ISSN 2354-8428
e-ISSN 2598-8727

JURNAL KEPERAWATAN

KOMPREHENSIF

COMPREHENSIVE NURSING JOURNAL

Published by :

Sekolah Tinggi Ilmu Keperawatan
PPNI Jawa Barat

Vol. 11 No. 1, January 2025

JURNAL KEPERAWATAN KOMPREHENSIF	VOL. 11	NO. 1	Bandung January 2025	ISSN 2354-8428	e-ISSN 2598-8727

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

Review Article

Knowledge, Attitude, and Practice Toward Infection Prevention Strategies Pre- and Post-COVID-19 Among Nursing Students: A Systematic Review

Yayu Nidaul Fithriyyah[1]* | Syahirul Alim[2]

[1]Department of Medical Surgical-Nursing, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, 55281 Indonesia

[2]Department of Basic & Emergency Nursing, Faculty of Medicine, Public Health and Nursing, UGM Yogyakarta, 55281, Indonesia.

***contact**

yayu.n.f@ugm.ac.id

Received : 19/12/2024
Revised : 21/01/2025
Accepted : 22/01/2025
Online : 28/01/2025
Published : 28/01/2025

Abstract

Aims: COVID-19 (Coronavirus Disease 2019) has significantly impacted infection control, highlighting the vulnerabilities of the global healthcare system. This study evaluates measurable outcomes and barriers in nursing students' knowledge, attitudes, and practices, and barriers to infection prevention before and after COVID-19.
Method: systematic review, with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) registered on PROSPERO: CRD42022322706. Using the PICO framework for article selection: Population (involving nursing students), Intervention/exposure (infection control or prevention), Compare and Outcome (knowledge, attitudes, and practice). We searched nine databases from March to June 2022, with inclusion criteria for full-text articles published in English from 2012 to 2022. The study quality used The Joanna Briggs Institute (JBI) Critical Appraisal tool and the National Institutes of Health (NIH). PICO synthesis for analysis.
Results: Of 3,030 articles, only 15 met the criteria for inclusion: Cross-sectional (12/15, 80%), Descriptive study (2/12, 13%), and pre-post study (1/15, 6.67%). Infectious disease (4/15, 26.6%) and All disaster events (4/15, 26.6%), with the condition: pre-COVID-19 (11/15,73.3%), and during COVID-19 (4/15, 26.6%). The five themes were: (1) nursing students' knowledge level regarding infection control standards, (2) nursing students' attitudes towards infection control standards, (3) nursing students' practice on infection control standards, (4) factors affecting infection control in nursing students, (5) roles of nursing schools and hospitals in infection control.
Conclusion: Nursing students showed increased knowledge, but gaps in attitudes and practice remain. Future efforts should develop standardized infection prevention curricula, integrate social media training, and strengthen academic-healthcare partnerships.

Keywords:
Attitudes, COVID-19, Health Knowledge, Infection Control, Nursing student, Practice

INTRODUCTION

Healthcare-associated infections (HAIs) pose a significant challenge to healthcare systems, frequently resulting from invasive medical procedures, extended hospitalizations, or patients' compromised immune systems (1). HAIs significantly increase morbidity and mortality, lead to financial losses, and extend hospital stays, ultimately diminishing patients' quality of life (2). Therefore, preventing HAIs is

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

paramount, especially since the emergence of the COVID-19 pandemic (3). In this context, adherence to prevention standards effectively controls HAIs (4). Key strategies include hand hygiene, proper use of personal protective equipment (PPE), environmental cleaning, and antimicrobial stewardship. Effective implementation requires education, and monitoring to address challenges and improve outcomes in preventing infections (5).

As future nurses, nursing students play a vital role in preventing HAIs, due to their direct involvement in patient care, so they need to understand why infection prevention is so important. HAIs significantly increase morbidity, mortality, and healthcare costs, posing a significant risk to patient safety (6,7). Mastery of strategies such as hand hygiene, use of PPE, and aseptic technique helps reduce the risk of infection, but limited clinical exposure and inadequate knowledge often hinder the development of competency (6,8).

The COVID-19 pandemic has significantly impacted infection control, highlighting the vulnerabilities of the global healthcare system. This situation underscores the importance of knowledge and skills in dealing with infectious outbreaks and emphasizes the need to adapt to continuously evolving conditions (9,10). According to CDC's National Healthcare Safety Network data, there was an increase in HAI incidents in 2020 (9). This underscores the need for deeper understanding and awareness of infection control and strengthening healthcare programs' resilience to future pandemics. This responsibility extends to various healthcare professionals, including nursing students. Nursing students play a key role in this effort, as they form the foundation of future healthcare resilience. Our systematic review evaluates changes in nursing students' knowledge, attitudes, and practices toward infection prevention before and after the COVID-19 pandemic, while also identifying barriers, and training strategies in addressing these challenges effectively.

METHODS

Study Design

The systematic review was conducted as a comprehensive synthesis and relevant study of nursing students' knowledge, practices, and attitudes toward infection prevention strategies pre and post-COVID-19. This study used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (11) and was registered in the PROSPERO CRD42022322706.

Sample

Inclusion and exclusion criteria

The PICO framework was employed to screen and select articles (12) (Table 1). The criteria for selection included that the articles be full text, published between 2012 and 2022, and written in English. The exclusion criteria for articles: Literature types such as reviews, research protocols, abstracts, conference proceedings, editorials, and book chapters were excluded from consideration.

Table 1. PICO Framework

Criteria	Inclusion
Population	Nursing students as single or part including other health students
Intervention	Content, strategy, standard infection control, infection prevention
Comparison	None
Outcome	Investigate knowledge, attitudes, and practice.
Design	Qualitative or quantitative design or mixed method

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

Search strategy

We use Nine electronic journal databases to search relevant articles from March to June 2022, including PubMed, EBSCO/MEDLINE, Scopus, ProQuest, ScienceDirect, Sage Pub, SpringerLink, Taylor and Francis, and Wiley. The specific search was: (Baccalaureate OR nursing students OR undergraduate nurse) AND (Infection Control OR infection prevention) AND (Knowledge OR Attitudes OR Practice OR KAP) (Appendix Supplementary 1)

Study selection

After the initial search, a total of 3,303 articles were imported into the Mendeley reference manager. Duplicate articles have been removed. Then the titles and abstracts were filtered for relevance, resulting in a total of 56 articles. However, only 51 of them can be reviewed in full. Ultimately, 15 articles were included in this systematic review (Figure 1). Reporting of this research complies with PRISMA guidelines (11). There was no disagreement among the authors during this process.

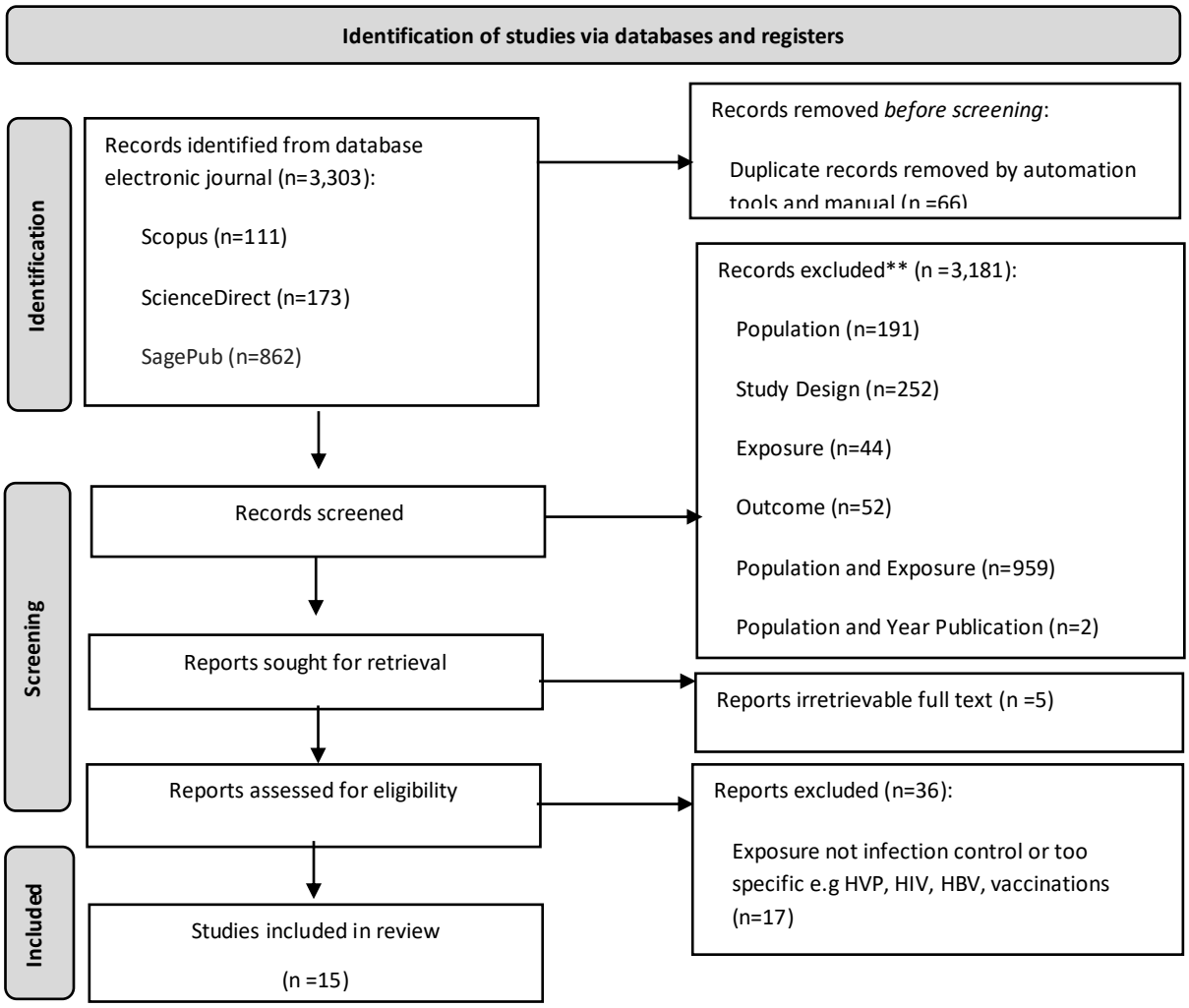

Figure 1. Flow diagram using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (11)

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

Extraction, analysis, and synthesis of data

A pilot test was performed on one article to determine the specific information to be extracted, which included article characteristics and participant characteristics such as age and gender, and the results and findings were also extracted (Table 2). The synthesis of this data led to the identification of themes.

Risk of bias and study quality

Assessment of the methodological quality using The Joanna Briggs Institute (JBI) Critical Appraisal tool for 12 cross-sectional and two descriptive studies (13,14). National Institutes of Health **(**NIH) to assess observational cohort and pre-post study without a control group (15).

RESULTS

Identify study characteristics

The search yielded 3,030 articles, and only 15 articles were included in the systematic review (Table 2). The publication years (46.6%) it was ranged from 2020 to 2022 (16–22). Five studies originated from Asia (33.3%) (16,22–25). The predominant study design was cross-sectional (80%) (16–18,22–24,26–28), followed by two studies (13.3%) with a descriptive design (19,27) and pre-post study design (25). All studies were conducted in university settings (100%), with the majority targeting all years of nursing students (73.3%). Participant ages were reported in 13 studies (86.6%), with most participants aged between 18 and 23 years (16,17,19–24,26–28). Most participants were female (71.6%), with 73.3% discussing the standard precautions and infection control measures pre-COVID-19 (19–24,26,28,29).

Assessment of risk of bias and study quality

The quality assessment using the JBI Critical Appraisal Tool for Analytical Cross-Sectional Studies showed a variation in quality. Of the fourteen studies evaluated, three (20,21,28)were good (88% to 100%). The remaining eleven studies were rated as fair, each achieving a score of 75%. Meanwhile, using the NIH Quality Assessment Tool for Before-After Studies without a Control Group for the study by Hassan (2018) it had a fair score (66.6%). However, it fell short in aspects such as blinding outcome assessors and reporting group-level interventions and individual-level outcome efforts (Table 2, Appendix Supplementary 2).

Findings from narrative analysis

In this systematic review, 15 studies were included, revealing five significant themes focused on pre and post-COVID-19 pandemic (Appendix Supplementary 3), namely: (1) nursing students' knowledge level regarding infection control standards, (2) nursing students' attitudes towards infection control standards, (3) nursing students' practice on infection control standards, (4) factors affecting infection control in nursing students, (5) roles of nursing schools and hospitals in infection control (Appendix Supplementary 3).

Nursing Students' Knowledge Level Regarding Infection Control Standards

Pre-COVID-19, two subthemes emerged: knowledge in nosocomial infection prevention and knowledge assessment (Appendix Supplementary 2). Brosio et al. (2017) and Ojulong et al. (2013) revealed low levels of knowledge and awareness. Meanwhile, there is a lack of knowledge regarding nosocomial infection control and hand hygiene practices (25), Majidipour et al. (2019), Melo et al. (2017), and Turan et al. (2018).

Post-COVID-19, the focus is on a single subtheme: knowledge of infection prevention and control. The study found a slight improvement in the general understanding of infections (16), contrasting with the findings reported increased awareness and understanding,

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

Table 2. Summary of studies selected and quality of study (n=15)

Authors	Country	Design	Date of data collection	Total student participants (n) (%)	Age (years(n))	Sex (n) (%)	Results and Finding	Quality of study
Pre-COVID-19								
(30)	Namibia	cross-sectional	N/A	Medicine: 31 Radiology: 17 Nursing: 114	Mean: 24.3 ± 0.8	M: 40 (24,7) F: 122 (75.3) Medicine= M: 14 ; F: 17 Radiology = M: 6 ; F: 11 Nursing = M: 20 ; F: 94	No gender/school location differences in knowledge. Medicine students scored higher than Radiology and Nursing (p<0.05)—awareness in IPCs.	6/8, 75%, Fair
(29)	Australia	cross-sectional	N/A	349 all year	19-21: 83 22-25: 87 26-35: 81 > 35: 98	M: 30 (8.6) F: 319 (91.4)	59.8% correct answers. Higher scores in standard precautions (p < 0.001). Majority compliant. Primary IPC source: infection control professionals.	6/8, 75%, Fair
(28)	Italy	observational survey	N/A	1st: 203 (59.9) 2nd: 88 (25.9) 3rd: 48 (14.2)	< 22: 218 ≥ 22: 121	M: 86 (25.4) F: 253 (74.6)	Sufficient knowledge of standard precautions. Significant year-wise difference in glove use knowledge (p < 0.0001). Periodic knowledge checks are needed.	8/8, 100%, Good
(26)	Brazil	cross-sectional	February to May 2014.	186 all year	Mean 23.1 ±3.4, ranged (18-36)	M: 19 (10.2) F: 167 (89.8)	Low knowledge of blood pressure, PV measurement. Similar SHH knowledge across groups. Varied hand hygiene, protective barrier understanding. Limited IV catheter knowledge.	5/8, 62.5%, Fair

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

(25)	Jordan	A pretest-posttest	March and April, 2017	2nd: 80 (31.3) 3rd: 83 (32,4) 4th: 93 (36,3)	N/A	M: 120 (46.9) F: 136 (53.1)	Improvement in knowledge and compliance post-intervention. 57% inadequate pretest knowledge; 45.7% high posttest knowledge. The online curriculum's utility is highlighted.	8/12, 66.6%, Fair
(23)	Saudi Arabia	cross-sectional	January 19, 2017.	Medicine: 75 (58.1) Dentistry: 18 (14) Applied Medical Sciences: 17 (13.2) Nursing: 14 (10.9) Pharmacy: 5 (3.9)	N/A	M: 67 (52.0) F: 62 (48.0)	66.7% got IC and SPs information from the curriculum. 73.6% had sufficient knowledge. Effective formal teaching in university.	6/8, 75%, Fair
(27)	Turkey	descriptive	December 2013 and March 2014.	Junior: 344 (80) Senior: 86 (20)	N/A	M: 118 (27.4) F: 312 (72.6)	43.2% correctly identified contamination method. 61.9% defined HAIs correctly. High mean knowledge in nursing students. Significant knowledge variation across schools/years.	6/8, 75%, Fair
(24)	Iran	cross-sectional	May 13, 2017,	3rd : 51 (50.0) 4th: 51 (50.0)	Mean: 23.83 ± 1.81	M: 53 (52.0) F: 49 (48.0)	Mean knowledge score 12.49±2.3, performance score 43.07±0.67. Significant correlation between knowledge and performance (r = 0.46, p < 0.0001).	6/8, 75%, Fair
(20)	Ethiopia	cross-sectional	May 1 to May 3, 2019,	1st: 111 (46.4) 2nd: 56 (23.4) 3rd: 72 (30.2)	Mean = 28.58 ± 3.19 20–24: 16 25–29: 143 30–34 62	M: 167 (69.9) F: 72 (30.1)	Mean knowledge score 4.17. 59% below the mean on PVC knowledge. Training increases knowledge likelihood (AOR = 2.9)—age-related knowledge	8/8, 100%, Good

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

					> 35 18		differences.
(21)	Nigeria	cross-sectional	December 30, 2018,	100 all year	21-30: 95 31-40: 5 (	M: 25 (25.0) F: 75 (75.0)	Low practice levels are indicated by mean practice score. Significant correlation between knowledge and practice (r = −0.123). Rigorous training recommended.	7/8, 87.5%, Good
(19)	Turkey	descriptive	Feb-19	2nd: 62 (29.8) 3rd: 84 (40.4) 4th: 62 (29.8)	Mean: 21.78±2.21, ranged (19-35)	M: 41 (19.7) F: 167 (80.3)	72.1% had hospital infection training, but 90.4% needed more education. Average NI knowledge score 26.62±2.73. Curriculum revision is recommended.	6/8, 75%, Fair
Post-COVID-19								
(22)	Oman	cross-sectional	March and June 2020	330 all year	Mean: 21.57 (SD=1.9)	M: 144 (43.6) F: 186 (56.4)	Female students scored higher (M=53.84) than males (M=45.03). Internet main information source. Low overall knowledge level (51.53%).	6/8, 75%, Fair
(16)	Saudi Arabia	cross-sectional	March 22 to April 4, 2020.	2nd: 471 (38.4) 3rd: 310 (25.3) 4th: 265 (21.6) Internship: 180 (14.7)	18–45 (M = 21.62, SD = 2.06)	M: 348 (28.4) F: 878 (71.6)	99.2% aware of COVID-19, 71.0% from social media. Positive correlations in knowledge and preventive behavior. Differences across university, year, gender.	6/8, 75%, Fair
Fakhri, Nada. et al. (2021)	Morocco	cross-sectional	20-30 April 2020	1216 all year	18-23: 1162 (95.6) 24-27: 46 >27: 8	M: 275 (22.6) F: 941 (77.4)	67.9% learned about COVID-19 from social networks. 60% had specific training. Majority knew transmission modes symptoms. Majority positive about overcoming COVID-19.	6/8, 75%, Fair
(18)	Poland	cross-sectional	April 8 2021 to	nursing: 175 midwifery: 60	Mean 21.5 ±3.83, ranged	M: 37 (13.5) F: 238 (86.5)	The main source is the Ministry of Health website (32%). No	6/8, 75%, Fair

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

	June 6 2021	emergency medical services: 40 and 97 first-year 1st : 97 2nd : 88 3rd : 90	(19-39)			maximum knowledge scores. Knowledge influences attitudes, and behaviors. Females were more fearful of SARS-CoV-2 (p = 0.021).

Abbreviations: F: Female, M: Male, HAIs: Healthcare-Associated Infections, IC: Infection Control, IV: Intravenous, N/A: Not Available, NI: Nosocomial Infections, PVC: *peripheral* venous catheter, SPs: Standard Precautions.

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

particularly in COVID-19 prevention (17,18). Despite being uneven, there was increased knowledge about transmission, prevention, and protection against infection (22).

Nursing Students' Attitudes Towards Infection Control Standards,

This theme highlights the evaluation of their knowledge and attitudes in infection prevention. Pre-COVID-19, nursing students understood standard preventive measures, particularly regarding the risk of contamination with biological fluids. Brosio et al. (2017) found that almost all students correctly implemented these preventative measures. However, Ojulong et al. (2013) indicated a deficiency in the use of alcohol-based hand rubs. Mitchell et al. (2014) emphasized the need for more specific education despite high awareness of the HAIs.

Post-COVID-19 studies by (16–18) showed a significant increase in knowledge, proactive attitudes, and infection prevention practices among nursing students. They generally agree on the importance of preventive measures such as social distancing, quarantine, and vaccination, especially during the pandemic. However, there remains a gap in practical knowledge regarding preventive tools.

Nursing Students' Practice on Infection Control Standards

Pre- COVID-19, there are two subthemes: studies on compliance and practice in standard infection prevention revealed variations in the application and adherence to preventive infection (21,23,26,28,29). These studies highlighted a link between insufficient early education in Infection Prevention and Control (IPC) and the management of nosocomial infections, pointing out a gap in practical knowledge, especially regarding alcohol-based products and the implementation of infection control practices in intensive care areas (24,30)

Post-COVID-19, research indicated increased compliance and responsibility toward infection prevention practices among nursing students during the pandemic. Many students adapted to changes in their routines (17,18) and followed government health guidelines and regulations (16), demonstrating a heightened level of commitment to infection control measures.

Factors Affecting Infection Control in Nursing Students

This theme comprised six subthemes. 1) training and knowledge level significantly influenced infection control (19,20,24,26–28). 2) academic level, based on the academic year, showed variation in knowledge and performance (24,28). 3) Age is significantly related to the knowledge of managing specific procedures (20). 4) Field of Study revealed differences in the level of knowledge (23,27,30). 5) Gender, although not a primary factor influencing knowledge or performance in infection control (23,24,27,29,30) 6) Sources of Learning among Nursing Students, most nursing students (48.8%) favored a self-study approach (23). Information was commonly sought from experienced professionals, followed by organizational policies and guidelines, and via the Internet, especially among students under 25 (29) Formal and informal learning occurred within hospital wards and through organized Infection Control (IC) courses as part of nursing education.

Post-COVID-19, based on four subthemes. 1) Training highlighted the relationship between COVID-19 knowledge and behaviors and perceptions related to the virus (16,18). 2) Academic Level was significant in prevention knowledge and behavior (16) 3) Gender showed variations in prevention knowledge and behavior scores (16,18,22) 4) Psychology found that infection prevention practices were influenced by risk perception and anxiety during COVID-19 (18). 5) learning information sources shifted towards social media and online platforms, with knowledge about COVID-19 becoming less dependent on traditional sources (18). Most nursing students (72.1%) did not receive

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

COVID-19 information through their courses, turning to social media as a primary source (16). Furthermore, Fakhri et al. (2021) revealed that the first source of information about COVID-19 for 67.9% of participants was social networks, followed by television (12.3%), healthcare workers (7.9%), and family (5.1%). Overall, the main sources of knowledge were information posted on the Ministry of Health website (32%), from the World Health Organization (19%), and on social media (19%) (18).

Roles of Nursing Schools and Hospitals in Infection Control

This theme was divided into two main sub-themes pre-COVID-19. First, the integration of HAIs into the nursing curriculum (19,21,27) Training is essential before nursing students commence clinical practice. Further, there is a need for effective tutor guidance to optimize students' field training (25,28). Second, it underlines the role of hospital management in providing safety equipment and training according to clinical practice guidelines (20,21)). Post-COVID-19, the focus has shifted to curriculum development, emphasizing the importance of education on infectious diseases such as COVID-19. They advocate for the integration of this material into the curriculum to prepare nursing students for public health crises (16–18,22).

DISCUSSION

This systematic review highlights significant differences in study characteristics, methodologies, and regional findings, including cultural and educational disparities regarding knowledge and attitudes among nursing students before and after COVID-19. In Namibia, no differences in knowledge were observed based on gender or location, while in Italy and Brazil, year-to-year variations were evident. The finding of review covering 15 studies identified five main themes regarding nursing students' knowledge, practices, and attitudes toward infection prevention strategies. Pre-COVID-19, there was a lack of knowledge about HAIs and IPC (24–27) Most students showed positive attitudes and compliance toward infection prevention (28), yet there was a shortfall in the use of alcohol-based hand rubs (30). In terms of practices, there was variability in the application of infection prevention (21,23,26,28,29)

These findings align with the study by Botha et al. (2023) which observed that although students' levels of knowledge, attitudes, and practices regarding infection prevention vary, limited resources hinder effective practices in resource-constrained regions. Other studies highlighted low compliance among Ethiopian students despite adequate knowledge (32). Japanese students demonstrated better outcomes during COVID-19 due to workplace-supportive pre-practicum training, facilitating effective infection prevention (33).

In the post-COVID-19, there is substantial knowledge among nursing students regarding infection control, particularly in the prevention of COVID-19, yet there is a lack in effective prevention practices. Students exhibit proactive attitudes and a commendable level of concern but lack practical understanding of correctly using Personal Protective Equipment (PPE). Regarding practices, nursing students have a high level of adherence to infection prevention. They adhere more strictly to government health guidelines and regulations, demonstrating a positive shift in the application of infection prevention (16–18,22).

Supporting these results, a study by Alrawahi in Oman revealed that students possessed adequate knowledge (13.67 ± 3.46), a positive attitude (48.14 ± 12.29), and good practices (32.6 ± 6.12) regarding infection prevention during the COVID-19 (34). Similarly, a study in Indonesia indicated that 55.1% of respondents had good knowledge about PPE, with 54.1% showing a positive attitude and 45.9%

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

demonstrating good practices. These findings underscore the importance of training during the educational period to enhance students' abilities in correctly using PPE, thereby improving the overall effectiveness of infection control (35).

In this review, factors influencing infection control among nursing students in pre-COVID-19: training level, academic level, age, field of study, and gender. Post-COVID-19, academic levels remain significant. However, the emphasis is more widely discussed on COVID-19-related training. Gender differences became clearer in terms of knowledge and preventive behavior. Additionally, psychological factors such as risk perception and anxiety during the pandemic emerged as significant influences on infection prevention practices. The results, similar to Banstola et al. (2021) revealed that all nursing students experienced anxiety during clinical placements amid the COVID-19 pandemic, with the majority (81%) experiencing mild anxiety, which influenced their infection prevention behaviors. Additionally, Anxiety and fear were positively correlated, with higher anxiety levels leading to reduced compliance with preventive measures (37). In contrast, during non-emerging disease conditions, nursing students demonstrated an 83% compliance rate with infection prevention practices, driven primarily by strong clinical leadership and role modeling (38). However, there was no significant relationship between other sociodemographic post-COVID-19 outbreak in Kuantan (39).

The findings in this review are that psychological aspects influence knowledge, attitudes, and practices. In line with a study that showed. During COVID-19, the prevalence of moderate anxiety (42.8%) and severe anxiety (13.1%). Additionally, gender, lack of PPE, and fear of infection were significantly associated with anxiety scores (40). These findings show that the pandemic has changed the educational focus on infection control and nursing students' personal and psychological approaches to this practice.

Findings from the review indicate that pre-COVID-19, the focus of nursing schools and hospitals on infection control was primarily on curriculum development, including HAI courses and training, as well as the provision of safety equipment in hospitals. Post-COVID-19, the curriculum development became more specific towards infectious diseases such as COVID-19, emphasizing preparing nursing students to face crises and enhancing infection control practices. These results align with a review by Haque et al., highlighting the importance of a multi-faceted approach to HAIs to ensure hospital safety (41). Furthermore, the COVID-19 pandemic has significantly impacted the future of nursing education. Therefore, nursing must design curricula that strengthen partnerships for students' clinical experiences and meet community needs (42).

In this review, pre-COVID-19, infection control learning resources for nursing students included formal methods such as training and informal methods such as independent study and information from professionals. Post-COVID-19, the primary information is obtained from social media and online platforms, especially COVID-19. These results indicate a shift in which students increasingly rely on social media and official health websites, marking a change in how nursing students search for and process information. The qualitative study by Chang provides insights into how nursing students learn infection control care, emphasizing the importance of guidance from professors and clinical mentors in developing theoretical education and clinical practice opportunities (43). This study indicates that nursing students understand infection control education at varying learning levels within undergraduate nursing programs (44).

Overall, the findings indicate that factors such as nursing students' knowledge levels,

https://doi.org/10.33755/jkk

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

attitudes, and practices regarding infection prevention are interrelated and influenced by training, institutional support, and learning resources, both pre-and post-COVID-19 (19–21,24–28). However, during the pandemic, there was an increased reliance on social media as a primary source of information, which impacted the quality of learning (18,22,23,29). Furthermore, research on social media literacy among undergraduate nursing students in Poland during COVID-19 reveals significant differences in their competencies ($p < 0.001$), especially in verifying content on social media. This aspect is a critical skill that could significantly impact their professional competencies. Both findings underscore the need for a holistic educational approach to training nursing students, encompassing theoretical aspects, clinical practices, and social media literacy(45).

Limitation

This review has limitations, including the restriction to English-language studies, which may exclude relevant research, and variability in study designs, most cross-sectional studies, regions, or educational systems, limiting meta-analysis feasibility. Self-reported data may introduce bias, and findings specific to nursing students may not generalize to other healthcare professions. There is a need to update information with the latest articles on HAIs during the pandemic and the absence of searches in the gray literature.

CONCLUSION

The systematic review reveals a significant improvement in nursing students' knowledge and awareness, particularly regarding COVID-19 prevention, while highlighting persistent gaps in attitudes and practices. These gaps are shaped by the roles of educational institutions and hospitals in upholding infection control standards. Implications for practice include the necessity of collaboration between nursing education programs and hospitals to integrate infection control training into clinical placements and simulations. Future initiatives should prioritize the development of standardized infection prevention curricula for nursing students, incorporating advanced teaching strategies such as simulation-based learning and e-modules. Furthermore, nursing programs should embed social media training into infection prevention education, fostering students' capacity to navigate digital information effectively. Longitudinal studies are critical to assessing sustained behavioral changes and the long-term psychological impacts of infection prevention practices. Additionally, strengthening academic-healthcare partnerships is imperative to provide nursing students with robust practical training opportunities and leadership development. Such efforts are crucial for preparing the next generation of nursing professionals to address future public health challenges effectively and ensure the resilience of healthcare systems in managing infectious disease outbreaks.

Conflict of Interest

The authors have no conflict of interest associated with this research.

The funding source

This study did not receive any funding support.

Author's contributions

YNF contributed to conceiving and designing this research, performing a systematic review, and arranging the manuscript. YNF and SA contributed to reviewing it, analyzing results, and supervising the process.

REFERENCES

1. Rodríguez Plasencia A, Donoso Noroña RF, Gómez Martínez N, Vilema Vizuete EG. Identification of the impact of healthcare-associated infections in intensive care units[Identificación del impacto de infecciones asociadas a atención de

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

salud en unidades de cuidados intensivos]. Revista Cubana de Investigaciones Biomedicas. 2024 Jan 1;43:e3642.

2. Iliyasu G, Dayyab FM, Habib ZG, Tiamiyu AB, Abubakar S, Mijinyawa MS, et al. Knowledge and practices of infection control among healthcare workers in a Tertiary Referral Center in North-Western Nigeria. Ann Afr Med [Internet]. 2016 Mar 1 [cited 2023 Dec 8];15(1):34. Available from: /pmc/articles/PMC5452692/
3. Livshiz-Riven I, Hurvitz N, Ziv-Baran T. Standard Precaution Knowledge and Behavioral Intentions Among Students in the Healthcare Field: A Cross-Sectional Study. Journal of Nursing Research [Internet]. 2022 Oct 23 [cited 2023 Dec 8];30(5):E229. Available from: https://journals.lww.com/jnr-twna/fulltext/2022/10000/standard_precaution_knowledge_and_behavioral.3.aspx
4. Fithriyyah YN, Aulawi K. Using mobile phone applications in engaging nurses for preventing healthcare-associated infections: A systematic review. Nursing Practice Today [Internet]. 2022 Mar 13 [cited 2023 Dec 8];9(2):84–101. Available from: https://publish.kne-publishing.com/index.php/NPT/article/view/8892
5. Hill B, Lamichhane G, Wamburu A. Infection prevention and control: Critical strategies for nursing practice. British Journal of Nursing. 2024 Sep 19;33(17):804–11.
6. Park E, Park HR, Lee JH. Barriers to Learning Healthcare-Associated Infections Prevention and Control during Clinical Practicum among Nursing Students in Korea: A Focus Group Study. Int J Environ Res Public Health. 2023 Jul 1;20(14):6430.
7. Lee SH, Yang IS. Enhancing competency in infection prevention and control: Identifying priorities for clinical nurse educational needs. Nurse Educ Today. 2024 Mar 1;134:106085.
8. Hawker C, Courtenay M, Gould D. How aseptic technique is taught to undergraduate student nurses: A qualitative study. Nurse Educ Today. 2023 Mar 1;122:105717.
9. NJ Health Department. Department of Health | Communicable Disease Service | Healthcare Associated Infections (HAIs) [Internet]. 2021 [cited 2023 Dec 8]. Available from: https://www.nj.gov/health/cd/topics/hai.shtml
10. Filip R, Gheorghita Puscaselu R, Anchidin-Norocel L, Dimian M, Savage WK. Global Challenges to Public Health Care Systems during the COVID-19 Pandemic: A Review of Pandemic Measures and Problems. J Pers Med [Internet]. 2022 Aug 1 [cited 2023 Dec 8];12(8). Available from: /pmc/articles/PMC9409667/
11. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. The BMJ. 2021 Mar 29;372.
12. Brennan SE, Cumpston MS, McKenzie JE, Thomas J. The use of 'PICO for synthesis' and methods for synthesis without meta-analysis: protocol for a survey of current practice in systematic reviews of health interventions. F1000Res. 2020 Nov 1;9.
13. Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetc R, et al. Chapter 7: Systematic Reviews of Etiology and Risk. JBI Manual for Evidence Synthesis. 2020;
14. Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: Methodological guidance for systematic reviewers utilizing meta-aggregation. Int J Evid Based Healthc. 2015 Sep 1;13(3):179–87.
15. National Institutes of Health. Study Quality Assessment Tools | NHLBI,

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

NIH [Internet]. 2021 [cited 2023 Dec 8]. Available from: https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

16. Albaqawi HM, Alquwez N, Balay-odao E, Bajet JB, Alabdulaziz H, Alsolami F, et al. Nursing Students' Perceptions, Knowledge, and Preventive Behaviors Toward COVID-19: A Multi-University Study. Front Public Health. 2020 Dec 23;8.
17. Fakhri N, Jallal M, Belabbes S, Khudur K, Kaddar R, Oubaasri A, et al. COVID-19 and Moroccan nursing students: A multicentre cross-sectional survey on their related knowledge, attitudes and practices. Nurs Open. 2021 Jul 1;8(4):1634–41.
18. Stefanowicz-Bielska A, Słomion M, Stefanowicz J. COVID-19 pandemic—Knowledge, attitudes, behaviours, and actions among faculty of health sciences students. Int J Environ Res Public Health. 2021 Nov 1;18(22).
19. Davran E. Knowledge Level of Nursing Students on Nosocomial Infection. Erciyes Medical Journal. 2020;
20. Etafa W, Wakuma B, Tsegaye R, Takele T. Nursing students' knowledge on the management of peripheral venous catheters at Wollega University. PLoS One. 2020 Sep 1;15(9 September).
21. Olorunfemi O, Oyewole OM, Oduyemi RO. Nursing students' knowledge and practice of infection control in Burns and Medical-Surgical Units at the University of Benin Teaching Hospital, Nigeria, 2019. Journal of Nursing and Midwifery Sciences. 2020 Jan 1;7(1):42–6.
22. Alriyami M, Al Omari O, Al-Daken L, Alriyami T, Al Rashdi R, Al Shukaili S, et al. Assessing knowledge of nosocomial infection among Omani student nurses: a cross-sectional study. https://doi.org/1012968/bjon20223 1266 [Internet]. 2022 Jan 29 [cited 2023 Dec 8];31(2):66–70. Available from: https://www.magonlinelibrary.com/doi/10.12968/bjon.2022.31.2.66
23. Khubrani A, Albesher M, Alkahtani A, Alamri F, Alshamrani M, Masuadi E. Knowledge and information sources on standard precautions and infection control of health sciences students at King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh. J Infect Public Health. 2018 Jul 1;11(4):546–9.
24. Majidipour P, Aryan A, Janatolmakan M, Khatony A. Knowledge and performance of nursing students of Kermanshah-Iran regarding the standards of nosocomial infections control: A cross-sectional study. BMC Res Notes. 2019 Aug 6;12(1).
25. Hassan ZM. Improving knowledge and compliance with infection control Standard Precautions among undergraduate nursing students in Jordan. Am J Infect Control. 2018 Mar 1;46(3):297–302.
26. Melo G de SM, Tibúrcio MP, Freitas CCS de, Vasconcelos QLD de AQ de, Costa IKF, Torres G de V. Semiotics and semiology of Nursing: evaluation of undergraduate students' knowledge on procedures. Rev Bras Enferm. 2017 Apr 1;70(2):249–56.
27. Turan GB, Mankan T, Asst R. Nursing Students' Levels of Knowledge on the Prevention of Intravascular Catheter Infections [Internet]. Vol. 11, International Journal of Caring Sciences. 2018. Available from: www.internationaljournalofcaringsciences.org
28. Brosio F, Kuhdari P, Stefanati A, Sulcaj N, Lupi S, Guidi E, et al. Knowledge and behaviour of nursing students on the prevention of healthcare associated infections. Vol. 58, J PREV MED HYG. 2017.
29. Mitchell BG, Say R, Wells A, Wilson F, Cloete L, Matheson L. Australian graduating nurses' knowledge,

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

intentions and beliefs on infection prevention and control: A cross-sectional study. BMC Nurs. 2014 Dec 12;13(1):1–7.

30. Ojulong J, Mitonga KH, Iipinge SN. Knowledge and attitudes of infection prevention and control among health sciences students at University of Namibia. Afr Health Sci. 2013;13(4):1071–8.
31. Botha BS, Hugo-van Dyk L, Nyoni CN. Simulating infection prevention and control through virtual reality: a vehicle for equity, diversity, and inclusivity in Africa. Front Educ (Lausanne). 2023 Jan 1;8:1214321.
32. Ayele DG, BayeTezera Z, Demssie NG, Woretaw AW. Compliance with standard precautions and associated factors among undergraduate nursing students at governmental universities of Amhara region, Northwest Ethiopia. BMC Nurs. 2022 Dec 1;21(1):375.
33. Nakagawa H, Sasai H. Nursing students' practicums during the covid-19 crisis and the effect on infection-prevention behavior in students: A mixed-method approach. Medicina (Lithuania). 2021 Dec 1;57(12):1354.
34. Sultan Hamood Al Rawahi M, Muthukrishnan A, Tayyib NA, Lathamangeswari C, Pandurangan H, Nomani I, et al. Infection Control Behavior Factors to Prevent COVID-19 among Nursing Students: Cross-Sectional Online Survey. ASEAN Journal of Psychiatry [Internet]. 2022 May 30 [cited 2023 Dec 8];23(5):1–18. Available from: https://www.aseanjournalofpsychiatry.org/articles/infection-control-behavior-factors-to-prevent-covid19-among-nursing--students-crosssectional-online-survey-89525.html
35. Amalia RN, Emaliyawati E, Mediawati AS. Description Of Perceptions Of The Donning And Doffing Of Personal Protective Equipment In Unpad Nursing Students Class Of 2017. Padjadjaran Acute Care Nursing Journal [Internet]. 2021 [cited 2023 Dec 8];3(1). Available from: https://jurnal.unpad.ac.id/pacnj/article/view/38346
36. Banstola B, Shakya N, Sharma P. Anxiety among nursing students towards clinical placement during covid-19 in a tertiary hospital of nepal: A descriptive cross-sectional study. Journal of the Nepal Medical Association. 2021 Jun 1;59(238):542–6.
37. Kim K, Jeong H, Lee J. COVID-19 Related Fear, Risk Perceptions, and Behavioral Changes According to Level of Depression among Nursing Students. Int J Environ Res Public Health. 2022 Apr 2;19(8):4814.
38. Bouchoucha SL, Philips NM, Lucas J, Kilpatrick M, Hutchinson A. An investigation into nursing students' application of infection prevention and control precautions. Nurse Educ Today. 2021 Sep 1;104:104987.
39. Jamiran NS, Ludin SM. Knowledge, Attitude and Practice on Infection - Control Among IIUM Kuantan Nursing Students During Coronavirus 2019 Disease (COVID-19) Outbreak. INTERNATIONAL JOURNAL OF CARE SCHOLARS [Internet]. 2021 Dec 9 [cited 2023 Dec 8];4(Supp1):58–65. Available from: https://journals.iium.edu.my/ijcs/index.php/ijcs/article/view/219
40. Savitsky B, Findling Y, Ereli A, Hendel T. Anxiety and coping strategies among nursing students during the covid-19 pandemic. Nurse Educ Pract [Internet]. 2020 Jul 1 [cited 2023 Dec 8];46:102809. Available from: /pmc/articles/PMC7264940/
41. Haque M, McKimm J, Sartelli M, Dhingra S, Labricciosa FM, Islam S, et al. Strategies to Prevent Healthcare-Associated Infections: A Narrative Overview. Risk Manag Healthc Policy [Internet]. 2020 [cited 2023 Dec

p-ISSN : 2354 8428 | e-ISSN: 2598 8727

Jurnal Keperawatan Komprehensif
Volume 11 Issue 1 January 2025

8];13:1765. Available from: /pmc/articles/PMC7532064/

42. Leaver CA, Stanley JM, Goodwin Veenema T. Impact of the COVID-19 Pandemic on the Future of Nursing Education. Academic Medicine [Internet]. 2022 Mar 1 [cited 2023 Dec 8];97(3):S82. Available from: /pmc/articles/PMC8855777/
43. Chang SO, Sohng KY, Kim K, Won J, Chaung SK, Choi MJ. How nursing students learn infection control education through undergraduate nursing programs: a phenomenographic research study. BMC Nurs [Internet]. 2023 Dec 1 [cited 2023 Dec 8];22(1):1–11. Available from: https://bmcnurs.biomedcentral.com/articles/10.1186/s12912-023-01465-9
44. Boeira ER, Silva e Souza AC, Pereira MS, Vila V da SC, Tipple AFV. Infection control and patient safety measures addressed in nursing pedagogical projects. Rev Esc Enferm USP [Internet]. 2019 [cited 2023 Dec 8];53. Available from: https://pubmed.ncbi.nlm.nih.gov/30726337/
45. Cieślak I, Łuszczki JJ, Panczyk M, Nowak-Starz G, Wawrzuta D, Jaworski M, et al. Social media literacy among nursing students during the COVID-19 pandemic – does year of study matter? A nationwide cross-sectional study. Annals of Agricultural and Environmental Medicine [Internet]. 2023 Mar 31 [cited 2023 Dec 8];30(1):171–6. Available from: https://www.aaem.pl/Social-media-literacy-among-nursing-students-during-the-COVID-19-pandemic-does-year,162219,0,2.html