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Preventive Effect of Cognitive Stimulation and Sleep Hygiene on Delirium in COVID-19 Intensive Care Patients

COVID-19 Yoğun Bakım Hastalarında Bilişsel Uyaran ve Uyku Hijyeninin Deliryumu Önleyici Etkisi

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Abstract

Objective: This study was conducted to evaluate the effect of a two-stage intervention, including sensory stimulation and sleep hygiene based on a nursing model, on the reduction of delirium development in Coronavirus disease-2019 (COVID-19) patients in the intensive care unit (ICU).

Materials and Methods: The study was conducted as a pretest-posttest control group and trial model. The sample size of the study was 92 patients with COVID-19, including 43 in the experimental group and 49 in the control group, based on power analysis. The study was conducted in two separate COVID-19 ICUs. Sensory stimulation and sleep hygiene interventions were applied to the patients in the intervention group according to the Living Activities-Based Nursing Model. The intervention was applied to the experimental group until the patients were discharged.

Results: It was determined that there was no statistical difference between the experimental and control group patients included in the study in terms of demographic and treatment characteristics and vital and arterial blood gas values ($p>0.05$). In the study, it was determined that sensory stimulation and sleep hygiene intervention based on the nursing model creates a statistically significant difference in the delirium development levels of the experimental and control group patients ($p<0.05$). It was determined that delirium developed in 56% of the patients in the experimental group and 80% in the control group after the intervention, and that the difference was statistically significant ($p<0.05$).

Conclusion: The sensory stimulation and sleep hygiene intervention based on the nursing model was effective in reducing the incidence of delirium in critically ill COVID-19 patients.

Keywords: COVID-19, delirium, ICU, nursing care, sleep hygiene

Öz

Amaç: Bu çalışma yoğun bakım ünitesindeki (YBÜ) Koronavirüs hastalığı-2019 (COVID-19) hastalarına duyusal uyarım ve uyku hijyenini içeren iki bileşenli girişimin deliryum gelişiminin azaltılması üzerine etkisini değerlendirmek için yapılmıştır.

Gereç ve Yöntem: Randomize kontrollü deneysel tasarımla yapılan çalışmaya, müdahale grubunda 43, kontrol grubunda 49 hasta dahil edildi. Çalışma iki ayrı COVID-19 YBÜ'de gerçekleştirildi. Müdahale grubundaki hastalara Yaşam Aktivitelerine Dayalı Hemşirelik Modeli'ne göre duyusal uyarım ve uyku hijyeni müdahaleleri uygulandı.

Bulgular: Çalışmaya alınan deney ve kontrol grubu hastaları arasında demografik ve tedavi özellikleri ile vital ve arteriyel kan gazı değerleri açısından istatistiksel olarak fark olmadığı belirlendi ($p>0,05$). Müdahale sonrası deney grubundaki hastaların %56'sında, kontrol grubundaki hastaların %80'inde deliryum geliştiği ve aradaki farkın istatistiksel olarak anlamlı olduğu belirlendi ($p<0,05$).

Sonuç: Deliryum önlemede kullanılan duyusal uyarım ve uyku hijyeni müdahaleleri yoğun bakımdaki COVID-19 hastalarında deliryum insidansını azaltmada etkilidir.

Anahtar Kelimeler: COVID-19, deliryum, YBÜ, hemşirelik bakımı, uyku hijyeni

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Introduction

Delirium is a transient neurocognitive syndrome associated with acute brain failure, changes and fluctuations in consciousness, attention deficit, decreased or increased psychomotor activity, and disruption of circadian rhythm (1). Delirium is a frequently encountered problem, especially in patients receiving treatment in the intensive care unit (ICU), and its prevalence varies between 56-64% (2,3). It has been reported that the prevalence of delirium is 55-84% in patients followed in the ICU due to Coronavirus disease-2019 (COVID-19) (4-6).

Similarities in the physiopathological mechanism and risk factors of COVID-19 and delirium are the reason for the high incidence of delirium in COVID-19 patients. Delirium risk factors are generally old age, sensory status, alcohol use, surgery, mechanical ventilation, sepsis, comorbidities, inactivity, social isolation, sensory deprivation, and sleep problems (7). Advanced age, comorbidities, high mortality and morbidity, which are among the specific patient characteristics of COVID-19, are accepted as the main risk factors for the development of delirium. COVID-19 results in an increase in anaerobic metabolism with hypercapnia, hypoxia and accumulation of toxic compounds due to respiratory failure and pneumonia, which causes cerebral edema due to cerebral vasodilation and inhibition of cerebral blood flow (8-10). The same mechanisms have been identified as causal factors in the development of delirium (10). Environmental factors are thought to be another factor that may cause hallucinations and delirium development in patients, especially the appearance of healthcare personnel as astronauts or aliens in personal protective equipment used to reduce the risk of COVID-19 transmission (11).

Delirium changes the clinical course of the patient negatively and causes undesirable situations. Since delirium in ICUs can cause problems that endanger patient safety, such as unplanned extubation, catheter withdrawal, and falls, it should be foreseen in the early period, and risk factors should be evaluated for its treatment and management (7,12). Delirium can potentially be prevented by appropriate identification of risk factors by nurses (2). In the diagnosis and management of delirium, it is recommended to use multi-component care interventions that include sensory, physical, psychological and environmental interventions for the patient in line with clinical guidelines. These are expressed as the ABCDE (Awakening and Breathing Coordination, Delirium Monitoring/Management, and Early Exercise/Mobility) bundle (7,12,13). However, the high contagiousness of the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) virus makes it impossible to administer some elements of the ABCDEF bundle to COVID-19 patients due to the lack of personal protective equipment and medical isolation to reduce virus transmission (14). Therefore, there is an urgent need for simple, safe, effective and applicable interventions that target delirium risk factors in order to protect COVID-19 patients from negative outcomes associated with delirium (7,15).

Although some special circumstances in the care of COVID-19 patients limit the number of methods to be used, considering the high prevalence of delirium, we planned a two-stage study that combines methods that are both free of contamination and provide sensory support to the patient. In our study, we think that two nurse-based practices, which will provide patients with sensory support instead of family visits and increase sleep hygiene through regulation of environmental stimuli, will be effective in preventing the development of delirium.

This study was conducted to evaluate the effect of a two-stage intervention, including sensory stimulation and sleep hygiene based on Living Activities-Based Nursing Model, on the reduction of delirium development in COVID-19 patients in the ICU.

Materials and Methods

Study Design and Participants

This study was conducted as a trial model with pretest-posttest control group. The inclusion criteria of the study were: to age 18 years or older; to receive treatment in the ICU due to SARS-CoV-2 infection; not to be connected to the life support unit for at least 24 hours after admission to the ICU; not to have pre-diagnosed mental health problems, neurodegenerative disorders, and congenital or acquired brain injury; and to have a Glasgow Coma Scale (GCS) score of 10 or higher. The exclusion criteria were as follows: to be less than 18 years of age; to have a GCS score below 10; and to be blind or deaf.

The population of the study consisted of 158 patients who were treated in the COVID-19 ICU with the diagnosis of COVID-19. Out of 158 patients, 56 patients were not included in the study because 25 had a GCS score of less than 10 or a Richmond Agitation-Sedation Scale (RASS) score of -3, 25 did not meet the inclusion criteria, and 6 refused to participate in the study. The incidence of delirium in COVID-19 patients in the ICU varies between 55-84% (5,7,16). As a result of the power analysis to determine the sample size of the research, the sample size of delirium incidence was accepted as 55% and was calculated as 78 COVID-19 patients (39 in the experimental group and 39 in the control group) at the 0.05 significance level and 0.95 confidence interval. The effect size of the study was 0.6, whereas the power to represent the population was 0.95.

In order for the experimental and control groups not to be affected by each other, patients with similar characteristics were selected and the study was conducted in two separate COVID-19 ICUs. Which unit would be the experimental or control group was determined by drawing lots.

In order to increase the power of the study, 96 (experimental group n=46, control group n=50) patients were included in the study. Due to the discharge or death of 4 patients, the study was completed with 92 patients, 43 in the experimental group and 49 in the control group.

Data Collection Tools

"Personal Information Form", "Confusion Assessment Method for the ICU (CAM-ICU)", "RASS" and "GCS" were used to collect the data of the research.

Intervention

Nursing uses a combination of theory and practice. Nursing models guide practice, and practices are based on the model.

Models assist the practitioner in making informed decisions based on thought and interpretation. Thus, it is reported that a nurse who uses model-based nursing practices can define nursing problems, anticipate and take initiatives to cope with risky situations (17).

As a frequently encountered problem in ICUs, the prevention of delirium is thought to be more important than its treatment. It has been reported that when ICU nurses, who are in constant contact with the patient, follow the patient for delirium and continuously apply preventive interventions, it can reduce the incidence of delirium, and ultimately, positive results can be obtained for the patient and the hospital (18). According to the Nursing Model Based on Activities of Living developed by Roper et al. (19) nursing is perceived as the prevention or resolution of problems related to daily living activities rather than the treatment of the disease. Considering that the most appropriate nursing model that can be used in the prevention of delirium is the Nursing Model Based on Activities of Living, the theoretical framework of the study was created in accordance with this model. The ABCDEF bundles (Awakening and Breathing Coordination, Delirium Monitoring/Management, Early Exercise/Mobility and Family engagement/empowerment) are among the key strategies to prevent delirium and shorten its duration. The ABCDEF bundles and non-pharmacological interventions are used in the prevention of delirium. Non-pharmacological interventions that reduce the development of delirium include the following interventions: Effective communication (calling the patient by name, explaining interventions, making the conversation continuous), reorientation, reducing environmental stimuli, ensuring sleep hygiene (maintaining a light-dark environment consistent with the daily cycle, minimizing night sleep interruptions, and reducing monitor sounds), increased family support through the use of less sedation, early mobilization, sensory stimulation, and extended family visits (12,13). Many of these interventions are compatible with the 12 basic activities of daily living that make up the model of life. In the model, the components, such as ensuring and maintaining a safe environment, communication, mobility, and sleep, are similar to the bundles.

Many of these accepted interventions in the prevention of delirium cannot be applied in COVID-19 patients. For example, staff-time limitations often result in an inability to provide reorientation and sensory stimulation. Due to the high risk of contamination and sometimes limited access to personal protective equipment, early mobilization is not provided and family visiting hours are limited or even not allowed; therefore, the interventions to be made are limited.

Sensory stimulation and sleep hygiene interventions were applied to the experimental group in order to provide social and sensory support and to establish sleep hygiene, since family visits, which are one of the most important parameters in the prevention of delirium, were prohibited.

Nurses in the control group provided standard ICU care and no intervention was applied to the patients. The scope of sensory initiatives includes re-orientation of the patient and administration of appropriate sensory stimuli. Gloves filled with warm water were put on the hands of the patients to give the feeling of holding hands. During routine visiting hours, the gloves, which were filled with warm water and the fingers of which were tied together, were put on the hands of the patients and kept like this for half an hour. The sensory stimulation intervention applied by the researcher was applied to both hands while the patients were in the supine position. Sleep deprivation is a common ICU problem that can cause delirium. Environmental factors such as noise, crowded environment, lighting (bright lights), care and treatment practices, and disruption of day and night rhythm contribute to sleep deprivation (1,18,20). The intervention application scheme of the research is shown in Table 1.

Implementation of Data Collection Tools

The research was carried out at University of Health Sciences Turkey, Mehmet Akif İnan Training and Research Hospital, Turkey between October-December 2021. There are two ICUs serving COVID-19 patients in the hospital. The patients in one of them were determined as the experimental group and the other as the control group. While determining the participants, selection was made on a group basis, not on an individual basis. The reason for this is that the sleep hygiene intervention to be applied is not specific to the patient, but an intervention applied throughout the unit.

COVID-19 patients, who constitute the sample of the study, were informed about the study by visiting ICUs. The nurses collected the patients' data within the first 24 hours of their admission to the ICU and in each shift, not exceeding 30 days during their stay in the ICU. The nurses evaluated the patients once a day for consciousness with RASS in intubated patients and GCS in extubated patients, and for delirium with CAM-ICU. The patients with a RASS score of -4 or -5 or a GCS score of <8 who did not respond to verbal stimulation were considered comatose. The patients who responded to verbal stimulation and were positive according to CAM-ICU were considered to have delirium. The patients who were evaluated positive for delirium at least once in a 24-hour period were considered delirium positive. The research flowchart is shown in Figure 1.

Ethical Approval of Research

The study was approved by Harran University Ethics Committee (decision no: 29, date: 16.08.2021) and institutional permission were obtained in order to conduct the study. Permission was obtained for the measurement tools used in the study. The consent was obtained from human participants and that ethical clearance was obtained from the appropriate authority.

Statistical Analysis

IBM SPSS Statistics 25.0 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp., USA) was used for statistical analysis and calculations. In the evaluation of the data, descriptive features were given as a percentage, and the relationship between the variables was tested with Student's t-test, One-Way analysis of variance, and logistic regression analysis. G*power v3.1.9.4 statistical analysis program was used to calculate the sample size. The significance level was 0.05.

Table 1. Intervention application scheme of the research

Bundle component/ components of nursing theory	Theoretical framework	Interventions	Evaluation
Sensory stimulation/ communication, work and leisure Objective: The aim of this intervention is to provide sensory support to patients who are deprived of family visits and familiar items.	Reorientation interventions are included within the scope of sensory interventions in the prevention of delirium development in the ICU. • It should be ensured that the patient is in contact with his/her relatives or familiar belongings, • It should be ensured that the patient wears personal vision devices and hearing aids, • Clock and calendar should be kept in a place where the patient can see them easily, • The patient should be oriented to place, person and time every day, • Daily news or events should be discussed with the patient and reminded to him/her, • It should be evaluated whether the patient can hear and understand the spoken language, and whether s/he responds by speaking or sign language, • Patients who cannot express their feelings and thoughts verbally may seem very anxious, restless and stressed. Patients should be followed closely in this respect, • Factors that prevent reorientation and communication (noise, pain, anxiety, darkness) should be eliminated (19-21).	• Many of these interventions cannot be applied to COVID-19 patients. For example, staff-time limitations often result in a lack of reorientation and sensory stimulation, • Due to the high risk of contamination, personal vision devices and hearing aids did not be given to the patient, family photos should not be placed next to the patient, and family visiting hours should be limited or should not be even allowed, • Protective equipment such as masks, goggles and visors used by the personnel make faces unrecognizable and limit place and person orientation, • When speaking under the mask, the sound may not be clear and the lips may not be visible, and this creates an extra problem for patients who can only read lips because of having hearing problems, • A component specific to COVID-19 patients is needed in order to maintain communication and reorientation, such as not discussing daily events with the patient due to staff and time limitations, • In particular, in order to prohibit patient visits and to prevent patients from feeling lonely, a sensory stimulation method was applied with gloves filled with warm water, which provided social and sensory support.	Statistically, significantly less delirium developed in the experimental group compared to the control group. Very few patients showed improvement in person, place and time orientation. • The patient's agitated emotions and behaviors decrease. After the intervention, some patients experienced reactions such as smiling, squeezing their eyes, and trying to pull warm water balls towards themselves, which can be seen as a result of a sensory stimulation. • It was observed that patients who did not develop delirium conveyed their thoughts and needs appropriately. • Adequate mobilization could not be achieved in patients due to high contamination and limited personal protective equipment.
Sleep hygiene/ sleep, ensuring a safe environment The goal of the sleep hygiene intervention was to get the patients to sleep for at least 4 hours each night.	Environmental factors such as noise, crowded conditions, and bright lights contribute to sleep deprivation. • Sleep hygiene interventions are included through the reduction of environmental stimuli, • Circadian rhythm should be regulated with dark-bright light cycles in closed ICU environments devoid of natural light, • Overhead or under-bed lamps should be used in beds, • Sleep pattern and night-day cycles should be established, • Noise level should be minimized in the ICU environment, • Patient safety should be ensured by lifting bed edges, • A comfortable sleep environment should be created by minimizing the physical limitation of the patient, • Tubes and catheters used should be hidden as much as possible, • Pain should be relieved, • Care interventions to support uninterrupted sleep (e.g., measurement of vital signs, radiographs, blood collection) should not be applied during the specified sleep period (midnight to 5 am).	• Within the scope of sleep hygiene interventions, in the ICU where the experimental group was located; • During the study period, ICU overhead lights were turned off between 24:00 and 01:00 in the evening. In this unit, bedside lamps on the heads of the patients were sufficient to observe the patient. • The circadian rhythm was maintained by turning on the lamps between 05:00 and 06:00 in the morning. • In order to minimize the noise level in the ICU environment, the sounds that created stimulating noise were turned down. The ambient noise (<80 decibels) was minimized by turning off the television and radios. A RadioShack was used to monitor the ambient noise level. • Bed edges were lifted. • Since undesirable situations (unplanned extubation, and removal of tubes and catheters) may be experienced in patients with restrictions, restrictions were terminated in some patients according to the condition of the patients. • Tubes and catheters were positioned in such a way that they did not disturb patients. • Painkillers were administered in the evening hours, allowing patients to sleep more comfortably. • Care interventions were made before the specified time, only patients with special conditions were awakened for care in between.	• Statistically significant less delirium developed in the experimental group compared to the control group. • It was observed that many patients in the sleep hygiene group slept for at least 4 hours at night.

ICU: Intensive care unit, COVID-19: Coronavirus disease-2019

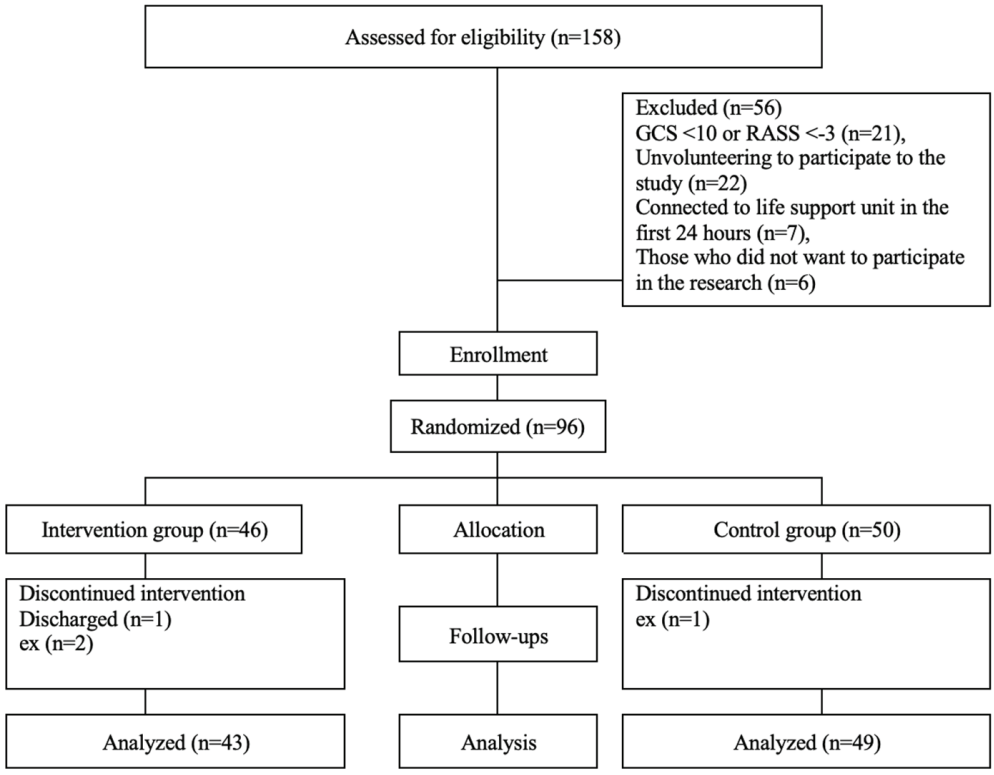

Figure 1. Consort flow chart of the study
GCS: Glasgow Coma Scale, RASS: Richmond Agitation-Sedation Scale

Results

During the study period, 158 patients were eligible for the study. After giving information about the study, 60 patients were not included in the study because they did not meet the inclusion criteria and refused to participate in the study. The study was completed with 92 patients and the criteria obtained in the power analysis were reached.

It was determined that there was no statistical difference between the experimental and control group patients included in the study in terms of demographic and treatment characteristics, and vital and arterial blood gas values ($p>0.05$). It was determined that 49% of the patients in the experimental group were vaccinated with a single dose, that 67% of the control group were unvaccinated, and that there was a statistically significant difference between the two groups in terms of vaccination status ($p<0.05$) (Table 2).

The distribution of the patients included in the study according to the state of delirium development is shown in Figure 2 and Table 3. Only patients without delirium were included in the study due to the initial inclusion criteria. Therefore, no comparison was made before the intervention in terms of delirium. It was determined that delirium developed in 56% of the patients in the experimental group and 80% in the control group after the intervention, and that the difference was statistically significant ($p<0.05$) (Table 3).

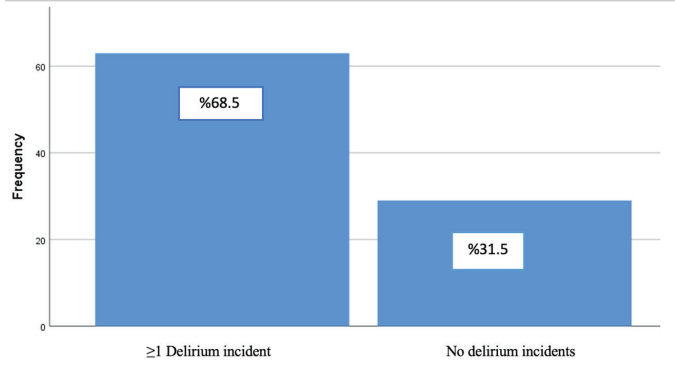

Figure 2. Graph of development of delirium in all patients included in the study. While delirium developed in 68.5% of the patients included in the study, delirium did not develop in 31.5%

Comparisons between the introductory information of the patients receiving COVID-19 treatment in the ICU and delirium incidence are shown in Table 4. According to the table, it was determined that the probability of delirium development was higher in the group that included patients who were 75 years old or older and who were unvaccinated and had lower PaO_2 and HCO_3, higher BE values and higher Acute Physiology and Chronic Health Examination (APACHE II) score. This was

Table 2. Socio-demographic characteristics of the patients (n=92)					
	Intervention group (n=43)		Control group (n=49)		Test and significance
Descriptive characteristics	**n**	**%**	**n**	**%**	**p**
Age (65.48±16.56)					
<45	6	14.0	5	10.2	-
45-64	12	27.9	18	36.7	-
65-74	10	23.3	11	22.4	0.813
≥75	15	34.9	15	30.6	-
Gender					
Female	19	44.2	22	44.9	-
Male	24	55.8	27	55.1	0.945
Smoking					
Yes	19	44.2	23	46.9	-
No	24	55.8	26	53.1	0.836
Type of respiratory support					
Invasive mechanical ventilation	1	2.3	3	6.1	-
Non-invasive mechanical ventilation	4	9.3	5	10.2	-
High flow nasal cannula	22	51.2	23	46.9	-
Low flow nasal cannula	16	37.2	18	36.7	0.637
Restraint					
Yes	9	20.9	16	32.7	-
No	34	79.1	33	67.3	0.207
Vaccination status					
Single dose	21	48.8	13	26.5	-
Double dose	4	9.3	3	6.1	0.048
Unvaccinated	18	41.9	33	67.3	-
Vital signs					
Temperature, °C	36.88±0.46		37.18±0.72		0.023
Arterial blood gases					
PaO_2 (mmHg)	73.69±14.80		70.87±13.91		0.349
$PaCO_2$ (mmHg)	42.85±10.21		42.95±10.71		0.964
pH	7.32±0.13		7.35±0.10		0.337
HCO_3	23.51±5.12		21.67±6.60		0.144
BE	3.36±1.91		3.70±2.12		0.438
Days in intensive care unit, mean (3-26 days)	10.67±4.62		10.36±6.46		0.796

Table 3. Delirium incident in experimental and control groups after intervention			
Delirium	**After intervention**		**p**
	Intervention group (n=43)	**Control group (n=49)**	
	n (%)	**n (%)**	
≥1 delirium incident	24 (55.8)	39 (79.6)	-
No delirium incidents	19 (44.2)	10 (20.4)	**0.013**

statistically significant (p<0.05). In male and non-smoker patients, who received oxygen supplementation with a high-flow nasal cannula, who did not have any restrictions and who had lower body temperature and pH, higher $PaCO_2$ values, and longer stays in the ICU, it was determined that the probability of delirium development was higher; however, this level was not statistically significant (p>0.05) (Table 4).

The logistic regression analysis revealed that all 8 explanatory (independent) variables were statistically significant (X^2=26,574, p<0.001), and these variables explained 61.7% of the variance in the risk of developing delirium (Cox & Snell R Square = 0.461; Nagelkerke R Square = 0.617) (Table 5). As shown in Table 5, it was determined that increases in age, PaO_2, PCO_2 values and APACHE II scores were associated with a significant increase in the risk of developing delirium (p<0.05). It was also found out that not smoking, not using restrictions, and increases in HCO_3 and negative base values were not statistically significant on delirium incidence (p>0.05) (Table 5).

Table 4. Examination of patients' delirium development according to variables

Characteristic	≥1 delirium incident (n=63)	No delirium incidents (n=29)	p
Age			
<45	1 (1.6)	10 (34.5)	0.001
45-64	19 (30.2)	11 (37.9)	
65-74	17 (27.0)	4 (13.8)	
≥75	26 (41.3)	4 (13.8)	
Gender			
Female	31 (49.2)	10 (34.5)	0.187
Male	32 (50.8)	19 (65.5)	
Smoking			
Yes	25 (39.7)	17 (58.6)	0.092
No	38 (60.3)	12 (41.4)	
Type of respiratory support			
invasive mechanical ventilation	4 (6.3)	0 (0.0)	
Non-invasive mechanical ventilation	7 (11.1)	2 (6.9)	0.452
High flow nasal cannula	28 (44.4)	17 (58.6)	
Low flow nasal cannula	24 (38.1)	10 (34.5)	
Restraint			
Yes	21 (33.3)	4 (13.8)	0.051
No	42 (66.7)	25 (86.2)	
Vaccination status			
Single dose	16 (25.4)	18 (62.1)	<**0.001**
Double dose	0 (0.0)	7 (24.1)	
Unvaccinated	47 (74.6)	4 (13.8)	
Vital signs			
Temperature, ºC	37.03±0.64	37.08±0.60	0.712
Arterial blood gases			
PaO2 (mmHg)	67.68±14.05	81.98±9.20	<**0.001**
PaCO2 (mmHg)	43.88±11.90	40.77±5.72	0.185
pH	7.33±0.13	7.35±0.10	0.361
HCO3	21.65±6.44	24.44±4.42	0.037
BE	3.90±2.04	2.66±1.63	**0.004**
APACHE II score	20.07±7.71	12.41±7.02	<**0.001**
Days in intensive care unit, mean	10.87±6.04	9.72±4.68	0.368

APACHE II: Acute Physiology and Chronic Health Examination

Table 5. Logistic regression results of sensory stimulation and sleep hygiene

Variable	Odds ratio (95% CI)	p
Age	0.915 (0.853-0.981)	**0.012***
Smoking	2.452 (0.277-21.714)	0.420
Restraint	0.608 (0.073-5.079)	0.646
Arterial blood gases		
PaO_2 (mmHg)	1.087 (1.007-1.172)	**0.032***
$PaCO_2$ (mmHg)	0.844 (0.726-0.980)	**0.027***
HCO_3	1.166 (0.953-1.425)	0.135
BE	0.966 (0.795-1.174)	0.727
APACHE II score	4.271 (1.581-11.534)	<**0.001***

*Statistically significant, APACHE II: Acute Physiology and Chronic Health Examination, CI: Confidence interval

Discussion

The study, which was conducted to evaluate the effectiveness of sensory stimulation and sleep hygiene interventions applied to prevent delirium development in patients diagnosed with COVID-19 and receiving treatment in the ICU, was completed with a total of 92 patients, 43 in the experimental group and 49 in the control group.

It was determined that the mean age of the patients included in the study was 65 (24-96) and that there was no statistical difference between the two groups in terms of age, gender, smoking habit, respiratory support type, restriction application, intensive care duration, and vital and arterial blood gas values. This situation is valuable in terms of comparing two homogeneous groups in the study and showing that there is no effect of socio-demographic variables on the outcome parameter.

Being treated in ICUs poses a serious risk for the patient to develop delirium. Especially if the individual has chronic diseases or has a disease that can cause serious problems both mentally and physically, such as COVID-19, the risk of possible delirium in the individual increases considerably (5,22-25). In this study, the prevalence of COVID-19 was found to be 68.5%. This rate is similar to the studies in the literature on COVID-19 patients followed in the ICU (4-6). Similarities in the physiopathological mechanism and risk factors of COVID-19 and delirium are the reason for the high incidence of delirium in COVID-19 patients. The use of non-pharmacological nurse-based interventions to prevent delirium development in the ICU has many advantages. Its most important advantages are that it can be easily applied every day to all patient groups, including those who are intubated and extubated or test positive for COVID-19, focuses on the goal of making patients more active sensoryly and functionally, and is a cost-effective and applicable method. Second, because it focuses on the assessment, prevention, and management of symptoms rather than disease processes, it is particularly important in the course of critical illness and is considered appropriate for use in conjunction with other life-sustaining treatments. Finally, it has found a place in routine practices in ICUs, as it serves to facilitate the ability of patients to express their unmet physical, emotional and spiritual needs and to help meet these needs (12,13). Sensory stimulation and sleep hygiene interventions were applied in this study. In the study, the development of delirium in 79.6% of the uninterrupted control group and 55.8% of the experimental group showed that sensory stimulation and sleep hygiene interventions were effective interventions in reducing the development of delirium. When the literature was examined, it was reported that the data

obtained in various studies were in parallel with our study results and that reducing environmental stimuli or applying positive stimuli to patients was preventive for delirium (13,18,25). In the meta-analysis study conducted by Liang et al. (7) on the effects of non-pharmacological methods applied to ICU patients on the development of delirium, it was reported that family visits and early mobilization were effective in reducing the development of delirium in ICU patients. In the same article, extended family visits and interventions that offer psychological support by communicating and encouraging patients were recommended (7). In the study of Rosa et al. (26), in which they compared the effect of restricted and extended family visits in the ICU on the development of delirium, it was reported that less delirium was observed in patients with long family visits. In the study of Simons et al. (27), in which they gave bright light during the day to regulate the circadian rhythm, the percentage of delirium development was higher in the experimental group, unlike the findings of our study. It is thought that this difference is due to the fact that only the sleep hygiene application was included in the study of Simons et al. (27) and that it was a single application. Indeed, Martinez et al. (28) reported that multi-component interventions were effective in reducing the prevalence of delirium incidence. Studies reported that environmental arrangements, such as sleep hygiene, and sensory interventions, such as reorientation and family visits, were effective in reducing the development of delirium. Due to the pandemic, the inability to apply many interventions that support the patient psychologically, such as reorientation and family visits, which were easily applied before, is thought to be a factor that increases the development of delirium in patients. In this study, it was seen that sensory stimulation and sleep hygiene interventions used to reduce the development of delirium and support patients during the pandemic process showed positive results. It is thought that this positive effect was realized thanks to the stimulations created by gloves filled with hot water and sleep hygiene interventions, which eliminate the sensory deprivation that individuals often experience, especially in ICUs, and create both physical and spiritual warmth.

It is of great importance to determine the precipitating and predisposing factors in terms of delirium and to control it with appropriate interventions, especially in COVID-19 patients receiving treatment in the ICU for various reasons (23,29). In this study, factors contributing to delirium incidence were determined in the group that included patients who were 75 years old or older and who were unvaccinated and had lower PaO_2 and HCO_3, higher BE values and APACHE II score. It is noteworthy that the interventions applied in this study are generally more effective in the lower age group. When the literature is examined, it was revealed by many studies that age was a determining factor on the development of delirium (5,30). It is thought that the main reason for the emergence of more delirium in the elderly individuals in the sample group is that old age causes serious destruction in all tissues, organs and systems (31) and may be related to sensory deterioration due to COVID-19 infection.

Vaccine is the most important agent for the end of all global or regional diseases and has made significant contributions to the immunization of individuals from all walks of life in the COVID-19 pandemic (32). It was determined that the vaccine was an important factor in delirium incidence. In the study, the development of delirium in the majority of the unvaccinated and the absence of delirium in the double-dose vaccinated patients clearly reveal the effect of the vaccine on the development of delirium. In the study, there was no statistical difference between the experimental and control groups included in the study in terms of vaccination, whereas there was a high rate of delirium development in the unvaccinated after the intervention. This indicates that the intervention made a significant contribution to reducing the development of delirium together with the vaccine. Although SARS-CoV-2 infection was initially assumed to directly contribute to neurological symptoms, neurological effects seem more likely to result indirectly from factors such as low blood-oxygen levels, coagulopathy, exposure to sedative and analgesic drugs, isolation, and immobility (5). In this study, the high rate of delirium development in patients with low PaO_2 and the statistical significance of this high rate suggested that low oxygen level contributed to the development of delirium. In the study, it was determined that there was a difference in terms of delirium development in patients with lower HCO_3 and higher BE values, and this difference was statistically significant. However, when the literature was examined, it was determined that there was no study data to compare these values. It is thought that this situation increases the power of the study in terms of revealing predisposing factors that have not been studied before.

In this study, it was determined that factors such as gender, smoking, type of oxygen support, restriction interventions, body temperature, pH, $PaCO_2$, and length of stay in intensive care were not effective factors on the development of delirium. Similar to our study results, it was reported in the literature that gender (25,30,33) and smoking (30) did not differ in terms of delirium development. Contrary to our study findings, it was reported in the literature that the use of restrictions and being on a mechanical ventilator caused significant differences in the development of delirium (4-6,13). It is thought that the difference between the results in the literature and our study may be related to the difference in study populations and treatment protocols applied to patients.

Study Limitations

The study has several limitations. As delirium affects primarily very sick patients this is a very important aspects to evaluate whether both groups are equally distributed in terms of delirium risk. While the patients included in the study were divided into groups, separation on a unit basis rather than on a patient basis can be considered as a limitation. However, although the distinction was made according to the unit, the fact that the socio-demographic distribution of the patients to the groups was homogeneous and that there was no difference between the two groups are valuable in terms of showing that the outcome parameters were not affected by demographic

characteristics. The fact that the study was conducted in a single hospital was accepted as another limitation. However, the fact that one of the researchers in the study group was an ICU nurse and the other an ICU doctor contributed to the appropriate collection of the data. In addition, the study was conducted in a province where the vaccination rate was low. However, although the study was conducted in a city with low vaccination coverage, these data provide clear information about the development of delirium in cases where vaccination is limited. It is, thus, important in terms of the limitations of the study. The responses of the patients as a result of sensory stimulation and sleep hygiene interventions were collected and recorded by nursing observation; however, the inability to analyze the relationship between these reactions and the development of delirium was considered as a limitation. The responses mentioned in the study were recorded, and the flow chart of the research was given in the evaluation section, giving the study a qualitative feature.

Conclusion

The sensory stimulation and sleep hygiene intervention based on nursing model was effective in reducing the incidence of delirium in critically ill COVID-19 patients. Patients with COVID-19 and receiving treatment in the ICU are severely affected by the social isolation resulting from visitor restrictions and infection control measures in hospitals during the pandemic. In our study, we determined that the application of hot water packs to provide social support to the patient group, for whom family visits were not allowed, made a difference in terms of delirium development. It is also known that sleep hygiene intervention, in which environmental stimuli are minimized, is among the effective interventions on the development of delirium. The fact that delirium developed in the majority of patients in the group, in which sensory stimulation and sleep hygiene interventions were not applied, and that this rate was lower in the experimental group is an indication that the interventions were effective.

As a result, it was determined that the prevalence of delirium in the COVID-19 patients was 68.5% and high, and that sensory stimulation and sleep hygiene interventions reduced the development of delirium in the ICU. It was also determined that advanced age, low vaccination rate, decrease in PaO_2 and HCO_3 values, and increase in BE values and APACHE II scores in the COVID-19 patients followed in ICU were among the effective factors on the development of delirium. It is recommended that ICU nurses who care for COVID-19 patients should closely observe patients with these parameters in terms of delirium while giving care to them.

It is thought that it will be possible to diagnose delirium at an early stage by routinely applying CAM-ICU, which was used in the determination of delirium in this study, to patients. In addition, it is recommended to develop a delirium prevention care model that combines evidence-based strategies and routine nursing interventions in ICU patients and to implement this model routinely in ICUs.

Ethics

Ethics Committee Approval: The study was approved by Harran University Ethics Committee (decision no: 29, date: 16.08.2021) and institutional permission were obtained in order to conduct the study.

Informed Consent: The consent was obtained from human participants and that ethical clearance was obtained from the appropriate authority.

Peer-review: Externallyand internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: D.Ş., V.K., N.D., Concept: D.Ş., Design: D.Ş., N.D., Data Collection or Processing: D.Ş., V.K., N.D., Analysis or Interpretation: D.Ş., V.K., Literature Search: D.Ş., Writing: D.Ş., V.K., N.D.

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References

1. Karadas C, Ozdemir L. Nursing responsibilities and non-pharmacological approaches in delirium management. J Psychiatric Nurs 2019;10:137-42.
2. Gravante F, Giannarelli D, Pucci A, Gagliardi AM, Mitello L, Montagna A, Latina R. Prevalence and risk factors of delirium in the intensive care unit: An observational study. Nurs Crit Care 2021;26:156-65.
3. Tsuruta R, Oda Y, Shintani A, Nunomiya S, Hashimoto S, Nakagawa T, Oida Y, Miyazaki D, Yabe S; Japanese Epidemiology of Delirium in ICUs (JEDI) Study Investigators. Delirium and coma evaluated in mechanically ventilated patients in the intensive care unit in Japan: a multi-institutional prospective observational study. J Crit Care 2014;29:472.e1-5.
4. Khan SH, Lindroth H, Perkins AJ, Jamil Y, Wang S, Roberts S, Farber M, Rahman O, Gao S, Marcantonio ER, Boustani M, Machado R, Khan BA. Delirium Incidence, Duration, and Severity in Critically Ill Patients With Coronavirus Disease 2019. Crit Care Explor 2020;2:e0290.
5. Pun BT, Badenes R, Heras La Calle G, Orun OM, Chen W, Raman R, Simpson BK, Wilson-Linville S, Hinojal Olmedillo B, Vallejo de la Cueva A, van der Jagt M, Navarro Casado R, Leal Sanz P, Orhun G, Ferrer Gómez C, Núñez Vázquez K, Piñeiro Otero P, Taccone FS, Gallego Curto E, Caricato A, Woien H, Lacave G, O'Neal HR Jr, Peterson SJ, Brummel NE, Girard TD, Ely EW, Pandharipande PP; COVID-19 Intensive Care International Study Group. Prevalence and risk factors for delirium in critically ill patients with COVID-19 (COVID-D): a multicentre cohort study. Lancet Respir Med 2021;9:239-50.
6. Helms J, Kremer S, Merdji H, Schenck M, Severac F, Clere-Jehl R, Studer A, Radosavljevic M, Kummerlen C, Monnier A, Boulay C, Fafi-Kremer S, Castelain V, Ohana M, Anheim M, Schneider F, Meziani F. Delirium and encephalopathy in severe COVID-19: a cohort analysis of ICU patients. Crit Care 2020;24:491.
7. Liang S, Chau JPC, Lo SHS, Zhao J, Choi KC. Effects of nonpharmacological delirium-prevention interventions on critically ill patients' clinical, psychological, and family outcomes: A systematic review and meta-analysis. Aust Crit Care 2021;34:378-87.
8. Ahmad I, Rathore FA. Neurological manifestations and complications of COVID-19: A literature review. J Clin Neurosci 2020;77:8-12.
9. Abboud H, Abboud FZ, Kharbouch H, Arkha Y, El Abbadi N, El Ouahabi A. COVID-19 and SARS-Cov-2 Infection: Pathophysiology

and Clinical Effects on the Nervous System. World Neurosurg 2020;140:49-53.

10. Sher Y, Rabkin B, Maldonado JR, Mohabir P. COVID-19-Associated Hyperactive Intensive Care Unit Delirium With Proposed Pathophysiology and Treatment: A Case Report. Psychosomatics 2020;61:544-50.
11. van den Boogaard M, Zegers M. Delirium in ICU patients with COVID-19. Any difference? Intensive Crit Care Nurs 2021;64:103029.
12. Kaplan Serin E. Yoğun bakım ünitesinde deliryumu azaltmaya ve önlemeye yönelik stratejiler. Bülbüloğlu S (eds). Deliryum, Akut Beyin İşlev Bozukluğu ve Bakım. Çukurova Nobel Tıp Kitabevi, Antalya, 2020;139-46.
13. Pun BT, Balas MC, Barnes-Daly MA, Thompson JL, Aldrich JM, Barr J, Byrum D, Carson SS, Devlin JW, Engel HJ, Esbrook CL, Hargett KD, Harmon L, Hielsberg C, Jackson JC, Kelly TL, Kumar V, Millner L, Morse A, Perme CS, Posa PJ, Puntillo KA, Schweickert WD, Stollings JL, Tan A, D'Agostino McGowan L, Ely EW. Caring for Critically Ill Patients with the ABCDEF Bundle: Results of the ICU Liberation Collaborative in Over 15,000 Adults. Crit Care Med 2019;47:3-14.
14. LaHue SC, James TC, Newman JC, Esmaili AM, Ormseth CH, Ely EW. Collaborative Delirium Prevention in the Age of COVID-19. J Am Geriatr Soc 2020;68:947-49.
15. Duggan MC, Van J, Ely EW. Delirium Assessment in Critically Ill Older Adults: Considerations During the COVID-19 Pandemic. Crit Care Clin 2021;37:175-90.
16. Gokalp, Y. (2019). The effects of lean six sigma training on emotional intelligence in a large corporation (Doctoral dissertation, Grand Canyon University). https://www.proquest.com/openview/ff74861887a70ac499a321b3cbd6d520/1?pq-origsite=gscholar&cbl=18750&diss=y
17. Acob JRU. The Philosophical Bases of Nursing Knowledge Development. Aloha International Journal of Health Advancement 2018;1:117-120.
18. Smith CD, Grami P. Feasibility and Effectiveness of a Delirium Prevention Bundle in Critically Ill Patients. Am J Crit Care 2016;26:19-27.
19. Roper N, Logan W, Tierney A. The Roper-Logan-Tierney model of nursing: Based on activities of living. 1st Edition, Churchill Livingstone.2000.
20. Uslu Y, Demir Korkmaz F. Intensive Care Patients Sleep: Nursing Care. Journal of Education and Research in Nursing 2015;12:156-61.
21. Fitzpatrick JJ, Whall AL. Conceptual Models of Nursing Analysis and Application. New Jersey: Prentice Hall Health, 2005.
22. Alligood MR, Tomey AM. Nursing Teorists and Their Work. Seventh Edition. Mosby Elseiver. 2010:63-5.
23. Özdemir L. The Management of delirium in ıntensive care patients and the responsibilities of nurses. Journal of Hacettepe University Faculty of Nursing 2014;1:90-8
24. Zamoscik K, Godbold R, Freeman P. Intensive care nurses' experiences and perceptions of delirium and delirium care. Intensive Crit Care Nurs 2017;40:94-100.
25. Zaal IJ, Spruyt CF, Peelen LM, van Eijk MM, Wientjes R, Schneider MM, Kesecioglu J, Slooter AJ. Intensive care unit environment may affect the course of delirium. Intensive Care Med 2013;39:481-8.
26. Rosa RG, Tonietto TF, da Silva DB, Gutierres FA, Ascoli AM, Madeira LC, Rutzen W, Falavigna M, Robinson CC, Salluh JI, Cavalcanti AB, Azevedo LC, Cremonese RV, Haack TR, Eugênio CS, Dornelles A, Bessel M, Teles JMM, Skrobik Y, Teixeira C; ICU Visits Study Group Investigators. Effectiveness and Safety of an Extended ICU Visitation Model for Delirium Prevention: A Before and After Study. Crit Care Med 2017;45:1660-67.
27. Simons KS, Laheij RJ, van den Boogaard M, Moviat MA, Paling AJ, Polderman FN, Rozendaal FW, Salet GA, van der Hoeven JG, Pickkers P, de Jager CP. Dynamic light application therapy to reduce the incidence and duration of delirium in intensive-care patients: a randomised controlled trial. Lancet Respir Med 2016;4:194-202.
28. Martinez F, Tobar C, Hill N. Preventing delirium: should non-pharmacological, multicomponent interventions be used? A systematic review and meta-analysis of the literature. Age Ageing 2015;44:196-204.
29. Brummel NE, Girard TD. Preventing delirium in the intensive care unit. Crit Care Clin 2013;29:51-65.
30. Gong F, Ai Y, Zhang L, Peng Q, Zhou Q, Gui C. The Relationship Between PaO2/FiO2 and Delirium in Intensive Care: A Cross-Sectional Study, (In press) available at Research Square. https://mednexus.org/doi/full/10.1016/j.jointm.2022.08.002
31. Sarı N, Van Giersbergen MY. Assessment of delirium, dementia, and depression in older adoults and nursing care guidance. Journal of Ege University Nursing Faculty 2017;33:138-52.
32. Vural P, Hacibekiroğlu M, Yildiz FR, Vural P. Immunological Response After Vaccine in a Group of Health-Care Workers with and without COVID-19 During Pandemia. ANKEM journal 2021;35:45-52.
33. İnal MT, Memiş D, İnal V, Uyar AŞ, Tek ŞÇ, Çiftçi T, Efe S, Korkmaz S. Evaluation of Pre-Delirium Score in Intensive Care Patients. J Turk Soc Intensive Care 2018;16:26-9.