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ASSESSING CRITICAL CARE NURSES' KNOWLEDGE ON OXYGEN THERAPY IN COVID-19 PATIENT CARE IN TURKIYE; A MULTICENTER STUDY

TÜRKİYE'DE COVID-19 TANILI HASTALARA BAKIM VEREN YOĞUN BAKIM HEMŞİRELERİNİN OKSİJEN TEDAVİSİNE İLİŞKİN BİLGİ DÜZEYLERİ: ÇOK MERKEZLİ BİR ÇALIŞMA

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ABSTRACT

Objective: Oxygen therapy for individuals with COVID-19 includes best practices for supportive management of acute respiratory syndrome. The aim of this study was to determine critical care nurses' levels of knowledge on oxygen therapy during the COVID-19.
Method: This was a descriptive study. The study was conducted with COVID-19 critical care nurses (N=446) in a total of 16 hospitals affiliated with a healthcare group in Turkiye. A total of 322 nurses were included in the study. The data were collected via the Oxygen Therapy Information Form prepared based on the literature through Google survey.
Results: According to the oxygen therapy subscales, the mean score of the nurses varied from 40.77 to 86.21, and their total mean score was 72.99 (fairly). The nurses' knowledge on oxygen therapy was strongly correlated with their educational level and manner of work ($p<0.05$).
Conclusions: It can be asserted that in oxygen therapy, their knowledge on nursing interventions was adequate; however, their knowledge on oxygen therapy definitions and concepts was inadequate. In order to develop patient safety concerning oxygen therapy in COVID-19 patients, it is recommended that training programs be planned and competencies of nurses be assessed. In order to qualify legal competence about the safe oxygen therapy, clear protocols and professional guidelines are recommended.
Keywords: Critical Care Nurses, COVID-19, Intensive Care Unit, Patient Safety, Oxygen Therapy

ÖZ

Amaç: COVID-19 tanılı hastaların tedavi yönetiminde oksijen tedavisinin önemli bir yeri vardır. Bu araştırma COVID-19 tanılı hastalara bakım veren yoğun bakım hemşirelerinin oksijen tedavisine ilişkin bilgi düzeylerinin belirlenmesi amacıyla planlandı.
Yöntem: Tanımlayıcı çalışma, Türkiye'de özel bir sağlık grubuna bağlı toplam 16 hastanede COVID-19 yoğun bakım hemşiresi (N=446) ile gerçekleştirildi. Araştırmaya toplamda 322 hemşire dahil edildi. Veriler, Google anket aracılığıyla literatür kapsamında hazırlanan Oksijen Tedavisi Bilgi Formu ile toplandı.
Bulgular: Hemşirelerin oksijen tedavisi alt boyutlarından aldıkları puanlar ortalama 40,77 ile 86,21 arasında değişmekte olup toplam puan ortalamaları 72,99'dır. Hemşirelerin eğitim düzeyleri ve çalışma şekillerinin oksijen tedavisi bilgi düzeylerini etkilediği belirlendi ($p<0,05$).
Sonuç: Hemşirelerin, oksijen tedavisinde hemşirelik girişimlerine yönelik bilgilerinin yeterli; ancak oksijen tedavisi tanım ve kavramlarına ilişkin bilgilerinin yetersiz olduğu söylenebilir. COVID-19 hastalarında oksijen tedavisi ile ilgili hasta güvenliğinin geliştirilmesi için eğitim programlarının planlanması ve hemşirelerin yetkinliklerinin değerlendirilmesi önerilmektedir. Güvenli oksijen tedavisi konusunda yasal yetkinliği sağlamak için rehber ve kılavuzların geliştirilmesi önemlidir.
Anahtar Kelimeler: Yoğun Bakım Hemşireliği, COVID-19, Yoğun Bakım Ünitesi, Hasta Güvenliği, Oksijen Tedavisi

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INTRODUCTION

Oxygen therapy (OT) is commonly used by patients staying in hospital (1) and is listed on the World Health Organization Model of Essential Medicines, which is a list featuring the most effective and safe drugs used by clinics (2).

In critical care patients, OT is a part of daily treatment applications (3). OT for cases with COVID-19 includes best implementations for supportive treatment of acute respiratory syndrome (4, 5). The 41% of patients applying to a hospital due to COVID-19 and 70% of those having rigid symptoms need additional OT (6). A systematic review and meta-analysis reviewed including 46.959 cases with COVID-19, indicated that the incidence rate of cases requiring intensive care unit (ICU) was 29.3% (7). About 5–6% of COVID-19 patients suffered from severe hypoxemia. Patients need many invasive or non-invasive ventilation applications in ICU (8).

OT can cause harmful effects when used incorrectly and can even be fatal (9-11). The inappropriate assessment and monitoring also leads to prolonged length of hospital stay, need for non-invasive ventilation and an increased risk of death (1). Severe hypoxemia in such patients is associated with high physiological dead space, as compared with non-COVID-19 acute respiratory syndrome patients (12).

Given the frequency of oxygen application in the hospital environment and its harms for patient and employee safety, it is recommended that knowledge and practices of healthcare professionals concerning OT be developed (13). In the studies evaluating the knowledge levels and practices of nurses for OT, it is suggested that nurses have poor knowledge levels and be evaluated by different studies (14-16). It is important that critical care nurses should have an adequate level of knowledge about basic principles, indications, delivery methods, complications, assessment, and monitoring of patients and provide safe OT patients need (10, 14). The aim of this study is to define critical care nurses' level of knowledge on oxygen therapy during the COVID-19.

MATHERIAL and METHOD

Design and participants

This descriptive study was conducted between April and June 2021.

The population of the study comprised COVID-19 critical care nurses (N=446) in a total of 16 hospitals affiliated with a healthcare group in Turkiye. Without using sample selection, 322 ICU nurses (72%) who agreed to participate in the study were included in the sample. The nurses in the orientation process (a six-month basic orientation process) and nurses working in the ICU for one-day support were not included in the study.

Data collection and instruments

Oxygen Therapy Information Form

The form was prepared by the researchers in line with the literature (1, 15, 17-20). The first version of the form had 38 items. For expert opinion, opinions were received from two critical care nurses, a critical care physician, two nurse academicians and an assessment and evaluation in education expert, and the form was put into final form. It was not content validated after expert opinions.

Following the expert opinions, the form was revised, and six subscales and 30 items were specified. The subscales were OT-related definitions, indications and complications of OT, Safety of OT, OT methods, OT patient follow-up, and responsibilities of OT nurses. The 20 items were given as correct information (2,5,6,7,8,10,11,13,14,15,16,18,20,21,22, 25,26,27,28,30) and 10 items were given as wrong information (1,3,4,9,12,17,19,23,24,29). The nurses were asked to mark "True", "False" and "No idea" for each item. Those giving correct answers and wrong answers/no idea received "1 point" and "0 point", respectively. The maximum score for the questionnaire was 30. The scores were calculated and interpreted on the basis of 100 points. The interpretation system used by Goharani et al., in a similar study was used. The score interpretation was 90-100% excellent, 80-89% good, 70-79% fair, 60-69% weak and < 59% poor (21).

Statistical analyses

For statistical analyses, the R vers. 2.15.3 programme (R Core Team, 2013) was used. Compatibility of the quantitative data to normal distribution was evaluated via the Shapiro-Wilk test. The independent samples t-test was used in the two-group comparison of the normally distributed variables and the one-way analysis of variance was used to compare more than two groups. The Mann-Whitney U test was used in the two-group comparison of the non-normally distributed variables and the Kruskal-Wallis test and Dunn-Bonferroni test were used in the comparison of more than two groups. The Pearson's correlation analysis was used in determining the level of the correlation between the quantitative variables. The statistical significance was accepted to be $p<0.05$.

Ethical approval (2021-07/02) was obtained for the study. The data were collected via Google. At the beginning of the survey, the purpose of the study was explained, and the survey was completed by voluntary nurses.

RESULTS

The nurses were aged 21 to 50 years and their mean age was 25.87±5.08 years. Of the nurses, 73.6% (n=237) were female, 43.8% (n=141) were health high school graduates and 28.3% (n=84) were working in ICU for 3 to 5 years. 76.1% (n=245) of the nurses were staff nurses (Table 1).

The nurses were working in a COVID-19 ICU for 7.93±5.81 months on average. 73.9% (n=238) of them stated that they obtained information about oxygen therapies in in-hospital trainings. 84.5% (n=272) of them stated that they worked in night and day shifts (Table 1).

according to their age, gender, working duration, status of training on oxygen therapy and working status (p>0.05). Those who were vocational school of health graduates had lower mean scores than those who had associate and bachelor's degrees (p=0.011, p=0.032, respectively). Of the nurses, those

Table 1: Distribution of the critical care nurses' oxygen therapy knowledge scores according to their demographic characteristics (n=322)

	Min-Max (Median)	Mean±sd	Total Score		
			r	p	
Age (year)	21-50 (24)	25.87±5.08	0.038	0.501	
Duration of working in the Cov-19 ICU (month)	0-18 (7)	7.93±5.81	0.068	0.222	
	n	**%**	**Mean±sd**	**Test value**	**p**
Gender				at=0.266	0.791
Female	237	73.6	73.07±9.69		
Male	85	26.4	72.75±9.8		
Educational status				bχ2=12.914	0.005*
Health high school	141	43.8	70.83 (66.67, 76.92)		
Associate degree	71	22.0	75.86 (70, 82.14)		
Bachelor's degree	91	28.3	75 (68.97, 80.77)		
Graduate degree	19	5.9	70.37 (67.86, 81.48)		
Duration of working in the ICU				cF=1.579	0.180
0-1 years	85	26.4	71.73±9.17		
1-3 years	69	21.4	71.39±12.6		
3-5 years	84	26.1	74.25±9.28		
5-10 years	53	16.5	74.35±7.53		
10 years and above	31	9.6	74.25±7.51		
Working status during the pandemic				bχ2=9.202	0.056
Nurse in charge	24	7.5	76.89 (69.62, 82.14)		
Clinical training nurse	6	1.9	71.21 (67.86, 80.77)		
Team leader	37	11.5	77.78 (71.43, 80)		
Staff nurse	245	76.1	72.41 (66.67, 78.57)		
Other	10	3.1	72.04 (68.97, 79.17)		
In-service training related to oxygen therapy				at=-0.051	0.959
Yes	238	73.9	72.97±9.68		
No	84	26.1	73.04±9.85		
Manner of work				bχ2=10.022	0.007*
Day	47	14.6	76.67 (69.23, 82.14)		
Night	3	0.9	60 (60, 67.86)		
Day-night shift	272	84.5	73.21 (67.86, 79.24)		

r=Pearson's correlation coefficient**;** aIndependent samples t-test**;** bKruskal-Wallis test, the results are presented as median (first quartile, third quartile)**;** cOne-way analysis of variance; dMann-Whitney U test, the results are presented as median (first quartile, third quartile). *p<0.05

It was determined that there was no statistically significant difference between the total knowledge scores of the nurses

only working in the night shift had lower mean scores than those only working in the day shift (p=0.019) (Table 1).

Table 2: Distribution of the answers to the knowledge on oxygen therapy

The Subscales		True	False	No idea
		n (%)	n (%)	n (%)
Oxygen Therapy-Related Definitions				
1	Hypoxemia is a condition in which partial oxygen pressure in arterial blood drops below 90 mmHg.	228 (70.8)	**77 (23.9)**	17 (5.3)
2	Hypoxia is a state in which oxygen is not available in sufficient amounts for cellular functioning.	**300 (93.2)**	11 (3.4)	11 (3.4)
3	Pulse oximeter measures O2 saturation in venous capillary blood.	287 (89.1)	**26 (8.1)**	9 (2.8)
4	SaO2: Oxygen saturation. It is the amount of oxygen dispersed in a plasma. It indicates 2% to 3% of the total oxygen in the body.	164 (50.9)	**64 (19.9)**	94 (29.2)
Indications and Complications of Oxygen Therapy				
5	Oxygen therapy is applied in cardio pulmonary arrest.	**249 (77.3)**	41 (12.7)	32 (9.9)
6	Atelectasis is one of oxygen therapy complications.	**178 (55.3)**	109 (33.9)	35 (10.9)
7	If PaO2 in blood increases too much, respiration is depressed and the patient's ventilation decreases.	**195 (60.6)**	95 (29.5)	32 (9.9)
8	Giving oxygen at a high concentration may show a cytotoxic impact in the metabolism.	**264 (82)**	29 (9)	29 (9)
Safety of Oxygen Therapy				
9	Oxygen tubes should be fixed in horizontal position with appropriate stabilizers.	96 (29.8)	**217 (67.4)**	9 (2.8)
10	A warning sign indicating oxygen therapy should be hung in the room and door of the patient receiving oxygen therapy.	**166 (51.6)**	91 (28.3)	65 (20.2)
11	Insertion site of the oxygen tube or oxygen source should not be touched with creamy and oily hands.	**301 (93.5)**	13 (4)	8 (2.5)
12	In oxygen therapy, the reason for giving oxygen by moisturizing is to increase tissue oxygenation.	185 (57.5)	**120 (37.3)**	17 (5.3)
13	The use of helmet mask is safer for droplet dispersion in COVID-19 patients compared to face masks.	**241 (74.8)**	13 (4)	68 (21.1)
14	High-flow oxygen therapy is among applications causing aerosol in COVID-19 patients.	**211 (65.5)**	33 (10.2)	78 (24.2)
Oxygen Therapy Methods				
15	It starts with 5 L/min oxygen with a simple face mask and may be increased to 8-10 L/min at most.	**188 (58.4)**	122 (37.9)	12 (3.7)
16	Oxygen flow rate should be at least 6-10 L/min with reservoir face masks.	**228 (70.8)**	72 (22.4)	22 (6.8)
17	Nasal cannula provides maximum-intensity oxygen to the patient.	57 (17.7)	**248 (77)**	17 (5.3)
18	Oxygen can be given by moisturizing with a flow rising up to 20-60 L/min with a high-flow nasal cannula.	**228 (70.8)**	55 (17.1)	39 (12.1)
19	Flowmeter measures O2 saturation in arterial blood.	83 (25.8)	**197 (61.2)**	42 (13)
20	Oxygen flow should be adjusted to 10-15 lt/min with a non-rebreather mask. When the reservoir part inflates, it is possible to give FiO2 equalling to 80%-100%.	**207 (64.3)**	29 (9)	86 (26.7)
21	Partial rebreather masks enable the patient to rebreathe 1/3 of the air breathed.	**227 (70.5)**	19 (5.9)	76 (23.6)
22	Venturi masks can properly adjust oxygen concentration.	**127 (39.4)**	24 (7.5)	171 (53.1)
Oxygen Therapy Patient Follow-up				
23	Mouth dryness should be evaluated in the patient receiving oxygen therapy every 24 hours.	120 (37.3)	**197 (61.2)**	5 (1.6)
24	Tap water can be used as an oxygen moisturizer.	28 (8.7)	**285 (88.5)**	9 (2.8)
25	Nasal oxygen cannulas and masks should be replaced in case of observing any functional disorder or visible contamination.	**296 (91.9)**	19 (5.9)	7 (2.2)
26	Moisturizer should be used if oxygen flow is applied above 4 lt/min.	**269 (83.5)**	41 (12.7)	12 (3.7)
27	Prior to starting the oxygen therapy, the patient's position, respiratory rate/mode and SpO2 should be evaluated by a nurse.	**306 (95)**	6 (1.9)	10 (3.1)
Responsibilities of Nurses in Oxygen Therapy				
28	Oxygen therapy can be applied without physician's request.	145 (45)	**156 (48.4)**	21 (6.5)
29	Oxygen therapy should be given at certain intervals.	90 (28)	**208 (64.6)**	24 (7.5)
30	Prior to oxygen therapy the nurse is responsible for checking whether the equipment (humidifier, flowmeter, regulator) function or not.	**305 (94.7)**	8 (2.5)	9 (2.8)

Table 3: Oxygen therapy knowledge scores

	n	Item number	Min-Max (Median)	Mean±sd
Oxygen therapy-related definitions	316	4	0-100 (33.33)	40.77±19.26
Indications and complications of oxygen therapy	316	4	0-100 (75)	76.32±24.54
Safety of OT	322	6	16.67-100 (75)	74.21±18.08
Oxygen therapy methods	318	8	0-100 (80)	78.19±17.61
Oxygen therapy patient follow-up	317	5	0-100 (80)	86.21±15.43
Responsibilities of nurses in oxygen therapy	322	3	0-100 (66.67)	71.69±25.78
Total	322	30	23.53-100 (73.33)	72.99±9.71

Table 2 shows the answers of the critical care nurses to questions related to oxygen therapy.

It was determined that the mean score of the nurses was 40.77±19.26 in the OT-related definitions subscale, 76.32±24.54 in the indications and complications of OT subscale, 74.21±18.08 in the Safety of OT subscale, 78.19±17.61 in the OT methods subscale, 86.21±15.43 in the OT patient follow-up subscale, and 71.69±25.78 in the responsibilities of OT nurses subscale. It was determined that the total mean score of the nurses was 72.99±9.71 in the questionnaire (Table 3).

DISCUSSION

The need for OT in COVID-19 patients experiencing respiratory distress in the pandemic has drawn the attention to this therapy. Nurses could face some barriers while administering OT to patients. These barriers could be related to nurses' lack of knowledge and awareness, lack of continuous education in hospital or absence of protocol of OT (22). In this study, 322 critical care nurses' knowledge on OT was assessed. According to the OT subscales, the mean score of the nurses varied from 40.77% to 86.21%, and their mean total score was 72.99%. When this finding is compared with data in other countries, knowledge level rate of nurses in hospitals is 55.1% in Beirut, 22 56.7% in East Africa, 48% in Ethiopia (15), and the nurses had poor knowledge of OT. In the studies, it is seen that they are usually conducted in underdeveloped or developing countries. It is important to also conduct similar studies in developed countries for determining the OT needs. It can be asserted that in this study carried out in Turkiye, the nurses' knowledge on OT was at a fair level.

In the present study, it was found that the educational level and working status of nurses had an effect on OT information. It was observed that as the educational level increases, the knowledge on OT increases. In their study, Zeleke and Kefale (2021) indicated that nurses with higher level of knowledge on OT had a better application (15). Considine et al., specified that the knowledge score of the nurses regarding OT increased by 19.2% after they received training on the issue (23).

Educational approachs is enhancing nursing knowledge and practice in regard to the care of respiratory distress (24). Competent nurses with bachelor's degree can be chosen especially in working areas like ICU requiring critical care practices. Also, nurses' participation in certified trainings can be planned.

In the study, it was assigned that the nurses only working in the daytime shift had higher levels of knowledge than those only working in the night shift. Nurses included in the management and trainer team usually work in the day shift. The reason that knowledge scores were higher in the nurses only working in the day shift in the study may be because nurses working in the day shift are more competent. It is thought that having competent nurses in managerial positions work in the night shift may provide safer care.

It can be asserted that 40.77% of the nurses gave correct answers to the knowledge on definitions in OT, and they had poor knowledge. This result points out that the content of the training provided for the critical care nurses participating in the present study during both academic studies and in-service training was not sufficient. It was determined that 70.8% of the nurses misdefined hypoxemia, 89.1% pulse oximeter and 50.9% oxygen saturation. In the Elmak Nimir University Hospital in Sudan, half of nurses (50%) know hypoxemia as indication of OT. This might be caused by their poor knowledge about the description of OT (25). This study found out the knowledge of nurses on how to correctly define the term oxygen was fair to weak (in some aspects), and this could have a detrimental impression on their performance. Misinformation/lack of information about concepts related to OT may lead to problems in communication within the team, create incomprehensibility and affect patient safety negatively. In trainings related to OT, it is necessary to also include conceptual knowledge in order to provide a language unity.

It was determined that 76.32% of the nurses gave correct answers to the knowledge on indications and complications of OT. In a study conducted in Pakistan, half (50%) and nearly half (46%) of the nurses correctly answered the questions regarding indications and complications of OT (25). Eastwood et al., (2011) stated that episodes of some complications occurred while patients were receiving oxygen and nurses did not always respond appropriately (16).

In the study, 77.3% of the nurses stated that OT could be applied in case of a cardiac arrest. Ganeshan et al., determined that 25% of the physicians and half of the nurses do not prescribe

the correct dose and procedure of OT in cardiorespiratory arrest cases (26). OT is an essential component of resuscitation, and any errors in OT can worsen a patient's situation and may even be life threatening (21). "Oxygen therapy is like a two edged sword", at first, oxygen is vital for human beings to survive, and second edge OT may become harmful if it is delivered by inappropriate dose or method (27).

It was determined that 74.21% of the nurses gave correct answers to the knowledge on safe oxygen applications. It was found that 24.2% of the nurses had no knowledge on high-flow OT in COVID-19 patients, and 21.1% had no knowledge on droplet dispersion in COVID-19 patients. It was determined that the nurses had fair level of knowledge on safe OT applications; however, most of them marked the choice "no idea" in questions related to OT in COVID-19 patients. It is seen that there is a need for increasing information about OT specific to COVID-19, especially in the pandemic period.

It was determined that 78.19% of the nurses gave correct answers to the knowledge on OT methods. In the pandemic process, some OT methods were used frequently, especially. Since nurses do not use all OT methods, it is thought to affect their level of knowledge. Demirel and et al., determined that the knowledge mean scores of the nurses were lower than expected, and nurses' knowledge was particularly insufficient with regard to OT methods (14).

It was determined that 86.21% of the nurses gave correct answers to the knowledge on patient follow-up in OT, and they had good levels of knowledge. Any error in OT could lead to deterioration of the patient's situation and can even be life-threatening (26).

It was determined that 71.69% of the nurses gave correct answers to the knowledge on responsibilities of nurses in OT. Nearly half of the nurses (45%) stated that OT could be applied without physician's request. In nursing regulations in Turkiye, nurses are able to apply OT with a mask and nasal cannula without physician's request, which suggests that nurses do not have adequate knowledge on their legal responsibilities related to OT. In a study conducted with critical care nurses, 51% of nurses would not routinely increase OT in the absence of physician orders (28). Head nurses working in seven hospitals of Greece, commonly started, modified, and discontinued OT in the absence of a medical order (29).

Autonomy is an significant piece of nursing professionalism, but ensuring high quality care, deliberate with inter-professional teams may even be of greater importance (3). Georgiou and et al., emphasise the nurse-physician collaboration as an essential factor in developing patient outcomes of the critical ill patient (30).

CONCLUSION

It was stated that critical care nurses' knowledge on OT-related definitions was poor. Indications and complications of OT, safety of OT, OT methods, responsibilities of OT nurses knowledge of nurses were fair, and OT patient follow-up was good. The results of this study have important implications for patient safety during the COVID-19 pandemic. In order to raise awareness and knowledge of nurses, it is recommended to organize online training courses, and educational programs to provide safe practice of OT and standard nursing care for patients receiving OT. In order to eliminate the ambiguity and qualify legal competence about the safety of OT, clear protocols and professional guidelines are recommended to be prepared at the institutional and national levels. Establishing studies on surveyed practice of nurses is essential to justify observational and interventional research with the purpose of developing OT for critically ill patients.

Limitations

The study has some limitations. The oxygen therapy information form was prepared by the researcher and not with valid reliable tools. Only the knowledge levels of nurses about OT were evaluated, and their practice skills were not evaluated.

Ethics Committee Approval: This study was approved by Acıbadem University and Acıbadem Healthcare Institutions Medical Research Ethics Committee (Date: 07.04.2021, No: 2021/07-02).

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