Nurses' Knowledge Regarding Care Provided to Children on Mechanical Ventilation

Abeer Abd El Khalik Ebrahim [1], Amal Mohammed El-Dakhakhny [2] &

Heba AbdAllah AbdElnabi [3]

(1) B.Sc. of Nursing, Faculty of Nursing Zagazig University , Egypt , [2] Professor of pediatric Nursing, Faculty of Nursing, Zagazig University, Egypt & [3] Lecturer of pediatric Nursing, Faculty of Nursing, Zagazig University, Egypt

Background: Mechanical ventilation is a form of life support technology used to perform the work of breathing for children who are unable to do this on their own .Thus providing adequate nursing care for children on mechanical ventilation is the most contribution to the successful management and outcomes. **Aim of the study:** Assess nurses' knowledge regarding care Provided to children on mechanical ventilation. **Subjects and Methods: Research design:** A descriptive design was utilized to conduct this study. **Setting:** The study was convoyed at Pediatric Intensive Care unit at Al -Ahrar Educational Zagazig Hospital, General Zagazig hospital and Zagazig University Hospital. **Subjects:** A convenient sample of 60 nurses**. Tools of data collections:** Structured questionnaire interview to assess nurses' knowledge regarding care provided to children on mechanical ventilation**. Results :** Revealed that two thirds of studied nurses had poor knowledge and there was highly statistically significant relation between nurses` total knowledge score and their qualifications and years of experience in a PICU. **Conclusion:** Studied nurses had poor knowledge regarding care provided To children on mechanical ventilation. **Recommendation:** Based on the results of the present study in –service training programs should be developed for nurses directed toward all aspects of care provided for children on mechanical ventilation.
Key words: Nurses' Knowledge, Care, Children, Mechanical Ventilation

Introduction

Mechanical ventilation (MV) refers to the use of life support technology that assist the work of breathing for children who are unable to effectively oxygenate and maintain enough oxygenation and ventilation until the underlying pathologic process resolves[1].

Mechanical ventilation (MV) is the skill of using devices to easily transport oxygen and Co2 between the atmosphere and the alveoli with the goal of improving pulmonary gas exchange. MV is pointing to physiological and medical reasons. Physiological objectives include supporting cardiopulmonary gas exchange thereby, increasing lung volume and inhibiting the work of[2].

The main goals of MV are to prevent hypoxemia and acute respiratory acidosis, cure respiratory distress, prevent atelectasis and respiratory muscle fatigue, allow sedation and neuromuscular blockade, limit oxygen consumption, drop in the intracranial pressure, normal chest wall, and facilitate diagnostic and therapeutic procedures without exhaustion and collapse [3].

The MV is one of the most common care provided in intensive care units (ICUs) in the world. It is indicated for acute respiratory failure, heart failure, sepsis as well as in situations where children are not able to protect their airways, such as drug overdose, slow reversal of anesthetic agents and neuromuscular diseases[4].

As regards physiological risks associated with MV including ventilator-associated lung injury (VALI) and nosocomial infection such as ventilator-associated pneumonia (VAP). Ventilator-associated lung injury occurs through alveolar over distention and cyclic opening and closing of alveoli resulting in diffuse alveolar damage, increased permeability as well as pulmonary edema, cell contraction and cytokine production. Complications can occur due to inappropriate application of mechanical ventilation. This may result in extra alveolar gas causing pneumothorax or subcutaneous emphysema due to high peak inspiratory pressures and alveolar stretch and edema formation as the result of large tidal volume [5].

Therefore, many complications can be prevented or treated rapidly through vigilant nursing care. Best practice includes the implementation of a "ventilator bundle"

for all mechanically ventilated children to prevent complications and improve outcomes [6].

The care for a child who is receiving MV requires extensive training and supervised practice. The child will require protection from infection, continuous monitoring of vital signs, observation for hypoventilation and hyperventilation, measurement of intake and output, and prevention of disabilities or inactivity. Safe practice is a moral and experienced duty of health professionals. Therefore knowledge is an important part of child security management. Assessing the knowledge and practice of ICU nurses led to the introduction of appropriate education protocols in ICUs. This could raise both child safety and the individualized children caretaking protocol-directed care[7].

The purpose to give good inclusive care for children, while decreasing health care power the nurse must have the knowledge, practices and abilities to correctly manage children have MV. It is essential that educators, students, and nurse professionals strive to develop the data necessary to successfully manage children receiving ventilation support, proper MV education strategies at all levels to the health care providers will have a large impact on improving the quality of child intervention in such a field[8].

Nurses play an essential role in providing safe and effective nursing care to improve the quality of nursing care provided for children to raise the survival rate for these children , decrease morbidity and mortality rates. They also must provide a safe environment for these children in the unit and follow the infection control policies [9].

Significance of the Study:

Children's care on MV cannot be simplified. It needs excellent knowledge about several ventilator variables. This knowledge need to be incorporated into accurate and efficient decisions about the best skills while also avoiding ventilator-related risks . So, critical care nurses must have specialized knowledge to practice efficiently in critical situations. Also, they should be able to have a competent level of care for children on the MV.

Therefore, this study was conducted to assess nurses' knowledge regarding care provided To Children on Mechanical Ventilation.

Aim of the study:
The present study aims to;

Assess nurses' knowledge regarding care provided to children on mechanical ventilation.

Research Question:

1-Do nurses have a good level of knowledge regarding nursing care for children on mechanical ventilation?

2- Is there relation between nurses' knowledge and their qualifications and years of experience?

Subjects and Methods:
Research design:

A descriptive design was used to carry out the present study.

Descriptive research is usually defined as a type of quantitative research, though qualitative research can also be used for descriptive purposes .The research design should be carefully developed to ensure that the results are valid and reliable.

Descriptive research is an appropriate choice when the research aim to identify characteristics, frequencies, trends and categories

Study setting:

The study was conducted at three settings :

Pediatric Intensive Care Unit of Al -Ahrar Educational Zagazig Hospital, General Zagazig hospital and Zagazig University Hospital.

Study Subjects:

Aconvenience sample of 60 nurses with experience more than 6 months were included in the study .

Tools for data collection:
Tool (1): Structured Questionnaire Interview

Structured interview questionnaire was developed by the researcher under supervision of supervisors after thorough review of relevant literatures to collect the required data . It was divided into two main parts as the following :-

Part (I) :Characteristics of studied nurses

Characteristics of the studied nurses including gender, age, marital status, qualification, years of experience and any previous training programs.

Part (II):

Nurses' knowledge about mechanical ventilation including 5 items (definition, indications, complications, indication of weaning from mechanical ventilation, as well as nurses' knowledge regarding nursing care for children on mechanical ventilation)

Scoring System: -

Total nurses' knowledge score was developed by the researcher, Respiratory system(12 points), Mechanical ventilation (22 points),Types of mechanical ventilation(20 points) , Nursing care provided to children on mechanical ventilation (49 points) and Endotracheal tube and its suction(27 points) . Each right answer was given 1 point and zero for wrong one .The total scored nurses' knowledge about mechanical ventilation and it's care was (130 points).

The total score of nurses' knowledge about mechanical ventilation and its care was classified as follows:

Correct answer was given one point
Incorrect answer was given zero point

*Good ≥ 75%
*Poor <75%

Content Validity and Reliability:

For validity assurance purposes, tools were developed after thorough review of the related literature and submitted to a jury of three nursing and medical experts including: two professor of pediatrics nursing and one professor of pediatric medicine, the recommended modifications were done and the final was ready to use. It also involved their general or overall opinion about the form regarding its clarity, relevance and suitability for implementation as well as their suggestions for any additions or omissions of items. According to their opinions all recommended modifications were ascertained by the researcher.

The reliability of the tool scale was tested through measuring its internal consistency. It demonstrated good level of reliability with Cronbach alpha test (range 0-1) when alpha test >0.9 (Excellent) , >0.8 (Good) , > 0.7 (Acceptable), > 0.6 (questionable) > 0.5 (poor) and ‹ 0.5 (unacceptable). The reliability of nurses ' knowledge assessment tool (questionnaire used was good it was **0.833** .

Pilot study:

A pilot study was carried out on 6 nurses (10% of nurses)to test clarity and applicability of the tools as well as to estimate the time needed for filling the data. According to these pilot study .The required modification were made .Those nurses who were involved in the pilot study were included in the study.

Field work:

Data was collected during six months in the period from beginning November 2021 to the end of April 2022 .The researcher started the data collection three days per week from 9 am to 2 pm at the morning shift. Each nurse was individually interviewed to complete Tool I. the time consumed to answer each questionnaire sheet ranged from 20-30 minutes.

Ethical consideration and administration design:

An official permission was obtained by submission of an official letter issued from the Dean of the Faculty of Nursing, zagazig University, to the Director of pediatric intensive care unit of Zagazig Children's University Hospital, Zagazig Educational Al-Ahrar Hospital and Zagazig General Hospital .Meeting was conducted first with the director of PICU to obtain permission for conducting the research, explaining the aim and expected outcomes.

Statistical analysis:

Data collected from the studied sample was revised, coded and entered using Personal Computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of frequencies, percentages and Mean SD. **Chi Square test** statistic is commonly used for testing relationships between categorical variables. **linear regression** is a linear approach for modeling the relationship between a scalar response and one or more explanatory variables .**Cronbach's Alpha test** was used to test reliability of tools.

Significance of the results

- Highly significant p-value < 0.01 **   .
- Statistically significant was considered p-value < 0.05*
- -Non-significant p-value > 0.05

Results :

Table (1) Shows characteristics of studied nurses, it was found that 88.3% of the studied nurses was females and 50% was in the age group of 20 <30 years old. Moreover 66.7% was married . Concerning years of experience 71.7% of studied nurses had 10years of experience or less. Also the same table shows that 63.3% of studied nurses had attended previous training courses about mechanical ventilations .

Figure (1):presents qualification of studied nurses . It was found that 43.3% of studied nurses was graduated from nursing technical institute while 33.3% was obtained bachelor degree of nursing.

Nurses 'knowledge about Mechanical Ventilation were presented in table (2)¸ it was clarified that 36.7% ,40% of studied nurses had correct answer about definition of Mechanical Ventilation and conditions that require placing the child on mechanical ventilation respectively. Regarding indication of mechanical ventilation and what are respiratory diseases that require placing a child on a mechanical ventilation it was found that 60% ¸ 66.7 of studied nurses were mentioned incorrect answer respectively. It is revealed that 68.3%¸70% of studied nurses had incorrect answer about most common places we use mechanical ventilation and when start using mechanical ventilation respectively. In addition71.7%¸66.7% of studied nurses was answered incorrectly about definition of positive end expiratory pressure (peep) and tidal volume respectively. Also the same table clarified that 68.3%, 70.0% of studied nurses reported incorrect answer about definition of peak inspiratory (PIP) and Fraction or inspired oxygen (FIO2) respectively.

Table (3) shows nurses' knowledge about types of Mechanical Ventilation ¸it was found that 66.7%, 65% of studied nurses had incorrect answer about definition of non-invasive mechanical ventilation, definition of invasive mechanical ventilation respectively. It is revealed from the table that 38.3% of studied nurses reported correct answer about which of the following ventilator modes depends on. In addition¸ 66.7%, 66.7% ¸ 63.3% of studied nurses was answered incorrectly about definition of controlled

Mandatory Ventilation (CMV), synchronous Intermittent Mandatory (SIMV), and continuous Positive Airway Pressure (CPAP) respectively. Regarding¸ indications of CPAP and most common condition in which it is necessary to use the CPAP¸ 68.3%¸ 60% of studied nurses were mentioned incorrect answer respectively. It was found that 65.0%, 61.7% of studied nurses was told incorrect answer i about advantages of using the CPAP and when start using the CPAP respectively.

Nurses knowledge about nursing care provided to children on mechanical ventilation were presented in table (4) ¸it was found that 41.7%of studied nurses had correct answer regarding when to sterilize the connections for the child connected to the CPAP . 56.7%   , 58.3% mentioned incorrect answer about what should the nurse do when the child has stopping breathing and What the first nursing care the nurse should do when the heartbeat stops respectively. ¸ It is revealed from the table that 63.3%   ,60.0% of studied nurses reported incorrect answer about what should the nurse do it after disconnecting the child from the mechanical ventilation and what should do in case of malfunction of mechanical ventilation respectively. Also the same table portrays that 41.7% , 40.0% of studied nurses had correct answer about what the nurse should do to prevent bedsores and oral ulcer for child on mechanical ventilation respectively.

Figure (2) reveals total scores of nurses knowledge about mechanical ventilation, it was found that 61.7% of the studied nurses had total poor knowledge score ,compared to 38.3% had total good knowledge score.

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Relation between characteristics of studied nurses and their total knowledge were presented in Table (5),it was clarified that there was statistically significant relation between nurses` total knowledge score and their age (P=0.011)and job (P=0.012).Statistically significant relation was found between nurses` total knowledge score and their years of experience (P=0.040) and attended training courses(P= 0.010). Also the same table revealed that there was highly

statistically significant relation between nurses` total knowledge score and their qualifications (P=0.002) and years of experience in a PICU (P=0.005).

Table (6) shows relation between characteristics of studied nurses and their total practice, it was found that there was statistically significant relation between nurses` total practice score and the nurses' age (P=0.023), years of experience (P=0.038) and attended training courses (P= 0.044).Also the same table clarified that there was highly statistically significant relation between nurses` total practice score and qualifications (P=0.005), job (P=0.009) and years of experience in a PICU (P=0.004).

Discussion.

Mechanical ventilation (MV) is an automatic device that provides all or part of the work of breathing for children who are unable to breathe sufficiently on their own. The goal of mechanical ventilation is to maintain adequate pulmonary gas exchange, reduce the work of breathing and decrease exhaustion for children. Mechanical ventilation is indicated for numerous clinical and physiological reasons. The nursing management of the mechanically ventilated child is challenging on many levels: from the acquisition of highly technical skills; expert knowledge on invasive monitoring; and implementation of interventions to care for the children (**Borden et al.,**) [10].

The current study showed that most of nurses in the study sample were females .This result agrees with the study that conducted in **Baghdad** City to provide information about nurses' knowledge concerning neonatal sepsis in neonatal intensive care units at pediatric teaching hospitals and mentioned that less than three quarters of the studied nurses were females. from a researcher point of view. This finding may be most of nursing school's graduates were female's students because large number of nursing schools was concerned for females (**Obaid. et al.,**)[11].

Regarding age of studied nurses، the result of the present study revealed that half of them were in the age group of 20 <30 years old with mean age 30.25±4.87 years this may be due to that, newly graduated and young age nurses usually assigned to work

in ICUs and emergency departments. while higher age category 'senior nurses' perform administrative roles. This result goes in line with the study that conducted to assess nurses' knowledge toward the continuous positive airway pressure (CPAP) machine in neonatal intensive care unit in Al- Diwanyia and found that more than half of the studied nurses were in the age group of 20 <30 years old. (**Aziz &Abdul-Hamza**) [12].

On the other hand, this finding contradicts with the study that carried out to investigate the effect of simulation-based suction education on knowledge and performance of pediatric intensive care unit nurses in Tanzania and reported that, more than half of nurses their age ranged from 40-49years old(**Ebrahimi et al.,**) [13]. .

The study that conducted to assess nurses' knowledge and practices related neonatal sepsis in the neonatal intensive care units in **El-Minia** and reported that more than half of studied nurses were graduated from nursing technical institute. This finding was supported with the present study that showed less than half of studied nurses were graduated from nursing technical institute. This finding might be due to in Egypt nursing education showed noticeable growth of academic degrees and replacement of technical secondary school of nursing by technical institute of nursing this make bridging to allow carriers of secondary school diploma degree to increase their qualification and therefore, to be recruited in the critical care units believing that these cadres could have better knowledge and skills of caring for high -risk neonates (**Ibrahim et al.,**) [14].

the current study showed that two thirds of studied nurses had poor knowledge about indication of mechanical ventilation .This result is in same line with the study that conducted to assess nurses' knowledge toward the continuous positive airway pressure (CPAP) machine in neonatal intensive care unit at Al-Diwanyia City Hospitals in Baghdad and found that most of the studied nurses had low knowledge about indication of mechanical ventilation. from a researcher point of view. This finding may be due to lack of educational program to refresh nurses 's knowledge about mechanical ventilation (**Aziz &Abdul-Hamza**) [12].

Concerning Nurses knowledge about types of mechanical ventilation, the result of present study displayed that less than two thirds of studied nurses had poor knowledge about types of mechanical ventilation. This result may be due to more than one third of studied nurses not attended training courses and only one third of them had bachelor nursing. This result matches with the study that conducted to assess knowledge of pediatric critical care nurses regarding evidence based guidelines for prevention of VAP in both pediatric and neonatal intensive care units in Egypt and showed that most of the studied nurses had inadequate knowledge about types of mechanical ventilation**(Ahmed &Abosamra)**[15].

The study that performed to assess nurses' performance regarding care of children undergoing mechanical ventilation in **Egypt** and mentioned that more than half of the studied nurses had satisfactory knowledge about the nursing care provided to children on mechanical ventilation. This finding disagrees with the present study that illustrated that less than two thirds of the studied nurses had poor knowledge nursing care provided to children on of mechanical ventilation. this result might be due to lack of educational program and head nurse's follow up about nursing care provided to children on of mechanical ventilation **(Mostafa et al.,)** [16].

The present study that revealed less than two thirds of the studied nurses had poor knowledge about mechanical ventilation. This finding is in agreement with the study that carried out in **Egypt** to evaluate the influence of training program implementation on nurses' performance regarding neonates invasive mechanical ventilation and found that more than half of the studied nurses had poor knowledge about mechanical ventilation., this result might be due to lack of nurses' motivation for learning and limited number of nursing staff **(Thabet et al.,)** [17].

The study that conducted in Benha University Hospital, Teaching Hospital and Specialized Pediatric Hospital, **Egypt** and found that there was a statistically significant difference between nurses' total knowledge score and their age, qualifications, job ,

years of experience, years of experience in a PICU and attended training courses**.** This finding is in the same line with the current study that illustrated that there was a statistically significant relation between nurses' level of knowledge and age, qualifications, job, years of experience, years of experience in a PICU and attended training courses (**Abdel-fattah et al.,)** [18].

Conclusion:

In the light of the current study findings, It could be concluded that the studied nurses had poor knowledge about nursing care provided for children on mechanical ventilation **.**

Recommendations:

Based on finding, the study recommended:

1-In service training programs should be developed for nurses directed toward all aspects of care provided for children on mechanical ventilation.

2- Designing suitable booklet and boosters about proper care of children on mechanical ventilation.

3-Establishing standard of care for children on mechanical ventilation is essential.

4-Further studies are suggested to design , implement and evaluate a training program to improve nurses' performance regarding care provided to children on mechanical ventilation.

Table (1):Distribution of studied nurses according to their demographic characteristics (n=60).

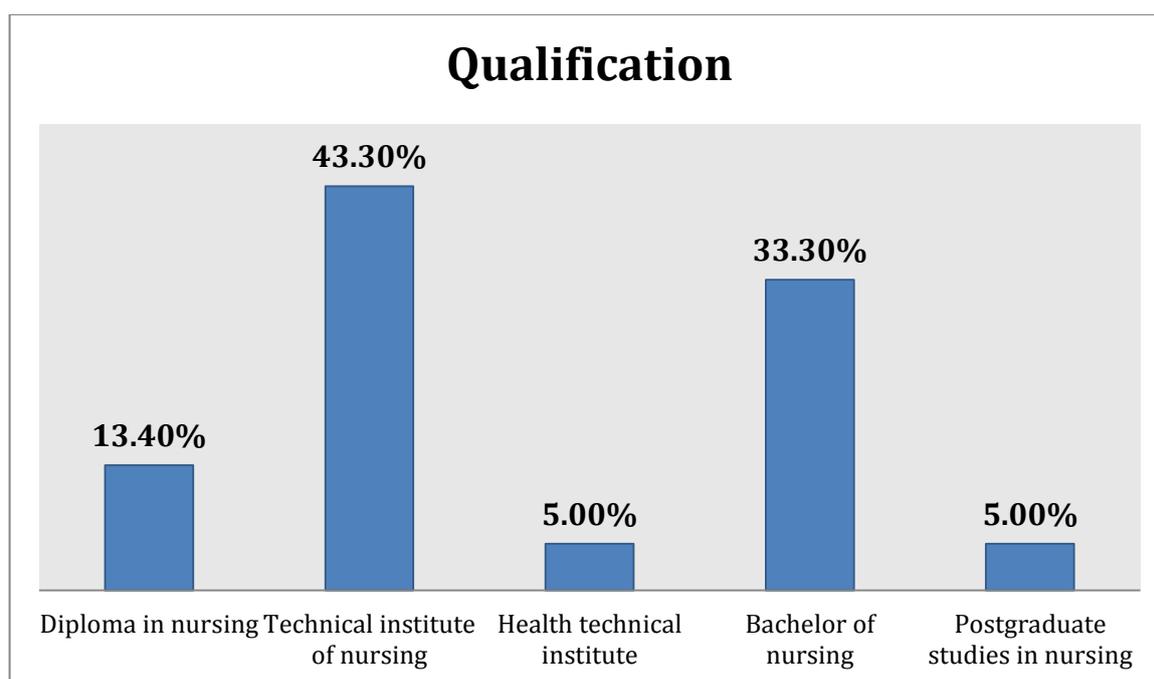| Characteristics	N	%
Gender		
Male	7	11.7
Female	53	88.3
Age /years		
20 – 30	30	50.0
30 – 40	27	45.0
≥40	3	5.0
$\bar{x}$S.D 30.25±4.87		
Marital status		
Single	17	28.3
Married	40	66.7
Divorced	2	3.3
Widow	1	1.7
Years of experience		
≤ 10 years	43	71.7
> 10 years	17	28.3
$\bar{x}$S.D 6.93±2.35 years		
Have you attended training courses for nursing care of cases on the ventilator		
Yes	38	63.3
No	22	36.7

Figure (1): Distribution of studied nurses according to their qualification.

Table (2): Nurses' Knowledge about Mechanical Ventilation (n=60).

Nurses' knowledge	Correct		Incorrect	
	N	%	N	%
Definition of mechanical ventilation	22	36.7	38	63.3
Conditions that require placing the child on mechanical ventilation	24	40.0	36	60.0
Indications of mechanical ventilation	24	40.0	36	60.0
What are respiratory diseases that require placing a child on a mechanical ventilation	20	33.3	40	66.7
The most common places we use mechanical ventilation	19	31.7	41	68.3
When start using mechanical ventilation	18	30.0	42	70.0
Definition of positive end expiratory pressure (peep)	17	28.3	43	71.7
Function of positive end expiratory pressure(peep)	19	31.7	41	68.3
Definition of tidal volume	20	33.3	40	66.7
Definition of peak inspiratory pressure (PIP)	19	31.7	41	68.3
Definition of Fraction or inspired oxygen (FIO2)	18	30.0	42	70.0

Table (3): Nurses' Knowledge about Types of Mechanical Ventilation (n=60).

Nurses' knowledge	Correct		Incorrect	
	N	%	N	%
Definition of non-invasive mechanical ventilation	20	33.3	40	66.7
Definition of invasive mechanical ventilation	21	35.0	39	65.0
Which of the following ventilator modes depend on	23	38.3	37	61.7
Definition of controlled Mandatory Ventilation (CMV) is	20	33.3	40	66.7
Definition of synchronous Intermittent Mandatory (SIMV)	20	33.3	40	66.7
Definition of continuous Positive Airway Pressure (CPAP)	22	36.7	38	63.3
Indications of CPAP	19	31.7	41	68.3
Most common condition in which it is necessary to use the CPAP	24	40.0	36	60.0
Advantages of using the CPAP	21	35.0	39	65.0
When start using the CPAP	23	38.3	37	61.7

Table (4): Nurses Knowledge about Nursing Care Provided to Children on Mechanical Ventilation (n=60).

| Nurses' Knowledge	Correct		Incorrect	
	N	%	N	%
When to sterilize the connections for the child connected to the CPAP	25	41.7	35	58.3
What should the nurse do when the child has stopping breathing	26	43.3	34	56.7
What the first nursing care the nurse should do when the heartbeat stops	25	41.7	35	58.3
What should the nurse do it after disconnecting the child from the mechanical ventilation	22	36.7	38	63.3
reason for not entering air to the child on mechanical ventilation (Ventilator inoperative)	20	33.3	40	66.7
What the nurse should do in case of a malfunction of mechanical ventilation	24	40.0	36	60.0
What should the nurse do to prevent the bed sores for the child on mechanical ventilation	25	41.7	35	58.3
What the nurse should do to prevent the oral ulcers for the child on mechanical ventilation	24	40.0	36	60.0
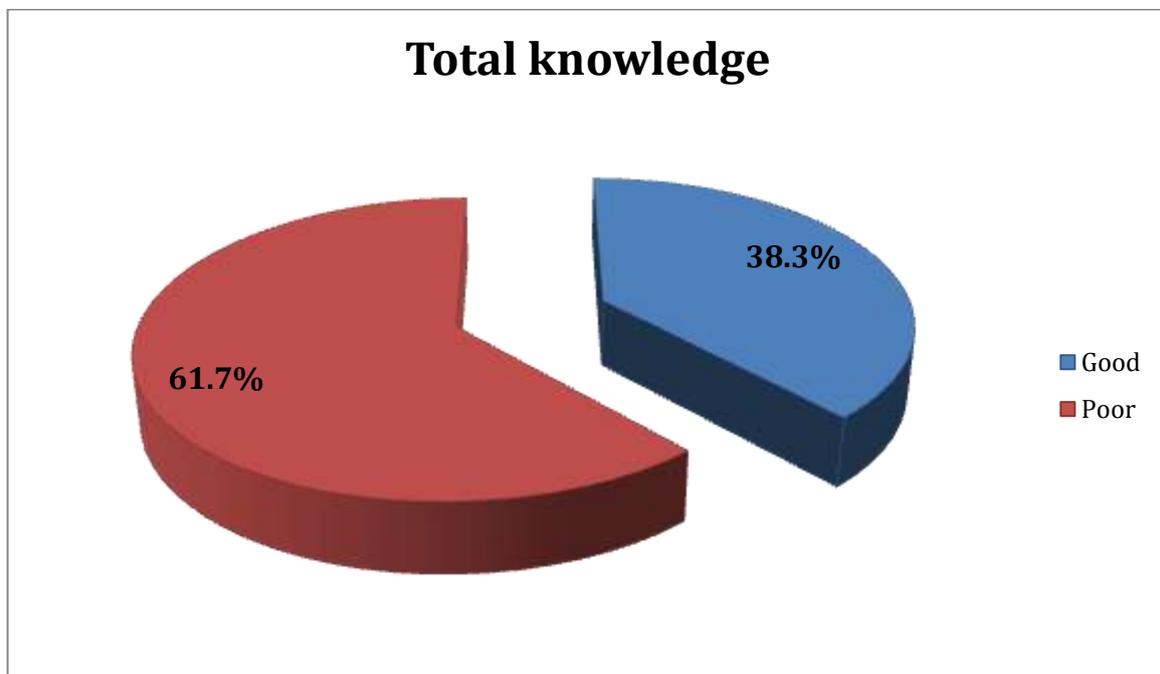
Figure (2): Total Scores of Nurses' knowledge about Mechanical Ventilation

Table (5): Relation between Characteristics of Studied Nurses and Their Total Knowledge (n=60).

Characteristics		Total knowledge				X^2	P-Value
		Good (n=23)		Poor (n=37)			
		N	%	N	%		
Gender	Male	5	21.7	2	5.4	1.063	.064
	Female	18	78.3	35	94.6		
Age	20 - 30	19	82.7	11	29.7	5.201	.011*
	30 - 40	3	13.0	24	64.9		
	≥40	1	4.3	2	5.4		
Marital status	Single	7	30.5	10	27.0	4.950	.550
	Married	14	60.9	26	70.3		
	Divorced	1	4.3	1	2.7		
	Widow	1	4.3	0	0		
Qualification	Diplom in nursing	0	0	8	21.6	9.022	.002**
	Nursing technical institute	2	8.7	24	64.9		
	Health technical institute	1	4.3	2	5.4		
	Bachelor of nursing	17	73.9	3	8.1		
	Postgraduate studies in nursing	3	13.0	0	0		
Job	Nurse	9	39.1	36	97.3	4.560	.012*
	Head of Department	2	8.7	0	0		
	Supervisor	12	52.2	1	2.7		
Years of experience	≤ 10 years	8	34.8	35	94.6	10.25	0.040*
	≥ 10 years	15	65.2	2	5.4		
Years of experience in a PICU	<3	0	0	22	59.5	7.901	.005**
	3-6	1	4.3	13	35.1		
	6-9	10	43.5	2	5.4		
	≥9	12	52.2	0	0		
Attended training courses	Yes	20	87.0	18	48.6	5.548	.010*
	No	3	13.0	19	51.4		

*Significant at p ‹0.05. **Highly significant at p ‹0.01. Not significant at p>0.05

Table (6):   Multiple Linear Regression Model for Total Knowledge of Studied Nurses (n=60).

Items	Unstandardized Coefficients	standardized Coefficients	T	P. value
	B	B		
Age	.145	.095	4.625	.029*
Qualification	.297	.164	8.305	.000**
Job	.199	.241	2.101	.031*
Years of experience	.139	.089	3.917	.025*
Years of experience in a PICU	.399	.246	6.595	.004**
Attended training courses	.201	.273	4.870	.030*

ANOVA				
Model	R^2	Df.	F	P. value
Regression	**0.51**	5	12.604	.000**

a. Dependent Variable: **Total Knowledge**
b. Predictors: (constant): **Age, Qualification, Job title, Years of experience, Years of experience in a PICU and Attended training courses**

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