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Effect of ergonomics training program on nurses' knowledge and safety practice

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Abstract---The significant health risk to the health care personnel is ergonomic related, because of manual handling activities. **Aim:** evaluate the effect of ergonomics training program on nurses' knowledge and safety practices in intensive care unit. Design: A Quasi-experimental design was utilized .sample: A convenient sample of staff nurses working at ICU, their number was (30). Setting: the study was conducted at ICU at general hospital. Study tools: 1- Nurses' ergonomics Knowledge questionnaire: part I - Personal characteristics data. Part II -Nurses' ergonomics Knowledge questionnaire. 2- Nurses' Ergonomics Practices Observational Checklist. Results: A statistically significant differences was found at nurses' ergonomics knowledge scores except for concept, purpose of ergonomics and lifting and moving techniques after program implementation and at different periods of assessment. Also, significant differences with marked improvement at all dimensions of nurses ergonomics safety practice scores was found after program implementation and at different periods of assessment than preprogram. A positive correlation was found between nurses total ergonomics knowledge and their safety practices at three and six months post program implementation, while no correlation was founded pre- program and immediately post program implementation. Conclusions: The training program had positive effects on nurses' ergonomics knowledge and safety practice. Recommendation: Periodic in-services training program for all nurses at hospital to improve knowledge and practices related to ergonomics principles of work place.

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Keywords---ergonomics, nurses' knowledge, safety practice.

Introduction

Occupational safety and health of nurses as a public health issue is considered a multidisciplinary field concerned with the safety, wellbeing, and welfare of people at work (22). Nursing is ranked as one of the top professions with the most incidences of workplace-related injury and illness. (38,39).The significant health risk to the health care personnel is ergonomic related, because of manual handling of patients that necessitates using force to pull, push, or lift them. (21). According to Bureau of Labor Statistics , one third of all cases of sick leave among health care workers are due to musculoskeletal disorders (MSDs) that were significantly more common in people who maintain prolonged awkward posture, those having long work shift, work overtime, those who struggle to keep-up with work pace and those who did not have enough rest time during working hours. (15).

Intensive care units (ICUs) are independent and closed units, where highly skilled nursing staff must be available around-the-clock to provide patients care (29). Because of their complexity, ICU environments are said to present the highest ergonomic risk. Compared to nurses working in other hospital units, those in high-demand patient care environments are more likely to experience work-related musculoskeletal diseases due to their heavier workloads, unfamiliar technologies, and psychological pressures. (4, 19). The prevention and control of MSDs fall within the realm of the applied science of ergonomics, as ergonomics help in creating a workspace that lessen employee exposure to dangers of occupational injuries. Additionally, good workplace designs can lessen overall discomfort and exhaustion caused by physical strain and stress on healthcare workers' bodies. (1). Ergonomics is the science of modification and optimization of the environment, jobs and equipment in a manner that is consistent with human limitations and capabilities (7). The application of ergonomics principles, including consideration of many factors that affect how people react effectively to the environment, this environment may be a work tool or piece of equipment or the spatial surroundings in which work is conducted (9).

Significance of the Study

According to the Bureau of Labour Statistics, nurses are among the 10 major occupations with a high risk of work-related musculoskeletal disease, and nearly 80% of the musculoskeletal injuries among nurses are caused by handling and moving of the patients incorrectly. Additionally, nearly 17% of the nurses leave work due to injuries sustained on the job. (17) In addition, nurses are becoming more morbidly ill as a result of a lack of understanding and practices about basic body mechanics approaches. In addition to lowering the standard of patient care, nurses' illnesses also increase job dissatisfaction and high turnover rates, which lower their productivity and efficiency. (37).

Health members are exposed to occupational hazards as a result of poor safety knowledge, or using medical equipment, failing to follow basic procedure in accomplishing task or management failing to the right safety standards and

resources for workers. (21). Poor health and safety practices cause illness, accidents and financial burden to the organization. Working in unsafe and unhealthy settings has an impact on employee productivity and retention as well as the quality of the services provided. (28). Understanding ergonomic postures can aid in enhancing ergonomic practices and reducing or eliminating workplace musculoskeletal related disorders. (16,36).Educational interventions on worksite have shown that education may improve knowledge, foster more positive attitudes, change ergonomic habits, reduce injuries and illnesses among health care workers, reduce absenteeism and employee turnover, which will ultimately increase productivity and work efficiency, and as well as improve quality of work and employee morale and engagement. (38).

Aim of the study

The current study aims to evaluate the effect of ergonomics training program on nurses' knowledge and safety practices in intensive care unit, through: (1) Assessment of nurses' ergonomics knowledge and safety practices in ICU. (2) Developing and implementing the ergonomics training program. (3) Evaluating the effect of the ergonomics training program on nurses' knowledge and safety practices.

Research hypothesis

H1: The nurses' ergonomics knowledge test scores were higher during the periods of testing after implementation of the program (immediately after implementation, 3 months and 6 months after) than before implementing the program. H2:- The Nurses' ergonomics safety practice scores were higher during the periods of testing after implementation of the program (immediately after implementation 3 months and 6 months after) than before implementing the program.

Methods

Research design

A quasi-experimental research design was utilized in the current study.

Setting

The study was conducted at ICU at the general hospital affiliated to ministry of health, Qena, Egypt

Sample

A convenient sample of staff nurses working at ICU at the general hospital was included in the study sample. Their number was (30), they are both genders with different educational levels, and agreed to participate in the study.

Tools for data collection

Two tools for data collection were used as follows: - 1) Nurses' Ergonomics Knowledge Questionnaire: developed by the researcher based on the review of related literatures (27, 12, 10, 8) to assess nurses' ergonomics knowledge, has two parts as follows: **Part 1**:- Personal characteristics data: - age, gender, level of education, years of experiences ICU and attendance of previous training. **Part 2:-** Nurses' ergonomics knowledge questionnaire: 30 MCQ grouped into 5 subgroups to assess nurses' knowledge of ergonomics concept and purpose (8 questions), principles (7 questions), lifting and moving techniques (6 questions), positioning and transferring techniques (4 questions), and ergonomics principles at work place environment (5 questions). Total score for the knowledge questionnaire was (30 grades), as right answers were awarded (1 grade) and erroneous answers were given (zero). After that, mean and SD were determined. 2) Checklist to examine ICU nurses' ergonomics practices. The researcher created it after reviewing relevant literature (27, 12, 13, 11), has two parts:

Part 1 included 55 practice steps to assess nurses' application of ergonomics principles at manual handling techniques. It was distributed as follows: general principles (21 steps), positioning and transferring (5 steps), lifting and moving (15 steps), pushing and pulling (9 steps), and prolonged standing (5 steps). Part 2 includes 49 elements to examine the use of ergonomics principles at the workplace Space , flooring and doors (12 items) , material storage (6 items),work station (7 items), equipment and facilities (14 items), physical environment (4 items) and Welfare facilities (6 items).Practice steps were either done or not. Each completed step earned a grade, whereas unfinished steps received zero. The overall score of the observational checklist determined for each nurse. After that, mean and SD were determined.

Tools validity and reliability: Content validity was tested by a panel of experts who assessed the relevancy of the items to the content addressed by objectives. Reliability was tested using cronbach's alpha test for internal consistency of the Nurses' Ergonomics Knowledge test and for Nurses' Ergonomics practices observational checklist, the reliability was (0.89 and 0.90) respectively.

Protection of ethical and human rights

The Committee of Scientific Research Ethics of Cairo-Faculty University of Nursing approval number is RHDIRB2019041701.

Procedure

From August 2020 through April 2021, data is collected. Phases of the study: Preparation, implementation, evaluation, follow-up. 1-Preparation: Reviewed relevant literature to design data collecting instruments. The researcher disclosed the study's purpose, nature, and importance to participants in writing to get their consent. The researcher translated an ergonomics exam into Arabic for nurses. This instrument was then given to nurses to complete in the researcher's presence to evaluate their ergonomics knowledge and highlight learning gaps. The researcher assessed nurses' ergonomics practice using the observational checklist. Every nurse was watched three times utilizing intermittent observations. Each nurse spent 30 to 40 minutes answering the ergonomics

knowledge questioner, while the researcher spent 45 minutes observing the nurses' ergonomics practice in August 2020. 2- Implementation: Nurses' schedules were coordinated with unit activities to guarantee their presence and not disrupt work. The training program began in September 2020; each 2-hour session was held twice a week and repeated as needed.

The first five teaching sessions comprised a pre-test of knowledge and theoretical part of ergonomics, musculoskeletal problems (concept and prevention), body mechanics, and manual handling methods. The remaining two sessions included practical parts of ergonomics principles, and a posttest. The theoretical component was taught by lecture and small group discussions, and the practical part through demonstration and re-demonstration. 3-Evaluation Phase: After program training sessions, the knowledge questioner and ergonomics practice observational checklist were filled out again immediately in October 2020. 4-Follow-up Phase: After three and six months of program implementation, staff nurses' knowledge and safety practice were examined to measure program validity in January and April 2021.

Results

Table 1
Distribution of nursing staff according to personal characteristics. (N= 30)

Personal characteristics	No.	%
Gender		
Male	9	30.0
Female	21	70.0
Age		
20 < 30 years	24	80.0
30 < 40 years	6	20.0
Level of education		
Nursing diploma	7	23.3
Associate degree of nursing	14	46.7
Bachelor of nursing	9	30.0
Years of experience in ICU		
Less than 5 years	22	73.3
5 < 10 years	8	26.7
Shift		
Morning	4	13.3
Afternoon	6	20.0
Night	8	26.7
Long day	12	40.0
Attending previous educational program about Ergonomics		
Yes	2	6.7
No	28	93.3
Having a work related complaint		
Yes	27	90.0
No	3	10.0

Pain Location		
None	3	10.0
Back	11	36.7
Legs	2	6.7
Back and leg	8	26.7
Back and shoulders	6	20.0
The pain have prevented nurses to do their normal activities		
Yes	24	80.0
No	6	20.0
Nurses needed to consult a doctor or physiotherapist due to the pain		
Yes	18	60.0
No	12	40.0
Personal characteristics	No.	%
Nurses have the intention to change or leave their job		
Yes	19	63.3
No	11	36.7
Nurses need time off work due to the pain or discomfort		
Yes	24	80.0
No	6	20.0

According to Table 1, 70% of participants were female and 80% were between (20 - 30 years.). 46.7% of participants had an associate degree in nursing, whereas 30% had a bachelor's. 73.3% had less than 5 years of experience, while 26.7% had 5-10 years. 40% of participants worked lengthy shifts. Most participants (93.3%) haven't taken an ergonomics course. Most of the participants (90.0%) had work-related complaints, and the highest percentage was for back pain (36.7%). Most of them (80%) their pain prevented them from doing normal activities, (60%) had consulted a doctor or physiotherapist due to their pain at pretest, (63.3%) have the intention to change or leave their job, and the highest percentage of them (80%) need time off work due to the pain.

Table 2
Mean differences between ergonomics knowledge test scores of nursing staff during different periods of assessment (Pre, immediately post program, three and six months later). (N= 30)

Ergonomics knowledge dimensions	Pre Program		Immediately Post program		Three months later		Six months later		F-value	p-value
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD			
Concept and purpose of ergonomics	19.76	3.31	20.50	2.50	20.96	2.37	20.53	2.92	0.94	0.421
General principles of	17.76	2.31	16.13	1.79	15.90	2.00	15.66	2.21	6.21	0.001**

ergonomics										
Lifting and Moving techniques	5.20	1.39	4.83	0.64	4.76	0.72	4.70	0.79	1.69	0.173
Positioning and transferring techniques	10.13	1.69	8.03	1.65	8.03	1.79	7.93	1.83	11.23	0.001**
Ergonomics principles at workplace environment	9.66	1.82	7.96	1.86	8.46	1.77	8.40	1.86	4.73	0.004**
Total (Mean ± SD)	12.90	4.58	22.43	5.61	21.36	7.93	20.46	7.58	21.05	0.001**

*significant at P ≤ 0.05
**Significant at P ≤ 0.001

Table (2) showed highly statistically significant differences in nursing staff knowledge test scores immediately post programme, three months and six months post programme compared to preprogram regarding general principles of ergonomics, positioning and transferring techniques, and total scores (p .001). Statistically significant variations in nursing staff knowledge test results relating ergonomics and lifting and moving procedures were not found.

Table 3
Comparison of the mean scores of ergonomics safety practices of nursing staff during different periods of assessment (Pre, immediately post program, three and six months later). (N= 30)

Dimensions of ergonomics safety practice	Pre Program		Immediately Post program		Three months later		Six months later		F-value	p-value
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD			
Ergonomics principles for manual handling techniques	4.86	3.47	14.06	3.26	12.56	5.34	12.06	5.78	37.11	0.001**
Ergonomics principles at work place environment	2.56	.56	3.60	.62	3.13	1.16	3.03	1.29	7.28	0.001**
Total ergonomics safety practice	19.70	7.77	43.66	7.05	38.93	14.89	37.46	16.46	33.79	0.001**

*significant at P ≤ 0.05
**Significant at P ≤ 0.001

Table (3) showed that there were highly statistical significant differences in mean scores of all dimensions of ergonomics safety practice during different periods of assessment immediately post program, three and six months later compared to preprogram, which was reflected on the total score respectively (19.70±7.77, 43.66±7.05, 38.93±14.89, 37.46±16.46),(F= 33.79, p= 0.001).

Table 4

Comparison of the mean scores of nursing staff ergonomics safety practice regarding total principles of manual handling techniques during different periods of assessment (Pre, immediately post program, three and six months later) (N= 30)

Total principles for manual handling techniques dimensions	Pre Program		Immediately Post program		Three months later		Six months later		F-value	p-value
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD			
General principles	4.86	3.47	14.06	3.26	12.56	5.34	12.06	5.78	37.11	0.001**
Positioning and repositioning	2.56	0.56	3.60	.62	3.13	1.16	3.03	1.29	7.28	0.001**
Lifting / Moving	4.53	2.31	12.06	1.77	10.70	3.99	10.26	4.41	42.70	0.001**
Pushing and pulling	3.36	1.80	7.36	1.37	6.60	2.62	6.36	2.88	23.87	0.001**
Prolonged Standing	4.36	1.06	6.56	1.00	5.93	2.19	5.73	2.44	27.00	0.001**
Total	19.70	7.77	43.66	7.05	38.93	14.89	37.46	16.46	33.79	0.000**

*significant at P ≤ 0.05
**Significant at P ≤ 0.001

Table (4) shows statistically significant differences in mean scores of all dimensions of manual handling techniques immediately post program, three and six months post program compared to preprogram (19.707.77, 43.667.05, 38.9314.89, 37.4616.46), (F= 33.79, p= 0.001).

Table 5
Comparison of the mean scores of nursing staff ergonomics practice regarding total principles of work place environment during different periods of assessment (Pre, immediately post program, three and six months later) (N= 30)

Total principles for work place environment dimensions	Pre Program		Immediately Post program		Three months later		Six months later		F-value	p-value
	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD			
Space , flooring and doors	4.96	1.56	10.00	.78	8.90	3.10	8.56	3.49	33.08	0.001**
Material Storage	0.00	0.00	5.03	1.29	4.63	2.00	4.43	2.16	128.85	0.001**
Work stations and chairs	1.96	2.38	5.06	2.01	4.46	2.50	4.30	2.62	27.00	0.001**
Equipment and facilities	7.06	2.93	12.56	3.31	11.23	5.03	10.76	5.40	15.31	0.001**
Physical environment	3.30	.46	3.90	.30	3.50	1.22	3.36	1.37	3.55	0.018**
Welfare facilities	3.00	1.57	4.90	.99	4.43	1.77	4.23	1.92	12.20	0.001**
Total	20.46	6.80	41.46	7.35	37.16	14.58	35.66	15.99	31.71	0.001**

*significant at P ≤ 0.05

**Significant at P ≤ 0.001

Table (5) shows statistically significant differences in mean scores of all dimensions of principles of work place environment immediately post programme, three and six months post programme compared to preprogram, as reflected in the total mean scores (20.466.80, 41.467.35, 37.1614.58, 35.6615.99), (F= 31.71, p= 0.001).

Table 6
Correlation between nursing staff total ergonomics knowledge and safety practice after ergonomics training program implementation (Immediately post program, three and six months later) (N= 30)

Staff nurses ergonomics knowledge	Staff nurse safety practices	
	R	P-value
Pre – program	0.22	0.2
Immediately post program	0.11	0.5
Three months post program	0.59	0.001**
Six months post program	0.51	0.004**

* Significant at the 0.05 level
** Significant at the 0.01 level

Table (6) indicated a statistically significant positive correlation between nursing staff ergonomics knowledge and safety behaviors three and six months post program implementation (p = 0.001, 0.004), but not pre- and immediately after program implementation.

Discussion

The nursing profession presents numerous ergonomic hazards to nurses, which have negative effects on both their health and the quality of care they provide. Ergonomic interventions that attempted to enhance the workplace design proved to be economically efficient. However, nurses could be reluctant to implement ergonomic modifications in the workplace, Thus, educating people about ergonomics is essential to persuading them.(3) The aim of the study was to evaluate effect of ergonomics training program on nurses' ergonomics knowledge and safety practice in intensive care unit.

Regarding personal characteristics of the studied nurses

Most of the study participants were female, and their ages were between 20 and 30 years old, while the minority of the total subject was 30 to 40 years old. These findings clarify that the nurses' age is young, and this age is a productive age, that indicates they highly need training to continue the productivity of their work and avoid MSD symptoms. This finding was consistent with Abo El Ata et al. (5) who found that most nurses at Cairo University Hospitals were female and under 30 years old. Bernal et al. (14) found that majority of their research participants were women, and MSD is more frequent in women than males. Dhahir and Al Mayahi (20) stated that majority of the sample was under 30 years old. Opposing

to that, Mohammad, Abbas, & Narges (30) evaluated the association between ergonomics knowledge and musculoskeletal disorders. They discovered that most nurses were in the 36–40 age range and that musculoskeletal diseases were greater among older nurses with more job experience.

Most of the studied nurses have an associated degree of nursing, and the majority of them had less than five years of experience, matching Bolbol,et al. (16), who reported that (more than 50%) of his subjects were nursing school graduates in implementing an ergonomic intervention program among Al-Azhar hospital ICU nurses. Saad,& Ebraheem (35) discovered that more than half (62.5%) of participants had technical nursing education, and the longest work experience years attained was 1–5 (53%). Most nurses worked 12-hour shifts. These data may explain how work-related complaints might be caused by cumulative negative effects on the body. Abd El-Rasol & Rahman (2) supported this finding. Above two thirds of nurses (68%) worked 8 to 12 hours/day, and work length had a substantial influence on job-related musculoskeletal illnesses. Zayed, et al. (39) agreed with our findings, finding that almost half of nurses with WRMSD symptoms (48.5%) worked long hours.

Most research participants didn't attend ergonomics training, according to the data. From the researcher's perspective, this may be because ergonomics is a new course at the organization and not in the nursing department's yearly training schedule. This may explain why nurses' knowledge and practices were lacking, exposing them to work dangers and accidents. This conclusion agreed with Abd Rabou, & Akel (3), who said most nurses (80.2%) did not attend training program in investigating workplace ergonomics training intervention and its influence on nursing interns' work life. Ali & Abdel-Hakeim (9) studied the influence of an ergonomics program on nurses' knowledge and practice in the operating room. They found that 80% of nurses haven't had ergonomics training, and that it's a high-need to increase their efficiency.

Two-thirds of the nursing staff had low back discomfort that stopped them from conducting everyday duties, and more than half saw a physiotherapist or doctor owing to the pain. This may be because back pain, the most common work-related musculoskeletal disorder (MSD), is associated with locally stressful physical activities found mainly in ICUs, due to the increased manual handling of critical patients within a short period of time. Heavier manual tasks may be referred to younger nurses, and a shortage of male nurses in this working unit may force them to do more physical work. El Far (21) reported that 81% of employees had persistent lower back discomfort in the past year. These effects may be due to difficult bending/twisting, standing extended periods while serving several patients, lack of back support when seated, and insufficient rest time. Mohammad, Abbas, & Narges (30) observed that low back discomfort, neck, shoulder issues, arm injuries, wrist, and knee are the most prevalent nursing injuries.
Mot and Vinodhini (32), in determining the effectiveness of ergonomic training on work-related musculoskeletal disorders and body posture among hospital nurses, found that 83.4% of the population had WRMSD in at least one body segment, with 60% of the population suffering from low back pain and 10% from neck pain. In contrast Elsherbeny et al. reported the lowest incidence in the low back (24).

These disparities may be due to nurses' various jobs, procedures, and activities in the research hospitals.
Most of the study participants were absent from work and have the intention to change or leave job because of the pain they suffered from. Zayed, et al. (39) indicated that WRMSD symptoms may affect increased nurse absenteeism by (51.4 percent). Bolbol et al. (16) found that Al-Azhar hospital critical care unit nurses reported low back pain as the most prevalent reason for restricting and limiting daily tasks, receiving medical treatment, experiencing discomfort, taking many days off, and considering a career change. 72.5 percent of participants missed work or changed jobs due of low back discomfort, according to Ibrahim & Elsaay (26). Carneiro, Braga, and Barroso (18) showed that most nurses were not prevented from doing their normal work despite a high prevalence of musculoskeletal disorders complaints. The value of absenteeism is not higher because nurses (due to their own education and self-knowledge) often self-medicate WRMSDs symptoms.

As regards to nurses' ergonomics knowledge

The present study found highly statistically significant differences and marked improvement in nursing staff ergonomics knowledge regarding general ergonomics principles, positioning and transferring techniques, ergonomics principles at work, and total ergonomics knowledge during different assessment periods. No statistically significant variations were seen in nurses' knowledge test results related ergonomics and lifting and moving procedures across evaluation periods. According to the study, this considerable gain in nurses' knowledge showed enhancement owing to applied training and updating information via active learning throughout program implementation, employing group discussion, brainstorming, and group activities. Abd Rabou, & Akel (3) found that nurse knowledge and practice related to workplace ergonomics increased in the post-intervention and follow-up phases of assessing the influence of ergonomics training on nurses' work life quality. Ali & Abdel-Hakeim (9) found a statistically significant increase in nurses' ergonomics knowledge and practice related patient handling, lifting, and moving objects before and after intervention. The preceding finding is consistent with Prapti, Nurhesti, & Tirtayasa (23) who found a substantial influence of ergonomic programme on student's knowledge, attitude, and conduct connected to ergonomic standard in executing nursing interventions.

As regards to nurses' ergonomics practices

The research found statistically significant improvements in all variables of ergonomics safety practice immediately, three, and six months after program implementation compared to previously. According to the researcher, this improvement in different dimensions of ergonomics safety practice may be due to exposure to educational content and activities that highlighted the principles of different dimensions of ergonomics safety practice and its application. The present research agreed with Abd Rabou &Akel (3) who found an improvement in nurses' ergonomics practices during post-intervention and follow-up phases compared to the pre-intervention phase while examining the influence of ergonomics training on nursing work life quality. Also, the prior conclusion

concurred with Ali & Abdel-Hakeim (9) in implementing an ergonomic program to nurses, confirming a difference between pre- and post-intervention practice.

Abd El-Rasol& Rahman (2) found that body mechanics and ergonomics practices (particularly patient handling duties) were significantly different before, after, and three months after program implementation. This research contradicts Mossburg et al (31) A comprehensive study of occupational risks among healthcare professionals in Africa found that they didn't follow safety protocols since they weren't beneficial. Noncompliance with safety procedures was commonly attributed to attitude; others cited discomfort. 6–14% of respondents cited time as a reason for noncompliance.

A highly statistical significant differences were found at all dimensions of principles of manual handling techniques and work place environment immediately post program , three months and six months post program relative to preprogram. This conclusion was comparable to Eldomiaty, Shazly, & EL-Sayed (22), who found in their research on Menouf Fevers Hospital nurses that manual material handling had the best ergonomic adequacy. Hemed et al. (25) found a substantial increase in nurses' knowledge and practice of manual handling procedures due to an educational program that emphasized proper lifting and handling techniques and practical training to avoid aggravating job activities such as extended sitting and standing.

Also, Ali & Abdel-Hakeim (9) found statistically significant differences between mean scores of nurses' performance in both groups regarding prolonged standing, pushing, pulling, and moving objects on wheels. However, there were no statistically significant differences regarding patient positioning and repositioning.

A statistical significant positive correlation was found between nurses' ergonomics knowledge and their safety practices at three and six months post program implementation, while no statistical correlation was found at preprogram and immediately post program. Ramadan, Mahfouz, & Taha (34), in studying correlation coefficient between nurses' knowledge and practice toward safety measures throughout study phases, stated a statistically significant positive correlation between nurses' knowledge and practice. Elewa and El-Banan, (23), demonstrated a statistical significant relation between total nurses' knowledge scores about ergonomic hazards and their scores towards safety measures. Conversely, Adje,etal.(6) found no significant association between knowledge and practice of ergonomic principles among study participants.

Conflict of Interest: No conflict of interest

Conclusion

The results of this study concluded that the implementation of the ergonomics training program had positive effect on improving nurses' knowledge related to (general ergonomics principles, positioning and transferring techniques, ergonomics principles at workplace environment), and on all dimensions of nurses' practice related to ergonomics.

Recommendations

Based on study findings, it was recommended to:

- Conducting periodic in-services training program for all nurses at hospital to improve knowledge and practices related to ergonomics principles of work place.
- Involvement of ergonomics training program at orientation program for all newly hired staff.
- Incorporate ergonomics as a science in nursing curriculum at the faculties of nursing.
- Generalization of research findings is needed on a broader scale of nurses on different hospital departments.

References

1. A.El-Ghany G M , Mahmoud S F. Effect of educational intervention about first aid and ergonomics on improving bakery workers' performance related to occupational hazards at Zagazig City. Egyptian Nursing Journal. .2019 October 18; 16:10–24.
2. Abd El-Rasol Z M , Rahman R M .Effect of implementing body mechanics and ergonomics training program on nurses' low back pain and quality of nursing work life. Journal of Nursing and Health Science, 2018; 7(3), 20-35 Available at www.iosrjournals.org.
3. Abd Rabou H M, Akel D T. Workplace ergonomics training intervention and its effect on quality of nursing work life among nurse interns. Clinical Nursing Studies).2020; 8, (3), 34–44.
4. Abdallah S A , Shabaan F M , Ghadery S H , Shokier M E. Effect of Management Program on Nursing Staff Leading Role and Compliance to Follow Safety Measures at Intensive Care Units. Tanta Scientific Nursing Journal.2019; 17(2), 8-32.
5. Abo El Ata G, Khalifa E , El Desouky S , Sabry D, & Manawil M. Occupational Risk Factors for Musculoskeletal Disorders among Operation Room Nurses at Cairo University Hospitals. BJMMR.2016; 14 (9): 1–11.
6. Adje M , Odebiyi D O, Okafor U A, Kalu M E. Ergonomic principles in patient handling: Knowledge and practice of physiotherapists in Nigeria. Work .2019; 64(4), 825-832.
7. Afshari A , Khalili A, Dehghani M, Beiramijam M, Lotf M, Noodeh F, Oshvandi K. Comparing the frequency of occupational injuries among medical emergency staff and nurses of intensive care units in Hamadan. Annals of Tropical Medicine and Public Health. 2017; 10(3).
8. Akhtar S , Afzal M , Kousar R, Waqas A , Amir S G. Assess knowledge and practices of body mechanic technique among nurses at Punjab institute of cardiology Lahore. Saudi J. Med. Pharm. Sci. 2017 June; 3(6),A:545-555
9. Ali H, Abdel-Hakeim E . The Effect of Ergonomics Program on Nurses' Knowledge and Practice in Operating Room, IOSR Journal of Nursing and Health Science (IOSR-JNHS).2018; 7(1): 6-15. Available from: www.iosrjournals.org

10. Aly A. Occupation hazards facing staff nurses: An intervention study. Thesis submitted in partial fulfillment of the requirement of Doctorate degree in nursing administration.2014; The Military Medical Academy, Cairo.
11. Andrew S I. Ergonomic Checkpoints in Health Care Work.International Ergonomics Association.IEA Press. 2017 June; ISBN 978-0-9976041-1-5
12. AORN .Guidelines for safe patient handling in the preoperative setting, pocket references guide.2007; available at: http://www.wrha.mb.ca/professionals/safety/files/SafePatientHandling/AORNGuidanceStatement.pdf
13. Audrey L , Motacki K ,&Nivison N . The Illustrated Guide to Safe Patient Handling and Movement. 2009; Springer Publishing Company, LLC.
14. Bernal D, Campos-Serna J, Tobias A , Vargas-Prada S, Benavides F G, Serra C. Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides: a systematic review and meta-analysis. International journal of nursing studies, 2015; 52(2), 635–648. https://doi.org/10.1016/j.ijnurstu.2014.11.003
15. BLS (Bureau of Labor Statistics). Occupational Injuries And Illnesses Among Registered Nurses. 2018 November. Available At ;- https://www.bls.gov/opub/mlr/2018/article/occupational-injuries-and-illnesses-among-registered-nurses.htm
16. Bolbol SA,El- Shafie DA, Abdelsalam AE, Abdelsalam NM, Alian SM.Work – related musculoskeletal disorders: an ergonomic intervention program among Al-Azhar hospital intensive care units nurses, ejom.2017; 41 (3): 429–446.
17. Bureau of Labor Statistics (BLS), U.S. Department of Labor. Nonfatal occupational injuries and illnesses by case circumstances and worker characteristics.Injuries, Illnesses, and Fatalities.2017. Available at: http://www.bls.gov/iif/oshcase1.htm.
18. Carneiro P, Braga A C, & Barroso M. Work-related musculoskeletal disorders in home care nurses: Study of the main risk factors. International Journal of Industrial Ergonomics.2017; 61, 22-28.
19. Chhabra S. Health hazards among health care personnel. Journal of Mahatma Gandhi Institute of Medical Science.2016; 21(1): 10-24.
20. Dhahir DM, & Mayahi NY. Assessment of Health Workers Knowledge toward Occupational Health and Safety Program in Alkut City's Primary Health Care Centers. Medico-Legal Update.2021; 21, 1536-1541.
21. El Far H, Albitar E, Araby E, Nabil N, Hassan O. (2020).Patterns of Work-related Musculoskeletal Disorders among Health Care Workers. The Egyptian Journal of Hospital Medicine.2020; 81(7), 2325-2334.
22. Eldomiaty R , Shazly M, EL-Sayed S. Ergonomics and work-related stress among staff nurses, Egyptian Journal of Health Care.2019; 10 (2), 179-189.
23. Elewa A, El-Banan S.Occupational hazards as perceived by nursing

interns and protective measures, IOSR Journal of Nursing and Health Science (IOSR-JNHS) .2016;5(6), Pp: 107-118
24. Elsherbeny E, Elhadidy S, El-Masry R, El-Bahnasawy A. Prevalence and associated factors of musculoskeletal complaints among nurses of Mansoura University children hospital. Egyptian Journal of Occupational Medicine.2018; 42 (2): 151– 166. 3.
25. Hemed A , Taha N M , Abd-Elwahab H , Mohamed E H (2017). Effect of Educational Program on Nurses' Performance Regarding Body Mechanics. Zagazig Nursing Journal.2017; 13(2), 21-37.
26. Ibrahim R, Elsaay O. The effect of body mechanics training program for intensive care nurses in reducing low back pain. IOSR Journal of Nursing and Health Science.2015; 4(5), 81-96.
27. Johnsson C, kjellberg K, kjellberg A, Lagerstrom M. A direct observation instrument for assessment of nurses' patient technique, (DINO), applied ergonomics.2004; pp.43-47
28. Kumar S P. Profession Induced Health Hazards Of Health Workers In Medical Profession: A Sociological Study Of Nurses Working In Private Hospital Of India. Int. J. of Adv. Res. .2018; 1087-1092] (ISSN 2320-5407). DOI URL: http://dx.doi.org/10.21474/IJAR01/7774
29. Mahmoudifar Y, Seyedamini B. Ergonomic relationship during work in nursing staff of intensive care unit with operating room. International Archives of Health Sciences.2017; 4(2), 42. Available from: http:// www.i ahs.ka ums.ac .ir/text.asp?2017/4/2/42/216137.
30. Mohammad A ,Abbas B , Narges H. Relationship between knowledge of ergonomics and workplace condition with musculoskeletal disorders among nurses. International Archives of Health Sciences, Published by Wolters Kluwer - Medknow. 2019; 6(3), 121- 126.
31. Mossburg S, Agore A, Nkimbeng M , Commodore-Mensah Y. Occupational Hazards among Healthcare Workers in Africa: A Systematic Review. Annals of global health.2019; 85(1), 78. https://doi.org/10.5334/aogh.2434
32. Mot S K, Vinodhini C. A Study to Determine the Effectiveness of Ergonomic Training on Body Posture and Musculoskeletal Disorder in Hospital Nurses. International Journal of Pharmaceutical and Clinical Research.2017; 9(07), 498-504.
33. Prapti N K , Nurhesti P O, Tirtayasa K. Ergonomic Program and Nursing Intervention In Nursing Students. Journal of a Sustainable Global South.2020; 4(1), 17.
34. Ramadan E N , Mahfouz H H, Taha A S. Safety Measures Program for Prevention of Occupational Hazards among New Graduate Bachelor Nurses. IOSR Journal of Nursing and Health Science (IOSR-JNHS) .2018; Volume 7, Issue 4 Ver. XI, PP 98-111
35. Saad E, Ebraheem S. Ergonomics as Perceived by Staff Nurses and Its Relation to Their Job Satisfaction. Evidence-Based Nursing Research.2019; 1(4),97-108
36. Sanaeinasab H , Saffari M , Valipour F, et al. The effectiveness of a model-based health education intervention to improve ergonomic posture in office computer workers: a randomized controlled trial. Int Arch Occup Environ Health.2018; 91, 951–962. https://doi.org/10.1007/s00420-018-1336-1

37. Soylar P , Ozer A . Evaluation of the prevalence of musculoskeletal disorders in nurses: A systematic review. Medicine Science International Medical Journal .2018; 06- 8747.
38. Yang S, Li L, Wang L, Zeng J, Yan B, Li Y. Effectiveness of a multidimensional intervention program in improving occupational musculoskeletal disorders among intensive care unit nurses: a cluster-controlled trial with follow-up at 3 and 6 months. BMC nursing.2021; 20(1), 1-14. https://doi.org/10.1186/s12912-021-00561-y
39. Zayed H A, Saied S M, El-sallamy R M , Shehata W M. Work-related musculoskeletal disorders among nursing staff of Tanta University Hospitals: pattern, risk factors, and coping strategies. The Egyptian Journal of Community Medicine.2019; 37(4), 51-61.