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ORIGINAL RESEARCH

Nurses' Knowledge Regarding Oxygen Therapy; a Cross-Sectional Study

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Abstract: **Introduction:** Oxygen therapy, if done correctly, can save patients' life promptly. However, improper use will be just as dangerous. The present study aimed to investigate the level of nurses' knowledge on properly using oxygen. **Methods:** This was a cross-sectional study with a minimum sample size of 72 nurses who were randomly selected from various wards of Masih Daneshvari Hospital, Tehran, Iran. To determine the level of knowledge about oxygen therapy, a questionnaire was used to collect data. This questionnaire consists of seven items, each of which is designed to determine the level of the individual's knowledge about the various details of oxygen therapy. **Results:** Seventy-eight nurses with the mean age of 35.80±7.42 years participated in the study (87% female). The mean knowledge score of nurses regarding oxygen therapy was 8.89 ± 2.79 out of 16 points. 84.6% of the nurses were able to differentiate various types of oxygen masks. Accordingly, 94.9% of nurses had good knowledge on oxygen humidification. Also, 50% of the nurses had sufficient knowledge about the amount of oxygen flow produced by different masks. 10.3% of the nurses could choose the most appropriate mask for different clinical conditions. 6.4% of the nurses had knowledge of working with flowmeters, and 15.4% of the nurses had sufficient information about the maximum level of oxygen required for the patient. 17.9% of the nurses were familiar with measuring the appropriate amount of oxygen for patients. There was no statistically significant relationship between age (p = 0.57), gender (p = 0.09), employment status (p = 0.38), workplace (p = 0.86), current position (p = 0.11), degree (p = 0.27), and graduation time (p = 0.58) of nurses with good knowledge of using oxygen. However, a statistically significant relationship was reported between nurses' related work experience and their knowledge of the proper use of oxygen (p = 0.03). **Conclusion:** In general, the nurses' knowledge at Masih Daneshvari Hospital on how to properly use oxygen is at a moderate level. Nurses' knowledge in some areas, such as working with the flowmeter, choosing the suitable mask for specific clinical conditions, and the maximum oxygen required for patients, is meager and requires training intervention.

Keywords: Oxygen Inhalation Therapy; Nurses; knowledge

1. Introduction

Oxygen is an essential element of life. However, it can have both extraordinary biological benefits and acute toxic effects, like medicine. In addition, the World Health Organization has introduced oxygen as one of the essential medical items required in the health system (1). Supplemental Oxygen Therapy (SOT) is a treatment that plays a vital role in preventing and managing tissue hypoxemia in patients with acute and chronic problems (2,3). This method, if used correctly, can improve treatment outcomes and save the patient's life; however, improper use can be extremely harmful (4).

According to the British Thoracic Society guidelines, the indicator of proper oxygen therapy is to achieve normal or near-normal oxygen levels of inpatients in the intensive care unit (ICU) or emergency (5). The amount and method of delivering oxygen to the patient depend on the underlying condition and whether the patient's condition is acute or chronic. The choice of device and the right amount of oxygen depends on many factors, such as the patient's age, the doctor's treatment goals, and patient's tolerance (6,7). Oxygen should be administered to achieve a 94-98% saturation level for most patients

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with acute conditions or 88-92% for patients at risk of respiratory failure (8). Breathing oxygen at a concentration more than 50% can poison the patient after 24 hours (9). The central nervous system, the respiratory system (especially the lungs), and the eyes are the organs that are primarily affected by the improper use of oxygen. Given that there is no treatment that can reverse toxic pulmonary changes, the only logical way is to prevent oxygen-induced poisoning (10). For this reason, it is essential to employ experienced staff to use oxygen, and monitor arterial blood gases and pulse oximetry of the patient.

In most medical centers, nurses are responsible for oxygen therapy and immediate response to the undesirable therapy-induced effects (11). Based on studies conducted in different countries, in most cases, there is a significant knowledge gap in nurses' knowledge about how to use oxygen properly (12–14). For example, studies in Ethiopia indicated that only one-third of nurses had the practical knowledge to use oxygen (15). Another study in Turkey found that nurses over 45 or those with more than 14 years of experience in the ward and nurses in the surgical ward were significantly less likely to use oxygen properly (16). Studies conducted in Saudi Arabia also showed a lack of proper knowledge among nurses about oxygen therapy. According to the results, high workload and lack of local guidelines were the fundamental causes (12). Studies conducted in Uganda have also shown that all nurses need training in this area (17). The present study aimed to investigate the knowledge of nurses working in an educational hospital on the correct use of oxygen for therapy.

2. Method

2.1. Study design and setting

In this cross-sectional study, nurses were consecutively enrolled from different wards of Masih Daneshvari Hospital, Tehran, Iran, from October to December 2021. The nurses' knowledge about various aspects of oxygen therapy was investigated using a predesigned and validated questionnaire. Prior to implementation, the study protocol was discussed in the Research Ethics Committee of Shahid Beheshti University of Medical Sciences and approved with the code of ethics number IR.SBMU.MSP.REC.1399.565.

2.2. Participants

All nurses working in Masih Daneshvari Hospital were included without sampling. The inclusion criterion was working as a nurse in one of the hospital's clinical wards. Nurses who did not want to participate in the study and fill out the questionnaire were excluded from the study.

Table 1: Baseline characteristics of studied cases

Variables	Values
Age (year)	35.80 ± 7.42
Gender	
Male	10 (13)
Female	68 (87)
Academic degree	
Bachelor's	73 (93.6)
Master's	5 (6.4)
Employment status	
Contractual	15 (19.2)
Permanent	49 (62.8)
Compulsory medical service program	12 (15.4)
Temporary	2 (2.6)
Workplace	
ICU Emergency	6 (7.7)
ICU Internal	7 (9.0)
Emergency	3 (3.8)
Internal ward	12 (15.4)
Pediatric ward	5 (6.4)
Oncology	5 (6.4)
Surgery	16 (20.5)
ICU surgery	5 (6.4)
CCU	12 (15.4)
Bronchoscopy	2 (2.6)
Infectious diseases emergency	5 (6.4)
Current position	
Nurse	67 (86)
Nursing assistant	4 (5)
Supervisor (Matron)	7 (9)
Graduation time (year)	11.28 ± 7.77
Work experience in Masih Daneshvari Hospital	
Less than eight months	17 (21.8)
8-16 months	40 (51.2)
More than 16 months	21 (27)
Relevant work experience	
Less than eight years	29 (37.2)
8-16 years	28 (35.8)
More than 16 years	21 (73)
Relevant educational experience	
Yes	46 (59)
No	32 (41)

Data are presented as mean ± standard deviation (SD) and frequency (%) ICU: intensive care unit; CCU: critical care unit.

2.3. Data gathering

The questionnaire previously used in the study by Cinar et al. (18), which comprised seven questions and each question was designed to determine the individual's knowledge level about the various aspects of oxygen therapy, was used for data gathering. The questionnaire was translated into the Persian language. Specialists confirmed its validity, and its reliability of was verified by conducting a pilot study (on 20 nurses outside of the sample, α=0.7). After distributing

Table 2: Frequency distribution of correct answers given by nurses to the Questionnaire

Questions	Value
Q1. Identifying the types of oxygen masks	
A	69 (88.5)
B	73 (93.6)
C	69 (88.5)
D	71 (91.0)
Q2: The amount of oxygen flow produced by different masks	
A	39 (50.0)
B	41 (52.6)
C	62 (79.5)
D	63 (80.8)
Q3: How to choose the most suitable mask for different clinical conditions	
A	18 (23.1)
B	17 (21.8)
C	35 (44.9)
D	32 (41.0)
Q4: How to measure the suitable amount of oxygen for the patient	14 (17.9)
Q5: How to work with a flowmeter	5 (6.4)
Q6: Maximum oxygen level required for the patient	12 (15.4)
Q7: Oxygen humidification	74 (94.9)

Data are presented as number (%).

the questionnaire among the nurses, they were asked to answer the questions within 20 minutes. For each correct answer to the questions, a score of one, and for each incorrect answer, a score of zero was considered. Given that the first three questions consisted of four sections, the possible scores ranged from zero to 16. Questionnaires were completed anonymously.

The first part of the questionnaire includes demographic information and details about the degree, graduation time, employment status, work experience in Masih Daneshvari Hospital, related work experience, workplace in the hospital, current position, and history of attending oxygen therapy course.

2.4. Statistical analysis

After the questionnaires were filled out, the data were entered into SPSS software version 23 and analyzed. Mean and standard deviation were used to describe qualitative variables, and frequency to describe quantitative variables. One-way analysis of variance was used to investigate the relationship between nurses' level of knowledge on how to use oxygen and independent study variables. The significance level of the calculations was considered 0.05.

3. Results

3.1. Baseline characteristics of studied nurses

A total of 78 nurses with a mean age of 35.80±7.42 years participated in the study (87% female). Most of the nurses in the study had a bachelor's degree (93.6%) and were permanently employed (62.8%). Most nurses' work experience was between 8 and 16 months (51.2%), and 59% of nurses had previously received oxygen therapy training. Table 1 shows more details about the baseline characteristics of the studied nurses.

3.2. Knowledge of the studied nurses regarding O2 therapy

Reviewing the nurses' answers to the questions showed that none of the nurses could answer all the questions correctly. Details of the correct answers provided to the questions are shown in Table 2. The overall mean score obtained from the questionnaire was 8.89± 2.79. There was no statistically significant relationship between age (p = 0.57), gender (p = 0.09), employment status (p = 0.68), workplace (p = 0.86), current position (p = 0.11), degree (p = 0.27), and graduation time of nurses (p = 0.58) and their knowledge of using oxygen properly. Besides, there was no statistically significant relationship between nurses' work experience in Masih Daneshvari Hospital and the history of oxygen therapy training courses with their knowledge of properly using oxygen (p = 0.15). However, there was a statistically significant relationship between nurses' relevant work experience and their knowledge of properly using oxygen (Table 3).

4. Discussion

According to the results of the present study, the mean score obtained by nurses from the questionnaire to determine the level of knowledge of oxygen therapy was 8.89± 2.79. Given that the maximum score is 16, it can be said that most nurses had a moderate knowledge of properly using oxygen. The obtained results were consistent with similar studies in other parts of the world. For example, in Zeleke and Kefale's study, only one-third of the nurses had relevant practical knowledge of the proper use of oxygen (15). In Demirel and Kazan's study, the nurses' knowledge of oxygen therapy was much lower than expected (16). In addition, the results of the present study, along with other studies, indicate that nurses do not receive adequate training on how to properly work with oxygen. However, more detailed studies on each of the questionnaire areas indicate that in some areas, nurses have a relatively good level of knowledge; in contrast, in some areas they are severely weak. For example, in the present study, 84.6% of the nurses were able to differentiate between various types of oxygen masks. However, in the study of Demirel

Table 3: Investigating the relationship between independent research variables and nurses' knowledge about oxygen therapy

Variables	Values	P-value
Age (year)		
Less than 30	9.3±04.24	
30-40	8.2±63.85	0.57
More than 40	8.2±91.33	
Gender		
Male	8.2±94.64	0.09
Female	7.4±57.28	
Academic degree		
Bachelor's	8.2±81.82	0.27
Master's	9.2±80.77	
Employment status		
Contractual	8.3±07.93	
Permanent	9.2±10.36	0.38
Compulsory medical service program	9.3±00.13	
Temporary	10.0±50.71	
Workplace		
ICU Emergency	7.2±67.66	
ICU Internal	7.3±43.74	
Emergency	10.0±67.58	
Internal ward	9.2±33.50	
Pediatric ward	9.2±60.07	
Oncology	9.2±00.55	0.86
Surgery	8.2±50.75	
ICU surgery	10.1±00.87	
CCU	10.0±50.76	
Bronchoscopy	7.2±50.12	
Infectious diseases emergency	9.2±60.19	
Current position		
Nurse	9.2±43.21	
Nursing assistant	11.0±50.71	0.11
Supervisor (Matron)	8.2±00.83	
Graduation time		
Less than ten years	8.3±25.26	
10-20 years	9.2±30.45	0.58
More than 20 years	9.2±22.33	
Work experience		
Less than eight months	9.2±12.83	
8-16 months	9.2±23.38	0.15
More than 16 months	8.2±67.64	
Relevant work experience		
Less than eight years	8.3±79.28	
8-16 years	9.1±55.99	0.03
More than 16 years	8.2±80.40	
Relevant educational experience		
Yes	9.2±20.45	0.38
No	8.3±36.3	

Data are presented as mean ± standard deviation (SD). ICU: intensive care unit; CCU: critical care unit.

and Kazan (16) and Cinar et al. (18), nurses' knowledge about recognizing different types of masks was less than in the present study. The cause can be the type of hospitals studied. In addition, nurses working in public hospitals were evaluated in the two mentioned studies. Many oxygenation methods and masks are not used in these hospitals, so the lower level of nurses' knowledge about the type of masks is not surprising. However, Masih Daneshvari Hospital is a specialized hospital for respiratory diseases, for this reason, different types of oxygenation methods are used in the clinics of this hospital. Therefore, it seems logical that the knowledge of this hospital's nurses regarding the types of masks and oxygenation methods is higher than other hospitals.

Another area in which the nurses' knowledge was at a de-

sirable level is oxygen humidification. Oxygen can easily remove humidity from the upper respiratory tract membrane. Proper oxygen humidification can stimulate secretions in the upper respiratory tract membrane and make the patient comfortable (19). Therefore, nurses' knowledge of oxygen humidification is vital in the oxygen therapy process. In the present study, most nurses (94.9%) had the correct knowledge of oxygen humidification. In the studies of Arsalan et al. (20) and Demirel and Kazan (16), more than 95% of nurses answered the question about the knowledge of oxygen humidification correctly. However, this is not far from the expectation because oxygen humidification is among the primary information provided in nursing education.

According to obtained results, only 50% of the nurses had sufficient knowledge about the amount of oxygen flow produced by different masks. In other areas of the questionnaire, nurses' knowledge was much lower. Therefore, only 10.3% of the nurses could choose the most appropriate mask for different clinical conditions. Similarly, only 6.4% of the nurses knew how to work with a flowmeter, and only 15.4% of them had sufficient knowledge about the maximum level of oxygen needed by the patient. The lack of' correct answers to the questions presented in the mentioned areas indicates the lack of nurses' knowledge in these areas.

The latest report from the National Health System (NHS) on oxygen safety suggests that the main concern about oxygen safety includes determining the amount of oxygen a patient needs (21). Given that excessive or insufficient oxygen administration can significantly affect patient health and treatment outcomes, the desired level of nurses' knowledge in this area will be of great importance. However, in the present study, only 17.9% of nurses were familiar with measuring the appropriate amount of oxygen for patients.

In general, none of the nurses were able to answer all the questions correctly. This rate was significantly lower than the rate reported in a similar study conducted by Cinar et al. in Turkey. In this study, despite most nurses' low knowledge about the correct way of oxygen therapy, 9% of nurses correctly answered all the questions (18).

Based on the present study's results, having relevant work experience had a significant relationship with nurses' knowledge. Nurses who had between 8 and 16 years of relevant work experience were more knowledgeable about oxygen therapy. However, nurses with more than 16 years of experience had a lower average level of knowledge than nurses with 8 to 16 years of experience. Age also seems to be an influential factor in nurses' knowledge of how to appropriately work with oxygen, because in younger nurses (less than 30 years), the average score was higher than other nurses. However, the observed difference was not statistically significant. In Demirel and Kazan's (16) research, nurses older than 45 years had obtained significantly lower scores. The significance of the relationship in the study of Demirel and Kazan may be due to the higher volume of samples studied.

In the current study, the average score obtained by nurses with a master's degrees was also higher than nurses with a bachelor's degree. However, this difference was not statistically significant. Similarly, there was no statistically significant relationship between nurses' gender and their average score. In Demirel and Kazan's study (16), there was no statistically significant relationship between nurses' degree and gender with their level of knowledge of oxygen therapy. There was no statistically significant relationship between nurses' employment status, current position, length of nurses' experience in this hospital, and nurses' graduation time with their level of knowledge on properly using oxygen. Among the nurses working in different hospital wards, the nurses in the emergency ward scored higher than the nurses in other wards. However, this difference was not statistically significant.

One of the practical factors in nurses' ability to perform their tasks and provide proper care is complete mastery in that functional area. Training programs and regular retraining on the proper use of oxygen can help build mastery in nurses. Some other measures may also help improve the condition. Educational posters, information through various information channels about the effects, role, and risks of oxygen therapy, and the development of standard guidelines for the practical guidance of nurses are some of the suggested measures that can affect the level of nurses' knowledge on properly using oxygen.

5. Limitations

This study had some limitations. First, the present study only examined the nurses working in Masih Daneshvari Hospital. Therefore, the generalization of the results to the nurses of other hospitals in the country should be made cautiously. Also, due to the small sample size, the interpretation of relationships between variables should be made with caution. In order to accurately identify the factors affecting nurses' knowledge about oxygen therapy, it is suggested that a multi-center study be conducted.

6. Conclusion

According to the present study's results, in general, the nurses of Masih Daneshvari Hospital have a moderate knowledge of properly using oxygen. In some areas, such as working with flowmeters, choosing the suitable mask for specific clinical conditions, and the maximum oxygen required for patients, nurses' knowledge is deficient and requires educational intervention.

7. Declarations

7.1. Acknowledgments

7.2. Author contribution

Study design: Hojjat Derakhshanfar, Maryam Hassanzad
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Data analysis: Mahsa Mirzendehdel, Elham Sadati
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7.4. Conflict of Interest

There is no conflict of interest for the authors.

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