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Adapting and validating the Hospital Survey on Patient Safety Culture (HSOPS) for nursing students (HSOPS-NS): A new measure of Patient Safety Climate

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ABSTRACT

Background: Patient Safety Culture and Patient Safety Climate (PSC) are different factors. PSC is the shared perception that is held within a hospital's area or unit at a specific moment in time. This measure is necessary for designing activities for promoting and improving safety. It must include the perception of all the agents involved, including future nurses throughout their patient safety education.

Objectives: The aim was to adapt and validate a new version of the Hospital Survey on Patient Safety Culture (HSOPS), targeted specifically at nursing students. It provides a new comprehensive and more complete measure of PSC that contributes to improving patient safety.

Methods: Data were obtained from 654 undergraduate and postgraduate nursing students. PSC was tested using factor analyses and structural equation modeling. In order to facilitate the improvement of PSC, we examined differences in climate strength across different academic groups using the Rwg(j) and ICC measures of inter-rater agreement.

Results: Factor analyses confirmed a five-factor solution that explained between 52.45% and 54.75% of the variance. The model was found to have adequate fit χ^2 (5) = 14.333, p = .014; CFI = 0.99; RMSEA = 0.05. Cronbach's alphas for PSC were between 0.74 and 0.77. “Teamwork within units” was the highest rated dimension, and “Staffing” the lowest rated. Medium-to-high scores were obtained for PSC. The median of Rwg (j) was high in the five dimensions of the PSC survey, supporting the idea of shared climate perceptions (0.81–0.96) among undergraduate and postgraduate nursing students.

Conclusions: HSOPS-NS is a useful and versatile tool for measuring the level and strength of PSC. It screens knowledge regarding patient safety in clinical practice placements and compares nursing students' perceptions of the strength of PSC. Weaknesses perceived in relation to PSC help implement changes in patient safety learning.

1. Introduction

The development of a safety culture is fundamental to minimizing errors and adverse patient effects, and its measurement is necessary for designing activities aimed at fostering and improving it (National Quality Forum, 2010). The term safety culture is widely used in the initiatives of the World Health Organization (WHO) to promote patient safety.

Safety culture is a key element within organizational culture. Any explanation of safety culture requires an understanding of the collective behavior of an organization. In this sense, the interactions of the organizational processes and practices contribute to the safety culture present in the different dimensions of the organization.

The term safety climate identifies and describes the safety-related

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policies, procedures and practices that can be measured through workers' perceptions (Singer et al., 2009). This term also refers to the general way in which safety is perceived within certain units/areas at a specific moment in time (synchronical perspective). Patient safety culture, on the other hand, is located at a higher level of analysis and reflects individual and group values over time (diachronical perspective), along with the attitudes and usual patterns of behavior in the hospital that determine the commitment of an organization to safety management.

The perceived experience on patient safety (PSC) precedes, influences and changes attitudes about safety care. These attitudes are based on perceptions and precede actions (Pickens, 2005) and safe care behaviors. Both attitudes and behaviors are important elements of the patient safety culture in an organization.

The different perceptions of safety climate which exist among the various professional groups working at a hospital (i.e. managers, physicians, nursing staff, etc.) may suggest different aspects to be identified and strengthened (Singer et al., 2008, 2009). These aspects should be evaluated separately in accordance with the professional status of the individual in question within the health organization.

However, the content of patient safety education is not always stated clearly and explicitly in the nursing curriculum. Tella et al. (2014) suggest that effective teaching and learning methods should be properly described and used in both academic and clinical practice settings. EUNetPas (2010) provides patient safety guidelines for health care education, promoting similar patient safety competencies among nursing students in Europe.

In our Faculty, the theoretical contents relating to patient safety are distributed transversally across the different subjects of the Nursing degree. It is not until the third year that patient safety is taught in a more monographic way in the following subjects: Service and Quality Management, and Care, Safety and Quality. The intensity with which patient safety is taught throughout the degree gradually increases, in parallel to the performance of clinical practices. In the first year (see Fig. 1), students are introduced to the practice of care, but hardly interact with patients at all. This interaction begins in the second year and increases (practical European Credit Transfer System ECTS) exponentially until the end of the degree (fourth year). Moreover, the University Hospital in which the clinical practices are carried out, runs specific awareness and reinforcement programs for students in the area of patient safety, with these programs being more intense in the 3rd and 4th years of the degree.

2. Background

Colla et al. (2005) conducted a meta-analysis of the instruments which exist to measure Patient Safety Climate (PSC) in healthcare, in accordance with different fields of application. However, while all the instruments analyzed had a five-point Likert-type response scale, not all included exhaustive information regarding factor analyses and psychometric properties. Among the instruments, the Hospital Survey on Patient Safety - HSOPS developed by the Agency for Healthcare Research and Quality (AHRQ) (Westat, 2003) is highlighted. This survey analyzes various dimensions such as leadership, procedures, staff, communications and reports, very useful for examining the influential factors in patient safety.

The HSOPS is commonly used in the healthcare system in both our country (Gascón-Cánovas et al., 2005) and the majority of European countries (European Union Network for Patient Safety, 2010; Danielsson et al., 2017) and is possibly the instrument which has received most statistical and psychometric treatment (Blegen et al., 2009; Flin et al., 2006; Guldenmund, 2007).

The HSOPS (Westat, 2003) has been applied in different healthcare fields, including physicians, nurses, hospital staff, etc. and analyzes 12 different dimensions. Nevertheless, we have observed that certain items and sections of the original HSOPS (Westat, 2003), such as issues related to hospital management (Section F), number of events reported (Section G) and employee background information (Section H), do not really apply to nursing students.

Recent studies have measured the competencies of nursing students in patient safety (Bressan et al., 2016; Mansour, 2015; Stevanin et al., 2015; Stomski et al., 2018), but not the safety climate of their clinical practice units. PSC should be assessed among nursing students to analyze the degree of consistency which exists between university education in patient safety and clinical practice. It is also useful to give voice to nursing students in these kinds of institutional safety assessments, in accordance with a model that aims to ensure patient-centered care and patient safety. As result, this additional measure provides a more realistic analysis.

Since nursing students are not workers with a stable job and their stay at the hospital is of limited duration, it is appropriate to use a synchronic perspective to evaluate their perceptions. According to Ginsburg and Gilin-Oore (2015), rather than a dispersion model, literature on PSC generally tends to use a consensus model. In our case, PSC is a common perception of safety among all our nursing students in the clinical practice placements (units/areas). Therefore, PSC scores can only reflect the climate level, although a more complete analysis can show the strength of the safety climate (agreement among nursing students) and the shape of an academic group's agreement.

Therefore, the objectives were to: 1) design a version of the HSOPS specifically adapted to nursing students (HSOPS-NS); and 2) obtain a more precise, complete and realistic measure of the theoretical construct PSC among nursing students, in order to improve patient safety.

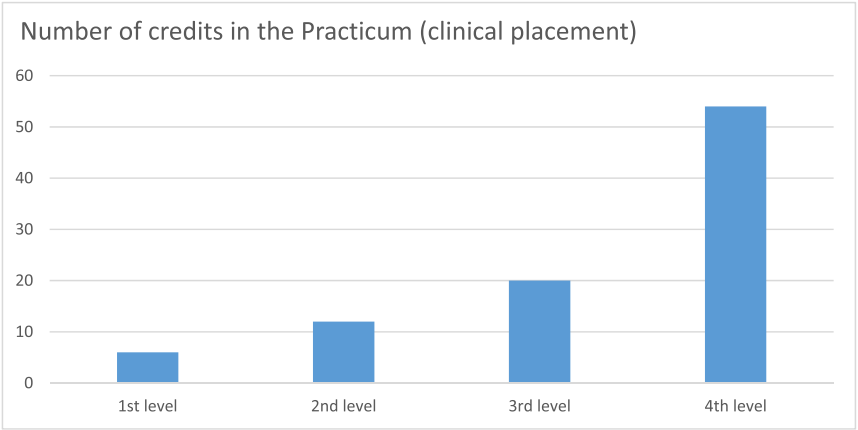


Fig. 1. Histogram of ECTS distribution in the clinical placement.

3. Methods

3.1. Sample

Participants were 654 nursing students (86% women) aged between 17 and 58, with a mean age of 25 (SD = 7.47). Of these, 439 were Nursing degree undergraduates (84% of all students enrolled at this level) and 215 were postgraduates (86% of all students enrolled at this level). All were students at the University of the Basque Country and all carried out their clinical internships at the Donostia University Hospital.

3.2. Regulatory Approval

The study was authorized by the University of the Basque Country and the Basque Public Health Service. All participants received written information about the study, its aim and the voluntary nature of their participation, and gave their informed consent. They were also informed that refusal to participate would have no detrimental effect on their studies.

3.3. Instruments

The HSOPS questionnaire is used as a screening instrument to identify strengths and weaknesses (understood as improvement opportunities). The questionnaire is administered on paper and takes approximately 20 min to complete.

The new HSOPS-NS instrument is an adaptation for nursing students of the HSOPS questionnaire designed by the AHRQ (Westat, 2003). The Spanish version of the HSOPS (Gascón-Cánovas et al., 2005) has been specifically adapted for professional nurses: HSOPS-N (Orkaizagirre-Gómara, 2016). Taking this version as a reference and bearing in mind the specific circumstances of nursing student interns (non-professional status), a series of modifications were carried out, as described below.

The “Additional information about your Service/Unit” appendix of the Spanish version of the instrument (Gascón-Cánovas et al., 2005) which was not included in the original HSOPS, was kept. The appendix comprises 8 items used to measure some good praxis indicators for patient safety, adapted and applied to nursing student level.

The main changes pertain to Section D “Additional information”. The ordinal scale measuring perceived level of patient safety was maintained, and items linked to students' knowledge of events, the event reporting system and the number of events reported were added. A blank space was also provided to enable respondents to add any additional information they feel is relevant regarding issues of interest not covered by the items. Items 44, 45, 46, 47, 49 and 51 were eliminated from this section because they refer to work-related questions not applicable to student interns. Furthermore, item 23 on the role of the hospital management was also eliminated, since most nursing students are unaware of this aspect of the organization.

The HSOPS-NS is not an attitude scale in which subjects assess, judge or give their opinion regarding specific patient safety practices. Rather, it is a patient safety perception scale in which subjects identify, in their immediate environment (unit/area), the safety practices presented in the different items by rating their presence or absence on an agreement/disagreement scale. In other words, subjects indicate the degree to which they perceive compliance with patient safety.

A specific section was added at the beginning of the new HSOPS-NS questionnaire to gather sociodemographic and academic information: course within which the clinical internship program is being carried out, gender, date of birth, Unit or Service to which the intern has been assigned, etc. These additional questions were formulated and agreed upon by three of the authors.

A series of minor changes were made to some of the items in order to adapt them to nursing student level. These small-scale adaptations were carried out by a team of experts made up of Medicine and Nursing lecturers. Mostly, the term supervisor/manager was replaced with tutor/unit or service supervisor, without altering the essence of the statement in any way. These minor changes to the original version were not extensive enough to warrant the use of the Content Validity Index (CVI).

To establish an English-language version of the HSOPS-NS, a reverse translation (Hambleton, 2005) was carried out by an expert translator with extensive experience in academic and nursing texts. The final English version (see Appendix A) was then translated back into Spanish (Balluerka et al., 2007) by three other university professors working independently of those responsible for the initial adaptation proposed. Finally, a definitive consensus model (Kappa = 0.87, $p < .04$) was agreed upon for the Spanish version of the HSOPS-NS.

The questionnaire was then administered to a small sample of 15 participants using a “face validity procedure” to test for possible mistakes and general understanding. The final version presented no problems.

In general terms, any element analyzed is deemed to be a strength when it has a positive response rate of 75% or over. A response is positive when either 4 (agree/most of the time) or 5 (strongly agree/always) are ticked on the original 5-point Likert-type scale of the HSOPS. In general, a dimension is considered to be an improvement opportunity when over 50% of the responses given are negative (values 1 or 2 on the Likert-type scale). In the case of negatively worded items, the same procedure is used but with the item value inverted. A Pareto chart is generally used to analyze improvement opportunities in more detail. These data reveal in graphic terms the level of safety culture in a healthcare organization.

To assess safety climate, the general version of the HSOPS analyzes responses to two specific questions: Individual perception of the degree of patient safety (1 to 10 points) and the number of events reported over the past year. However, due to the nature of current training programs, nursing students rarely remain in the same unit for an entire year, and therefore do not have access to reported events. This was the main reason behind the decision to propose a new regrouping of the meaningful dimensions for analyzing PSC in the HSOPS-NS.

3.4. Procedure

After participants had been told about the study and had given their informed consent, the HSOPS-NS questionnaire was administered at the University Hospital itself during the course of their clinical internship. SPSS version 24 (IBM) was used for the reliability, descriptive and exploratory factor analyses (EFA) and AMOS version 24 (IBM) was used for the confirmatory factor analysis (CFA).

First, the sociodemographic data of the study sample were analyzed. Next, an EFA was conducted of the theoretical construct PSC with the HSOPS questionnaire (AHRQ) adapted to nursing students. Following the strategy described by Guldenmund (2007) and Flin et al. (2000), we proposed a more exhaustive model with five variables present at HSOPS to test the PSC construct. This model was tested with AMOS (Structural Equation Models –SEM-) exploring five paths: a.- factor 1: safety-related event reporting, b.- factor 2: overall perceptions of patient safety in the hospital, c.- item 42: individual perception of patient safety (1 to 10),weighted to a 5-point scale, d. - an integrative factor (13) encompassing factors 3 to 8: perception of safety in the unit or service, and e.- factor 14: indicator of good praxis (Gascón-Cánovas et al., 2005).

This structure was replicated by means of a CFA. The goodness of fit indexes used were: (a) the ratio between chi squared and degrees of freedom (χ^2/df), (b) the *Comparative Fit Index* (CFI), (c) the *Incremental Fit Index* (IFI), and (d) *Root Mean Square of Approximation* (RMSEA). According to Hu and Bentler (1999), CFI and IFI values of above 0.90 are acceptable, while Marsh et al. (2004) consider values of between 0.05 and 0.09 to be acceptable for RMSEA. Finally, a reliability analysis of the scales was conducted using Cronbach's alpha and the descriptive data of the HSOPS-NS were calculated for the two academic levels

(undergraduate and postgraduate).

Following Ginsburg and Gilin-Oore (2015), in addition to the PSC scores (mean), we also used a specific tool in Excel 2007 (Biemann et al., 2012) to examine possible differences in climate strength between different academic groups using the Rwg(j) and intraclass correlation coefficient (ICC) measures of inter-rater agreement. Finally, we compiled histograms for each academic group on the dimensions of the PSC in order to visually depict both the strength of agreement and the shape of that agreement.

4. Results

4.1. Sociodemographic Data of the Sample Population

Both subsamples analyzed contained more women than men (> 80%), a finding consistent with the general trend identified in this field of study, in which there is a preponderance of women. The majority of the undergraduate students participating in the study were in their 3rd or 4th year (63.6%), which is most likely due to the fact that few clinical internship periods are programmed during the initial part of the degree course, with most being scheduled for the final two years (see Table 1).

4.2. Exploratory Factor Analysis of the Theoretical Construct Patient Safety Climate (PSC)

An exploratory factor analysis (EFA) of the theoretical construct PSC was conducted for each subsample using the principal components method with varimax rotation. The Kaiser-Meyer-Olkin (KMO) index, which was used as a measure of sampling adequacy, oscillated between 0.77 and 0.80. Barlett's test was statistically significant in both cases, enabling the factors selected to measure safety climate to be included in the factor analysis.

The five factors with eigenvalues > 1 for the undergraduate and postgraduate samples explained 52.45% and 54.75% (respectively) of the variance observed in the safety climate construct. Factor saturations were equal to or higher than 0.65 in all cases (see Table 2).

Table 1
Sociodemographic data.

	n = 439		n = 215	
	Undergraduate		Postgraduate	
Age [range], mean and (SD)	[17–57] 23 (6.21)		[20–58] 29 (8.53)	
	N	**% Valid**	**N**	**% Valid**
Sex				
Men	57	13	33	15.4
Women	382	87	182	84.6
Academic level				
1st year	33	7.5	–	–
2nd year	127	28.9	–	–
3rd year	100	22.8	–	–
4th year	179	40.8	–	–
Master's	–	–	215	100
Hospital areas				
1. Outpatient care: day clinics, primary care and rehabilitation	19	4.33	1	0.47
2. Medical-surgical inpatient care: medical and surgical inpatient units.	220	50.11	37	17.21
3. Critical-special services: intensive care, accident and emergency and the OR	85	19.36	106	49.30
4. Mother-child inpatient care: maternity and pediatrics, obstetrics, gynecology.	80	18.22	34	15.81
5. Other areas.	35	7.98	37	17.21

Table 2
Exploratory factor analysis of the criterion variable Patient Safety Climate for nurses.

	1. Undergraduate sample	2. Postgraduate sample
	n = 439	n = 215
KMO coefficient	0.798	0.770
Barlett's test	533.14	315.55
	df = 10	df = 10
	p = .001	p = .001
Loading factors:		
F1	0.68	0.70
F2	0.71	0.72
Item 42	0.65	0.67
F13	0.84	0.80
F14	0.72	0.73
Variance explained	52.45%	54.75%

Predictors: F1: frequency of events reported, F2: perceptions of safety, Item 42: safety ratio (from 1 to 10), F13: perception of safety in the unit/service, and F14: indicator of good praxis.

4.3. Confirmatory Factor Analysis of the Theoretical Construct Patient Safety Climate

This latent construct was tested using Confirmatory Factor Analysis (CFA) techniques within an SEM framework. The same criterion as in the EFA was used. First, the PSC construct was verified in the undergraduate sample. Although it was found to have a good fit, the five-factor model was not statistically significant (see Table 3). A decision was therefore made to test a four-factor model, eliminating the *Indicator of good praxis* factor, whose items refer to the procedure manuals.

This four-factor model was found to have a good fit in the undergraduate sample and was statistically significant χ^2 (5) = 6.587, p = .037; CFI = 0.98; IFI = 0.98; RMSEA = 0.07. It also had moderate factor loadings (0.51 to 0.85).

Next, the five-factor model was tested in the postgraduate student sample. The model was found to be statistically significant (see Table 3) and have moderate factor loadings (0.55 to 0.88). Finally, the model was tested (see Fig. 2) with the entire study sample (N = 634) and was found to have a good fit (see Table 3) and moderate factor loadings.

4.4. Reliability Coefficients and Descriptive Statistics of the Various HSOPS-NS Scales

A reliability analysis was conducted of the HSOPS-NS questionnaire factors that included the two new dimensions F13 *Perception of safety in the unit* (factor integrating dimensions F3 to F6) and F14 *Indicator of good praxis* (Gascón-Cánovas et al., 2005). The theoretical PSC construct resulting from the CFA was also tested. The same criterion as that used for the factor analysis was used to test reliability in the

Table 3
Model fits for the criterion variable Patient Safety Climate for nurses.

Model fit index	Undergraduate	Postgraduate	Total sample
	n = 439	n = 215	n = 654
Chi^2	6.873	22.959	14.333
df	5	5	5
p	.230	.001	.014
Chi^2/df	1.375	4.592	2.867
CFI	0.99	0.94	0.99
IFI	0.99	0.94	0.99
RMSEA	0.03	0.13	0.05

Predictors: F1: frequency of events reported, F2: overall perceptions of safety, Item 42: safety ratio (from 1 to 10), F13: perception of safety in the unit, and F14: indicator of good praxis.

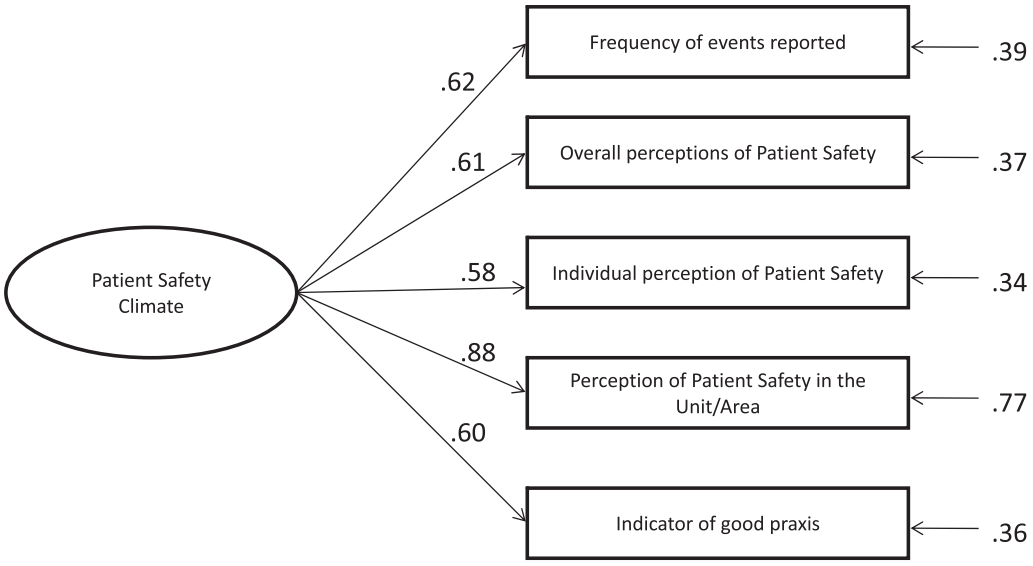


Fig. 2. Predictor model for Patient Safety Climate (N = 634).

Table 4
Means, descriptive values and reliabilities for the criterion variable and subscales of the HSOPS-NS.

	1			2			3		
	n = 163			n = 276			n = 215		
	Mean (SD)	Skewness	α	Mean (SD)	Skewness	α	Mean (SD)	Skewness	α
Patient Safety Climate for nursing students	4.01 (0.36)	0.195	0.71	3.74 (0.42)	−0.541	0.76	3.53 (0.43)	−0.107	0.79
F1 Frequency of events reported	3.99 (0.76)	−0.321	0.71	3.56 (0.82)	−0.465	0.61	3.38 (0.79)	0.006	0.85
F2 Overall perceptions of patient safety	3.59 (0.55)	0.402	0.52	3.34 (0.55)	−0.354	0.41	3.29 (0.52)	−0.049	0.44
F3 Supervisor/manager expectations & actions promoting patient safety	3.99 (0.55)	−0.286	0.71	3.72 (0.65)	−0.641	0.75	3.53 (0.61)	−0.253	0.77
F4 Organizational learning/continuous improvement	3.86 (0.49)	0.269	0.57	3.73 (0.58)	−0.466	0.58	3.58 (0.51)	−0.507	0.58
F5 Teamwork within unit	4.19 (0.50)	−0.252	0.65	4.15 (0.55)	−0.524	0.74	4.01 (0.63)	−0.560	0.78
F6 Communication openness	3.85 (0.66)	−0.248	0.63	3.61 (0.64)	−0.249	0.67	3.28 (0.67)	−0.092	0.64
F7 Feedback & communication about error	4.16 (0.62)	−0.620	0.42	3.98 (0.67)	−0.586	0.50	3.72 (0.69)	−0.446	0.77
F8 Nonpunitive responses to errors	3.47 (0.66)	−0.149	0.58	3.34 (0.70)	−0.289	0.57	3.12 (0.67)	−0.055	0.60
F9 Staffing	3.14 (0.80)	0.162	0.61	2.99 (0.81)	0.031	0.63	2.88 (0.74)	0.100	0.53
F10 Management support for patient saf.	3.79 (0.65)	−0.174	0.36	3.47 (0.80)	−0.221	0.24	3.33 (0.70)	−0.061	0.69
F11 Teamwork across units	3.68 (0.58)	−0.680	0.40	3.52 (0.55)	−0.323	0.56	3.49 (0.61)	−0.495	0.71
F12 Handoffs & transitions	3.65 (0.66)	0.320	0.71	3.42 (0.72)	−0.340	0.57	3.28 (0.68)	−0.244	0.70
F13 Perception of PS in the unit/area	3.92 (0.39)	0.097	0.76	3.75 (0.44)	−0.440	0.79	3.54 (0.45)	−0.161	0.80
F14 Indicator of good praxis	3.72 (0.53)	0.119	0.60	3.35 (0.64)	−0.160	0.67	3.34 (0.61)	−0.364	0.68
Individual perception of patient safety[a]	4.84 (0.37)	1.877	–	4.68 (0.52)	−2.006	–	4.11 (0.56)	−0.129	–

1 = Undergraduate sample 1st and 2nd years.
2 = Undergraduate sample 3rd and 4th years.
3 = Postgraduate sample.
[a] Single item.

undergraduate and postgraduate samples. In both samples (see Table 4), the lowest values were found for factor 2 *Overall perceptions of patient safety*, factor 4 *Organizational learning* and factor 9 *Staffing*.

The two new factors and the PSC construct had moderately good alpha coefficients of between 0.68 and 0.80 in both subsamples.

In general, the nursing student version of the instrument was found to have a similar pattern of reliability indexes (see Table 4) to the HSOPS-N version for professional nurses (Orkaizagirre-Gómara, 2016) and the Spanish-language HSOPS adaptation for health professionals (Gascón-Cánovas et al., 2005).

Next, the mean values (1 = poor PSC to 5 = excellent PSC), SDs and asymmetry indexes were calculated for the HSOPS-NS factors and PSC construct. Table 5 shows the ICC(1), ICC(2) and the median Rwg(j) values for the three academic groups. ICC(1) reflects the extent to which individual ratings can be explained by group membership with ≥0.05 indicating a substantial group effect or sufficient between-group variance, ICC (2) > 0.70 shows a sufficient group mean reliability, and Rwg(j) > 0.70 reflects a high inter-rater agreement (LeBreton and Senter, 2008). The Rwg(j) values in parentheses are medians for a non-uniform distribution, in this case, for a slight skew. These results fit with a consensus model of PSC (Ginsburg and Gilin-Oore, 2015).

Additionally, we tested Rwg(j) in each academic group for five dimensions of PSC, considering a slightly skewed (non-uniform) distribution. In general, we found similar mean climate scores (*level*) and similar climate *strength* values, with the exception of Indicator of good praxis [Rwg(j) $group_1$ = 0.79, Rwg(j) $group_2$ = 0.56, Rwg(j) $group_3$ = 0.71]. Fig. 3 shows the histograms compiled for these three groups in this dimension of PSC, which had similar climate means but moderate differences in climate strength. In the HSOPS, the respondents of a group who "agree" or "strongly agree" with items in a PSC dimension represent the proportion that reports "positive safety climate".

The percentage of respondents in the *Indicator of good praxis* who reported a "positive safety climate" in $group_1$ (44.8%) was moderately

Table 5
HSOPS-NS Patient Safety Climate dimension agreement indices.

Patient Safety Climate – dimension	A	B "Academic groups"		C Median Rwg(j)
	Scale mean (SD)	ICC(1)	ICC(2)	n = 3 levels
(1) Frequency of events reported	3.61 (0.83)	0.11	0.97	0.81 (0.65)
(2) Overall perceptions of patient safety	3.38 (0.55)	0.06	0.94	0.85 (0.72)
(3) Perception of patient safety in the unit	3.73 (0.45)	0.14	0.97	0.96 (0.94)
(4) Individual perception of the overall grade	4.53 (0.58)	0.35	0.99	0.88 (0.82)
(5) Indicator of good praxis	3.44 (0.62)	0.09	0.96	0.86 (0.68)

Academic groups: Undergraduate sample 1st and 2nd years, Undergraduate sample 3rd and 4th years, Postgraduate sample.
A = Climate level mean and Standard Deviation on each dimension of PSC (Patient Safety Climate).
B = ICC(1) within-group and between-group variability, ICC(2) reliability of academic group means.
C = Rwg(j) is a measure of absolute agreement in the ratings endorsed on each dimension of PSC by students of the three different academic groups. Values in the parenthesis are median Rwg(j) for a slight skew distribution. Note: Measure of agreement in the dimension nr 4 was calculated as Rwg (single-item).

greater than percentages in $group_2$ (29.3%) and $group_3$ (23.7%).

5. Discussion

This study is a first attempt at finding a factor solution for a model designed to measure the theoretical construct Patient Safety Climate (PSC) among nursing students, using an adaptation of the HSOPS questionnaire which takes into account a broad range of data and information (Guldenmund, 2007).

The sociodemographic data obtained indicate that this activity continues to be a mainly female area (Cash, 1997; Davis, 1995; Holroyd et al., 2002; Meadus, 2000). The Exploratory Factor Analysis (EFA) of the PSC construct gave satisfactory results. The CFA later verified that the five-factor model was not suitable for the undergraduate sample due to the presence of the *Indicator of good praxis* factor. The explanation may lie in the fact that nursing students in the first two years of their degree are probably not familiar with the procedure manuals. Another explanation may be the feeling of a "lack of independence" among nursing students, a term used (Adachi and Kikuchi, 2017) to define the scarce proactive participation and low level of autonomy that condition the way in which risk perception is evaluated among non-professional nurses.

When the model was applied through a CFA to the postgraduate subsample and the entire sample group, however, it was found to have a very good fit and good stability values. Therefore, the five-factor model can be said to be a predictor model of PSC in accordance with both the results of the EFA and our own theoretical proposal regarding this construct, thereby fulfilling the study's two aims.

Similarly to that found in other studies (Gascón-Cánovas et al., 2005; Sorra and Dyer, 2010; Hedsköld et al., 2013; Orkaizagirre-Gómara, 2016), the highest reliability values were found in the following HSOPS-NS factors: *Frequency of events reported, Supervisor/ manager expectations and actions promoting safety, Teamwork within unit* and *Teamwork across units*.

As regards the low reliability score obtained for F2 (*overall perceptions of patient safety*), we believe that this may be due to the non-professional status of participants in our study. We also suspect that some of the items (e.g. It. 10 "*It is just by chance that more serious mistakes don't happen around here*") may be couched in slightly biased terms. Moreover, the factor is mainly measured through two items, which may be insufficient (Thurstone, 1947; Morales-Vallejo, 2006). This suggests that it may be a good idea to increase the number of items here and reformulate the factor, even in the professional version of the instrument, in which it has one of the lowest reliability values (Gascón-Cánovas et al., 2005; Orkaizagirre-Gómara, 2016).

The reliability indexes of the PSC construct were found to have a good consistency level. The indexes found in the new HSOPS-NS instrument (0.68 to 0.80) are very similar to those reported by Singh et al. (2008) in the ambulatory version of the Safety Attitude Questionnaire SAQ-A survey (0.65 to 0.79), and only slightly lower than those founded in the French and German versions (Gehring et al., 2015) of the Safety Climate Survey –SCS (0.84 to 0.85). HSOPS-NS scores revealed that *Teamwork within units* was the highest rated factor, and *Staffing* was the lowest rated one, similarly to that reported by other studies (Danielsson et al., 2017; Gascón-Cánovas et al., 2005).

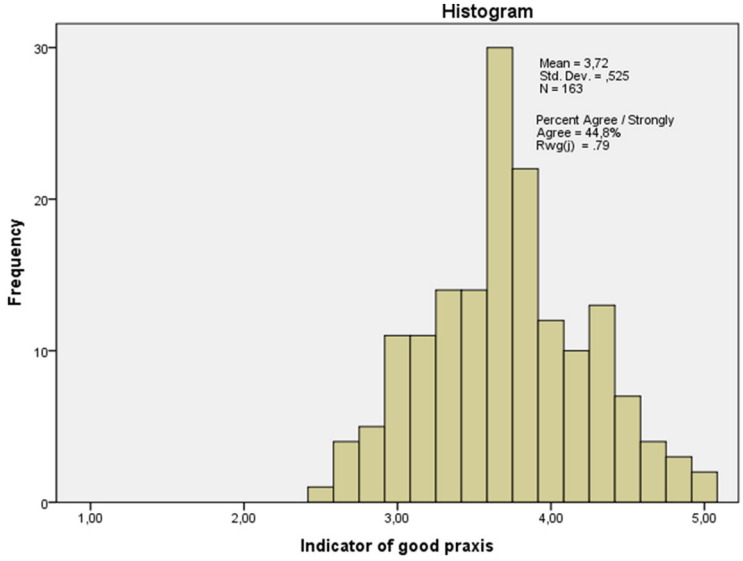
Nevertheless, these two factors, along with *Management support for Patient Safety* and *Handoffs & Transitions*, refer to the entire hospital and were therefore not considered relevant to the analysis of PSC in the units/areas. The five dimensions of PSC, on the other hand, were taken into consideration, particularly the *Indicator of good praxis* dimension, which had more comprehensive items than the others.

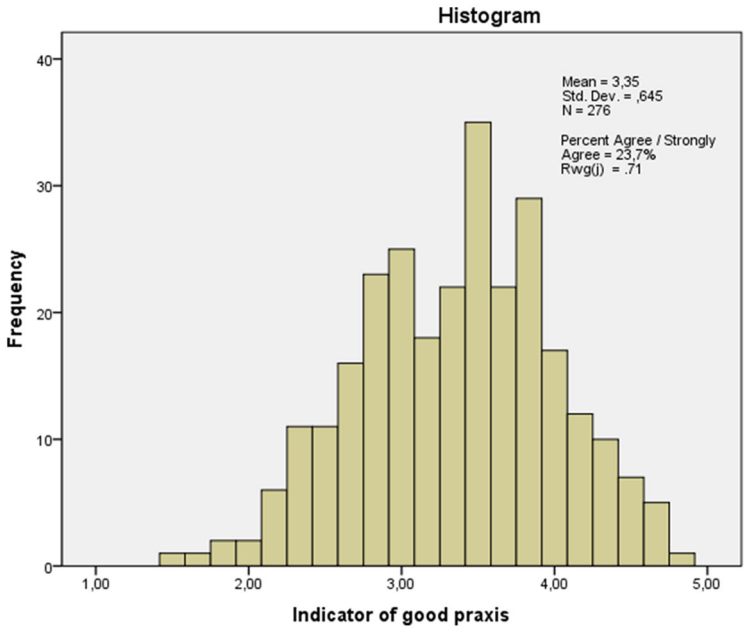
In addition to validating the HSOPS, it is important to address the issue of its applicability to the educational process. As stated by Ginsburg and Gilin-Oore (2015), complementary measures (e.g. strength and shape of climate perceptions) provide a more complete and graphical picture of PSC. Taken together, these results can provide an illustration of nursing students' perceptions regarding PSC throughout the safety education process, since their PSC scores revealed a high degree of consensus. Moreover, the moderate differences observed between the three academic groups in the Rwg (j) coefficients for Indicator of good practice may reflect a poorer knowledge of and critical capacity for the praxis of safety among students in the early years (1st and 2nd) of their clinical training (Ortiz-Molina, 2003).

There are several factors that may justify this. Firstly, the progressive intensity of ECTS in the practicums and specific patient safety programs at the University Hospital may result in greater critical knowledge and experience among 3rd and 4th year undergraduate and postgraduate students. Secondly, given the intensity of ECTS practice in the 1st and 2nd years of their degree, these students may feel more comfortable responding and are not so worried about making mistakes in their clinical practice, something also observed by Adachi and Kikuchi (2017). Thirdly, effective coordination between University theorists and clinical associate professors can influence a coherent acquisition of safety competencies that can be observed indirectly in a PSC consensus model.

6. Conclusions and Implications for Education and Policy

Yanhua and Watson (2011) highlight the low level of existing consensus regarding the evaluation of competences during Nursing programs, as well as in relation to the validated tools used to measure them. The HSOPS-NS was not developed to obtain direct measures of patient safety competencies, but rather to evaluate perceptions regarding PSC. Students may have knowledge about patient safety that may (or may not) coincide with the perceptions of the professionals working in the organization, area or team analyzed. This instrument may therefore be a useful alternative for testing how closely nursing students' perceptions coincide with those of professionals, something





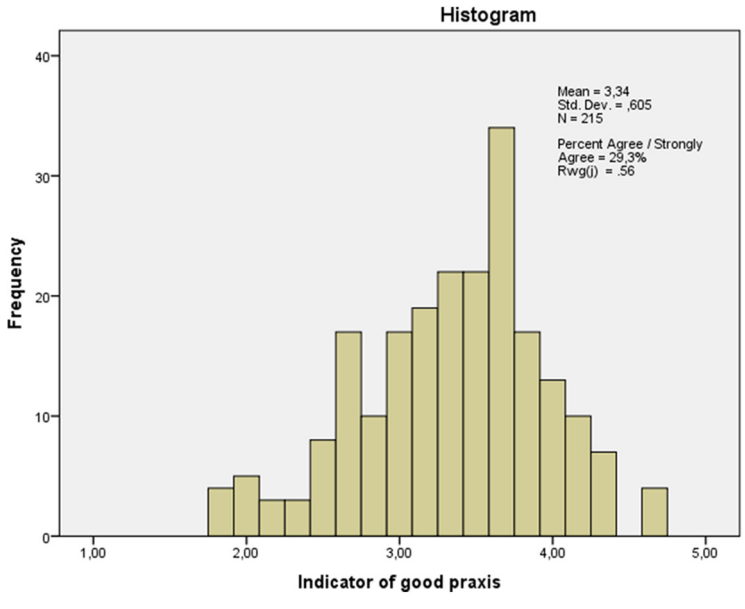


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Fig. 3. Indicator of good praxis histograms for the three Academic Groups.

which may also help calibrate the status of current nursing students as future professionals who should participate in the patient safety process and its improvement. We would like to highlight the instrument's versatility, since it can be used in both training/educational environments and to evaluate PSC in healthcare.

One of the limitations of this study is the fact that it does not include equipoised groups to enable comparative analyses in accordance with unit/service or gender.

In sum, the HSOPS-NS focuses on the five dimensions of PSC and can be used to screen climate strength. Low values in the Rwg(j) median of these dimensions suggest a low level of consensus between students regarding PSC. These weaknesses perceived in relation to PSC level alert us, as educators, to the need to implement changes in safety learning. These changes must be experienced in clinical practice placements in order to improve safety in interactions between students/professionals and patients.

Finally, a complete measure of HSOPS-NS screens PSC, prompting nursing students to identify the practice of safety, compare it with safety protocols and reflect on safety care. As result, these perceptions have an effect on nursing students' safety attitudes, as well as on their increasingly autonomous interactions with patients.

Future research may wish to verify and evaluate the theoretical PSC construct using the HSOPS-NS in samples from other hospitals and other cultures, or among patients (Monaca et al., 2017). Future studies may also wish to use the instrument to analyze the construct's relationship with incident rates or results in the field of patient safety.

Declaration of Interest

None.

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Author Contribution

All authors listed on the title page participated in the full process of designing, planning and implementing the study.

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Appendix A. Supplementary Data

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