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Systematic Review

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The effectiveness of quality and safety education for nurses competencies intervention to improve knowledge-skills and attitude of the undergraduate faculty at nursing institutes: a systematic review and meta-analysis

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ABSTRACT

BACKGROUND & OBJECTIVE: Quality and Safety Education for Nurses (QSEN)competencies-based interventions have emerged as a promising approach to improve knowledge, skills, and attitudes of quality and safety education for nurses. There is a need for more data to prove the effectiveness of these interventions in enhancing undergraduate nursing faculty's competencies. The main goal of this study was to find out how well (QSEN)based interventions improve the knowledge, skills, and attitudes of nursing faculty at the undergraduate level.

METHODOLOGY: The researchers conducted a systematic review and meta-analysis of intervention studies that compared QSEN-based interventions with standard education or no intervention at all. The search included both published and unpublished sources from 2005 to 2022 and covered nurses, nursing students, and nursing faculty.

RESULTS: Out of 6385 records, only 06 were suitable for inclusion, involving 1374 individuals. However, the results were significant. The meta-analysis showed that QSEN interventions made a big difference in the knowledge, skills, attitude, motivation, and trust of the people who took part, with a total estimate of 1.54 (0.16–2.92). The meta-analysis of variance for trial heterogeneity found a statistically significant difference, and the researchers found no evidence of publication bias.

CONCLUSION: QSEN-based interventions are effective in improving the knowledge, skills, attitudes, motivation, and trust in the safety of nurses, nursing students and nursing faculty.

KEYWORDS: Quality and Safety Education for Nurses, Nursing schools/Institute, Nursing Faculty, Randomized Controlled Trials, Quasi Experimental, Pre-Post-Test with Control Groups, QSEN Competencies, Clinical Trial Studies with QSEN Competencies.

INTRODUCTION

The QSEN skills comprise patient-centered care, teamwork and cooperation, evidence-based practice, quality improvement, safety, and informatics, among other crucial facets of healthcare delivery [1–4]. The undergraduate nursing faculty is responsible for ensuring the preparation of nursing students with high-quality and competent skills. In 2021, Khazana and Dolansky noted that a lack of inclusion in nursing as undergraduate nursing faculty introduced their students to the Quality and Safety Education for Nurses (QSEN) program necessitated that many nursing faculties acquire QSEN competencies .

Nursing faculty plays a crucial role in shaping their students' competencies. However, no data shows that undergraduate nursing instructors employ interventions to teach quality and safety information to undergraduate nursing [5], and quality and safety studies have shown that many academics need more formal quality and safety education for nursing faculty. For instance, 79% require help, faculty development, and instructional methods. Graduates exhibited greater confidence and competence than faculty [6], and 40% required mastery of QSEN abilities [7]. Thus, instructors use limited strategies to educate students on quality and safety and lack the training and confidence to show safety cycles [5,8].

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Nursing faculty QSEN competencies, thus, need more research, highlighting a research gap [9]. Only one study [10] conducted a faculty program and QSEN knowledge, skill, and attitude: a descriptive comparative study in Bachelor of science in Nursing (BSN),associate degree in nursing and faculty groups. Even though there are few studies, and found that BS nursing program faculty did better regarding their knowledge, skills, and self-reported readiness to teach benchmark quality and safety competencies. Evidence also uses QSEN competencies to improve undergraduate nursing faculty knowledge, skills, and attitude.

There is a growing need for QSEN-based intervention in undergraduate nursing programs worldwide. Therefore, undergraduate faculty who are qualified in QSEN can be very important in ensuring quality and safety education. The literature review exhibited that interventions based on QSEN competencies can improve skills, knowledge, and attitudes needed to successfully carry the quality and safety curriculum. Enhancing the knowledge, skills, and QSEN competencies of undergraduate nurse faculty will contribute to the development and growth of future nurse faculty training and development by fostering the growth and development of the potential knowledge, abilities, and attitude required to instruct undergraduate nursing students in QSEN competencies across various training programs.

Thus, this meta-analysis looked at how well interventions based on QSEN competencies improve knowledge ,skills, and attitudes compared to those that used traditional competencies or no intervention. The meta-analysis addresses the following research question:
To determine the effectiveness of QSEN based interventions in improving the knowledge,skills and attitude of the undergraduate faculty at nursing institutes.

METHODOLOGY

The researchers did not need ethical clearance for the literature review but registered it with Prospero (CRD42023478257). This study looked at how QSEN competencies-based interventions affect the knowledge, skills, and attitudes of undergraduate nursing faculty in both clinical and educational settings.

The study was conducted during November 2022-November 2023 by using data from recent randomized clinical trials and quasi-experimental studies. The PICO framework was used to search for studies, with the population being undergraduate nursing faculty, the intervention being QSEN-based competencies, the comparison being a non-QSEN-based intervention, and the outcome being improved knowledge, skills and attitudes (KSA) levels of QSEN-based competencies. The goal of this study was to find quality and safety education (QSEN) competencies for nurses published between 2005 and 2022. Boolean operators (ADD,OR. NOT) were used to include and exclude all searches related to the topic of quality and safety education competencies.

Key databases including ProQuest, Elsevier/Science Direct, PUBMED, PUBMED-PMC, NIH-NCBI, COCHRAN, and Google Scholar were used. The search criteria included "QSEN competencies," "knowledge, skills, and attitudes," "intervention," "quality and safety education for nurses," "nursing institutes," "nursing faculty," and "randomized controlled trials." Boolean operators (AND,OR,NOT) were used to include and exclude all searches related to the topic of quality and safety education competencies. The selected articles were assessed for relevance and suitability for inclusion in the review.

A complete search approach was used, including manual analysis of reference lists and systematic searches of databases. Using the Mendeley Reference Manager allowed for the removal of redundant entries. The search scope was limited to 2005 and 2022, resulting in concise and extensive published articles.

The study adhered to the PRISMA standards for conducting systematic reviews and meta-analyses to ensure the accuracy and credibility of the research results. The PRISMA flowchart outlining the research selection process is displayed in Figure-I .

Inclusion and Exclusion criteria:
1) They must use a range of research methods, such as experimental studies, randomized control trials (RCTs), cluster randomized control trials (RCTs), non-randomized trials, and cluster non-randomized trials; and 2) They must have a clear start date that shows when the intervention began and collect data at least twice, before and after the intervention. 3) Diverse participants backgrounds, including nursing faculty, registered nurses (RNS),advance practice nurses (APNS),Chief nursing superintendent (CNS),nurse practitioner (NPs) nurses in leadership positions, and student nurses 4) The QSEN framework based intervention, delivered to nursing professionals (nurses, nursing students, and nursing faculty) in educational and clinical settings by any provider and using any method, for a set amount of time that includes contact time and follow-up time. 5) Inclusion of a control group receiving no intervention or traditional education for comparison purposes.6) Placing knowledge, skills, and attitudes as primary objectives, with the augmentation of confidence and motivation about safety as a secondary aim; the criteria for exclusion were as follows:1) Evaluate and analyze the findings of previous investigations.2)Studies not involving interventions;3) Qualitative and descriptive research 4) Conference reports 5) Studies published in languages other than English 5) Studies with pre- and post-study designs with no control or comparison groups. The data was collected from the relevant research and put into an Excel spreadsheet. The correctness and completeness of the inputted data were checked with expert supervisor. The extracted data were compared, as were the discrepancies.

As shown in figure-II: Quality Assessment RCTs using ROB the risk-of-bias framework of the Cochrane Collaboration was utilized to assess the methodological rigor of randomized controlled trials (RCTs). The tool assesses risk levels, classifying them as low, high, or uncertain [11–13] . An examination of these trials was conducted utilizing the most recent version of the Cochrane Risk of Bias tool for randomized trials.

The quality of RCTs was judged by looking at five main areas: whether there was any bias in the randomization process, how different the planned intervention was, and whether there were any data gaps in outcomes, metrics, or reported results. Figure-III provides a comprehensive illustration of the ROBINS-1 tool, which was also used to assess the quality of quantitative evidence syntheses quasi-experimental studies (QESs) across seven distinct criteria [13].

RESULTS

Search strategy reported 6385. Publications included ProQuest, Elsevier/Science Direct, PUBMED, PUBMED-PMC, NIH-NCBI, COCHRAN, and Google Scholar. Reference list of relevant articles uncovered ten more records. Two hundred fifty-five full-text articles remained after 5,76 duplicates, and 375 evaluated and deleted from 6385 items. After eliminating 375 full text articles with reasons, 50 remained for quality evaluation after removing 50 full text articles due to absence of control group. From the 50 articles for quality assessment 38 general articles on QSEN competencies were removed leaving 12 articles for final screening.

A comprehensive screening method involves nine quasi-experimental pre- and post-tests with a control group and three cluster randomized controlled trials. Six more studies more than five years of publication were excluded in the review. Finally total six studies included in the meta -analysis.. Figure-I shows the PRISMA flowchart for twelve articles [14]. Six (46.2%) articles published during 2018-2022 and remaining articles were published between 2005–2022. The study was 75% quasi-experimental. This research contains 1643 participants. All studies compared QSEN competence programs to conventional or no schooling. Traditional education emphasizes teaching, online courses, practical training, residency programs, safety, and active learning. Researchers studied South Korea, Portugal, Spain, Toronto, and Iran.

The United States (US) conducted six studies. The study included nursing students, clinical leaders, nurses, and supervisors. Baccalaureate, prelicensure, senior, newly licensed registered nurses (RN), vocational school students, medical patients, and nurses participated. Table- I lists the study's 12 articles. Three studies include randomized controlled trials and quesi-experimental studies (QES) with control groups and pre- and post-tests. These studies examined QSEN competencies and research methods utilizing QSEN competencies-based educational interventions.

These clinical and educational initiatives span 18 years. Six of 12 studies [15–20] offered adequate theoretical model knowledge to build and implement "quality and safety education for nurses (QSEN) competencies" interventions. Two studies [17,20] explored single safety competency content to improve motivation and confidence level : evidence-based practice (EBP) to improve knowledge and skills [19] and quality improvement and patient safety competence. Interventions averaged 13 weeks, ranging from 0.4 weeks [15] to 8 months [21].

Daily competency-based bedside rounds enhanced patient satisfaction for eight months [21]. Research focused on EPB, safety, QSEN therapies, quality improvement, and informatics (6/12). Follow-up lasted 2–5 [17-22] weeks–12 months [16]. Seven of the 12 trials used QSEN-based interventions using the thinking model about evidence-based practice, Fuld Fellows, PDSA, patient-centered bedside rounds, online courses with flipped classrooms, the TOT-COT checklist, and DETPP residency [19–23]. Few studies examined undergraduate nursing education, while several examined university interventions—a vocational school intervention study [18].

Meta-Analysis :

The study aimed to improve participants' knowledge, skills and attitudes related to Quality and Safety Education for Nurses (QSEN) competencies. A meta-analysis was conducted using REVMAN 5.4.1[24] to evaluate the overall effect and the combined impact. Six of the twelve analyzed research papers focused on intervention aimed at enhancing QSEN competencies. The six papers included two cluster randomized controlled trials and four quantitative evidence syntheses. The mean and standard deviation of QSEN competency intervention results were recorded using Review Manage.

The study assessed the differences in QSEN knowledge, abilities, and attitudes scores between experimental and control groups using the standardized mean difference (SMD) and 95% confidence intervals (CIs). The study revealed a variance level of over 50% [25] and performed a funnel plot analysis to identify potential publication bias [26]. If inaccuracies were detected, the trim-and-fill procedure was used to determine their severity [27]. The fail-safe N metric was used to assess the reliability of the outcomes obtained from the meta-analysis. The study concluded that fewer additional articles are needed to enhance the reliability of the effect size estimated by the meta-analysis [28].

Effectiveness of the QSEN Intervention: We categorized quantitative QSEN intervention efficacy studies. QSEN knowledge, skills, and attitudes were tested in all the research. Research-based QSEN implementation studies improved abilities, knowledge, and attitudes. QSEN-based interventions improved nurse knowledge, skills, attitudes,

confidence, and safety motivation in 12 trials. Trial impact sizes were moderate to high. Compared to a control group, patient-centered care, informatics, evidence-based practice, and quality improvement enhanced senior nursing students and newly registered nurses' QSEN competence and confidence. Effect sizes may depend on sample sizes.

The study [15] evaluated how a 3-day professional development program affected nursing students and licensing in 2019.

The DETPP residency program was studied using learning theories and techniques. Reflection, self-assessment, power point, learning group scenarios, simulation, practice, and workbooks were used. Research demonstrates that workshop participants' competence and confidence increased. With a 95% confidence range of 3.21 to 4.92, the increase was 4.07.

The workshop-attending nurses and students vary statistically and clinically from the control group. The study [18] the cluster-randomized controlled safety competence interventions had the second-largest effect and found that 12-hour training enhanced safety. Graduate-minded upper-secondary vocational students were targeted.

Figure-I: PRISMA standards

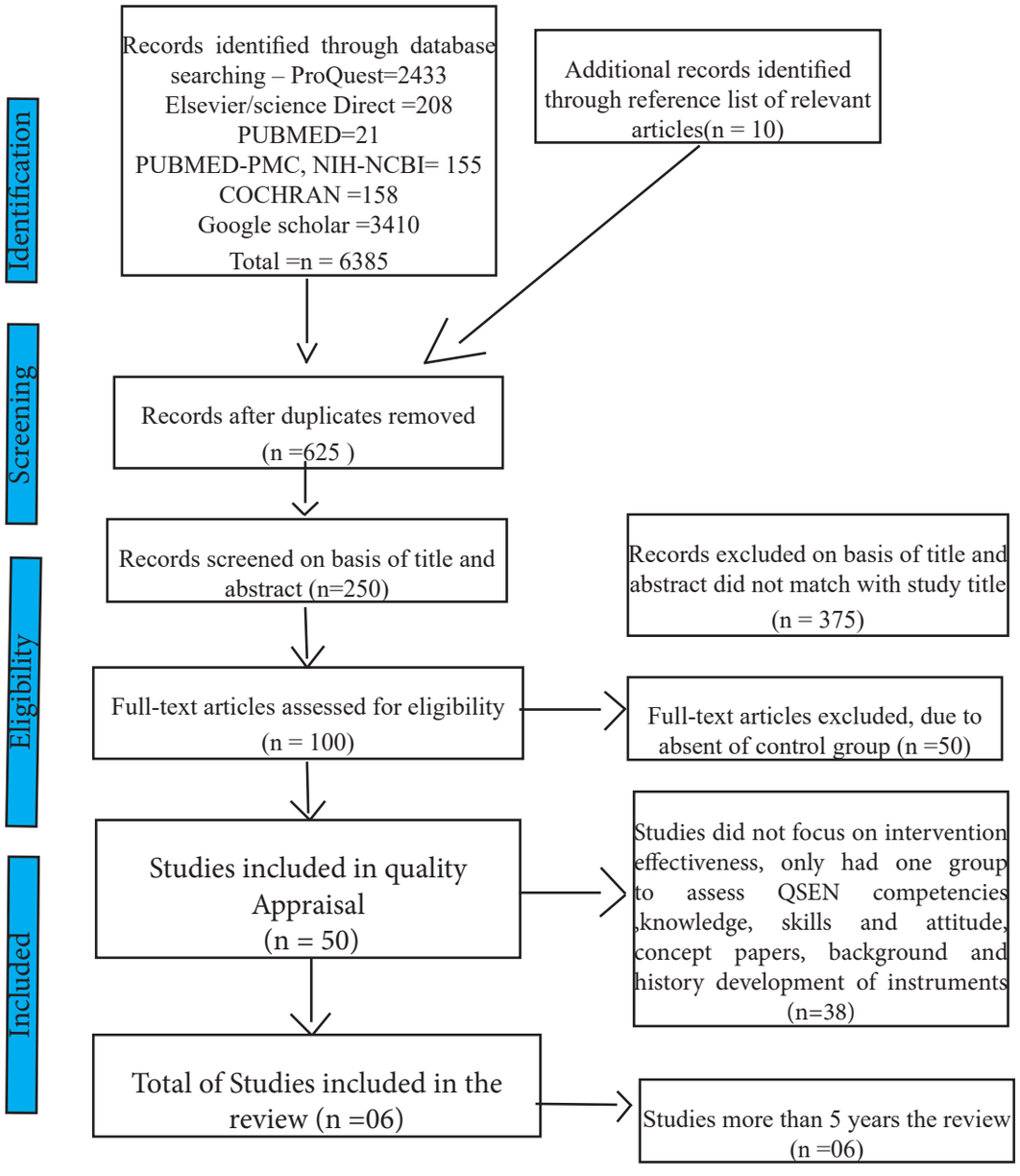


Figure -II : Quality Assessment RCTs using ROB-2

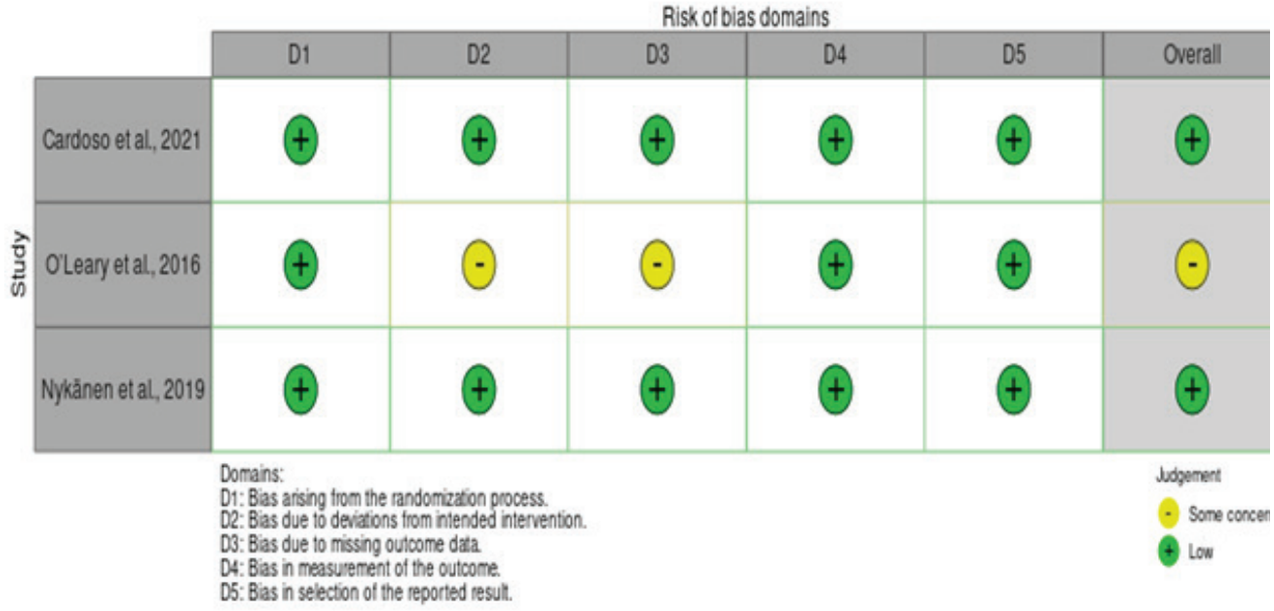
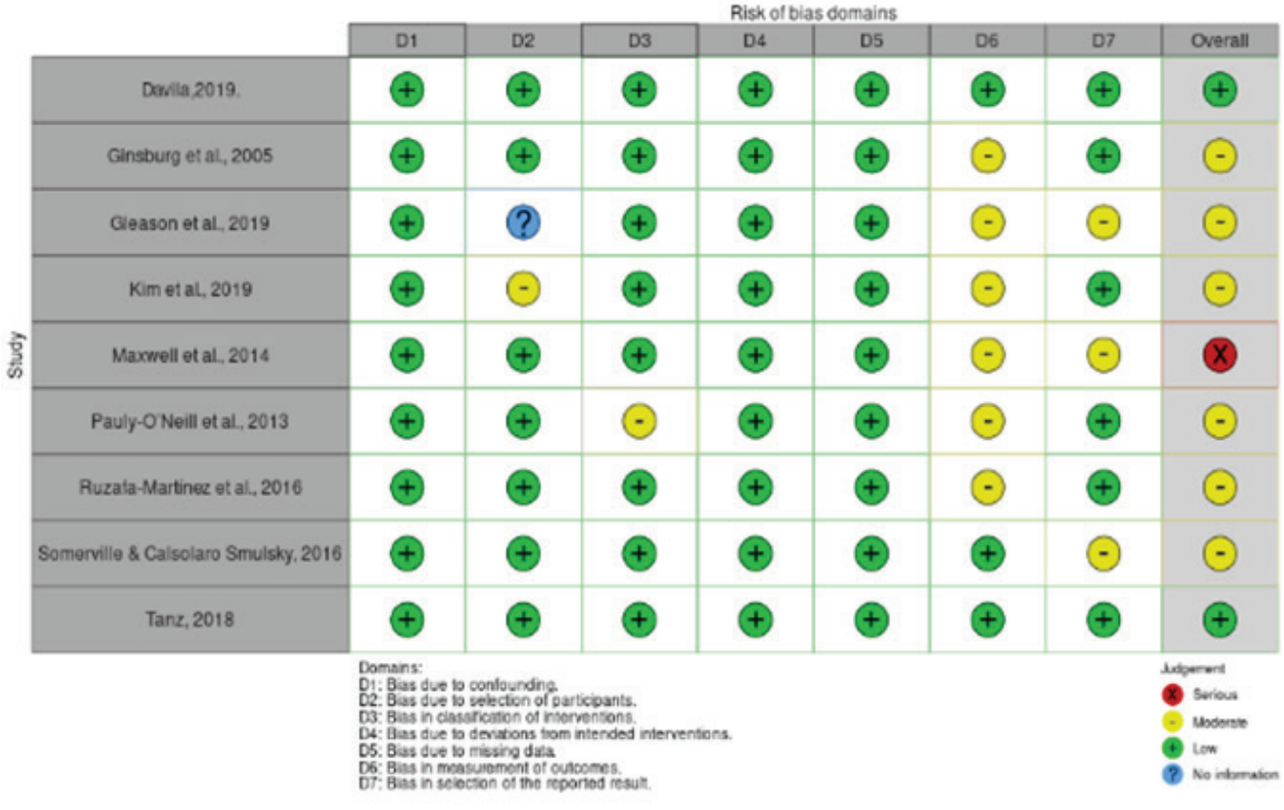


Figure -III: Quality Assement of QES using ROBIN-I



The initiative made student workplaces safer. Safety was driven by accident prevention, overcoming workplace hazards, proactive safety communication, and personal and occupational health objectives. This investigation found a 2.45-magnitude effect. The statistics were significant (0.00 p-value). Effect sizes between 2.21 and 2.69 are reliable with 95% confidence. The control group, which received printed safety warnings and attended school, did not improve two weeks following the intervention.

Three empirical studies [16,17,20] used self-reported safety and quality improvement criteria. The effect sizes of these studies are 1.10–1.48, bigger than [19] cluster randomized controlled trial. The intervention group understood EBP Evidence Based practice better than the control group (p = 0.00, 95% CI: -1.32, -0.64).

Care satisfaction, activation, and collaborative decision-making did not improve with PCBR (p=0.59). The previous study(21) showed that patient safety interventions improved student safety knowledge, skills, and attitudes (0.23, p=0.29). The research should have proved PCBR measuring equipment reliability and validity. Studies indicated that measurements were accurate and useful. Invalid research failed. Somerville and Casolaro Smulsky (2016) examined the Student Officer of Patient Safety (SOS) program, which taught students safe, high-quality patient care [29-36].

Maxwell et al., showed no change in students' quality improvement and patient safety attitudes following online education modules and flipped classroom discussions (p = 0.56) [22]. The study observed no effect in two major pediatric settings (p = 0.26). This research accurately measures the QSEN intervention's effects on nurses' knowledge, abilities, and attitudes [23].

Results of the meta-analysis:

The aggregate random effect estimated from our forest plot of data effected from each research project is shown in Figure- IV. Diamonds represented 95% confidence intervals and estimated values. In six trials, knowledge, skills, attitudes, confidence, and safety motivation were increased. The random effect model was used since the studies differed (>50%). RCTs and QEs with 877 participants showed a significant effect size of 1.54 (95% CI 0.16, 2.92), p < 0.00001.

The experimental group outperformed the control group in knowledge, skills, attitudes, confidence, and safety motivation (95% CI). The QSEN intervention's pooled effect size is shown in Figure- V.study had distinct mean differences. The study in 2021 [19] found a -0.98 mean difference. One hundred forty-eight people took the Fresno Test. Another study [15] found a 4.07 mean difference. Sixty-eight freshly registered nurses completed the nursing quality and safety self-inventory to determine QSEN confidence. A 0.00001 trial heterogeneity p-value verified QSEN's efficiency and random effects paradigm. The 99% I2 statistic heterogeneity, suggesting high variance(30). Pre-test baseline and QSEN competence knowledge, talents, and attitude change scores correlate positively (r =.931).

Figure -IV: Meta-Analysis

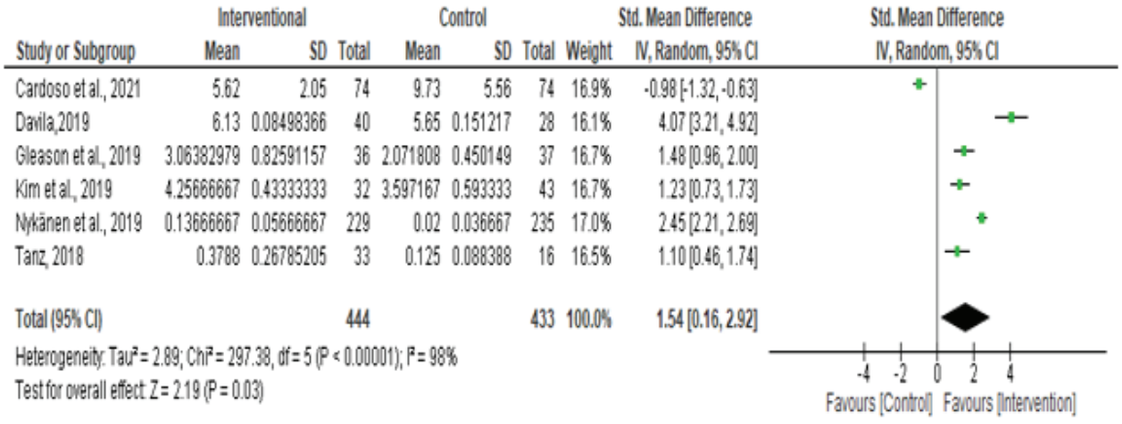


Table 1: Characteristics of review studies published 2005-2022

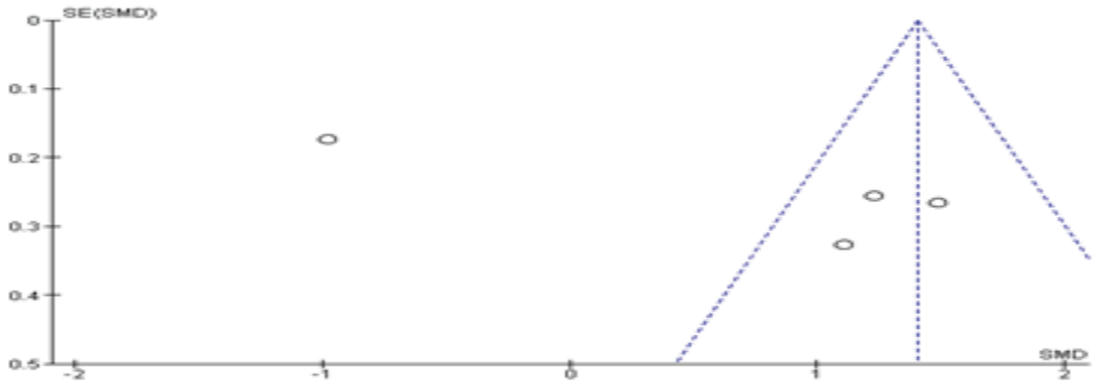
No.	Author and year	Country	Study design RCT/QEs	Sample Target group	Interventions		No. of participants recruited /follow-up	Intervention					Length of follow up	Outcome measures	Results
					EXP	Cont.		Theoretical basis	Mode of intervention delivery	Setting	Competency type	Duration			
1	Ginsburg et al., 2005 (31)	Toronto, Canada	QE with untreated control group design (pretest and posttest)	nurses in clinical leadership roles (nurse managers and educators/ CNSs)	two patient safety workshops	did not attend either of the workshops	78/150	Safety Culture model	face to face	teaching hospitals	Safety	over a 6-month period	4 months	Patient safety	Significant improvement in valuing safety, fear of repercussions, and perceived state of safety in interventional group
2	Cardoso et al., 2021 (19)	Portugal	A cluster RCT with two-armed parallel group design	Nursing students	Usual education plus the EBP educational program	_	72/74	Thinking model about evidence based practice(EBP),like question development, searching for studies, study selection process, data extraction, and data synthesis.	through the nursing school's website.	nursing school	EBP knowledge and skills	6 sessions over 17 weeks	after the intervention (week 18)	EBP knowledge and skills	Significant improvement in interaction between the intervention and time on EBP knowledge and skills ($p = 0.002$). Significant improvement in students' knowledge and skills on EBP in both intervention and control groups: $p < 0.001$
3	Gleason et al., 2019 (32)	USA	QE design with focus group comparison (pre-and post-test)	The Nursing students	4 stand-alone patient safety courses	Not participated	52/36	The Fuld Fellows Program	Face to face & Online reflective learning journals	nursing school	Patient Safety	6 months	12 months	teamwork, communication, managing risk, recognize and respond to risk and culture	Significantly mean scores of cultures of safety, working in teams , communication, managing risk in intervention group
4	Tanz, 2018 (20)	Southeast Missouri State. USA	QE design, with control group (Pre- and posttest	undergraduate nursing students' clinical group	Student-designed simulation project (SDSP), and a Good Catch and Error Reporting (GCER) program	Control group did not conducted students led interventions	33/33	The Plan-Do-Study-Act (PDSA) QI process Model	face to face	University	safety	16-weeks	weekly basis	safety, knowledge, skills, and attitudes (KSAs)	Overall significant improvement in all cat¬egories measured by the QUISKA2, and mean scores increased by 37% in intervention group
5	O'Leary et al., 2016 (21)	Chicago, Illinois, USA	Cluster RCT	medical patients and nursing staff	patient-centered bedside rounds	Not received	114/219	communication framework	face to face	non-teaching hospitals	patient-centered care	8 months	48 h and 6 weeks	patient-centered bedside rounds medical decision-making activation or satisfaction with care	No significant impact PCBR on on patients' perceptions of shared decision-making, activation or satisfaction with care

6	Maxwell et al., 2014 (33)	the southeastern United States	QE with control group (pretest/ post-test)	nursing students'	online modules in conjunction with a flipped classroom discussion seminar	online modules only	37 /31	QI and Safety QSEN competencies	Online Modules with Flipped Classroom	university	QI and Safety quality improvement (QI) and safety	120 hours for eight weeks	Weekly	Knowledge, skills, and attitudes of the quality improvement (QI) and safety	No significant effect on knowledge, comfort of skills, and attitudes in experimental group
7	Kim et al., 2019 (17)	South Korea	QE with a non-equivalent control group (pre- and post-test)	undergraduate nursing students	the World Health Organization patient safety educational modules	No intervention was provided	32/30	QSEN -safety competency	the online and face-to-face discussions in the classrooms	university	patient safety	3 months The 14 sessions	At the end 3rd month	Attitude, skills, and knowledge	Significantly high scores of patient safety competency attitude, skills, and knowledge in the experimental group
8	Pauly-O'Neill et al., 2013 (23)	San Francisco, California.	pilot observational study	Prelicensure nursing students.	the time-on-task/clinical observation tool (TOT-COT). pediatric simulation experience	clinical experiences	13	13	_	two large, urban, tertiary care children's hospitals	_	pediatric simulation experience 210 minutes	Not reported	Six QSEN competencies patient-centered care, teamwork and collaboration, safety, evidence-based practice, quality improvement, and inform	Significant use of Patient-centered care, Teamwork and collaboration and, Safety intervention group
9	Davila,2019. (15)	Minnesota. Minneapolis USA	QE design with posttest only to compare two convenience sample educational groups at one point in time	senior nursing students new RNs	dedicated transition to practice program (DETPP) residency program plus a prelicensure program.	only attended the residency program	40 /40	the Duchscher theory (Insights into the transition experiences) and the QSEN framework	face to face	hospitals	Six QSEN competencies	A 3-day professional development (PD) workshop	Not reported	the difference between QSEN competency confidence levels of new registered nurses	statistically significant improvement in the QSEN competency confidence level in knowledge and skills in evidence-based practice, quality improvement, informatics, and patient-centered care skills of intervention group.
10	Somerville & Calsolaro Smulsky, 2016 (29)	Minneapolis, Minnesota. USA	QE design with non-equivalent control groups	nursing student	Policies and procedures designed for safe and quality patient care	Did not participated in the SOS learning activity	40/85	QSEN competency framework	face to face	university	patient safety; knowledge of patient safety.	The intervention group participated in 15 weeks	at the end of the semester after the intervention	knowledge, skills, and attitudes	No significant improvement in HPPAA scores in intervention group
11	Nykänen et al., 2019 (18)	Finland.	cluster RCT	vocational school students	Attitude to Work to work for safety	received written material on safety and participated in normal school activities and lessons.	229/229	Social cognitive approach	_	vocational schools	Safety	12-hour	two weeks	Safety motivation Internal safety locus of control and safety self-efficacy	Significant improvement in safety motivation via the internal safety locus of control in intervention group.
12	Ruzafa-Martínez et al., 2016 (34)	Spain	QES with non-randomized intervention and control groups	undergraduate nursing students' students	The educational intervention course designed to teach EBP competence	a control group of nursing students who did not attended an EBP course	59/59	Classification Rubric for EBP Assessment Tools in Education (CREATE)	Face to face	university	15-week	2 months	EBP Competence	Attitude Knowledge Skills	Significantly improved in attitude , knowledge and skills in the intervention group.

Publication Bias

Figure -V depicts a funnel plot of research publication bias. Publication bias causes asymmetry in pooled effect size studies. The research's unequal distribution indicated data heterogeneity. Unfilled gaps show publishing bias without dispersed data points left of the mean. Egger regression and trim-and-fill reduce publication bias. After trim-and-fill, Egger's regression test demonstrated funnel plot symmetry (t = -0.330, df = 5, p = 0.758). Rosenthal's fail-safe N (stability coefficient)(35,36) showed that at least five more studies were needed to disprove this meta-analysis.

Figure - v: Funnel Plot



DISCUSSION

The offered content is a complete literature review on Quality and Safety Education for Nurse's interventions. Quality and Safety Education for Nurses (QSEN) programs were tested in the classroom and clinical settings to increase nurses' KSA (knowledge, skills, and attitudes). These single- and multi-QSEN competency-based educational programs improve nurses' KSA.

The evaluation revealed a large body of academic literature. After a careful selection, 12 articles were included between 2005 and 2022, with 50% conducted in various US locales. Given their increased credibility to provide quality and safety-based education to undergraduate nursing students, our study focused on undergraduate nursing faculty QSEN competencies. Most accessible studies focused on nursing students, clinical leaders, nurses, and other nursing professionals with varied educational backgrounds.Quasi-experimental studies predominated this review, but they require more randomization to determine cause and effect [37].

Quality and Safety Education for Nurses (QSEN)-based interventions were utilized in the research. Quality and Safety Education for Nurses (QSEN) skills have been improved by many research. These studies aimed to increase all QSEN competencies or focus on EBP, quality improvement, and patient safety. The typical intervention lasted 13 weeks, although the length varied. Some studies examined the short-term effects of QSEN intervention on knowledge, skills, and attitudes. Others measured knowledge retention and clinical effect over weeks or months.

The sample sizes, intervention durations, and follow-up periods caused variability. Consistent findings found that despite sample size differences induced heterogeneity, the research population showed positive advances in knowledge, skills, attitudes, confidence, and safety motivation [38]. Researchers should take these results with caution due to research heterogeneity and bias. This review compared bias-risk studies—8% severe, 33% low, 58% moderate, and some prejudice.

The meta-analysis of six studies showed a standardized mean difference score of 1.54. Also,tool validity and dependability are critical for data collection [39–41]. Valid and reliable tools, such as QulSKA, PSCSE, H-PEPSS, and others [16,17,20,22], were used to measure QSEN knowledge, skills, and attitudes outcomes in the reviewed study data. However, one study's validity and reliability (reproducibility) were questioned due to the use of an untested assessment instrument [23].

Although most research indicated the efficacy of Quality and Safety Education for Nurses (QSEN) interventions, it is noteworthy that the magnitudes of the effects differed across the studies. Furthermore, selecting certain Quality and Safety Education for Nurses (QSEN) skills focused on in the interventions impacted the results. The research showed that the experimental groups that were given Quality and Safety Education for Nurses (QSEN) interventions did

better than the control groups. The meta-analysis findings indicate a substantial improvement in knowledge, skills, attitudes, confidence, and safety motivation in around 50% of the trials included in the study The use of the random effects model was employed in order to address the presence of heterogeneity in the research.

The presence of publishing bias was detected via the use of a funnel plot analysis, and efforts were made to address this bias through the use of appropriate statistical tests. The review presented interesting insights into the efficacy of QSEN interventions. However, it is crucial to address several limitations, including the heterogeneity across the studies and the possible presence of biases [42].The systematic study shows that QSEN treatments improve nurses' knowledge, abilities, and attitudes in numerous patient care and safety areas.

However, impact sizes and publication bias must be considered. Improved QSEN abilities of undergraduate nursing faculty and quality and safety education for undergraduate nursing students may be achieved with more study and implementation of standardized QSEN interventions.

Strengths of the study :

1. According to this research, the QSEN competencies can enhance KSA, confidence, and safety motivation, resulting in safer work practices. The comprehensive and precise systematic review and meta-analysis evidence synthesis strengthen the reliability and generalizability of this conclusion.
2. The predominance quasi-experimental studies assess hospital staff intervention effectiveness in real life, making them more generalizable than RCTs [43].
3. The inclusion and exclusion criteria made the results representative of the population by applying them to clinical and educational nurses and nursing students.

Limitations :

The research findings are subject to the following limitations:

1. The study only included English-language publications, although China and Korea also conducted QSEN research.
2. Six studies published between 2018 and 2022 were selected for meta-analyses due to their heterogeneity. The search method concluded in November 2022, but due to the search's conclusion, other relevant papers may have been published after this period.
3. The quality of the selected studies was low to moderate in their risk of bias (Cochran risk of bias tools ROBINS-1 and ROB-2). Low risk inspires trust in research results, whereas intermediate risk requires rigorous analysis to identify limits that may affect validity.

CONCLUSION

The QSEN-based interventions are significant in improving knowledge, skills and attitudes of undergraduate nursing faculty. Therefore, there is a need for further research to develop undergraduate nursing faculty QSEN competencies with a larger sample size and examine their impact.

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