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Evaluating a patient safety course for undergraduate nursing students: A quasi-experimental study

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ABSTRACT

Background: Although it has long been recognised that prelicensure education is essential for preparing nurses with the necessary patient safety competencies, patient safety education tends to be inadequately addressed in nursing curricula in South Korea and elsewhere.
Aim: This study examined the effectiveness of a recently developed 8-week standalone course on patient safety by comparing the patient safety competencies, knowledge, and attitudes of students who attended and did not attend the course, after controlling for baseline levels of each outcome measure.
Methods: The study used a quasi-experimental pretest-posttest design with a non-equivalent comparison group, with 40 undergraduate nursing students in the intervention group, and 67 in the comparison group. Outcomes included the total score and six subscale scores measured with the Health Professional Education in Patients Safety Survey, and the Patient Safety Attitude scale developed by the WHO patient safety program. Additionally, there was an objective measure of patient safety knowledge using 15 multiple-choice questions.
Findings: After adjusting for baseline scores, Time 2 scores on all outcome measures were significantly higher in the intervention group than the comparison group, indicating the intervention's effectiveness. We found that the largest effect of the course accrued to patient safety knowledge. Overall, the students' assessment of the course was highly positive.
Discussion: Our patient safety course could be a model for teaching patient safety in undergraduate nursing curriculum.
Conclusion: This study shows the potential for a standalone patient safety course to increase undergraduate nursing students' patient safety competencies, knowledge, and attitudes towards patient safety.

Summary of relevance

Problem

Though it has long been recognised that prelicensure education is essential for preparing nurses with the necessary patient safety competencies, patient safety education tends to be inadequately addressed in nursing curricula.

What is already known

Patient safety educational interventions designed for undergraduate nursing students have been developed previously. However, the duration of the intervention, educational content, curricula structure, teaching strategies, outcome measures, analytic methods vary, which limits our understanding of the effects of such interventions.

What this paper adds

This study demonstrated the positive effects of formal patient safety education for undergraduate nursing students.

1. Introduction

Large numbers of patients continue to experience avoidable harm in healthcare settings; thus, patient safety has become a global healthcare priority (World Health Organization [WHO], 2017). As healthcare becomes increasingly complex and fast paced, healthcare professionals must be better prepared to deliver safe

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care and prevent patient harm. Nurses, in particular, because of their 24-hour care of hospital patients, play a critical role in ensuring patient safety (Maeda, Kamishiraki, Starkey, & Ehara, 2011). Though it has long been recognised that prelicensure education is essential for preparing nurses with the necessary patient safety competencies (American Association of Colleges of Nursing, 2006), patient safety education tends to be inadequately addressed in nursing curricula in South Korea and elsewhere (Kirwan, Riklikiene, Gotlib, Fuster, & Borta, 2019; Lee, Dahinten, & Do, 2020; Tella et al., 2014).

Efforts have been made to incorporate patient safety in nursing education, but challenges remain. These include a lack of faculty prepared to teach patient safety concepts (Lee et al., 2020; Tregunno, Ginsburg, Clarke, & Norton, 2014), an over-crowed curriculum, competing work pressures and lack of time to develop a new curriculum (Lee et al., 2020; Wu & Busch, 2019), and a lack of funding and resources for faculty to teach patient safety (Lee et al., 2020). Evaluation of patient safety education has also been hampered by the lack of consensus on the outcomes to be assessed (Levett-Jones et al., 2017). In addition, although resource materials such as the WHO multi-professional Patient Safety Curriculum Guide (2011) have been developed to identify key content areas, there has been little guidance on the inclusion of such content within nursing curricula (Kirwan et al., 2019). Moreover, the guide fails to address issues such as empowerment, workplace culture, and work environment that are also important for preparing nurses with the necessary patient safety skills (Kirwan et al., 2019).

Although researchers and educators alike have long emphasised the importance of patient safety education for nursing students (Jang & Lee, 2017), nursing students have reported that they lack an understanding of patient safety principles and feel incompetent in-patient safety matters, and that there is a gap between classroom learning about patient safety and application in clinical practice (Mansour, 2013). In a study of four Korean baccalaureate nursing programs, researchers found that although most students received some patient safety education, there were significant differences in content and student competencies across nursing schools. Overall, patient safety was not well covered in the nursing programs, and students showed lower scores in knowledge and skill than they did in patient safety-related attitudes (Lee, Jang, & Park, 2016). Similarly, a more recent Korean study revealed that although all nurse educator participants reported that patient safety was integrated into their existing nursing curricula, the majority reported that it was not adequately taught (Lee et al., 2020). Finally, most nursing curricula in various countries do not have a standalone patient safety course (Jang & Lee, 2017; Lee et al., 2020; Tregunno et al., 2014; Usher et al., 2018). Rather, patient safety education has been integrated across several nursing subjects, with the risk that patient safety is not taught comprehensively in any subject area (Tella et al., 2014).

The current study builds on two previous Korean studies that examined the effectiveness of patient safety educational interventions designed for undergraduate nursing students (Kim, Yoon, Hong, & Min, 2019; Park & Kim, 2016). Both were quasi-experimental studies with a comparison group, but they varied from each other and the current study in terms of the duration of the intervention, educational content, curricula structure, teaching strategies, and outcome measures. Also, both studies were limited by their analytic methods. Both studies employed pre- and post-tests, and used independent t-tests to examine the effects of the educational interventions on nursing students' self-reported patient safety attitudes, skills and knowledge (Kim et al., 2019; Park & Kim, 2016), but did not control for pretest scores on the outcome measures. In addition, both studies measured patient safety knowledge solely via participants' subjective perceptions regarding their knowledge levels, rather than including a more objective measure (e.g., a test) as recommended in the literature (Hwang et al., 2016; Levett-Jones et al., 2020). Finally, the design of the interventions lacked input from patient safety experts in clinical areas. Therefore, working with experts in clinical areas, one nursing school developed a standalone patient safety course for undergraduate students, and the purpose of this study was to examine the effectiveness of the course by comparing patient safety competency, knowledge, and attitudes before and after students completed the course, and between those who attended and did not attend the course.

2. Methods

2.1. Study design

This pilot study employed a quasi-experimental pretest-posttest design with a non-equivalent comparison group to examine the effectiveness of the standalone patient safety course on nursing students' competency, knowledge, and attitudes toward patient safety. The comparison group consisted of students who did not take the course, but were exposed to patient safety education as it was then taught, integrated within the existing nursing curricula.

2.2. Setting and sample

Patient Safety is an elective course offered in a 4-year nursing program at a university in South Korea. At the study site, elective nursing courses are offered to all second- through fourth-year nursing students (about 70 students in each academic year), with a maximum enrolment of 40 in each course. This study used convenience sampling, wherein all second- through fourth students in the nursing program during the 2020 spring semester were eligible, and invited to participate in the study. Recruitment flyers identifying the purpose of the study were posted in the students' lounge. Students were informed that trained research assistants, who were not responsible for instruction or grading in the patient safety course would conduct recruitment, consent procedures, and data collection. They were also informed that the course instructor would not have access to the data until the semester ended and the students had received their grades. Only students in the intervention group took the patient safety course (Fig. 1). This study was approved by the Yonsei Univerity Health System Institutional Review Board (Y-2020-0002) and was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The need for informed consent was waived by the Institutional Review Board due to the nature of the online survey. However, participants who agreed to participate in this study were required to acknowledge the consent statement before beginning the online survey.

A total of 107 nursing students in their second, third, or fourth year agreed to participate: 40 in the intervention group, and 67 in the comparison group. However, two students withdrew from the patient safety course during the course change period (an attrition rate of 5%), leaving 38 students in the intervention group. There was no attrition from the comparison group.

2.3. Course description

Patient Safety, a 2-credit, elective course taught in English, was offered in Spring 2020. Because previous research has shown a gap between university nursing education and clinical practices supporting patient safety (Usher et al., 2018), to help narrow this gap, we created an academic-practice collaboration with clinical partners. Patient safety and quality improvement managers working in an affiliated university medical centre and a Joint Commission International consultant were invited to provide important input for course development. The course instructor has a PhD degree

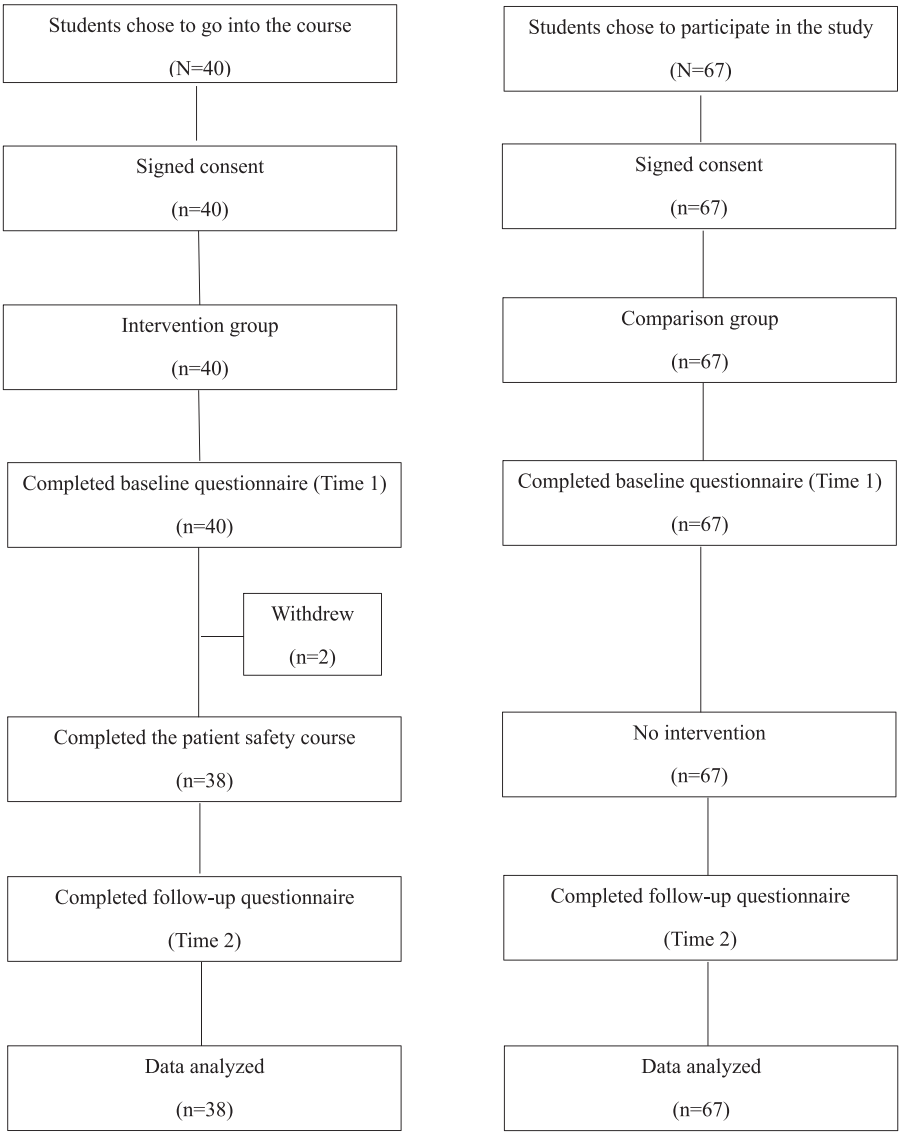

Fig. 1. Research process flow chart.

in nursing, with a graduate certificate in patient safety. The patient safety curriculum guide, the CPSI's safety competency framework, guided curriculum development. We also drew on findings from previous literature on patient safety education in nursing and medicine (Kirkman et al., 2015; Mayer, Klamen, Gunderson, & Barach, 2009) in developing the course and planning teaching modalities. Table 1 shows the course content and teaching methods used in this course.

Classes were originally scheduled as weekly face-to-face, two-hour sessions over 13 weeks. However, due to the COVID-19 outbreak, the course was taught online, with 13 two-hour sessions delivered over eight weeks. Six sessions were delivered through independent online learning using the online course management system supported by the authors' institution. Students were expected to view six video clips of lectures. Each video clip was approximately 60-minutes long. They were then required to complete online activities including case studies with online discussions. Completing the online activities was considered evidence of having viewed the online videos. Seven sessions were delivered by through synchronous (real-time) online meetings using online class software. During these meetings, the instructor recapped important points from the contents covered in the video clips of previous lectures prior to each real-time online lecture and answered questions that students had during their independent learning.

Course materials included book chapters, journal articles, videos, and online materials available from the Agency for Healthcare Research and Quality and the Institute for Healthcare Improvement. In addition, instructor-developed written materials on the class topic were provided to students 1 week before each class to support preclass preparation. The course consisted of lectures and discussions, and included case studies with associated questions, videos, quizzes, and individual and group activities. The instructor reinforced key concepts during the real-time online lectures, and the classes were highly interactive. Group discussion was required to complete class assignments. For all small group activities, students were divided into 10 groups (with 3 or 4 students in each group); these were completed during the real-time online classes, using a group discussion application, followed by a large group discussion involving the whole class. Students were asked to apply core course concepts to solve task-based problems drawn from case studies and other materials, and to answer questions about specific cases after watching videos set within a real, work-related context. Students also role-played handover communications using structured communication tools such as Situation,

Table 1
Course topics and learning activities.

Session	Topics	Learning activities
1	Course overview What is patient safety and why is it important?	Lecture (real-time), discussion
2	Introduction to patient safety History of patient safety movement	Lecture (video), discussion
3	Human factors Systems approach	Lecture (video), discussion, video, case study
4	Human factors engineering	Lecture (real-time)
5	Culture of safety High reliability organisation	Lecture (video), discussion, video, case study
6	Teamwork and communication	Lecture (real-time), discussion, video, case study, role play
7	Responding to adverse events	Lecture (real-time), discussion, video, case study, group activity
8	Medication error prevention	Lecture (video), discussion, video, case study
9	Infection prevention and control	Lecture (video), discussion
10	Patient safety/quality improvement tools, methodologies, and techniques	Lecture (real-time), discussion, video, case study, group activity
11	Error reporting and quality improvement in clinical settings	Lecture (video), discussion
12	Quality improvement project	Group presentation (real-time), peer evaluation
13	Quality improvement project	Group presentation (real-time), peer evaluation

Background, Assessment, and Recommendation with instructor-developed cases to learn effective communication among healthcare professionals.

Two sessions were jointly led by two clinical experts in patient safety. One session was jointly led by a professor in human factors engineering with the course instructor. During these sessions, the clinical experts shared their expertise and actual patient cases with the students. They also shared challenges in the workplace, emphasising that responsibility for patient safety must be shared by everyone, including students. The clinical experts also shared how changes in practice had been made based on a systems approach for improving patient safety. The professor in human factors engineering explained the importance of understanding human factors and a need for growing collaborations between the healthcare sciences and human factors engineering for improving patient safety. Specific examples were given to help students understand how the discipline can aid healthcare professionals to analyse events and develop effective countermeasures.

Students' knowledge and understanding of the concepts were evaluated throughout the semester with quizzes and individual and group assignments. For example, students were required to individually identify errors and their causes, the role of human factors on the errors, and ways to improve team work and communication among healthcare professionals based on an instructor-provided case of a near miss. In addition, using an instructor-provided case of a patient adverse event, student groups were tasked to identify errors and their causes, conduct a root cause analysis using a fish-bone diagram or other methods such as five whys, discuss ways to communicate adverse events to patients and their families (error disclosure), and discuss means of creating a culture of safety. And for a final PowerPoint presentation, student groups selected and analysed an actual patient adverse event that had occurred in Korean hospitals; they also identified ways to implement changes designed to eliminate the root causes and to measure the effectiveness of the changes using the Plan-Do-Study-Act cycle.

2.4. Measures

Patient safety competency was measured using the Health Professional Education in Patients Safety Survey (H-PEPSS) (Ginsburg, Castel, Tregunno, & Norton, 2012). This measure consists of 16 items asking students to self-report their competence in six domains of patient safety: working in teams (3 items), communicating effectively (3 items), managing safety risks (3 items), understanding human and environmental factors (2 items), recognising and responding to adverse events (2 items), and culture of safety (3 items).

After obtaining permission from the instrument developer (Ginsburg et al., 2012), three nursing professors who are fluent in both Korean and English, each with extensive working experience in Korea and the United States, translated the measure using the committee-based translation approach (Furukawa, Driessnack, & Colclough, 2014). The final translated version was then assessed for content validity by five patient safety experts who rated the relevance and appropriateness of each item for the Korean health care context, and a content validity index (CVI) was calculated for each item and the total scale. All 16 items achieved the minimum acceptable item-CVI values, ranging from 0.80 to 1.00, and the scale-CVI value was 0.98 (Polit & Beck, 2020). Additionally, understandability of the survey was verified through cognitive interviews with five nursing students. Confirmatory factor analysis confirmed the original six-factor model, showing acceptable values for the root mean square error of approximation (0.09) (Browne & Cudeck, 1992), the standardised root mean square residual (0.07), and the comparative fit index (0.93) (Hu & Bentler, 1999). Previous research showed Cronbach's alpha scores ranging from 0.81 to 0.85 for the six H-PEPSS domains (Ginsburg et al., 2012) and 0.91 for the entire scale (Hwang, 2015). For the study sample, Cronbach's alphas were 0.85, 0.85, 0.87, 0.73, 0.83, and 0.78 for the six subscales, and 0.94 for the total scale. Items were rated on a 5-point Likert type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Mean scores were calculated for each of the six subscales, and the total scale, with higher scores indicating higher patient safety competency.

Patient safety attitude was measured using the 4-item scale developed by the WHO patient safety program (Farley, Zheng, Rousi, & Leotsakos, 2013), translated through the committee approach described above. The items asked students' personal attitudes to patient safety and were rated on a 5-point Likert type scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher mean scores indicated higher levels of patient safety attitudes. For the study sample, the Cronbach's alpha for this measure was .74.

Patient safety knowledge was measured using 15 multiple-choice questions developed by the WHO Patient Safety Program (Farley et al., 2013). The questions were translated and modified using the committee approach described above to render the items appropriate to the Korean context. This scale was used in addition to the H-PEPSS as it is considered a more objective measure of patient safety knowledge competency (Lee et al., 2016). A total score was calculated by summing the number of items with correct answers.

Students' assessment of the course was measured using nine items developed by the WHO patient safety program, translated and adapted to make them appropriate to the study setting (Farley et al., 2013). The items were answered on a 5-point response scale ranging from 1 (strongly disagree) to 5 (strongly agree). In addition, two open-ended items asked students about the teaching received: (i) What was particularly helpful or worthwhile in the teaching you received in this course? and (ii) What would you recommend to improve the teaching you received in this course?

Students' demographic characteristics (age, gender, year in the program, and previous patient safety education) were also collected.

2.5. Data collection

Data were collected from students in both groups at baseline (Time 1, beginning of the semester) and 9 weeks later (Time 2, one week after the students in the intervention group had completed the patient safety course) when students in the intervention group had completed the patient safety course. Patient safety competency, attitudes, and knowledge were assessed at both time points. The Time 1 questionnaire also included demographic questions. All questionnaires were administered in an electronic format.

2.6. Data analysis

Descriptive statistics were computed to describe sample characteristics, key study variables, and the students' assessments of the course. Chi-square tests, Fisher's exact tests, and independent t-tests were used to examine differences in baseline characteristics between the intervention and comparison groups. Within-group differences and between-group differences in the outcome variables were examined using paired t-tests and independent t-tests, respectively. Also, one-way analysis of covariance (ANCOVA) was used to provide unbiased estimates of the between-group differences in Time 2 scores by adjusting for Time 1 scores for each outcome. Multivariate regression analyses were conducted to examine the effects of the patient safety course on the Time 2 scores for each of the nine outcome variables, after controlling for Time 1 scores and the student's year in the program. All statistical analyses were conducted using STATA version 16 and SPSS version 25 with a significance level of 0.05.

3. Results

The majority of participants were female (90%) with a mean age of 22 years (SD = 1.79). Half of the students (52%) were in their third year, with about 10% in their second year. Very few (6%) had received any prior patient safety education. Table 2 shows that there were no statistically significant differences in the demographic characteristics or patient safety competency, attitude, or knowledge scores between the intervention and the comparison group at baseline.

3.1. Within-group and between-group differences in outcome scores

As shown in Table 3, all outcome variables were significantly higher at Time 2 compared with Time 1 for the intervention group. Time 2 scores were also higher for the comparison group on six of the nine outcomes; the exceptions were managing safety risks, understanding human and environmental factors, and patient safety knowledge. However, results from ANCOVA showed that after adjusting for Time 1 scores, Time 2 scores on all outcome measures were significantly higher in the intervention group than the comparison group, indicating the effectiveness of the intervention. Specifically, ANCOVA results showed significant between-group differences in Time 2 scores in overall patient safety competency ($F(1,102) = 69.40$, $p < 0.001$), working in teams ($F(1,102) = 26.37$, $p < 0.001$), communicating effectively ($F(1,102) = 20.52$, $p < 0.001$), managing safety risks ($F(1,102) = 6.55$, $p < 0.001$), understanding human and environmental factors ($F(1,102) = 66.70$, $p < 0.001$), recognize and respond to reduce harm ($F(1,102) = 34.71$, $p <$

Table 2
Comparison of demographic characteristics of participants and key study variables at baseline.

	Intervention group (n =38)	Comparisongroup (n =67)	p
Age (M, SD)	22.39 (1.59)	22.28 (1.91)	0.761[a]
Year in the program (n, %)			
2nd	1 (2.63)	7 (10.45)	0.163[b]
3rd	18 (47.37)	37 (55.22)	
4th	19 (50.00)	23 (34.33)	
Gender (n, %)			
Male	6 (15.79)	5 (7.46)	0.200[b]
Female	32 (84.21)	62 (92.54)	
Previous patient safety education (n, %)			
No	36 (94.74)	63 (94.03)	1.000[b]
Yes	2 (5.26)	4 (5.97)	
Overall patient safety competency (M, SD)	3.43 (0.66)	3.52 (0.64)	0.516[a]
Working in teams	3.26 (0.80)	3.42 (0.76)	0.330[a]
Communicating effectively	3.63 (0.71)	3.82 (0.82)	0.246[a]
Managing safety risks	3.29 (0.84)	3.30 (0.83)	0.958[a]
Understanding human & environmental factors	3.42 (0.78)	3.54 (0.80)	0.474[a]
Recognising and responding to adverse events	3.33 (0.78)	3.23 (0.85)	0.562[a]
Culture of safety	3.68 (0.72)	3.83 (0.68)	0.291[a]
Patient safety attitude (M, SD)	4.00 (0.56)	4.19 (0.49)	0.069[a]
Patient safety knowledge test (M, SD)	7.37 (1.87)	7.81 (1.93)	0.262[a]

M, mean; *SD*, standard deviation.
[a] Independent t-test.
[b] Fisher's exact test.

Table 3
T-test results for comparison of pretest and posttest scores by group.

Variable	Group	Pretest	posttest	*p*
		M (SD)	*M (SD)*	
Overall patient safety competency	Intervention	3.43 (0.66)	4.48 (0.47)	< 0.001
	Comparison	3.52 (0.64)	3.76 (0.55)	< 0.001
Working in teams	Intervention	3.26 (0.80)	4.32 (0.59)	< 0.001
	Comparison	3.42 (0.76)	3.79 (0.58)	< 0.001
Communicating effectively	Intervention	3.63 (0.71)	4.54 (0.54)	< 0.001
	Comparison	3.82 (0.82)	4.04 (0.75)	0.019
Managing safety risks	Intervention	3.29 (0.84)	4.32 (0.67)	< 0.001
	Comparison	3.30 (0.83)	3.46 (0.79)	0.075
Understanding human and environmental factors	Intervention	3.42 (0.78)	4.67 (0.50)	< 0.001
	Comparison	3.54 (0.80)	3.72 (0.68)	0.077
Recognizing and responding to adverse events	Intervention	3.33 (0.78)	4.34 (0.10)	< 0.001
	Comparison	3.23 (0.85)	3.48 (0.84)	0.018
Culture of safety	Intervention	3.68 (0.72)	4.71 (0.46)	< 0.001
	Comparison	3.83 (0.68)	4.06 (0.61)	0.004
Patient safety attitude	Intervention	4.00 (0.56)	4.61 (0.45)	< 0.001
	Comparison	4.19 (0.49)	4.35 (0.41)	0.013
Patient safety knowledge test	Intervention	7.37 (1.87)	10.82 (1.61)	< 0.001
	Comparison	7.81 (1.93)	8.16 (2.01)	0.136

M, mean; *SD*, standard deviation.

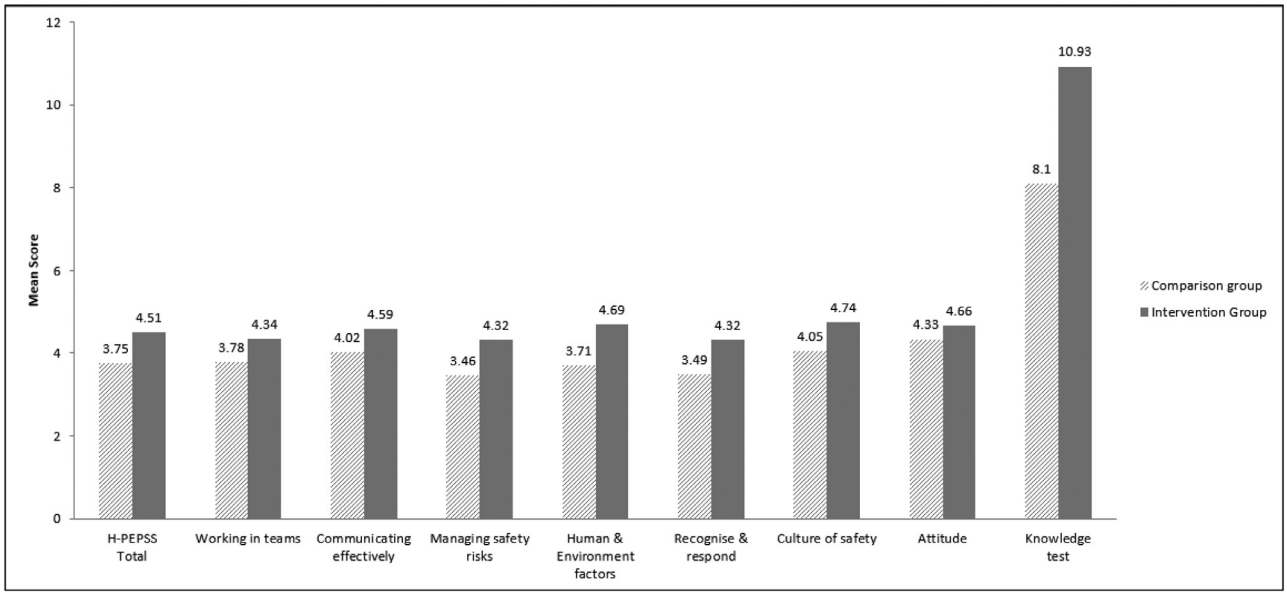

Fig. 2. Differences in post-test scores on the outcome variables between the intervention and comparison groups. Analyses using ANCOVA models were adjusted for pretest scores for each outcome variable.

0.001), and culture of safety ($F(1,102) = 44.01$, $p < 0.001$), patient safety attitude ($F(1,102) = 16.85$, $p < 0.001$), and patient safety knowledge ($F(1,102) = 65.98$, $p < 0.001$). The largest difference in Time 2 scores accrued to patient safety knowledge (see Fig. 2).

3.2. Multiple regression results

As presented in Table 4, after controlling for Time 1 scores and the student's year in the program, the patient safety course showed positive effects on all outcome variables. Among the nine outcomes, the patient safety course showed the strongest effect on patient safety knowledge, $B = 2.69$, $p < 0.001$, 95% CI (1.99, 3.39).

3.3. Students' assessment of the course

Overall, the students' assessment of the course was highly positive, with a mean satisfaction score of 4.66 ($SD = 0.53$) out of 5 points. Almost all students agreed or strongly agreed that the course helped them acquire new knowledge and skills about patient safety that they could apply in their clinical practice (97%); that the course increased their motivation to apply patient safety practices in their professional roles (95%); that the teaching methods, resources and assignments facilitated their understanding (93%); that they would recommend this course to their peers (97%); and that it is important to incorporate a patient safety course in the nursing curriculum (95%).

The qualitative data yielded several themes that reflected the quantitative findings. For example, students stated that the course increased their understanding of patient safety principles and how to apply that knowledge to improve patient safety. Students valued learning about when, why, and how to use patient safety-related tools and methodologies, and commented that they had become more aware of situations posing potential harm to patients and of system-oriented approaches they could use to reduce error in their clinical practices. Students also reported being highly motivated to study patient safety further because they found the course content to be novel and important, which they had not recognised earlier. In terms of teaching practices, students reported that the use of

Table 4
Multivariate linear regression results for Time 2 scores on nine outcome variables (N = 105).

	B	95% CI	R^2	*F* (4, 100)
Overall PS competency T2				
Overall PS competency T_1	0.40[d]	0.26 to 0.54		
Program year[a]				
3rd	0.04	-0.30 to 0.39		
4th	0.14	-0.22 to 0.50		
Group[b]	0.74[d]	0.55 to 0.93	50%	25.46[d]
Working in teams T2				
Working in teams T_1	0.27[d]	0.13 to 0.41		
Program year[a]				
3rd	-0.21	-0.62 to 0.20		
4th	0.04	-0.38 to 0.47		
Group[b]	0.55[d]	0.33 to 0.77	32%	11.43[d]
Communicating effectively T2				
Communicating effectively T_1	0.36[d]	0.20 to 0.52		
Program year[a]				
3rd	0.21	-0.25 to 0.68		
4th	0.30	-0.18 to 0.79		
Group[b]	0.53[d]	0.28 to 0.79	29%	10.28[d]
Managing safety risks T2				
Managing safety risks T_1	0.42[d]	0.25 to 0.58		
Program year[a]				
3rd	0.06	-0.45 to 0.58		
4th	0.11	-0.43 to 0.64		
Group[b]	0.84[d]	0.57 to 1.12	41%	17.14[d]
Understanding human and environmental factors T2				
Understanding human and environmental factors T_1	0.19[c]	0.03 to 0.34		
Program year[a]				
3rd	0.35	-0.09 to 0.80		
4th	0.51	-0.04 to 0.98		
Group[b]	0.92[d]	0.68 to1.17	45%	20.17[d]
Recognising and responding to adverse events T2				
Recognising and responding to adverse events T_1	0.41[d]	0.23 to 0.58		
Program year[a]				
3rd	-0.12	-0.66 to 0.41		
4th	-0.07	-0.63 to 0.50		
Group[b]	0.83[d]	0.54 to 1.11	38%	15.39[d]
Culture of safety T2				
Culture of safety T_1	0.32[d]	0.18 to 0.46		
Program year[a]				
3rd	0.10	-0.30 to 0.49		
4th	0.21	-0.19 to 0.61		
Group[b]	0.67[d]	0.46 to 0.88	38%	15.14[d]
Patient safety attitudes T2				
Patient safety attitudes T_1	0.36[d]	0.21 to 0.51		
Program year[a]				
3rd	-0.05	-0.35 to 0.24		
4th	-0.00	-0.31 to 0.30		
Group[b]	0.32[d]	0.16 to 0.49	26%	8.80[d]
Patient safety knowledge T2				
Patient safety knowledge T_1	0.38[d]	0.20 to 0.56		
Program year[a]				
3rd	0.38	-0.90 to 1.66		
4th	1.01	-0.31 to 2.33		
Group[b]	2.69[d]	1.99 to 3.39	46%	21.65[d]

CI, confidence interval; PS, patient safety; T_1, Time 1; T_2, Time 2.
[a] Program Year: 2nd year = reference.
[b] Group: comparison = reference.
[c] $p<0.05$.
[d] $p<0.001$.

videos facilitated their understanding of the course material, but they experienced difficulties in completing their group projects online.

4. Discussion

This study examined the effectiveness of a standalone patient safety course by comparing patient safety competency, attitudes, and knowledge before and after undergraduate nursing students completed the course, and between those who attended and did not attend the course. Results showed that after accounting for baseline measures, Time 2 scores on all nine outcomes were significantly higher in the intervention group than the comparison group, indicating the effectiveness of the patient safety course. The largest effect accrued to patient safety knowledge, assessed with an objective test. This result is important as previous researchers found that patient safety knowledge scores were much lower than attitudes or skills scores among Korean undergraduate nursing students (Kim et al., 2019; Lee et al., 2016). Similarly, although Korean students in the healthcare professions self-reported high levels of overall safety competency, objective measures of their patient safety knowledge (i.e., test scores) were lower (Hwang et al., 2016). Together, these findings suggest a need for formal patient safety education (Hwang et al., 2016), and reinforce the impor-

tance of measuring patient safety knowledge with an objective test score.

Our results showed that the patient safety course was effective for increasing nursing students' self-assessed competencies in teamwork, communication, risk management, understanding human and system factors, recognising and responding to adverse events, and a culture of safety. These findings are consistent with two previous studies that reported significant improvements in patient safety competencies after a one-day patient safety course for senior-year healthcare profession students in Korea (Hwang et al., 2016), and a 4-semester patient safety program for nursing students in the United States. (Gleason et al., 2019). Both studies measured patient safety competencies with the H-PEPSS, as in the current study. These results suggest that a standalone patient safety course covering important patient safety topics guided by the WHO patient safety curriculum guide (2011) and the Safety Competencies Framework is promising for improving patient safety competencies, as well as attitudes and knowledge among undergraduate nursing students.

In South Korea, there has been a national emphasis on patient safety education for students in the health professions since the Patient Safety Act was enacted in 2016. Although various educational interventions have been developed to teach patient safety in nursing curriculum, there has been little consistency in hours of instruction, breadth of content, teaching modalities, and qualification of the instructors, limiting our understanding of the most effective approaches to patient safety education (Kim et al., 2019; Lee et al., 2020; Lee, Morse, & Kim, 2021). Moreover, many Korean nurse educators have reported being inadequately prepared to teach patient safety, hindering the patient safety education of future nurses in Korea (Ahn, Lee, & Jang, 2018; Jang & Lee, 2017; Lee et al., 2020). A lack of agreement about what to teach, and a lack of support for teaching patient safety are well-known challenges for educators (Lee et al., 2020; Tregunno et al., 2014; Wu & Busch, 2019). Patient safety should be taught in undergraduate nursing curricula to prepare nurses for their future roles in clinical practice, and our patient safety course could be a model for teaching patient safety in undergraduate nursing curriculum.

This study has some limitations. First, as the patient safety course was developed within one nursing program in one city in Korea, study findings cannot be generalised. Second, although the study showed positive effects for students in the intervention group for all outcomes measured, it should be noted that the patient safety course was an elective course. Although we found no baseline differences between the intervention and comparison groups, it is possible that the students who enrolled in the course had higher levels of interest in patient safety that may have affected study results. Third, although we used an objective measure of students' patient safety knowledge, other measures were self-reported, and subjective in nature. We also recognise that a single course experience might not produce lasting changes in students' patient safety-related competencies, attitudes, and knowledge, and therefore recommend that that knowledge and skill acquisition, as well as behaviour change, be evaluated in the longer term (Myers & Wong, 2019). Fourth, there may have been treatment diffusion (i.e., shared learning between groups), but this cannot be fully controlled in education research (Copper, 2016; Sullivan, 2011). Fifth, we were limited to using a quasi-experimental design as the patient safety course was an elective course and, thus, the students' choice whether to take it or not. Also, as the course was one semester long and offered only once a year, so we could not feasibly randomise to a wait-list design. However, as the comparison group consisted of students who were exposed to patient safety education as it was then taught, integrated within the existing nursing curricula, we considered this a reasonable design to assess the difference in learning offered by a standalone course, at that stage of the nursing program. The use of a quasi-experimental pretest-posttest design with a comparison group is often more applicable in education research than the stronger RCT design (Copper, 2016; Sullivan, 2011) although it limits our ability to draw causal conclusions. Thus, we recommend that future studies use a more rigorous design (e.g., clustered randomised trial). Finally, for translating the measures used in this study, we used a committee-based approach, which has been supported in previous nursing literature (Lee & Dahinten, 2021). However, we acknowledge that the use of this approach remains somewhat controversial.

5. Conclusion

This study demonstrated the positive effects of formal patient safety education for undergraduate nursing students. Students who took an 8-week standalone patient safety course showed higher levels of patient safety competencies, attitudes and knowledge than students in a comparison group. It is critical that nursing students be prepared to not only provide safe care to their patients at the bedside, but to also contribute to patient safety more generally within their work environments—and this study shows the potential for a stand-alone patient safety course to achieve just that.

Author contributions

All authors contributed significantly to this study and meet authorship requirements. SEL designed the study and collected data. SEL and VSD analysed and interpreted data. SEL and VSD drafted the manuscript. SEL and VSD substantially revised the manuscript. All authors read and approved the final manuscript.

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Ethical Statement

This study was approved by Yonsei University Health System Institutional Review Board (#Y-2020-0002) on March 4, 2020 and was conducted in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). The need for informed consent was waived by the Institutional Review Board due to the nature of the online survey. However, participants who agreed to participate in this study were required to acknowledge the consent statement before beginning the online survey.

Conflict of interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.colegn.2022.06.001.

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