

Active learning versus lecture-based approaches in occupational training programs of intensive care nursing staff at Al-Ahrar Hospital, Zagazig City, Egypt

Mısır Zagazig şehri Al-Ahrar Hastanesi'nde çalışan yoğun bakım hemşirelerinin mesleki eğitim programlarında ders verme tabanlı yaklaşımlara karşı aktif öğrenme

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Abstract

The occupational health and safety (OHS) training will facilitate nurses' understanding of the connection between workplace factors and their injuries and illnesses. Nursing training must keep up with the rapidly changing medical landscape to support the competences of nurses in the areas of critical thinking, problem solving and creativity. Promotion of OHS system through integration of active learning approaches of occupational training into the hospitals' overall training program at Al-Ahrar hospital, Zagazig city with the following objectives: (1) Identify and assess OHS hazards for Intensive Care Unit (ICU) nurses. (2) Prioritize OHS hazards. (3) Implement different intervention training methods for ICU nurses for highly prioritized hazards. (4) Compare the effect of active training methods versus conventional training methods on ICU nurses' knowledge and attitude. A biphasic study was done on ICUs of Al-Ahrar hospital, Zagazig city: First phase: Cross-sectional study was carried out with 60 nurses to evaluate their job hazards. Second phase: Interventional study; an OHS training program was conducted for 48 nurses. Participants were randomly assigned into two different groups; conventional lecture-based learning (CLL) and problem-based learning (PBL) strategy. The improvement of knowledge and attitude was significantly higher among PBL group than CLL group in both post-test ($P<0.05$) and follow-up test ($P<0.01$). There was statistical significant difference between both groups of PBL and CLL in there evaluation of the training method ($P<0.05$). There is a clear need for changes in the OHS training strategies to be more interactive and collaborative.

Keywords: Active learning; intensive care; nursing staff; occupational training programs

Özet

Mesleki sağlık ve güvenlik (MSG) eğitimi hemşirelerin işyeri etmenleri ile kendi yaralanmaları ve hastalıkları arasındaki bağlantıyı anlamalarını kolaylaştıracaktır. Hemşirelik eğitimi, hemşirelerin kritik düşünme, problem çözme ve yaratıcılıklarının desteklenmesi için hızla değişen tıbbi zemine ayak uydurmak zorundadır. Mısır Zagazig şehri Al-Ahrar Hastanesi'nin genel mesleki eğitim programına aktif öğrenme yaklaşımlarının entegre edilmesi ile MSG sisteminin özendirilmesi şu hedefleri içermektedir:(1) Yoğun bakım ünitesi (YBÜ) hemşireleri için MSG tehlikelerinin belirlenmesi ve değerlendirilmesi. (2) MSG tehlikelerinin öncelenmesi. (3) YBÜ hemşireleri için yüksek oranda öncelenmiş tehlikeler için farklı müdahale eğitimi metodlarının uygulanması. (4) Aktif eğitim metodlarına karşılık geleneksel eğitim metodlarının YBÜ hemşirelerinin bilgi ve tutumlarına olan etkilerinin kıyaslanması. Zagazig Şehri Al-Ahrar hastanesinin YBÜ hemşirelerinde iki aşamalı bir çalışma gerçekleştirilmiştir. İlk aşama: 60 hemşirenin mesleki tehlikelerini değerlendirmek üzere kesitsel bir çalışma gerçekleştirilmiştir. İkinci aşama: Müdahaleli çalışma; 48 hemşireye MSG eğitimi verilmiştir. Katılımcılar geleneksel ders verme tabanlı öğrenme (DTÖ) ve probleme dayalı öğrenme (PDÖ) stratejileri olmak üzere iki farklı gruba rastgele olarak dağıtılmıştır. Bilgi ve tutum yönünden ilerleme PDÖ grubunda DTÖ grubuna kıyasla anlamlı derecede hem post-test ($P<0.05$) hem de takip testinde ($P<0.01$) yüksekti. Her iki grupta eğitim metodu değerlendirilmesi yönünden istatistikî yönden anlamlı fark vardı ($P<0.05$). MSG eğitim stratejilerinde daha etkileşimli ve katılımcı olunması yönünde değişiklik yapılmasına net bir ihtiyaç vardır.

Anahtar kelimeler: Aktif öğrenme; yoğun bakım; hemşirelik personeli; mesleki eğitim programları

Introduction

Nurses play an important role in today's health care system. They constitute the largest health care

occupation (1). According to Occupational Safety and Health Administration (OSHA) the principle exposures specific to nurses are bloodborne pathogens (BBPs), working space, slips/trips/falls, latex allergy, equipment hazards, workplace violence,

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workplace stress, and methicillin resistant staphylococcus infections (MRSA) (2).

The right to work in a safe and healthy environment is the fundamental right of every worker (3). Several studies have indicated the need to identify the factors causing hazards in a critical area such as an intensive care unit "ICU", as well as strategies to avoid them, so that the health of these workers is not affected (4). Until recently, safety and health policies in hospitals were developed mainly for patients not worker, except for infectious diseases and sharp injuries which recognized by hospital administrators' as potential occupational risks (5). Special efforts including training, exposure to information, awareness rising, are recommended for improving occupational health and safety in hospitals (6). Today's, there is an increased need for professional nurses to be autonomous, capable of independent thought and able to make their own assumptions and decisions. Performance of nursing requires a cognitive ability that includes problem solving, decision-making, and clinical judgment (7).

The growth of Problem based learning (PBL) modules and curricula throughout many health care disciplines have increased dramatically over recent years (8). The question remains, would PBL be a helpful teaching methodology for Occupational Safety and Health educators? PBL encourages a more meaningful engagement by trainees in problems representative of the scope, complexity and difficulty of real-world OSH issues they are likely to encounter in the workplace. In this way, PBL facilitates the instructor in achieving one of the most important goals of OSH education, the development of trainees who are effective problem solvers (i.e., critical thinkers) and life-long learners (9). Thus, this study aims to promote OHS system through integration of active learning approaches of occupational training into the hospitals' overall training program at Al-Ahrar hospital, Zagazig city with the following objectives: (1) Identify and assess occupational health and safety hazards for ICU nurses. (2) Prioritize OHS hazards. (3) Implement different intervention training methods for ICU nurses for highly prioritized hazards. (4) Compare the effect of active training methods versus conventional training methods on ICU nurses' knowledge and attitude.

Subjects and Methods

I. Technical design

Study design: A biphasic study was done on the intensive care units (ICU) of Al-Ahrar hospital, Zagazig city: First phase: Cross-sectional study, Second phase: Interventional study.

Setting: The Intensive Care Units (ICU) of Al-Ahrar hospital, Zagazig city.

Target groups: All ICU nurses working in Al-Ahrar Hospital, Zagazig city, Sharkia Governorate, Egypt, from the 1st May 2012 till 30th April 2014.

Inclusion criteria: ICU Nursing staff of all ICUs of Al-Ahrar hospital, Zagazig city who accepted to participate in the study.

Exclusion criteria: ICU Nursing staff participated in the pilot study or were in long legal leaves was excluded.

Sample size: The total number of staff nurses in Al-Ahrar hospital ICUs at the period of this study was 78. Six of them were in long legal leaves and 8 of them were participated in the pilot study so they were excluded.

Sixty-four of staff nurses working in the six ICUs of Al-Ahrar hospital were offered to participate in this study. Sixty nurses accepted to participate. In the 2nd phase of this study; a sample of 48 nurses have continued participation, 24 were randomized by means of a random number table into the problem-based learning (PBL) group and 24 into the conventional lecture-based learning (CLL) group.

II. Operational design

Data collection: Semi-structured questionnaires were the principal method employed in this study.

First phase: A cross sectional study was carried out with 60 nurses working at ICUs of Al-Ahrar hospital, Zagazig city, to evaluate their job hazards.

Questionnaire: Participant ICU nurses were interviewed and offered to fill a questionnaire of 3 parts:

1st part: The Socio-demographic data such as age, sex, marital status, qualifications, and years of experience.

2nd part: Occupational hazards likelihood of occurrence and severity of exposure consequences as evaluated by ICU nurses based on National institute for Occupational Safety and Health (NIOSH) standards (10).

3rd part: Attendance history and future needs of OHS training program (Training Needs Assessment).

Risk Assessment

It was evaluated through "26" different questions: Biological (5 items), Physical (4 items), Chemical (4 items), Ergonomic (5 items), Accidents (4 items), and Psychological (4 items) hazards.

The Health and Safety Executive (HSE) (11) outline an approach to risk assessment, which involves assessment for risk rating for each hazard by multiplying a "probable frequency rating" by a "severity rating".

Risk Assessment Matrix

Probability	Consequence		
	Slightly Harmful (1)	Harmful (2)	Extremely Harmful (3)
Highly Unlikely (1)	1	2	3
Unlikely (2)	2	4	6
Likely (3)	3	6	9

Second phase: Interventional Study

Occupational health and safety training programs was conducted for 48 ICU nurses participated in this phase. The interview was conducted during their available time, through training sessions.

Subject

They were divided randomly into two equal groups 24 in each group.

Group I: Consisted of 24 of the nursing staff who was divided into two groups and trained to learn by using problem-based learning (PBL) strategy. They were further divided into two groups each one consisted of twelve nurses for facilitating learning by PBL.

Group II: Consisted of 24 nursing staff who was learned by the traditional training strategy (Conventional-Lecture Learning).

Training program

The educational programs were designed according to the 1st phase assessments "Risk and training needs assessments" which have decided aim of occupational training directed towards "Psychological hazards; mainly occupational stress in ICUs". Both educational intervention courses had the same objectives and content, and carried out for 3 days; 1 day a week over a 3-week period during March and April 2013.

The sessions were hold from (8.30 – 9.30 am) as the participants preferred. Different training aids were used for illustration as data show, photos, and video films. While all nurses had previously experienced lecture delivery, none of them had any prior exposure to PBL. Thus, a workshop for one day was conducted for study group to introduce the concept, importance, steps, and managerial skills of PBL. Post-test evaluation was done immediately after training to test the feasibility and understanding. Follow up "FU" evaluation was done 3 months after implementation of the training program in July and August 2013. The participants were asked to complete the same questionnaires that were used in the pre-test to detect the effect of the training program.

Tools of the study

Before distributing the questionnaire, a formal letter from the hospital manager was taken to get their permission to collect data from the hospital then distributing the questionnaire to the study subjects. The component of the tool was explained to the participants. They were reassured that the information collected would be used for the scientific research only and would be treated with confidentiality. Only code numbers were used to mark sheets and it was nameless. The questionnaire sheets were distributed to the respondents individually in their work setting by the researcher. The time needed to complete the sheets ranged from 15-20 minutes, then the researcher checked each sheet after the participant completed it to ensure

completeness of data. This was performed throughout the three evaluation stages; pre-, post-, and FU. At the end of the training program the "Participants' program evaluation Questionnaire" was used to evaluate the outcome of the program.

The questionnaires composed of 4 parts:

Part 1: Socio-demographic data

The 1st part of the questionnaire is the Socio-demographic data of the participants.

Part 2: Knowledge test (pre / post-test)

A Questionnaire was developed based on review of related literature to collect data related to nursing staff level of knowledge regarding the psychological hazards. Knowledge was evaluated through 33 different questions, covering nearly all aspects of psychological hazards with special focus on occupational stress and workplace violence (Definition, causes, burnout, stress management and workplace violence).

Scoring system

1- Questions in which all answers are correct (choosing more than one answer was allowed):

- Each chosen answer took 1 degree.
- Do not know took zero degree.

2- Questions with yes or no answer:

- Yes took 1 degree.
- No took zero degree.

The total score was 100 degrees and was classified as follows: satisfactory score ($\geq 60\%$ of total score), and unsatisfactory score ($< 60\%$ of total score) (12).

Part 3: Nurses' attitude towards psychological hazards prevention and control

Questionnaire was developed by the researcher based on review of related literature to assess ICU nurses' attitude towards psychological hazards, prevention and control. The questionnaire consisted of 30 different questions which were assessing nurses' attitude on a 3-point Likert scale (agree, uncertain, and disagree).

Scoring system

The response of agree, uncertain, disagree were scored 2, 1, and zero, respectively.

The total score was 60 degrees and was classified as follows: positive attitude ($\geq 60\%$ of total score), and negative attitude ($< 60\%$ of total score) (12).

Part 4: Program Evaluation Form

A structured form was developed by the researcher to evaluate the outcome of the program from nursing staff' point of views immediately after program implementation. It has included 13 different questions related the objectives, content of the program and the methods of training.

It was divided into two categories:

- A. Program evaluation dimensions; evaluation of the training method, training aids, lecture duration, and meeting trainees' expectations.
- B. Comments or suggestions for improvement of the educational program.

Scoring system

- The evaluation was conducted through giving score of 1 to 5 for each item in each dimension (bad, fair, good, very good, and excellent).
- For each subscale, the score of the items were summed-up and the total divided by the number of items, giving a mean score for the subscales. These scores were converted into a percent score.
- For overall adequacy of the program, the score of 60% or more of the total score was considered adequate or less than 60% was considered inadequate (12).

Validity Test: The developed questionnaires was submitted to a panel of three experts in the field of occupational medicine for content language clarity, relevancy, and readability, ease of understanding, question sequence, and completion time.

Reliability Test: The reliability coefficients (Cronbach's alpha) were generally high for all questionnaires, and suitable for scientific purposes, where the Cronbach's alpha values were: Risk assessment (0.82), Training needs assessment (0.89), Knowledge (0.87), Attitude (0.92), Program evaluation (0.86).

Pilot study

For testing the study tools, pilot study was conducted during June 2012. It was carried out on 10% of the study sample 8 nurses who were chosen randomly and excluded from the study. To enhance the reliability of the study tools, "test-re-test" was performed and the same questionnaire re-administered to the same 8 nurses after two weeks. The result showed similar answers and responses. All ICU nurses of the pilot were excluded from the results of the study. According to the result of the pilot study, the questionnaire was assessed and some modifications were done.

Administrative design and Ethical issues

Official permissions were obtained from the IRB Ethical Committee of the collage, community medicine department, and the director of Al-Ahrar Hospital. The study group was informed about the nature and the purpose of the study and verbal consent was taken before interview. The study group did not exposed to any harm or risk. Full reassurance about the strict confidentiality of any obtained information, and the study result would be used only for purpose of search.

Data analysis

The collected data were computerized and statistically analyzed using SPSS program (Statistical Package for Social Science) version 16.0 (13). Qualitative data were represented as frequencies and percentages, Chi-square test, and McNemar test was carried out for comparing the qualitative data.

Quantitative data were compared using Student's t-test and one-way analysis of variance test (ANOVA) for multiple group comparisons. The test results were considered significant when P-value <0.05.

Results*Socio-demographic characteristics of the study subject (nurses)*

Age of the participants ranged from (20.0 - 32.0) with mean of 24.22 ± 2.54 . The majority of them (95.0%) were females and more than half were single (58.3%). Their level of education ranged between nursing institute and faculty of nursing (35.0% each) (Table 1). Also, most participants were on nurse category (35.0%) from the Neonatal unit "NICU" (23.3%). Years of Experience ranges from (1.0-14.0) with mean of 4.45 ± 2.24 . Morning Shifts were the most nurses' shifts with range of (14.0 - 30.0) and mean of (17.05 ± 3.66) monthly (Table 1).

Risk assessment of ICUs

The mean total hazards Risk rating were respectively; Psychological hazards (3.53 ± 0.217), Biological hazards (2.59 ± 0.319), Ergonomics (1.82 ± 0.118), Chemical hazards (1.45 ± 0.121), Physical hazards (1.43 ± 0.139), and Accidents (1.08 ± 0.115) (Table 2).

Training needs assessment

Almost all participants (95.0%) had general knowledge about OHS knowledge mostly from On-job training (68.4%). Most of them (76.7%) had attained previous OHS training which was satisfactory for more than half of them (60.9%). Nurses' satisfaction with their OSH knowledge was almost fair (61.7%) (Table 3).

Psychological hazards were the most needed topic (40.0%), while Biological hazards were the least (5.0%). Most participant Nurses agreed that the best time for the training program during the Morning shift from 8 am-2 pm (60.0%) and inside the hospital (83.3%) (Table 4).

Prioritization of occupational health and safety hazards in ICUs according to Risk Assessment and Need Assessment

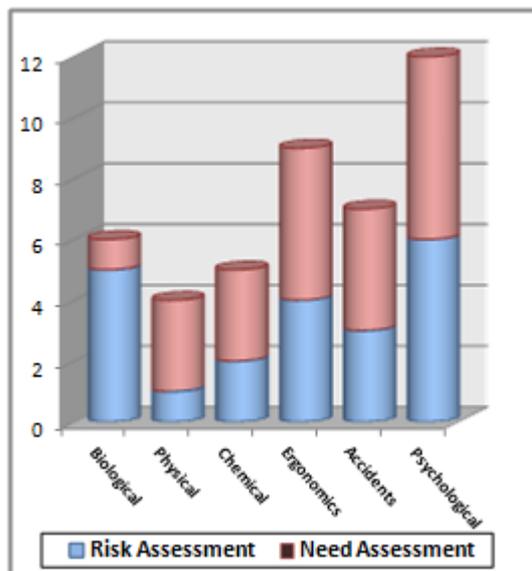
Psychological hazards had highest prioritization score of 12 according to both risk and need assessments, while Physical hazards had least score of 4 (Graph 1).

Socio-demographic characteristics of studied nurses of PBL and CLL groups

There were no statistical significant differences between both groups of PBL and CLL regarding age, marital status, education, nurse category, work department and years of experience (Table 5).

Table 1. Socio-demographic characteristics of the study participants

Socio-demographic characteristics	n (%) (n=60)	P
Age (years):		
- Mean \pm SD	24.22 \pm 2.54	
- Range	20.0 - 32.0	
Sex:		
- Male	3 (5.0)	<0.001
- Female	57 (95.0)	
Marital Status:		
- Single	35(58.3)	0.068
- Married	25(41.7)	
Education:		
- School of nursing	18 (30.0)	0.799
- Nursing institute	21 (35.0)	
- Faculty of nursing	21 (35.0)	
Nurse category		
- Assistant nurse	18 (30.0)	0.011
- Nurse	21 (35.0)	
- Professional nurse	15 (25.0)	
- Head nurse	6 (10.0)	
Work Department		
- Cardio-thoracic unit	7 (11.7)	0.538
- Intermediate care unit	12 (20.0)	
- Internal medicine unit	10 (16.7)	
- Emergency unit	9 (15.0)	
- Neonatal unit	14 (23.3)	
- Cardiology unit	8 (13.3)	
Years of Experience (years):		
- Mean \pm SD	4.45 \pm 2.24	
- Range	1.0 - 14.0	
Shift time (days)		
- Morning (8 am-2 pm)		
Mean \pm SD	17.05 \pm 3.66	
Range	14.0 - 30.0	
- Evening (2 pm-8 pm)		
Mean \pm SD	6.48 \pm 1.84	
Range	0.0 - 8.0	
- Night (8 pm-8 am)		
Mean \pm SD	6.47 \pm 1.83	
Range	0.0 - 8.0	

**Graph 1.** Prioritization of OHS hazards in ICUs according to Risk and Need Assessments

Assessment of Nurses' Knowledge before and after PBL and CLL interventions

The majority of PBL group (95.8%) acquired a satisfactory level of knowledge immediately after applying the training program with a highly significant difference ($P < 0.01$) and (79.2%) during FU stage with a significant difference ($P < 0.05$). While most of CLL group (87.5%) acquired a satisfactory level of knowledge immediately after applying the training program with a significant difference ($P < 0.05$) and (66.7%) during FU stage but with a non-significant difference ($P > 0.05$) (Table 6). Improvement of knowledge was significantly higher among PBL group than CLL group in post-test ($P < 0.05$) in all dimensions mainly in "preventive strategies" while in FU highly significant improvement in most dimensions ($P < 0.001$) (Table 7).

Assessment of Nurses' Attitude towards psychological hazards before and after PBL and CLL interventions

Most of PBL group (87.5%) acquired a satisfactory attitude scale immediately after applying the

Table 2. Risk rating for occupational hazards among ICU' nurses

Potential Hazards	Mean \pm SD		
	Probability	Consequence	Risk
Biological Hazards			
Communicable infectious diseases	1.90 \pm 0.573	1.52 \pm 0.504	2.89 \pm 0.289
BBPs from blood spills	1.70 \pm 0.910	1.48 \pm 0.504	2.52 \pm 0.459
BBPs from sharps injuries	1.70 \pm 0.646	1.82 \pm 0.431	3.09 \pm 0.278
Infection from infectious waste	1.53 \pm 0.566	1.58 \pm 0.497	2.42 \pm 0.281
Contracting MRSA infection	1.55 \pm 0.622	1.30 \pm 0.462	2.02 \pm 0.287
Mean total	1.68\pm0.664	1.54\pm0.480	2.59\pm0.319
Physical Hazards			
Tissue & genetic changes from exposure to X-rays	1.37 \pm 0.520	1.23 \pm 0.427	1.69 \pm 0.222
Electric shock from defibrillator	1.37 \pm 0.581	1.07 \pm 0.252	1.47 \pm 0.146
Electric shock from Electrical Equipment	1.18 \pm 0.390	1.13 \pm 0.343	1.33 \pm 0.134
Noise from Computer monitor	1.23 \pm 0.427	1.02 \pm 0.129	1.25 \pm 0.055
Mean total	1.29\pm0.479	1.11\pm0.288	1.43\pm0.139
Chemical Hazards			
Inhaling Toxic fumes from sterilizer	1.58 \pm 0.591	1.28 \pm 0.454	2.02 \pm 0.268
Skin irritation from disinfectants	1.23 \pm 0.465	1.07 \pm 0.252	1.32 \pm 0.117
Latex allergy from Gloving	1.32 \pm 0.504	1.02 \pm 0.129	1.35 \pm 0.065
Mercury spills from broken thermometers	1.07 \pm 0.252	1.02 \pm 0.129	1.09 \pm 0.033
Mean total	1.30\pm0.453	1.09\pm0.241	1.45\pm0.121
Ergonomics			
MSDs & varicose from prolonged Standing	2.30 \pm 0.671	1.22 \pm 0.415	2.81 \pm 0.278
MSDs from Lifting, moving, transfer of patients	2.32 \pm 0.504	1.33 \pm 0.475	3.09 \pm 0.239
MSDs from Lifting boxes of supplies	1.08 \pm 0.279	1.02 \pm 0.129	1.10 \pm 0.036
Harmful rays, eye strain & MSDs from VDTs	1.08 \pm 0.279	1.02 \pm 0.129	1.10 \pm 0.036
Injury due to STF & eye strain from Poor lighting	1.00 \pm 0.000	1.00 \pm 0.000	1.00 \pm 0.000
Mean total	1.56\pm0.347	1.12\pm0.229	1.82\pm0.118
Accidents			
Falls from Standing on Stools	1.08 \pm 0.279	1.00 \pm 0.129	1.08 \pm 0.036
Explosion of Compressed gas tanks	1.00 \pm 0.000	1.00 \pm 0.000	1.00 \pm 0.000
Injuries from Rolling Cart & Chairs	1.20 \pm 0.403	1.03 \pm 0.181	1.24 \pm 0.073
Burns from Fires	1.00 \pm 0.000	1.00 \pm 0.000	1.00 \pm 0.000
Mean total	1.07\pm0.171	1.01\pm0.078	1.08\pm0.115
Psychological Hazards			
Work stress due to workload	2.78 \pm 0.415	1.47 \pm 0.503	4.09 \pm 0.209
Workplace Violence (WPV)	2.42 \pm 0.497	1.63 \pm 0.688	3.94 \pm 0.342
Work stress due to Conflicts with peers	1.45 \pm 0.502	1.17 \pm 0.376	1.69 \pm 0.189
Work stress due to Shortage of staff	3.00 \pm 0.252	1.47 \pm 0.503	4.41 \pm 0.127
Mean total	2.41\pm0.417	1.44\pm0.518	3.53\pm0.217

program with a highly significant difference ($P < 0.01$) and (70.8%) during FU stage with a significant difference ($P < 0.05$). Most of CLL (75.0%) acquired a satisfactory attitude scale immediately after applying the training program with a significant difference ($P < 0.05$) and 62.5% during FU stage with a non-significant difference ($P > 0.05$) (Table 8). Improvement of attitude was significantly higher among PBL group than CLL group in post-test ($P < 0.05$) in all dimensions mainly in "preventive strategies" while in FU highly significant improvement in both dimensions of "Work stress" and "Sources of work stress" ($P < 0.001$) (Table 9).

Evaluation of the program outcome from the nurses' point of view

There was high statistical significant difference between both groups of PBL and CLL in evaluation of the training method ($P < 0.01$), and statistical significant difference in evaluation of "Meeting trainees' expectations" ($P < 0.05$) (Table 10).

Discussion

There is no doubt that training programs significantly improve the level of knowledge of nurses about the hazards they are exposed to (14). Scheduled training programs for identification of ICU hazards should be an integrated part of quality improvement program at any hospital (15).

All nursing staff in the six ICUs of Al-Ahrar hospital, Zagazig city, matched the inclusion criteria offered to participate in this study. The Age of the participants ranges from (20.0 - 32.0) with an average age 26 years. The majority of them (95.0%) were females and more than half of them (58.3%) were single. Their level of education ranged between nursing institute and faculty of nursing (35.0% each) (Table 1). Moreover most of the participants were on nurse category (35.0%), working at Neonatal unit (23.3%) and intermediate care unit (20.0). Years of experience ranges from (1.0 - 14.0) with mean of 4.45 \pm 2.24. Morning Shift time were the most nurses' shifts with range of (14.0 - 30.0) and mean of (17.05 \pm 3.66) monthly (Table 1).

Risk management focuses on improving the quality and safety of health care services by identifying the circumstances and opportunities that put patients and health care workers "HCWs" at risk of harm and acting to prevent or control those risks (16). Risk rating of biological hazards among nurses was listed in Table 2 from which we can notice that the maximal biological hazards' Risk rating was "BBPs from sharps injuries", while minimal was "Infection from infectious waste". These results may be explained according to the actual practice of most nurses who usually neglect simple procedures in dealing with sharp objects as one-handed recapping technique and wearing protective gloves. However for the infectious waste usually nurses do not deal directly with it as it is the mainly a role of workers, in addition most hospitals including Al-Ahrar implement the strategy of safe medical waste disposal. In a previous study (17) the main risk of occupationally acquired BBPs infection in ICU found to be acquired from sharp objects. BBPs among nurses are one of emerging and increasing threats to the whole community (18).

Medical waste considered as the main source of BBPs infections in hospitals (19). Poor medical waste management unquestionably exposes HCWs, waste handlers, and the community to infections, toxic effects, and injuries (20).

As regards physical hazards, Table 2 illustrates that maximal Physical hazards' risk rating was "tissue and genetic changes from exposure to X-rays" while minimal was "noise from computer monitor". Cupitt et al. (21) noticed that ICU' nurses are repeatedly exposed to scattered radiation, chiefly from frequent diagnostic chest X-rays.

Noise from Computer monitor was the least may be due to adaptation to the work environment as most of the participant has mean years of experience 4.45 ± 2.24 . In contrast with our results, the most important physical hazards in ICUs were found to be exposure to noise, inadequate light, and finally exposure to radiation (22).

For chemical hazards, Table 2 clarified that maximal Chemical hazards' Risk rating was "Inhaling Toxic fumes from sterilizer", while minimal was "Mercury spills from broken thermometers". In consistency with these results, it has been assumed that the problem of respiratory irritants and inhaled toxic chemicals is common in ICU settings (23).

Table 2 cleared that maximal ergonomic hazards' Risk rating was "MSDs from Lifting, moving, transfer of patients" while minimal was "Injury due to slip, trips, and fall (STF) and eye strain from poor lighting". The higher rates of MSDs from Lifting, moving, transfer of patients may be explained by that the majority of nursing staff were females who may be owed to lifting patients with average weights of 150 pounds.

Table 3. General Occupational Safety and Health (OSH) knowledge and training history of the study participants

General OSH knowledge and training history	n (%)	P
General knowledge		
Yes	57 (95.0)	<0.001
No	3 (5.0)	
Total	60 (100.0)	
Information sources		
Education	18 (31.6)	<0.001
On-job training	39 (68.4)	
Total	57 (100.0)	
Previous training		
Yes	46 (76.7)	<0.001
No	14 (23.3)	
Total	60 (100.0)	
Satisfaction with previous training		
Agree	28 (60.9)	<0.001
Neutral	12 (26.1)	
Disagree	6 (13.0)	
Total	46 (100.0)	
Previous training method		
Lectures and seminars	27 (58.7)	0.095
Booklets	19 (41.3)	
Total	46 (100.0)	
Satisfaction with OSH knowledge		
Poor	19 (31.7)	<0.001
Fair	37 (61.7)	
Good	4 (6.7)	
Total	60 (100.0)	

Table 4. Training need assessment of the study participants

Training Need assessment	n (%) (n=60)	P
Hazard need training		
Biological	3 (5.0)	<0.001
Physical	5 (8.3)	
Chemical	5 (8.3)	
Ergonomics	12 (20.0)	
Accidents	11 (18.3)	
Psychological	24 (40.0)	
Best time		
Morning shift (8am-2pm)	36 (60.0)	0.028
Evening shift (2pm-8pm)	24 (40.0)	
Best place		
Inside hospital	50 (83.3)	<0.001
Outside hospital	10 (16.7)	

Nursing was classified in the top 10 industries for MSDs (24). The lumbago and back are the most affected body parts and the most critical cause for such MSDs was lack of training to be aware of the associated work-related situations, suggesting that education of ergonomics should be included in the nurse curriculum to reduce risks of MSDs (25).

Belongs to accidents hazards (Table 2), maximal Accidents hazards' Risk rating was "Injuries from Rolling Cart and Chairs" while minimal was both "Explosion of Compressed gas tanks" and "Burns from Fires". Higher rates of Injuries from Rolling Cart and Chairs may reflect bad environmental design in ICUs. Falls were ranked as the most common accident may occur to nurses especially due to slippery floors and bad environmental design (26).

Table 5. Socio-demographic characteristics of PBL and CLL groups

Socio-demographic characteristics	PBL (n=24)	CLL (n=24)	P
	n (%)	n (%)	
Age (years):			
- Mean \pm SD	23.67 \pm 2.26	23.46 \pm 1.67	0.716
- Range	20.0 - 28.0	21.0-27.0	
Marital Status:			
- Single	17 (70.8)	15 (62.5)	0.54
- Married	7 (29.2)	9 (37.5)	
Education:			
- School of nursing	6 (25.0)	8 (33.3)	0.47
- Nursing institute	8 (33.3)	10 (41.7)	
- Faculty of nursing	10 (41.7)	6 (25.0)	
Nurse category			
- Assistant nurse	6 (25.0)	8 (33.3)	0.525
- Nurse	8 (33.3)	7 (29.2)	0.755
- Professional nurse	5 (20.8)	6 (25.0)	0.731
- Head nurse	5 (20.8)	3 (12.5)	0.439
Work Department			
- Cardio-thoracic unit	3 (12.5)	4 (16.7)	0.683
- Intermediate care unit	4 (16.7)	5 (20.8)	0.712
- Internal medicine unit	4 (16.7)	4 (16.7)	1.000
- Emergency unit	4 (16.7)	2 (8.3)	0.383
- Neonatal unit	5 (20.8)	6 (25.0)	0.731
- Cardiology unit	4 (16.7)	3 (12.5)	0.683
Years of Experience (mean \pm SD)	3.83 \pm 1.88	4.17 \pm 1.58	0.501

Table 6. Changes of knowledge after application of training program to the PBL and CLL groups

Knowledge score	Group	Pre (n=24)	Post (n=24)	FU (n=24)	P1	P2
		n (%)	n (%)	n (%)		
Unsatisfactory	PBL	11 (45.8)	1 (4.2)	5 (20.8)	0.009	0.041
Satisfactory		13 (54.2)	23 (95.8)	19 (79.2)		
Unsatisfactory	CLL	11 (45.8)	3 (12.5)	8 (33.3)	0.027	0.547
Satisfactory		13 (54.2)	21 (87.5)	16 (66.7)		

N.B: McNemar test of significance.

P1: Difference between Pre-intervention and Post-intervention.

P2: Difference between Pre-intervention and follow up

Table 7. Comparison of changes of knowledge of PBL and CLL groups throughout the training program

Nurses Knowledge	Pre		P*	Post		P*	FU		P*
	PBL	CLL		PBL	CLL		PBL	CLL	
Occupational hazards	56.9 \pm 18.8	54.6 \pm 9.4	0.594	92.8 \pm 6.3	89.5 \pm 4.4	0.041	78.8 \pm 12.5	69.8 \pm 12.4	0.016
Work stress	52.8 \pm 17.4	53.8 \pm 15.7	0.835	93.5 \pm 6.2	90.1 \pm 4.3	0.032	81.7 \pm 11.2	71.7 \pm 7.6	<0.001
Sources of work stress	49.5 \pm 21.2	51.3 \pm 16.4	0.744	94.6 \pm 5.9	91.4 \pm 4.7	0.043	78.2 \pm 8.3	68.2 \pm 9.3	<0.001
Preventive strategies	51.9 \pm 17.7	49.5 \pm 17.7	0.641	94.1 \pm 5.5	88.4 \pm 5.6	<0.001	79.6 \pm 7.6	64.6 \pm 11.7	<0.001
Workplace violence	57.1 \pm 13.5	58.3 \pm 13.7	0.761	93.4 \pm 5.3	90.6 \pm 4.3	0.050	78.6 \pm 12.8	69.3 \pm 11.5	0.011
TOTAL	54.2 \pm 17.7	53.5 \pm 14.6	0.882	93.6 \pm 5.1	89.9 \pm 4.8	0.036	79.4 \pm 10.6	68.7 \pm 10.8	0.0012

*Student's t-test

Table 8. Changes of attitude scale after application of training program to the PBL and CLL groups

Attitude scale	Group	Pre (n=24)	Post (n=24)	FU (n=24)	P1	P2
		n (%)	n (%)	n (%)		
Unsatisfactory	PBL	14 (58.3)	3 (12.5)	7 (29.2)	0.003	0.046
Satisfactory		10 (41.7)	21 (87.5)	17 (70.8)		
Unsatisfactory	CLL	14 (58.3)	6 (25.0)	9 (37.5)	0.013	0.074
Satisfactory		10 (41.7)	18 (75.0)	15 (62.5)		

N.B: McNemar test of significance.

P1: Difference between Pre-intervention and Post-intervention.

P2: Difference between Pre-intervention and follow up.

Table 9. Comparison of changes of Nurses' Attitude of both PBL and CLL groups throughout the training program

Nurses' Attitude	Pre		P*	Post		P*	FU		P*
	PBL	CLL		PBL	CLL		PBL	CLL	
Occupational hazards	48.1 ± 9.8	48.6 ± 13.4	0.883	84.2 ± 7.2	80.1 ± 6.1	0.039	68.2 ± 8.5	61.7 ± 7.8	0.008
Work stress	50.7 ± 13.4	50.1 ± 15.7	0.887	84.7 ± 8.2	79.8 ± 8.3	0.045	71.7 ± 6.8	60.5 ± 5.7	<0.001
Sources of work stress	50.3 ± 19.2	49.3 ± 13.1	0.834	86.2 ± 9.5	81.2 ± 7.3	0.047	68.7 ± 7.6	60.1 ± 8.2	<0.001
Preventive strategies	46.4 ± 17.6	47.8 ± 18.7	0.791	87.5 ± 8.5	79.2 ± 10.6	0.004	65.3 ± 7.3	58.9 ± 8.1	0.001
Workplace Violence	49.1 ± 15.7	48.3 ± 14.9	0.857	84.9 ± 8.1	80.4 ± 7.2	0.048	68.3 ± 7.9	60.2 ± 8.7	0.001
TOTAL	49.2 ± 15.6	48.3 ± 13.6	0.832	85.8 ± 8.9	80.1 ± 7.1	0.018	68.3 ± 8.6	60.1 ± 7.7	0.001

*Student's t-test

Table 10. Evaluation of the program outcome from nursing staff point of views

Dimensions	PBL group (n=24)		CLL group (n=24)		P
	Satisfactory	Unsatisfactory	Satisfactory	Unsatisfactory	
	n (%)	n (%)	n (%)	n (%)	
Training method	24 (100.0)	0 (0.0)	18 (75.0)	6 (24)	0.009
Training aids	22 (91.7)	2 (8.3)	18 (75.0)	6 (24)	0.121
Lectures' duration	22 (91.7)	2 (8.3)	19 (79.2)	5 (20.8)	0.220
Meeting trainees' expectations	24 (100.0)	0 (0.0)	19 (79.2)	5 (20.8)	0.018

Maximal Psychological hazards' Risk rating (Table 2) was "Work stress due to Shortage of staff "while minimal was "Work stress due to Conflicts with peers". Stress was the most probable psychological hazard in ICU as noted by McCauley and Irwin (27) who explained situations in which nurses can experience stress by work in which the demands imposed are threatening and not well matched to the knowledge, skills and ability to cope. A variety of studies (28-30) have shown that quantitative work overloads are potent sources of workplace stress. Table 3 described the frequency distribution of the nursing staff as regard general OHS knowledge and training history, and it revealed that almost all (95.0%) of the participants had general knowledge about OHS knowledge mostly from On-job training (68.4%). Most of them (76.7%) had attained previous OHS training and it was satisfactory for (60.9%) of them. The training methods were both lectures and seminars (58.7%) and booklets (41.3%). Nurses' satisfaction with their OHS knowledge was almost fair (61.7%). Ramsay et al. (31) assumed in his study that regular OHS training of nurses can decrease the incidence of ICU hazards by more than 80%, reducing job-related injuries and illnesses.

In Table 4, assessment of the needs of the nurses in order to plan for an effective training program, and it was concluded that psychological hazards were the most needed topic (40.0%), while Biological hazards were the least (5.0%). Most participant nurses agreed that the best time for the training program during the morning shift from 8 am-2 pm (60.0%) and inside the hospital (83.3%). Psychological hazards took the highest priority may be due to feel of the nurses with work related stress, while least scoring for biological hazards may be attributed to continuous infection control training programs at Al-Ahrar Hospital. Morning time was chosen as the

brain still fresh and ready to gain knowledge; in addition training inside the hospital may overcome the barrier of distant place and increase the rate of adherence to the program, also all participants were females who usually avoid foreign places especially due to Egypt's security issues nowadays. The first and the cornerstone step in planning an effective training program is addressing the educational needs of the trainees. Addressing the needs make the program more interesting and enjoyable to the participants in addition it help in designing the program objectives (32).

In the morning the brain is not fatigued and the blood supply to it is plenty thus making it more ready for new knowledge, more ready for critical thinking and the knowledge gained usually persist for a longer time (33). Moreover, when the place of training is familiar to the trainees thus save more time from exploring the place, also it increase attention and prevent distraction occur when the person visit a place for the first time (34).

Adequate prioritization of safety risks during risk assessment is crucial for planning, budgeting, and management of safety related risks (35). In Graph 1, Prioritization of occupational health and safety hazards in ICUs according to risk Assessment and need assessment revealed that psychological hazards had highest prioritization score of 12 according to both risk and need assessments, while Physical hazards had least score of 4. Higher score of psychological hazards may reflect the overall stressful work conditions. Nearly the same as previous studies (36,37) concluded, Stress Management Interventions showed feasibility, acceptability, and potential benefit in reducing emotional exhaustion and stress of nurses. In contrast, it was recommended that most important

occupational hazards which need regular training programs were biological hazards even if infection control knowledge among the nurses was fairly good (38).

The difference in Socio-demographic characteristics among both study groups was shown in (Table 5) that showed insignificant difference as regards age, marital status, education, nurse category, work department and years of experience. Most occupational health educators prefer to use traditional lecturing as a common way method of conveying information to trainees. However, despite lectures being as effective as other methods in presenting information and providing explanations, they have limitations (39). PBL has been widely discussed as an effective learning approach that promotes knowledge acquisition and skills. PBL is a motivating, challenging, and enjoyable learning approach (40).

In Table 6 it was noticed that (45.8%) of PBL group was of unsatisfactory level of knowledge before applying the training program but the majority of them (95.8%) acquired a satisfactory level of knowledge immediately after applying the training program with a highly significant difference ($P<0.01$) and 79.2% during follow up stage with a significant difference. The higher level of knowledge improvement immediately after the program more than the FU period explained by the memory of nurses still fresh and most of the knowledge still clear in their minds. Marked improvement after PBL application was suggested (41) that PBL allows structuring of knowledge for use in clinical contexts.

Wijnia et al. (42) noticed decrease in the level of knowledge in the follow up period in comparison to immediately after the program, so recommended continuous and regular training to maintain satisfactory level of knowledge. However, Neville (43) noticed no difference in the knowledge level after implementing PBL program and explained that by good level of knowledge before program application.

Changes of knowledge after application of training program to the CLL showed that (45.8%) of CLL group was of unsatisfactory level of knowledge before applying the training program but (87.5%) of them acquired a satisfactory level of knowledge immediately after applying the training program with a significant difference and 66.7% during follow up stage but with a non-significant difference. That may be explained by that CLL usually depend on the educator with no active role for the trainee, so it is easy to gain knowledge but not easy to retain. CLL usually does not need any reaction from the trainees that may lower the focus of their attention and subsequently affect the level of gained knowledge (44).

The causes that the knowledge usually not persist for a long time after CLL approach were summarized in three directions (45); a) trainees' focus is set in the wrong direction; in taking notes rather than understanding and absorbing new concepts. b) Too much focus on presentation, little time left for practice. c) A trainer's lecture is generally one-size-fit-all. In contrast, CLL was believed (46) to be a good approach for knowledge gaining because; it gives the instructor the chance to expose students to unpublished or not readily available material, allows the instructor to precisely determine the aims, content, organization, pace and direction of a presentation.

Table 7 illustrates that improvement of knowledge was significantly higher among PBL group than CLL group in post-test in all dimensions mainly in "preventive strategies" while in FU highly significant improvement in most dimensions. The same conclusion was found in previous studies (47-49), as they found knowledge scores of the PBL group were significantly higher than those of the CLL group. In contrast (50,51) insignificant difference was found in the knowledge level between PBL and CLL approaches.

As regards attitude of nurses (Table 8) describe the attitude change after PBL application, it was noticed that (58.3%) of PBL group was of unsatisfactory attitude scale before applying the training program but (87.5%) of them acquired a satisfactory attitude scale immediately after applying the training program with a highly significant difference and (70.8%) during follow up stage with a significant difference. In consistence with these results previous studies (52-54) noticed significant change in participants' attitude after applying PBL and they explained by better environment of learning, self directed learning and interesting contents and methods. However, Hwang and Jang (55) did not notice any change in trainees' attitude before and after PBL implementation. As regard CLL group, (58.3%) of them was of unsatisfactory attitude scale before applying the training program but (75.0%) of them acquired a satisfactory attitude scale immediately after applying the training program with a significant difference and 62.5% during follow up stage with a non-significant difference. Low positive attitude acquired by CLL was explained (56, 57) due to that CLL usually carry less motivation, less interest, usually does not meet their needs and not linked to the practice.

Table 9 described the comparison of changes of nurses' attitude towards psychological hazards of both PBL and CLL groups throughout the training program, improvement of attitude was significantly higher among PBL group than CLL group in post-test in all dimensions mainly in "preventive strategies" while in FU highly significant improvement in both dimensions of "Work stress" and "Sources of work

stress". This finding is in parallel to the previous studies (54,58), that noticed marked positive attitude in PBL group and explained that by PBL make the student more creative, and more interested in self learning. The PBL also has a psychological effect on trainees and trainers: more trainees reported that they found the training environment "more stimulating, more democratic and more humane" than did CLL (59). In contrast to study (60) that noticed no significant difference in attitude change between PBL and CLL groups and they related that to the reason might be that in the PBL method, the students are confronted with case studies, accurate observation, and self-learning for the first time.

Evaluation is critical for program design, improvement, and long-term success. An essential component to improving the health care system will require health care educators to continually gather and analyze information from teaching sites and develop pedagogical solutions to identified problems that result in improved health care education and practice. Implementation of sustainable high quality education is facilitated through systematic integration of evaluation into the learning process (61).

Table 10 Evaluate the program outcome from nursing staff point of views, there was high statistical significant difference between both groups of PBL and CLL in there evaluation of the training method. Also, there was statistical significant difference in their evaluation of "Meeting trainees' expectations". Training method may be more interesting in PBL as it depends upon simulation of the real practice which is more interesting to the trainees. Meeting the trainee's expectations is the ultimate goal of any training program. It means covering their scheduled objective they put before joining the program (62). Meeting the expectations of the trainees starts from assessing their needs and put objectives according to these needs (63). In addition, meeting trainee's expectation means effective educator, effective methods and aids, suitable contents and proper evaluation (61). There was high statistical significant difference between both groups of PBL and CLL in there evaluation of the % to which course met expectation. This was explained (60) by that trainees in the cooperative learning group felt that cooperation helped them learn, it was fun to study and expressed satisfaction but they complained about the amount of time the groups had to work together, difficulties of group work, and noise during the sessions. In contrast, a study (49) found that both PBL and CLL courses were well accepted by trainees according to the satisfactory scores.

Conclusion and recommendations

In this study, there were significant statistical differences between the two training strategies within the two groups. The improvement of

knowledge and attitude was significantly higher among PBL group than CLL group in both post-test and FU test. There was a clear indication that there is a need for changes in the OHS training strategies, without abandoning the traditional methods. In the light of this study, it is recommended to change training strategies to more interactive and collaborative types according to the reception of the trainees at the time. OHS training programs should be tailored according to priority of need assessment of the trainees and risk assessment. Finally, this study should be replicated in different occupational groups, and also in different workplaces to test the utility of the instrument and to generalize the results.

Limitations of the study

Notwithstanding its strengths, the study has some limitations. Some participants refuse to complete participation in the study. The researcher excluded them from the results. Long time was spent to convince the respondents to fill the sheets without any missing data.

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