

Original Article

Effectiveness of an E-Learning Activity Regarding Research Methodology and Fragility Fractures in a Sample of Nurses: Evidence from Greece

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Abstract

Background: Continuous education is crucial to improve nurses' knowledge and keep them update to new information.

Aim: To evaluate the effectiveness of an e-learning activity regarding research methodology and fragility fractures in a sample of nurses. Moreover, we investigated the impact of demographic characteristics on knowledge level of nurses.

Methods: We conducted a before-after study with a convenience sample of nurses working in different clinical settings. We conducted an e-learning activity regarding research methodology and fragility fractures. We developed 10 questions to assess the knowledge level of nurses before and after the e-

learning activity. We created an online form of the questionnaire with Google forms. Our nurses completed the study questionnaire before and after the e-learning activity to assess differences in their knowledge. Additionally, we measured overall evaluation, material evaluation, and educators' evaluation in a scale from 0 to 10 with higher values indicating higher levels of evaluation.

Results: Study population included 93 nurses. Among our sample, 86% (n=80) were females and 14% (n=13) were males. Mean age of nurses was 37.1 years, while mean years of experience was 13.6. Percentage of correct answers was improved after the e-learning activity for all questions. Moreover, we found a statistically significant improvement in eight questions ($p<0.05$) and a marginal statistically significant improvement in two questions ($p<0.10$). Mean knowledge score before the e-learning activity was 5.5, while after the e-learning activity improved to 7.6 ($p<0.001$).

Conclusions: Effectiveness of the e-learning activity was very high, since nurses improved their knowledge in all fields. Continuous education is essential for nurses to improve their knowledge and thus provide high quality of healthcare especially in fragility fracture patients.

Keywords: e-learning activity; research methodology; nurses; fragility fractures; effectiveness

Introduction

E-learning activities have proved to be a convenient and effective way to improve nurses' knowledge and skills in clinical settings (Ding et al., 2024; Kimura et al., 2023; Alfaleh et al., 2023; Rouleau et al., 2019; Voutilainen, Saaranen & Sormunen, 2017). In this context, e-learning activities can improve nursing skills and thus patients' healthcare.

A recent meta-analysis included eight studies that measured the effectiveness of e-learning activities for improving professional practices and knowledge of nurses in managing pressure injuries patients (Ding et al., 2024). Authors found that the pooled standardized mean differences for classification skill and for the knowledge score were 1.75 and 1.40 respectively, while the pooled odds ratio for the classification skills was 1.75.

A scoping review examined the effectiveness of interactive online modules and video modules for the continuing education of

nurses in clinical settings (Kimura et al., 2023). Authors identified four themes among studies: resource access, scenario-based learning, gamification, and computer simulation or virtual reality. The most common study outcome was knowledge acquisition.

A meta-analysis of 11 randomized controlled trials identified that e-learning activities improve nurses' knowledge and skills in a higher level than traditional educational techniques (Lahti, Hätönen & Välimäki, 2014). Thus, e-learning activities can be an alternative educational method for improving nurses' knowledge and clinical skills.

The effects of e-learning activities on nursing care are summarized under four levels of evaluation: learning, reactions to e-learning, behavior, and results (Rouleau et al., 2019). Moreover, learning is divided into knowledge, skills, and self-efficacy, while results are divided into patients' outcomes and costs.

Therefore, e-learning activities have been recognized as promising educational tools for improving nurses' knowledge to handle patients and adapt to changing circumstances. Especially during the COVID-19 pandemic, e-learning activities have become the mainstream choice among the learning formats. In this context, we conducted a study to evaluate the effectiveness of an e-learning activity regarding research methodology and fragility fractures in a sample of nurses. Moreover, we investigated the impact of demographic characteristics on knowledge level of nurses.

Methods

Study design and participants: The Fragility Fracture Network (FFN) was created in Europe in 2011. The FFN aims to address the burden of fragility fracture patients in public health and healthcare systems. The Greek FFN was established in 2018 in association with the FFN Global. The Greek FFN conducted five e-learning activities in Greek language: research methodology; sarcopenia and nutrition; falls and secondary prevention of fragility fractures; delirium; discharge planning and rehabilitation. All e-learning activities are online available here <https://fragilityfracturenetwork.org/european-region-greece/>. We conducted a before-after study with a convenience sample of nurses working in different clinical settings in Greece. We conducted an e-learning activity regarding research methodology and fragility fractures. We developed 10 questions to assess the knowledge level of nurses before and after the e-learning activity. Moreover, we measured gender, age, and years of experience. We created an online form of the questionnaire with Google forms. Our nurses completed the study questionnaire before and

after the e-learning activity to assess differences in their knowledge. Additionally we measured overall evaluation, material evaluation, and educators evaluation in a scale from 0 to 10 with higher values indicating higher levels of evaluation.

Ethical issues: Our study protocol was approved by the Ethics Committee of Faculty of Nursing, National and Kapodistrian University of Athens (reference number; 444, May 2023). Additionally, we applied the guidelines of the Declaration of Helsinki. Moreover, nurses gave their informed consent to participate in the study.

Statistical analysis: We use numbers and percentages to present categorical variables. Moreover, we use mean, standard deviation, median, minimum value, and maximum value to present continuous variables. We calculated an overall knowledge score by adding correct answers in 10 questions and dividing by 10. Thus, we obtained a knowledge score with values from 0 to 10. Higher values indicated higher levels of knowledge. We used McNemar's test to evaluate differences in knowledge before and after the e-learning activity. Moreover, we used the independent samples t-test to estimate the relationship between gender and knowledge. Also, we used Pearson's correlation coefficient to estimate the correlation between knowledge score and age and experience. P-values less than 0.05 were considered as statistically significant. We used the IBM SPSS 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) for the analysis.

Results

Study population included 93 nurses. Among our sample, 86% (n=80) were females and 14% (n=13) were males. Mean age of nurses was 37.1 years (standard deviation = 10.7) with a range from 18 to 59 years. Mean years of experience was 13.6 (standard deviation = 13.6) with a range from 1 to 50 years.

Nurses' answers before and after the e-learning activity are shown in Table 1. Percentage of correct answers was improved after the e-learning activity for all questions. Moreover, we found a statistically significant improvement in eight questions ($p < 0.05$) and a marginal statistically significant improvement in two questions ($p < 0.10$).

Mean knowledge score before the e-learning activity was 5.5 (standard deviation = 2.1), while after the e-learning activity improved to 7.6 (standard deviation = 1.9), ($p < 0.001$). Mean knowledge score among females was 5.4 (standard deviation = 2), while among males was 6.2 (standard deviation = 2.5), ($p = 0.22$). We found a positive correlation between knowledge score and age ($r = 0.06$, $p = 0.56$), and experience ($r = 0.02$, $p = 0.84$) but these relationships were not significant. E-learning evaluation by nurses is shown in Table 2. We found that e-learning evaluation was excellent in the three dimensions. In particular, mean overall evaluation was 9.5, mean material evaluation was 9.4, and mean educators evaluation was 9.6.

Table 1. Nurses' correct answers before and after the e-learning activity (N=93).

Question	Correct answers (%)		P-value ^a
	Before	After	
A study includes only males and investigates the relationship between smoking and heart attack. The study determinant is:	34.4	71.9	<0.001
Males			
Smoking			
Heart attack			
In a systematic literature review:	58.1	77.1	0.005
We analyze the results of one study and we extract our conclusions			
We analyze the results of all relevant studies in a research question			
We analyze only the results of studies with high quality			
A pilot study should be conducted:	64.5	76.1	0.084
Only if scholars have doubts			
Always			
Only when scholars have time to conduct it			
We conduct a study in an emergency department of one public hospital in Athens. We collect data for the dates of on-calls and the reasons of visit. Is the hospital a variable?	48.4	83.3	<0.001
No			
Yes			
We conduct a study in an emergency department of one public hospital in Athens. We collect data for the dates of on-calls and the reasons of visit. Are the reasons of visit a variable?	87.1	95.8	0.033
No			
Yes			

We measure educational level as low, moderate, and high. What kind of variable is the educational level?	53.8	74.0	0.004
Nominal			
Ordinal			
Continuous			
What kind of variable is the blood type;	57.0	75.0	0.009
Nominal			
Ordinal			
Continuous			
What kind of variable is the blood pressure;	65.6	81.3	0.015
Nominal			
Ordinal			
Continuous			
In what tense should we write the results of our study in an article?	35.5	66.7	<0.001
Present			
Past			
Present and past			
Methods section in an article includes:	46.2	58.3	0.097
Study results			
Methodology that scholars employed in their study			
Results from other studies			
All the above			

Bold text denotes correct answers. ^a McNemar's test

Table 2. E-learning evaluation by nurses (N=93).

	Mean	Standard deviation	Median	Minimum value	Maximum value
Overall evaluation	9.5	0.9	10	6	10
Material evaluation (e.g. powerpoint slides)	9.4	1.1	10	5	10
Educators evaluation	9.6	0.8	10	5	10

Discussion

We conducted a before-after study to examine the effectiveness of an e-learning activity in a sample of nurses in Greece. Our findings demonstrated that the e-learning activity improve nurses' knowledge. Total knowledge score was improved significantly after the e-learning activity. Moreover, nurses' satisfaction from the e-learning activity was very high. Literature confirms our results since several studies demonstrated the positive impact of e-learning activities.

Several systematic reviews suggest the positive impact of e-learning activities among healthcare professionals including nurses. In particular, a scoping review showed that massive open online courses can improve healthcare professionals' knowledge on some public health issues offering, thus, a quick and effective education tool (Longhini, Rossetini & Palese, 2021). A meta-analysis including nine studies with nurses revealed that e-learning activities result in knowledge test scores, on average, five points higher than

conventional educational methods (Voutilainen, Saaranen & Sormunen, 2017).

Additionally, an umbrella review including 22 systematic reviews summarized the effects of e-learning on nursing care and found that most of the patient outcomes and cost are in a positive way, e.g. nurses are satisfied with e-learning activities and these activities improve nurses' knowledge (Rouleau et al., 2019). This umbrella review included reviews that measured skills, attitudes, knowledge and self-efficacy of nurses towards e-learning activities. Another systematic review revealed that e-learning activities is an effective way for integrating knowledge with clinical nursing skills (Alfaleh et al., 2023). This systematic review identified four themes: learning in practice barriers; facilitators of e-learning; barriers to e-learning; e-learning approaches.

Moreover, a recent quasi-experimental single group pre-post-test study in Canada found significantly more knowledge and reduced ageist attitudes following an e-learning activity in a sample of undergraduate nursing students (Devkota et al., 2023). Moreover, Badiei et al. found that e-learning is more effective than booklet in enhancing the learning and retention of knowledge of diabetes updates in a sample of nurses in Iran (Badiei et al., 2016).

Several studies showed that nurses display favorable attitudes toward e-learning (Chen et al., 2008; Chong et al., 2016; Karaman, 2011; Moule, Ward & Lockyer, 2010). Nurses' positive attitudes toward e-learning activities underline the importance of this educational tool. E-learning activities are an easy, convenient and cost-effectiveness was to improve nurses' knowledge offering a rich and flexible learning environment.

Additionally, e-learning activities are considered as a suitable way to nurses' working habits and circumstances.

Our study had several limitations. First, we cannot establish a causal relationship between our e-learning activity and changes on nurses' knowledge. Future studies with an experimental design can improve this knowledge. Moreover, we assessed nurses' knowledge only after the end of the e-learning activity. Thus, we cannot estimate the effectiveness of our e-learning activity over time. Longitudinal studies are necessary to understand the way that e-learning activities improve nurses' knowledge. Furthermore, we investigated the impact of a limited number of socio-demographic characteristics on nurses' knowledge. Future research should expand this knowledge identifying the factors that affect nurses' knowledge through an e-learning activity. Finally, our sample size was small and cannot be representative of nurses' population in Greece. Thus, we cannot generalize our findings.

In conclusion, our e-learning activity has proved a convenient and effective approach to improve nurses' knowledge. Nurses managers and policy makers should motivate nurses to engage with e-learning activities. Continuous education is essential for nurses to improve their knowledge and thus provide high quality of healthcare especially in fragility fracture patients.

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