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A relationship analysis of the effects of COVID-19 isolation on pressure sores in a tertiary hospital

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Abstract

Management of pressure sores can have various environmental effects; moreover, the COVID-19 pandemic notably affected efforts towards effective management of pressure sores. Some cases of COVID-19 infections require long-term hospitalization in the intensive care unit. Moreover, special protective equipment worn by physicians owing to the pandemic complicate wound management. In this study, we compared the pressure ulcer characteristics between isolated patients with and those without COVID-19 and evaluated the effects of isolation on pressure sores. From November 2022 to February 2023, patients who had pressure sores were included and their medical records were reviewed retrospectively. The experimental group included patients with confirmed COVID-19 infections, who received clinical treatment in an isolated unit. Wound characteristics in each group and associated risk factors were analysed. Fifty-four isolated patients with COVID-19 and 58 control patients were included. The Braden Scale score and Korea patient classification system-1 did not vary significantly between the two groups. However, the number of Grade I pressure sores in the COVID-19 isolation group was significantly lower than those in the control group ($p < 0.001$), while the number of lesions was significantly higher ($p = 0.034$). The mortality rate in the COVID-19 isolation group was higher than that in the control group ($p = 0.008$), and more patients were discharged with unhealed wounds ($p = 0.004$). A higher treatment effect on pressure sores may be expected if the disease is more actively managed. Moreover, the wound care systems for isolated patients with COVID-19 require further attention.

KEYWORDS

COVID-19, nursing, pressure ulcer, retrospective study, wound and injuries

Key Messages

- This study evaluated the effects of isolation on pressure sores.

- The grade of pressure sore first detected and number of lesions in isolation group was higher than that in the control group.
- The rate of discharge after healing of sores was significantly higher in the non-isolation group.

1 | INTRODUCTION

The management of pressure sores can have various environmental effects. Pressure sores are a serious health concern, particularly for individuals with limited mobility or those who are bedridden. Management of these sores can have both positive and negative environmental impacts, depending on the approach and the healthcare setting. Microscopically, a wound may face the risks of infection and friction control; adequate cleaning and sterilization of equipment and surfaces can help minimize these risks. Moreover, proper environmental cleanliness and hygiene are essential in healthcare facilities to prevent the spread of infections. Pressure sore prevention and management often involve the use of specialized surfaces, such as pressure-relief mattresses and cushions, the production and disposal of which can contribute to environmental impacts. However, on a macroscopic level, the patient's nursing team and their institution are very actively connected due to sustained patients' immobility. Thus, the environmental effects of pressure sore management are closely tied to the healthcare facility's practices and their commitment to sustainability.

As the COVID-19 pandemic was the most recent major change in our society's environment, its effects on pressure sore management were notable as well, especially since patients with pressure ulcers are inevitably most sensitive to changes in the environment. In December 2019, the novel coronavirus was isolated by a Chinese scientist. Following this, the COVID-19 infection quickly became a worldwide pandemic, and its high infectivity gave people cause for fear.[1,2] Moreover, infected patients had to be isolated in unique spaces, and its clinical treatment required high standards for preventing contagiousness and specialized protective equipment.[3,4] In some cases, COVID-19 infection require long-term hospitalization in the intensive care unit (ICU); on average, these patients comprise 21% of ICU admissions, with an average stay of 7.78 days.[5] The prevalence of pressure injury among patients with COVID-19 in the ICU was 3 times higher than in those without COVID-19.[6] Prolonged hospitalization and multiple medical devices like assisted ventilation make position change difficult, leading to pressure sores. Moreover, nurses' attempts to provide care to patients in these complex situations further complicate the prevention of bedsores.

In our hospital, which functions as a regional base tertiary hospital, we faced various configurations of COVID-19 isolation systems and wound care environments. Many physicians believe that dressing wounds and changing patients' positions while wearing protective gear is difficult; however, there is a lack of objective reports on the effects of patient isolation and sterile environments on wound care for pressure sores. Moreover, many physicians dismiss the need for wound care for this condition, as they believe that this environment overcomplicates the process. In fact, the urgent need for care for pressure sores has been dismissed owing to the high severity and difficulty in providing close nursing care in this environment. In this study, we compared the pressure ulcer characteristics of isolated patients with COVID-19 with patients without COVID-19 and evaluated the effects of isolation on pressure sores.

2 | MATERIALS AND METHODS

Patients admitted to the ICU of our hospital from November 2022 to February 2023 who were reported for pressure sores were included, and their charts were retrospectively reviewed. The included patients were treated by the integrated wound care team, which was led by a plastic surgeon.[7] This study was approved by the Institutional Review Board of Ajou University Hospital (AJOUIRB-DB-2022-533). Patients were classified into two groups: the COVID-19 isolation group and the non-isolation group. The isolation group was defined as the patients who had COVID-19 infection and required critical care, such as mechanical ventilator or high flow oxygen treatment, and admission to an isolation unit (Figure 1). On the contrary, the non-isolation group was defined as the patients who could either be admitted to a general ward or an ICU.

Patients' basic information, including sex, age and underlying disease information, as well as information related to risk factors, such as intubation status and usage of physical restraint, was collected. Braden scale score was used as a risk assessment tool for pressure sores, and the Korea patient classification system-1 (KPCS-1) score was used as an indicator to represent the patient's systemic condition. Wounds were evaluated based on initial state, size, stage of sore, aetiology, location, initial

FIGURE 1 A 65-year-old male patient with COVID-19-related bronchopneumonia was admitted to a negative pressure-controlled isolation unit. The patient was treated with Remdesivir® and antibiotics and was administered a high flow oxygen supplement; he developed a grade II pressure sore at his coccyx. A specialized nurse under the wound management team wore protective equipment, such as N95 mask, sterile surgical gown and two layers of gloves, to manage the wound by applying foam. The sore wound was photographed using a smartphone wrapped in vinyl bag, to record the current state of wound. At least two people were required to manage the wound at the patient's coccyx. The time required for wound management in isolated patients was two or three times that required for the same procedure in non-isolated patients.

detection location and number of pressure sores. The number of pressure sores in each patient was analysed; based on this, they were categorized as one, two, and two and more. In addition, categories of the Braden Scale Score, such as activity, nutrition, moisture of wound and perception, were collected for analysis of the risk factors. Pressure sores were graded according to the Scottish Adaptation of the European Pressure Ulcer Advisor Panel (EPUAP) pressure ulcer classification from grade I to IV.[8]

When patients with pressure sores were admitted to the hospital, a trained wound care nurse visited them and evaluated their current sore state. Wound management was discussed in a daily wound conference, where instructions on proper dressing methods and wound care were provided and then applied to patients. The results of treatment were divided into four categories. Healing was defined as restored functional and anatomical continuity.

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows version 18.0 (SPSS Inc., Chicago, IL, USA). Data are presented as mean ± 2 standard deviation. Chi-squared test was performed to evaluate qualitative data. Statistical significance was set at $p < 0.05$.

3 | RESULTS

A total of 112 patients with pressure sores were included and classified into two groups: COVID-19 isolation group ($n = 54$) and non-isolation group ($n = 58$) (Table 1). Based on the demographic data, the mean age of the patients in the COVID-19 isolation group was higher than that of patients in the non-isolation group ($p = 0.038$). Regarding pressure sore severity analysis, both the Braden scale and KPCS-1 severity scores did not differ significantly between the groups ($p = 0.078$). Among the various attributable factors, the isolation group had a greater proportion of patients requiring application of physical restraint (COVID-19 isolation 46.3% vs. control 25.9%, $p = 0.024$). The occurrence of comorbidities, such as diabetes and cancer, existence of endotracheal intubation and administration of total parenteral nutrition, did not differ significantly between the groups.

In terms of wound characteristics, the two groups did not vary significantly. The mean wound size was 18.57 ± 31.90 cm^2 in COVID-19 isolation patients and 18.03 ± 24.37 cm^2 in non-isolation patients ($p = 0.920$) (Table 2). However, when each wound was classified into four stages, the proportion of wounds in each stage differed significantly ($p = 0.002$). In the COVID-19 isolation group, the proportion of wounds in the initial stage was higher than that in the control group; that is, in specified wound depth analysis, the proportion of grade I wounds differed significantly between the two groups ($p < 0.0005$). However, the COVID-19 isolation group had a higher proportion of wounds from the grade II and higher groups than the non-isolation group (Table 3). The locations of the first sore and the common wound showed similarity between the two groups. However, the number of wounds varied significantly between the groups ($p = 0.034$). The control group had a higher proportion of patients with a single lesion, while the isolation group had a higher proportion of patients with two or more lesions (Table 2). In the risk factor analysis of pressure sores, the factors of activity, nutrition,

TABLE 1 Patient demographics.

		COVID-19 isolation			
		Yes ($N = 54$)	**No ($N = 58$)**	**Total**	***p*-Value**
Sex, *N* (%)	Male	34 (63.0)	38 (65.5)	72	0.778
	Female	20 (37.0)	29 (34.5)	40	
Age, mean ± SD		74.76 ± 15.05	68.16 ± 18.04	-	0.038
Braden Scale Score, mean ± SD		13.72 ± 2.39	13.29 ± 3.02	-	0.410
KPCS-1 Score, *N* (%)	1–10	3 (5.6)	5 (8.6)	8	0.078
	11–20	7 (13.0)	17 (29.3)	24	
	21–30	21 (38.9)	22 (37.9)	43	
	31 and above	23 (42.6)	14 (24.1)	37	
Diabetes, *N* (%)	Yes	18 (33.3)	24 (41.4)	42	0.379
	No	36 (66.7)	34 (58.6)	70	
Cancer, *N* (%)	Yes	11 (20.4)	14 (24.1)	25	0.632
	No	43 (79.6)	44 (75.9)	87	
	No	54 (100.0)	58 (100.0)	112	
Physical restraint, *N* (%)	Yes	25 (46.3)	15 (25.9)	40	0.024*
	No	29 (53.7)	43 (74.1)	72	
Intubation, *N* (%)	Yes	8 (14.8)	9 (15.5)	17	0.918
	No	46 (85.2)	49 (84.5)	95	
TPN, *N* (%)	Yes	39 (55.6)	26 (44.8)	62	0.967
	No	24 (44.4)	32 (55.2)	50	

Abbreviations: KPCS-1 score, Korean patient classification system; SD, standard deviation; TPN, total parental nutrition.
*$p < 0.05$.

moisturization and perception showed similar risks between the two groups ($p = 0.062$, 0.763, 0.993, 0.485) (Table 4).

In the management of a pressure sore, which is treated by a plastic surgeon, significant differences were found between the two groups in treatment results ($p = 0.004$) (Table 5). In the control group, higher number of healed wounds, which were treated prior to discharge, was observed. However, the proportion of patients with unhealed wounds at discharge was higher in the isolation group than in the control group. Moreover, the mortality rate of the isolation group was significantly higher than that of the control group ($p = 0.008$).

4 | DISCUSSION

In the management of pressure sores, several factors may affect wound healing, regardless of wound severity and patients' activity. These include age, BMI, malnutrition, low physical activity, neurologic impairment, long hospitalization and underlying disease.[9–15] Of these, patients' prolonged immobility and physical inactivity are major risk factors for pressure injury; position change is a necessary intervention to avoid this situation. Darvall et al. suggest that changing position every 3–5 h can halve the incidence of pressure injury.[11,12] However, efforts towards relieving these risk factors can only affect local wounds. Macroscopically, patients who were bedridden effected from systematically society thus its changes directly impact on an individual level. If these factors are addressed, patients with pressure sores may be able to experience holistic healing and an improved quality of life. Moreover, clinicians and caretakers should alter their approach to care for each patient based on their individual needs and preferences.

Notably, the severity of sores may not be linked to the severity of the disease. Although many physicians seem to acknowledge this, patients with high disease severity tend to receive inadequate wound care. In this study, we investigated a specified wound management system during the COVID-19 pandemic. We demonstrated that the notion that patients with COVID-19 infection requiring isolation had more severe pressure sores is largely misleading. In our study, although the severity of infection and patients' age were higher in the isolation group than

TABLE 2 Comparative analysis of wound characteristics in patient's pressure sore.

		COVID-19 isolation			
		Yes ($N = 54$)	No ($N = 58$)	Total	*p*-Value
Wound size (cm^2), mean ± SD		18.57 ± 31.90	18.03 ± 24.37	-	0.920
First detected wound stage, *N* (%)	Grade I	16 (29.6)	37 (63.8)	53 (47.3)	0.002*
	Grade II	19 (35.2)	9 (15.5)	28 (25.0)	
	Grade III	16 (29.6)	11 (19.0)	27 (24.1)	
	Grade IV	3 (5.6)	1 (1.7)	4 (3.6)	
Cause of wound, *N* (%)	Position	48 (88.9)	53 (91.4)	101 (90.2)	0.889
	Medical device	4 (7.4)	3 (5.2)	7 (6.3)	
	Restrain, stocking	2 (3.7)	2 (3.4)	4 (3.6)	
First detection location, *N* (%)	Home	29 (53.7)	28 (48.3)	57 (50.9)	0.547
	Nursing home	8 (14.8)	5 (8.6)	13 (11.6)	
	Other hospital	5 (9.3)	8 (13.8)	13 (11.6)	
	In hospital	12 (22.2)	17 (29.3)	29 (25.9)	
Location of wound, *N* (%)	Coccyx, Hip	43 (79.6)	46 (79.3)	89 (79.5)	0.884
	Greater trochanter	3 (5.6)	3 (5.2)	6 (5.4)	
	Malleolus, Heel, Toe	3 (5.6)	2 (3.4)	5 (4.5)	
	Arm, Elbow	1 (1.9)	1 (1.7)	2 (1.8)	
	Face, Occiput	2 (3.7)	5 (8.6)	7 (6.3)	
	Back	2 (3.7)	1 (1.7)	3 (2.7)	
Number of lesions, *N* (%)	Only one lesion	29 (53.7)	32 (55.2)	61 (54.5)	0.034*
	Two lesions	11 (20.4)	17 (29.3)	28 (25.0)	
	Three or more	14 (25.9)	9 (15.5)	23 (20.5)	

Abbreviation: SD, standard deviation.
*$p < 0.05$.

TABLE 3 Comparative analysis of pressure sore grade between two groups.

	COVID-19 isolation			
	Yes	No	Total	*p*-Value
Grade I, *N* (%)	16 (29.6)	37 (63.8)	53 (47.3)	0.000*
Grade II, *N* (%)	19 (35.2)	9 (15.5)	28 (25.0)	0.016*
Grade III, *N* (%)	16 (29.6)	11 (19.0)	27 (24.1)	0.187
Grade IV, *N* (%)	3 (5.6)	1 (1.7)	4 (3.6)	0.275

*$p < 0.05$.

the control group, the Braden severity and KPCS-1 scores did not differ significantly between groups. In tertiary hospitals, the lesions of both isolated and non-isolated patients have similar severities. Thus, pressure sore management is important regardless of isolation status of the patient.

In our comparative study group, the disease severity was similar between groups (Braden scale $p = 0.140$. KPCS-1 $p = 0.078$). However, the physical restraint ratio was higher in the COVID isolation group ($p = 0.024$), as shown in Table 2. Compared with physical barriers such as isolation, physical restraint impacts wound more significantly; this is why contemporary research trends have been focusing on medical device-induced pressure sores. This is consistent with the results of several studies. Barakat-Johnson et al. reported that medical device-related pressure injuries, such as oxygen tube and endotracheal tube, were represented in 27.9% in patients with hospital-acquired pressure sores.[16] Coyer et al. reported a device-related ulcer prevalence of 3.1%. Moreover,

TABLE 4 Comparative analysis of risk of pressure sore between two groups.

		COVID-19 isolation			
		Yes	No	Total	*p*-Value
Activity, *N* (%)	Bed restoration	39 (72.2)	31 (53.4)	70 (62.5)	0.062
	Walk occasionally	5 (9.3)	17 (29.3)	22 (19.6)	
	Walk frequently	1 (1.9)	1 (1.7)	2 (1.8)	
	Chair restoration	9 (16.7)	9 (15.5)	18 (16.1)	
Nutrition, *N* (%)	Poor	19 (35.2)	22 (37.9)	41 (36.6)	0.763
	Adequate	35 (64.8)	36 (62.1)	71 (63.4)	
	Excellent	0 (0.0)	0 (0.0)	0 (0.0)	
Wound moisture, *N* (%)	Humid	14 (25.9)	15 (25.9)	29 (25.9)	0.993
	Occasionally humid	35 (64.8)	38 (65.5)	73 (65.2)	
	Rarely humid	5 (9.3)	5 (8.6)	10 (8.9)	
Perception, *N* (%)	Very limited	27 (50.0)	24 (41.4)	51 (45.5)	0.485
	Slightly limited	20 (37.0)	22 (37.9)	42 (37.5)	
	No impairment	7 (13.0)	12 (20.7)	19 (17.0)	

TABLE 5 Comparative analysis of results of management between two groups.

	COVID-19 isolation				
	Yes	No	Total	*p*-Value	
Healed, *N* (%)	19 (35.2)	34 (58.6)	53 (47.3)	0.013	0.004*
Discharge, *N* (%)	20 (37.0)	16 (27.6)	36 (32.1)	0.285	
In care, *N* (%)	0 (0.0)	3 (5.2)	3 (2.7)	0.244	
Expire, *N* (%)	15 (27.8)	5 (8.6)	20 (17.9)	0.008*	

*$p < 0.05$.

endotracheal and nasogastric tubes were the most common cause of device-related ulcers.[17] Black et al. reported that patients with medical devices were 2–4 times more likely to develop pressure ulcers of any kind.[18] Therefore, managing the existence of various medical devices, such as physical restraint band, Levin tube and endotracheal tube, is more important in reducing the risk of pressure sores than disease severity or isolation conditions.

Physical boundaries are less crucial than other factors of developing a pressure sore; focusing on factors which aggravate or interfere treatment is more important. However, this condition requires much attention from nurses; moreover, a nurse who cares for patients face to face may face difficulties due to physical boundaries. In our institution, three nurses are responsible for patients in all wards as well as the ICU, which has physical boundaries. In addition, when evaluating a patient's wounds at the isolation ward, nurses may face many difficulties in changing their personal protective equipment to meet the regulations. In terms of institutional support, physical boundaries will not affect the patient's pressure sores. This study was conducted in a tertiary hospital with sufficient facilities, manpower and institutional support; hence, support for this type of care should be prioritized in low-level hospitals with insufficient facilities and manpower.

In this study, the first detected wound stage of pressure sore was found to be grade III or higher in the isolation group (35.2%); moreover, the proportion of patients with three or more lesions was higher than that in the control group (25.9% vs. 15.5%). Based on the results, the risk factors for sores were found to be similar, and the only significant difference between these two groups was detection time. Initial detection of pressure sores may occur later in the isolation group than in the control group, which may be related to the existence of multiple sores. Several early detection efforts have been suggested in recent studies. The Sub-Epidermal Moisture (SEM) Scanner (Bruin Biometrics [BBI], LLC) is a hand-held device that assesses increases in interstitial fluid or subepidermal moisture, indicating early tissue damage. Raizman et al. reported that the use of the SEM Scanner resulted in a 93% decrease in hospital-acquired pressure ulcers.[19] Moreover, efforts have been made to use biomarkers in identifying the risk of pressure injury before it

is visible. Wang et al. suggested a combination of haemoglobin, CRP, albumin, age and gender as biomarkers for early detection of pressure injury formation.[20]

This study is meaningful because we investigated the epidemiology of pressure sores between the COVID-19 isolation and control groups and reported the results after proper sore management of a plastic surgeon. The most frequent stage of each group in which sores were detected was different. Moreover, in the isolation group, several patients had uncured sores at the time of discharge, while this was not the case in the control group. More active treatment was insufficient for the isolation group, which is thought to have directly affected the outcome. When the isolation ward had its first patient with COVID-19, many doctors and nurses did not know how to manage a pressure sore; hence, they preferred conservative management rather than perform a procedure. For example, changing the dressing material alone was more common than performing wound debridement. Moreover, the interval of dressing material change was longer than that of in the control group, resulting in aggravation of infection and increased size of wound. Thus, prejudices towards surgical procedures directly affected treatment outcomes, especially in the management of pressure sore. Moreover, the active perception and approach of doctors should be prioritized under any circumstances.

4.1 | Limitation

Although our study showed that the patients in the COVID isolation group had higher severity than non-isolation group, the disease severity was not adjusted in the comparative analysis. As this is an important risk factor for pressure sores, it requires consideration as well. Other limitations included the relatively small sample size of isolated patients with COVID-19. The hospital capacity for patients who had severe COVID-19 infection and needed intensive care was limited due to the small number of isolation units. To improve the reliability of results, it is necessary to compare many isolated patients through the multi-centre study.

5 | CONCLUSIONS

In our comparative study, the disease severity score did not vary significantly between the two groups. However, the grade of pressure sore first detected in the COVID-19 isolation group was higher than that in the control group. Moreover, the average number of lesions in patients in the isolation group was found to be more than that in the control group. In terms of treatment outcomes, the rate of discharge after healing of sores was significantly higher in the non-isolation group, whereas the mortality rate was significantly higher in the COVID-19 isolation group.

Disease severity and risk factors in isolated patients were like those in patients from the control group. Therefore, it can be inferred that a higher treatment effect can be expected with more active disease management. Therefore, the wound care system for isolated patients with COVID-19 requires further attention.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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