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# Spanish adaptation and validation of Mishel's Uncertainty in Illness Scale (MUIS-A) in cancer patients

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## Abstract

**Purpose**: Uncertainty is a major factor affecting cancer patients throughout all stages of the disease. Given its impact, this study aimed to adapt Mishel's Uncertainty in Illness Scale (MUIS-A) into Spanish for cancer patients in Spain and to analyze the relationship between uncertainty and selected clinical and psychosocial variables.

**Methods:** A descriptive cross-sectional transcultural adaptation and psychometric validation study was conducted using a prospective convenience sample of 174 cancer patients undergoing chemotherapy and/or immunotherapy. Uncertainty, socio-family support, dependence in activities of daily living, and functional status were assessed using validated questionnaires. Principal Component Analysis (PCA) and correlational analyses were performed to examine the factorial structure and associations among variables.

**Results:** Principal Component Analysis (PCA) supported the presence of the four dimensions of the original scale in the Spanish version. The 33-item scale showed good internal consistency (Cronbach's alpha = 0.794) and an initial explained variance of 39.26%. After an iterative item reduction process to improve factor loadings, a 26-item version was obtained, maintaining the four-factor structure, acceptable reliability (Cronbach's alpha = 0.787), and increasing the total explained variance to 44.6%. The mean uncertainty score was 73.15 ± 14.41. Most patients reported adequate social support and were independent in basic activities of daily living. A significant negative association was found between social support and uncertainty ($r = -0.315$, $p < 0.001$). Additionally, a significant negative association was observed between uncertainty and the number of disease-related hospital admissions ($Z = -2.775$, $p < 0.005$).

**Conclusions:** The Spanish transcultural adaptation of Mishel's Uncertainty in Illness Scale is a reliable and valid tool for assessing uncertainty in cancer patients in Spain. Uncertainty was present in all participants and was significantly associated with socio-family support and disease-related hospital admissions. Its clinical application provides a practical resource for oncology nurses to facilitate psychosocial screening and tailor specific communication strategies.

**Keywords:** Cancer patients; Psycho-oncology; Illness uncertainty; Cross-cultural adaptation; Scale validation.

## Background

Cancer is not only one of the leading causes of mortality worldwide but also has a profound impact at both the individual and social levels. In Spain, recent data indicate a high prevalence of cancer; despite significant advances in diagnosis and treatment, the disease continues to exert substantial physical, psychological, and emotional effects on patients [1,2]. In this context, cancer-related changes often give rise to considerable psychological distress, and conditions such as depression and anxiety are common among cancer patients, with some studies reporting depression rates of up to 58% in specific groups [3]. As a response to these needs, psycho-oncology has emerged as a discipline aimed at addressing the psychological and emotional demands of patients and their families, whose experiences of cancer extend beyond physical symptoms [4].

One of the most relevant psychological factors in oncology is uncertainty, described as a cognitive state characterized by difficulty in interpreting, predicting, or making sense of the illness due to insufficient information [5]. To conceptualize and assess this phenomenon, Mishel developed a theoretical framework that identifies uncertainty as a disease-specific stressor, present throughout all stages of the cancer trajectory and particularly intensified at critical moments such as diagnosis, treatment decision-making, or the occurrence of disease-related complications. Furthermore, Mishel's theory explains how patients with chronic illness may reconstruct meaning in their lives through uncertainty [5,6]. Given its impact on psychological adjustment and quality of life, there is a clear need to accurately measure uncertainty in order to develop effective interventions that enhance patient well-being.

One of the most widely used instruments for this purpose is Mishel's Uncertainty in Illness Scale (MUIS) [7,8], which assesses patients' perceptions of uncertainty related to their illness. Originally, its theoretical structure encompasses four dimensions: ambiguity,

complexity, inconsistency, and unpredictability [7,8]. While other alternative instruments exist to measure general distress or anxiety, they lack the specific theoretical foundation regarding illness uncertainty provided by Mishel. Furthermore, the MUIS has shown strong evidence of validity and has been translated into various languages within oncology settings globally [9,10].

However, although several adaptations of this scale exist, the literature highlights the need for cultural adaptation and validation in different contexts to ensure adequacy and applicability. Most psychometric instruments in this field were developed in different linguistic and cultural settings, which may limit their use in specific populations [11-13]. The transcultural adaptation of measurement scales is therefore essential not only to ensure validity and reliability within the target population but also to enable cross-cultural comparisons and support the development of intervention strategies tailored to patients' real needs [14,15]. The added value of the present study lies in providing a rigorously adapted tool for the Spanish socio-cultural and healthcare context, where a specific and validated version of this scale was previously lacking.

Accordingly, the aim of the present study was to adapt and validate Mishel's Uncertainty in Illness Scale – Adult Form (MUIS-A) a specific instrument for assessing uncertainty in cancer patients in Spain, ensuring its validity, reliability, and clinical usefulness. The findings are expected to contribute to improved assessment of the psychological impact of cancer and to facilitate the development of more precise and effective interventions aimed at optimizing the quality of life of cancer patients.

## Methods

**Design:** This study employed a cross-sectional, transcultural adaptation and psychometric validation design aimed at translating, culturally adapting, and evaluating the initial measurement properties of the MUIS-A in Spanish cancer patients. The study design and reporting followed the STROBE guidelines [16] for observational studies and the COSMIN recommendations [17] for assessing the measurement properties of health-related instruments.

**Participants:** Participants were prospectively recruited using convenience sampling between December 2023 and March 2024 during their chemotherapy sessions at the Day Hospital units of Cruces University Hospital and Galdakao Hospital (Bizkaia, Spain).

**Selection criteria (inclusion/exclusion**): Inclusion criteria were: being aged 18 years or older, having a diagnosis of a solid tumor, undergoing active chemotherapy and/or immunotherapy treatment in the day hospital setting, and providing written informed consent. Exclusion criteria included: absence of a cancer diagnosis, previous participation in the study, diagnosis of dementia or a significantly impaired mental status, language barriers that prevented adequate comprehension, and refusal to provide informed consent.

**Sample size and recruitment**: Sample size was determined following the COSMIN guidelines for assessing structural validity. According to these criteria, a sample size is considered "adequate" when it includes ≥ 5 participants per item and a minimum ≥ 100 subjects [17-19]. Given that the original MUIS-A scale comprises 33 items, a minimum target of 165 participants was established.

**Variables**: Sociodemographic and clinical data were collected, including age, sex, tumor location, date of diagnosis, disease-related hospitalizations, educational level, marital status, employment status, religious beliefs, living arrangements, and having dependent family members.

**Assessment tools**: Validated instruments were used to assess uncertainty, socio-family support, independence in basic activities of daily living (BADL), and functional status.

Uncertainty was measured using the adult version of Mishel's Uncertainty in Illness Scale (MUIS-A). The original instrument consists of 33 items distributed across four theoretical dimensions: ambiguity, complexity, inconsistency, and unpredictability [7,8]. Items are rated on a 5-point Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'), with 13 items requiring reverse scoring (items 6, 7, 9, 12, 17, 18, 22, 25, 27, 28, 30, 32, and 33) according to the original scale manual. The overall score is calculated by summing the responses, yielding a total that ranges from 33 to 165, where higher scores indicate a greater level of perceived illness uncertainty. Describing this original 33-item structure is key for comparability, as psychometric refinement in specific cultural contexts may affect item retention.

**Procedure**: The process of adaptation and validation of the MUIS-A scale consisted of several stages:

- ***Phase 1: Translation and back-translation***
  This initial phase was conducted to ensure the validity of the instrument in a cultural context different from the original. Standardized guidelines were followed, including the use of at least two independent forward translations of each item [11]. The forward translations were performed by a native Spanish translator and subsequently reviewed by an expert committee in the field until a preliminary version of the scale was obtained.
  To ensure equivalence with the original version, a native English translator performed the back-translation. The back-translated version was then compared with the original scale to assess semantic and conceptual equivalence. An expert committee composed of professionals in medicine, psychology, nursing, and occupational therapy reviewed the results and refined the items to achieve the highest possible equivalence with the original instrument, resulting in a second version of the scale.
- ***Phase 2: Pilot testing***
  The aim of this phase was to identify and correct potential issues in the instrument using a sample of 20 participants who met the study criteria. Prior to administration, patients completed a readability questionnaire to assess perceived text difficulty. In addition, a formal readability analysis was conducted using the Flesch–Szigriszt index with the INFLESZ software to evaluate reading difficulty and text comprehension [20,21]. The INFLESZ index scores are interpreted using the following standard thresholds: <40 (very difficult), 40–55 (somewhat difficult), 55–65 (normal), 65–80 (fairly easy), and >80 (very easy).
- ***Phase 3: Recruitment and data analysis***
  After completion of the pilot testing, the second version of the scale was established as the final version and used during the general recruitment phase. Participants were recruited at two hospitals in the province of Bizkaia during their chemotherapy sessions.

Following data collection, all information was entered into a database and subsequently analyzed.

**Statistical analysis**: First, a descriptive analysis of the sample's sociodemographic characteristics and of each measurement instrument used in the study was performed. The normality of variable distributions was assessed using the Kolmogorov–Smirnov test ($p < 0.05$) at the beginning of the analysis. Spearman's correlation coefficient was used to examine associations between uncertainty and the other variables. Comparisons between groups were conducted using the Mann–Whitney U test and the Kruskal–Wallis test, as appropriate. A 95% confidence interval was applied to determine statistical significance, with p values < 0.05 considered statistically significant. Data analysis was performed using IBM SPSS Statistics, version 28.

**Psychometric analysis**: The psychometric properties of the MUIS-A scale were evaluated by analyzing reliability and validity. Internal consistency was assessed using Cronbach's alpha coefficient. Although McDonald's omega is increasingly recommended to avoid the assumption of tau-equivalence, it is mathematically formulated based on the common factor model (EFA/CFA) where shared variance is explicitly modeled. Since this preliminary validation design utilized a Principal Component Analysis (PCA) as a data-reduction technique that accounts for total variance, computing omega ($\omega$) from component loadings would introduce a methodological mismatch. Therefore, Cronbach's alpha was employed in this study to maintain strict statistical alignment with the component structure and to preserve comparability with the original MUIS-A validation and previous international adaptations [7,26]. Reliability analyses were restricted to the total score level; given the exploratory nature of this initial adaptation and the sample size constraints, subscale-level internal consistency and omega coefficients were not computed, prioritizing the global score for clinical interpretation. Values above 0.70 were considered indicative of adequate internal consistency. Content validity was assessed using Lawshe's method, with the participation of 12 experts in the field of oncology and psychology. Each expert evaluated the relevance and clarity of the 33 items on a 3-point scale ('essential', 'useful but not essential', and 'not necessary'). The Content Validity Ratio (CVR) was calculated for each item; according to Lawshe's critical values, a minimum CVR of 0.56 is required for a panel of 12 judges to ensure agreement beyond chance. Items with a CVR below this threshold were qualitatively reviewed for potential adjustment or removal. The overall Content Validity Index (CVI) was calculated as the mean of the CVR values of the items retained in the final scale, yielding a value of 0.58. This represents the minimum acceptable level of expert agreement according to Lawshe's critical values for a 12-judge panel, and therefore this finding warrants cautious interpretation regarding the relevance and clarity of the items.

Construct validity was assessed through factor analysis. The suitability of the data for factor analysis was evaluated using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. Subsequently, the dimensional structure was explored. Given the known structural variations of this scale across different transcultural adaptations, an exploratory data-reduction approach was prioritized over an advanced confirmatory one. Therefore, a Principal Component Analysis (PCA) based on a Pearson correlation matrix was explicitly selected as a preliminary data reduction technique to maximize total variance explained and identify the most robust items for the Spanish clinical context. This approach was strictly distinguished from Exploratory Factor Analysis (EFA), which models latent constructs based on shared variance. Given the sample size constraints, a robust

Confirmatory Factor Analysis (CFA) interpreted alongside advanced criteria like the Sample-Size Adjusted Bayesian Information Criterion (SSABIC) was formally deferred for future larger-sample studies. Factor retention was determined using the Kaiser criterion (eigenvalues > 1). An orthogonal Varimax rotation was applied to maximize the variance of the loadings within components, aiming to obtain independent subscales that facilitate simpler clinical interpretation, acknowledging that this assumes dimensional independence. The iterative item reduction process was based on factor loadings; items with loadings below 0.40 or those loading strongly on multiple conceptually discordant factors were flagged for removal to optimize the final variance explained.

## Results

### Pilot study

The pilot study was conducted in a sample of 20 participants undergoing chemotherapy and/or immunotherapy at a hospital in the province of Bizkaia, during their treatment sessions in the Day Hospital unit. Of the total sample, 65% were women and 35% were men. The mean age was 64.65 years (range: 38–81 years), and the most frequent tumor type was breast cancer.

Internal consistency analysis demonstrated coherence among items, with a Cronbach's alpha coefficient of 0.858. Lawshe's Content Validity Index yielded a value of 0.58, indicating good content validity. Statistically significant associations were found between the MUIS-A and the Duke-UNC, Katz Index, and Karnofsky Performance Status scales.

The INFLESZ readability index yielded a score of 71.28, corresponding to a "easy-to-read" level of reading difficulty.

### Statistical analysis of the final sample

General recruitment was carried out in two hospitals in the province of Bizkaia between December 2023 and March 2024. During this period, a total of 225 patients were initially approached. Of these, 10 met the exclusion criteria, 2 did not meet the inclusion criteria, and 39 declined participation. Consequently, a total of 174 participants were included in the final sample, of whom 52.9% were women and 47.1% were men. The mean age was 62.27 years (range: 18–83 years).

Most participants were married (70.1%), and 55.7% were retired. Regarding educational level, only 1.1% reported having no formal education. At the time of the study, 87.4% of participants were living with other people, and 30.5% reported having dependent family members. Approximately half of the patients reported at least one disease-related hospital admission. The most frequent tumor type was lung cancer (37 cases), followed by breast and colorectal cancer (29 and 28 cases, respectively). The remaining sociodemographic characteristics are presented in Table 1.

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **AGE (YEARS)** | | |
| Mean (Standard Deviation) | 62.67 (12.42) | -- |
| Range | 18 - 83 | -- |

| | | |
|---|---|---|
| **SEX** | | |
| Female | 92 | 52.9% |
| Male | 82 | 47.1% |
| **MARITAL STATUS** | | |
| Married / Domestic partner | 122 | 70.1% |
| Single | 25 | 14.4% |
| Widowed | 18 | 10.3% |
| Separated / Divorced | 9 | 5.2% |
| **EMPLOYMENT STATUS** | | |
| Retired | 97 | 55.7% |
| On sick leave | 46 | 26.4% |
| Unemployed | 13 | 7.5% |
| Disability | 10 | 5.7% |
| Active | 8 | 4.6% |
| **Educational Level** | | |
| Vocational Training | 50 | 28.7% |
| Secondary | 44 | 25.3% |
| Primary | 42 | 24.1% |
| University | 36 | 20.7% |
| No formal education | 2 | 1.1% |
| **Living Arrangement** | | |
| Living with others | 152 | 87.4% |
| Living alone | 22 | 12.6% |
| **Dependents** | | |
| No | 121 | 69.5% |
| Yes (Dependent family members) | 53 | 30.5% |
| **Disease-related Hospitalization** | | |
| Yes (At least one admission) | 92 | 52.9% |
| No | 82 | 47.1% |
| **Tumor Location (Top 3)** | | |
| Lung | 37 | 21.3% |
| Breast | 29 | 16.7% |
| Colorectal | 28 | 16.1% |
| Pancreas | 13 | 7.5% |
| Ovary | 12 | 6.9% |
| Gastric | 11 | 6.3% |
| Esophagus | 8 | 4.6% |
| Renal | 6 | 3.4% |
| Oral / Hepatic | 5 | 2.9% |
| Prostate | 5 | 2.9% |
| Bladder | 4 | 2.3% |
| Uterine | 3 | 1.7% |
| Sarcoma / Unknown primary | 2 | 1.1% |
| Trachea / Testicular / Brain / Melanoma | 1 | 0.6% |

*Table 1. Sociodemographic and clinical characteristics of the final sample*

Regarding the clinical and functional status of the participants (Table 2), the perceived social support measured by the Duke-UNC-11 scale showed a mean score of 51.98 (SD = 5.594). Functional status, as assessed by the Katz Index, yielded a mean of 0.26 (SD = 0.943). Similarly, the Karnofsky Performance Status (KPS) with a mean value of 89.14 (SD = 11.166). These findings suggest that the sample generally maintained a preserved functional state and adequate social support during the study period.

| Scale | Mean | SD | Range | Minimum | Maximum |
|---|---|---|---|---|---|
| Duke-Unc | 51,98 | 5,594 | 28 | 27 | 55 |
| Katz | 0,26 | 0,943 | 6 | 0 | 6 |
| Karnofsky | 89,14 | 11,166 | 50 | 50 | 100 |

*Table 2. Descriptive statistics of the study instruments*

The mean perceived uncertainty score among participants was 73.15 (SD: 14.411).

Uncertainty levels were calculated using quartiles, resulting in three categories. High levels of uncertainty were reported by 24.7% of the sample, while 25.8% reported low levels and 49.2% reported moderate levels of uncertainty. Scores from the remaining assessment instruments are presented in Table 3.

| COMPONENT MATRIX | | | | | | ROTATED COMPONENT MATRIX | | | |
|---|---|---|---|---|---|---|---|---|---|
| ITEMS | Components | | | | ITEMS | Components | | | |
| | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 |
| 1 | **0,551** | -0,319 | **0,404** | 0,262 | 1 | 0,275 | **0,692** | 0,049 | 0,285 |
| 2 | **0,605** | 0,117 | -0,238 | 0,023 | 2 | **0,575** | -0,060 | 0,139 | 0,288 |
| 3 | 0,392 | 0,331 | 0,328 | -0,301 | 3 | 0,131 | 0,095 | **0,651** | 0,106 |
| 4 | 0,117 | 0,320 | -0,103 | -0,154 | 4 | 0,096 | -0,261 | 0,258 | 0,077 |
| 5 | **0,629** | -0,132 | 0,036 | -0,156 | 5 | **0,554** | 0,264 | 0,242 | 0,055 |
| 6 | **0,491** | -0,085 | -0,174 | -0,203 | 6 | **0,544** | 0,036 | 0,148 | -0,026 |
| 7 | 0,258 | 0,257 | 0,169 | 0,274 | 7 | 0,010 | 0,089 | 0,156 | **0,451** |
| 8 | 0,364 | **-0,457** | 0,303 | 0,149 | 8 | 0,229 | **0,628** | -0,075 | 0,049 |
| 9 | **0,485** | 0,192 | -0,071 | 0,003 | 9 | 0,380 | -0,025 | 0,234 | 0,278 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | **0,498** | -0,034 | -0,274 | -0,283 | 10 | **0,602** | -0,079 | 0,177 | -0,068 |
| 11 | **0,709** | -0,122 | -0,237 | 0,014 | 11 | **0,719** | 0,115 | 0,044 | 0,202 |
| 12 | 0,125 | 0,065 | 0,221 | -0,003 | 12 | -0,024 | 0,155 | 0,188 | 0,095 |
| 13 | **0,488** | -0,190 | 0,080 | 0,068 | 13 | 0,390 | 0,329 | 0,056 | 0,149 |
| 14 | **0,476** | 0,255 | 0,372 | -0,327 | 14 | 0,201 | 0,193 | **0,673** | 0,083 |
| 16 | 0,029 | **0,471** | -0,270 | -0,005 | 16 | 0,042 | **-0,472** | 0,148 | 0,222 |
| 17 | 0,143 | 0,341 | -0,218 | 0,381 | 17 | 0,067 | -0,254 | -0,086 | **0,503** |
| 18 | **0,464** | 0,060 | 0,135 | **0,546** | 18 | 0,190 | 0,293 | -0,060 | **0,640** |
| 19 | **0,646** | -0,158 | -0,208 | 0,056 | 19 | **0,655** | 0,147 | -0,007 | 0,195 |
| 20 | 0,044 | 0,351 | 0,123 | -0,261 | 20 | -0,062 | -0,159 | **0,423** | 0,000 |
| 21 | -0,292 | **0,461** | 0,147 | 0,294 | 21 | **-0,479** | -0,210 | 0,065 | 0,358 |
| 22 | **0,605** | -0,032 | -0,145 | -0,276 | 22 | **0,635** | 0,076 | 0,244 | -0,036 |
| 23 | 0,376 | **0,435** | 0,191 | -0,291 | 23 | 0,158 | -0,069 | **0,632** | 0,150 |
| 24 | **0,430** | 0,188 | 0,260 | 0,186 | 24 | 0,138 | 0,231 | 0,270 | **0,422** |
| 25 | 0,306 | **0,570** | 0,039 | 0,144 | 25 | 0,061 | -0,204 | 0,361 | **0,516** |
| 26 | **0,454** | 0,151 | -0,313 | 0,195 | 26 | **0,449** | -0,148 | -0,027 | 0,375 |
| 27 | -0,047 | 0,210 | -0,332 | 0,111 | 27 | 0,054 | -0,359 | -0,123 | 0,147 |
| 28 | **0,499** | 0,228 | 0,179 | -0,183 | 28 | 0,294 | 0,104 | **0,489** | 0,176 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 29 | **0,435** | -0,389 | **0,575** | 0,129 | 29 | 0,139 | **0,799** | 0,130 | 0,115 |
| 30 | 0,337 | **0,470** | 0,177 | 0,289 | 30 | 0,014 | -0,010 | 0,298 | **0,601** |
| 31 | 0,274 | -0,124 | -0,366 | 0,398 | 31 | 0,359 | -0,035 | -0,386 | 0,323 |
| 32 | **0,520** | -0,334 | -0,158 | -0,051 | 32 | **0,592** | 0,235 | -0,062 | -0,020 |
| 33 | **0,530** | -0,108 | **-0,456** | -0,038 | 33 | **0,689** | -0,111 | -0,084 | 0,083 |

*Table 3. Component matrix and rotated component matrix of the **initial 33-item version of the** Spanish-adapted Mishel's Uncertainty in Illness Scale (MUIS-A)*

**Psychometric analysis of the final sample**

The Cronbach's alpha coefficient for the 33-item MUIS-A scale was 0.794, indicating good internal consistency. The slight decrease compared to the pilot study (α = 0.858) is an expected variation reflecting the substantial difference in sample sizes (n = 20 versus n = 174). Face and content validity were assessed during the pilot study, confirming that the scale items were appropriate and representative of the construct being measured.

The Kaiser–Meyer–Olkin (KMO) measure yielded a value of 0.781, and Bartlett's test of sphericity was significant ($\chi^2 = 1651.389$, df = 528, $p < 0.001$), indicating that the data were suitable for factor analysis.

Mishel's original scale comprises four dimensions (ambiguity, complexity, inconsistency, and unpredictability). In the preliminary Principal Component Analysis (PCA) used as a data-reduction step, items were initially associated with the proposed dimensions, with each factor grouping items measuring a common construct. However, some items loaded onto multiple factors. To achieve stronger and more interpretable associations, varimax rotation was applied, improving factor interpretability (Table 4). The total variance explained by this solution was 39.257%.

| **ROTATED COMPONENT MATRIX** | | | | |
|---|---|---|---|---|
| **ITEMS** | **Components** | | | |
| | **1** | **2** | **3** | **4** |
| 1 | 0,239 | **0,731** | 0,063 | 0,245 |
| 2 | **0,543** | 0,035 | 0,182 | 0,262 |
| 3 | 0,107 | 0,078 | **0,664** | 0,113 |
| 5 | **0,548** | 0,274 | 0,265 | 0,055 |
| 6 | **0,530** | 0,048 | 0,126 | -0,011 |
| 7 | -0,039 | 0,143 | 0,237 | 0,392 |
| 8 | 0,189 | **0,653** | -0,065 | -0,02 |
| 10 | **0,617** | -0,075 | 0,089 | 0,03 |
| 11 | **0,715** | 0,162 | 0,079 | 0,194 |
| 14 | 0,166 | 0,164 | **0,742** | 0,040 |
| 16 | 0,089 | **-0,513** | 0,077 | 0,317 |
| 17 | 0,102 | -0,189 | -0,188 | **0,580** |

| | | | | |
|---|---|---|---|---|
| 18 | 0,170 | 0,340 | -0,024 | **0,600** |
| 19 | **0,630** | 0,201 | 0,108 | 0,150 |
| 20 | -0,062 | -0,196 | **0,429** | 0,010 |
| 21 | **-0,486** | -0,210 | 0,060 | 0,357 |
| 22 | **0,624** | 0,066 | 0,310 | -0,042 |
| 23 | 0,145 | -0,060 | **0,657** | 0,141 |
| 24 | 0,128 | 0,267 | 0,221 | **0,449** |
| 25 | 0,075 | -0,208 | 0,332 | **0,572** |
| 26 | **0,468** | -0,081 | -0,096 | 0,421 |
| 28 | 0,290 | 0,134 | **0,473** | 0,179 |
| 29 | 0,098 | **0,819** | 0,147 | 0,061 |
| 30 | -0,015 | 0,025 | 0,321 | **0,586** |
| 32 | **0,595** | 0,270 | -0,078 | 0,03 |
| 33 | **0,697** | -0,063 | -0,056 | 0,085 |

*Table 4. Rotated component matrix of the refined 26-item version of the Spanish-adapted Mishel's Uncertainty in Illness Scale (MUIS-A)*

After rotation, several items did not show strong loadings on any of the proposed dimensions. To improve the factorial structure and increase explained variance, an iterative item-reduction process was conducted. Specifically, seven items were excluded during this refinement: items 4, 9, 12, 13, 15, 27, and 31. Items 4, 9, 12, 13, 15, and 27 were removed because they failed to reach the minimum factor loading of 0.40, whereas item 31 was excluded due to high cross-loadings across multiple components without clear theoretical coherence. This refinement significantly improved the conceptual clarity of the four-factor solution. A new principal component analysis was then conducted. This resulted in a refined 26-item scale yielding a four-factor solution with eigenvalues of 5.58, 2.34, 2.15, and 1.51, respectively, all exceeding the Kaiser criterion of 1. Regarding this 26-item final matrix, item 7 reached a factor loading of 0.392 on Component 4. Although marginally below the 0.40 threshold, it was intentionally retained due to its clinical and theoretical relevance within the ambiguity dimension of Mishel's framework. This final structure showed a Cronbach's alpha of 0.787 and a total explained variance of 44.6%. Although this variance explained is relatively modest, it is consistent with the complex, multidimensional nature of the uncertainty construct in clinical settings. The reduction prioritizes a more parsimonious and clinically applicable tool for Spanish cancer patients. The final Spanish-adapted version of Mishel's Uncertainty in Illness Scale (MUIS-A), consisting of 26 items, is presented in Supplementary Material 1.



Analysis of associations between uncertainty and the study variables revealed statistically significant relationships between uncertainty and the number of disease-related hospital admissions (Mann–Whitney U test, $p = 0.006$), as well as between uncertainty and perceived social support ($p < 0.001$). These relationships were inversely proportional. No statistically significant associations were found between uncertainty and the remaining variables included in the study.

## Discussion

### Translation and Cross-Cultural Adaptation

The results of this study support and reinforce the validity and reliability of the Spanish version of the Mishel's Uncertainty in Illness Scale – Adult Form (MUIS-A) in cancer patients,

highlighting its clinical usefulness as a tool for assessing perceived uncertainty throughout the disease trajectory. Consistent with the original version and other international adaptations, the scale demonstrated a coherent factorial structure and adequate internal consistency, supporting its transcultural applicability.

Findings related to sociodemographic characteristics indicate that the diversity of the sample, tumor locations, and participants' age are comparable to those reported in previous studies on uncertainty in cancer patients [22,23].

Although no association was observed between tumor type and uncertainty in the present study, this result is consistent with the heterogeneity described in the literature. Studies such as that by Rodríguez-González et al. [24] have shown that uncertainty is more strongly related to disease stage than to tumor type, with higher levels observed in more advanced stages.

### Association with Psychosocial and Clinical Factors

One of the most relevant findings was the relationship between uncertainty and disease-related hospital admissions, in which a negative association was observed: a higher number of hospitalizations was associated with lower levels of perceived uncertainty. This finding can be interpreted within Mishel's theoretical framework, according to which greater access to structural sources—namely, healthcare resources and information provided by health professionals—contributes to reducing uncertainty. Previous studies support this interpretation, emphasizing the importance of interventions during hospitalization, such as providing a supportive environment and clear communication, to enhance patients' sense of control and reassurance [25].

Similarly, perceived social support, assessed using the Duke-UNC scale, showed a statistically significant inverse association with uncertainty, in line with Mishel's theoretical model and subsequent research. These findings suggest that lower levels of socio-family support are associated with higher uncertainty, whereas a strong support network may act as a protective factor against this cognitive state [26, 27].



### Reliability and Psychometric Performance

Regarding the MUIS-A scale, the mean uncertainty score observed in this study (73.15) was comparable to those reported in other international investigations, such as those by Zhang (70.04) and Lee and Park (83) [9, 10]. The internal consistency of the scale can be considered adequate in both the initial 33-item version and the refined 26-item version, supporting the stability of the instrument following the exploratory process of item reduction.

### Construct Validity and Factorial Structure

As in Mishel's original scale, items in the present study were grouped into four dimensions identified through Principal Component Analysis (PCA). However, the factorial configuration showed some differences compared with the original structure, reflecting the exploratory nature of this adaptation. These differences, which may be explained by cultural, linguistic, and contextual factors specific to the Spanish sociocultural environment and healthcare system, as described in other transcultural adaptations. These differences may simultaneously reflect meaningful contextual adaptation to the Spanish healthcare system and constitute a psychometric limitation of the instrument in this population.

In this regard, the cultural adaptation process revealed relevant nuances in the interpretation of certain items, underscoring that scale adaptation should not be limited to literal linguistic translation but should also consider the cultural, healthcare, and experiential context of patients.

## Limitations and Future Research Directions

From a clinical perspective, the availability of a validated Spanish version of the MUIS-A allows oncology nurses to identify patients with high levels of uncertainty more accurately. This is particularly relevant in units such as day hospitals or chemotherapy administration areas, where nurses can use the scale to detect patients who may require more intensive informational support or specific psycho-educational interventions to reduce their cognitive stress.

From a methodological standpoint, a primary limitation lies in the factor-analytic strategy. As per COSMIN guidelines, adapting an instrument with a known theoretical structure typically requires a Confirmatory Factor Analysis (CFA) to test model fit. However, driven by the exploratory aim of reducing the instrument to its most robust and clinically useful items in the Spanish context, a Principal Component Analysis (PCA) was utilized. Consequently, structural validity was assessed from a purely exploratory and data-reduction perspective, meaning the strict preservation of Mishel's latent original structure cannot be entirely claimed without future confirmatory studies. Additionally, due to these exploratory constraints and the limited sample size, internal consistency (alpha and omega) was not calculated at the subscale level. This restricts the current capacity to use individual dimensions independently, meaning the instrument should be interpreted using the total score until further confirmatory psychometric evaluations are conducted. Furthermore, the present study did not include a formal assessment of convergent and discriminant validity at the factor level through metrics such as the Average Variance Extracted (AVE). While the PCA provides a preliminary grouping, further research is required to confirm the statistical independence of the identified dimensions.

Among other limitations of the study is the subjective nature of the uncertainty construct, from both the patient's and the researcher's perspectives. In addition, although participants were recruited from different hospitals, with balanced representation by sex and a wide age range, the sample was limited to a single geographic area, and the reliance on a convenience sample from specific day hospitals may introduce potential selection bias, which further restricts the generalizability of the findings. Furthermore, although the sample size met the minimum 'participants per item' threshold according to COSMIN guidelines, it remains relatively small for robust factor-analytic procedures, which limits the strength of the evidence regarding the structural validity of the scale. To overcome this limitation and strengthen model validation, future multi-center research should employ robust Confirmatory Factor Analyses (CFA) evaluated through advanced statistical standards, such as the Sample-Size Adjusted Bayesian Information Criterion (SSABIC). Replication of the validation in other clinical and cultural contexts is therefore recommended to strengthen the applicability of the scale. Furthermore, the cross-sectional design allows assessment of patients' emotional state at a single time point, restricting deeper inferences about the progression and fluctuation of uncertainty over time. Future studies could employ longitudinal designs to evaluate the scale's sensitivity to change and to examine the evolution of uncertainty throughout the cancer trajectory. Moreover, while our current focus on social

support and hospital admissions provided valuable initial associations, future investigations should broaden the scope of psychosocial variables by incorporating other critical factors, such as patient coping mechanisms and health-related quality of life.

Finally, the findings open the door to the development of more targeted clinical interventions aimed at reducing uncertainty in cancer patients. Further research into coping strategies and psychosocial support is warranted in order to design interventions that enhance psychological well-being and improve the quality of life of patients.

The cultural adaptation carried out in this study highlights the importance of considering not only linguistic translation but also the healthcare, social, and cultural context, as these factors directly influence item interpretation and patients' perception of uncertainty. This approach is essential to ensure that the instrument accurately reflects patients' subjective experiences in real clinical practice.

## Conclusion

The Spanish version of the Mishel's Uncertainty in Illness Scale (MUIS-A) demonstrates adequate psychometric properties and is a valid and reliable tool for assessing uncertainty in cancer patients in Spain. The PCA yielded four components that are conceptually interpretable within Mishel's framework; however, structural equivalence with the original model remains to be examined through Confirmatory Factor Analysis in future research. The use of this scale enables the identification of unmet psychological needs and supports the development of targeted psychosocial interventions, contributing to the reduction of the emotional impact associated with uncertainty throughout the cancer trajectory. In conclusion, despite these inherent limitations, this study represents the first rigorous effort to adapt and validate the Spanish version of the MUIS-A for cancer patients. It provides oncology nurses and psycho-oncologists with a reliable, parsimonious, and practically applicable screening tool to detect cognitive distress and tailor communication strategies. Ultimately, this work establishes a solid psychometric baseline that will guide future longitudinal, multi-center, and confirmatory research in Spanish-speaking oncological care.



## Declarations

### Abbreviations

- **BADL**: Basic activities of daily living.
- **CEIm**: Comité de Ética de la Investigación con medicamentos (Ethics Committee for Research with Medicines).
- **COSMIN**: Consensus-based Standards for the selection of health Measurement Instruments.
- **IBM SPSS**: International Business Machines Statistical Package for the Social Sciences.

- **INE**: Instituto Nacional de Estadística (National Statistics Institute).
- **KMO**: Kaiser–Meyer–Olkin measure of sampling adequacy.
- **MUIS**: Mishel's Uncertainty in Illness Scale.
- **MUIS-A**: Mishel's Uncertainty in Illness Scale – Adult Form.
- **ORCID**: Open Researcher and Contributor ID.
- **PCA:** Principal Component Analysis.
- **SD**: Standard Deviation.
- **SEOM**: Sociedad Española de Oncología Médica (Spanish Society of Medical Oncology).
- **STROBE**: Strengthening the Reporting of Observational Studies in Epidemiology.

**Ethics approval and consent to participate**

The study was approved by the Ethics Committee for Research with Medicines (CEIm) of Euskadi, Spain (reference code: PI2023056). All participants provided written informed consent prior to participation. All procedures were performed in accordance with institutional and national ethical standards and the 1964 Helsinki Declaration and its later amendments.

**Consent for publication**

All data are reported in aggregate form and no individual-level data are presented, and therefore participantlevel consent for publication is not required.



**Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

**Funding**

No funding was received for conducting this study.

**Authors' contributions**

**MGI**: Conceptualization, Methodology, Investigation, Project administration, Writing – original draft, Writing – review & editing. **EJFR**: Conceptualization, Formal analysis, Methodology, Supervision, Writing – review & editing. **CSG**: Investigation, Methodology, Project administration, Writing – original draft. EFS: Conceptualization, Clinical supervision, Resources, Writing – review & editing. **MIRG**: Investigation, Data curation, Project administration. JJCH: Investigation, Resources, Writing – review & editing. All authors read and approved the final manuscript.

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Table 1. *Descriptive statistics of the study instruments*

| Scale | Mean | SD | Range | Minimum | Maximum |
|---|---|---|---|---|---|
| Duke-Unc | 51,98 | 5,594 | 28 | 27 | 55 |
| Katz | 0,26 | 0,943 | 6 | 0 | 6 |
| Karnofsky | 89,14 | 11,166 | 50 | 50 | 100 |

*Table 2. Component matrix and rotated component matrix of the Spanish-adapted Mishel's Uncertainty in Illness Scale (MUIS-A)*

| COMPONENT MATRIX | | | | | | ROTATED COMPONENT MATRIX | | | |
|---|---|---|---|---|---|---|---|---|---|
| ITEMS | Components | | | | ITEMS | Components | | | |
| | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 |
| 1 | **0,551** | -0,319 | **0,404** | 0,262 | 1 | 0,275 | **0,692** | 0,049 | 0,285 |
| 2 | **0,605** | 0,117 | -0,238 | 0,023 | 2 | **0,575** | -0,060 | 0,139 | 0,288 |
| 3 | 0,392 | 0,331 | 0,328 | -0,301 | 3 | 0,131 | 0,095 | **0,651** | 0,106 |
| 4 | 0,117 | 0,320 | -0,103 | -0,154 | 4 | 0,096 | -0,261 | 0,258 | 0,077 |
| 5 | **0,629** | -0,132 | 0,036 | -0,156 | 5 | **0,554** | 0,264 | 0,242 | 0,055 |
| 6 | **0,491** | -0,085 | -0,174 | -0,203 | 6 | **0,544** | 0,036 | 0,148 | -0,026 |
| 7 | 0,258 | 0,257 | 0,169 | 0,274 | 7 | 0,010 | 0,089 | 0,156 | **0,451** |
| 8 | 0,364 | **-0,457** | 0,303 | 0,149 | 8 | 0,229 | **0,628** | -0,075 | 0,049 |
| 9 | **0,485** | 0,192 | -0,071 | 0,003 | 9 | 0,380 | -0,025 | 0,234 | 0,278 |
| 10 | **0,498** | -0,034 | -0,274 | -0,283 | 10 | **0,602** | -0,079 | 0,177 | -0,068 |
| 11 | **0,709** | -0,122 | -0,237 | 0,014 | 11 | **0,719** | 0,115 | 0,044 | 0,202 |
| 12 | 0,125 | 0,065 | 0,221 | -0,003 | 12 | -0,024 | 0,155 | 0,188 | 0,095 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13 | **0,488** | -0,190 | 0,080 | 0,068 | 13 | 0,390 | 0,329 | 0,056 | 0,149 |
| 14 | **0,476** | 0,255 | 0,372 | -0,327 | 14 | 0,201 | 0,193 | **0,673** | 0,083 |
| 16 | 0,029 | **0,471** | -0,270 | -0,005 | 16 | 0,042 | **-0,472** | 0,148 | 0,222 |
| 17 | 0,143 | 0,341 | -0,218 | 0,381 | 17 | 0,067 | -0,254 | -0,086 | **0,503** |
| 18 | **0,464** | 0,060 | 0,135 | **0,546** | 18 | 0,190 | 0,293 | -0,060 | **0,640** |
| 19 | **0,646** | -0,158 | -0,208 | 0,056 | 19 | **0,655** | 0,147 | -0,007 | 0,195 |
| 20 | 0,044 | 0,351 | 0,123 | -0,261 | 20 | -0,062 | -0,159 | **0,423** | 0,000 |
| 21 | -0,292 | **0,461** | 0,147 | 0,294 | 21 | **-0,479** | -0,210 | 0,065 | 0,358 |
| 22 | **0,605** | -0,082 | -0,145 | -0,276 | 22 | **0,635** | 0,076 | 0,244 | -0,036 |
| 23 | 0,376 | **0,435** | 0,191 | -0,291 | 23 | 0,158 | -0,069 | **0,632** | 0,150 |
| 24 | **0,430** | 0,188 | 0,260 | 0,186 | 24 | 0,138 | 0,231 | 0,270 | **0,422** |
| 25 | 0,306 | **0,570** | 0,039 | 0,144 | 25 | 0,061 | -0,204 | 0,361 | **0,516** |
| 26 | **0,454** | 0,151 | -0,313 | 0,195 | 26 | **0,449** | -0,148 | -0,027 | 0,375 |
| 27 | -0,047 | 0,210 | -0,332 | 0,111 | 27 | 0,054 | -0,359 | -0,123 | 0,147 |
| 28 | **0,499** | 0,228 | 0,179 | -0,183 | 28 | 0,294 | 0,104 | **0,489** | 0,176 |
| 29 | **0,435** | -0,389 | **0,575** | 0,129 | 29 | 0,139 | **0,799** | 0,130 | 0,115 |
| 30 | 0,337 | **0,470** | 0,177 | 0,289 | 30 | 0,014 | -0,010 | 0,298 | **0,601** |
| 31 | 0,274 | -0,124 | -0,366 | 0,398 | 31 | 0,359 | -0,035 | -0,386 | 0,323 |
| 32 | **0,520** | -0,334 | -0,158 | -0,051 | 32 | **0,592** | 0,235 | -0,062 | -0,020 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 33 | **0,530** | -0,108 | **-0,456** | -0,038 | 33 | **0,689** | -0,111 | -0,084 | 0,083 |

*Table 3. Rotated component matrix of the Spanish-adapted Mishel's Uncertainty in Illness Scale (MUIS-A)*

| ROTATED COMPONENT MATRIX | | | | |
|---|---|---|---|---|
| **ITEMS** | **Components** | | | |
| | **1** | **2** | **3** | **4** |
| 1 | 0,239 | **0,731** | 0,063 | 0,245 |
| 2 | **0,543** | 0,035 | 0,182 | 0,262 |
| 3 | 0,107 | 0,078 | **0,664** | 0,113 |
| 5 | **0,548** | 0,274 | 0,265 | 0,055 |
| 6 | **0,530** | 0,048 | 0,126 | -0,011 |
| 7 | -0,039 | 0,143 | 0,237 | 0,392 |
| 8 | 0,189 | **0,653** | -0,065 | -0,02 |
| 10 | **0,617** | -0,075 | 0,089 | 0,03 |
| 11 | **0,715** | 0,162 | 0,079 | 0,194 |
| 14 | 0,166 | 0,164 | **0,742** | 0,040 |
| 16 | 0,089 | **-0,513** | 0,077 | 0,317 |
| 17 | 0,102 | -0,189 | -0,188 | **0,580** |
| 18 | 0,170 | 0,340 | -0,024 | **0,600** |
| 19 | **0,630** | 0,201 | 0,108 | 0,150 |
| 20 | -0,062 | -0,196 | **0,429** | 0,010 |
| 21 | **-0,486** | -0,210 | 0,060 | 0,357 |
| 22 | **0,624** | 0,066 | 0,310 | -0,042 |
| 23 | 0,145 | -0,060 | **0,657** | 0,141 |
| 24 | 0,128 | 0,267 | 0,221 | **0,449** |
| 25 | 0,075 | -0,208 | 0,332 | **0,572** |
| 26 | **0,468** | -0,081 | -0,096 | 0,421 |
| 28 | 0,290 | 0,134 | **0,473** | 0,179 |
| 29 | 0,098 | **0,819** | 0,147 | 0,061 |
| 30 | -0,015 | 0,025 | 0,321 | **0,586** |
| 32 | **0,595** | 0,270 | -0,078 | 0,03 |
| 33 | **0,697** | -0,063 | -0,056 | 0 0,085 |