Effect of Preventive Bundle Care on Nurses' Knowledge, Compliance and Patients' Outcome Regarding Pressure Ulcer in the Intensive Care Unit

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ABSTRACT

Contents: The critical care services had the highest pressure-ulcer rates. Bundle care incorporates those best practices that, if done in combination, are likely to lead to better outcomes.
Aim: Evaluate the effect of preventive bundle care on nurses' knowledge, compliance, and patients' outcome regarding pressure ulcers in the intensive care unit.
Methods: Quasi-experimental design used to achieve aim in this study. The study conducted at the intensive care unit at Benha Teaching Hospital. All available nurses (30) and a purposive sample of adult patients (85) recruited in this study. Three tools used; interview questionnaire sheet for nurses to assess nurses' knowledge regarding pressure ulcer prevention, the pressure-ulcer prevention bundle compliance checklist which used for assessing nurses' compliance and patients' assessment record.
Results: The study revealed that (36.7%) of nurses were in the age category (20-<25 years old), (90%) female**s,** and (46.7%) had an experience of more than seven years. Regarding total nurses' knowledge level and compliance pre/post intervention, there was a highly statistically significant difference (p=0.000). Concerning patients' outcomes, there are statistically significant differences between the control and study groups observed at (P<0.05).
Conclusion: there was a statistically significant improvement in nurses' knowledge and their compliance after implementing bundle care. Also, there were statistically significant improvements in patients' risk, including reducing the incidence of risk of pressure ulcers in the study group than patients in the control group. The study recommends preventive pressure ulcer bundle guidelines should be revised and be available in adult intensive care units in both Arabic and English language. Also, it is essential to provide continuous education and training sessions for nurses about pressure ulcer prevention by applying preventive bundle guidelines to improve their compliance.

Keywords: pressure ulcer, preventive bundle care, critical care, patient's outcome.

1. Introduction

Pressure injuries (formerly called pressure ulcers) are localized areas of damage to the skin, underlying tissue, or both, as a result of pressure. Hospital-acquired pressure injuries occur in 3% to 34% of hospitalized patients worldwide and result in more extended hospital stays, increased morbidity, and increased human suffering. Critical care patients represent a highly specialized patient population, and risk for pressure injuries in this population is likely to be different from the risk in other populations, particularly as it relates to perfusion and general skin status due to severity of illness and treatments *(Alderden, Rondinelli, Pepper, Cummins, & Whitney, 2018).*

The prevalence rates of pressure ulcers (PUs) worldwide continue to be reported at significant rates, with *Dealey, Posnett, & Walker, (2012); Moore, Johanssen, & van Etten, (2013***)** reported rates from 8.9– 25%. These prevalence rates indicate that PUs remains a real issue in healthcare organizations, with the associated negative effect on health and wellbeing *(Fiona, 2014).* The incidence rates of pressure ulcers vary significantly with health care settings. The National Pressure Ulcer Advisory Panel (NPUAP) stated the incidence ranges from 0.4 percent to 38 percent in hospitals, from 2.2 percent to 23.9 percent in skilled nursing facilities, and from 0 percent to 17 percent for home health agencies. There is ample evidence that the majority of pressure ulcers occur relatively early in the admissions process. For patients in the hospital, they can occur within the first two weeks *(Lyder & Ayello, 2008).*

Pressure ulcers have been labeled as one of the most expensive and physically debilitating complications in the 20thcentury after cancer and heart diseases. Pressure ulcers are the third most expensive disorder There are several factors in the intensive care unit (ICU) patients that increase the risk of PU. These patients have respiratory equipment, urinary catheter, several intravenous catheters, restricting devices, and infusion of vasoactive drugs due to reduced blood pressure. All of these make the patient unable to move and increases the risk of PU. Therefore, all nurses

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must be aware of standards guidelines to prevent any complication associated with PU to promote patient safety and better outcomes. The patient suffers from pain and discomfort because of PU and also cause prolonged illness, delay rehabilitation, increase patient's hospital stay, and may lead to disability and even death *(Dilie & Mengistu, 2015).*

Despite advances in technology and preventive equipment, unfortunately, the incidence of pressure ulcers in patients admitted to intensive care units has not diminished, and the incidence of pressure ulcers remains a significant problem in all healthcare systems. Several studies *Taha, (2014); Hashad & Hassan, (2018); El-Sayed, Mohamed, Mohamed, & El-Sonbaty, (2003)* had shown that nurses' lack of knowledge and skills can affect the performance and success of the pressure ulcers preventive interventions and might be associated with an increase in the prevalence of pressure ulcers.

Prevention of pressure ulcers is a priority in nursing care and considered a vital indicator of the quality of nursing care. The nursing staffs are primarily responsible for the patient's skincare and the preventive measures of pressure ulcers *(Sardari1, Esmaeili, Ravesh & Nasiri, 2019).*

Care bundles contain three to five evidence-based practices, which need to be delivered collectively and consistently to improve patient outcomes. Care bundles have used within healthcare organizations for many different conditions (e.g., to prevent ventilator-associated pneumonia and PUs). The benefits of evidence-based practice interventions cannot be maximized without consideration of compliance with intervention guidelines *(Lavallée, Gray, Dumville, Russell, & Cullum, 2017).* Thus, the next challenge is to address the compliance of intervention implementation in the hospital setting. Implementation, evaluating, and testing the effectiveness of PU prevention strategies to reduce PU incidence in clinical settings, particularly in the ICU, can pose challenges to researchers, as effective implementation, while required, can be challenging to attain *(Tayyib, Coyer, & Lewis, 2016).*

A care bundle approach has been frequently used in clinical practice, as it provides improvement in the delivery of evidence-based care and results in patient outcomes *(Horner & Bellamy, 2012)*. Several studies reported the effect of care bundle on patients' outcome *Baldelli, & Paciella, (2008)* conducted study about creation and implementation of a pressure ulcer prevention bundle improves patient outcomes, and found that the implementation of a pressure ulcer prevention bundle has decreased prevalence and incidence rates of pressure ulcer and improved the quality of patient care. Also, *Tayyib, Coyer, & Lewis, (2015)* concluded in their study that significant improvements observed in PU-related outcomes with the implementation of the PU prevention bundle in the ICU. PU incidence, severity, and the total number of PUs per patient reduced.

2. Significance of the Study

World's stop pressure ulcer day showed that nearly 700,000 patients were affected by pressure ulcers each year. Around 186,617 patients developed a new pressure ulcer in acute care settings each year. This trend has shown from January 2012 to December 2013 between 4 and 6% of patients in acute care settings and more than 5–10% of patients in non-acute care had pressure ulcers. . Pressure ulcers are accountable for 2% of preventable deaths *(Dilie & Mengistu, 2015).*

In Egypt, statistics of incidence or prevalence rate of pressure ulcers among immobilized patients lack because of the fear of legal accountability, and it is considered an indicator for knowledge and practice defect of nurses toward prevention and management of pressure ulcers. So only one study in 2009 according to statistics record at a health insurance organization in Alexandria, indicate that pressure ulcer ranged from 40% to 50%. Regarding the lack of nurses' knowledge and practice, the complication of PU was ranged from 20% to 30% in each department *(El Enein & Zaghloul, 2011).*

The rise and popularity of care bundles in healthcare today is playing an essential role in attaining consistent patient care with the associated reduction/elimination of adverse patient outcomes. The main objective of this study was to implement a PU prevention care bundle to improve nurses' performance in the critical care unit for all critically ill patients and to decrease the risks of hospital-acquired rates.

3. Aim of the study

The present study aimed to evaluate the effect of preventive bundle care on nurses' knowledge, compliance, and patients' outcome regarding pressure ulcer in the intensive care unit through**:**

- Assessing nurses' knowledge regarding preventive bundle care towards pressure ulcer**.**
- Assessing nurses' compliance with preventive bundle care towards pressure ulcer.
- Designing and implementing preventive bundle care for nurses who provide care to critically ill patients.
- Evaluating the effect of preventive bundle care on nurses' knowledge, compliance, and the degree of risk for hospital-acquired pressure injury of critically ill patients.

3.1. Research hypotheses

H1. Nurses who exposed to preventive bundle care will have better knowledge compared to their pre-intervention level.

H2. Nurses who exposed to preventive bundle care will have better compliance compared to their pre-intervention level.

H3. A statistically significant positive correlation will be revealed between nurses' knowledge and compliance after the implementation of preventive bundle care.

H4. Patients who are cared for by the preventive bundle care will exhibit better outcomes compared to controls.

3.2. Operational definition

Patient Outcomes

The patient outcome in this study means a risk level reduction as a result of intervention by pressure ulcer preventive bundle.

4. Subjects & Methods

4.1. Research design

A quasi-experimental research design utilized to conduct the aim of this study.

4.2. Research setting

This study conducted at an intensive care unit (ICU) at Benha Teaching Hospital. The ICU located on the fourth floor and consists of two big rooms; each room contains eight beds, which equipped with an electrical air mattress and a mechanical ventilator.

4.3. Subjects

Two groups of subjects included in the study:

- All available nurses (30) who have been working in the setting mentioned above and agree to participate in the study.
- A convenient sample of adult patients from both gender who admitted to the intensive care unit through six months with the following inclusion criteria, their age ranged between 18 ≥ 60 years old and have free from a pressure ulcer on admission (n=85). They divided into (45) patients (control group) pre-program who received care according to a hospital routine and (40) patients (study group) post-program who received preventive bundle care

4.4. Tools of the study

4.4.1. Structured interview questionnaire

The researchers constructed it after reviewing relevant literature *Nasreen, Afzal, Sarwar & Waqas, (2017)*; *Hulsenboom, Bours, & Halfens, (2007)* to assess the nurses sociodemographic characteristics and nurses' knowledge regarding pressure ulcer preventive care. It wrote in simple Arabic language. It included two parts:

Part (I): Demographic characteristics of nurses**,** such as age, gender, level of education, years of experiences, and previous attendance of training courses related to preventing pressure ulcers among patients in the intensive care unit.

Part (II): Nurses' knowledge which included 25 Questions (multiple choose and true/false) about pressure ulcer definition (1 question), causes (1 question), stages (2 questions), signs (1question), common sites (1 question), complications (1 question), prevention (2 questions), and preventive bundle guidelines of pressure ulcer (16 questions). This tool is distributed twice (before and after two weeks of implementation of preventive bundle care.

Scoring system

Knowledge obtained from nurses was scored and calculated. Each question ranged from 0 –1 grade. Whereas correct answer scored 1 grade and scored zero for an incorrect answer. The total score level for the questionnaire sheet was 25 grades (equal 100%).

- ≥80% considered satisfactory knowledge.
- <80% considered unsatisfactory knowledge.

4.4.2. The pressure-ulcer prevention bundle compliance checklist

It was adapted from *Baldelli and Paciella, (2008)* and modified by researchers to be applicable by staff nurses working in the intensive care unit at Benha Teaching Hospital. It used for assessing nurses' compliance towards pressure-ulcer preventive bundle guidelines. It included (20 sub-items) under the leading eight bundled practices such as risk assessment (2 items), skin assessment (3 items), the head elevated minimally 30º unless contraindicated (2 items), moisture prevention and skincare (4 items), turning and positioning (2 items), heel elevation (3 items), nutritional assessment (2 items) and pressure relief (2 items).

Scoring system

The score of each item of the previous tool was ranged as follows: Comply satisfactorily (2), comply unsatisfactorily (1), not comply (0). The total scores converted into percent scores,

- The score of ≥75% is considered a satisfactory level of compliance.
- The score of<75%is considered an unsatisfactory level of compliance.

4.4.3. Patients' risk assessment record

The researchers constructed it after reviewing the relevant literature. It was used to assess PU risk and guiding the appropriate interventions to reduce risk. It included two parts:

Part (I): Demographic characteristics of patients, which included age, gender, diagnosis, comorbid diseases, and length of stay in the intensive care unit.

Part (II): Braden risk assessment scale: It adopted from *Bergstrom, Demuth, & Braden (1987)*. The Braden scale used for predicting pressure ulcer risk. It is a summated rating scale composed of six subscales: sensory perception, mobility, activity, moisture, nutrition and friction, and shear. The six subscales are rated from 1 (least impaired) to 4 (most impaired), except friction and shear, which rates from 1–3.

Scoring systems

A total score range of 6 to 23 is possible.

- A score ranging from 19 to 23 at no risk.
- A score of 15-18 at mild risk.
- A score of 13-14 at moderate risk.
- A score of 10-12 at high risk.
- ≤ 9 at severe risk development.

4.5. Procedures

Permission granted from the Dean of Faculty of Nursing, Benha University, hospital directors, and head of the intensive care unit at Benha teaching hospital. The researcher obtain approval for data collection. The

objectives and the nature of the study explained, so it was possible to carry out the study with minimum resistance. Additional oral consent took from the nurses who participate in the study after the explanation of nature, aims, and expected outcomes of the study.

Tool's validity and reliability: Validity tested though a jury of 3 experts from the medical-surgical nursing department. Faculty of nursing, Benha University. The experts reviewed the tools for clarity, relevance, comprehensiveness, simplicity, and applicability. Minor modification was done. This phase took one month from the beginning to the end of August 2018. Testing reliability of proposed tools was done by Cronbach's alpha test (0.867) for structured interview questionnaire and (0.92) for the pressure-ulcer prevention bundle compliance checklist.

A pilot study carried out on 10% of the studied subjects (3 nurses and 9 patients), who excluded from the main study sample. The pilot study conducted to ensure clarity, applicability, the feasibility of the study tools, the time needed for each tool to be filled in and the feasibility of the study process. Some modifications were done according to the pilot study findings. This phase took one month from the beginning to the end of September 2018.

All ethical issues considered during all phases of the study. The ethical research consideration in this study included the following: the research approval obtained before program implementation, also the approval taken from the Ethics Committee in the Faculty of Nursing, Benha University, to conduct this study. The objectives and aim of the study explained to all participants. The researchers maintained the anonymity and confidentiality of information, the right of voluntary participation, and obtained the informed consent. They allowed withdrawing from the study without giving a reason. Ethics, values, culture, and beliefs were respected.

Preparatory phase: This phase included reviewing of the available literature and different studies related to the research problem, and theoretical knowledge of its various aspects of the study, using textbooks, evidence-based articles, internet periodicals, and journal in order to collect data of this study. This phase took three months from the beginning of March 2018 to the end of May 2018.

Designing preventive bundle care: The researchers developed the bundle for use in nursing settings using a multi-staged and theoretically driven approach. The following articles provide useful insights on how to do this *(Lavallée et al., 2017; Tayyib, et al., 2016; Rockville, 2014)*. The bundle development spent a period from the beginning of June 2018 to July 2018. The researchers designed an Arabic booklet concerning pressure-ulcer preventive bundle care for nurses. The preventive bundle care contains theoretical and practical parts. The theoretical part contained general objective, specific objectives, the definition of PU, causes of PU, risks of PU, the pathophysiology of PU, pressure points in the body, signs and symptoms of PU, and the degrees of PU. The practical part contains; risk assessment, skin assessment, head of bed ≤ 30º, skincare, turning and positioning, head elevation, nutritional assessment, and pressure relief.

Field work: The process of data collection carried out from the beginning of September 2018 to the end of August 2019. The researchers visited the intensive care unit three days weekly (morning and afternoon) to collect the data by using previous tools. The researchers interviewed the available nurses in intensive care unit, introduced herself to initiate communication, explained the aim of the study and took their approval to participate in the study prior to data collection, then the researchers assessed the nurses' knowledge and compliance level regarding pressure ulcer prevention by using questionnaire sheet and compliance checklist as following:

Firstly**,** the researcher observed nurses' practice during caring for patients using the preventive bundle compliance checklist. Each nurse observed at least two times, and the performance scores obtained the average performance values.

Secondly The researchers explained the questionnaire sheets. Then distribute it to all nurses individually to assess their knowledge regarding pressure ulcer prevention and preventive bundle practices of pressure ulcer. The average time needed for the completion of a questionnaire by the nurse was between 20–30 minutes. This period of pre-tests (knowledge and practice) took one month.

Thirdly, the researchers assessed the risk of a pressure ulcer for each patient (control group) by using the Braden scale. This phase took three months.

The implementation phase of preventive bundle guidelines: The researcher prepared the teaching aids and media (pictures, handouts) to facilitate the implementation of preventive bundle care. It was followed by arranging for the training sessions schedule based on the contents of the booklet, numbers of staff nurses involved, time availability, shifts as well as the resources available. After that, for conducting the training sessions, the nurses divided into small groups (10 groups), and each group contained 2 to 3 nurses. Each group took one week.

This phase took a period of 7 months in addition to one month for preprogramming baseline assessment and another one month for post-program evaluation. They are taking into consideration the use of the Arabic language that suits the level of the nurses. Motivation and reinforcement during training sessions used in order to enhance motivation for the sharing in this study. The total number of sessions for each group of the nurses included in this study were five sessions, two sessions for the theoretical part, and three sessions for the practical part. The duration of the session ranged between 30 minutes to 45 minutes, including 10 minutes for discussion and feedback. Each session started with a summary of the previous session and the objectives of the new topics. Feedback and reinforcement of teaching performed according to the nurses' needs to ensure their understanding.

Teaching methods for the theoretical part were lecture and group discussion, meanwhile for the practical part were demonstration and re-demonstration. The media utilized

were handouts, posters, and videos. The content of training sessions covered in the booklet. Each nurse obtained a copy of the Arabic booklet.

Evaluation phase: It carried out after implementing preventive bundle guidelines, the post-tests were administered to assess nurses' knowledge and compliance using the same forms of pre-tests, and this helped to evaluate the effect of implemented preventive bundle care.

Besides, the researcher assessed the risk of a pressure ulcer for each patient (study group**)** by using the Braden scale. The evaluation performed after one weak and two weak of the intervention. This phase took about three months.

4.6. Limitation of the study

The nurses were very busy, so the data collection was challenging for the researcher to be completed at the same time. So, the researcher divided nurses into groups and implemented preventive bundle guidelines for each group separately.

Generalization was constricted because the sample was selected from one geographical area in Egypt.

4.7. Data analysis

The collected data were organized, coded, computerized, tabulated, and analyzed by using the statistical package for social science (SPSS), version (20). Data analysis accomplished through the use of the number, percentage distribution, mean, standard deviation, and correlation coefficient; a Paired t-test was used to test the significance of some variables. A significant level value considered when $p<0.05$, $p<0.001$.

5. Results

Table 1 demonstrates the distribution of nurses according to their demographic characteristics. This table shows that 36.7% of the study subject were in the age category of 20-<25 years old, 90% were females. According to the level of education, the nursing diploma (secondary school) was the highest proportion (46.7%). Also, 46.7% had experience of more than seven years, and 70% of them did not attend any previous training courses about preventive bundles for pressure ulcers. 66% of those who attended training reported they could apply what they are trained for, and among those who did not attend reported limited resources and work overload.

Table 2 shows the distribution of the studied nurse regarding their knowledge level about pressure ulcers. There is a highly statistically significant difference between nurses' knowledge scores in most items pre and post-program intervention (P= 0.000; P<0.001) except for definition, prevention, and pressure relieving.

Table 3 demonstrates the mean score of nurses' knowledges about preventive bundle pre- and post-implementation. It shows a general improvement in the mean knowledge scores of nurses in all items post-program implementation as compared to their pre-intervention level with highly statistically significant differences (P= 0.000) except for pressure relief there is a statistically significant difference at (p=0.012).

Figure 1 illustrates the distribution of the studied nurses' total knowledge level regarding pre/post-intervention. It shows that there was a highly statistically significant difference (P= 0.000) between pre and post.

Table 4 shows the distribution of sub-total nurses' practice regarding their compliance with preventive bundle care of pressure ulcers. It clarifies that in pre-intervention all of the studied nurses not comply with risk assessment and most of them did not comply with skincare for the incontinent patient, for nutritional assessment, elevation head of bed ≤ 30, and heel elevation with percent (100%, 96.7%, 93.3%, 90%, and 90%) respectively. With highly statistically significant differences between pre and post compliance, p= 0.00 regarding all parameters except for skin assessment and pressure relief as all of them were complying before and after the intervention.

Figure 2 shows the percentage distribution of the studied nurses according to total compliance level. This figure shows that there were highly statistically significant differences in compliance post-intervention with (p=0.000) compared to their pre-intervention level

Table 5 shows the correlation between total knowledge score and total compliance score of the studied nurses regarding preventive bundle pre/post- intervention. It showed that there was a statistically significant relationship pre-intervention (p= 0.03), while there were a highly statistically significant difference (p=0.000) post-intervention.

Table 6 illustrates the distribution of the studied patients' demographic characteristics in both study and control groups. This table reveals an age category of 50-≤60 (55.6%, 60%), for the studied patients respectively. Also, the gender reveals males were constituting (48.9%, 52.5%), of the study sample respectively. Regarding diagnosis, 26.7% of the control group had cerebrovascular stroke and infarction compared to 22.5% of the study group. Also, (48.9%, 56.5%), respectively, of the control and study group suffered from diabetes mellitus. Concerning the duration of staying in ICU, 53.3% of the control group, and 47.5% of the study group stayed from 5-10 days. Also, there are non-statistically significant differences between the control and study groups.

Table 7 illustrates the distribution of studied patients in both study and control groups according to patients' risk level. This table presents that more than one-third of the control and study group were at severe risk on admission (40%, 42.5%), respectively, with a non-significant difference between them. While after two weeks (30%, 25%) of the study group were at moderate risk and mild risk compared to the control after two weeks, that was 12.5%, and 10% respectively with a statistically significant difference (p2= 0.03).

Table (1): Frequency and percentage distribution of the studied nurses according to their demographic characteristics (N=30).

Demographic characteristics	N = 30	
	No.	%
Nurses' age		
20-<25	11	36.7
25-< 30	9	30
30-< 40	6	20
40-<45	4	13.3
Gender		
Male	3	10
Female	27	90
Level of education		
Diploma (secondary school)	14	46.7
Diploma + specialty	3	10
Technical nursing institute	6	20
Bachelor's degree	7	4.3
Years of experience		
<3year	10	33.3
3<5year	5	16.7
5<7year	1	3.3
≥7 year	14	46.7
Attendance of training courses		
Yes	9	30
No	21	70
Ability to apply training program (n=9)		
Yes	6	66.7
No	3	33.7
Causes of limitation (n=21)		
Limited resources of the hospital	11	52.4
Work overload	10	47.6

Table (2): Comparison of pre/post-intervention knowledge level of studied nurses regarding pressure ulcer.

knowledge items	Pre-intervention n=30				Post-intervention n=30				X^2	P-value
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory			
	No.	%	No.	%	No.	%	No.	%		
Definition	27	90	3	10	30	100	0	0.0	3.158	0.076
Causes	14	64.7	16	53.3	30	100	0	0.0	21.81	0.00
Characteristic of first degree	19	63.3	11	36.7	30	100	0	0.0	13.47	0.00
Characteristic of four degree	14	46.7	16	53.3	29	96.7	1	3.3	18.47	0.00
Symptoms	19	63.3	11	36.7	29	96.7	1	3.3	10.42	0.001
Most common places	17	56.7	13	43.3	28	93.3	2	6.7	10.76	0.001
Complication	187	60	12	40	28	93.3	2	6.7	9.32	0.002
Prevention	25	83.3	5	16.7	28	93.3	2	6.7	1.46	0.228
Pressure relieve	25	83.3	5	16.7	29	96.7	1	3.3	2.96	0.085

Table (3): Comparison of knowledge score of studied nurses regarding preventive bundle pre- and post-intervention.

Items	Pre intervention n=30	Post intervention n=30	t-test	P-value
	Mean±SD	Mean±SD		
Assessment	1.100±0.402	1.900±0.305	8.614	0.000
Turning	1.833±0.379	2.900±0.305	12.006	0.000
Elevation of bed	0.1333±0.345	1.000±0.000	13.730	0.000
Nutrition	1.133±0.681	1.900±0.305	5.624	0.000
Skin care	2.267±0.739	3.366±0.718	5.84	0.000
Heel elevation	1.433±0.504	1.900±0.305	4.34	0.000
Pressure relieve	0.1667±0.379	0.467±0.507	2.59	0.012

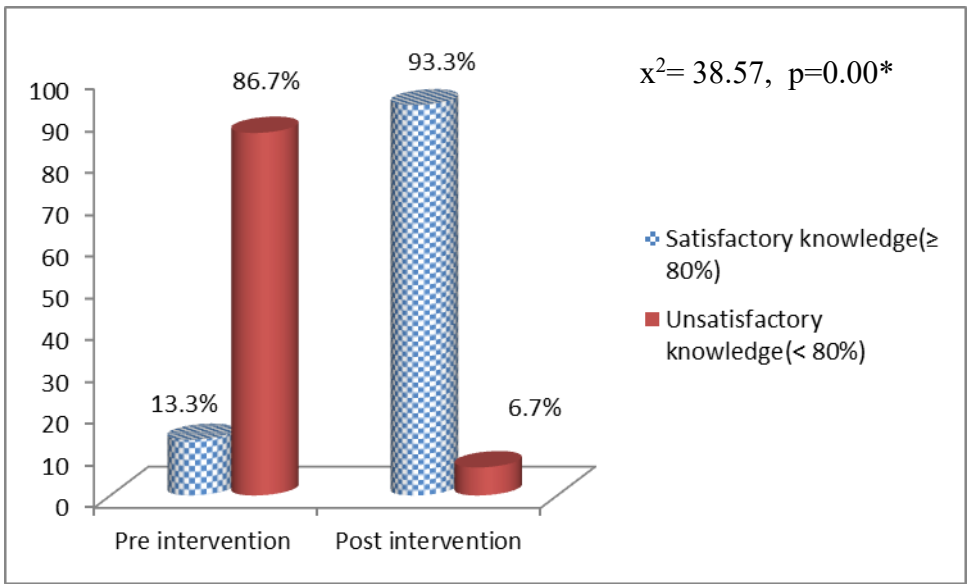

Figure (1): percentage distribution of the studied nurses' total knowledge level regarding pre/post intervention (n=30).

Table (4): Comparison of the studied nurses' compliance with the preventive pressure ulcer bundle (n=30).

Items	Pre intervention n=30				Post intervention n=30				X^2	P-value
	Comply		Not comply		Comply		Not comply			
	No	%	No	%	No	%	No	%		
Risk assessment	0	0.0	30	100	9	30.0	21	70.0	10.59	0.001
Skin assessment	10	33.3	20	66.7	17	56.0	13	43.3	3.300	0.69
Head of Bed ≤ 30°	3	10	27	90	18	60.0	12	40.0	16.48	0.000
Incontinence skin Care	1	3.3	29	96.7	28	93.7	2	6.7	48.65	0.000
Turning and positioning	4	13.3	26	86.7	17	56.7	13	43.3	12.38	0.000
Heel elevation	3	10	27	90	14	46.7	16	53.3	9.93	0.002
Nutritional assessment	2	6.7	28	93.3	13	43.3	17	56.7	10.76	0.001
Pressure relief	30	100	0	0.0	30	100	0	0.0	-	-

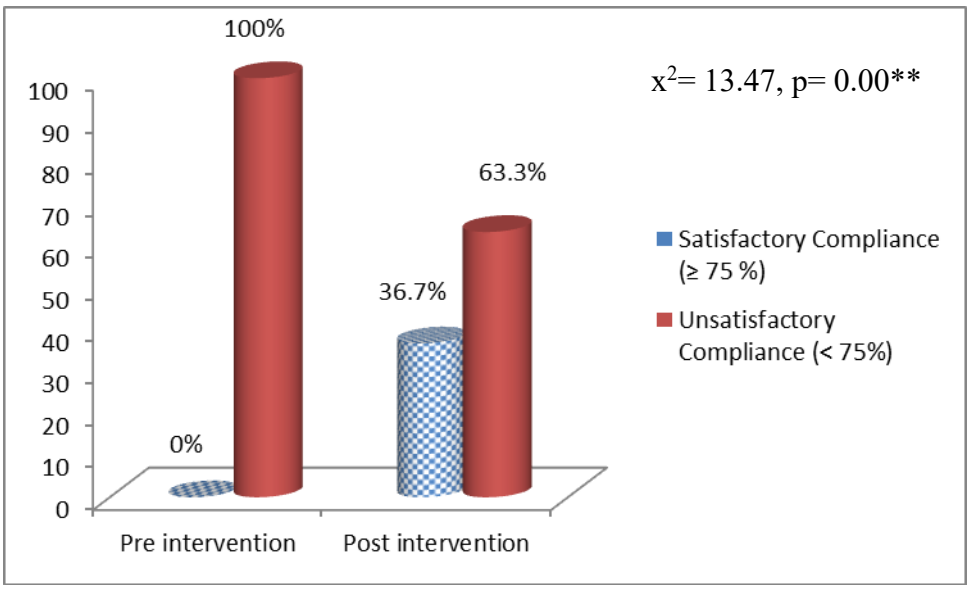

Figure (2): Distribution of the studied nurses according to a total compliance level.

Table (5): Correlation between total knowledge score and total compliance score of the studied nurses regarding preventive bundle pre- and post-intervention.

Variables	Total knowledge score pre	Total compliance score post
	r / p	r / p
Total knowledge score post	--------	0.700/ 0.000**
Total compliance score pre	0.338/ 0.034	--------

Table (6): Comparison of study and control patients regarding their demographic characteristics.

Demographic characteristics of the patients	Control group n= 45		Study group n= 40		χ^2	P-value
	No	%	No	%		
Age						
20-≤ 29 year	3	6.7	1	2.5	1.59	0.64
30-≤ 39 year	7	15.5	4	10		
40-≤ 49year	10	22.2	11	27		
50-≤ 60 year	25	55.6	24	60		
Gender						
Male	22	48.9	21	52.5	0.457	0.5
Female	23	51.1	19	47.5		
Diagnosis						
Cerebrovascular stroke &infarction	12	26.7	9	22.5	4.106	0.392
respiratory failure	11	24.4	9	22.5		
Brain edema	5	11.1	10	25		
Hepatic encephalopathy	12	26.7	6	15		
Pneumonia & COPD	5	11.1	6	15		
Comorbid diseases						
Diabetes	22	48.9	26	56.5	4.92	0.29
Hypertension	14	31.1	11	27.5		
Heart disease	5	11.1	3	7.5		
Hepatic disease	3	6.7	0	0.0		
Cancer	1	2.2	0	0.0		
Duration of stay in ICU						
5-10 day	24	53.3	19	47.5	0.70	0.873
11-15 day	13	28.9	13	32.5		
16-20day	7	15.6	6	15		
≥20 day	1	2.2	2	5.0		

Table (7): Comparison of study and control group patients regarding their risk of developing a pressure ulcer

Patient's outcome (Braden scale)	Control group (receive hospital routine care) n = 45				Study group (receive preventive bundle care) n = 40				χ^2 1 (P 1)	χ^2 2 (P 2)
	On admission		After two weeks		on admission		After two weeks			
	No	*%*	*No*	*%*	*No*	*%*	*No*	*%*		
Severe risk (total score≤ 9)	16	40	13	32.5	17	42.5	7	17.5	4.44	8.94
High risk (total score 10-12)	13	32.5	18	45	18	45	11	27.5		
Moderate risk (total score 13-14)	3	7.5	5	12.5	3	7.5	12	30	10.218	0.03
Mild risk (total score 15-18)	8	20	4	10	2	5	10	25		

χ^2 1(P 1): Relation between study and control group on admission.
χ^2 2(P 2): Relation between study and control group after two weeks of admission.

6. Discussion

Pressure ulcers (PUs) are localized injuries of the skin, or underlying tissue caused by prolonged pressure, exposure to shear forces, or friction. PUs represents a significant concern for hospitalized patients and the health professionals responsible for their wellbeing. Intensive care unit (ICU) patients are at high risk of PU development, and the development of PU scan significantly extend the length of time a patient must remain in the ICU *(Zuoa & Meng, 2015).* The present study aimed to evaluate the effect of preventive bundle care on nurses' knowledge, compliance, and patients' outcome regarding pressure ulcers in the intensive care unit**.**

As regards nurses' characteristics, the findings of the current study revealed that more than one-third of nurses were in the age category (20-< 25) years old. This finding might be due to most of the nurses were diploma level of nursing education, who graduated at eighteen. These findings are consistent with *El-Sayed, et al. (2003),* who

studied "Impact of an in-service training program on bed sores identification, prevention, and management among immobilized patients" and stated that nurses' age mostly ranged from 20 to 25 years.

As regard to nurses' gender, the present study revealed that the majority of nurses were females. This result might be due to the overall ratio of male to female nurses were less in the nursing profession. Also, this result supported by *Mohamed and Weheida, (2015)* in their study about "Effects of implementing educational program about pressure ulcer control on nurses' knowledge and safety of immobilized patients," who reported that most of the studied nurses were females.

According to the level of nurses' education, the present study indicated that about half of nurses had a secondary school diploma in nursing. It may be due to the nursing job in Egypt exclusive for females only till a few years ago. Thus, the profession of nursing in Egypt was mostly feminine, and the number of nurses who graduated from secondary schools is higher than bachelor graduated nurses. This result agreed with *Sabaq and Mohamed (2018),* who studied **"**Effect of preventive bundle guidelines on reducing iatrogenic pressure injuries among critically ill neonates*"* and reported most of the studied nurses has a secondary school diploma in nursing.

Regarding years of experiences for nurses, the finding of the present study revealed that nearly half of them had an experience of more than seven years. This finding might be due to the stability of most nurses in their places from their appointed in the intensive care unit. These results disagree with *Taha (2014),* whose study about "Nurses knowledge and practices related to pressure ulcer" stated that more than half of the study sample had experienced years from one to five years.

Concerning attendance of nurses training courses, the present study showed that majority of nurses had not attended any previous training courses about pressure ulcer prevention. This finding might be due to lack of hospital financial resources for training or shortage of nursing staff and work overload which considered as a barrier for nurses to leave the work and attend training course.

This result agreed with *Awali, Al-Naghshabandi and Elgmail, (2018),* in their study about "The effect of implementing pressure ulcer prevention educational protocol on nurses' knowledge, attitude and practices," who mentioned that 53% of studied nurses had never attended a workshop regarding pressure ulcer.

The current study revealed a statistically significant improvement between pre and post-test of nurses' knowledge regarding pressure ulcer, pressure ulcer preventive bundle, and total nurses' knowledge scores level about preventive bundle guidelines of pressure ulcer. The current study revealed that the majority of the studied nurses had unsatisfactory knowledge level pre-guidelines implementation. However, most of them had a satisfactory knowledge level post bundle implementation. It might be due to a lack of educational and training background for nurses under the study, whereas almost all the staff nurses did not receive formal training courses about preventive bundle guidelines of pressure ulcers.

Besides, the majority of the nurses had the only diploma in nursing education in which the content of the preventive bundle of pressure ulcers was limited in their curriculum, so they benefit the most from the preventive bundle guidelines. These results supported by *Mohamed and Weheida, (2015),* who found that most of the nurses (77.5%) had unsatisfactory knowledge regarding pressure ulcer pre-program implementation, while the majority of them (87.5%) had a satisfactory knowledge after application of the program. Also, these results in the same line with *Awali et al., (2018),* who reported that nurses' level of knowledge had improved and sustained through the study period compared to pretest.

This finding is similar to study done by *Baron, Brandenburg, Beatriz, and Krug, (2016)* entitled "Experimental study with nursing staff related to the knowledge about pressure ulcers." They found that the mean knowledge score of study group was higher than the mean knowledge score of the control group after the educational intervention.

Also, this result supported by *Saleh, Qaddumi, and Anthony, (2012)***,** who conduct study entitled "An interventional study on the effects of pressure ulcer education on Jordanian registered nurses' knowledge and practice," who reported the mean score of knowledge for experimental group was higher than the mean score of knowledge for the control group. These findings are supporting the first research hypothesis.

Regarding compliance of nurses with preventive bundle care, the present study revealed that pre-program intervention all of the studied nurses do not comply with risk assessment, and most of them did not comply with skincare for the incontinent patient, for nutritional assessment, elevation head of bed ≤30, and for heel elevation, with highly statistically significant differences between pre and post-program implementation. This finding might be due to the majority of nurses had not attended any previous training courses about pressure ulcer prevention. The lack of opportunity to be trained about pressure ulcer prevention programs might prevent the nurses from applying the best practices regarding pressure ulcer prevention. Also, lack of hospital policies for utilizing risk assessment tools and lack of equipment are contributing factors for nurses to provide quality care for patients.

These results agreed with *Sabaq and Mohamed (2018),* who found that there was a highly statistically significant improvement of nurses' compliance immediately post-program intervention regarding most items of risk assessment, skin assessment, repositioning, and nutrition (P<0.000). Also these results in the same line with *Awali et al. (2018),* who stated that after implementing the educational intervention about PU prevention, nurses level of practice had significantly improved to following areas: Patient assessment upon admission, turning patient timeframe, protection of skin during transfer and minimized elevation of the bed.

Regarding the total compliance score, the result of the present study reflected that all of the studied nurses had unsatisfactory compliance pre-program intervention, while more than one-third of them had satisfactory compliance post-program intervention with a highly statistically significant difference. This result might be due to the unavailability of preventive bundle guidelines in ICU, inadequate equipment, and poor in-service training programs that improved after the application of preventive bundle care.

This result is consistent with *Tayyib et al. (2016),* who conducted a study entitled "The implementation of a pressure ulcer prevention bundle in adult intensive care," and demonstrated a highly significant improvement in the level of compliance among nurses (78.1%) after the pressure ulcer prevention bundle implementation. Also, the result supported by *Hashad and Hassan (2018)* on their study about "The effect of implementing a designed skin care bundle protocol on modifying nurses' practices toward pediatric intensive care unit patients." They reported that more than half of the studied nurses had an unsatisfactory practice score before program implementation, and most of them had satisfactory practice score after program implementation These findings are supporting the second research hypothesis.

Also, the results revealed that there is a positive correlation between total nurses' knowledge and compliance post implementing preventive bundle care with highly statistically significant difference at (p=0.000). This finding indicated that skills could be easily improved, especially if linked to relevant scientific base of knowledge. This result was congruent with *Sabaq and Mohamed (2018); Hashad and Hassan (2018); Mohamed and Weheida (2015),* who found the same results in their studies.

These findings agreed with *Trueman and Whitehead (2010),* who illustrated that nurses should attain and maintain a high level of nursing knowledge and nursing practice, but to be effective in practice, nurses must gain knowledge before they enter practice. These findings are supporting the third research hypothesis.

Concerning the demographic characteristics of studied patients, the current study revealed that more than half of the control and study group in the age category between 50-<60. This result similar to the study conducted by *Ateyea, Mohamed, and Abdel-Aziz, (2013)* about "The effect of nursing guidelines for preventing pressure ulcer in intensive care units on patient's outcomes." They reported the mean age for the studied patients were (51.83±12.59 vs. 48.67±12.46) in the study and control group respectively.

Also, more than half of them in the control and study group were males. This finding was in the same line with the study done by *Shahin, Dassen, and Halfens (2009)* about "Incidence, prevention, and treatment of pressure ulcers in intensive care patients" and mentioned that the majority of the patient are males.

Concerning the length of stay in ICU, more than half of the control group and less than half of the study group stayed from 5-10 days. These results agreed with *Mohamed and Weheida, (2015),* who stated that most of the patients (67.5%) were stayed a period ranged from (5-10) days.

As regards the patient outcome measured by the Braden scale, the study presented that more than one-third of the control and study group were at severe risk on admission, while after two weeks, around one-third and one-fourth of the study group were at moderate risk and mild risk, respectively. This result proved that implementing preventive bundle care had a positive effect on patient outcome in terms of decreased the risk of exposure to pressure injury. This result congruent with study conducted by *Tayyib, et al. (2015)* entitled "A two-arm cluster randomized control trial to determine the effectiveness of a pressure ulcer prevention bundle for critically ill patients," who reported that the prevention bundle helps in reducing pressure injury in the intervention group 17.1% as compared with 52.8% in the control group.

Also, the current study result was supported by *Mohamed and Weheida, (2015),* who found that the majority of all patients at risk for pressure ulcers based on the total score of the Barden scale. The score improved after implementing the program on five days and ten day. In the same context, *Miller et al. (2010)* showed an association between improved compliance with bundle elements and improved clinical outcomes. These findings are supporting the fourth research hypothesis.

7. Conclusion

In the light of the study findings, it might be concluded that the majority of studied nurses had unsatisfactory knowledge and compliance before implementing preventive pressure ulcer bundle care, while they had satisfactory knowledge and compliance post implementing preventive pressure ulcer bundle care. Also, preventive bundle care was statistically significantly effective in improving patients' outcomes, including reducing the risk level of pressure ulcers in the study group compared to the controls.

8. Recommendations

Based on the findings of the present study, the following recommendations can be suggested:

- Preventive pressure ulcer bundle care should be revised periodically and be available in adult intensive care units in both Arabic and English language.
- Provide continuous education and training sessions for nurses about pressure ulcer prevention by applying preventive bundle guidelines to improve their compliance.
- ICU environment should enable a nurse to translate knowledge into practice by ensuring the availability of supplies and equipment required for applying preventive bundle guidelines.

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