

## Nurses' Knowledge and Practices Regarding Care of High-Risk Neonates Connected with Mechanical Ventilator

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### ABSTRACT

**Background:** A high-risk neonate refers to a newborn who has an elevated likelihood of experiencing adverse health outcomes or death, irrespective of their gestational age or birth weight. A mechanical ventilator controls or helps a neonate's respiration when he or she cannot maintain adequate gas exchange because of respiratory or ventilatory failure. **Aim of the study:** Assess the nurses' knowledge and practices regarding care of high-risk neonates connected with mechanical ventilator. **Research design:** A descriptive research design was used. **Setting:** The study was conducted in the Neonatal Intensive Care Unit (NICU) at Minia University Hospital for Obstetrics and Pediatrics. **Sample:** All the available nurses (40) working in NICU at Minia University Hospital for Obstetrics and Pediatrics. **Tools:** Tool (I): A structured interview questionnaire covering the demographic characteristics of the studied nurses and nurses' knowledge. Tool (II): Observational checklist sheet. **Results:** The results of this study proved that; the vast majority of the studied nurses had poor knowledge, and most of them had an incompetent level of total practice regarding the care of high-risk neonates under mechanical ventilator. There is also, a statistically significant relation between the total mean score of nurses' knowledge and practices and their marital status and qualifications. **Conclusion:** A minority of the studied nurses had average knowledge and competent level of total practices regarding the care of high-risk neonates under mechanical ventilator. **Recommendations:** Periodical training programs and educational workshops should be conducted for nurses working in the NICU about the nursing care of mechanically ventilated neonates.

**Keywords:** High-risk neonate, Knowledge, Mechanical ventilator, Nurses, Practices.

### Introduction

A high-risk neonate (HRNs) refers to an infant, irrespective of gestational age or birth weight, who exhibits an elevated likelihood of experiencing health complications or death. This increased risk is typically attributed to various conditions or circumstances related to the birth process and the transition to life outside of the mother's body (Hockenberry et al., 2020). HRNs is a neonate born with an increased risk for maintaining life like a normal newborn either because of prematurity or because of multiple factors leading to risk for life owing to maternal, fetal, or environmental factors (Beevi, 2019).

The preterm infant is likely to have difficulty making the pulmonary transition from intrauterine to extrauterine life. There are several challenges that can impact the respiratory system of preterm infants. These include a reduced number of functional alveoli, inadequate levels of surfactant, narrower airway passages, increased susceptibility to collapse or obstruction of the respiratory passages, incomplete calcification of the bony thorax, underdeveloped or absent gag reflex, fragile and immature lung capillaries, and a greater distance between functional alveoli and the capillary bed. Collectively, these deficiencies have the potential to significantly impede the respiratory effort of preterm infants, leading to respiratory distress or apnea (Lowdermilk et al., 2019).

A mechanical ventilator (MV) can support or help a neonate's respiration when he or she cannot maintain adequate gas exchange because of respiratory or ventilatory failure. It can be used for short- or long-term support for those who cannot support their respiratory effort, such as those with neuromuscular disorders (Perry et al., 2021).

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Neonatal nurses have the responsibilities of comprehending the intricacies involved in providing care to neonates who require mechanical ventilation. Their primary objectives include delivering safe and effective care, closely monitoring the usage of mechanical ventilation, and continuously documenting these activities around the clock. This diligent approach aims to prevent potential issues, address any challenges related to mechanical ventilation promptly, and provide support during the weaning process (Thabet et al., 2021). It is imperative for nurses to maintain a high level of attentiveness to subtle variations in infants requiring respiratory support. Early identification of changes in vital signs and other relevant indicators can play a crucial role in preventing significant deterioration. Therefore, it is essential for nurses to consistently monitor and assess parameters such as heart rate, blood pressure, oxygen saturation, mode of mechanical ventilation, arterial blood gas results, and chest auscultation (Elmohamady et al., 2023).

### Significance of the Study

The neonatal period is widely recognized as a critical phase of life, characterized by unique medical and health challenges that primarily affect individuals born prematurely or with low birth weight (Mokhtar et al., 2021). The global neonatal mortality rate has witnessed a significant reduction, declining from 5 million in 1990 to 2.4 million in 2019. However, it remains crucial to acknowledge that neonates are most vulnerable to mortality within the initial 28 days of their lives. In the year 2019, approximately 47% of all deaths among children under the age of 5 took place during the neonatal period. It is noteworthy that around one-third of these deaths occurred on the very day of birth, while nearly three-quarters occurred within the initial week of life. The primary causes of neonatal mortality are preterm birth, intrapartum-related complications such as birth asphyxia or respiratory distress, infections, and birth defects (WHO, 2020).

Nurses maintain a continuous presence at the bedside of neonates, assuming the role of primary healthcare professionals who are accountable for monitoring and attending to all the needs of these infants. It is expected that individuals maintain vigilant oversight of all equipment necessary for the care of critically ill neonates, including ventilator and monitoring devices (Hegazy & Abusaad 2019). The provision of neonatal care on mechanical ventilation is a complex process that requires a high level of knowledge and skill. It involves the careful management and understanding of various ventilator variables, which interact in a dynamic manner. Simplifying this process is not feasible, as it necessitates a comprehensive understanding and competent practice. It is imperative to integrate this knowledge and practice into making precise and effective decisions regarding optimal skills, while also mitigating risks associated with ventilator usage (Mahfoz et al., 2022).

A recent study conducted by El-Garhy (2020) in Egypt examined the quality of nursing care provided to neonates undergoing mechanical ventilation at neonatal intensive care units affiliated with Cairo University, specifically Abu El-Rish Children's Hospital and El-Kaser El Ainy Hospital. The findings of the study revealed that the nurses involved demonstrated inadequate knowledge and incompetence in delivering quality nursing care to neonates undergoing mechanical ventilation.

During my presence in the NICU, I found that the nurses have deficient knowledge and practices regarding the care of high-risk neonates connected with mechanical ventilator. So, this study will hopefully assess nurses' knowledge and practices regarding the care of high-risk neonates connected with mechanical ventilator to determine the deficient area of knowledge and practices of nurses.

### Aim of the Study

The aim of the current study was to:

Assess the nurses' knowledge and practices regarding the care of high-risk neonates connected with mechanical ventilator.

### Research questions

1. What are the nurses' knowledge and practices regarding care of high-risk neonates connected with mechanical ventilator?
2. Is there a relation between nurses' knowledge and practices regarding caring for high-risk neonates connected with mechanical ventilator?

3. Are there relations between nurses' knowledge and practices with their demographic characteristics?

### Subjects and Methods

#### Research Design:

The aim of this study was achieved through the utilization of a descriptive research design.

#### Sample:

Include all the available nurses (40) working at neonatal intensive care units at Minia University Hospital for Obstetrics and Pediatrics (MUHOP).

#### Setting:

The research was carried out in NICU located on the third floor of Minia University Hospital for Obstetrics and Pediatrics (MUHOP). The unit receives neonates from various regions within Minia governorate who present with a range of medical conditions, including neonatal jaundice, respiratory distress syndrome, congenital anomalies, and infants born to diabetic mothers. The unit is equipped with a total of 30 incubators and 7 mechanical ventilators, allowing for the provision of care up to the third level.

#### Data collection tools:

The current study utilized two tools, which are as follows:

**Tool (I):** The researcher developed a structured interview questionnaire following a comprehensive review of recent literature related to the topic.

#### It was composed of two parts:

##### Part (I):

Demographic characteristics of the studied nurses such as (age, marital status, residence, educational level, years of experience, and number of attended training courses about mechanical ventilator).

##### Part (II): Nurses' knowledge questionnaire

Included closed-ended questions to assess nurses' knowledge regarding care provided to high-risk neonates connected with mechanical ventilator, consisting of 17 items such as (definition, indications, complications of a mechanical ventilator, etiology of sudden deterioration, indicators of extubation, signs of intubation displacement, skin care, positioning, indications of endotracheal suctioning, guidelines, nursing care for endotracheal suctioning .....etc). The tool was adapted from (Said et al., 2020) and adjusted by the researcher.

**Scoring system for nurses' knowledge:** The correct incomplete answer was given (one), the correct complete answer was given (two), and the incorrect answer was given (zero), then scores were converted into a percent score, and these scores were summed and converted into a percent score. The knowledge was categorized into three groups: good knowledge if the score  $\geq 85\%$  = ( $\geq 28$ marks) average knowledge if the score from  $75 < 85\%$  = ( $25 < 28$ marks), and poor knowledge if the score is  $< 75\%$  = ( $< 25$  marks) (Said et al., 2020).

##### Tool (2): Observational checklists sheet

The researcher developed it based on a recent literature review, scientific paper, and scientific documents (Kalia, 2015, Al-Sharkawi, et al. 2019) to assess the nursing

care for high-risk neonates connected with mechanical ventilators. It comprised of 4 procedures involving (hand washing (19 steps), endotracheal tube suctioning (17 steps), oral care (7 steps), and eye care (7 steps)

**Practice scoring system**

The nurses' practices were categorized as Incompetent (< 85 %=( < 28 marks) and competent (≥ 85%=( ≥28 marks); each done step took one score, and not done step took zero (Al-Sharkawi et al. 2019).

**Tools Validity and Reliability**

The tools submitted to a panel of five experts in the fields of neonatology and pediatric nursing to test the content validity. In accordance with the feedback and recommendations provided by experts, judgment on the clarity of the sentences and appropriateness of the content. Cronback alpha test were done for both tool were 0.719 and 0.810 respectively which reflect good reliability.

**Ethical Consideration:**

The study received written initial approval from the research ethical committee of the Faculty of Nursing at Minia University. Additionally, oral informed consent was obtained from the participating nurses in accordance with the study protocol. The assessment sheets were appropriately coded to ensure anonymity and confidentiality. Prior to their involvement in the study, the researcher provided a clear explanation of the study's purpose and nature through direct personal communication. The previously mentioned data were treated as confidential and exclusively utilized for research purposes. The study adhered to standard ethical guidelines for participation in clinical research, ensuring the privacy of participants during data collection. Furthermore, measures were taken to guarantee anonymity and privacy by coding the data.

**Pilot study:**

The tools were provided to a panel consisting of five experts in the fields of neonatology and pediatric nursing. Their task was to assess the content validity, clarity, relevance, applicability, wording, length, format, and overall appearance of the tools. In accordance with the feedback and recommendations provided by experts, necessary modifications have been implemented.

**Data collection procedure:**

Administrative approval was obtained from the Dean of the Faculty of Nursing and the managers of the previously

mentioned hospital before implementation of the study; the study's objectives were explained to gain cooperation and allow a meeting with the nurses, and the researcher introduced herself to the nurses.

Oral consent was taken from each nurse after completing a description of the aim of the current study; meeting with the nurses was done in the morning, evening, and night shifts. Each nurse was interviewed separately after the researcher explained the aim of the interview.

The questionnaire sheet took from 25-30 minutes to be filled by each nurse and includes demographic data of nurses, knowledge about the care of high-risk neonates connected with mechanical ventilator that include (definition, indications, complications of mechanical ventilator, etiology of sudden deterioration, indicators of extubation, signs of intubation displacement, skin care, positioning, indication of endotracheal suctioning, guidelines, nursing care for endotracheal suctioning .....etc).

The researcher stayed with the nurses until they filled out the sheet and explained any unambiguous items; the researchers wore protective face masks and kept a proper physical distance between the researcher and the nurses during data collection. The researcher observed the nurses during the care of high-risk neonates connected with mechanical ventilator; the nurses' practices regarding (hand washing, endotracheal tube suctioning, oral care, and eye care) were assessed and recorded through an observational checklist, the time of data collection was started from the beginning of January 2022 to the end of March 2022.

**Statistical design:**

The data entry process was conducted utilizing a compatible personal computer. Following the completion of data collection, the collected data underwent a thorough revision process, where it was carefully reviewed, coded, and subsequently inputted into the statistical software known as IBM SPSS version 21. The statistical analysis was conducted using two-tailed tests and a significance level of 0.05. A p-value that is less than or equal to 0.05 is generally regarded as statistically significant. The chi-square test and percentages were employed to analyze qualitative data and responses with a count of less than five. Spearman's correlation is a statistical test used to assess the nature and strength of the relationship between two variables that are either quantitative or ordinal in nature. The sign of the coefficient denotes the nature of the relationship (positive or negative), while the magnitude of the coefficient indicates the strength of the relationship.

**Results:**

**Table (1) Distribution of the Studied Nurses Regarding their Demographic Characteristics (n=40)**

Demographic characteristics	Nurses (n = 40)	
	No.	%
<b>Age of nurses/ year</b>		
Less than 25years	29	72.5
25-30 years	9	22.5
More than30 years	2	5
<b>Mean ± SD</b>	25.28 ± 3.762	
<b>Marital status</b>		
Single	18	45
Married	22	55
<b>Residence</b>		
Urban	3	7.5
Rural	37	92.5
<b>Qualification</b>		

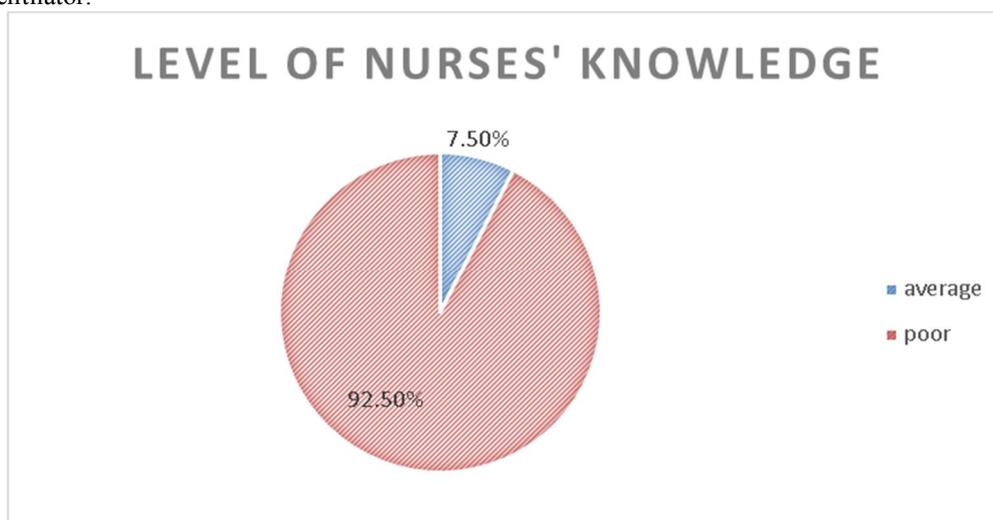
Demographic characteristics	Nurses (n = 40)	
	No.	%
Baccalaureate degree	3	7.5
Technical institute of nursing	26	65
Diploma degree	11	27.5
<b>Years of experience</b>		
Less than 5 years	35	87.5
5-10 years	3	7.5
More than 10 years	2	5
<b>Mean ± SD</b>	<b>4.60±3.808</b>	
<b>Training courses</b>		
Yes	10	27.5
No	30	72.5
<b>If yes, No. of training courses(N=10)</b>		
One course	9	90
Two courses	1	10
<b>Mean ± SD</b>	<b>0.28±0.506</b>	

Table (1) shows the demographic characteristics of the studied nurses and it was observed that, 72.5% of the studied nurses their age were less than 25 years old, with the mean of their age  $25.28 \pm 3.762$ . Meanwhile, 55% of the studied nurses were married, and 92.5% came from rural areas. In addition, 65% of the studied nurses had a technical institute of nursing, and 87.5% had less than 5 years of experience in the neonatal intensive care unit, with the mean of their years of experience  $4.60 \pm 3.808$ . On the other hand, only 27.5% of them attended training courses regarding the care of high-risk neonates connected with mechanical ventilator, and 90% of these nurses attended one course.

**Table (2) Distribution of Total Nurses' General Knowledge, Endotracheal Tube Suctioning and Nursing Care Knowledge Regarding Care of High-Risk Neonates under Mechanical Ventilator (N=40)**

Item	No	%
<b>General Knowledge</b>		
Good	38	95
Fair	1	2.5
Poor	1	2.5
<b>Endotracheal Tube Suctioning Knowledge</b>		
Good	3	7.5
Fair	0	0.0
Poor	37	92.5
<b>Nursing Care Knowledge</b>		
Good	1	2.5
Fair	3	7.5
Poor	36	90

Table (2) clarifies the total nurses' general knowledge, endotracheal tube suctioning and nursing care knowledge and it was noted that, 95% of the studied nurses had good general knowledge regarding the care of high-risk neonates under mechanical ventilator, 92.5% and 90% of them had poor knowledge about endotracheal tube suctioning and nursing care of high-risk neonates under mechanical ventilator.



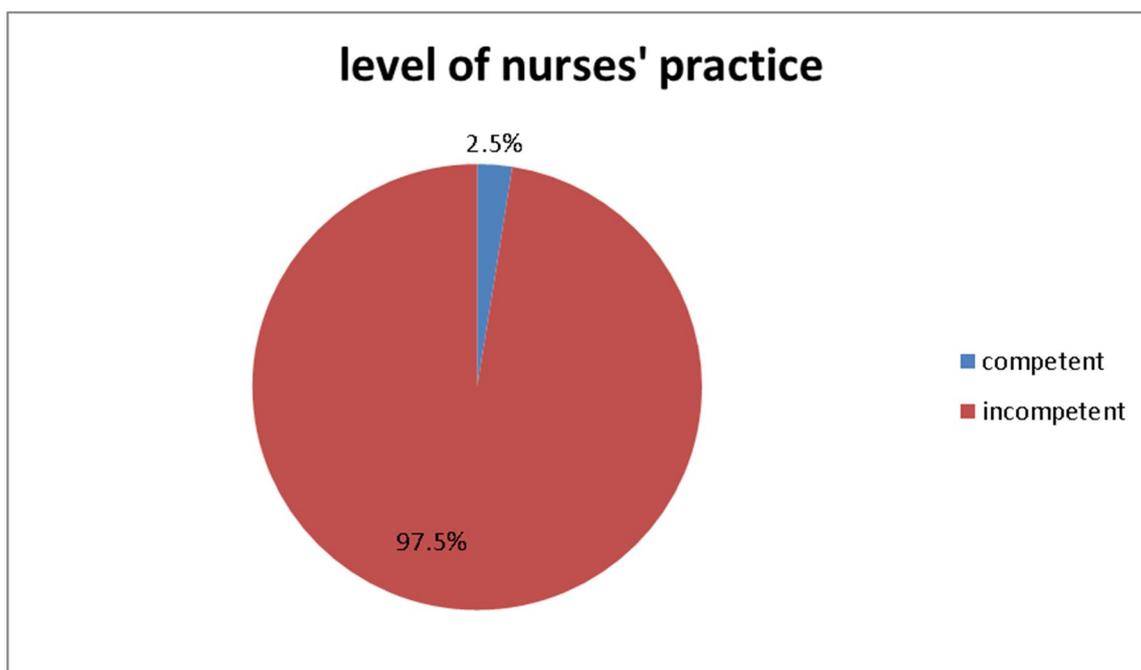
**Figure (1) Nurses' Total Knowledge Level Regarding Care of High-Risk Neonates under Mechanical Ventilator (N=40)**

Figure (1) clarifies the studied nurses' total knowledge level and it was observed that, 92.5% of the studied nurses had poor knowledge and 7.5% of them had average knowledge while no one had good knowledge regarding the care of high-risk neonates under mechanical ventilator.

**Table (3) Total Score of Nurses' Practice Regarding Care of High-risk Neonates under Mechanical Ventilator (n=40)**

Item	No	%
<b>Hand washing</b>		
Competent	0	0.0
Incompetent	40	100
<b>Endotracheal tube suctioning</b>		
Competent	1	2.5
Incompetent	39	97.5
<b>Oral care</b>		
Competent	29	72.5
Incompetent	11	27.5
<b>Eye care</b>		
Competent	27	32.5
Incompetent	13	67.5

Table (3) shows the total score of the studied nurses' practice and it was clarified that, regarding hand washing all of the studied nurses had incompetent practices regarding the care of high-risk neonates under mechanical ventilator. On the other hand, 97.5% had incompetent practice regarding endotracheal tube suctioning. In addition, 72.5% had competent practice regarding oral care and 67.5% of the studied nurses had incompetent practice regarding eye care.



**Figure (2) Nurses' Total Practice Level Regarding Care of High-Risk Neonates under Mechanical Ventilator (N=40)**

Figure (2) clarifies the studied nurses' total practice level and it was observed that, 2.5% of the studied nurses had a competent level of total practice compared to 97.5% of them had an incompetent level.

**Table (4) Relation between Total Mean Score of Nurses' Knowledge and their Selected Demographic Characteristics (n=40)**

Demographic characteristics	Nurses (n = 40)		Knowledge M±SD	Test of significance	P. value
	No.	%			
<b>Marital status</b>					
Single	18	45	16.7 ± 3.	t-test 2.322	0.026*
Married	22	55	19.4 ± 3.8		
<b>Residence</b>					
Urban	3	7.5	21.0 ± 4.4	t-test 1.362	0.181
Rural	37	92.5	17.9 ± 3.7		
<b>Qualification</b>					
Baccalaureate degree	3	7.5	18.5 ± 0.7	One -way A nova 3.308	0.031*
Technical institute of nursing	26	65	17.1 ± 3.3		
Diploma degree	11	27.5	21.2 ± 3.8		
<b>Training courses</b>					
Yes	10	27.5	19.7 ± 4.9	t-test 1.361	0.181
No	30	72.5	17.7 ± 3.3		

Table (4) shows the total mean score of nurses' knowledge and their selected demographic characteristics and it was noted that, there were statistically significant relations between the total mean score of nurses' knowledge and their marital status and qualification with P. value at 0.026 and 0.031, respectively.

**Table (5) Relation between Total Mean Score of Nurses' Practice and their Selected Demographic Characteristics (n=40)**

Demographic characteristics	Nurses (n = 40)		Practice	Test of significance	P. value
	No.	%	Mean ±SD		
<b>Marital status</b>					
Single	18	45	33.7 ± 2.5	t-test 2.797	0.008**
Married	22	55	35.9 ± 2.5		
<b>Residence</b>					
Urban	3	7.5	34.8 ± 2.8	t-test 0.500	0.620
Rural	37	92.5	35.7 ± 2.5		
<b>Qualification</b>					
Baccalaureate degree	3	7.5	33.0 ± 0.0	One- way A nova 4.145	0.013*
Technical institute of nursing	26	65	34.2 ± 2.6		
Diploma degree	11	27.5	36.6 ± 2.4		
<b>Training courses</b>					
Yes	10	27.5	34.9 ± 3.3	t-test 0.014	0.989
No	30	72.5	34.9 ± 2.6		

Table (5) shows the relation between the total mean score of nurses' practice and their selected demographic characteristics and it was clarified that, there was a highly statistically significant relation between the total mean score of nurses' practice and their marital status and qualification with P. value at 0.008\*\* and 0.013\*, respectively.

**Table (6) Correlation between the Studied Nurse's Knowledge and Practice Scores with Selected Demographic Characteristics (n=40)**

Items		Knowledge	Practice
Age	r	.137	.037
	P – value	.398	.820
Years of experience	r	.273	.092
	P – value	.088	.574
Total practice scores	r	.172	
	P – value	.288	

**Correlation is significant at the 0.05 level \*\* Correlation is significant at the 0.01 level. Spearman correlation test.**

Table (6) clarifies the correlation between the studied nurse's knowledge and practice scores with selected demographic characteristics and it was observed that, there was no statistically significant correlation between nurse's knowledge and practice. Also, no statistically significant difference between knowledge and practice with age and years of experience was found.

**Discussion**

The results of this study covered the main areas that were discussed within the following frame of reference: First, the characteristics of the studied nurses. Secondly, actually nurses' knowledge and practices regarding the care of high-risk neonates on mechanical ventilator, the relationship between nurses' knowledge and practices with their selected demographic characteristics and finally the correlation between nurses' knowledge and practices regarding the care of high-risk neonates connected with mechanical ventilator.

**Socio-demographic characteristics of the studied nurses**

The current study's socio-demographic findings revealed that; a significant proportion of the nurses included in the study (about two fifth) were below the age of 25 years old. The average age of the nurses was calculated to be 25.28 ± 3.762 and the majority of them had less than 5 years of experience in the neonatal intensive care unit.

From the researcher's perspective, it was noted that; most of the nurses in question were recent graduates who displayed a higher level of adaptability to the demands of the critical care unit.

A similar study on the "effect of instructional guidelines on nurses' performance in caring for high-risk neonates during extubation of mechanical ventilation" done by **Kunswa and Mohamed, (2021)** supported these findings.

Furthermore, **Mohammed and Abou Zed (2019)** who conducted a study on the "effect of instructional guidelines on nurses' performance in caring for high-risk neonates undergoing surfactant replacement therapy "pointed out that; approximately half of their study's sample was within the age range of 20 to less than 25 years and over than three quarters of them had between 1 and less than 5 years of experience. On the other side, the present study results were incongruent with the findings of **Mahfoz et al. (2022)**, who conducted a study on the "effect of designed nursing instructions on mechanically ventilated children in pediatric intensive care units." and found that; over than half of the participating nurses were between the ages of 30 and 35.

Regarding qualifications, the findings of the current study indicated that; about two-thirds of the nurses included in the study possessed a technical institute of nursing certification. This could be attributed to the significant expansion of academic nursing education in Egypt, which led to the replacement of Technical Secondary School of Nursing with the Technical Institute of Nursing. It is believed that; these individuals possess a higher level of knowledge and skills in caring for high-risk neonates. In addition, the current status of nursing qualifications in Egypt indicates that; holders of a bachelor's degree in nursing often assume administrative roles rather than direct patient care responsibilities. This finding was reinforced by **Ebrahim et al. (2023)** who were studying "anticipated outcomes of nursing interventions for

pediatric patients on mechanical ventilation" and reported that; over two fifth of the participating nurses had obtained their nursing education from a technical institute.

In relation to the training courses attended, the findings of the current study indicated that; over two-thirds of the participants did not receive training on the care of high-risk neonates in relation to mechanical ventilator. The finding were consistent with a study conducted by **El-Garhy et al. (2020)** titled "quality of nursing care provided to neonates undergoing mechanical ventilation: An Assessment Study." which revealed that; over two-thirds of the studied nurses had not participated in any training courses, and three-quarters of them perceived the training courses as lacking usefulness. Similarly, the same findings were reported by **Mahfoz et al. (2022)** and **Abdel Fattah and Mohammed (2019)** who conduct study about "impact of nursing guidelines on nurses' knowledge and performance in preventing ventilator-associated pneumonia in neonates." which revealed that; a significant proportion of nurses, specifically less than two-thirds did not receive instruction on the care of neonates with invasive mechanical ventilation.

From a researcher's perspective, it is possible that ;this outcome can be attributed to a lack of ongoing training and education provided by hospitals to their nursing staff, as well as an increase in nurses' workload.

The present study's demographic findings revealed that; a significant majority of the participants originated from rural regions and were married. The findings of this study align with the previous researches conducted by **Thabet et al. (2021)** on the " impact of training program implementation on nurses' performance in relation to neonates undergoing invasive mechanical ventilation", as well as the study conducted by **Mustafa et al. (2019)** on the "quality of nursing care provided to neonates on mechanical ventilation". Which revealed that; less than three-quarters of the nurses included in the study were from rural areas. As regard, the marital status of the nurses **Ebrahim et al. (2023)** study revealed that; over two-thirds of the nurses included in the study were married.

#### **Nurses' knowledge regarding the care of high-risk neonates on mechanical ventilator**

Proper knowledge is vital and essential determinants of compliance in the nursing profession. The results of the current study have provided clarification that; Although the majority of nurses possessed a satisfactory level of general knowledge related to providing care to high-risk neonates on a ventilator, the majority demonstrated limited understanding of indications for mechanical ventilation.

The same finding reached by the recent study conducted by **Ebrahim et al. (2023)** reported that; a significant proportion of the surveyed nurses exhibited inadequate understanding regarding the indications and various forms of mechanical ventilation.

Moreover, the present study showed that; the vast majority of the participating nurses exhibited a limited understanding of nursing care pertaining to high-risk neonates on a mechanical ventilator. This finding go with the study conducted by **Mostafa et al. (2016)** to "assess nurses' performance regarding care of children undergoing mechanical ventilation", as it showed that; approximately half of nurses demonstrated an unsatisfactory level in their overall knowledge score concerning the nursing care of children undergoing mechanical ventilation .

Similarly, a study carried out by **Priyanka et al. (2017)** on the "effectiveness of a structured teaching program on the knowledge and practices of pediatric nurses regarding the care of children on mechanical ventilator", observed that; the significant proportion of the studied nurses demonstrated insufficient knowledge regarding the care of children on mechanical ventilator during the pre-test phase.

As regard nurses' knowledge about endotracheal tube suctioning, the study results showed that; the vast majority of the nurses demonstrated a limited understanding of endotracheal tube suctioning. This is consistency with the research conducted by **Mohamed et al. (2022)** about " effect of a competency-based training program on nurses' performance in relation to endotracheal tube suction for neonates on mechanical ventilation", revealed that; a majority of the nurses exhibited a deficient level of knowledge regarding endotracheal tube suctioning.

Add to this, **Aboalizm and Elhy (2019)** who conducted study on the "impact of educational intervention on nurses' knowledge and practices regarding endotracheal tube suctioning", noted that; the most of the nurses surveyed demonstrated inadequate knowledge regarding endotracheal tubes and suctioning techniques. Conversely, **Bano et al. (2020)** who studied the "measurement of knowledge and performance of pediatric ICU nurses in relation to endotracheal suctioning", demonstrated that; a significant proportion of studied nurses possess sufficient knowledge regarding the technique of endotracheal suctioning.

#### **According total mean score of the nurses' knowledge regarding nursing care pertaining to high-risk neonates on a mechanical ventilator**

The current results showed that; the vast majority of the nurses demonstrated poor knowledge, smaller proportion displayed average knowledge and none of them exhibited a high level of knowledge regarding the care of high-risk neonates on mechanical ventilator. This might be attributed to that, after graduation nurses abandon reading and neglect to update their professional knowledge. Another possible reason might be the absence of any resources or programs for continued nursing education; this was indicated by their low percent of attending a training course.

These findings were confirmed by **Kunswa and Mohamed (2021)** who found that; over half of the surveyed nurses exhibited inadequate knowledge regarding the application of pre-instructional guidelines for the care of high-risk neonates. Also, **El-Garhy et al. (2020)** concluded that; approximately half of the surveyed nurses exhibited a low level of overall knowledge.

On the other hand, in a related study conducted by **Mostafa et al. (2016)** which revealed that; a majority of the nurses examined demonstrated a satisfactory level of knowledge, while a minority exhibited unsatisfactory knowledge pertaining to the care of children undergoing mechanical ventilation. Additionally compared to the results of the current study, **Hendy et al. (2020)** who conducted study about the "nursing competency for the care of high-risk neonates at the neonatal intensive care unit." Concluded that; fewer than half of nurses possessed adequate knowledge regarding the care of high-risk neonates on mechanical ventilation. Simultaneously, it is noteworthy that; over one-quarter of nurses exhibited an average level of total knowledge.

### Nurses' practices regarding the care of high-risk neonates under mechanical ventilator

The study findings indicated that; the nurses examined demonstrated incompetent practices in hand washing when it comes to caring for high-risk neonates under mechanical ventilator. However, a significant number of the nurses examined demonstrated incompetent proficiency in the practice of endotracheal tube suctioning. Furthermore, it was observed that; over two-thirds of the nurses examined demonstrated proficient skills in providing oral care, while a similar proportion exhibited inadequate skills in delivering eye care .

The findings of the present study align with the research conducted by **Ebrahim et al. (2023)**, indicated that; a significant proportion of the nurses examined had inadequate knowledge and skills in the areas of eye care and endotracheal suction for ventilated children. Specifically, more than half of the nurses demonstrated insufficient practice in eye care, while more than two-thirds exhibited a lack of proficiency in endotracheal suction. Furthermore, it should be noted that the findings of **Mahfoz et al. (2022)** reveal inconsistencies with the current study. Specifically, their research indicated that; prior to the implementation of nursing instruction, a significant proportion of nurses demonstrated satisfactory adherence to eye care protocols. Additionally, approximately three-quarters of the participants were found to adequately practice hand washing, while roughly two-thirds demonstrated adequate proficiency in endotracheal tube suctioning .

The findings of our current study differed from those of **Thabet et al. (2021)** found that; prior to implementing the training program, a majority of nurses engaged in complete endotracheal tube suctioning followed by hand washing. Additionally, their study revealed that; more than one-third of nurses incompletely practiced neonates' eye care. Furthermore, the findings of the present study diverged from those of **Mahmoud et al. (2017)** regarding the " effect of endotracheal suction intervention on oxygen saturation levels in preterm infants" , The aforementioned study reported that; over two-thirds of the participating nurses demonstrated proficient skills in performing endotracheal tube suctioning.

### Regarding total practice scores regarding care of high-risk neonates under mechanical ventilator

The results of the present study indicated that; a minority of the nurses examined demonstrated competent levels of total practice, while the majority exhibited levels of incompetence. The findings were consistent with a study conducted by **El-Garhy et al. (2020)**, which indicated that; a significant proportion of the nurses examined demonstrated inadequate overall proficiency in delivering nursing care to neonates undergoing mechanical ventilation.

The findings of the present study were incongruent with those of **Priyanka et al. (2017)**, as they revealed that; less than half of the surveyed pediatric nurses demonstrated moderately adequate practices in caring for children on mechanical ventilator during the pre-test phase. Additionally, the study conducted by **Hendy et al. (2020)** demonstrated that ;slightly over three-quarters of the nurses examined exhibited incompetence in providing care for high-risk patients connected to mechanical ventilation.

The present study findings align with the research conducted by **Hegazy & Abusaad (2019)** on "nurses' knowledge and practices regarding the care of neonates on

mechanical ventilator with respiratory distress." The results indicated that; over two-thirds of the nurses in the study demonstrated inadequate practical skills, while less than one-third exhibited competent practical skills in caring for neonates with respiratory distress on mechanical ventilation. The findings of this study align with the research conducted by **Ebrahim et al. (2023)**, which demonstrated that; over half of the surveyed nurses exhibited an overall inadequate level of practice in providing nursing care for children on mechanical ventilation. In contrast, slightly over two fifth demonstrated an overall sufficient level of practice.

From a researcher's perspective, the study findings suggest that the absence of an educational program and inadequate follow-up by hospital authorities may have contributed to the suboptimal nursing care provided to neonates on mechanical ventilation.

### Relation between total mean score of nurses' knowledge and practices with their selected demographic characteristics

The results of the present study indicate a statistically significant relationship between the overall average score of nurses' knowledge and their marital status and qualifications, with P-values of 0.026 and 0.031, respectively. The findings of this study align with the research conducted by **Thabet et al. (2021)**, demonstrating a significant correlation between the total knowledge score of the nurses under investigation and their qualifications .

Additionally, the results of the study were in line with the findings of **Mahfoz et al. (2022)**, who reported a statistically significant correlation between the overall score of the nurses' knowledge level and their demographic factors, including qualifications, years of experience, and participation in training programs ( $P < 0.017$ ,  $P < 0.049$ , and  $P < 0.016$ , respectively). Furthermore, the present study's findings align with those of **El-Garhy et al. (2020)**, demonstrating a positive correlation between the total knowledge of the nurses under investigation and their qualifications and years of experience ( $P < 0.001$ ).

Regarding relation between total mean score of nurses' practices with their selected demographic characteristics, the findings of the current study indicate a strong statistical correlation between the overall average score of nurses' practice and their marital status and qualification, with a P-value of 0.008 and 0.013, respectively.

The findings of this study were consistent with the research conducted by **El-Garhy et al. (2020)**, which demonstrated a significant positive correlation ( $P < 0.011$ ) between the overall practice of the nurses under investigation and their qualifications. Furthermore, the research conducted by **Ebrahim et al. (2023)** has provided clarification regarding the existence of a significant statistical correlation between the total practice score of nurses and their qualifications ( $P = 0.005$ ) within the pediatric intensive care unit (PICU).

The findings of the present study were found to be in contrast with the research conducted by **Qasem (2022)** on the "effectiveness of an intervention program on nurses' performance in neonatal endotracheal suctioning procedure", reported that; there was no statistically significant association between nurses' practice and variables such as age, years of experience in the neonatal intensive care unit, and participation in training sessions prior to the implementation of the program.

The findings of the present study align with the research conducted by **Thabet et al. (2021)**, which demonstrated a statistically significant association between the overall score of nurses' level of practice and their demographic variables, specifically marital status, qualifications, and years of experience ( $P < 0.034$ ,  $P < 0.012$ , and  $P < 0.011$ ), respectively.

The present study's findings align with the research conducted by **Mahfoz et al. (2022)**, which identified a statistically significant correlation between the overall score of the nurses' level of practice and their demographic characteristics, specifically their qualifications and years of experience in relevant programs ( $P < 0.039$  and  $P < 0.014$ ).

#### **Correlation between the studied nurse's knowledge and practice scores with selected demographic characteristics**

The findings of the present study have demonstrated that; there is no statistically significant correlation between the knowledge and practice of nurses. Furthermore, no statistically significant disparity was observed in terms of knowledge and practice when considering factors such as age and years of experience. The present study results align with the findings of **Tayel et al. (2017)** who conducted a study titled "implementation of ventilator-associated pneumonia prevention bundle in the neonatal intensive care unit at alexandria university children's hospital." Their study reported that; there was no statistically significant association between the overall scores of nurses' knowledge and their practice.

The findings of the present study were incongruent with the results reported by **Mahfoz et al. (2022)** and **Thabet et al. (2021)**, as they observed a statistically significant relationship between the total knowledge score and total practice score in the pre-test phase. In contrast to the findings of **El-Garhy et al. (2020)** and **Priyanka et al. (2017)**, this study reveals significant statistical differences between the overall knowledge and practice levels of the nurses under investigation ( $p$ -value  $< 0.001$ ). Furthermore, a notable correlation was observed between the knowledge scores of pediatric nurses in regard to the care of children on mechanical ventilator and their age and level of experience.

The findings of the present study were not in line with the study conducted by **Mostafa et al. (2016)** which demonstrated a statistically significant correlation between the knowledge score and practice score ( $p = 0.026$ ). Furthermore, the research conducted by **Hegazy and Abusaad (2019)** demonstrated a strong and statistically significant correlation between the knowledge and practice of the nurses under investigation.

#### **Conclusion**

Based on the findings of the present study, it could be concluded that; the vast majority of the studied nurses had poor knowledge regarding nursing knowledge of high-risk neonates under mechanical ventilator. As well as most of the studied nurses had an incompetent level of total practice. Also, there was a statistically significant relation between the total mean score of nurses' knowledge and practices and their marital status and qualification with  $P$  value at 0.026 and 0.031 for knowledge and  $P$  value at 0.008 and 0.013 for practices, respectively.

#### **Recommendations**

- Periodical educational training programs and workshops should be conducted for nurses working at NICU about

caring for mechanically ventilated neonates to raise and update nurses' knowledge and practice.

- Further research is required to enhance the knowledge and proficiency of nurses in the care of high-risk neonates who are connected to mechanical ventilator.
- It is recommended that the neonatal intensive care unit have readily accessible manual handbooks that contain essential nursing procedures for high-risk neonates who are connected to mechanical ventilator.
- Regularly scheduled assessments to evaluate the knowledge and practices of all nurses in relation to the care of high-risk neonates undergoing ventilator support.
- Further research can be done to guide nurses toward caring for high-risk neonates under mechanical ventilator.
- Nurses should develop and use protocols of care about neonates undergoing mechanical ventilation.

#### **Limitations of the study**

- 1- Lack of interest and cooperation from some of studied nurses.
- 2- There were many workloads of the nurses which was an obstacle during answering the questionnaires.
- 3- Small sample size to make generalization.

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