



## Knowledge, attitudes, behavioral and organizational factors of health professions students for a competent smoking cessation practice: An instrument adaptation and psychometric validation study in Spanish and English samples

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### ABSTRACT

**Background:** To improve smoking cessation, training of health professions students is essential. However, no specific instrument is available to assess factors that may affect students' learning about smoking cessation practice.

**Aim:** To adapt and validate the Knowledge, Attitudes, Behaviors and Organization questionnaire in the population of undergraduate health professions students.

**Design:** Methodological research.

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**Methods:** The researchers conducted this study with 511 Spanish and 186 English health professions students from four different universities. We used a four-step approach: 1) adaptation of the items to the target population and validation of the content by a panel of experts; 2) a pilot study to test face validity; 3) linguistic adaptation of the Spanish version to English; and 4) the psychometric assessment based on construct validity, criterion validity and internal consistency.

**Results:** Exploratory factor analysis revealed four subscales for the Spanish version, namely 'Individual knowledge and skills', 'Individual attitudes and beliefs', 'Organizational support' and 'Organizational resources', which accounted for 85.1% of the variance. Confirmatory factor analysis in the holdout Spanish and English samples revealed adequate goodness-of-fit values, supporting the factor structure. Hypotheses testing demonstrated significant differences by capacitation in smoking cessation interventions and degree courses, providing further evidence regarding construct validity. All the subscales correlated positively with the criterion variables (5 A's smoking cessation model), except for the 'Organizational resources' subscale, which was not significantly correlated with the 5 A's. The overall Cronbach's alpha was .83 for the Spanish version and .88 for the English one.

**Conclusions:** Our results provide empirical support for the use of the Knowledge, Attitudes, Behaviors and Organization questionnaire for Students as a reliable and valid instrument to assess knowledge, attitudes, behaviors and organization perceptions in health professions students, which is essential for competent smoking cessation practice. Interestingly, 'Organizational resources' subscale presented the lowest correlations among factors and did not correlate with any component of the 5 A's, suggesting the need of enhancing students' responsibility and involvement during their internships, as well as the interest of some organizations.

## 1. Introduction

Nowadays, tobacco use is one of the greatest public health threats, responsible for nearly 8 million deaths annually worldwide (World Health Organization, 2022). Healthcare professionals have a great potential to promote and assist in the reduction of tobacco use (Warren et al., 2008). Although providing brief advice or intensive counselling increases quit probability by 30% and 84%, respectively, the help offered for smoking cessation by health professionals is insufficient (Duaso et al., 2017).

To improve the tobacco cessation interventions, it is essential that health professions students are trained (Hyndman et al., 2019; Sreeramreddy et al., 2018). Higher education is not only the most appropriate time for capacitation on the hazards of tobacco (Zhang et al., 2021), but also for improving attitudes and skills to learn and implement smoking cessation interventions (Zhang et al., 2020).

Prior literature has explored students' knowledge and perception of smoking cessation counselling, their attitudes and behaviors toward their role in smoking cessation and what training they received during their education (Martínez et al., 2021). The results of this study reveal that nursing students report that they lack sufficient knowledge to assess and treat tobacco dependence and that they rarely receive training on these topics. Fukada et al. (2018) pointed out that knowing students' perception of their self-competence and learning needs is crucial for their correct professional development. However, studies assessing smoking cessation content and training in the curricula of health professions degrees (Forman et al., 2017) suggest that there is still a gap in assessing students' self-perceptions of their knowledge, attitude, practice and skills in tobacco cessation. This issue emerges the importance of monitoring tobacco cessation competencies through reliable tools to detect shortcomings factors and areas for improvement.

Only a few instruments have been designed to assess factors affecting the implementation of smoking cessation practices among healthcare professionals (Andrés et al., 2019; Hasan et al., 2019; Newhouse et al., 2011; Tsai et al., 2019). One of these instruments is the Smoking Cessation Counseling Scale (SCCS) that measures evidence-based smoking cessation counseling processes following the 5 A recommendations (Asking about tobacco use, Advice to quit, Assessing willingness to make quitting attempts, Assisting in quitting attempt and Arranging for follow-up). The instrument has been applied in clinical practice allowing the assessment of smoking cessation counseling activities performed by nurses (Newhouse et al., 2011). Other available questionnaire is the Providers' Smoking Cessation Training Evaluation (ProSCiTE), also based on the 5 A's model. This valid and reliable tool

was developed to measure knowledge, attitude, self-efficacy, behavior and barriers tobacco-related policy and smoking cessation-related programs in Malaysia (Hasan et al., 2019). Finally, the Knowledge, Attitudes, Behaviors and Organization questionnaire (KABO) is a reliable and valid tool to assess a myriad of individual and contextual factors related to the provision of smoking cessation services among healthcare professionals (Andrés et al., 2019). The KABO original was developed following the concepts proposed by Sheffer to assess cognitive and behavioral factors such as: motivation, knowledge, self-efficacy, perceived relevance of providing intervention on tobacco cessation, effectiveness, importance of barriers, preparedness and resources (Sheffer et al., 2009). Also, the KABO included organizational factors (Chatdokmaiprai et al., 2017). More specifically, the concept of "Knowledge" has been associated with understanding the health side effects of smoking, the benefits of quitting smoking and the pharmacological and/or behavioral treatments for smoking cessation (Park et al., 2019). The concept "Attitudes" refers to empathy and self-confidence in giving smoking cessation advice is described, as well as awareness of the role of the health professional in helping to quit smoking (Park et al., 2019). The concept "Behaviors" or skills relates to the ability to offer motivational and self-confidence strategies, have counseling and stress management techniques, as well as relapse prevention tools (Park et al., 2019). Finally, the last concept of "Organizations" was designed to explore professionals' perceptions of the clinical environment and organizational characteristics and barriers, both in terms of organizational support and resources (such as lack of protocols, patient education materials or pharmacological aids, as well as assessing social support from supervisors and/or co-workers) (Andrés et al., 2019; Chatdokmaiprai et al., 2017).

In recent years, many studies have been interested in examining these concepts, especially knowledge, attitudes and skills, to determine the effectiveness and impact of different tobacco cessation training programs for health professions students (Aldiabat et al., 2022; Nduaguba et al., 2018; Park et al., 2019). In addition, the Global Health Professions Student Survey has been extensively applied to study tobacco-related training received to provide counselling and cessation techniques (Iyer et al., 2019); and an adaptation has used to explore related attitudes (Martínez et al., 2021). However, to our knowledge, there is no instrument specifically designed to assess individual (knowledge, skills, attitudes) and contextual (clinical placements) factors that may affect students learning about smoking cessation services delivery so far.

Therefore, the main aim of the current study was to adapt and psychometrically validate the "Knowledge, Attitudes, Behaviors and

Organization Questionnaire”, in Spanish and English health professions undergraduate students (KABO\_S). According to the Standards for educational and psychological testing (American Educational Research Association, 2014) and the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN; Mokkink et al., 2010), the validation of an instrument consists of accumulating evidence to support the use and interpretation of scores. This study specifically aimed to provide evidence regarding i) content validity, ii) construct validity throughout the examination of structural validity, hypotheses testing and cross-cultural validity, iii) criterion validity throughout the relationship between the construct measured and the 5 A’s model and iv) reliability throughout internal consistency.

## 2. Methods

### 2.1. Design

This is a validation study with a cross-sectional design. It involves four major steps: Step one entailed adapting the item to the target population and their content validation. Step two included a pilot study to test face validity. Step three referred to the translation and back-translation of the newly adapted Spanish version KABO\_Students (KABO\_S) questionnaire into English. Finally, the fourth step provided psychometric information on construct validity, criterion validity and reliability in the Spanish and English samples of health sciences students.

This study was part of a larger European project, which sought to design, implement and evaluate the effectiveness of an online innovative training program in Brief Intervention for smoking cessation in health sciences students.

### 2.2. Instrument

#### 2.2.1. KABO questionnaire

The KABO questionnaire, developed by Andrés et al. (2019), is a self-report measure designed to assess factors relevant to smoking cessation implementation practices. It consists of 26 items scored on an 11-point Likert-type scale that are organized into seven subscales related to the dimensions developed by Sheffer et al. (2009) to measure cognitive, behavioral and attitudinal factors and environment and organizational factors (Freund et al., 2009; Leitlein et al., 2012; Sarna et al., 2009; Sheffer et al., 2009): ‘Individual skills’ (items 1–6), ‘Individual attitudes and beliefs’ (items 7–10), ‘Individual commitment’ (items 11–13), ‘Beliefs about patient readiness to quit’ (items 14–17), ‘Positive organizational support’ (items 18–21), ‘Organizational resources’ (items 22–24) and ‘Organizational endorsement’ (items 25 and 26). Items 28, 33–35, 37–39 and 43–48 are scored inversely. Higher scores on the subscales indicate higher levels of support and implementation of smoking cessation practices. For this study, the adaptation and translation of the instrument was carried out from the Spanish version developed by Andrés et al. (2019). Psychometric testing of this version, validated in 702 health-care professionals, had sound validity properties, explaining 69.7% of the variance and presented satisfactory internal consistency with an overall Cronbach’s alpha coefficient of .88, ranging subscales from .67 to .88.

### 2.3. Step I: Item adaptation and content validation

Consisted of adapting the items of the KABO questionnaire (Spanish) for health professions students and validating their content in terms of clarity by the judgment of experts. The interdisciplinary panel of experts consisted of seven people, six women and one man. Six of them were nurses and university professors specialized in the fields of public health and mental health, while the remaining member was a clinical psychologist specialized in tobacco control. These experts were selected based on their years of practice and professional background in smoking

cessation, which includes clinical experience and/or research background with projects and publications in refereed journals. In addition, they met the criteria of availability, motivation and impartiality in accordance with the requirements outlined by Escobar-Pérez and Martínez-Cuervo, (2008). A four-point Likert scale (1 = Not clear, 2 = Needs major revision, 3 = Clear but needs minor revision and 4 = Very clear) was applied (Polit et al., 2007), as well as free-text spaces for additional modifications. We calculated the content validity index for each dimension (S-CVI/Ave – scale-level content validity index, averaging calculation method; acceptable limit  $>.90$ ) and for each item (I-CVI; acceptable limit  $>.78$ ) with the modified kappa concordance index ( $k^*$ ; acceptable limit  $>.60$ ) (Polit and Beck, 2017). We also reconsidered the items that did not meet the minimum standards and did not reach a percentage of total agreement regarding consistency.

### 2.4. Step II: Pilot study and face validity

During October 2020, we conducted a qualitative study to analyze face validity with a sample of six nursing students. They received the KABO\_S and an additional open-ended question to provide feedback on the formal and functional aspects of each item and the instrument.

### 2.5. Step III: Translation of the Spanish version into English

We made the translation of the KABO\_S into English in accordance with the International Test Commission Guidelines for Translating and Adapting Tests (International Test Commission, 2010). First, two bilingual expert nurses with extensive experience in the tobacco cessation field conducted the forward translation of the original Spanish version into English. Second, a native Spanish speaker back-translated this first English version and any differences between both versions were discussed and resolved by consensus between the native Spanish speaker who did the back-translation and the original translators. Back-translation is a common practice in translation quality assurance to ensure that any differences or discrepancies between translations are solved by agreement and that the final translation accurately reflects the meaning and intent of the original text (International Test Commission, 2010). Finally, to confirm that the instrument was clear and understandable, two other English-speaking nurses who had not been involved in the translation procedure reviewed the English KABO\_S. We also conducted cultural adaptations during this process to ensure the tool appropriateness for the target population.

### 2.6. Step IV: Psychometric evaluation in Spanish and English samples

We conducted the construct validity, criterion validity and internal consistency analyses to provide psychometric guarantee of the Spanish and English versions of the KABO\_S.

#### 2.6.1. Settings

The data were collected between February and April 2021. Four leading international universities participated, three of which are located in Spain (University of Navarra, University of Barcelona and University of Lleida) and one in the United Kingdom (Florence Nightingale Faculty of Nursing, Midwifery & Palliative Care).

#### 2.6.2. Participants

A total of 697 health professions students participated in the study, of whom 511 completed the Spanish version of the questionnaire and 186 the English version. We conducted the study using a convenience sample of health professions students from different courses and centers to ensure representativeness. We carried out the estimation of a minimum sample of 135 students for both versions following guidelines for factorial techniques (Streiner and Norman, 2008). Additionally, we followed the recommendations of Lloret et al. (2014) who advise a sample size of 300–500 participants for very good performance of

factorial techniques.

Table 1 reflects participants' characteristics. For the Spanish sample, most were female (84.9%), with a mean age of 21.8 years ( $SD = 4.5$ ), nursing students (96.5%) on their third year (74.0%) and 11.5% reported previous smoking cessation training. Regarding smoking status, 27.8% of the Spanish participants were tobacco smokers, both daily and occasionally.

For the English sample, most were female (95.2%), with a mean age of 24.9 years ( $SD = 7.5$ ), nursing students (97.3%) on their second year (97.2%) and 12.9% had been previously trained on smoking cessation. In relation to the smoking status, 18.3% of the English students were tobacco users, both daily and occasionally.

2.6.3. Data collection and study procedures

We administered the KABO\_S questionnaire accompanied by a sociodemographic data form in a digital format to be filled out online. The sociodemographic form prepared by the researchers recorded information on the several variables including age, gender, bachelor's degree, academic year, smoking status and prior training in smoking cessation practices.

Along with the sociodemographic form, we also asked about their level of performance on each of the 5 A's (Ask, Advise, Assess, Assist and Arrange) in their role as a student during their clinical internship, to assess the implementation of the brief smoking cessation intervention. Each item was measured according to its level of implementation on a 11-point Likert scale from 0 ("Not at all/Never") to 10 ("Completely/Always").

One member of the research team informed undergraduate students about the study and requested their collaboration in the recruitment

**Table 1**  
Sociodemographic characteristics of the Spanish and English samples.

Variables	Spanish sample		English sample	
	Mean (SD)	n (%)	Mean (SD)	n (%)
Age (years old)	21.8 (4.5)		24.9 (7.5)	
Gender				
Female		434 (84.9%)		177 (95.2%)
Male		73 (14.3%)		8 (4.3%)
Other		4 (0.8%)		1 (0.5%)
Bachelor degree				
Nursing		493 (96.5%)		181 (97.3%)
Medicine		18 (3.5%)		1 (0.5)
Psychology		0		2 (1.1%)
Others		0		2 (1.1%)
Course				
1st		0		4 (2.2%)
2nd		126 (24.7%)		182 (97.8%)
3th		378 (74.0%)		0
4th		7 (1.3%)		0
6th		0		0
Training in smoking cessation				
Yes		59 (11.5%)		24 (12.9%)
No		452 (88.5%)		162 (87.1%)
Tobacco use				
Daily		49 (9.59%)		10 (5.38%)
Occasionally		93 (18.20%)		24 (12.90%)
Never smoke		285 (55.77%)		127 (68.28%)
Ex-smoker		84 (16.44%)		25 (13.44%)

Note. SD = standard deviation

process. Participants who volunteered to participate were asked to sign a consent form.

2.6.4. Data analysis

We conducted a descriptive analysis of all the items to evaluate the appropriateness of the items for inclusion to factorial analysis through acceptability and internal consistency. We estimated acceptability based on scores distribution: missing data < 5%, ceiling and floor effects < 15% (Terwee et al., 2007), theoretical range of the scores against the observed range being similar (Streiner and Norman, 2008) and skewness from - 1 to + 1 (Viladrich et al., 2016). We determined the internal consistency using the corrected item-total correlation (acceptable limit  $\geq .2$  (Ebel, 1965)).

We tested construct validity in terms of structural validity and hypotheses testing. Structural validity refers to the degree to which the scores of the instrument are an adequate reflection of the dimensionality of the construct to be measured (Mokkink et al., 2010). We tested the structural validity through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). With the total Spanish sample, we used a random splitting approach to divide the sample into two subsamples of equal size (50% of all cases) and thereby guarantee that each subsample was representative of the original sample and reduce the risk of bias or systematic error (Lorenzo-Seva, 2022; Mondo et al., 2021). We used the first Spanish subsample to perform an EFA and the second to conduct a CFA for validating the EFA structure. Due to the sample size of the English population and taking into account the recommendations of Lloret et al. (2014), we conducted only a CFA with the total English sample to test whether the internal structure fitted the model obtained in the factorial analysis with the Spanish sample. For running the EFA (iterated principal factor extraction method), we used the Kaiser-Meyer-Olkin (KMO) test ( $> .80$ ) to define sampling adequacy and we checked it with the Bartlett test (Viladrich et al., 2016). The criteria for factor extraction were eigenvalue > 1, scree plot and Horn's parallel analysis (Horn, 1965). The criteria for item selection included (i) factor loadings ( $> .40$ ) (Ratray and Jones, 2007), (ii) communalities ( $> .30$ ) and (iii) absence of cross-loads (Viladrich et al., 2016). Given the psychological nature of the measured construct, we applied an oblique rotation method (promax) (Lloret et al., 2014). Regarding the CFA, we applied the unweighted least squares (ULS) estimation method, taking into consideration that data both in the Spanish subsample and the English sample did not fit multivariate normality. We also evaluated goodness of fit using the comparative fit index (CFI), Tucker-Lewis Index (TLI), the Relative Noncentrally Index (RNI) and the standardized root mean square residual (SRMR). According to Hu and Bentler (1999), values equal or higher to 0.95 reflect a good fit to the model in the goodness-of-fit indices, whereas values below 0.08 are acceptable for the residual variance of the model (SRMR).

Hypothesis testing for construct validity refers to the degree to which the scores are consistent with hypotheses based on the assumption that the instrument validly measures the construct of interest (Mokkink et al., 2010). To do this, we compared mean scores among predefined groups. Based on previous evidence, specific hypotheses were: (a) students who had received prior smoking cessation training would have higher levels of knowledge, skills and attitudes compared with students who had not (Hayes et al., 2015; Schwindt et al., 2019); and (b) students in higher grades would have higher levels of these aspects compared with those from lower courses (Martínez et al., 2021). We undertake comparisons using t-testing and U-Mann Whitney. The significance level was set at 5%.

We further validated the KABO\_S in terms of criterion validity that refers to the degree to which the scores are an adequate reflection of a "gold standard" (Mokkink et al., 2010). We assessed criterion validity through Pearson correlation analysis between the KABO\_S scores and the 5 A's smoking intervention model to explore how students' competence contributes to the implementation of each component of the model. The 5 A's is a referent model in providing smoking cessation



services. The 5 A's model has been proposed by evidence-based guideline and has been adopted by several international health care organizations (Agency for Healthcare Research and Quality, 2012; Andrés et al., 2019; Fiore and Baker, 2011).

Finally, we assessed the reliability, that is the degree to which the measurement is free from measurement error and the interrelatedness among the items (Mokkink et al., 2010). We tested reliability of the instrument and of each factor in terms of internal consistency, with Cronbach alpha values of .70 to .95 considered acceptable (Terwee et al., 2007) and through corrected item-total correlation (acceptable >.30) (Streiner and Norman, 2008).

We used STATA 12.0 for descriptive and correlational analyses and for conducting the EFA. Also, we performed the CFA using IBM SPSS Amos.

### 3. Results

#### 3.1. Item adaptation and content validation

The S-CVI/Ave values ranged from .82 to 1.00, five of the seven indexes being higher than .90 (See Table 2). The I-CVI values ranged from .71 to 1.00 and  $k^*$  indices were excellent, except for five good items (I-CVI = .71;  $k^*$  = .65). Based on the reported ratings and comments, we made modifications to both the syntactic and semantic statements. Experts suggested adding a new additional item in the 'Organizational resources dimension' ('Resources and self-help materials needed to promote smoking cessation were lacking').

This step resulted in the preliminary Spanish version of the KABO questionnaire adapted for students (KABO\_S). It comprised 27 items with a 11-point Likert scale grouped into seven dimensions: 'Individual knowledge and skills' (items 1–6), 'Individual attitudes and beliefs' (items 7–10), 'Individual commitment' (items 11–14), 'Beliefs about patient readiness to quit' (items 15–17), 'Positive organizational support' (items 18–21), 'Organizational resources' (items 22–25) and 'Organizational endorsement' (items 26–27). Items assessing knowledge, skills and attitudes ranged from 0 = none to 10 = high; and the remaining items measuring commitment, beliefs and organization perceptions ranged from 0 = totally disagree to 10 = totally agree.

#### 3.2. Pilot study and face validity

All participants noted that the instructions and the items were clear

**Table 2**  
Evaluation of content validity index by clarity criteria.

Dimensions	No. of items	I-CVI <sup>a</sup> (range)	Evaluation <sup>b</sup> ( $k^*$ ) <sup>c</sup>	S-CVI/Ave <sup>d</sup>
1. Knowledge and individual skills	6	.71–1.00	Good - Excellent	.93
2. Attitudes and beliefs	4	.71–1.00	Good - Excellent	.82
3. Individual commitment	4	.71–1.00	Good - Excellent	.89
4. Beliefs patients desire/readiness to quit	3	1.00	Excellent	1.00
5. Positive organizational support	4	.71–1.00	Good - Excellent	.94
6. Organizational resources	4	.86–1.00	Excellent	.97
7. Organizational endorsement	2	.86–1.00	Excellent	.93

I-CVI (item content validity index) = No. of experts who rated the item with a 3 or 4 / No. of experts (Polit and Beck, 2017). b Evaluation criteria  $k^*$ : Excellent = .75–1.00; Good = .60–.74; Fair = .40–.59; Poor = <.40. c  $k^*$  (modified kappa index) = (I-CVI- $p_c$ )/(1- $p_c$ ) |  $p_c$  (probability of occurrence) = [N!/(N-A)!] × 0.5 N, N = No. of experts; A = No. of experts who agree to rate a 3 or 4 (Polit et al., 2007). d S-CVI/Ave (scale content validity index average) = I-CVI average (Polit and Beck, 2017).

and understandable. Five participants said that the questionnaire was short, simple and easy to administer. None of them suggested any changes.

#### 3.3. Translation of the Spanish version into English

The translation process resulted in the preliminary version of the instrument in English. This version included a slight cultural adaptation, more specifically in item 4 related to clinical practice guidelines. In particular, we removed the Spanish entities that propose national clinical practice guidelines from the English version, leaving only the reference to the international NICE guideline.

#### 3.4. Psychometric validation in Spanish and English samples

##### 3.4.1. Spanish version

**3.4.1.1. Items analysis.** The acceptability and internal consistency parameters for the Spanish version are in Supplementary Table S1. There was no missing data. The floor effect was present for six items (22.2%) and the ceiling effect for 10 items (37.0%). All the items covered the theoretical full range. Six items (22.2%) were asymmetric. In contrast, the corrected item-total correlations were greater than .20 for 19 items (70.1%), resulting in the deletion of seven items (11, 14–17, 26 and 27) due to their weakening of construct representativeness. We retrained one item (23) because it was considered theoretically important (Rattray and Jones, 2007).

##### 3.4.2. Structural validity

EFA was first conducted on the retained 20 items with oblique rotation in half of the Spanish sample (n = 255). Data screening indicated that the measure of sampling adequacy was sufficiently high for factor analysis (KMO = .833) and the Bartlett test of sphericity ( $\chi^2 = 3.106.51$ ,  $df = 190$ ,  $p < .001$ ) indicated that the correlation matrix was not an identity matrix and was therefore also suitable for application. Kaiser criteria and the scree-plot test suggested a four-factor structure accounting for 78.5% of the total variance, converging with the parallel analysis.

Based on these results, we applied a four-factor solution (See Supplementary Table S2 and Table S3). The stepwise procedure resulted in the elimination of items 12, 13 and 18 due to their communality (.257, .263 and .193, respectively). We decided to retain item 22 (communality = .240) because of their content importance after discussion among the research group (Doval and Viladrich, 2016).

The final 17 items, which were retained for a second factor analysis, yielded a four-factor solution (eigenvalues > 1), accounting for 85.12% of the total variance (Table 3). We noted the compliance of items in subscales based on the comparison of the content of the statements and the conceptual framework of the original KABO questionnaire. The four subscales were: 'Individual knowledge and skills' (factor 1), 'Individual attitudes and beliefs' (factor 2), 'Organizational support' (factor 3) and 'Organizational resources' (factor 4). Correlations between factors are presented in Supplementary Table S4.

The CFA assessed the fit of data to this four-factor structure using the other half of the Spanish sample (n = 256). For this four-factor model, CFI = .976, TFI = .972 and RNI = .976, whereas SRMR = .048. Standardized regression weights of items to their corresponding factor ranged from .432 to .931. Consequently, data indicated a good fit to the four-factor model found in the EFA. It has to be noted that the standardized regression weight of the 'Organizational resources' subscale (factor 4) to the second-order factor was low (–.176), whereas standardized regression weight was higher to .514 in the other subscales.

##### 3.4.3. Hypothesis testing

Our hypotheses were partially confirmed. Results indicated that

**Table 3**  
Exploratory factor analysis of the Spanish version of the KABO\_S.

	Factor loading			
	F1	F2	F3	F4
1 Knowledge about different smoking cessation interventions	<b>.837</b>	.028	-.016	-.007
2 Preparedness for offering help	<b>.856</b>	.048	-.001	-.014
3 Preparedness in recommending smoking cessation drugs	<b>.838</b>	-.025	.040	.020
4 Familiar with practical guidelines for smoking cessation	<b>.774</b>	-.075	.010	.013
5 Familiar with recommending smoking cessation resources	<b>.815</b>	-.015	-.001	-.008
6 Knowledge and skills about performing smoking cessation	<b>.861</b>	.092	-.001	.004
7 Motivation to help patients stop smoking	-.044	<b>.652</b>	.001	.070
8 Confidence in overcoming difficulties	-.020	<b>.835</b>	.020	-.004
9 Self-confidence in the ability to assist patients to quit	.096	<b>.793</b>	.005	.009
10 Self-confidence in the capacity to motivate smokers to quit	.028	<b>.898</b>	.007	-.046
19 Quitting interventions are required by my practice area	.040	-.077	<b>.637</b>	.157
20 Having support to provide help quitting smoking	-.033	.037	<b>.915</b>	-.017
21 Receiving positive assessment from my practice area	.042	.101	<b>.698</b>	-.086
22 Helping to quit smoking was not protocolised <sup>a</sup>	.015	-.071	.101	<b>.452</b>
23 Lack of drug resources needed to help quit smoking <sup>a</sup>	.011	.103	-.150	<b>.709</b>
24 Lack of resources and self-help materials <sup>a</sup>	-.010	-.044	.072	<b>.856</b>
25 Lack of records for monitoring smoking cessation actions <sup>a</sup>	-.006	.043	.023	<b>.863</b>
Eigen value	6.00	2.41	1.74	1.33
% Explained variance	44.47	17.90	12.87	9.88
% Cumulative variance	44.47	62.37	75.24	85.12

<sup>a</sup>: Inverted scores

health professions students who received prior training in smoking cessation practices and those that were in higher year of degree had higher scores with significant differences in all subscales, except for ‘Organizational resources’ (Table 4). This means that students who received capacitation and those from higher year of degree have significantly better levels of knowledge, skills and attitudes and higher organizational support.

**3.4.4. Criterion validity**

Correlations among the Spanish KABO\_S and the 5 A’s components

**Table 4**  
Hypothesis testing: Spanish and English version KABO\_S questionnaire sensitivity throughout known-groups method.

	Individual knowledge and skills		Individual attitudes and beliefs		Organizational support		Organizational resources		Total score	
	M (SD)	t/z	M (SD)	t/z	M (SD)	t/z	M (SD)	t/z	M (SD)	t/z
Spanish version										
Training in smoking cessation										
Yes (n = 59)	27.3 (11.1)	5.4 * *	29.2 (6.9)	3.4 * *	17.6 (7.7)	3.8 * *	24.3 (8.9)	0.1	98.5 (21.6)	5.4 * *
No (n = 452)	18.7 (11.7)		25.5 (8.0)		13.5 (7.9)		24.2 (9.2)		81.8 (22.3)	
Course degree										
Second year (n = 126)	16.6 (10.9)	-3.3 *	23.4 (8.3)	-4.1 * *	10.8 (7.6)	-5.1 * *	24.9 (9.6)	1.0	75.8 (21.3)	-4.5 * *
Third year (n = 378)	20.6 (12.1)		26.8 (7.7)		14.9 (7.8)		23.9 (9.0)		86.2 (22.8)	
English version										
Training in smoking cessation										
Yes (n = 24)	27.6 (10.8)	2.1 *	25.3 (8.1)	2.6 *	10.1 (8.3)	1.2	21.9 (9.5)	0.3	84.8 (23.9)	2.3 *
No (n = 162)	21.3 (13.9)		20.2 (9.1)		8.3 (7.1)		21.3 (10.3)		71.1 (27.4)	

Note. M = median. SD = standard deviation. Spanish version analysis with t-Student test (t value) English version analysis with U-Manwhitney test (z value)

\*p < 0.05

\* \*p < 0.01

reflected that the dimensions ‘Individual knowledge and skills’ and ‘Individual attitudes and beliefs’ displayed a significant positive correlation with all items in the 5 A’s model, particularly Assist (Table 5).

‘Organizational support’ was a particularly appropriate factor for considering the implementation of 5 A’s activities, while ‘Organizational resources’ was not significantly correlated to the 5 A’s.

**3.4.5. Reliability of the Spanish version**

Internal consistency was high for the overall Spanish version (Cronbach  $\alpha = .83$ ). Cronbach  $\alpha$  values for each subscale were as follows: ‘Individual knowledge and skills’ = .92, ‘Individual attitudes and beliefs’ = .88, ‘Organizational support’ = .83 and ‘Organizational resources’ = .81. Corrected item-total correlations were adequate for all subscales (> 0.30), indicating that all items contributed to the internal consistency of the scale.

**3.4.6. English version**

**3.4.6.1. Items analysis.** The acceptability and internal consistency parameters obtained for the English version are presented in Table S1. There was no missing data. Seven items presented floor effect (25.9%) and 11 items had ceiling effect (40.7%). All the items cover the full theoretical range and four items (14.8%) were asymmetric. The corrected item-total correlations were greater than .20 for 20 items (74.1%), resulting in six items being deleted (11, 12, 15–17 and 27).

**Table 5**  
Criterion validity correlation and reliability coefficients for the Spanish and English version.

Scale/ Subscale	Criterion validity				
	Ask	Advise	Asses	Assist	Advocate
Spanish version					
Individual knowledge and skills	.15 **	.22 **	.21 **	.46 **	.38 **
Individual attitudes and belief	.20	.34 **	.31 **	.33 **	.23 **
Organizational support	.29 **	.32 **	.34 **	.50 **	.43 **
Organizational resources	.02	.00	.04	.05	.01
<b>Overall scale</b>	<b>.25 **</b>	<b>.33 **</b>	<b>.36 **</b>	<b>.53 **</b>	<b>.42 **</b>
English version					
Individual knowledge and skills	.18 *	.34 **	.39 **	.34 **	.35 **
Individual attitudes and beliefs	.08	.27 **	.29 **	.23 *	.19 *
Organizational support	.14	.36 **	.43 **	.39 **	.43 **
Organizational resources	-.01	-.11	-.07	-.08	.02
<b>Overall scale</b>	<b>.15 *</b>	<b>.31 **</b>	<b>.39 **</b>	<b>.33 **</b>	<b>.37 **</b>

Note. \*p < .05 \* \*p < .001

**3.4.6.2. Structural validity.** Data from the English version ( $n = 186$ ) fit the four-factor model tested in the Spanish version of the questionnaire, since  $CFI = .966$ ,  $TFI = .959$ ,  $RNI = .966$  and  $SRMR = .064$ . Standardized regression weights in this sample ranged from .469 to .918. Similar to the Spanish version, standardized regression weight of the 'Organizational resources' subscale (factor 4) to the second-order factor was low (.023), compared with those obtained in the other subscales (higher to .499).

**3.4.6.3. Hypothesis testing.** We only tested the hypothesis regarding previous smoking cessation instruction because of the sample size of the comparative groups. Results indicated that health professions students who had received capacitation had significantly higher scores in all the subscales except for the dimensions 'Organizational support' and 'Organizational resources' (Table 4).

**3.4.6.4. Criterion validity.** 'Individual knowledge and skills' and 'Individual attitudes and beliefs' had a significant positive correlation with almost all items of the 5 A's model, particularly Assess. 'Organizational support' was a particularly appropriate factor for considering the implementation of 5 A's activities, while 'Organizational resources' scored low values, with not significant correlations (Table 5).

**3.4.6.5. Reliability of the English version.** Internal consistency was high for the English questionnaire (Cronbach  $\alpha = .88$ ). Cronbach  $\alpha$  values for each subscale were as follows: 'Individual knowledge and skills' = .94, 'Individual attitudes and beliefs' = .90, 'Organizational support' = .82 and 'Organizational resources' = .85. Item-total correlations by subscales in all cases were  $> .30$ .

#### 3.4.7. KABO\_S scoring

The KABO\_S questionnaire consists of 17 items scored on a 11-point Likert-type scale organized in four subscales: 'Individual knowledge and skills' (items 1–6), 'Individual attitudes and beliefs' (items 7–10), 'Organizational support' (items 11–13) and 'Organizational resources' (items 14–17). The explained variance by the first factor of the Spanish version (44.5%) confirmed the one-dimensionality of the KABO\_S [cut-off criteria:  $> 40\%$ ; (Burga, 2006)]. According to these results and the criteria of one-dimensionality, it is possible to obtain a total score for the overall scale and for each of their subscales/dimensions. The overall scale score for both versions ranged from 17 to 170. Items 14–17 are scored inversely. A higher score in each subscale indicated a higher level of knowledge, skills, attitudes and beliefs and positive organizational aspects for a competent smoking cessation practice.

## 4. Discussion

This study aimed to adapt and psychometrically test the KABO\_S, the first instrument for assessing knowledge, attitudes, behaviors and organizational elements regarding their smoking cessation competence among health professions students. Specifically, this study provides the first empirical evidence regarding the psychometric properties (content validity, construct validity, criterion validity and reliability) of both Spanish and English versions to support the use and interpretation of their scores (Mokkink et al., 2010).

Content validity is one of the most important measurement properties (Terwee et al., 2007). The KABO\_S is based on a robust evidence-based framework that follows the key concepts for assessing smoking cessation competence proposed by Sheffer et al. (2009) (i.e., motivation, knowledge, self-efficacy, perceived relevance of providing a cessation intervention, effectiveness, importance of barriers, readiness and resources) and maintains substantially the same structure as the original instrument designed for healthcare professionals (Andrés et al., 2019). The content validity of the questionnaire was excellent in terms of clarity. Most of S-CVI/Ave values were higher than .9 (desirable

cut-offs) (Polit and Beck, 2006). The kappa statistics were good-excellent, highlighting the specific degree of agreement beyond chance among the experts (Polit et al., 2007). Likewise, the pilot study confirmed the adequate feasibility of the tool, considering all the items as relevant, understandable and suitable for the target population.

The use of a systematic and rigorous method in the translation and adaptation process ensured the quality of the English measure, enabling the validity, acceptability and feasibility of the content of the English version of the KABO\_S (Sousa and Rojjanasrirat, 2011). A strong point for providing cross-cultural validity evidence was the involvement of expert translators with knowledge of the source and the target languages. Moreover, given that hardly any cultural adaptations were required in the English adaptation (only in one item on clinical guidelines), this suggests that the questionnaire may be suitable for international administration in different countries and cultures.

The EFA and CFA supported the construct validity of the KABO\_S. The exploratory analysis yielded a four-factor solution that explained 85.1% of the total variance, demonstrating that the KABO\_S is sufficient to capture the main characteristics of the measured construct (Viladrich et al., 2016). Despite the reduction in the number of dimensions in contrast with the original KABO questionnaire, the factor structures obtained were consistent with the proposed framework encompassing the cognitive, attitudinal, behavioral and organizational domains that are key for measuring students' holistic competence on smoking cessation (Cowan et al., 2007). All the items exhibited a high factor loading ( $> .40$ ) supporting the good validity of its internal structure. Although the overall fit of the CFA is acceptable, the subscale 'Organizational resources' in both samples has a low loading. This could be explained because unlike professionals, undergraduates are rarely informed about smoking cessation resources that are available during their practicum (Rojewski et al., 2019). Despite the low correlations, the research team decided to keep it because of its importance for measuring the construct of interest.

We observed differences in the subscale scores between groups, supporting the construct validity of the KABO\_S. Consistent with previous literature, students who reported less training in smoking cessation scored lower in all dimensions than those who considered themselves trained (Hayes et al., 2015; Schwindt et al., 2019). Our results also revealed a cultural difference in the 'Organizational support' dimension between the students who had received previous training compared with those who had not, when they completed the English and the Spanish version. Thus, while Spanish students with prior tobacco training scored significantly higher on 'Organizational support' than those not trained, we found no significant differences among English students. This difference may be attributed to different social norms and public health policies on smoking cessation between UK and Spain. Workplace factors, including organizational support, are known to influence the provision of smoking cessation services (Leitlein et al., 2012). Therefore, it is very important not to neglect cultural differences in this organizational factor when assessing smoking cessation competence in different countries. In this vein, previous studies (Chatdokaiprai et al., 2017; Leitlein et al., 2012) pointed out that tobacco control policy is directly associated with organizational support which, in turn, is related to higher willingness to provide smoking cessation services by nurses. Also, students with higher degrees also reported slightly higher scores. This finding suggests that the further in the degree that one is, the more competence is acquired (Martínez et al., 2021). In both comparatives, for 'Organizational resources' there weren't significant differences between group scores, that could be explained by the absence tobacco cessation practice during their clinical placements and the lack of responsibility that they normally have when they go to health care centers as undergraduates (Schwindt et al., 2019).

The positive association between the KABO\_S scores and each component of the 5 A's model offered evidence of criterion-related validity (Ask, Advise, Assess, Assist and Arrange) consistent with the original KABO questionnaire (Andrés et al., 2019) and the other

validated instruments available to assess smoking competence in healthcare professionals (Hasan et al., 2019; Newhouse et al., 2011; Tsai et al., 2019). One of the most recommended brief smoking cessation interventions in the international clinical guidelines is the 5 A's model. Therefore, our results support the validity of the factors comprising the KABO\_S questionnaire (i.e., knowledge, attitudes, behaviors and organizational factors) to adequately and comprehensively assess the relationship with smoking cessation interventions in health professions students.

Only 'Organizational resources' did not correlate with any component. This could be explained by the lack of responsibility of students during their placements and by the limited interest of some organizations (Martínez et al., 2020). However, 'Organizational support' was the most relevant factor for each of the components of the 5 A's model, similarly to Andrés et al. (2019). This suggests that while knowledge and attitudes are key factors (Ajzen, 2011), it would also be paramount to take organizational support into consideration when designing interventions (Andrés et al., 2019). Previous studies (Rogers, 2003; Rojewski et al., 2019) emphasizes the importance of organizational resources and support for implementing innovations by healthcare professionals. Some studies reveal that students who had received education with simulation techniques increased their counselling skills and self-efficacy to provide tobacco cessation (Schwindt et al., 2019; Zhang et al., 2021).

Reliability was also adequate in relation to the internal consistency of the two versions of the instrument. Since stability was not tested, future studies should explore it to confirm the suitability for studying the effectiveness of training programs (Doval and Viladrich, 2016).

The KABO\_S provide first-hand knowledge about students' perceptions of their own competence and learning needs, which is fundamental to their professional development (Fukada, 2018). Additionally, this study responds to the need of investing in tobacco cessation training for these students, as they are crucial for health promotion and disease prevention (Hyndman et al., 2019).

This study has some limitations. First, the content validation indices were not re-evaluated with a second round of expert consultation. However, members of the target population were consulted during the pilot test phase. Second, the sample size in the English version was smaller than the Spanish one, which led to conduct only the confirmatory factor analysis. Moreover, despite the good structural validity of the English and Spanish versions, 'Organizational resources' subscale presented low correlations with the rest of the subscales and with the 5 A's, so that the interpretation of the scores should be given with caution. Third, self-reported data on the 5 A's model may be biased towards an overestimate or underestimate of actual performance. Finally, the sample to validate the Spanish and English KABO\_S questionnaires consisted mainly of nursing students; therefore, caution should be exercised when applying these questionnaires to other health profession students. Future validation studies should be conducted on other health sciences students.

## 5. Conclusions

The KABO\_S is the first instrument (Spanish and English) for the assessment the knowledge, attitudes, behavioral and organizational domains for the smoking cessation competency of health professions students. The findings provided evidence that the KABO\_S is a valid and reliable measure for identifying learning needs to assist in smoking cessation and for testing training programs in this area. In addition, KABO\_S might be an appropriate tool to promote self-reflection related to this competency.

## Ethical considerations

This research was approved by the Research Ethics Committee Bellvitge University Hospital (ref. number: PR389/19). Explicit

informed consent was obtained online from all participants.

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.nepr.2023.103647.

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