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Predictors of hand hygiene practice among Saudi nursing students: A cross-sectional self-reported study



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Summary Hand hygiene is an important component of infection control, which is critical to ensuring patients' safety in hospitals. Nursing students are regarded as healthcare workers in training and can also be vehicles of cross-contamination within the hospital. Thus, this study aimed to identify the predictors of hand hygiene practice among Saudi nursing students. A descriptive, cross-sectional, self-reported study was conducted among 198 Saudi nursing students. Knowledge, attitude, and practice of hand hygiene were assessed using the WHO Hand Hygiene Knowledge Questionnaire for Health-Care Workers and its adopted scales. A regression analysis was performed to identify the predictors of hand hygiene practice. The respondents demonstrated moderate knowledge of hand hygiene (mean 13.20 ± 2.80). The majority displayed a moderate attitude toward hand hygiene (52.1%), while only a few reported a poor attitude (13.1%). Approximately 68.7%, 29.8%, and 1.5% of the respondents reported moderate, good, and poor practice of hand hygiene, respectively. Having a good attitude toward hand hygiene, being male, being aware that hand hygiene is an effective intervention in preventing healthcare-associated infections (HAIs), attendance at hand hygiene trainings and seminars, and being in the lower academic level of nursing education were identified as predictors of better hand hygiene practice. The importance of ensuring a positive attitude toward hand hygiene and improving awareness of hand hygiene is emphasized, as are educational interventions. Educational interventions should be implemented to reinforce knowledge and instill a positive attitude toward hand hygiene.

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Introduction

Regarded as the simplest yet most cost-effective intervention in reducing healthcare-associated infections (HAIs), hand hygiene is important in any healthcare concern around the world. Hand hygiene is an essential component of infection control, which is critical to ensuring patients' safety in hospitals [1]. Due to the increasing incidence rate of HAIs and the growing burden accompanying them, the increasing complexity of illnesses and their complications, the soaring cost of hospitalization, and the occurrence of multiple-resistant pathogens causing new types of infections, the necessity for strict and effective compliance with hand hygiene has been emphasized [2]. A wide array of studies supports evidence of the effectiveness of hand hygiene, if accurately implemented, in reducing cross-contamination and infection in a healthcare facility [2–4]. Various studies have reported that good compliance with hand hygiene significantly decreases the number of Methicillin-resistant *Staphylococcus aureus* (MRSA) infections in various units of the hospital, such as in the adult Intensive Care Unit (ICU), Neonatal Intensive Care Unit, and neurosurgery units [5,6].

Similar to the rest of the world, HAIs in Saudi Arabia are a great concern. In a previous study, 668 of 1382 patients were reported to contract HAIs during the study period in a military hospital [7]. Furthermore, a study conducted from 2010 to 2011 reported that 48.3% of 170 investigated patients developed HAIs. From the total number of HAIs reported, 32.3% were respiratory tract infections, 25.3% were urinary tract infections, 18.2% were blood infections and 12.9% were surgical site infections [8]. The literature on hand hygiene strongly supports the evidence that strict hand hygiene practice can significantly decrease the incidence of HAIs [9–11]. Another issue of concern relevant to Saudi Arabia is the occurrence of the new disease called Middle East Respiratory Syndrome coronavirus (MERS-CoV). The majority of laboratory-confirmed cases have been associated with healthcare settings through human-to-human transmission [12]. This poses a threat to the members of a healthcare team. Because of this, the WHO and the CDC have issued recommendations for the prevention and control of this novel infection in healthcare settings that include standard, contact, and airborne precautions [13].

One of the key responsibilities of healthcare workers is to prevent cross-contamination

within the healthcare facility. Nurses in particular have the highest risk of transmitting infection-causing microorganisms within the hospital premises because of their high visibility. Moreover, nurses often come in contact with contaminated objects. Most nursing interventions require direct or close contact with the patient, which can become an avenue for the transfer of pathogens if hand hygiene is not properly observed [14,15]. However, compliance with hand hygiene remains a great challenge in healthcare settings, most especially in limited-resource countries [16]. It has been suggested that interventions be multidimensional to attain a sustainable improvement in compliance with hand hygiene in healthcare settings. An example is the International Nosocomial Infection Control Consortium (INICC) Multidimensional Hand Hygiene Approach (IMHHA), which includes administrative support, availability of supplies, education and training, reminders, process surveillance, and performance feedback. Previous studies have reported significant improvement in adherence to hand hygiene with the implementation of the IMHHA in ICUs in various countries [17–23].

Nursing students are regarded as healthcare workers in training. Because these students have direct contact with patients during their tour of duty, they can also be vehicles of cross-contamination within the hospital. Various studies have been conducted regarding hand hygiene practices of nursing students. It has been reported that nursing students have a low level of knowledge of infection control and poor application of such knowledge to their clinical practice [24]. Low knowledge, understanding, and skills regarding hand hygiene were reported to have a negative effect on the students' compliance with hand hygiene practice [25]. Studies on infection control, including predictors of hand hygiene among undergraduate nursing students, are lacking in the literature [24,25]. Hand hygiene practices also vary depending on the individual, institution, culture, and many other factors. It has also been suggested that further studies investigate the factors that modify hand washing among professional groups [15]. There have been a limited number of studies conducted in Saudi Arabia that focus on this topic [26]. It is therefore difficult to draw a clear picture of hand hygiene practices and the factors that tend to influence compliance with hand hygiene among nursing students in the Kingdom of Saudi Arabia. This study was conducted to examine the predictors of hand hygiene practice among Saudi nursing students.

Methods

Design

This study employed a descriptive, cross-sectional, self-reported design in examining the predictors of hand hygiene practice among the Saudi nursing students.

Participants and settings

This study was conducted in the Nursing Department of the College of Applied Medical Sciences of a government-run university situated in the central region of Saudi Arabia. The nursing program in the university is composed of 4 academic years with 2 semesters (levels) each year. A convenience sample of 223 nursing students was included in the study. Inclusion criteria were set, which included being (1) a Saudi national, (2) male or female nursing student, (3) enrolled in the second semester of academic year 2014–2015, (4) registered for levels 3–8 (2nd–4th year of the BSN program), and (5) enrolled in courses with clinical or Related Learning Experiences (RLE) laboratory exposure.

Instruments

This study utilized a self-administered questionnaire to gather data from the respondents. The survey tool has four parts, each measuring specific variables in the study. Part one elicited information on the respondents' characteristics such as (1) gender, (2) age, (3) academic level, (4) training or seminars attended about hand hygiene in the past 6 months, (5) awareness of the risk that they can be the source of cross-contamination in the hospital, and (6) awareness of the effectiveness of hand hygiene to prevent HAIs.

Knowledge of hand hygiene was assessed using the WHO Hand Hygiene Knowledge Questionnaire for Health-Care Workers. Some modifications were made to suit the respondents and the current study. This tool has both multiple choice questions and 'yes or no' questions. The questionnaire includes questions about possible routes of contamination in healthcare facilities, most frequent sources of germs that can cause HAIs, hand hygiene actions that prevent transmission of germs to patients and healthcare workers, hand hygiene using soap and water and by alcohol-based hand rub, and actions that can increase colonization of germs in the hands [27]. Correct responses were counted and recorded for each respondent. Computed scores higher than 75% were considered good, scores between 50% and

74% were considered moderate, and scores lower than 50% were interpreted as poor.

Attitude toward hand hygiene and hand hygiene practice were measured in parts three and four, respectively. These tools have 10 and six items, respectively, that were adopted from an earlier study, and each item involves a 1–5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The attitude scale assesses the attitude of the respondents toward adherence, importance, priorities, and practices of hand hygiene of the respondents. The practice scale assesses the self-reported practices of hand hygiene in general. Maximum scores of 50 and 30 for attitude and practice, respectively, can be obtained from each scale. Higher scores indicate a positive attitude and better practice of hand hygiene among nursing students. Computed scores higher than 75% were considered good, scores between 50% and 74% were considered moderate, and scores lower than 50% were interpreted as poor [28,29].

For the purpose of this study, the instrument was translated into Arabic using the forward-backward translation method. The questionnaire was presented to three bilingual (Arabic and English) members of the faculty of nursing. They were asked to translate the English version into Arabic. The Arabic version was then presented to another three bilingual nurses who translated it back into English. After consensus was reached, the final Arabic version was produced. The translated questionnaire was subjected to validity and reliability testing in a sample of 100 nursing students. The result demonstrated an acceptable validity and reliability with a Cronbach's alpha ranging from 0.78 to 0.84.

Ethical considerations

The researchers sought approval and permission to conduct the study from the Office of the Dean of the College of Applied Medical Sciences of the university. Proper conduct was observed in the collection of data from the female campus with respect to Saudi culture. A cover letter explaining the purpose of the study and the expected participation of the respondents was attached to each questionnaire. Additionally, a written informed consent form was attached to each questionnaire. The respondents were asked to sign the informed consent form before they were allowed to answer the questionnaire to signify their understanding and voluntary participation. No incentive was offered to the respondents. For the questionnaire, permission was sought and was granted from the original authors.

Data collection

Collection of data was conducted during the second semester of the 2014–2015 academic year. The researchers visited the respondents in their respective classrooms during their scheduled classes to administer the questionnaire. The respondents were given 15–20 min to answer the questionnaire. For the female respondents, the questionnaires were administered by their lecturers following the same procedure.

Data analysis

All data analyses were carried out using the SPSS version 21. Frequency count, percentage, and mean values were used to analyze the knowledge of, attitude toward and practice of hand hygiene. A stepwise multiple linear regression analysis was employed to identify the significant independent variables that could predict the practice of hand hygiene among the respondents. Significance was set at the 0.05 level (2-tailed).

Results

From the 223 questionnaires distributed to the respondents (112 males and 111 females), 198 (107 males and 91 females) were sufficiently answered and retrieved (88.8% response rate). The mean age of the respondents was 21.77 ± 1.26 years, and

the majority of respondents were male (54.0%). Regarding levels, 10.1% were registered in level 3, 13.1% in levels 4 and 5, 19.2% in level 6, 29.8% in level 7, and 14.7% in level 8 during the course of the study. The majority of the respondents (60.6%) had attended trainings or a seminar on hand hygiene in the last 6 months. Furthermore, more than half of the respondents (67.2%) answered 'yes' when asked if they were aware that they could possibly cause cross-contamination in the hospital. The majority of the respondents (57.1%) agreed that hand hygiene is effective in preventing HAIs (Table 1).

Hand hygiene knowledge, attitude, and practice

Table 2 indicates the self-reported knowledge, attitude toward and practice of hand hygiene of the respondents. Using the WHO Hand Hygiene Knowledge Questionnaire for Health-Care Workers, the knowledge of the nursing students was evaluated as moderate (mean 13.20 ± 2.80 ; range 6–23 out of the total score of 25). Most of the respondents (58.6%) demonstrated moderate knowledge, and very few respondents (5.1%) showed good knowledge of hand hygiene. Furthermore, more than half of the respondents showed a moderate attitude (52.1%), while very few of the respondents reported a poor attitude (13.1%) toward hand hygiene. Regarding the practice of hand hygiene, 68.7% of the respondents reported moderate

Table 1 Characteristics of respondents ($N = 198$).

Characteristics		Mean	SD
Age		21.77	1.26
		<i>n</i>	%
Gender	Males	107	54.0
	Females	91	46.0
Academic level	Level 3	20	10.1
	Level 4	26	13.1
	Level 5	26	13.1
	Level 6	38	19.2
	Level 7	59	29.8
	Level 8	29	14.7
Training/Seminars in hand hygiene in the last 6 months	Yes	120	60.6
	No	78	39.4
Aware that they can possibly cause cross-contamination in the hospital	Yes	133	67.2
	No	65	32.8
Aware of the effectiveness of hand hygiene in preventing HAIs	Yes	113	57.1
	No	85	42.9

Table 2 Knowledge, attitude and practice of hand hygiene among ($N = 198$).

Study variables		<i>n</i>	%	Range	Mean \pm SD
Knowledge on hand hygiene	Good	10	5.1	6–23	13.20 \pm 2.80
	Moderate	116	58.6		
	Poor	72	36.3		
Attitude toward hand hygiene	Good	69	34.8	12–50	34.38 \pm 7.79
	Moderate	103	52.1		
	Poor	26	13.1		
Practice of hand hygiene	Good	59	29.8	10–30	20.37 \pm 4.19
	Moderate	136	68.7		
	Poor	3	1.5		

practice, 29.8% reported good practice, and only 1.5% had poor practice.

Predictors of hand hygiene practice

A stepwise multiple regression analysis was employed to identify the predictors of hand hygiene practice by the Saudi nursing students. The respondents' characteristics as well as their knowledge and attitude toward hand hygiene were analyzed to determine the factors that predicted their practice of hand hygiene. Of the eight factors, five were included in the prediction model that reached five steps with none of the variables being removed. The model was statistically significant ($F(5, 192) = 8.68$, $p < 0.001$). It accounted for 50.5% of the variance of the practice of hand hygiene, $R^2 = 0.517$, *Adjusted* $R^2 = 0.505$. As reflected in Table 3, academic level, attendance at a training or seminar in the last 6 months, awareness of the effectiveness of hand hygiene in preventing HAIs, attitude toward hand hygiene, and gender were identified as predictors of hand hygiene practice among the respondents.

The hand hygiene practices of Saudi nursing students were primarily influenced by having a good attitude toward hand hygiene, followed by being male, being aware that hand hygiene is an effective intervention in preventing HAIs, and, to a lesser extent, attendance at hand hygiene trainings and seminars and being in the lower academic level of nursing education. Having a positive attitude toward hand hygiene resulted in the largest beta weight ($\beta = 0.281$, $p < 0.001$), demonstrating the largest contribution to the regression equation while controlling all of the other predictor variables as constants. Gender received the second largest contribution ($\beta = -0.227$, $p < 0.001$), followed by awareness of the effectiveness of hand hygiene ($\beta = 0.218$, $p < 0.001$) and attendance at hand hygiene trainings and seminars ($\beta = 0.215$, $p < 0.05$); academic level exhibited the lowest contribution to the regression model ($\beta = -0.208$, $p < 0.05$). With the sizeable correlation among the predictors of hand hygiene practices, the unique variance of each of the predictors identified (as demonstrated by the squared semi-partial

Table 3 Predictors of the practice of hand hygiene among Saudi nursing students ($N = 198$).

Model	<i>b</i>	SE- <i>b</i>	Beta	<i>sr</i> ²	<i>t</i>	<i>p</i> -value
Academic level	-0.555	0.175	-0.208	0.025	-3.167	0.002*
Training/Seminars in hand hygiene in the last 6 months	1.836	0.527	0.215	0.031	3.481	0.001*
Aware of the effectiveness of hand hygiene in preventing HAIs	1.838	0.503	0.218	0.033	3.656	<0.001*
Attitude toward hand hygiene	0.151	0.036	0.281	0.045	4.228	<0.001*
Gender	-1.903	0.469	-0.227	0.041	-4.055	<0.001*

Note: Practice of hand hygiene was the dependent variable; *b* is the unstandardized coefficients; SE-*b* is the standard error; and *sr*² is the squared semi-partial correlation.

$R^2 = 0.517$; adjusted $R^2 = 0.505$.

* $p < 0.05$.

correlations) was relatively low. Attitude toward hand hygiene and gender uniquely accounted for 4.5% and 4.1% of the variance of hand hygiene practice, respectively. Moreover, awareness of the effectiveness of hand hygiene, attendance at hand hygiene trainings or seminars and the academic level uniquely accounted for 3.3%, 3.1% and 2.5% of the variance of the practice of hand hygiene, respectively.

Discussion

This study investigated the knowledge, attitude, and practice of hand hygiene in a sample of nursing students at a Saudi university. Predictors of the practice of hand hygiene were identified based on the self-reported responses of the participants.

As reported, 60.6% of the respondents had attended hand hygiene trainings or seminars in the past 6 months. Although this is a majority of the respondents, we cannot neglect the fact that approximately 39.4% of the respondents did not receive any training or educational intervention about hand hygiene in the last 6 months. Additionally, approximately 32.8% of the respondents were unaware that cross-contamination in hospitals can be caused by healthcare workers, including themselves, and 42.9% were unaware of the effectiveness of hand hygiene in preventing HAIs. These are significant numbers and should not be ignored. Further analyses revealed that awareness of the effectiveness of hand hygiene in preventing HAIs and attendance at trainings or seminars were identified as predictors for the practice of hand hygiene. This implies that being aware of the preventive role of hand hygiene and attending hand hygiene educational interventions may have influenced the practice of hand hygiene among the respondents. The significance of educational interventions in improving the practice of hand hygiene has been well documented [30,31]. Educational interventions regarding hand hygiene, such as educational campaigns, reminders, and in-service training, can significantly enhance the practice of hand hygiene [32]. These educational interventions may increase the awareness of hand hygiene and thus improve its practice. Nursing education plays a significant role in improving the awareness of nursing students about the role of hand hygiene in preventing the incidence of HAIs. However, a previous study conducted to examine the effectiveness of basic nursing education on hand hygiene revealed a significant deficit in the quality of information provided. This deficit was shown to be directly correlated with low levels of hand hygiene knowledge

and poor compliance to hand hygiene practice during the clinical training of nursing students [25].

Moderate knowledge regarding hand hygiene was also reported in this study. This result is similar to previous studies that reported a moderate level of knowledge about hand hygiene by nursing students [29,33]. Increased knowledge about hand hygiene was reported to have a positive correlation with a decreased risk of cross-contamination among healthcare workers [34]; however, in this study, knowledge was not identified as a significant predictor of hand hygiene practice. Earlier studies have noted that an increased level of knowledge of hand hygiene does not necessarily result in improvement in hand hygiene practice [35,36]. This could suggest that continuous reinforcement programs in the clinical setting should be initiated to support knowledge acquired in the classroom [37]. Nonetheless, having adequate knowledge about hand hygiene coupled with continuous training and seminars could have a positive impact on the practice of hand hygiene.

In this study, the majority of the nursing students reported a moderate attitude toward hand hygiene, and approximately 34.8% reported a good attitude, which is consistent with other studies [38,39]. This can be attributed to the respondents' positive perception of hand hygiene, as interpreted by the positive responses regarding their awareness of the importance of hand hygiene in HAI prevention, and their belief that cross-contamination could be caused by healthcare workers. This could be supported by different behavioral theories, which explain that good perception of some action can result in a more positive display of attitude [40]. Furthermore, a positive attitude was identified as the strongest predictor of the practice of hand hygiene, accounting for 4.5% of the variance. Having a good attitude toward hand hygiene may increase the hand hygiene practice of nursing students. Similar findings were reported by previous studies [33,41]. Nursing students practice hand hygiene more effectively when they have positive beliefs about the benefits of hand hygiene and understand the risks of poor compliance with this practice [33].

Finally, this study also reported that gender and academic level were significant predictors of the practice of hand hygiene among Saudi nursing students. According to the findings, both gender and academic levels were negatively related to the practice of hand hygiene. This finding suggests that being male and being in the early academic levels of nursing education can be associated with better practice of hand hygiene. Conversely, previous studies reported better adherence to

hand hygiene by females [42,43]. However, other previous studies examining the gender differences in hand hygiene among Saudi nursing and medical students reported that male students have significantly better hand hygiene practice compared to female students [15,44]. The results supporting “being male” may be due to the influence of culture on gender differences in the Kingdom, where males are socially dominant compared to females [15]. Consequently, males in the Kingdom are expected to display a positive image with every action. Gender role differences are distinct within Saudi Arabia. As reported in a previous study, male Saudis have a considerably more stable and clearer personal identity compared to females. They have higher confidence in accomplishing tasks and worry less about their behavior and style of doing things. On the other hand, female Saudis have lower self-confidence and are more emotionally vulnerable than males [45]. These may explain the better hand hygiene practice reported by male Saudis. However, this influence of gender on hand hygiene needs to be validated in future studies. Hand hygiene is an important component of infection control and is aligned with academic level; the topic is a part of the Fundamentals of Nursing course taught in the earlier years of the nursing program. It is covered in classroom lectures and is reinforced in the nursing laboratories through continuous demonstration. In addition, students in the lower years are more exposed to trainings and seminars about infection control in the hospital. This can be related to the higher level of practice of nursing students in the lower academic levels of the nursing program. Furthermore, most courses offered in the latter years of nursing programs include clinical exposure. Training in the clinical setting was shown to have a contextual influence that weakens the students’ performance [46]. Moreover, the clinical set-up represents a very complex and dynamic environment, which can have a significant effect on students’ learning and skills, including hand hygiene practice [47].

This study has some limitations. One of the limitations is using self-reports to gather data on the practice of hand hygiene among the respondents. Although self-reporting is the easiest way to collect data, bias can be introduced as respondents may report better practice than their actual practice. Furthermore, this study was conducted using a convenience sampling technique and with a small sample size. This limits the generalizability of the results. Careful interpretation and use of the findings are recommended as a result of this limitation. Further, the study was conducted in a single nursing department of a Saudi university. Future

research should explore a broader setting to obtain a clearer picture about hand hygiene practice in Saudi Arabia. Nevertheless, this study has substantially contributed to the limited literature on this topic in the Kingdom. The results were validated by other similar studies elsewhere, and these new findings regarding the perception of Saudi nursing students about hand hygiene can reinforce the existing knowledge on this topic.

Conclusion

This study was conducted to identify factors that can predict the practice of hand hygiene among Saudi nursing students. Five factors were determined that can significantly predict the practice of hand hygiene, which include positive attitude toward hand hygiene, being male, being aware of the effectiveness of hand hygiene in preventing HAIs, attendance at hand hygiene trainings or seminars, and academic level. The importance of ensuring a positive attitude of nursing students toward hand hygiene, improving awareness of hand hygiene, and educational interventions are underscored. Educational interventions such as trainings and seminars on hand hygiene should be implemented to reinforce knowledge and instill a positive attitude toward hand hygiene. Reinforcement and support of nursing students by clinical instructors and staff nurses are likewise encouraged to promote better practice of hand hygiene in the latter years of the nursing program. Gender-specific educational interventions should also be planned and implemented to meet the gender-specific needs of the students regarding hand hygiene.

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Competing interest

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Ethical approval

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