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Original article

The first Italian validation of the Nurse-Nurse Collaboration Scale

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Abstract. *Background and aim of the work:* Collaboration between colleagues is an essential element of clinical nursing care because it helps to ensure patient safety. This study aimed to evaluate the psychometric properties of the Italian version of the Nurse-Nurse Collaboration Scale (NNCS). The secondary goal of this study was to assess the degree of collaboration between nurses in Italy. *Methods:* First, the cultural adaptation of the NNCS tool was performed. The face and content validity of the tool were assessed through the involvement of nursing experts. To test construct validity, a cross-sectional web-based study was conducted on a sample of 362 clinical nurses. *Results:* The Italian version of the NNCS was composed of 23 items distributed across the original five domains. Ten items were removed from the original instrument because they showed several cross-loadings on more than one factor. The five-dimensional model showed an adequate model goodness of fit (RMSEA=0.075, CFI=0.883, SRMR=0.072). The NNCS dimension with the highest average score was *Professionalism* (M=3.10 ± 0.45), while *Conflict Management* (M=2.14 ± 0.47) exhibited the lowest score. *Conclusions:* The Italian version of the NNCS is a valid and reliable tool. More effort should be made to ensure the proper management of conflicts in healthcare environments.

Key words: Collaboration, Communication, Nurse-Nurse collaboration, Reliability, Scale, Validity

Background

Dougherty and Larson (1) defined collaboration among nurses as "a marker of a nurse's ability as well as a professional obligation" (p.18). Collaboration between nurses is a complex process influenced by organisational and individual factors (2). At the organisational level, leadership should promote and support collaboration by fostering a common vision and philosophy of practice, as well as an appropriate management of resources and workloads. In particular, work shift length was identified as an obstacle to collaboration, especially in contexts where nurses worked overtime or more than 12 hours a day. The need to dedicate time during work shifts to building relationships with other colleagues and establish a climate of mutual trust and respect was also identified (3). Other studies have suggested that healthcare organisations might foster collaboration by promoting the use of technologies or tools to facilitate communication and coordinate care (4,5). Some researchers have found that at the individual level, the factors influencing collaboration are linked to nurses' ability to listen, communicate, pay attention and respect the opinions of others, as well as to their willingness to work together (6). In nursing care, collaboration between colleagues is an essential element of clinical practice because it helps ensure patient safety and reduce errors made in

healthcare environments (1,7). Specifically, improving collaboration impacts patient outcomes (4,8) in terms of safety, satisfaction, patient mortality, and length of hospitalisation (6). Previous findings highlight that teamwork and positive collaboration among nurses reduce episodes of delays or omission in nursing care (9,10). Delays and omission in nursing care have been observed to occur less frequently when all nursing team members feel that nursing care is not the sole duty of the individual nurse, but of all members of the group (9,11). Moreover, several studies report that nurses operating in contexts with an inadequate degree of collaboration are less satisfied with their work and more frequently expressed their intention to leave their job (12,13). In one study conducted in the United States, a higher level of collaboration between nurses, led to a 31% decrease in the probability of staff developing pressure-related ulcers and a similarly reduced probability of patients falling (14). Other studies report a direct correlation between nursing collaboration, quality of care (14), and patient satisfaction (15).

Collaboration among nurses has an impact on the clinical outcomes of the patients (14), on the professional's job satisfaction and on his intention to leave his job (12,13), therefore it deserves to be investigated. Literature review highlighted the existence of three assessment scales of collaboration between nurses: nurse-nurse collaboration scale (NNCS), nurse-nurse collaboration behaviour scale (NNCBS) and nurse- nurse interaction scale (RN-RN). They focus on very similar domains: conflict management, communication, process sharing, coordination and professionalism. Despite the limited number of tools and the reduced application to specific contexts, the reliability indices of the scales (all with α Cronbach >.87) found support their application. None of these scales were validated in Italian, but some scales that evaluate interprofessional collaboration have been: Nurse-physician collaboration scale (16) interprofessional collaboration scale (IPC) involving physicians and nurses (17) and Interprofessional Team Collaboration Scale II (I-AITCS II) involving multiple health care professions (18).

The scale that has had the widest application has been the NNCS and this suggests that it is the most suitable and appropriate of all for evaluating collaboration among nurses. Indeed, it is important to evaluate nurse-nurse collaboration to promote targeted interventions aimed at improving well-being in healthcare settings. Therefore Dougherty and Larson (1) developed the Nurse-Nurse Collaboration Scale (NNCS) in the USA. This instrument is composed of 35 statements divided into five domains: *Conflict Management*, *Communication*, *Process Sharing*, *Coordination*, and *Professionalism*. The response options are distributed on a 4-point Likert scale (from 1 = strongly disagree to 4 = strongly agree). The original authors did not test the construct validity of the tool. However, the original instrument shows good internal reliability both for the single domains (Cronbach indices ranged from 0.66 to 0.90) and for the overall scale (Cronbach alpha = 0.89). Moreover, the tool has been translated into several languages and the construct validity has been confirmed through factor analysis (19,20).

The literature demonstrates that no tools are currently available in Italy to measure collaboration between nurses.

Aim

The aim of this study was to adapt the NNCS to the Italian context. The study's secondary goal was to evaluate the degree of collaboration between nurses in Italy.

Methods

Study Design

This multiphase validation study consists of three stages. First, a cultural adaptation of the NNCS tool was performed. The second step was to evaluate the face and content validity of the tool through the involvement of nursing experts. Third, a descriptive cross-sectional study was conducted to assess construct validity and reliability. The entire study took place from June to December 2020.

Stage 1: Cultural adaptation

After obtaining written consent from the primary authors to use and translate the instrument, the NNCS was culturally adapted to the Italian context.

The adaptation of the Brislin's model (21) for conducting cross-cultural research was used as a guide. Per this methodology, a group approach is used during the back-translation process, which ensures a high degree of accuracy across the various stages of the cultural adaptation process. Two bilingual authors translated the text from English into Italian independent of one another. Each version of the Italian text was than back-translated into the original language (English) by two further authors. Then, all the authors gathered in a consensus meeting with four nursing experts to discuss the forward translation and find the best solution for the Italian context. A native speaker translated the final version of the tool again into English. Finally, the instrument was submitted to the original author, who approved the new formulation of the text.

Stage 2: Face and content validity

Following the recommendations of Polit and Beck (22), the face and content validity of the NNCS were tested. Six panellists outside the research group were involved as follows: three nurses (50%), two nurse managers (33.33%), and one research nurse (16.67%). The panel of experts mainly consisted of women (83.33%) with an average age of 45± 13 years. Five of the experts held a bachelor's degree or a master's degree (83.33%), and one a PhD in Nursing Sciences (16.67%). On average, the experts had 25± 5 years of work experience. To assess the face validity of the tool, three open questions were submitted to the panellists. Then, each panellist was asked to evaluate the relevance of each item on a 4-point Likert scale (1= not relevant; 2 = somewhat relevant; 3 = quite relevant; 4 = highly relevant). The Content Validity Index (CVI) was then calculated for each item of the NNCS (I-CVI) and for the whole instrument (S-CVI) to assess content validity. Only CVI values higher than or equal to 0.70 were considered acceptable (23). The first and second steps of the study were concluded in June 2020.

Stage 3: Construct Validity and Reliability

A cross-sectional study was conducted online from July to December 2020. Nurses were recruited if, (a) they were working in a clinic ward, (b) they had a minimum of six months' work experience (to allow them to familiarize themselves with the practice). A letter presenting the research and containing the link to the online survey was sent to nurses' associations in Lombardy. The researchers' direct contacts let to the enrolment of additional nurses. The socio-anagraphic variables of the sample were also collected (i.e., gender, education, work experience as a nurse, years of experience in the current ward). No information was permitted to be omitted, and participants had to complete all survey fields to move forward. The sample size for the exploratory factor analysis (EFA) was determined based on recommendation to enrol 10 participants for each item of the scale (24).

Statistical analysis

Descriptive statistics were adopted to describe the sample characteristics and the responses provided by nurses. The psychometric properties of the instrument were evaluated EFA with the principal axis factoring method and Oblimin rotation. The Bartlett's test and the Kaiser-Meyer-Olkin (KMO) index allowed the adequacy of the correlation matrix to be evaluated. To establish the number of factors to be extracted, the original instrument, eigenvalues and the Scree test were all considered. Items were included if they had a factor loading equal to or higher than 0.35 (sharing a significant variance on a single factor) (25). The goodness of fit was assessed using the comparative fit index (CFI; values > 0.90 indicated an adequate fit), the root mean square error of approximation (RMSEA; values < 0.08 indicated an adequate fit), and the standardised root mean square residual (SRMR; values < 0.08 indicated an adequate fit). Cronbach's alpha calculations were then used to estimate the internal consistency reliability of the tool. Cronbach's indices were calculated for each of the NNCS items and for the overall scale, to assess internal consistency. Cronbach's indices equal to or greater than 0.70 were considered acceptable (23).

The Statistical Package for Social Science Version 22 (SPSS; Chicago, IL, USA) and Mplus Version 8.3 were used to perform the statistical analysis.

Ethical Considerations

The Institutional Review Board of the University of Milan approved this study. The participants were

informed about the purposes of the research and gave informed consent electronically.

Privacy and anonymity were guaranteed to all research participants. The data collected were stored electronically and managed only for the purpose of scientific research, pursuant to Italian Legislative Decree No. 101 of 10 August 2018, which regulates the protection of individuals with regard to the processing of personal data.

Results

Face and Content Validity

After answering the open questions, the six panellists stated that the items were clear and understandable. Table 1 presents the CVI indices. All the I-CVI indices were higher than 0.70, except for items 3.4 (" I have a lot to say over what happens for patient care on my unit") and 3.8 ("Nurses may stop a procedure that violates infection control standards for central line insertions") (I-CVIs = 0.50). After careful consideration by the research team and the panellists, these items were deleted from the Italian version of the instrument due to their lack of representativeness compared to the construct they intended to measure in the Italian context. The final CVI for the overall scale was 0.92.

Construct Validity

Participants

A total of 362 registered nurses agreed to participate in the cross-sectional study. As shown in Table 2, the nurses were mainly female (68.80%) and of an average age of 37.68 ± 10.61 [Range: 20-55] years. More than half of the sample (55.80%) had a bachelor's degree. On average, the participants had spent 8.26± 8.63 years [Range: 1-15] working in the current ward, while the average total work experience was 13.98 ± 11.02 [Range: 1-20].

Exploratory Factor Analysis

The calculation of the KMO test (0.88) and the Barlett Sphericity Test (χ^2 = 4319.377, p = 0.001) confirmed the adequacy of the correlation matrix to perform EFA. The principal axis factoring method with an Oblimin rotation was used to conduct the EFA. Sev-

Table 1. Content validity

Panelists (N=6)		
	I-CVIs	**S-CVI**
Item 1.1	1	
Item 1.2	1	
Item 1.3	1	
Item 1.4	1	
Item 1.5	0.83	
Item 1.6	0.83	
Item 1.7	1	
Item 2.1	0.83	
Item 2.2	1	
Item 2.3	0.83	
Item 2.4	0.83	
Item 2.5	0.83	
Item 2.6	0.83	
Item 2.7	0.83	
Item 2.8	0.83	
Item 3.1	1	
Item 3.2	1	0.90
Item 3.3	1	
Item 3.5	0.83	
Item 3.6	0.83	
Item 3.7	0.83	
Item 4.1	1	
Item 4.2	0.83	
Item 4.3	1	
Item 4.4	0.83	
Item 4.5	1	
Item 5.1	0.83	
Item 5.2	1	
Item 5.3	0.83	
Item 5.4	0.83	
Item 5.5	1	
Item 5.6	0.83	
Item 5.7	1	

Legend

Note. Content Validity Index (I-CVIs; S-CVI): to assess the relevance, through a four-point ordinal scale (1 = not relevant; 2 = somewhat relevant; 3 = quite relevant; 4 = highly relevant).

Table 2. Sample descriptive statistics (N=362)

		N	%
Gender			
	Male	113	31.20
	Female	249	68.80
Education level			
	High school	75	20.72
	Degree	202	55.80
	Post graduate	85	23.48
		Mean [range]	SD
Age (years)		37.68 [20-55]	10.61
Working time in the actual unit (years)		8.26 [1-15]	8.63
Total years of working		13.98 [1-20]	11.02

Legend

Note. Post graduate includes: master's degree, residencies, doctorate.

Table 3. Item excluded

Item	Definition
2.3	In questa unità operativa, posso contare il numero di volte in cui ho ricevuto informazioni scorrette dagli infermieri
2.5	In questa unità operativa, spesso ritengo necessario ricontrollare l'accuratezza delle informazioni che ho ricevuto dagli infermieri
2.8	Ritengo che alcuni infermieri non comprendano completamente le informazioni che ricevono
3.5	In questa unità operativa, gli infermieri concordano gli obiettivi per la gestione del dolore degli assistiti
3.6	In questa unità operativa, gli infermieri concordano gli obiettivi per garantire la sicurezza degli assistiti
3.7	Gli infermieri sono autorizzati ad interrompere le procedure che violano le norme di sicurezza per l'identificazione degli assistiti
4.1	Gli infermieri si confrontano direttamente tra loro sui problemi assistenziali
4.2	Gli infermieri effettuano riunioni specifiche per discutere dei problemi assistenziali
5.6	In questa unità operativa, gli infermieri con più esperienza assumono ruolo di mentore verso gli infermieri meno esperti
5.7	In questa unità operativa, il coordinatore infermieristico favorisce e sostiene la collaborazione

eral EFA analyses were conducted to identify the best model. Ultimately, the five-dimensional model of the original instrument was confirmed. Ten items (2.3, 2.5, 2.8, 3.5, 3.6, 3.7, 4.1, 4.2, 5.6 and 5.7) were removed because they showed several cross-loadings on more than one factor (Table 3). The final Italian version of the NNCS was composed of 23 items. The model explained 58% of the total variance. Table 4 illustrates the factor loadings of the 23 items, means and standard deviations. The goodness of fit was expressed as follows: RMSEA=0.075, CFI=0.883, SRMR=0.072.

Reliability

Cronbach's coefficients were calculated for each of the dimensions and removing the individual item from the scale. The Cronbach's coefficients for each domain of the tool were as follows: *Conflict Management* = 0.61, *Communication* = 0.87, *Process Sharing* = 0.66, *Coordination* = 0.74, *Professionalism* = 0.81. The overall Cronbach's index of the NNCS was 0.83. Alpha coefficients were consistently lower if the individual item was deleted.

NNCS scores and related variables

The NNCS dimension with the highest average score was *Professionalism* (M=3.10 ± 0.45), followed by *Process Sharing* (M=3.04 ± 0.44), *Communication* (M=3.02 ± 0.47), *Coordination* (M=2.72 ± 0.51), and *Conflict Management* (M=2.14 ± 0.47). The items with the lowest average score were as follows: "In this unit, the accuracy of the information transmitted between nurses leaves much to be desired" (item 2.7; *Communication* domain), "When nurses disagree, they ignore the conflict, pretending that it will pass" (item 1.1; *Conflict management* domain), "Nurses abandoned the conflict" (item 2.2, *Conflict management* domain).

Discussion

Interprofessional collaboration is a common strategy for improving quality of care and patient safety (1). Having a tool capable of assessing the degree of collaboration among nurses within healthcare environments would be useful for health organizations to identify areas for improvement.

This article describes the adaptation of the NNCS to the Italian context. To use an instrument designed

Table 4. Mean of each item and factor loadings

	Conflict management	Communication	Process sharing	Coordination	Professionalism	Mean±DS
Item 1.1	0.58					2.01±0.72
Item 1.2	0.68					2.13±0.65
Item 1.3				0.63		2.80±0.69
Item 1.4				0.65		2.84±0.75
Item 1.5	0.49					2.28±0.61
Item 1.6				0.61		2.54±0.64
Item 1.7				0.43		3.01±0.68
Item 2.1		0.81				2.96±0.64
Item 2.2		0.66				2.86±0.67
Item 2.4		0.59				3.11±0.59
Item 2.6		0.63				3.16±0.59
Item 2.7		-0.48				2.00±0.68
Item 3.1			0.58			3.09±0.54
Item 3.2			0.69			2.96±0.60
Item 3.3			0.58			2.96±0.60
Item 4.3					0.43	3.02±0.68
Item 4.4				0.40		2.44±0.85
Item 4.5					0.57	2.98±0.60
Item 5.1		0.60				3.02±0.66
Item 5.2		0.65				3.04±0.59
Item 5.3					0.70	3.14±0.58
Item 5.4					0.78	3.09±0.59
Item 5.5					0.67	3.21±0.54

Note. the item 2.7 is formulated in reverse score

in another cultural and linguistic context, a simple translation is not sufficient; it is necessary to also verify whether the resulting tool is equivalent to the original one from a semantic and cultural point of view. This study found that the Italian version of the NNCS was a valid and reliable tool.

The content validity process showed some critical issues connected with the adaptation of some items from English to Italian, which led to the removal of two items. Conversely, face validity evaluations revealed no criticisms, and the involved panellists reported that all the items were clear and understandable. The EFA confirmed the hypothesis that the instrument would maintain its original five dimensions. Further, the five-dimensional model showed an adequate goodness of fit. A further 10 items were removed from the original tool following the EFA. None the domains showed any problems related to ceiling effects or cross-loadings that could undermine the interpretability of the EFA model. The final version of the NNCS was composed of 23 items. The removal of 12 items from the original instrument is not surprising because similar results were reported after the NNCS was adapted for use in other countries (19,26). The instrument's reliability indices were all found to be optimal, except for some sub-optimal values reported in the *Process Sharing* and *Conflict Management* dimensions (23).

This study allowed the degree of collaboration among nurses to be investigated at a national level, which also facilitated comparisons with other countries. In the present study, the degree of nurse-nurse collaboration was similar to that observed in Finland and Norway (20), Turkey (19), and Iran (26).

In line with previous studies, our results reported the highest mean score in the *Professionalism* dimension. This dimension is connected to the presence in the nursing group of mutual respect and cordial relationships among nurses, the degree of individual openness to collaboration and the existence of leadership that supports collaboration (1).

As with previous studies, *Conflict Management* was found to be the dimension with the lowest score (19,20). This dimension reflects the group's strategies for solving common problems and conflicts, the ability of the nursing team to consider all points of view in making decisions and the involvement of professionals in achieving care goals (1). Conflict resolution should be a priority within a team. The daily use of appropriate conflict management methods is one of the many challenges that nurses face in their work. Resolving conflicts promotes a positive work environment, stimulates personal growth, and aids the provision of quality care (27,28). Conversely, unresolved conflicts can negatively affect work and the nursing care provided (29). Thus, the present results emphasise that strategies for conflict management should be pursued and encouraged by nursing managers whose support facilitates collaboration and promotes nurses' well-being. Likewise, healthcare organisations should establish conflict management standards to foster a collaborative climate and improve patient outcomes.

Conclusion

The Italian version of the NNCS is a valid and reliable tool. Organisations could use it to gain a better understanding of the degree of collaboration among nurses and to adopt targeted interventions for increasing well-being in the workplace. Further, this study is the first to measure nurse-nurse collaboration in Italy. The findings indicate that more effort should be made to ensure that conflict is managed properly in healthcare organisations. Further research is needed to gather more evidence on the validity of the NNCS. Moreover, cross-national investigations would help deepen understanding of the relationship between nurse-nurse collaboration and contextual factors.

This research has several strengths and limitations. To the best of current knowledge, this study is the first to investigate nurse-nurse collaboration in Italy and offer a tool to measure this phenomenon. As for limitations, any generalisation of the present findings should be conducted with caution due to the reduced extent of the sample. A second limitation could be the NNCS as a self-reporting scale: biases of social desirability may have influenced the results. Third, this study collected data via online surveys instead of face-to-face meetings. A further limitation is the lack of a comparison scale. However, the COVID-19 pandemic limited the access to COVID wards. Finally, not all psychometric properties of the instrument were tested, so additional studies should be carried out to accumulate evidence on the validity of the NNCS.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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