questionnaires. T1 (J.B.-C., project leader) was a sports physiotherapist, whereas T2 (M.T.-L.) had experience in the cross-cultural adaptation process.[25,30] The third translator was a Hispanic philologist who was Spanish-English bilingual.
2. Translation synthesis: Each translation was reviewed by the other 2 translators. Electronic contact (email and video conference), conducted by the project leader, was maintained to reach consensus in 1 Spanish version of the questionnaires.
3. Back-translation: The first Spanish versions were back-translated into English by 2 independent translators whose native language was English but who did not have health-related knowledge. They held a meeting to synthesize their versions into 1 back-translation.
4. Back-translation review: The first author of the original versions (B.C.), a native English speaker, reviewed the back-translations to assess equivalence with the original versions. Contributions were clarified with the translators, back-translators, and the original author to produce the preliminary Spanish versions.
5. Comprehensibility analysis: Face-to-face, semistructured, cognitive debriefing interviews were conducted by the project leader with 30 athletes aged between 12 and 18 years. Consecutive sampling was performed using physical therapy consultations at the M86 High-Performance Training Centre (CETD-M86) (Madrid, Spain). Interviews started with an oral introduction of the aims of the session. Participants were asked to read and fill out the questionnaires and tell the interviewer their interpretation of the content. Misconceptions, unclear words or explanations, translation alternatives, or other comprehensibility issues were discussed and written down in a final report.
6. Expert committee review: All translators and the original author reviewed the process and the report from the comprehensibility analysis. Then, the final Spanish versions were developed by incorporating the relevant findings. These versions were proofread for minor errors.

## Phase 2: Testing Measurement Properties

### *Participants and Recruitment*

A total of 73 athletes between 12 and 18 years old from the CETD-M86 (swimming, water polo, artistic swimming, and triathlon teams) without mental disorders or the inability to answer the questionnaires were invited to participate in the study without any compensation. The Consensus-Based Standards for the Selection of Health Measurement Instruments recommendations for sample size were used (>100 questionnaires rated as "excellent" and 50-99 as "good").[17]

### *Data Collection*

An initial meeting was held with participants and trainers to explain the time line and methods of the study. In this meeting, the participants completed a questionnaire that collected information on their anthropometric characteristics, sporting history, training load, competitive level, and educational level and contact information.

During 10 consecutive Sundays (between January 28 and April 4, 2018), a mobile message was sent to the participants with a link to the questionnaires hosted on Wufoo (www.wufoo.com; SurveyMonkey Inc). The participants were instructed to complete the questionnaire after the last activity of the week. A reminder was sent 24 hours later to participants who had not answered the questionnaire. Each weekly survey was closed every Monday at 11:59 PM.

During the first week, the participants completed the OSTRC-H2 and OSTRC-O2 (shoulder, lower back, and knee); in weeks 2 through 9, they completed the OSTRC-H2; and at week 10, they completed both questionnaires again. For the OSTRC-H2, given the complex configuration of the electronic survey system, the first week was used as a pilot test, and these questionnaires were not included in the analysis.

In addition, the participants completed an online survey at the beginning of the second week (for OSTRC-O2) and the 11th week (for OSTRC-H2). In this survey, participants were asked questions about content validity of the questionnaires (content relevance and the need to modify items or include new items) and about various aspects of feasibility (administration method, time to complete the questionnaires, and difficulty of completing the questionnaires as well as the implications of these aspects for future, routine use of the questionnaires throughout the sports season).

To establish the test-retest reliability, participants were asked to again complete the questionnaires 48 hours after their response to the OSTRC-O2 administered in the first week and the OSTRC-H2 administered in the 10th week. Because these retest questionnaires were sent on a Tuesday or Wednesday, the questionnaires referred to the week before (Monday to Sunday). Responses were not admitted after 11:59 PM on Wednesday.

### Data Analysis

Statistical analyses were conducted using SPSS Version 23.0 (IBM Corp). Descriptive statistics were calculated using the arithmetic mean and SD as indices of central tendency and dispersion for the quantitative variables or using the median and interquartile ranges when wide dispersions conditioned the interpretation of the variable. Absolute and relative percentage frequencies were used for the categorical variables. The inferential analysis was estimated with a 95% CI.

A measurement property analysis was conducted according to the Consensus-Based Standards for the Selection of Health Measurement Instruments recommendations[16-18] for the properties of interpretability/feasibility, validity, reliability, and responsiveness.

*Interpretability and Feasibility.* The response rate, score distribution, and floor and ceiling effects for participants with health problems were calculated (>15% of the sample with maximum or minimum scores).[28] Prevalence measures were calculated each week, dividing the number of athletes reporting complaints by the number of questionnaire respondents.

*Validity.* Group differences and hypothesis-testing approaches were chosen to estimate the construct validity for the OSTRC-H2.[16-18] Because correlations between measures of the same construct should range from 0.4 to 0.8,[27] an a priori hypothesis was formulated[16-18]: A positive correlation ≥0.4 (Spearman rho) between the severity score and self-reported days of time loss (total and partial) was expected. For group differences, the participants reporting a time loss health problem (defined by the Fédération Internationale de Natation as a partial or total loss of activity in a week)[21] were expected to have a score that was statistically significantly different from the scores of participants with no time loss (using a nonparametric Wilcoxon-Mann-Whitney test). The questionnaires reporting a health problem (except retests) were included in this analysis.

*Reliability.* The Cronbach alpha was used as an estimator of internal consistency, assuming a value of ≥0.7 as acceptable.[28] Questionnaires from the retest and those scoring 100 in item 1 were excluded from this analysis. An intraclass correlation coefficient (ICC) model that entailed 2-way random-effects, single-measures, absolute agreement was used to assess the test-retest reliability of the score,[27,28] assuming a value ≥0.7 as acceptable.[28]

Derived from the test-retest reliability study, the SEM and smallest detectable change (SDC) were calculated. The SEM was calculated following the formula $SD\,x\,\sqrt{1-ICC}$, where SD is the SD of the mean of all observed scores and the ICC is the reliability estimator. The SDC was calculated as $SEM\,x\,1.96\,x\,\sqrt{2}$ at an individual level and as $SEM\,x\,1.96\,x\,\sqrt{2}/n$ at a group level.[9]

The Cohen kappa (assuming a value ≥0.7 as acceptable)[28] and the agreement percentage were calculated as estimators of discriminative reliability and error, respectively.

*Responsiveness.* To establish the responsiveness of the OSTRC-H2, we expected to find a positive correlation ≥0.4 (Spearman rho) between changes in the OSTRC-H2 score and the number of days of time loss from the sport. This analysis was performed using the questionnaires from the participants with a change in their health status between weeks 2 and 10.

TABLE 1
Participants' Characteristics in Phases 1 and 2[a]

| | Phase 1 (n = 30) | Phase 2 (n = 63) |
|---|---|---|
| Female/male, n | 17/13 | 38/25 |
| Age, y | 16 ± 1.9 (12-18) | 15.1 ± 1.4 (12-17) |
| Sport, n | | |
| Swimming | 23 | 6 |
| Artistic swimming | 3 | 12 |
| Water polo | 4 | 36 |
| Triathlon | 0 | 9 |
| Years of practice | 7.2 ± 1.9 (3-10) | 6.5 ± 1.9 (3-11) |
| Training load, h/wk | 24.9 ± 6.9 (18-42) | 26 ± 7 (20-42) |
| Current competitive level, n | | |
| International | 15 | 10 |
| National | 15 | 46 |
| Regional | 0 | 7 |
| Education level, n | | |
| Years 1-3 SOE | 9 | 24 |
| Year 4 SOE | 5 | 16 |
| Preuniversity | 16 | 23 |
| Health status, n | | |
| Injured | 7 | — |
| Sick | 4 | — |
| Healthy | 19 | — |
| Body mass index | 20.6 ± 2.3 (14.7-24.6) | 20.6 ± 2.6 (14.7-27.3) |

[a]Data are expressed as mean ± SD (range) unless otherwise noted. SOE, Secondary Obligatory Education. —, not applicable.

## RESULTS

There were 30 athletes in phase 2 and 63 athletes in phase 2 who participated in this study. Their characteristics are shown in Table 1.

### Phase 1: Cross-Cultural Adaptation

During the first and second steps, the literal Spanish translations of the 4 main items were found to be grammatically wrong due to the syntax combinations between the question and response options. Consensus was reached between the translators to produce 1 initial Spanish version, introducing the use of adverbs in the response options. For example, *en un grado severo* ("to a severe extent") was replaced by *severamente* ("severely"). Minor problems related to the sentence structures and nouns explaining symptoms were also resolved in this phase. Back-translation synthesis was developed without any discrepancies. Both questionnaires were reviewed by the original author, who reported minor drafting considerations in the introduction of the OSTRC-O2. These considerations were discussed with the back-

TABLE 2
OSTRC-H2 Score, OSTRC-O2 Score, and Time-Loss Descriptive Data[a]

| | Median (IQR) | Mean ± SD | Range (Min-Max) | Minimum Score, n (%) | Maximum Score, n (%) |
|---|---|---|---|---|---|
| OSTRC-H2 score[b] | | | | | |
| All questionnaires (n = 577) | 0 (24) | 14.33 ± 23.53 | 100 | — | — |
| All complaints (n = 217) | 32 (21) | 38.09 ± 23.82 | 92 (8-100) | 12 (5.5) | 11 (5.1) |
| Injury (n = 149) | 32 (17) | 34.87 ± 20.91 | 92 (8-100) | 9 (6) | 4 (2.7) |
| Illness (n = 68) | 33 (44) | 45.16 ± 28.10 | 92 (8-100) | 3 (4.4) | 7 (10.3) |
| OSTRC-O2 score[c] | | | | | |
| All questionnaires (n = 361) | 0 (0) | 5.82 ± 14.34 | 100 | — | — |
| All problems (n = 73) | 24 (17) | 28.78 ± 18.91 | 88 (8-100) | 9 (12.3) | 2 (2.7) |
| Total time loss, d/wk[d] | | | | | |
| All complaints (n = 217) | 0 (0.75) | 0.62 ± 1.44 | 0-7 | 162 (75) | 6 (2.8) |
| Partial time loss, d/wk[d] | | | | | |
| All complaints (n = 217) | 0 (1) | 1.03 ± 2.02 | 0-7 | 140 (64.8) | 18 (8.3) |

[a]IQR, interquartile range; Min, minimum; Max, maximum; OSTRC-H2, Oslo Sports Trauma Research Center Questionnaire on Health Problems, 2nd version; OSTRC-O2, Oslo Sports Trauma Research Center Overuse Injury Questionnaire, 2nd version. —, not applicable.

[b]The number of OSTRC-H2 questionnaires in the "all questionnaires" cell is derived from 9 weeks of administration among 63 athletes, with a response rate of 98.6%. The athletes completed 1 questionnaire for each health problem in the week. The questionnaires classified as "all complaints" include only injury and illness reports.

[c]The number of OSTRC-O2 questionnaires in the "all questionnaires" cell is derived from 2 weeks of administration of shoulder, knee, and lower back versions of the questionnaire among 63 athletes, with a response rate of 95.5%. The questionnaires classified as "all problems" include only injury reports from the 3 body areas.

[d]Questionnaires in the total and partial time-loss rows are linked to the OSTRC-H2 questionnaires for reporting any health problem.

translators, who noted that the initial Spanish version retained the original content.

The initial Spanish versions were tested in the comprehensibility analysis. This phase demonstrated some common comprehensibility problems with the OSTRC-H2. A total of 7 participants understood that the term "health problems" referred only to problems that made them stop their practice. For example, swimmers training with persistent shoulder pain did not consider themselves to have an injury or a health problem. According to their contributions and the expert committee opinion, a new explanation was included in the introduction: "The term 'health problems' refers to any injury symptoms (eg, pain, stiffness, catching/clicking, and instability) or illness symptoms (eg, cough, sneezing, headache, and intestinal problems), regardless of their severity or consequences. In this context, we regard depression, anxiety, sadness, etc. as 'illness.'" In addition, the terms "injury" or "illness" in the response options of item 1 were replaced by the term "health problems."

The distinction of the injury area as "arm" or "forearm" and "thigh" or "leg" was not understood by 4 participants. Consequently, we decided to include the full description used in the Orchard Sports Injury Classification System Version 10[24]: "arm (between shoulder and elbow)," "forearm (between elbow and wrist)," "thigh (between hip and knee)," and "leg (between knee and ankle)." No problems were detected for items 2, 3, and 4 in the Spanish version of the OSTRC-O2 for shoulder, lower back, and knee complaints.

After this process, the final Spanish versions of the OSTRC-O2 and OSTRC-H2, which maintained the original content and adapted it to the new population, were achieved.

## Phase 2: Testing Measurement Properties

### *Interpretability and Feasibility*

Given the electronic setting of the questionnaires, unanswered items were not allowed. Therefore, all questionnaires received were complete. The score distributions are reported in Table 2. Floor and ceiling effects were not found in either of the 2 questionnaires.

The prevalence data derived from the OSTRC-H2 are reported in Figure 1A, whereas the OSTRC-O2 data from the first and last weeks are reported in Figure 1B.

The response rate for the OSTRC-O2 was 95.5% (2.4% completed after the 24-hour reminder). The OSTRC-H2 had a 99.6% response rate (8% after the 24-hour reminder). In total, 59 (94%) of the participants completed all the questionnaires during the study.

The final survey for each questionnaire was answered by 92% (OSTRC-O2) and 94% (OSTRC-H2) of the participants. Regarding completion time, 5% of athletes reported that the OSTRC-H2 took too much time to complete. None of the athletes reported this situation for the OSTRC-O2. We found that 96% (OSTRC-O2) and 98% (OSTRC-H2) of participants believed that filling out the questionnaire online was the best method. Regarding the hypothetical use of the questionnaires as a routine over the entire year, 78% (OSTRC-O2) and 72% (OSTRC-H2) of participants reported that they would answer all or most weeks; 21% (OSTRC-O2) and 22% (OSTRC-H2) said they would answer some weeks; and 2% (OSTRC-O2) and 5% (OSTRC-H2) said they would not answer at all. For both OSTRC-O2 and OSTRC-H2, 2% of participants reported that the questionnaires were difficult to complete.

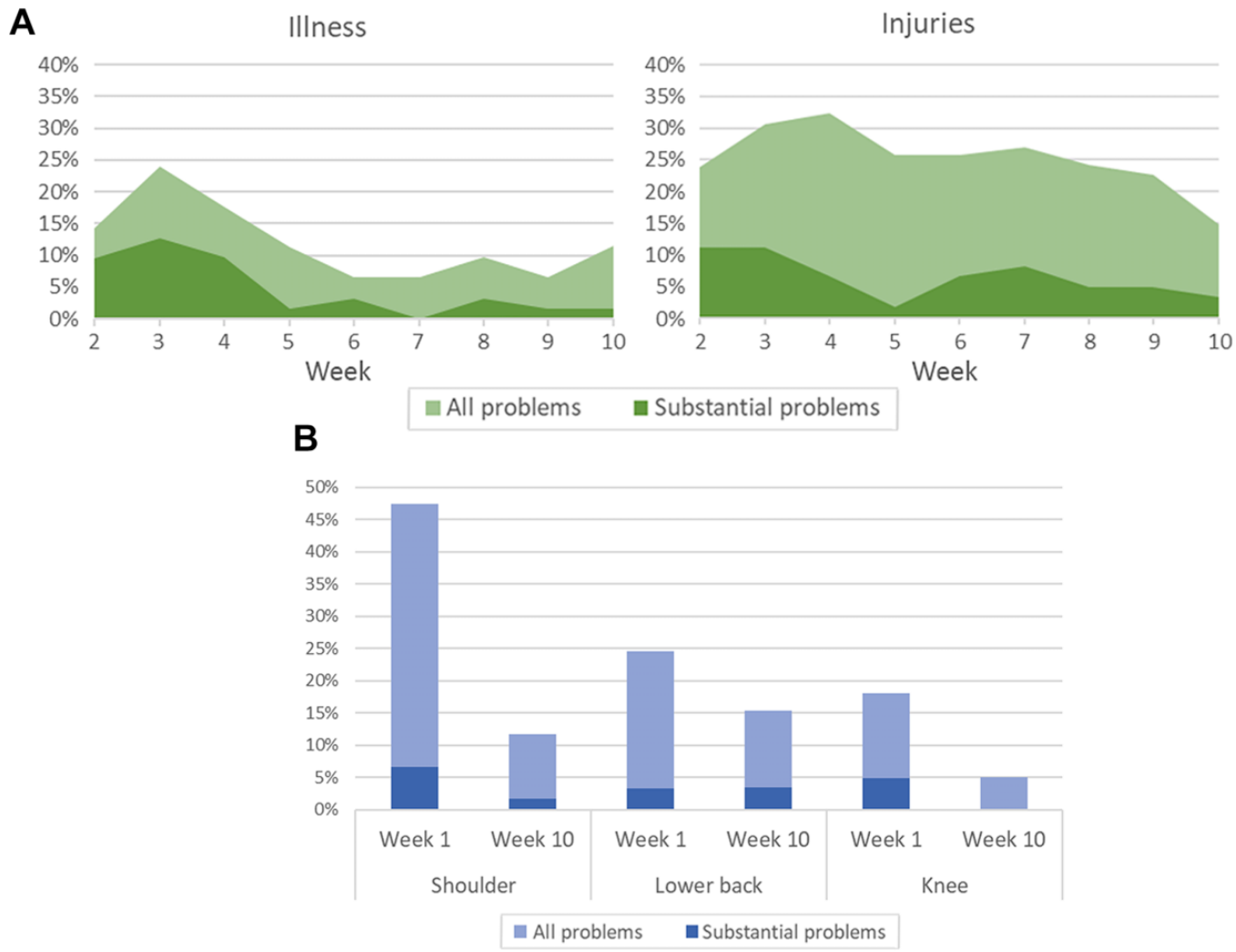


**Figure 1.** (A) Prevalence of injury and illness complaints derived from the Oslo Sports Trauma Research Center Questionnaire on Health Problems, 2nd version, for 9 weeks. (B) Prevalence measures derived from the Oslo Sports Trauma Research Center Overuse Injury Questionnaire, 2nd version.

### *Validity*

For content validity, 88% (OSTRC-O2) and 78% (OSTRC-H2) of the participants who completed the final survey agreed with the relevance of the items included in the questionnaires. Furthermore, 90% did not consider it necessary to add or modify items in the OSTRC-O2. All of the participants who proposed including new items (10%) suggested adding questions about other injury areas or health problems. For OSTRC-H2, 7% of the participants suggested adding new items. Suggestions from these athletes were heterogeneous and unrelated to the purpose of the questionnaire.

Results confirmed the predefined hypotheses for construct validity of the correlations between the severity score in the OSTRC-H2 and days of total time loss (n = 217; Spearman rho = 0.61) and days of partial time loss (Spearman rho = 0.54). The hypothesis concerning the OSTRC-H2 score differences between participants with and without time-loss problems was also confirmed (Figure 2).

### *Reliability*

The results of this study showed good reliability for both questionnaires (consistency and test-retest) according to the proposed criteria ($\geq$0.7). The Cronbach alpha values are shown in Table 3. The test-retest reliability analysis included 60 participants for OSTRC-H2 and 59 participants for OSTRC-O2 (Table 4). In total, 3 participants (OSTRC-H2) and 4 participants (OSTRC-O2) did not answer the test or retest questionnaires and were not included in this analysis.

### *Responsiveness*

Predefined hypotheses regarding correlations between changes in the OSTRC-H2 severity score and days of time

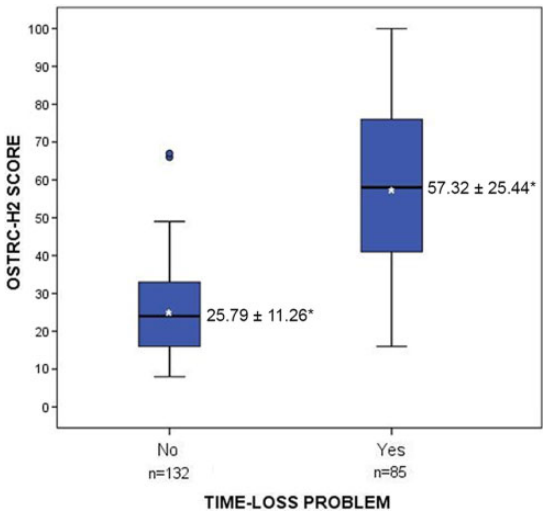


**Figure 2.** Box plot of the Oslo Sports Trauma Research Center Questionnaire on Health Problems, 2nd version (OSTRC-H2) score distribution in participants with and without time loss. *Mean ± SD, median (horizontal line inside the box), first and third quartile (blue box), range (error bars), and outliers (dots) are represented. Differences were found between both groups ($P < .001$).

TABLE 3
OSTRC-H2 and OSTRC-O2 Internal Consistency[a]

| | Cronbach Alpha (95% CI) |
|---|---|
| OSTRC-H2 | |
| Total (n = 566) | 0.93 (0.92-0.94) |
| All complaints (n = 206) | 0.82 (0.77-0.86) |
| Injury (n = 145) | 0.80 (0.74-0.85) |
| Illness (n = 61) | 0.85 (0.77-0.90) |
| OSTRC-O2 | |
| Total (n = 359) | 0.88 (0.86-0.90) |
| All injuries (n = 71) | 0.74 (0.63-0.83) |

[a]OSTRC-H2, Oslo Sports Trauma Research Center Questionnaire on Health Problems, 2nd version; OSTRC-O2, Oslo Sports Trauma Research Center Overuse Injury Questionnaire, 2nd version.

loss were confirmed for both total (n = 28; Spearman rho = 0.78) and partial time loss (n = 28; Spearman rho = 0.49).

## DISCUSSION

Youth sports epidemiology is gaining attention because of the increasing physical and psychological demands in this population.[4] The OSTRC questionnaires were developed to allow continuous monitoring of athlete health status in the adult population and have been widely used for this purpose.[7,8] However, evidence is lacking regarding the reliability of using these questionnaires as a discriminative tool or about the other measurement properties of these instruments, making it difficult to interpret the severity score. To our knowledge, no similar instruments are available for use in the Spanish population. Despite the previous use of these questionnaires in young athletes,[15,19,20,23] we are not aware of validation studies that have tested the measurement properties of OSTRC questionnaires in this population. Although some measurement properties remain unknown, the results of this study support the feasibility, validity, and reliability of the Spanish versions of the OSTRC-O2 and OSTRC-H2 questionnaires.

### Cross-Cultural Adaptation and Content Validity

The process used in this study was developed according to internationally recognized guidelines.[3,33] Moreover, we collaborated with the developer, thus ensuring the quality of the Spanish OSTRC-O2 and OSTRC-H2 versions.

In this study, as in previous adaptations,[10,13,14] translation and back-translation were conducted without major problems. Only some grammatical issues prevented the use of a literal translation, as was the case during the German translation.[13] However, it was necessary to introduce some new explanations in the introduction and to reword some items in the OSTRC-H2 after cognitive debriefing interviews to ensure comprehensibility. The need for these changes may be linked to the fact that our cohort was younger (age range, 12-18 years) than were those included in the original study and other cross-cultural adaptations, where the ages ranged from 18 to 55 years.[7,8,10,13,14] Otherwise, the improvements in the anatomic area description could

TABLE 4
Data Derived From Test-Retest Reliability Analysis[a]

| | Evaluative Reliability (Score) | | | | | | Discriminative Reliability (Prevalence) | |
|---|---|---|---|---|---|---|---|---|
| | Test, Mean ± SD | Retest, Mean ± SD | SEM | $SDC_{ind}$ | $SDC_{group}$ | ICC (95% CI) | Cohen Kappa (95% CI) | Agreement, % |
| OSTRC-H2, total (n = 60) | 8.47 ± 16.59 | 9.92 ± 17.51 | 5.31 | 14.72 | 1.90 | 0.87 (0.79-0.92) | 0.80 (0.71-0.89) | 91.7 |
| OSTRC-O2, total (n = 177) | 8.60 ± 16.76 | 8.91 ± 17.96 | 5.99 | 16.6 | 1.25 | 0.85 (0.81-0.89) | 0.87 (0.78-0.96) | 94.3 |

[a]ICC, intraclass correlation coefficient; OSTRC-H2, Oslo Sports Trauma Research Center Questionnaire on Health Problems, 2nd version; OSTRC-O2, Oslo Sports Trauma Research Center Overuse Injury Questionnaire, 2nd version; $SDC_{group}$, smallest detectable change (group level); $SDC_{ind}$, smallest detectable change (individual level).

prevent future misclassifications of self-reported injuries by athletes. Because a comprehensible Spanish version was achieved for young athletes, it is expected to also be comprehensible for adult athletes.

Comprehensibility, comprehensiveness, and content relevance are all part of content validity.[29] The content relevance and comprehensiveness of the questionnaires are supported by the original study, where experts (athletes and professionals) took part in the development of the questionnaires.[7] Furthermore, some evidence can be derived from our study, where the participants' opinions after real applications of the questionnaires resulted in major agreements regarding the relevance and completeness of the questionnaires. The German, Danish, and Swedish adaptations of the OSTRC questionnaires also considered athletes' opinions at some point in their studies, none of which resulted in substantial changes to the 4 key items.[10,13,14]

### Feasibility and Interpretability

We were unable to register the time required by participants to complete the questionnaires in the electronic survey system; however, the athletes interviewed in this study indicated that the electronically administered OSTRC-O2 and OSTRC-H2 Spanish questionnaires were not time-consuming and were easy to complete. We had a high response rate, and most athletes in our cohort were amenable to administration of these questionnaires across the entire sports season, making such surveys a valuable tool for injury surveillance studies and medical staff planning.

In contrast with the low capacity shown in this study when using the time-loss approach to capture improvements in the sports participation of athletes with health complaints, the absence of floor and ceiling effects in the OSTRC questionnaires proves their ability to distinguish among different levels of the construct.[28] These data are not available for the original version and other adaptations. Moreover, estimation of the SEM and the SDC is essential for interpretability of the scores.[9] To our knowledge, this is the first published study providing this information for OSTRC questionnaires. There is a minimal important difference associated with the SDC, which refers to the minimum change in the score needed to capture a clinically relevant change. The minimal important difference should be higher than the SDC and needs to be estimated in future studies to properly interpret changes in OSTRC-O2 and OSTRC-H2 scores.[9,29]

### Reliability

A high internal consistency was found according to the original instrument and the other published adaptations,[7,8,10,13,14] meaning that the items are interrelated and they measure consistently.[29] In this study, different subgroups were analyzed because the measurement properties can vary with the score distribution.[27] The smaller sample size in the injured subgroup (OSTRC-O2) led to a bigger CI, the lower limit of which was less than the expected range.

According to previous reports in other cultural adaptations,[10,13,14] a high test-retest reliability was found for the severity score. In addition, the high Cohen kappa indicated the high reliability of discriminative intention. Test-retest was closely related to the time between the 2 measures. In our study, a time frame of 48 to 72 hours was selected. Because these questionnaires refer to the week before, it is assumed that a longer time frame could negatively influence the results of the second administration, presenting lower reliability than reality. Nevertheless, these results could be influenced at some point by memory bias.[27] Our reliability results for the score are in line with those found in the German adaptation, for which the same time frame was selected.[13]

### Construct Validity and Responsiveness

Some evidence of the construct validity and responsiveness of the questionnaires can be derived from this study. Correlations between similar instruments should be between 0.4 and 0.8 for a construct and responsiveness evaluation.[27] Time loss (days) is the measure traditionally used to determine injury or illness severity in sports,[21] and our hypotheses related to this measure's correlation with the OSTRC-H2 score were confirmed. However, the measurement properties of self-reported number of days of time loss are unknown, and self-reported time loss was used here because of the absence of validated instruments measuring similar constructs. Thus, future studies should complement and confirm our results.

### Limitations

As previously discussed, this study has some limitations. The survey system did not allow us to measure the duration of time that participants needed to complete the questionnaires, so we had to rely on the athletes' responses for the time burden regarding weekly completion of the questionnaires. Also, results of validity and responsiveness should be taken with caution because of the lack of other similar and recognized instruments to evaluate the construct of interest. Thus, future investigations are needed to increase knowledge about the measurement properties of the OSTRC-H2 questionnaire.

## CONCLUSION

Equivalent Spanish versions of OSTRC-O2 and OSTRC-H2 were developed. Both Spanish versions were shown to be reliable and feasible when applied to the youth sports population. The Spanish version of the OSTRC-H2 also showed evidence of its construct validity and responsiveness.

## REFERENCES

1. Asker M, Waldén M, Källberg H, Holm LW, Skillgate E. A prospective cohort study identifying risk factors for shoulder injuries in adolescent elite handball players: the Karolinska Handball Study (KHAST) study protocol. *BMC Musculoskelet Disord*. 2017;18(1):485.

2. Bahr R. No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *Br J Sports Med*. 2009; 43(13):966-972.
3. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*. 2000;25(24):3186-3191.
4. Bergeron MF, Mountjoy M, Armstrong N, et al. International Olympic Committee consensus statement on youth athletic development. *Br J Sports Med*. 2015;49(13):843-851.
5. Clarsen B, Bahr R, Heymans MW, et al. The prevalence and impact of overuse injuries in five Norwegian sports: application of a new surveillance method. *Scand J Med Sci Sports*. 2015;25(3):323-330.
6. Clarsen B, Bahr R, Myklebust G, et al. Improved reporting of overuse injuries and health problems in sport: an update of the Oslo Sport Trauma Research Center questionnaires. *Br J Sports Med*. 2020; 54(7):390-396.
7. Clarsen B, Myklebust G, Bahr R. Development and validation of a new method for the registration of overuse injuries in sports injury epidemiology: the Oslo Sports Trauma Research Centre (OSTRC) Overuse Injury Questionnaire. *Br J Sports Med*. 2013;47(8):495-502.
8. Clarsen B, Ronsen O, Myklebust G, Florenes TW, Bahr R. The Oslo Sports Trauma Research Center questionnaire on health problems: a new approach to prospective monitoring of illness and injury in elite athletes. *Br J Sports Med*. 2014;48(9):754-760.
9. Davidson M, Keating J. Patient-reported outcome measures (PROMs): how should I interpret reports of measurement properties? A practical guide for clinicians and researchers who are not biostatisticians. *Br J Sports Med*. 2014;48(9):792-796.
10. Ekman E, Frohm A, Ek P, Hagberg J, Wirén C, Heijne A. Swedish translation and validation of a web-based questionnaire for registration of overuse problems. *Scand J Med Sci Sports*. 2015;25(1): 104-109.
11. Finch C. A new framework for research leading to sports injury prevention. *J Sci Med Sport*. 2006;9(1-2):3-9.
12. Girdwood M, Webster M. High rates of shoulder and hip pain in water polo players across elite, sub-elite and recreational levels. *J Sci Med Sport*. 2017;20(suppl 3):S17-S19.
13. Hirschmüller A, Steffen K, Fassbender K, et al. German translation and content validation of the OSTRC Questionnaire on overuse injuries and health problems. *Br J Sports Med*. 2017;51(4):260-263.
14. Jorgensen JE, Rathleff CR, Rathleff MS, Andreasen J. Danish translation and validation of the Oslo Sports Trauma Research Centre questionnaires on overuse injuries and health problems. *Scand J Med Sci Sports*. 2016;26(12):1391-1397.
15. Martínez-Silván D, Díaz-Ocejo J, Murray A. Predictive indicators of overuse injuries in adolescent endurance athletes. *Int J Sports Physiol Perform*. 2017;12(suppl 2):S2153-S2156.
16. Mokkink LB, Terwee CB, Knol DL, et al. The COSMIN checklist for evaluating the methodological quality of studies on measurement properties: a clarification of its content. *BMC Med Res Methodol*. 2010;10:22.
17. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Qual Life Res*. 2010;19(4):539-549.
18. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *J Clin Epidemiol*. 2010;63(7):737-745.
19. Moseid CH, Myklebust G, Fagerland MW, Bahr R. The association between early specialization and performance level with injury and illness risk in youth elite athletes. *Scand J Med Sci Sports*. 2019; 29(3):460-468.
20. Moseid CH, Myklebust G, Fagerland MW, Clarsen B, Bahr R. The prevalence and severity of health problems in youth elite sports: a 6-month prospective cohort study of 320 athletes. *Scand J Med Sci Sports*. 2018;28(4):1412-1423.
21. Mountjoy M, Junge A, Alonso JM, et al. Consensus statement on the methodology of injury and illness surveillance in FINA (aquatic sports). *Br J Sports Med*. 2016;50(10):590-596.
22. Ng L, Sherry D, Loh WB, et al. The prevalence and severity of injuries in field hockey drag flickers: a retrospective cross-sectional study. *J Sports Sci*. 2016;34(18):1746-1751.
23. Pluim BM, Loeffen FGJ, Clarsen B, Bahr R, Verhagen EALM. A one-season prospective study of injuries and illness in elite junior tennis. *Scand J Med Sci Sports*. 2016;26(5):564-571.
24. Rae K, Orchard J. The Orchard Sports Injury Classification System (OSICS) Version 10. *Clin J Sport Med*. 2007;17(3):201-204.
25. Sanchez-Sanchez B, Torres-Lacomba M, Yuste-Sánchez MJ, et al. Cultural adaptation and validation of the Pelvic Floor Distress Inventory Short Form (PFDI-20) and Pelvic Floor Impact Questionnaire Short Form (PFIQ-7) Spanish versions. *Eur J Obstet Gynecol Reprod Biol*. 2013;170(1):281-285.
26. Soligard T, Schwellnus M, Alonso JM, et al. How much is too much? (Part 1) International Olympic Committee consensus statement on load in sport and risk of injury. *Br J Sports Med*. 2016;50(17): 1030-1041.
27. Streiner DL, Norman GR, Cairney J. *Health Measurement Scales: A Practical Guide to Their Development and Use*. 5th ed. Oxford University Press; 2015.
28. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol*. 2007;60(1):34-42.
29. Terwee CB, Prinsen CAC, Chiarotto A, Westerman MJ, Patrick DL, Alonso J. COSMIN methodology for evaluating the content validity of patient-reported outcome measures: a Delphi study. *Qual Life Res*. 2018;27(5):1159-1170.
30. Torres-Lacomba M, Sánchez-Sánchez B, Prieto-Gómez V, et al. Spanish cultural adaptation and validation of the shoulder pain and disability index, and the Oxford shoulder score after breast cancer surgery. *Health Qual Life Outcomes*. 2011;13:63.
31. van Mechelen W, Hlobil H, Kemper HC. Incidence, severity, aetiology and prevention of sports injuries: a review of concepts. *Sports Med*. 1992;14(2):82-99.
32. Weiss KJ, McGuigan MR, Besier TF, Whatman CS. Application of a simple surveillance method for detecting the prevalence and impact of overuse injuries in professional men's basketball. *J Strength Cond Res*. 2017;31(10):2734-2739.
33. Wild D, Grove A, Martin M, et al. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR Task Force for Translation and Cultural Adaptation. *Value Health*. 2005;8(2): 94-104.