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Validity and reliability assessment of the Compliance with Standard Precautions Scale Arabic version in Saudi nursing students

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Summary Strict compliance with standard precautions (SPs) is warranted to ensure the safety of patients in healthcare facilities. Nursing students (NSs), who are regarded as nurses in training, potentially play a role in cross-contamination in the hospital. NSs are also at high risk of acquiring infections in cases of ineffective compliance with SPs. Thus, an assessment of NSs' compliance with SPs should be conducted on a regular basis, which necessitates a valid and reliable tool. This study was conducted to assess the validity and reliability of the Compliance with Standard Precautions Scale Arabic version (CSPS-A) in Saudi NSs. A convenient sample of 230 respondents (158 NSs and 72 staff nurses) was included in this descriptive, cross-sectional study. The CSPS English version was translated into the Arabic language following a recommended guideline from cross-cultural adaptation and translation instruments. The Cronbach's alpha, the intraclass correlation coefficient (ICC) of the test—retest scores, and the item—total correlations (ITC) were computed to establish the reliability. Content validity and construct validity by the known-groups method and hypothesis testing method were performed. The CSPS-A exhibited good internal consistency and reliability (Cronbach's alpha, 0.89; ICC, 0.88; ITCs, 0.325—0.728). A satisfactory content and construct validity was also

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reported. The CSPS-A is a valid and reliable tool that can measure the compliance to SPs among NSs in Saudi Arabia.

Introduction

Nursing students (NSs) are often exposed to blood and other bodily fluids during their hospital clinical rotations. They are required to provide care to patients who are admitted regardless of the latter's disease status and overall condition. NSs perform invasive and non-invasive nursing interventions that, if improperly executed, may cause them injury, such as a needle stick and other sharps-related injuries, mucocutaneous injury and non-intact skin contact with blood [1]. In a previous study, a total of 239 cases of injury exposures were reported by 2514 NSs (3.15 incidence/100,000 clinical training days). Among the injury exposures, 187 NSs reported being contaminated by body fluids (92.5% by blood and 7.5% by urine, saliva and others) [2]. Because of this, nursing students, like any other healthcare worker (HCW), are at a high risk of acquiring infections if proper protection has not been instituted. In particular, NSs are at high risk of acquiring blood infections, such as viral hepatitis [3] and Human Immunodeficiency Virus (HIV) infection [4], as well as other infectious diseases, such as tuberculosis [5]. Because NSs are often in contact with contaminated articles while assuming their responsibilities in their respective areas, they can also become a vehicle for transmitting pathogens that can cause healthcare-associated infections (HAIs) to the patients. Nursing interventions often require touching the patients, which can facilitate cross-contamination if NSs fail to comply with proper infection prevention guidelines [6]. Hence, NSs must strictly adhere to infection prevention practices at all times [7].

Standard precautions (SPs) are the most recent guidelines for infection control. They consist of basic infection control precautions that are intended to decrease the risk of transmission of blood-borne pathogens and other disease-causing microorganisms within healthcare settings. SPs should be considered as the minimum level of precautions that all HCWs are required to observe when rendering care to every patient. SPs include performance of hand hygiene using personal protective equipment (PPE), such as gloves, gowns, masks, face and eye shields, guided by risk assessment and the extent of anticipated contact; respiratory hygiene and cough etiquette; environmental cleaning; proper handling, transporting and processing of used linens; proper sharps and waste disposal; and proper handling of patient care equipment [8,9]. Compliance with SPs has been shown to decrease the risk of exposure to blood and body fluids [10] as well as to reduce the incidence of HAIs [11].

Compliance with SPs among HCWs, including NSs, has been the focus of various studies in the past [7,12–14], which is an indication of the paramount importance given to strict compliance with SPs among HCWs in healthcare facilities. Interest in this topic is also growing in Saudi Arabia among various groups of HCWs [15–17]. A previous study evaluated the level of knowledge and the practices of HCWs with regard to exposure to blood-borne pathogens in a tertiary hospital in Saudi Arabia. Among the 466 HCWs who were surveyed, 27.9% and 51.9% had experienced blood/body fluid splashing in the eyes or mouth and a needle stick or sharps injury, respectively [18]. Nonetheless, studies have shown a high non-compliance rate with infection control components, such as hand hygiene and gloving practices, among HCWs in Saudi Arabia [6,16,19–21]. Moreover, only a modest proportion of HCWs are aware of the correct actions to be observed following exposure to possible infectious agents [18].

With the growing concern regarding ensuring stringent compliance with infection prevention, more studies are warranted among nurses and NSs in the Kingdom. Compliance with SPs of NSs should be regularly assessed to ensure strict adherence. Given this premise, a valid and reliable tool is needed to measure the competence of NSs regarding SPs. The Compliance with Standard Precautions Scale (CSPS) is an instrument that was developed to measure the self-reported compliance to SPs among nurses and NSs. The CSPS assesses compliance with the major dimensions of SPs and was comprehensively constructed to describe the daily routine of nurses in performing infection control practices in their work [13]. Unlike other tools that were used in previous related studies that employed the concept of universal precautions in measuring compliance with the current infection control practices of nurses [10,22], the CSPS is more precise in measuring the current compliance of nurses to SPs [13]. Furthermore, the CSPS has shown satisfactory results based on international

standards and is globally applicable because of its relevance in developed and developing regions [7]. The establishment of an Arabic version of the scale facilitates a more comprehensive and accurate assessment of compliance with SPs among nurses and NSs in the Kingdom and can serve as the basis for planning and implementing interventions to improve compliance. This version will also pave the way for more studies regarding this topic to be conducted in the Kingdom and other Arabic speaking countries, thus enriching the literature on SPs in this part of the globe. Therefore, this study was conducted to assess the validity and reliability of the Compliance with Standard Precautions Scale Arabic version (CSPS-A) in Saudi nursing students.

Methods

Design

This was a descriptive, cross-sectional study.

Participants and setting

This study was conducted in the Nursing Department (male and female campuses) of a government-run university and in two government hospitals located in Riyadh province, Saudi Arabia. A convenience sample of 230 respondents (158 NSs and 72 Arabic speaking nurses) was involved in the study. The inclusion criteria for the NSs were the following: (1) Saudi male or female full-time nursing students, (2) students registered in the 4th—8th levels (2nd—4th year) of the nursing program, and (3) students who had clinical exposure during the conduct of the study. The nurses were only included in the analysis of the validity of the scale by the known-groups method. The inclusion criteria for nurses were (1) staff nurses with direct contact with patients, (2) staff nurses who were able to read and write in Arabic, (3) staff nurses who were from any of the countries in the Middle-East region.

Ethical consideration

Approval to conduct this study was sought from the Research Committee and Dean of the College of Applied Medical Sciences of the University. Coordination with the female college was accomplished through the Vice Dean. Significant information about the study as well as the expected participation of the respondents was properly explained before they were asked to participate voluntarily. Those who agreed to participate were given a questionnaire. Confidentiality throughout the research process was assured. No incentive was offered to the respondents for their participation. For the translation and use of the CSPS, permission was granted by the original author via email with the approval code C300N14-201510.

Instrument

A self-administered questionnaire was used to gather data from the respondents. The questionnaire was divided into two sections. Part 1 asked for the characteristics of the NS respondents, which included their (1) age, (2) gender, (3) academic level, and (4) total hours of clinical exposure.

The second section was the Compliance with Standard Precautions Scale (CSPS). The CSPS is a 20-item scale that assesses the self-reported compliance with SPs. The scale is a meticulous review of the existing guidelines on universal precautions, SPs and existing instruments. The scale's items evaluate compliance with the use of PPE, disposal of sharps and wastes, decontamination of spills and used articles, and prevention of cross infection. The response set is a 4-point adjectival scale that consists of responses such as ''never'', ''seldom'', ''sometimes'' and ''always''. A score of 1 is interpreted as an ''always'' response, while 0 is applied for the other responses. A total range score of 0—20 is expected, with higher scores signifying better compliance with SPs. In addition, the compliance rate is also calculated (average compliance with the 20 items as a percentage). Items 2, 4, 6 and 15 are negatively stated; thus, scores are reversed before computations. The original version exhibited a sound reliability with a Cronbach's α of 0.73 and intraclass correlation coefficient (ICC) of 0.79 and 0.74 for the 2-week and 3-month test—retest, respectively. The CSPS also demonstrated satisfactory concurrent and construct validity as reported in previous studies [7,13].

Cross-cultural adaptation and translation of the CSPS

The cross-cultural adaptation and translation of the CSPS to CSPS-A was performed following the recommended guidelines in the cross-cultural adaptation and translation of instruments [23]. The CSPS was independently translated by two bilingual Saudi nationals. The first translator was an infection control expert in a governmental hospital, and the other was an expert in foreign languages and translations. A third Saudi national, who was a university nurse lecturer, synthesized the two Arabic versions to produce a single version. The synthesized Arabic version was then presented and independently

back-translated to English by two other bilingual translators who were not aware of the concept being studied. Thereafter, the two back-translated English scales were presented to a third translator who synthesized them to form a single back-translated version. The synthesized CSPS-A and the back-translated CSPS were presented to a panel of experts consisting of five members. The panel consisted of two infection control nurses, two infectious disease specialists and one nurse lecturer who specialized in infection control and prevention. The panel was asked to inspect the semantic, idiomatic, experiential and conceptual equivalence of the two versions. After the panel approved the translation, the CSPS-A was subjected to an analysis of content validity. The five experts were asked to evaluate the relevance of each item of the scale by responding from 1 (not relevant) to 4 (highly relevant) [24]. The findings of the content validity are presented later in this paper.

A pilot test was performed of the CSPS-A among forty (40) nursing students who were not participants in this study. The students were asked to respond to the questionnaire and to provide their comments on any items that they found difficult to understand. The respondents took 5—10 min to complete the entire questionnaire. There was no reported language problem or difficulty in answering the questionnaire. Thereafter, the CSPS-A was subjected to validity and reliability testing.

Data collection

Data were gathered from September to October 2015. The researchers collected data among the male respondents, while a trained female nurse lecturer collected data from the female respondents. Data collection was conducted during the first hour of the respondents' morning classes. Pertinent information about the study was given to the respondents verbally. The respondents were instructed not to write anything in the questionnaire that would identify them and were given 5—10 min to complete the questionnaire. Thereafter, the researchers collected the completed questionnaires. The same procedure was followed by the female research assistant. At the end of each week, the researchers collected the completed questionnaires from the assistant. Two weeks after the initial data collection, the CSPS-A was redistributed to the respondents to determine the test—retest scores. The same procedure was strictly followed during the second data collection.

The questionnaire was also administered to Arabic-speaking staff nurses in two government hospitals following the same procedure. The data that were collected from these nurses were used to establish the construct validity of the CSPS-A using the known-groups method.

Statistical analysis

All statistical analyses were carried out using the SPSS version 21.

Reliability testing

The reliability of the CSPS-A was established by reporting the internal consistency and stability reliability. The Cronbach's α was computed for the internal consistency, and the ICC of the test—retest scores was computed to determine the stability reliability. A Cronbach's $\alpha \geq 0.70$ was considered acceptable [25], and an ICC ≥ 0.80 was acceptable [26]. The item—total correlation coefficients (ITC) were also calculated to support the internal consistency of the scale. An ITC >0.30 was acceptable [27].

Validity testing

Content validity was established by computing the item-level content validity index (I-CVI) and scale-level content validity index (S-CVI/Ave). An I-CVI = 1 for a panel with ≤ 5 members [28] and an S-CVI/Ave ≥ 0.90 was acceptable [24]. Construct validity was established using the known-groups method and hypothesis testing method [29]. The known-groups method was previously used to establish the construct validity of the original version of the CSPS [7,13]. It has been previously reported that staff nurses have a higher compliance with SPs compared with NSs [7,13,22]. In this study, the expectation was that staff nurses would report higher compliance to SPs than the NSs. A *t*-test was performed to examine the difference in compliance with SPs between staff nurses and NSs. With reference to hypothesis testing, the literature shows that clinical experience is positively related to compliance with SPs among nurses. Nurses who are more clinically experienced demonstrate a higher compliance to SPs [6,10,30]. The Pearson product moment correlation was performed to examine the relationship between the clinical experience and compliance with SPs among the NSs. A strong positive correlation between the 2 variables signified satisfactory construct validity.

Results

Among the 158 NSs, the majority were females (55.7%) and had more than 360 h of clinical

Table 1 Validity assessment of the Compliance with Standard Precautions Scale in Saudi nursing students ($N = 158$).

	Characteristic	N (%)	Compliance with standard precautions	
			Mean ± SD	p-Value
Gender	Male	70 (44.3%)	10.94 ± 4.56	<0.01
	Female	88 (55.7%)	8.81 ± 4.22	
Academic level	Level 4	12 (7.6%)	5.00 ± 3.07	<0.001
	Level 5	47 (29.7%)	7.36 ± 3.06	
	Level 6	10 (6.3%)	9.80 ± 3.52	
	Level 7	46 (29.1%)	9.39 ± 4.05	
	Level 8	43 (27.2%)	14.07 ± 3.20	
Clinical exposure	≤360 h	67 (42.4%)	7.27 ± 3.41	<0.001
	>360 h	91 (57.6%)	11.58 ± 4.31	
Known-groups[a] ($N = 230$)	Nursing students	158 (68.7%)	9.75 ± 4.49	<0.001
	Staff nurses	72 (31.3%)	12.83 ± 3.39	
		Mean ± SD	r	p-Value
Age		20.66 ± 2.05	0.35	<0.001
Clinical exposure[b]			0.48	<0.001

[a] Construct validity by known-groups methods.
[b] Construct validity by hypothesis testing.

exposure (68.7%). The mean age of the NSs was 20.66 ± 2.05. The respondents were unevenly distributed between levels 4–8 (see Table 1).

Validity assessment of the CSPS-A

The content validity of the scale was assessed by five experts in infection control. The item-level and scale-level content validity were calculated. The computed I-CVIs of the scale were 1, and the computed S-CVI/Ave was also 1.

The construct validity of the scale was established using the known-groups method and hypothesis testing. As shown in Table 1, the staff nurses (12.83 ± 3.39) exhibited significantly higher compliance with SPs compared with the NSs (9.75 ± 4.49), $p < 0.001$. Furthermore, a strong positive correlation was manifested between the NSs' clinical experience and compliance with SPs ($r = 0.48$; $p < 0.001$).

Male NSs reported significantly higher compliance with SPs compared with female NSs ($p < 0.01$). NSs who were in level 8 of the nursing program reported significantly higher compliance with SPs compared with students in the lower levels ($p < 0.001$). Lastly, there was a positive correlation between the age of the NSs and their compliance with SPs ($r = 0.35$; $p < 0.001$).

Reliability assessment of the CSPS-A

The reliability assessment of the scale is summarized in Table 2. The computed Cronbach's alpha of the scale was 0.89. The intraclass correlation coefficient of the 2 weeks test–retest scores of the scale was 0.88. The computed ITCs ranged from 0.325 to 0.728.

Discussions

Our study attempted to assess the validity and reliability of the CSPS-A in Saudi nursing students. We have presented evidence that strongly supports the sound validity and reliability of the tool, which are significant indicators of quality measurement. The use of a valid and reliable tool is critical for ensuring accurate measurement of the constructs being studied and facilitates the reduction of errors in the measurement process. The reliability of the instrument is established by assessing the internal consistency of the measurement, the stability of measures and the interrater reliability of the instrument's scores. Validity, on the other hand, ensures that the instrument measures what was intended to be measured [31].

Our findings show an excellent item-level and scale-level content validity of the scale as evaluated by the five experts in infection control. Assessing the content validity of a scale is important in establishing its quality. It has also been recommended that the content validation of scales should be clearly reported in scale development studies; hence, both item-level and scale-level content validity should be reported [24]. In our study, all 20 items of the scale were rated 3 (quite relevant)

Table 2 Reliability assessment of the Compliance with Standard Precautions Scale Saudi nursing students ($N = 158$).

Item	Corrected item—total correlation	Cronbach's alpha	Intraclass correlation of test—retest scores
1. I wash my hands between patient contacts	0.728	0.89	0.88
2. I only use water for hand washing	0.536		
3. I use alcohol hand rubs as an alternative if my hands are not visibly soiled	0.636		
4. I recap used needles after giving an injection	0.679		
5. I put used sharp articles into sharps boxes	0.338		
6. The sharps box is only disposed when it is full	0.575		
7. I remove PPE in a designated area	0.643		
8. I take a shower in case of extensive splashing even after I have put on PPE	0.420		
9. I cover my wound(s) or lesion(s) with waterproof dressing before patient contacts	0.375		
10. I wear gloves when I am exposed to body fluids, blood products, and any excretion of patients	0.463		
11. I change gloves between each patient contact	0.325		
12. I decontaminate my hands immediately after removal of gloves	0.390		
13. I wear a surgical mask alone or in combination with goggles, face shield, and apron whenever there is a possibility of a splash or splatter	0.357		
14. My mouth and nose are covered when I wear a mask	0.385		
15. I reuse mask or disposable PPE	0.603		
16. I wear a gown or apron when exposed to blood, body fluids, or any patient excretions	0.486		
17. Waste contaminated with blood, body fluids, secretion, and excretion are placed in red plastic bags irrespective of patient's infective status	0.451		
18. I decontaminate surfaces and equipment after use	0.540		
19. I wear gloves to decontaminate used equipment with visible soils	0.514		
20. I clean up spillage of blood or other body fluid immediately with disinfectants	0.569		

and 4 (highly relevant) by the five experts. This yielded an I-CVI of 1 for all of the items, which met the standard criteria set for an acceptable I-CVI [28]. For the scale-level validity, we chose to report the validity using the S-CVI/Ave method as recommended by Polit and Beck, who have stated that universal agreement is very difficult to achieve if there are many members of the panel with varying viewpoints [24]. Thus, to conclude that a scale has excellent content validity, it should have an I-CVI of 1 for 3 to 5 panel members and a minimum of 0.78 for 6—10 members. In addition, the scale should have an S-CVI/Ave of 0.90 or higher [24,28]. These criteria were met in our study and thus support the excellent content validity of the CSPS-A.

Because of the lack of tools in the Arabic language for measuring the same construct, we decided to assess the construct validity of the tool using the known-groups method and hypothesis testing method. In a known-group analysis, a specific group is expected to manifest higher scores compared with other groups of respondents. Reporting a significant difference in the known-groups supports a satisfactory construct validity of the tool being assessed [32]. Consistent with the literature, staff nurses exhibited a more rigorous compliance with infection control practices, including SPs, compared with NSs [7,13,22,33]. Similarly, we found that staff nurses were more compliant with SPs compared with NSs as measured by the CSPS-A. We also used hypothesis testing to assess the construct validity, which was similarly employed by a previous study to establish the construct validity of the same tool [7]. The literature supports the hypothesis that nurses with more clinical experience will demonstrate better

compliance with SPs [7,10,30]. Similar findings were also revealed in our study. We found that nursing students who had more exposure to clinical duties exhibited better compliance with SPs. These significant findings support the satisfactory construct validity of the CSPS-A in Saudi NSs. In addition, we also examined the differences in compliance with SPs by the gender and academic levels of the NSs, which would also demonstrate the ability of the scale to detect differences between groups. As reported, male NSs reported higher compliance than female NSs. Our findings were consistent with previous observations that male NSs manifest better compliance and practice of the components of SPs, such as hand hygiene [6,16]. This higher level of compliance and better practice of male NSs in Saudi Arabia may be due to the following cultural influences. Socially, males are more dominant than females. Saudi males are known to possess a higher level of confidence when performing tasks and are not very particular about the manner in which the task is accomplished, while female Saudis exhibit less confidence in accomplishing tasks [6,16]. Moreover, our finding that compliance of NSs was higher in the latter years of the nursing program is consistent with reports from earlier studies [14,34] and is complementary to the significant correlation between clinical exposure and compliance to SPs. NSs who are in the latter years of the nursing program have greater exposure to clinical settings and therefore have more clinical experience than the NSs in the lower years. Clinical exposure may improve their compliance with SPs because of the union that occurs between theoretical learning and practical application. NSs' learning inside the classroom is validated by their hands-on experiences in the clinical arena. Furthermore, staff nurses and other health professionals serve as role models for NSs in training by teaching good practice skills and appropriate behaviors. Positive role modeling and clinical interactions strongly influence both the educational and practical aspects of NSs' training [35,36]. These findings conform with those from previous studies and further support the validity of the CSPS-A.

Our findings also support the excellent reliability of the scale. The computed Cronbach's alpha of the scale was greater than the accepted value of 0.70. This suggests a good internal consistency of the scale. The achievement of internal consistency of a scale implies that the items in the scale are intercorrelated [37]. The most commonly used measure of internal consistency is the computation of Cronbach's alpha. A higher value of the Cronbach's alpha indicates a higher level of reliability, thus a higher precision of measurement by the tool [31]. However, Cronbach's alpha does not measure the homogeneity and unidimensionality of a scale [37]. The computed corrected ITCs of the scale were within the acceptable value, which is another way of supporting the reliability of the scale. The ITC can assess the general congruence of an instrument at the same point in time [29]. Further, ITC is commonly used as a non-factor analytic analysis to remove items that do not correlate strongly with the construct that is being assessed [37]. Our results suggest a correlation between the individual item scores and the overall scale scores as indicated by the ITCs greater than 0.30. This indicates that none of the items were eliminated from the scale and thus implies a good internal consistency of the scale. We also reported an acceptable ICC of the two-week test–retest scores of the CSPS-A, which is higher than the reported value in a previous related study [7]. The use of ICC to examine the stabilityreliability is preferred because it considers both the consistency of performances from test to retest and the change in the average performance of the respondents as a group over time [38]. Our results show that the CSPS-A measured the compliance with SPs of Saudi NSs consistently in the periods of collection, thus supporting the scale's reliability over time.

The establishment of the validity and reliability of the CSPS-A has significant implications for nursing practice and nursing education. Infectious diseases are widely disseminated worldwide, and healthcare professionals have increasingly focused on the need for proper infection control [7]. Within healthcare facilities, infectious diseases present a threat to the safety of patients and HCWs. Strict practices in infection control are necessary to prevent cross contamination within hospitals. As discussed earlier, because NSs provide direct care to patients, poor compliance with SPs can pose risks for the transmission of infectious diseases within the hospital. Likewise, NSs can be infected if there is inadequate protection. Therefore, NSs' compliance with infection control practices should be regularly assessed. With the use of the CSPS-A, timely and accurate assessment of Saudi and other Arabic speaking NSs' compliance with SPs can be conducted. Individual needs with regard to infection control practices of NSs can also be assessed appropriately using this scale. Thus, appropriate interventions can be implemented to improve and ensure their stringent compliance with SPs.

Our study reported promising findings on the validity and reliability of the CSPS-A when used in Saudi NSs. However, we acknowledge some limitations of our study. Our use of a convenience sampling technique limits the generalizability of

the results. Our sample size is also small. Hence, a larger sample size is recommended for future studies. Although the methods we employed to establish the validity of the scale are adequate, other methods, such as convergent and divergent validity tests and concurrent validity tests, should also be attempted to strengthen our current findings. Because the CSPS was framed based on the infection control practice guideline checklist, items may not be highly inter-correlated such that factor analysis may not have been appropriate. Future studies should be conducted to further analyze the scale using an appropriate analysis, such as the RASCH analysis (item response theory). Nevertheless, our study offers valuable findings on the topic of infection control, which is very important for ensuring the safety of patients and healthcare workers.

Conclusions

We have reported the results of an assessment of the validity and reliability of the Compliance with Standard Precautions Scale Arabic version in Saudi NSs. We conclude that the CSPS-A is a valid and reliable tool for measuring the compliance of NSs with SPs. The need to regularly assess compliance with SPs among NSs is encouraged to ensure stringent compliance. The CSPS-A is an assessment tool that can be easily administered and interpreted. It can facilitate timely planning and interventions directed toward improving NSs' compliance with SPs. Furthermore, the CSPS-A can be employed by researchers to conduct meaningful studies evaluating compliance with SPs in Saudi Arabia and in other Arabic speaking countries.

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Competing interests

None declared.

Ethical approval

Not required.

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