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Translation, Cultural Adaptation, and Psychometric Validation of the Spanish (Spain) Version of the Osteoporosis Knowledge Assessment Tool (OKAT)

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Research Article

Keywords: Osteoporosis, Knowledge, Questionnaire, Validation, Psychometric propert

Posted Date: November 18th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11441473/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

The Osteoporosis Knowledge Assessment Tool (OKAT) assesses osteoporosis-related knowledge. Its use in Spain requires evaluation of its linguistic and cultural appropriateness and psychometric properties. This study aimed to translate and culturally adapt the OKAT into Spanish and evaluate its psychometric properties in a sample of women aged 50 years or older recruited from primary care centers.

Methods

The original 20-item OKAT was translated and culturally adapted into Spanish (Spain) using a forward–backward translation procedure. A multidisciplinary panel of 10 experts assessed relevance and clarity using item-level and scale-level content validity indices (I-CVI and S-CVI/Ave). Readability was evaluated using the Flesch–Szigriszt Index, interpreted according to the INFLESZ scale. The questionnaire was administered to 112 women aged 50 years or more recruited from primary care centers in Tarragona, Spain. Psychometric evaluation included item difficulty, discrimination, item-total correlations, internal consistency using the Kuder–Richardson Formula 20 (KR-20), and exploratory factor analysis. Associations between knowledge level and participant characteristics were explored.

Results

Participants had a mean age of 61.8 years (SD 11.3). S-CVI/Ave values were 0.805 for relevance and 0.815 for clarity, although 10 items fell below the prespecified I-CVI threshold for at least one dimension. Readability was classified as normal (INFLESZ = 56.7). Internal consistency was moderate (KR-20 = 0.659), with values ranging from 0.626 to 0.671 after individual item deletion. Higher knowledge was significantly associated with younger age, higher educational attainment, and seeking health or osteoporosis-related information.

Conclusions

We obtained a Spanish (Spain) version of the OKAT through translation, cross-cultural adaptation, and psychometric evaluation of the Spanish version. The OKAT-se demonstrated adequate readability and moderate internal consistency, comparable to that of the original version.

BACKGROUND

Osteoporosis is a major public health problem, particularly among women, because of its association with fragility fractures, morbidity, and mortality [1]. Preventive strategies, including adequate calcium

intake and physical activity, play an important role in maintaining bone health and reducing osteoporosis risk [2]. Osteoporosis-related knowledge and health beliefs have been associated with preventive behaviors, although these relationships may vary across populations [3, 4].

Reliable and valid assessment of osteoporosis knowledge is important in clinical practice and research to identify knowledge gaps and evaluate educational interventions. The Osteoporosis Knowledge Assessment Tool (OKAT), developed by Winzenberg et al. [5], comprises 20 items with “true,” “false,” and “don’t know” response options. It has undergone translation and cultural adaptation for different populations [6], including Chinese-speaking communities in Australia and Tamil-speaking postmenopausal women [7, 8], and has also been used to assess osteoporosis knowledge among premenopausal women in Saudi Arabia [9]. These studies illustrate its application across different linguistic and cultural settings, while highlighting the need to evaluate its measurement properties in each intended population.

The use of the OKAT in Spain requires linguistic and cultural adaptation and evaluation of its psychometric properties. A culturally adapted Spanish version would support the assessment of osteoporosis-related knowledge in this setting and facilitate comparisons with studies using other versions of the instrument.

Therefore, this study aimed to translate and culturally adapt the OKAT into Spanish (Spain) and evaluate its psychometric properties in a sample of women aged 50 years or older recruited from primary care centers.

METHODS

Study design and setting

The study comprised two stages: translation and cross-cultural adaptation of the OKAT into Spanish (Spain) [10], followed by a cross-sectional evaluation of its psychometric properties. Participants were recruited from primary care centers belonging to Xarxa Santa Tecla in Tarragona, Spain.

Participants

Women were consecutively recruited during routine clinical visits. The stated eligibility criteria were age ≥ 50 years, the ability to read and understand Spanish, and provision of informed consent. Women with cognitive impairment or an inability to complete the questionnaire were excluded.

Instrument

The Osteoporosis Knowledge Assessment Tool (OKAT) is a 20-item questionnaire that assesses osteoporosis-related knowledge, including risk factors, prevention, and treatment [4]. Each item has

three response options: “true,” “false,” and “don’t know.” Responses were scored using the original answer key: correct responses received 1 point, whereas incorrect and “don’t know” responses received 0 points. The total score ranged from 0 to 20, with higher scores indicating greater knowledge.

Translation and cultural adaptation

The Spanish (Spain) version of the OKAT was developed using a forward–backward translation procedure [10]. Two independent forward translations from English into Spanish were performed by bilingual translators, one with a healthcare background and one without. Discrepancies were discussed and resolved to produce a consensus version.

The consensus version was independently back-translated into English by two translators without access to the original questionnaire. The back-translations were compared with the original instrument to assess conceptual equivalence and identify discrepancies requiring revision (Fig. 1).

Content validity

Content validity was assessed by a multidisciplinary panel of 10 experts. Each item was independently rated for relevance and clarity using a four-point scale, ranging from 1 (not relevant/not clear) to 4 (highly relevant/highly clear).

The item-level content validity index (I-CVI) was calculated separately for relevance and clarity as the proportion of experts assigning a rating of 3 or 4. The scale-level content validity index using the averaging method (S-CVI/Ave) was calculated as the mean of the 20 I-CVI values for each dimension. An I-CVI ≥ 0.78 was considered acceptable [11].

Experts were also invited to provide qualitative comments on wording, conceptual equivalence, and clarity. These comments were reviewed by the research team before finalizing the Spanish version. Cognitive interviews with members of the target population were not conducted.

Readability

Readability was assessed using the Flesch–Szigriszt Index, interpreted according to the INFLESZ scale [12]. The calculation included only the wording of the 20 OKAT items, excluding questionnaire instructions, response options, and sociodemographic questions. Higher scores indicate greater readability.

Psychometric evaluation

Item analysis

Item difficulty was defined as the proportion of participants answering each item correctly; higher values indicate easier items. Following the original validation study, values above 0.75 were considered indicative of very easy items [5].

For item discrimination, participants were ranked by total OKAT score and divided into four approximately equal-sized groups. Discrimination was calculated as the proportion of correct responses in the highest-scoring group minus the corresponding proportion in the lowest-scoring group, multiplied by 100 and expressed in percentage points. Higher positive values indicate better discrimination.

Corrected item-total correlations were calculated between each item and the sum of the remaining 19 items. Values ≥ 0.20 were considered adequate.

Internal consistency

Internal consistency was assessed using the Kuder–Richardson Formula 20 (KR-20), calculated as the unstandardized Cronbach's alpha for the dichotomously scored items [13]. A coefficient ≥ 0.70 was considered acceptable. KR-20 was also calculated after deleting each item individually to assess its contribution to internal consistency.

Factor analysis

An exploratory one-factor model was fitted to the Pearson correlation matrix using maximum likelihood extraction without rotation. Factor loadings were examined, with values ≥ 0.30 considered acceptable. Model evaluation included the proportion of total variance explained, the likelihood-ratio chi-squared test, the Tucker–Lewis index, the root mean square error of approximation with its 90% confidence interval, and the root mean square residual. The one-factor specification was examined as an exploratory model and was not treated as prior evidence of unidimensionality.

An additional analysis using tetrachoric correlations was attempted to account for the binary nature of the items. A continuity correction of 0.5 was applied to bivariate tables containing empty cells. The resulting correlation matrix was not positive definite. No matrix smoothing was applied, and the planned tetrachoric parallel analysis was therefore not performed.

Exploratory comparisons between groups

Associations between osteoporosis knowledge and participant characteristics were explored using two groups defined by the sample median. Participants scoring > 8 were classified in the higher-knowledge group, and those scoring ≤ 8 in the lower-knowledge group. This classification represented a relative comparison within the sample rather than a validated threshold for adequate knowledge.

Statistical analysis

Continuous variables were summarized as means and standard deviations or medians and interquartile ranges, as appropriate. Categorical variables were summarized as frequencies and percentages, using non-missing observations as denominators.

Age was calculated in completed years at the time of questionnaire administration. Body mass index was calculated as weight in kilograms divided by height in meters squared.

Continuous variables were compared between knowledge groups using the Wilcoxon rank-sum test with an asymptotic approximation and continuity correction. Categorical variables were compared using Pearson's chi-squared test without continuity correction when all expected cell counts were ≥ 5; otherwise, Fisher's exact test was used. Missing values were excluded separately for each comparison without imputation.

All 112 participants provided complete responses to the 20 OKAT items and were included in the psychometric analyses. Analyses were performed using R version 4.5.1, with the psych package used for internal consistency and factor analysis. A p-value < 0.05 was considered statistically significant.

RESULTS

Translation and cultural adaptation

The translation and cross-cultural adaptation process identified differences in terminology, grammatical structure, and the interpretation of medical concepts. These differences were reviewed to preserve semantic and conceptual equivalence with the original English questionnaire. Examples included the translation of "peak bone mass" as "masa ósea máxima" and the retention of "factores de riesgo clínicos" for "clinical risk factors" to preserve the specificity of the original wording. Other linguistic adjustments aimed to improve readability while maintaining the intended meaning of the items. Key translation decisions are summarized in Supplementary Table 1.

Participant characteristics and knowledge scores

A total of 112 women completed all 20 OKAT items. Their mean age was 61.8 years (SD 11.3). The participant characteristics are presented in Table 1.

Table 1
Characteristics of the study population (n = 112)

Characteristic	Mean (SD) or n (%)[1]
Age, years	61.8 (11.3)
Height, cm	160.2 (7.3)
Weight, kg	69.5 (10.7)
Body mass index, kg/m²	27.2 (4.8)
Education level	
Primary or less	28 (25.5%)
Secondary	51 (46.4%)
University	23 (20.9%)
Postgraduate	8 (7.3%)
Missing	2
Age at menopause, years	49.1 (4.6)
Missing	15
History of fracture	
Don't know	1 (0.9%)
No	69 (62.2%)
Yes	41 (36.9%)
Missing	1
Previous bone densitometry	
Don't know	1 (0.9%)
No	64 (57.1%)
Yes	47 (42.0%)
Current osteoporosis treatment	
Don't know	1 (0.9%)
No	72 (64.3%)
Yes	39 (34.8%)

[1]Mean (SD); n (%)

The mean OKAT score was 8.67 (SD 3.23), with a median of 8 and an observed range of 0–15. Fifty-nine participants were classified in the lower-knowledge group (scores ≤ 8) and 53 in the higher-knowledge group (scores > 8).

Women in the higher-knowledge group were younger than those in the lower-knowledge group (60.3 [SD 8.6] versus 64.2 [SD 10.3] years; $p = 0.046$). Higher knowledge was also associated with higher educational attainment ($p = 0.017$), seeking health information ($p = 0.022$), and seeking osteoporosis-related information ($p < 0.001$). No statistically significant associations were observed with body mass index, age at menopause, history of fracture, previous bone densitometry, or current osteoporosis treatment (Table 2).

Table 2
Association between participant characteristics and osteoporosis knowledge level.

Characteristic	Low knowledge, n = 59[1]	High knowledge, n = 53[1]	p-value[2]
Age, years	64.2 (10.3)	60.3 (8.6)	0.046
Body mass index, kg/m²	27.7 (5.4)	26.7 (4.1)	0.5
Educational level			0.017
Primary or less	19 (32.8%)	9 (17.3%)	
Secondary	29 (50.0%)	22 (42.3%)	
Higher education	10 (17.2%)	21 (40.4%)	
Age at menopause, years	49.3 (5.0)	49.0 (4.2)	0.5
Missing	7	8	
History of fracture			0.094
Don't know	0 (0.0%)	1 (1.9%)	
No	32 (55.2%)	37 (69.8%)	
Yes	26 (44.8%)	15 (28.3%)	
Previous bone densitometry			0.10
Don't know	1 (1.7%)	0 (0.0%)	
No	29 (49.2%)	35 (66.0%)	
Yes	29 (49.2%)	18 (34.0%)	
Current osteoporosis treatment			0.4
Don't know	0 (0.0%)	1 (1.9%)	
No	36 (61.0%)	36 (67.9%)	
Yes	23 (39.0%)	16 (30.2%)	
Searches for health information			0.022
Never	28 (47.5%)	14 (26.4%)	
Ever	31 (52.5%)	39 (73.6%)	

[2]Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Data are presented as mean (standard deviation) or number (percentage). Participants were classified as having high knowledge when their OKAT score was above the median and low knowledge when their score was equal to or below the median.

Characteristic	Low knowledge, n = 59[1]	High knowledge, n = 53[1]	p-value[2]
Searches for osteoporosis information			< 0.001
Never	56 (94.9%)	37 (69.8%)	
Ever	3 (5.1%)	16 (30.2%)	

[1]Mean (SD); n (%)

[2]Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Data are presented as mean (standard deviation) or number (percentage). Participants were classified as having high knowledge when their OKAT score was above the median and low knowledge when their score was equal to or below the median.

Item analysis and internal consistency

The proportion of correct responses ranged from 7.1% for Q11 and Q18 to 90.2% for Q1. Two items, Q1 and Q4, exceeded the prespecified difficulty-index threshold of 0.75, indicating that they were very easy.

The corrected item-total correlations ranged from 0.004 to 0.405. Twelve items met the threshold of 0.20. Correlations below this threshold were observed for Q2 (0.151), Q3 (0.199), Q10 (0.071), Q11 (0.101), Q12 (0.199), Q13 (0.143), Q16 (0.004), and Q17 (0.140); Q3 and Q12 were just below the threshold.

Internal consistency was moderate (KR-20 = 0.659), below the prespecified threshold of 0.70. Individual item deletion yielded coefficients ranging from 0.626 to 0.671. The largest increase occurred after removing Q16, resulting in a KR-20 of 0.671. Removing Q10, Q13, or Q17 produced smaller increases. No individual item deletion raised the coefficient to 0.70. Despite its low proportion of correct responses, Q18 had a corrected item-total correlation of 0.234, and its removal reduced the KR-20 to 0.650 (Table 3).

Table 3
Psychometric properties of the Spanish version of the Osteoporosis Knowledge Assessment Tool (OKAT-esp).

Item	Difficulty	Discrimination (%)	Item-total correlation	KR-20 if item deleted	Factor loading
Q1	0.902	21.4	0.234	0.650	0.281
Q2	0.286	42.9	0.151	0.658	0.252
Q3	0.277	46.4	0.199	0.652	0.204
Q4	0.768	50.0	0.329	0.638	0.353
Q5	0.545	53.6	0.367	0.631	0.399
Q6	0.179	39.3	0.289	0.643	0.417
Q7	0.670	42.9	0.235	0.648	0.304
Q8	0.589	67.9	0.400	0.627	0.538
Q9	0.536	50.0	0.320	0.637	0.457
Q10	0.125	10.7	0.071	0.662	0.011
Q11	0.071	14.3	0.101	0.659	0.139
Q12	0.491	42.9	0.199	0.653	0.252
Q13	0.438	35.7	0.143	0.660	0.102
Q14	0.714	53.6	0.343	0.635	0.367
Q15	0.554	60.7	0.308	0.639	0.337
Q16	0.196	14.3	0.004	0.671	-0.002
Q17	0.393	21.4	0.140	0.660	0.195
Q18	0.071	21.4	0.234	0.650	0.250
Q19	0.402	53.6	0.275	0.643	0.401
Q20	0.464	71.4	0.405	0.626	0.518

Factor analysis

The one-factor model fitted to the Pearson correlation matrix using maximum likelihood explained 10.5% of the total variance. Factor loadings ranged from − 0.002 to 0.538, with 10 of the 20 items meeting the threshold of 0.30 (Table 3).

The model yielded a likelihood-ratio chi-squared statistic of 233.962 with 170 degrees of freedom ($p < 0.001$), a Tucker–Lewis index of 0.528, an RMSEA of 0.057 (90% CI 0.038–0.076), and an RMSR of 0.069.

These indicators provided mixed evidence of model fit and did not establish a unidimensional structure.

The additional tetrachoric correlation analysis produced a non-positive-definite matrix with three negative eigenvalues, the lowest being − 0.548. Four bivariate response tables contained an empty cell, all involving Q18. Therefore, the planned tetrachoric parallel analysis was not performed.

Content validity and readability

The S-CVI/Ave was 0.805 for relevance and 0.815 for clarity. Five items achieved complete agreement among experts for both dimensions (I-CVI = 1.00). Ten items had an I-CVI below 0.78 for relevance, clarity, or both: Q2, Q3, Q4, Q6, Q7, Q16, Q17, Q18, Q19, and Q20. The lowest relevance rating was observed for Q17 (I-CVI = 0.50), whereas the lowest clarity rating was 0.60, observed for Q16, Q18, Q19, and Q20 (Table 4).

Table 4
Content validity of the Spanish version of the OKAT

Item	I-CVI relevance	I-CVI clarity
Q1	1.0	1,0
Q2	0.7	0,90
Q3	0.6	0,70
Q4	0.6	0,90
Q5	1.0	1,00
Q6	0.7	0,70
Q7	0.9	0,70
Q8	1.0	1,00
Q9	1.0	0,90
Q10	0.8	0,80
Q11	0.9	0,90
Q12	1.0	1,00
Q13	0.8	0,80
Q14	1.0	1,00
Q15	0.8	0,80
Q16	0.6	0,60
Q17	0.5	0,80
Q18	0.8	0,60
Q19	0.7	0,60
Q20	0.7	0,60
S-CVI/Ave	**0.805**	**0.815**

I-CVI: item-level content validity index. S-CVI/Ave: average scale-level content validity index. Ratings of 3 or 4 were considered indicative of adequate relevance or clarity.

Suppelmentary Table 1. **Key translation and cross-cultural adaptation decisions for the Spanish (Spain) version of the OKAT**

The Flesch–Szigriszt Index was 56.72, corresponding to normal readability according to the INFLESZ scale.

DISCUSSION

This study translated the OKAT into Spanish, culturally adapted it for use in Spain, and evaluated its psychometric properties in women recruited from primary care centers. The OKAT-esp showed adequate readability and moderate internal consistency. Expert assessment and item-level analyses identified several items that require further evaluation, while exploratory comparisons suggested associations between osteoporosis knowledge, educational attainment, and health-information seeking. Overall, these findings provide initial evidence on the performance of the Spanish adaptation and underline the importance of examining individual items rather than relying solely on the overall internal consistency coefficient.

Internal consistency varied across language versions of the OKAT. The KR-20 of 0.659 obtained for the OKAT-esp was close to the Cronbach's alpha of 0.69 reported for the original 20-item questionnaire and slightly higher than the value of 0.57 found for the Serbian version [5, 6]. Higher coefficients were reported for the Hungarian, Arabic, and Hindi versions, with Cronbach's alpha values of 0.81, 0.824, and 0.892, respectively[14–16]. The Tamil version also reported a high overall coefficient of 0.85; however, it expanded the original questionnaire from 20 to 26 items and reorganized its content, limiting direct comparison with the OKAT-esp [8]. The Chinese cross-cultural adaptation did not report an internal-consistency coefficient and therefore cannot be included in the numerical comparison of reliability estimates [7]. Overall, these findings indicate that internal consistency varies across OKAT adaptations and should be interpreted in light of differences in questionnaire structure, target population, and study context.

Several items in the OKAT-esp showed patterns previously reported in other adaptations. Item 10, concerning whether any type of physical activity is beneficial for osteoporosis, had a low corrected item–total correlation and a near-zero factor loading. A similarly weak item–total association was reported in the original and Serbian versions, although the proportion of correct responses varied substantially across populations [5, 6]. The Hindi adaptation also reported a low proportion of correct responses and limited discrimination for this item [16]. In the present study, item 10 received favorable expert ratings for relevance and clarity. Nevertheless, expressions such as "any type" and "beneficial" may allow different interpretations and should be examined through cognitive testing.

Item 11, concerning whether osteoporosis risk can be identified from clinical risk factors, showed a very low proportion of correct responses, a weak corrected item–total correlation, and a low factor loading. Nevertheless, it received favorable expert ratings for both relevance and clarity (I-CVI = 0.90). During the adaptation process, the expression "clinical risk factors" was specifically discussed, and the term "factores de riesgo clínicos" was retained to preserve medical specificity and avoid subjective interpretation. Similar difficulties have been reported in other adaptations. In the Serbian validation, the item was judged to have insufficient content validity because it assumed that respondents already knew the clinical risk factors for osteoporosis [6]. In the Chinese adaptation, the direct translation of "clinical risk factors" was considered readable and grammatically correct but too difficult to understand [7].

Taken together, these findings suggest that, although the expression preserves clinical specificity, it may impose substantial conceptual demands on respondents. The weak performance of item 11 may therefore reflect difficulties in understanding the underlying concept rather than a problem specific to the Spanish translation.

Item 16, concerning moderate alcohol consumption, showed the lowest corrected item–total correlation and an essentially null factor loading. It also received low expert ratings for both relevance and clarity (I-CVI = 0.60 for each). Similarly low proportions of correct responses were reported in the Arabic (18.0%) and Hindi (22.6%) adaptations [14, 16]. During the Spanish adaptation, the expression “consumo moderado de alcohol” was retained as the most conceptually accurate wording. However, the item does not define “moderate” in terms of quantity or frequency. Responses may therefore reflect not only osteoporosis-related knowledge but also socially and culturally shaped norms, perceptions, and beliefs regarding alcohol consumption, as well as differing interpretations of what constitutes “moderate” consumption [17]. Although this explanation remains hypothetical, it may partly account for the item’s variable performance across populations. Deleting item 16 produced the largest increase in internal consistency, but the resulting KR-20 remained below the prespecified threshold of 0.70 (KR-20 = 0.671).

Items 13 and 17, concerning calcium and high salt intake, respectively, had low corrected item–total correlations and factor loadings; item 17 also received a low relevance rating. The Serbian version similarly reported weak item–total correlations for both items, and neither was retained in its shortened questionnaire [6]. In contrast, they showed stronger psychometric performance in the original and Hungarian versions [5, 15]. In the Chinese adaptation, item 17 was considered accurately translated, readable, and understandable, although its item-level psychometric properties were not evaluated [7]. Taken together, these heterogeneous findings suggest that the performance of these items may vary across populations and study contexts and may also be influenced by cultural interpretation, rather than indicating a consistent deficiency in the original questionnaire.

Item 18 showed a pattern closely resembling that reported in the original validation: the proportion of correct responses was very low in both studies (7.1% and 6%, respectively), whereas the corrected item–total correlations (0.234 and 0.22) and factor loadings (0.250 and 0.26) remained modestly positive [5]. In the Arabic adaptation, the proportion of correct responses increased from 4% at the initial assessment to 31% at retest, a significant difference that the authors attributed potentially to learning after the first administration, item difficulty, or lack of clarity. The Hindi adaptation also showed a higher, although still relatively low, correct-response rate of 28.4% [14, 16]. In the present study, deleting item 18 reduced the KR-20 from 0.659 to 0.650, indicating that, despite its extreme difficulty, the item contributed positively to internal consistency in this sample. Nevertheless, its low clarity rating (I-CVI = 0.60), together with the test–retest instability observed in the Arabic adaptation, suggests that its wording and interpretation warrant further investigation.

Item-level comparisons across validation studies showed that some difficulties recurred across versions, whereas others varied markedly between settings. The performance of individual OKAT items may

therefore depend on linguistic, cultural, and population characteristics. Because deleting individual items produced only small changes in internal consistency and did not increase the KR-20 above 0.70, the full 20-item questionnaire was retained to preserve content coverage and comparability with the original instrument. However, this decision does not resolve the limitations of individual items or establish that the retained scale is unidimensional or psychometrically optimal. Future revisions should therefore evaluate item comprehension, content coverage, and psychometric performance jointly.

The factorial findings provided only limited support for a single underlying dimension. The one-factor model explained a limited proportion of the variance, and only half of the items had acceptable factor loadings. Although some fit indices were relatively favorable, the overall evidence was mixed and did not support a clear unidimensional structure. These findings should also be interpreted cautiously because the analysis was based on Pearson correlations and maximum likelihood extraction, methods not specifically designed for binary indicators. An additional analysis using tetrachoric correlations yielded a non-positive-definite matrix, preventing the planned parallel analysis. Sparse response patterns may have contributed to this estimation problem, as four bivariate response tables contained an empty cell and all involved the very difficult item 18. The dimensionality of the OKAT-esp should therefore be re-examined in a larger sample using methods appropriate for binary data.

The associations with educational attainment and health information seeking were consistent with the expectation that osteoporosis knowledge differs according to educational background and exposure to information. However, these analyses were exploratory and used a sample-specific median split rather than a validated threshold for adequate knowledge. They provide preliminary evidence of expected group differences but should not be interpreted as definitive known-groups validity. Moreover, the cross-sectional design does not establish whether seeking information leads to greater knowledge or whether participants with greater knowledge are more likely to seek health information.

The study has several strengths, including a forward–backward translation procedure, evaluation by a multidisciplinary panel of 10 experts, and assessment of readability using an instrument developed for Spanish texts. The analysis also considered multiple aspects of item performance, enabling the identification of specific priorities for future refinement.

Several limitations should be acknowledged. The sample comprised 112 participants recruited from primary care centers in a single geographical area, which limits generalizability and the stability of factor-analytic estimates. Furthermore, a substantial proportion of participants reported a history of fracture, previous bone densitometry, or current osteoporosis treatment. These characteristics suggest that the sample may have been enriched with women who had previous experience with bone health-related conditions or healthcare. Such exposure could potentially influence osteoporosis knowledge and may limit the generalizability of the findings to the broader population of women aged 50 years or older. However, no statistically significant associations were observed between these characteristics and knowledge level in the present study. Differences from the younger population included in the original validation may reflect age, clinical characteristics, or previous exposure to health information, in addition

to linguistic and cultural factors [5]. Internal consistency remained below the prespecified threshold of 0.70. Cognitive interviews were not conducted; consequently, the proposed explanations for difficulties with particular items could not be examined directly with respondents. Test–retest reliability and responsiveness to change were also not assessed. These properties, together with the questionnaire's dimensionality and the comprehension of the weakest items, require further investigation before the OKAT-esp can be recommended for monitoring change after educational interventions.

In conclusion, we obtained a Spanish (Spain) version of the OKAT through translation, cross-cultural adaptation, and psychometric evaluation. The OKAT-esp demonstrated adequate readability and moderate internal consistency, comparable to that of the original version, although some items showed limitations in terms of content validity and psychometric performance. The full 20-item questionnaire was retained to preserve content coverage and comparability with other versions, as individual item deletion yielded only minor changes in internal consistency.

Declarations

Competing interests

The authors declare that they have no competing interests.

Ethics approval and consent to participate

The study was approved by the Comitè Ètic de Recerca amb Medicaments (CERm IRB CatSud), under reference number 322/2025. Informed consent was obtained from all participants prior to their inclusion in the study.

Clinical trial number

Not applicable. This study was not a clinical trial.

Funding

This research received no external funding.

Author Contribution

PC conceived the study. GFM performed the statistical analyses. PC, IA, DPC, APZ, and GFM worte the maing manuscript text and critically revising the manuscript. All authors reviewed the manuscript.

Acknowledgement

We declare that the authors used artificial intelligence to assist with English language editing and to improve the clarity and readability of the manuscript. The authors have reviewed the final manuscript and take full responsibility for the final content.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to participant confidentiality and data protection considerations but may be available from the corresponding author on reasonable request, subject to applicable ethical and data protection requirements.

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Figures

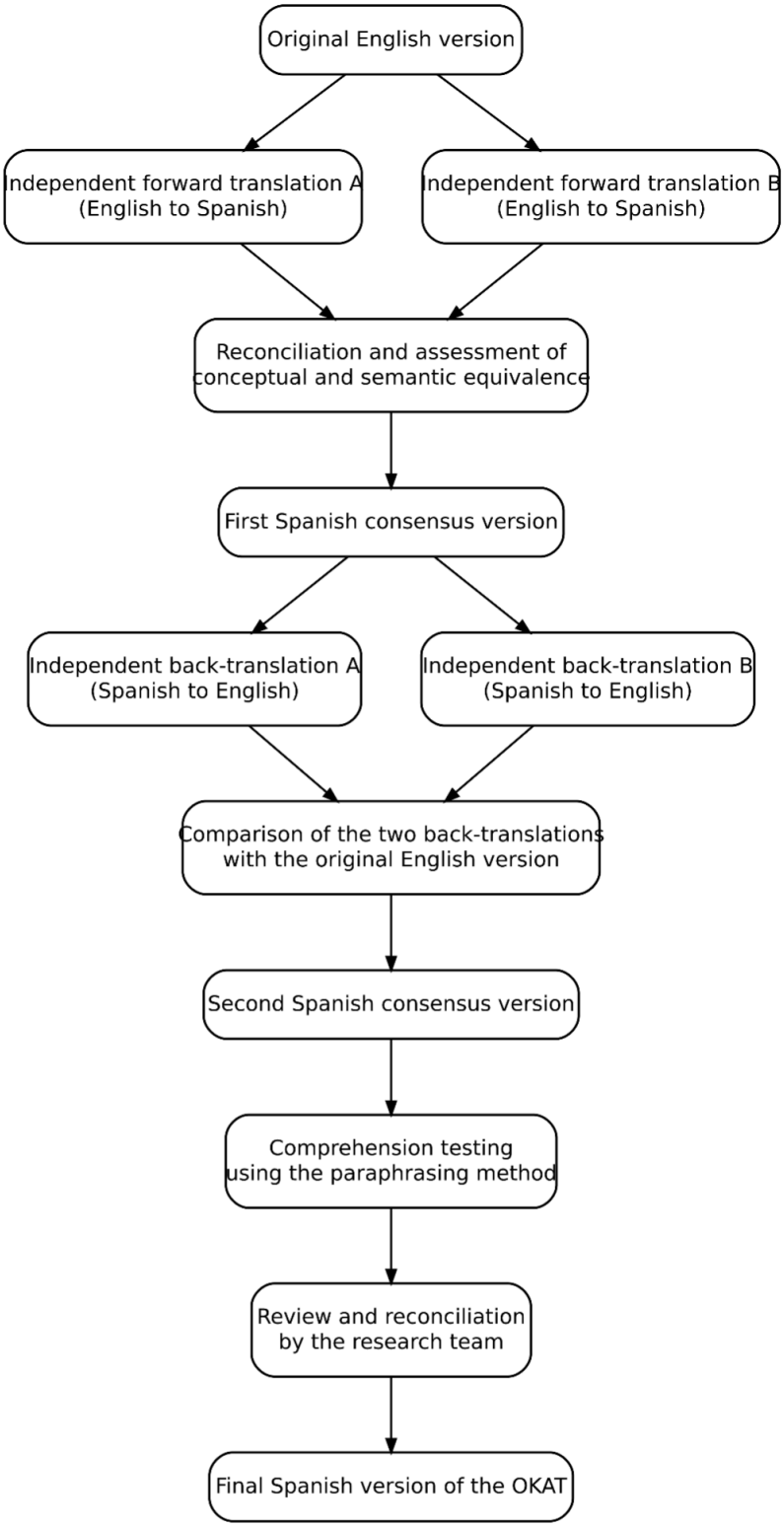


Figure 1

Translation process of the OKAT questionnaire into Spanish