ORIGINAL ARTICLE

Determinants of Hand Hygiene Compliance and Practice Among Nurses from West-coast Malaysia

Noor Hasliza Che Seman[1*], Juhary Ali[2] and Soon Lean Keng[3]

[1]Department of Nursing Science, Level 4th, Block I, Faculty of Medicine, Universiti Malaya, 50603 Lembah Pantai, Kuala Lumpur, Malaysia
[2]Asia e University, Wisma Subang Jaya, No.106, Jalan SS 15/4, 47500 Subang Jaya, Selangor, Malaysia
[3]Faculty of Nursing, Kolej Universiti Antarabangsa MAIWP, Kampus City Jalan Tangsi, 50480 Kuala Lumpur, Malaysia

Keywords:
Hand hygiene Compliance; Hand hygiene Practice; Nurses; Malaysia

Article histry:
Received: 4 May 2024
Accepted: 23 January 2025

ABSTRACT

Background: The Centers for Disease Control and Prevention emphasizes hand hygiene as a key strategy to reduce healthcare infection transmission. However, its significance is often overlooked, and compliance rates are low. This study aimed to assess self-reported hand hygiene compliance and practice among nurses at selected hospitals of West-coast Malaysia. **Methods:** A cross-sectional study using simple random sampling was conducted among 388 nurses from four hospitals, including private and government settings. A questionnaire on sociodemographic data, self-reported hand hygiene compliance and practices scale questionnaire were given to participants. Simple and multiple linear regression was used to identify associated factors with self-reported hand hygiene compliance and practice. **Results:** Analysis showed male nurses with degrees and diplomas outperformed female nurses in hand hygiene compliance and practice scores. Post-hoc analysis using Games-Howell revealed significant differences in self-reported hand hygiene compliance and practice between Malays (25.33, SD=2.57), Chinese (22.16, SD=3.55), and Indians (21.70, SD=1.36, P<0.001)In terms of the mean practice score, significant differences were observed between Malays (41.99, SD=3.74) and Chinese (54.31, SD=6.09) when compared with Indians (44.07, SD=1.89), P<0.001. The results found a significant difference (P<0.001) in nursing practice between Chinese and Indians. However, the mean practice score for the 'Others' group (47.50, SD=6.55) does not show any significant differences from those of Malays (P=0.170), Chinese (P=0.082), and Indians (P=0.498). **Conclusion:** Male nurses with degrees and diplomas outperformed females in self-reported hand hygiene compliance and practice scores, with Indian nurses scored higher on the hand hygiene compliance scale, while Chinese nurses outperformed Indian nurses in terms of nurses' practice scores. A quality improvement project aims to improve hand hygiene compliance and practice among nurses by identifying root causes is needed.

INTRODUCTION

Hand hygiene is a primary factor in reducing healthcare-associated infections (HAIs), which are a leading cause of harm, jeopardizing patient safety and increasing the disease burden (United Nations Children's Fund and World Health Organization, 2021)and account for about 25 infections in every 100 patient admissions in both developed and developing countries and remain the world's top contributor of morbidity and mortality (World Health Organization, 2020).A systematic review reveals high HAIs prevalence in Southeast Asian countries, posing a significant public health risk due to its high transmission rate (Goh et al., 2023). The first line of defence against many HAIs and illnesses linked to healthcare is good hand hygiene. Good hand hygiene helps reduce the microorganisms responsible for HAIs (Gammon and Hunt, 2019; McMichael, 2019). The Centre for Disease Control and Prevention (CDC) (2020) emphasizes the importance of healthcare personnel adhering to hand hygiene rules and recommendations in high-risk environments, exposing patients and health professionals to numerous microorganisms. Hand hygiene, particularly among nurses, is crucial for controlling HAIs. However, poor hand hygiene compliance remains a global challenge for health professionals (Pires et al., 2017). According to the World Health Organization (2022) report, hand hygiene compliance reduces pathogen spread, improves patient safety, and reduces hospital-acquired infections (HAIs), with 7% in developed countries and 10% in developing countries. Hand-hygiene compliance is defined as the proportion of observed handwashing practices using soap and water or alcohol-based hand-rubbing during any of 'the five moments of hand hygiene', as outlined by the

* *Corresponding author.*
E-mail address: haslizac@um.edu.my

World Health Organization (Toney-Butler et al., 2022) which is the most efficient and cost-effective intervention in healthcare settings (Engdaw et al., 2019). The World Health Organization recommends using a validated observation tool as a method for assessing hand hygiene adherence (McDonald et al., 2021).

Nurses are crucial in fighting infections and preventing healthcare-associated infections (HAIs)(Verbeek et al., 2020). However, global practices at the point of care remain suboptimal. Observing hand hygiene guidelines is crucial in minimizing infection risk in hospitalized patients (Ashinyo et al., 2021). There is a lack of research on Malaysian nurses' self-reported hand hygiene compliance and practice in preventing HAIs. A local study published 11 years ago focused on intensive care unit nurses' compliance with hand hygiene practice and knowledge at one public hospital (Ho et al., 2013). Still, it did not include nurses' self-reported hand hygiene compliance variables. Another study published three years ago focused on self-reported hand hygiene performance predictors among East Coast Malaysian nurses (Rahim et al., 2021). A more recent study examined hand hygiene knowledge, perception, and self-reported performance among East Coast Malaysian nurses (Abd Rahim and Ibrahim, 2022).

Hand hygiene practice varies based on various factors, including the individuals involved, the healthcare system, work characteristics and culture. Also, among the multidisciplinary healthcare professionals who frequently provide patient's bedside care and have direct patient contact are nurses. Therefore, drawing a realistic view of hand hygiene compliance and the factors that impact nurses' hand hygiene practice in Malaysia is difficult. This study aimed to assess self-reported hand hygiene compliance and practice among nurses at selected hospitals of West-coast Malaysia to fill a gap in the literature. The findings of this multisite, cross-sectional study among nurses will provide important evidence for formulating, developing, and applying infection prevention and control (IPC) strategies to support enduring and reliable IPC procedures. This study's findings will also serve as a foundation for future research and provide practical recommendations for programme planners, implementers, and policymakers to enhance hand hygiene compliance in hospitals.

MATERIALS AND METHODS

Ethical Approval

This study was approved by the National Medical Research Register (NMRR) Ethics Committee Malaysia, with a reference number of (09) dlm. KKM/NIHSEC/P15-488.

Study Design

This study utilized a cross-sectional study.

Subjects and Study Setting

A stratified sampling was used. Four hospitals (General Hospital Kuala Lumpur and Universiti Malaya Medical Centre) and two private hospitals (KPJ Damansara Specialist Hospital, Petaling Jaya and Thomson Medical Center, Petaling Jaya) were the first strata with the next being the types of departments in each hospital. A simple random sampling was performed to select the participants from each department, ensuring that participants had an equal chance of being chosen. The inclusion criteria were nurses with at least six months of involvement in clinical services and who had direct contact with patients. Nurses with IPC training was excluded due to the issue of confounders, as they have acquired sufficient knowledge and training to adhere to IPC guidelines. In this study, sample homogeneity was ensured by establishing eligibility and exclusion criteria, collecting data at the same time, assigning one researcher for data collection, and randomly assigning subjects to groups. A single-proportion method was used to estimate the sample size, based on Asmr et al.'s (2019) study on participants' knowledge of infection prevention and practice in Addis Ababa, Ethiopia, under the assumption of a 5% margin of error and a 95% confidence interval (CI). The computed sample size was 353. With a 10% non-response rate taken into account, 388 was the final projected sample size for this study.

Instrument

The study used a self-administered, structured questionnaire in English, adapted from Van de Mortel (2009) and Mitchell (2014), with permission to assess hand hygiene compliance and IPC practices. The questionnaire included sociodemographic characteristics (age, gender, race, highest nursing education and years of work experience), self-reported hand hygiene compliance, and IPC practices. The questionnaire, consisting of 14 items, used a 5-point Likert scale with a choice of answer as "1=strongly disagree", "2=disagree", "3=neutral", "4=agree", and "5=strongly agree" with higher scores indicating higher levels of hand hygiene compliance and practice. A pilot study prior to the actual

study was performed with 38 nurses to assess the comprehensibility, practicability, and acceptability of the adapted instrument from Van de Mortel (2009) and Mitchell (2014), and results were not included in the study findings. Cronbach's alpha test yielded a 0.7 value, indicating acceptable item reliability (Taber, 2018).

Data Collection

Data collection was conducted from October to December 2019. The lead researcher distributed invitation letters to nursing matrons and ward sisters in each hospital, followed by email invitations and electronic recruitment posters to the nurses.

Data Analysis

All data was analysed using the Statistical Package Software for Social Science (SPSS) version 26.0 for Windows. Continuous variables were reported as mean and standard deviation, while categorical variables were expressed as numbers and percentages. Numerical data analysis, including independent t-tests and one-way ANOVA tests, was used to assess data normality. Parametric tests were applied when the histogram indicated a normal distribution. Post-hoc tests were conducted using the Games-Howell test. Simple and multiple linear regression was used to identify associated factors with self-reported hand hygiene compliance and practice. Statistical significance was set at $P<0.05$.

RESULTS

Nurses' Demographic Characteristics

Table 1 showed the demographic of 388 participants. The mean age was 27.89 (SD 5.49), with 59.3% females and 51.8% Malays. 48.2% were non-Malay (Chinese, Indians and Other races). Over half (63.7%) had a diploma in nursing, while the remainder had a bachelor's degree. Most had at least 2.92 years of work experience.

Table 1: Demographic characteristics of participants, n=388

Characteristics	n (%)	Mean (SD)
Age, mean (SD)		27.89 (5.49)
Gender		
Male	158 (40.7)	
Female	230 (59.3)	
Ethnicity		
Malay	201 (51.8)	
Chinese	146 (37.6)	
Indian	33 (8.5)	
Others	8 (2.1)	
Highest nursing education		
Diploma	247 (63.7)	
Degree	141 (36.3)	
Years of working experience, mean (SD)		2.92 (1.45)

Nurses' Self-Reported Hand Hygiene Compliance

Table 2 presents the nurses' self-reported hand hygiene compliance scale. The study reveals that 45.9% of nurses believe they serve as role models for other health professionals, with 52.3% believing hand hygiene could reduce patient mortality and medical costs associated with HAIs. However, only 66% believe prevention of HAIs is part of their role, and 38.2% believe they can change workplace practices. Nearly half of the nurses (42.2%) agreed that they follow senior nurses' hand hygiene habits and consider failure to perform hand hygiene as negligence. Over half of nurses are confident in applying good habits during clinical practice, with 52% performing hand hygiene in clinical settings without extra effort. Additionally, 50.3% remind other healthcare workers to adopt hand hygiene habits, and 40.7% research hand hygiene to address discrepancies between guidelines and practice.

Nurses' Self-Reported Hand Hygiene Practice

Table 3 displays the nurses' self-reported hand hygiene practice. The study found that 38.9% of participants disagreed or strongly disagreed with the use of alcohol-based solutions before and after patient transfers, but 86.1% would use them before opening vascular access equipment. 61.1% agreed to use alcohol-based solutions before and after nursing care procedures. More than half (59.2%) of nurses would wash their hands before and after blood drawing. Less than half of nurses agreed to perform hand hygiene when a urinary catheter was inserted, cleaning body sites, and touching inanimate surfaces. 42.3% of nurses occasionally wear nail polish or artificial nails, but 48.7% always remove rings or bracelets before performing hand hygiene. The majority of nurses were compliant with recommended guidelines for reducing HAI transmission during emergencies.

Comparison of Results Between Gender, Education Level and Race

Table 4 compares results between gender and education level using the independence t-test. There was a statistically significant difference in the mean hand hygiene score between males [67.25 (SD=6.47)] and females [56.77 (SD=2.57)], $P<0.001$. The mean hand hygiene compliance score of males was higher than that of females. Males had a better practice score than females. Regarding the comparison of results between education level, nurses with a degree [68.33 (SD=5.96)] had better scores in hand-hygiene practice than diploma nurses [56.87 (SD=2.57)] with a point difference of 11.46 ($P<0.001$).

Table 2: Nurses' self-reported hand hygiene compliance (n=388)

No	Statements	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
1	I have a duty to act as a role model for other healthcare workers	31 (8.0)	110 (28.4)	69 (17.8)	53 (13.7)	125 (32.2)
2	The importance of completing tasks over performing hand hygiene is often prioritized when busy.^	219 (56.4)	28 (7.2)	111 (28.6)	9 (2.3)	21 (5.4)
3	Performing hand hygiene in the recommended manner can significantly decrease patient mortality	50 (12.9)	72 (18.6)	63 (16.2)	88 (22.7)	115 (29.6)
4	Performing hand hygiene in the recommended situations can reduce medical costs associated with hospital-acquired infections	54 (13.9)	87 (22.4)	43 (11.1)	81 (20.9)	123 (31.7)
5	I can't always perform hand hygiene in recommended situations because my patient's needs come first^	70 (18.0)	98 (25.3)	59 (15.2)	143 (36.9)	18 (4.6)
6	Prevention of hospital-acquired infection is a valuable part of a healthcare professional's role	40 (10.3)	25 (6.4)	67 (17.3)	93 (24.0)	163 (42.0)
7	I follow the example of senior nurses when deciding whether or not to perform hand hygiene^	65 (16.8)	115 (29.6)	44 (11.3)	58 (14.9)	106 (27.3)
8	I believe I have the power to change poor practices in the workplace	95 (24.5)	57 (14.7)	88 (22.7)	34 (8.8)	114 (29.4)
9	I believe failure to perform hand hygiene in the recommended situations can be considered negligence	89 (22.9)	56 (14.4)	80 (20.6)	109 (28.1)	54 (13.9)
10	Hand hygiene is a habit for me in my personal life	0 (0.0)	65 (16.8)	111 (28.6)	109 (28.1)	103 (26.5)
11	I am confident I can effectively apply my	30 (7.7)	58 (14.9)	85 (21.9)	82 (21.1)	133 (34.3)

	knowledge of hand hygiene to my clinical practice					
12	It is an effort to remember to perform hand hygiene in the recommended situations^	101 (26.0)	101 (26.0)	92 (23.7)	40 (10.3)	54 (13.9)
13	I would feel uncomfortable reminding a health worker to handwash^	83 (21.4)	112 (28.9)	71 (18.3)	71 (18.3)	51 (13.1)
14	If I disagree with a guideline, I look for research findings to guide my practice	80 (20.6)	79 (20.4)	71 (18.3)	76 (19.6)	82 (21.1)
Total score, mean (SD)						**61.04 (6.89)**

Scale: 1=strongly disagree to 5= strongly agree; ^ indicates the item is reverse coded

Table 3: Nurses' self-reported hand hygiene practice (n = 388)

No	Statements	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
1.	I follow recommended guidelines for the use of alcohol-based solutions or other antiseptics before and after helping a patient to move, lift or transfer the patient in and out of bed.	97 (25.0)	54 (13.9)	77 (19.8)	67 (17.3)	93 (24.0)
2	I follow recommended guidelines for the use of alcohol-based solutions or other antiseptics before opening vascular access equipment.	0 (0.0)	14 (3.6)	40 (10.3)	189 (48.7)	145 (37.4)
3	I use alcohol-based solutions or other antiseptics between each patient contact.	43 (11.1)	30 (7.7)	144 (37.1)	91 (23.5)	80 (20.6)
4	I wash my hands or rub with an alcohol-based solution or other antiseptics before and after providing a nursing procedure, for example, a bed bath or perineal care.	50 (12.9)	35 (9.0)	66 (17.0)	126 (32.5)	111 (28.6)
5	I wash my hands or rub them with an alcohol-based solution or other antiseptics after contact with equipment objects likely to be contaminated, followed by patient care activity, e.g., taking vital signs.	44 (11.3)	46 (11.9)	74 (19.1)	126 (32.5)	98 (25.3)
6	I wash my hands before and after drawing or manipulating the patient's body fluid sample.	15 (3.9)	71 (18.3)	72 (18.6)	96 (24.7)	134 (34.5)

7	I always wash my hands before and after having direct contact with a patient's intact skin.	24 (6.2)	109 (28.1)	131 (33.8)	49 (12.6)	75 (19.3)
8	I always wash my hands before and after inserting indwelling urinary catheters.	90 (23.2)	73 (18.8)	100 (25.8)	0 (0.0)	125 (32.2)
9	I always wash my hands when moving from a contaminated body site to a clean body site during patient care.	79 (20.4)	54 (13.9)	86 (22.2)	78 (20.1)	91 (23.5)
10	I occasionally polish my fingernails or wear artificial nails.	64 (16.5)	76 (19.6)	84 (21.6)	121 (31.2)	43 (11.1)
11	I am less compliant with recommended guidelines for reducing transmission of nosocomial infections when workload increases or in emergencies.	50 (12.9)	110 (28.4)	94 (24.2)	66 (17.0)	68 (17.5)
12	I wash my hands after touching inanimate surfaces and objects in the patient's surroundings	63 (16.2)	60 (15.5)	76 (19.6)	86 (22.2)	103 (26.5)
13	I chart or use the computer keyboard with my gloves on during a busy patient care episode.	63 (16.2)	13 (3.4)	105 (27.1)	118 (30.4)	89 (22.9)
14	I remove my ring{s}, watch or bracelet before beginning hand hygiene	14 (3.6)	38 (9.8)	147 (37.9)	19 (4.9)	170 (43.8)
Total score, mean (SD)						**46.91 (7.49)**

Table 4: Comparison of scales between gender and educational level (n=388)

Characteristics	**Mean (SD)**		**Mean difference (95% CI)**	**t-statistic (df)** [a]	**P value**
	Male (n=158)	**Female (n=230)**			
Nurses' self-reported hand hygiene compliance score	67.25 (6.47)	56.77 (2.57)	10.48 (11.55, 9.41)	19.33 (191.34)	< 0.001*
Nurses' self-reported hand hygiene practice	50.49 (8.02)	44.46 (5.98)	6.04 (7.51, 4.56)	8.05 (272.64)	< 0.001*
	Diploma (n= 247)	**Degree (n= 141)**			
Nurses' self-reported hand hygiene compliance score	56.87 (2.57)	68.33 (5.96)	11.46 (12.50, 10.42)	21.70 (170.22)	< 0.001*
Nurses' self-reported hand hygiene practice	44.24 (5.79)	51.60 (7.83)	7.36 (8.73, 5.99)	9.75 (228.52)	< 0.001*

Key: [a] Independent t-test; * Statistically significant

Table 5 shows the comparison of scales between races. The scales (nurses' self-reported hand hygiene compliance and practice score) exhibit significant differences between races using a one-way ANOVA test, P<0.001. The post-hoc analysis using Games-Howell on nurses' self-reported hand hygiene compliance and practice. Regarding the mean self-reported hand-hygiene compliance scores, Malays (25.33, SD=2.57) and Chinese (22.16, SD=3.55) are significantly different compared with Indians (21.70, SD=1.36), P<0.001. However, there are no significant differences between Malays (P=0.945), Chinese (P=0.157), and Indians (P=0.085) in the 'Others' group (24.75, SD=3.00). Significant differences in mean practice scores were observed between Malays (41.99, SD=3.74), Chinese (54.31, SD=6.09), and Indians (44.07, SD=1.89, P<0.001).The results found a significant difference (P<0.001) in nursing practice between Chinese and Indians. However, the mean practice score for the 'Others' group (47.50, SD=6.55) does not show any significant differences from those of Malays (P=0.170), Chinese (P=0.082), and Indians (P=0.498). In conclusion, Indian nurses scored higher on the hand hygiene compliance scale, while Chinese nurses outperformed Indian nurses in terms of nurses' practice scores.

Table 5: Comparison of scales between races (n=388)

Variables	Mean (SD)				F-statistics (df) [a]	P value
	Malay (n= 201)	Chinese (n= 146)	Indian (n= 33)	Others (n= 8)		
Nurses' self-reported hand hygiene compliance score	25.33 (2.57)	22.16 (3.55)	21.70 (1.36)	24.75 (3.00)	39.84 (3,384)	< 0.001*
Nurses' hand hygiene practice	41.99 (3.74)	54.31 (6.09)	44.07 (1.89)	47.50 (6.55)	195.72 (3, 384)	< 0.001*

Key: [a] One-way ANOVA test; * Statistically significant

Post-hoc analysis using Games-Howell:

Self-Reported Hand Hygiene Compliance	Nurses' Hand Hygiene Practice
Malay vs Chinese and Indian, p < 0.001*	Malay vs Chinese and Indian, p < 0.001*
Malay vs Others, p=0.945	Malay vs Others, p=0.170
Chinese vs Indian, p< 0.001*	Chinese vs Indian, p< 0.001*
Chinese vs Others, p=0.157	Chinese vs Others, p=0.082
Indian vs Others, p=0.085	Indian vs Others, p=0.498

* Statistically significant

Associated Factors of Self-Reported Hand Hygiene Compliance Among Nurses

Table 6 presents the associated factors of self-reported hand hygiene compliance among nurses using simple and multiple linear regression. Age, gender, race, education level, and years of work experience were significant predictors of self-reported hand hygiene compliance (P<0.001). In the simple linear regression analysis, a 1-year increase in age was associated with a 0.23 unit decrease in the score. Males had a 7.97 times higher chance of having a high hand hygiene belief score than females. Indian nurses had the highest score in self-reported hand hygiene compliance (11.41), followed by Chinese and other races, compared with Malays. Nurses with a degree had an 8.63 times higher chance of having high hand hygiene compliance than diploma holders. Those with one additional year of work experience had a 2.70 times higher chance of having a high hand hygiene belief score. In the multivariate analysis, gender, race, education level, and years of work experience remained significant predictors of the hand hygiene belief scale (P<0.001). Indian male nurses with a degree tend to have a higher self-reported hand hygiene compliance score than other nurses when considering other confounding factors. However, those with longer work experience have a 0.48 lower self-reported hand hygiene compliance score.

Table 6: Associated factors of self-reported hand hygiene compliance among nurses (n=388)

Variables	Simple linear regression b[a] (95% CI)	P-value	Multiple linear regression b[b] (95% CI)	P-value
Age	0.23 (0.14, 0.32)	< 0.001*	-	-
Gender				
Female	0	1	0	1
Male	7.97 (7.35, 8.60)	< 0.001*	2.56 (1.66, 3.45)	< 0.001*
Races				
Malay	0	1	0	1
Chinese	6.87 (6.25, 7.50)	< 0.001*	2.20 (1.32, 3.09)	< 0.001*
Indian	11.41 (10.32, 12.49)	< 0.001*	4.58 (3.20, 5.96)	< 0.001*
Others	6.77 (4.69, 8.85)	< 0.001*	3.43 (1.68, 5.19)	< 0.001*
Education				
Diploma	0	1	0	1
Degree	8.63 (8.06, 9.20)	< 0.001*	2.95 (1.79, 4.11)	< 0.001*
Years of Working Experience	2.70 (2.49, 2.91)	< 0.001*	0.48 (0.14, 0.82)	0.006*

Key: [a] Crude regression coefficient; [b] adjusted regression coefficient; *Statistically significant
Stepwise, backward and forward multiple linear regression methods were applied.

Associated Factors of Nurses' Hand Hygiene Practice Scores

Table 7 presents the associated factors of nurses' practice scores among study participants using simple and multiple linear regression. Age, gender, race, education level, and years of work experience influenced nurses' practice scores in simple linear regression. An increase of 1 year in age corresponded to a 0.27-point decrease in practice scores. Males scored 6.04 points higher than females on the practice scale. Chinese nurses achieved the highest practice scores compared to Malays, followed by other races (5.51 points) and Indians (2.07 points). Degree-holding nurses scored 7.36 points higher in practical skills than diploma-holders. Experienced nurses had a practice score of 2.46 points higher than junior nurses. The study's multiple linear regression analysis revealed that practice scores were significantly influenced by age and race. A 1-year increase in age resulted in a 0.28-point decrease in practice scores when adjusted for race. When age was taken into account, Chinese nurses had a 12.36-point greater probability of scoring on the practice scale than other racial groups, including Malays.

DISCUSSION

Hand hygiene compliance and practice are critical in preventing HAIs, as they disrupt the transmission cycle and mitigate risk. This present cross-sectional study assessed nurses' self-reported hand hygiene compliance and practice at four hospitals in Malaysia. This study reveals that nurses' mean age was 27.89 (5.49). Male nurses with degrees and diplomas outperformed females in self-reported hand hygiene compliance and practice scores. Chinese nurses had a 12.36 times higher chance of scoring on the hand hygiene practice scale. The average scores for the diploma and degree nurses were both higher than the average scores for the group of female nurses. Gender, race, education level, and years of working experience were significant predictors of self-reported hand hygiene compliance. Considering the age of nurses, the results are similar to results for the young nursing workforce in studies conducted in southern Malawi (Nzanga et al., 2022) and eastern Ethiopia (Umar et al., 2022).

The present study reveals that females dominate the nursing profession globally, with a significant gender gap. Female-dominated nursing is well-recognized globally, highlighting the vast gap ratio between females and males (Adhanom, 2019). However, in this study, male nurses, particularly degree and diploma nurses, have higher hand hygiene compliance and practice scores, aligning with Kamunge's (2013) study that found males perform hand hygiene compliance more than females. Contrary, Mohaithef 's (2020) study found that good hand hygiene practice was higher among female nurses

Table 7: Associated factors of hand hygiene practice score among nurses (n=388)

Variables	Simple linear regression b[a] (95% CI)	P-value	Multiple linear regression b[b] (95% CI)	P-value
Age	- 0.27 (-0.41, -0.14)	< 0.001*	- 0.28 (-0.37, -0.18)	< 0.001*
Gender				
Female	0	1		
Male	6.04 (4.64, 7.44)	< 0.001*	-	-
Races				
Malay	0	1	0	1
Chinese	12.32 (11.31, 13.33)	< 0.001*	12.36 (11.39, 13.33)	< 0.001*
Indian	2.07 (0.32, 3.82)	0.020*	4.33 (2.50, 6.17)	< 0.001*
Others	5.51 (2.16, 8.86)	0.001*	6.98 (3.74, 10.23)	< 0.001*
Education				
Diploma	0	1		
Degree	7.36 (5.99, 8.74)	< 0.001*	-	-
Years of Working Experience	2.46 (2.01, 2.91)	< 0.001*	-	-

Key: [a] Crude regression coefficient; [b] adjusted regression coefficient; * Statistically significant
Stepwise, backward and forward multiple linear regression method were applied.

than among male nurses. This difference may be due to females being more aware of their safety and others' safety and cultural influences, whereas males are more socially dominant. Further exploration is needed to understand the relationship between gender, hand hygiene compliance, and practice among nurses.

Findings from this study reveal that Indian male nurses with degrees have higher average scores in self-reported hand hygiene compliance. In comparison, Chinese nurses have higher scores in self-reported hand hygiene practice. Pittet et al. (2009) found that cultural and religious influences significantly influence attitudes towards communal handwashing, as per the WHO Guidelines on Hand Hygiene in Health Care. In Hindu culture (Indians), hand cleansing is a measure of preventing the spread of disease. The practice is clearly in harmony with the Hindu values of non-injury to others (ahimsa) and care for their wellbeing (daya).

The present study shows that nurses with higher degrees had higher self-reported hand hygiene compliance and practice scores, indicating a significant association between these factors. According to Abdo et al. (2020) and Bimerew and Muhawenima (2022), education improves knowledge, which in turn impacts individuals' hand hygiene compliance and practice. Hence, indicate education is deemed to be a vital factor in promoting good hygiene practices. Unfortunately, few studies have been done on self-reported hand hygiene compliance and practice among nurses from a multicultural study population linking to education and hand hygiene compliance and practice. Therefore, no similar data was available from other studies allowing the comparison of results according to race. Hence, further exploration to understand the relationship between race, education, self-reported hand hygiene compliance and practice among nurses is needed.

The present study found that work experience was associated with nurses' self-reported hand hygiene compliance and practice. Our findings concur with an earlier study by Omuga (2011) at Kenyatta National Hospital in Kenya, which found that most demographic factors (such as years of work experience) were related to nurses' hand hygiene compliance and practices. Dixit et al.'s (2012) study suggests that years of work experience are crucial for hand hygiene compliance and practice, while Zakeri et al. (2017) and Al Ra'awji et al. (2018) found that more experience lowers hand hygiene knowledge levels among healthcare workers. A possible explanation for this is that when nurses' work experience increases, complacency develops. Thus, hand hygiene knowledge may be less promoted, potentially impacting compliance and practice among experienced nurses. According to Ahmadipour et al. (2022), barriers to hand hygiene practices include individual, manager, and organizational factors. The findings from this study could help bridge the gap between nurses' self-reported hand hygiene compliance and actual practices with work experience.

There are some limitations in this study. The authors

collected data from one state in Malaysia. Therefore, the findings cannot be extrapolated to nurses working in other states who may have had different responses to the present study population. The study's use of a self-administered questionnaire raises the possibility that, even when participants apply identical actions, there may be discrepancies in their responses to some questions about hand hygiene compliance and practice, giving rise to the impression of subject biases. It may be that males tend to be more confident in their abilities compared to females so this would also result in bias. To further distinguish the potential knowledge participants may hold about hand hygiene compliance and practice, including a multiple-choice question that includes an incorrect response regarding hand hygiene knowledge in future studies would be interesting. In this way, researchers may discover if participants choose the incorrect answer randomly or knowingly. In addition, a comparison of the results of this study with those from other contexts, either national or international, is impossible due to a lack of comparable data.

CONCLUSION

In conclusion, male nurses with degrees or diplomas outperformed females in self-reported hand hygiene compliance and practice scores. Indian nurses scored higher on the hand hygiene compliance scale, while Chinese nurses excelled in practice scores. A quality improvement project to identify the root causes of nurses' hand hygiene compliance issues and identify areas for improvement is needed.

ACKNOWLEDGEMENTS

The authors would like to thank all participants taking part in this study. The authors would also like to thank the Directors of Malaysia National Medical Research, General Hospital Kuala Lumpur, University Malaya Medical Centre, Thomson Medical Centre, and KPJ Damansara Specialist Hospital for their approval of this study. In addition, the authors also want to thank Professor Van de Mortel and Professor Mitchell for their support.

CONFLICT OF INTEREST

The authors have no disclosure of interest, and there are no conflicts to declare.

REFERENCES

Abd Rahim. M.H &Ibrahim, M.I. (2022). Hand hygiene knowledge, perception, and self-reported performance among nurses in Kelantan, Malaysia: a cross-sectional study. BMC Nursing. 21,38. doi:10.1186/s12912-022-00820-6

Abdo, Z.A., Shentema, M.G., Awono, M.T. &Tefera, Y.L. (2020). Compliance to hand hygiene and its associated factors among health care providers in general hospital in Addis Ababa, Ethiopia. BLDE University Journal of Health Sciences. 1;5(1):32. 10.4103/bjhs.bjhs_45_19

Adhanom, G.T. (2019). World Health Organization. Female health workers drive global health: we will drive gender-transformative change. https://tinyurl.com/yc52kbjd (Accessed 3 April 2024)

Ahmadipour, M., Dehghan, M., Ahmadinejad, M., Jabarpour, M., Mangolian S.P. & Ebrahimi Rigi, A. (2020). Barriers to hand hygiene compliance in intensive care units during the COVID-19 pandemic: A qualitative study. Frontiers in Public Health. 10:968231. https://doi. org/10.3389/fpubh.2022.968231

Al Ra'awji, B.A., Almogbel, E.S., Alharbi, L.A., Alotaibi, A.K., Al-Qazlan, F.A. & Saquib, J. (2018). Knowledge, attitudes, and practices of healthcare workers regarding hand hygiene guidelines in Al-Qassim, Saudi Arabia: A multicenter study. International journal of Health Sciences. 12(2):3-8.

Ashinyo, M.E., Dubik, S.D., Duti, V. & Amegah, K.E. (2021). Infection prevention and control compliance among exposed healthcare workers in COVID-19 treatment centers in Ghana: A descriptive cross-sectional study. PLoS One. 16(3): e0248282. doi:10.1371/journal.pone.0248282

Asmr, Y., Beza, L., Engida, H., Bekelcho, T., Tsegaye, N. & Aschale, Y. (2019). Assessment of Knowledge and Practices of Standard Precaution against Blood Borne Pathogens among Doctors and Nurses at Adult Emergency Room in Addis Ababa, Ethiopia, Emergency Medicine International. 1-8. Article ID 2926415, https://doi.org/10.1155/2019/2926415

Bimerew, M. & Muhawenimana, F. (2022). Knowledge, attitude, and practices of nurses towards hand washing in infection prevention and control at a psychiatric hospital. International Journal of Africa Nursing Sciences. 1-7, https://doi.org/10.1016/j.ijans.2022.100399

Center for Disease Control and Prevention (CDC). (2020). Clean Hands Count for Safe Healthcare. Centers for Disease Control and Prevention. https://www.cdc.gov/

(Accessed 5 December 2023)

Dixit, D., Hagtvedt, R., Reay, T., Ballermann, M. & Forgie, S. (2012). Attitudes and beliefs about hand hygiene among paediatric residents: a qualitative study. *BMJ Open*. 2(6):e002188. doi:10.1136/bmjopen-2012-002188

Engdaw, G.T., Gebrehiwot, M.& Andualem, Z. (2019). Hand hygiene compliance and associated factors among health care providers in Central Gondar zone public primary hospitals, Northwest Ethiopia. Antimicrobial. Resistance and Infection Control. 8:190

Gammon, J &Hunt, J. (2019). The neglected element of hand hygiene - significance of hand drying, efficiency of different methods and clinical implication: A review. Journal of Infection Prevention. 20(2), 66–74. https://doi.org/10.1177/1757177418815549

Ho, S.E., Ho, C.C., Hng, S.H., Liu, C.Y., Jaafar, M.Z. & Lim, B. (2013). Nurses compliance to hand hygiene practice and knowledge at Klang Valley hospital. Clinica Terapeutica. 164(5):407-411. doi:10.7417/CT.2013.1604

Goh, P.W., Marbawi, H., Goh, S.M., Abdul Kahar, A.S. & Jualang Azlan, G. (2023). The prevalence of hospital-acquired infections in Southast Asian (1999 – 2022). The Journal of Infection in Developing Countries. 17(2):139-146.doi:10.3855/jidc.17135

Kamunge, E.W. (2013). Exploring Knowledge, Attitudes and Practices of Registered Nurses Regarding the Spread of Nosocomial Infections. doi: http://scholarship.shu.edu/cgi/viewcontent.cgi?article=2872&context=dissertations

McDonald, M.V., Bricker, C., Russell, D., Dowding, D., Larson, E.L., Trifilio, M., Bick, I.Y., Sridharan, S., Song, J., Adams, V., Woo, K., % Shang, J. (2021). Observation of Hand Hygiene Practices in Home Health Care. Journal of the American Medical Directors Association, 22(5), 1029-1034. https://doi.org/10.1016/j.jamda.2020.07.031

McMichael, C. (2019). Water, Sanitation and Hygiene (WASH) in Schools in Low-Income Countries: A Review of Evidence of Impact. International Journal of Environmental Research and Public Health. 16(3), 359. https://doi.org/10.3390/ijerph16030359

Mitchell, B.G., Say, R., Wells, A., Wilson, F., Cloete, L.& Matheson, L. (2014). Australian graduating nurses' knowledge, intentions and beliefs on infection prevention and control: a cross-sectional study. BMC Nursing. 13(1):43. doi:10.1186/s12912-014-0043-9

Mohaithef, M.A. (2020). Assessing hand hygiene practices among nurses in the Kingdom of Saudi Arabia. Open Public Health Journal. 13(1):220‑226. https://doi.org/10.2174/1874944502013010220

Nzanga, M., Panulo, M., Morse, T. & Chidziwisano, K. (2022). Adherence to Hand Hygiene among Nurses and Clinicians at Chiradzulu District Hospital, Southern Malawi. International Journal of Environmental Research and Public Health. 19(17):10981. doi:10.3390/ijerph191710981

Omuga, D. (2011). Factors Influencing Infection Control, Prevention and Injection Safety Practices among Nurses in the Medical and Surgical Wards at Kenyatta National Hospital Nairobi, Kenya. Kenya Nursing Journal. 41. Available online: http://erepository.uonbi.ac.ke/handle/11295/10577

Pires, D., Bellissimo-Rodrigues, F. & Pittet, D. (2017). The evolution in Hand Hygiene literature. In: Hand Hygiene: A Handbook for Medical Professionals. 2017; Oxford: Wiley-Blackwell, pp. 391–399.

Pittet, D., Allegranzi, B. & Boyce, J. (2009). The World Health Organization Guidelines on Hand Hygiene in Health Care and Their Consensus Recommendations. Infection Control & Hospital Epidemiology. 30(7):611-622. doi:10.1086/600379.

Rahim, M.H.A., Ibrahim, M.I., Noor, S.S.M. & Fadzil, N.M. (2021). Predictors of Self-Reported Hand Hygiene Performance among Nurses at Tertiary Care Hospitals in East Coast Malaysia. International Journal of Environmental Research & Public Health. 18(2):409. https://doi:org/10.3390/ijerph18020409

Taber, K.S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. Research in Science Education. 48:1273-1296.

Toney-Butler, T.J., Gasner, A. & Carver, N. Hand Hygiene. (2023). In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; https://www.ncbi.nlm.nih.gov/books/NBK470254/ (Accessed 5 April 2024)

Umar H, Geremew A, Kassie TW, Dirirsa G, Bayu K, Mengistu D.A., Berhanu, A. & Mulat, S. (2022). Hand hygiene compliance and associated factors among nurses working in public hospitals of Hararghe zones, Oromia region, eastern Ethiopia. Frontiers in Public Health. 10, 1032167. https://doi.org/10.3389/fpubh.2022.1032167

Van de Mortel, T.F. (2009). Development of a questionnaire to assess healthcare students' hand hygiene knowledge, beliefs and practices. Australian Journal of Advanced Nursing. 26(3): 9-16.doi/10.3316/ielapa.248030148222055

United Nations Childrens Fund and World Health Organization. (2021). State of the Worlds Hand Hygiene: A global call to action to make hand hygiene a priority in policy and practice. UNICEF, New York. https://tinyurl.com/mvyf7z3w (Accessed 3 April 2024)

Verbeek, J.H., Rajamaki, B., Ijaz, S., Sauni, R., Toomey, E., Blackwood, B., Tikka, C., Ruotsalainen, J.H. & Kilinc Balci, F.S. (2020). Personal protective equipment for preventing highly infectious diseases due to exposure to contaminated body fluids in healthcare staff. Cochrane Database of Systematic Reviews. 4(4): CD011621. https://doi.org/10.1002/14651858.CD011621. pub4

World Health Organization (2022). WHO launches first-ever global report on infection prevention and control; https://www.who.int/news/item/06-05-2022-who-launches-first-ever-global-report-on-infection-prevention-and-control (Accessed: 5 March 2024)

Zakeri, H., Ahmadi, F., Rafeemanesh, E. & Saleh, L.A. (2017). The knowledge of hand hygiene among the healthcare workers of two teaching hospitals in Mashhad. Electronic Physician. 9(8):5159 - 5165. doi: 10.19082/5159