

Characteristics of pressure injuries among geriatric patients at an Indonesian tertiary hospital: a cross-sectional study

Shannaz Nadia Yusharyahya¹, Lili Legiawati¹, Rinadewi Astriningrum¹, Reganedgary Jonlean², Vega Andhira²



pISSN: 0853-1773 • eISSN: 2252-8083
<https://doi.org/10.13181/mji.oa.237092>
Med J Indones. 2023;32:183–9

Received: July 17, 2023
Accepted: October 16, 2023
Published online: November 14, 2023

Authors' affiliations:

¹Department of Dermatology and Venereology, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia, ²Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jakarta, Indonesia

Corresponding author:

Shannaz Nadia Yusharyahya
 Department of Dermatology and Venereology, Faculty of Medicine, Universitas Indonesia, Cipto Mangunkusumo Hospital, Jalan Pangeran Diponegoro No. 71, Kenari, Senen, Central Jakarta 10430, Jakarta, Indonesia
 Tel/Fax: +62-21-31935383
 E-mail: nadiayusharyahya@yahoo.com

ABSTRACT

BACKGROUND Pressure injury develops due to sustained pressure at the bony prominence of the skin and tissues. Geriatric patients often have multiple comorbidities, predisposing them to pressure injury. Data on the characteristics of the geriatric with pressure injuries are still limited. This study aimed to report the characteristics of geriatric patients with pressure injuries admitted at a tertiary hospital in Indonesia.

METHODS This cross-sectional study used medical records of geriatric patients admitted with all stages of pressure injuries consulted to the Department of Dermatology and Venereology at a tertiary hospital in Indonesia between January 2017 and April 2021. Pressure injuries were classified based on the 2019 National Pressure Injury Advisory Panel guideline.

RESULTS 39 patients presented with varied pressure injury characteristics. The sacral region was the most reported site (36%), with stage 2 pressure injury being the most commonly found stage in the patients (74%). Interestingly, 22% of the patients had pressure injuries found on the atypical sites due to prolonged surgery or the pressure of medical devices. More than half of the patients used conventional dressings (51.3%). Immobility was found in 35.9% of the patients due to being bedridden.

CONCLUSIONS No characteristics were found as a significant risk factor for pressure injury formation during or outside the admission period. However, a history of surgery might be related to pressure injury formation during admission.

KEYWORDS geriatrics, Indonesia, inpatients, pressure ulcer

Pressure injury or pressure ulcer is a societal burden¹ that typically occurs due to sustained and prolonged pressure at the bony prominences of the skin and tissues, leading to insufficient blood flow.² Contributing factors to pressure injury include shearing forces, friction, and a moist environment, and pressure injury can extend to the muscle and bone.³ According to the National Pressure Injury Advisory Panel (NPIAP), pressure injuries are staged from 1–4, with higher stages indicating more severe injuries. There are two other stages, unstageable and

deep tissue pressure injuries. A systematic and meta-analysis⁶ reported the global prevalence of pressure injuries as 12.8% in hospitalized adult patients. In comparison, the prevalence of pressure injuries in four hospitals in Indonesia was 8%, with almost half of the patients (44%) having one or more pressure injuries upon admission; therefore, the prevalence of nosocomial pressure injuries in Indonesia was 4.5%.⁷

Geriatric patients (those aged ≥60 years) are more vulnerable to pressure injuries due to the progressive decline in skin integrity and function as

the dermoepidermal junctions flatten, affecting the nutritional and oxygen transport of the skin.⁸ These patients tend to develop chronic illnesses, making them immobile for extended periods.⁹ Geriatric patients also develop syndromes that may contribute to weight loss, malnutrition, and immobility. The use of medical devices, such as respiratory devices, diapers, restraining devices, medical catheters, and medical tubes attached to the patients, also contribute to developing pressure injuries.^{10–12}

Cipto Mangunkusumo Hospital is a top tertiary and referral hospital in Indonesia. However, no studies have been reported on the prevalence and characteristics of patients with pressure injuries at Cipto Mangunkusumo Hospital. A previous study reported the prevalence of pressure injuries in older people living in nursing homes in Barcelona as 3.5%.¹³ Hossain et al¹⁴ reported that 75.4% of critically ill patients with pressure injuries admitted to a tertiary hospital were 61 years or older. Ke et al¹⁵ reported that pressure injuries were observed in 5.6% of patients aged 65 years or older who are admitted to the emergency department in an Asian hospital. As pressure injuries are a common complication in inpatient geriatric patients that are associated with significant morbidity, identifying the characteristics of geriatric patients with pressure injuries is essential to reduce the physical and financial burdens on the patient and healthcare system.^{16,17} Data regarding the features and potential factors associated with pressure injuries in geriatric inpatients in Indonesia are rare. This study aimed to report the characteristics of geriatric patients admitted to Cipto Mangunkusumo Hospital for the dermatological treatment of pressure injuries.

METHODS

This cross-sectional study included geriatric patients with pressure injuries admitted to the Department of Dermatology and Venereology at Cipto Mangunkusumo Hospital, Jakarta, between January 2017 and April 2021. Due to the complexity of care received by patients in central hospitals and the emergence of the coronavirus disease 2019 pandemic, the data were collected retrospectively using medical records. This study included Indonesian patients admitted to inpatient care units (inpatient wards, emergency rooms, and intensive care units) to obtain more generalized results. Geriatric patients with all stages of confirmed pressure injuries were included in

this study. Pressure injuries were defined and staged using 2019 NPIAP guidelines: stage 1, pressure injuries manifested as an ulcer with non-blanchable erythema of intact skin; stage 2, pressure injuries manifested as an ulcer with partial-thickness skin loss with the exposed dermis; stage 3, pressure injuries manifested as an ulcer with full-thickness skin loss; and stage 4, pressure injuries manifested as an ulcer with full-thickness skin and tissue loss. Unstageable ulcers were defined as ulcers with full-thickness skin and tissue loss, and deep tissue injuries were defined as ulcers with persistent, non-blanchable deep red, maroon, or purple discoloration. Potential confounders in this study were ulcers with etiologies other than constant pressure, such as diabetes and venous ulcers. The NPIAP guidelines and the hospital's internal diagnostic standards were used to differentiate pressure injuries from other ulcers.

Data from medical records included patient age, sex, anatomical site of pressure injuries, stage, causes and duration of bedridden patients, and treatment modalities. The patients were classified based on the setting where the pressure injury was first detected (during or outside admission). Although this study exclusively examined geriatric patients, the patients were subdivided into three groups based on age: 60–69 years, 70–79 years, and ≥80 years. The anatomical sites of the pressure injuries were categorized using the three most common locations. Pressure injuries found in other locations were classified as “atypical sites.” In addition, the duration of hospitalization was categorized as <1 month, between 1–6 months, and >6 months. The causes and settings in which the pressure injuries were diagnosed were determined by the dermatovenereologist, which was reported in the medical records. The treatment modalities used in this study included dressings (conventional, modern, or both). Conventional dressings referred to the application of saline solution wet dressings or gauze twice daily for 15–20 min each, whereas modern dressings referred to the application of hydrocolloid, antimicrobial, or foam dressings. All patients who fulfilled the inclusion criteria were included in this study to represent the entire population of geriatric patients with pressure injuries at Cipto Mangunkusumo Hospital between 2017 and 2021.

This study was approved by the ethical committee of Cipto Mangunkusumo Hospital (No: 16.02/221/0775/2020) and Faculty of Medicine

Universitas Indonesia (No: 20-05-0564, amendment number: ND-141/UN2.F1/ETIK/PPM.00.02/2021). The study design was based on the Strengthening the Reporting of Observational Studies in Epidemiology for cross-sectional studies and was prepared according to the recommendations of the International Committee of Medical Journal Editors.

Data are presented descriptively. The SPSS software version 26 (IBM Corp., USA) was used to analyze the data descriptively without using any specific statistical test to plot the percentages of each assessed parameter, with $p < 0.05$ being set as a cut-off point of significance when necessary.

RESULTS

A total of 39 patients (50 pressure injuries) aged 60–89 years were included in this study (Table 1). The number of female (51%) and male (49%) patients were similar. Most patients developed pressure injuries outside the inpatient hospital stay. Some patients developed more than one type of pressure injury. The distribution of patients who developed pressure injuries during and outside hospital admission was not significantly different based on the patient's sex or age.

The three most common anatomical sites for the formation of pressure injuries were the lumbosacral region, back, and gluteus. Nearly one-fourth (24%) of the pressure injuries were located in atypical sites due to prolonged operation or the pressure of medical devices, such as urine catheters. The location of the pressure injuries did not differ significantly between the two groups. More than half of the patients had stage 2 pressure injuries. Only one patient experienced a stage 4 pressure injury, which occurred outside of the hospital admission period. Another patient had an unstageable pressure injury during hospital admission. No deep tissue pressure injuries were observed. The distribution of the stages of pressure injury was not significantly different between the two groups.

Each patient was treated according to the pressure injury stage and associated infections. Most patients were treated via conventional dressings. However, eight patients treated with conventional dressings received additional antimicrobial therapy, including six (16%) who received antifungal therapy and two (6%) who received antibiotic therapy due to infection. The treatments were not significantly different between the two groups.

Table 1. Patient characteristics and the pressure injuries

Patient characteristics (N = 39)	During admission, n (%)	Outside of admission, n (%)
Sex		
Female	11 (28)	9 (23)
Male	11 (28)	8 (21)
Age (years), mean		
60–69, n (%)	10 (26)	12 (31)
70–79, n (%)	8 (21)	7 (18)
>80, n (%)	1 (3)	1 (3)
Regions (n = 50)		
Lumbosacral	8 (16)	9 (18)
Back	6 (12)	5 (10)
Gluteus	5 (10)	5 (10)
Atypical sites		
Scalp & facial	2 (4)	1 (2)
Neck	1 (2)	-
Abdominal	1 (2)	-
Upper extremity	1 (2)	2 (4)
Lower extremity	2 (4)	2 (4)
Stages of pressure injury (n = 50)		
1	4 (8)	4 (8)
2	17 (34)	20 (40)
3	2 (4)	1 (2)
4	-	1 (2)
Unstageable	1 (2)	-
Treatments for pressure injury		
Conventional dressings	16 (41)	17 (44)
Modern dressings	1 (3)	1 (3)
Conventional and modern dressings	2 (5)	2 (5)
Others (in addition to conventional dressings)		
Antifungal topical/systemic therapy	3 (8)	3 (8)
Antibacterial topical/systemic therapy	1 (3)	1 (3)

All patients were bedridden for various causes and durations (Table 2). Immobility was the main cause of being bedridden. Patients with pressure injuries during admission had significantly more injuries due to being bedridden after a postoperative procedure. Most patients were bedridden for less than 1 month. The

Table 2. Causes and durations of bedridden

Causes and durations of bedridden (N = 39)	During admission, n (%)	Outside of admission, n (%)
Causes of bedridden		
Immobility	6 (15)	8 (21)
Weakness due to diseases	4 (10)	6 (15)
Post-surgery	9 (23)	-
Loss of consciousness	3 (8)	3 (8)
Durations of bedridden (month)		
<1	11 (28)	12 (31)
1–6	5 (13)	7 (18)
>6	2 (5)	2 (5)

duration of being bedridden was similar between the two groups.

DISCUSSION

In this study, the characteristics of patients who developed a pressure injury during hospital admission were similar to those of patients who had a pressure injury outside of the hospital stay. The only significant difference between these patient groups was the cause of being bedridden, as more patients who developed injury during admission were bedridden due to a procedure. However, surgeries can only be performed in hospitals; therefore, this difference is not unexpected. In addition, due to the small patient population, it cannot be determined if being bedridden after a surgical procedure is a significant risk factor for developing pressure injuries during hospital stay. The results of this study provide evidence regarding the natural disease history of pressure injuries, specifically in geriatric inpatients in Indonesia.

Most pressure injuries in this study were categorized as stage 2 injuries. Patients with pressure injuries upon hospital admission were less likely to be discharged home.¹⁸ Therefore, a thorough examination must be conducted to ensure that geriatric patients with pressure injuries receive prompt treatment to improve their prognosis. Pressure injuries are the leading etiology of ulcerative diseases requiring emergency geriatric dermatology consultations in Indonesia.¹⁹ Patients typically develop pressure injuries after prolonged hospitalization, including patients receiving post-surgical and intensive care. In the present study, all

patients who underwent surgery for pressure injuries developed injuries during hospital admission. Pressure injuries are a common complication in elderly patients hospitalized after undergoing various surgeries.^{20–22} Hyun et al²³ reported an increased number of drugs, a poor sedation status, and the use of feeding tubes as risk factors for hospital-acquired pressure injuries.

Several patients in this study developed multiple pressure injuries depending on their general conditions and comorbidities associated with wound formation. The sacral region was the most common anatomical site of pressure injuries in this study, which is consistent with findings from other studies.^{6,24,25} A meta-analysis by Hu et al²⁶ reported that the sacrococcygeal region was the most common site of pressure injury, and the hip was the third most common site. However, the heel was the second most common site reported in that study. Differences in anatomy and adipose tissue distribution may explain these differences.²⁷ The sacrum is typically the most affected region due to several factors, including thinner skin layers, constant pressure from the sacral bony prominence, impaired blood flow and perfusion, and a constant shearing force on the skin surface.^{28,29} In this study, a significant proportion of pressure injuries were observed at atypical sites, such as the scalp, face, posterior neck, abdomen, upper extremity, and lower extremity. Pressure injuries may develop on the head and neck due to positioning or medical devices.³⁰ A previous study reported that facial pressure ulcers developed in 27% of patients who underwent surgery in the prone position for more than 3 hours, mainly occurring in the bony prominences of the face.³¹ As excessive pressure on the interface between a supporting surface and the skin is a pivotal mechanism of pressure injury development,³² pressure injury on the abdomen may develop in patients lying prone for an extended period. However, pressure injuries in the extremities usually develop due to medical devices.³³ Pressure injuries are more frequently observed in the lower extremity than in the upper extremity and are most common on the ankle, heel, and hip.^{34–36}

At Cipto Mangunkusumo Hospital, a higher number of patients received conventional dressings because they are usually more affordable and easily accessible than modern ones.³⁷ Modern dressings include hydrocolloid, antimicrobial, or foam dressings and are used based on the condition of the injury. Modern dressings in combination with other

treatments are used more frequently for pressure injuries of various stages.³⁸⁻⁴⁰ However, these dressings are considered prophylactic rather than therapeutic.⁴¹ Modern dressings facilitate healing by providing a moist environment, controlling excessive exudate and bacterial contamination, and reducing pain.^{42,43} In some patients, both conventional and modern dressings were used simultaneously or alternately. Other treatments, such as topical antibiotics or antifungals, were administered to the patients depending on the presence or type of local infection. However, antimicrobial agents should not be routinely used as prophylaxis in patients with pressure injuries without a confirmed infection, as their efficacy is unclear.⁴⁴

All patients included in this study were bedridden for various durations and causes; however, these could not be investigated due to a lack of documentation. Immobility is an intrinsic risk factor that affects the formation of pressure injuries. A prolonged period of immobilization causes constant pressure from solid surfaces, impairs vascularization, and ultimately induces pressure injury formation.⁸ Furthermore, incorrect body positioning synergizes with immobilization to aggravate pressure injury formation, especially in geriatric patients after surgery.⁴⁵ Older patients with lower body mass index and Braden scores are at an increased risk of developing pressure injuries.^{46,47} Lower skin pH and stratum corneum moisture content are major skin barrier factors affecting the formation of pressure in patients who are bedridden, including geriatric patients.⁴⁸

This study was limited by its small sample size, as not all geriatric patients with pressure injuries were referred to the Department of Dermatology and Venereology. Patients who consulted to the Department of Dermatology and Venereology typically had stage 1 or 2 pressure injuries. In contrast, patients who developed stage 3 and higher pressure injuries were often referred to the Department of Reconstructive and Aesthetic Plastic Surgery. Furthermore, some patients with pressure injuries were treated by other departments without being consulted to the Department of Dermatology and Venereology, which introduced selection bias and further reduced the potential sample pool.

The findings of this study are significant for the rising burden of pressure injuries on healthcare systems. A healthcare economics study by Padula and Delarmente⁴⁹ reported that pressure injuries represent

a significant financial burden on healthcare system, with more than half of the total funding spent on treating a small percentage of stage 3 and 4 injuries, which can be attributed to the poor quality of healthcare facilities and early prevention systems. Understanding the characteristics of geriatric patients with pressure injuries can significantly reduce the healthcare costs. Therefore, geriatric patients with relevant features should be observed more closely, allowing early interventions to prevent pressure injuries. Educating patients and their caregivers may increase awareness regarding the characteristics of patients with pressure injuries. Robineau et al⁵⁰ concluded that education programs on pressure injury prevention yielded positive results, especially in geriatric patients, as older adults developing pressure injuries had a 2-fold higher 3-year risk of mortality.⁵¹ The findings of this study can be incorporated into clinical practice guidelines at healthcare facilities in combination with other relevant prevention strategies to prevent or treat pressure injuries at earlier stages, reducing unnecessary financial burdens for both the patient and the healthcare system.^{17,52}

In conclusion, neither patients with pressure injury during nor outside admission had significant characteristics that might act as a risk factor. However, pressure injuries are a significant burden in every hospital, and a history of surgery may increase the risk of developing pressure injuries during an inpatient stay.

Conflict of Interest

The authors affirm no conflict of interest in this study.

Acknowledgment

The authors thank the Universitas Indonesia for funding this study.

Funding Sources

This study was funded by Universitas Indonesia through the PUTI Grant with contract number NKB-317/UN2.RST/HKP.05.00/2020.

REFERENCES

1. Díaz-Carol, García Gómez-Heras S. Incidence of hospital-acquired pressure ulcers in patients with “minimal risk” according to the “Norton-MI” scale. *PLoS One*. 2020;15(1):e0227052.
2. Kottner J, Balzer K, Dassen T, Heinze S. Pressure ulcers: a critical review of definitions and classifications. *Ostomy Wound Manage*. 2009;55(9):22-9.
3. Mervis JS, Phillips TJ. Pressure ulcers: pathophysiology, epidemiology, risk factors, and presentation. *J Am Acad Dermatol*. 2019;81(4):881-90.
4. Reddy M. Pressure ulcers. *BMJ Clin Evid*. 2011;2011:1901.
5. Amir Y, Halfens RJ, Lohrmann C, Schols JM. Pressure ulcer prevalence and quality of care in stroke patients in an Indonesian hospital. *J Wound Care*. 2013;22(5):254-60.

6. Li Z, Lin F, Thalib L, Chaboyer W. Global prevalence and incidence of pressure injuries in hospitalised adult patients: a systematic review and meta-analysis. *Int J Nurs Stud.* 2020;105:103546.
7. Amir Y, Lohrmann C, Halfens RJ, Schols JM. Pressure ulcers in four Indonesian hospitals: prevalence, patient characteristics, ulcer characteristics, prevention and treatment. *Int Wound J.* 2017;14(1):184–93.
8. Greenhalgh DG. Pressure injury in the critically ill elderly patient. *Curr Geriatr Rep.* 2019;8:167–72.
9. Bhattacharya S, Mishra RK. Pressure ulcers: current understanding and newer modalities of treatment. *Indian J Plast Surg.* 2015;48(1):4–16.
10. Jackson D, Sarki AM, Betteridge R, Brooke J. Medical device-related pressure ulcers: a systematic review and meta-analysis. *Int J Nurs Stud.* 2019;92:109–20.
11. Kim JY, Lee YJ; Korean Association of Wound Ostomy Continence Nurses. Medical device-related pressure ulcer (MDRPU) in acute care hospitals and its perceived importance and prevention performance by clinical nurses. *Int Wound J.* 2019;16 Suppl 1(Suppl 1):51–61.
12. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: quick reference guide. Emily Haesler, editor. EPUAP/NPIAP/PPPIA; 2019.
13. Hernández-Martínez-Esparza E, Santasmases-Masana R, Román E, Abades Porcel M, Torner Busquet A, Berenguer Pérez M, et al. Prevalence and characteristics of older people with pressure ulcers and legs ulcers, in nursing homes in Barcelona. *J Tissue Viability.* 2021;30(1):108–15.
14. Hossain B, Mamun AA, Razi HA, Raisul NI. Evaluation of pressure ulcer among the critically ill patients admitted in a tertiary hospital. *J Bangladesh Coll Phys Surg.* 2022;40(1):23–30.
15. Ke YT, Peng AC, Shu YM, Chung MH, Tsai KT, Chen PJ, et al. Prevalence of geriatric syndromes and the need for hospice care in older patients of the Emergency Department: a study in an Asian Medical Center. *Emerg Med Int.* 2020;2020:7174695.
16. Kim MJ, Jeong YS, Kim HJ, Hahn HM, Thai DQ, Lee IJ. Effect of a team approach to pressure injury management over 5 years in a tertiary hospital. *Adv Skin Wound Care.* 2023;36(1):1–7.
17. Hartung B. Pressure injury prevention in a geriatric post-acute care setting: a quality improvement study. *Practice Improvement Projects.* 2019;40(4):12–6.
18. Santaegùènia SJ, Mas MÀ, Tarazona-Santabalbina FJ, Alventosa AM, García M, Monterde A, et al. Does the presence of pressure ulcers entail “high risk of negative outcomes” in geriatric rehabilitation? Results from a retrospective cohort study. *Nutr Hosp.* 2017;34(5):1305–10.
19. Yusharyahya SN, Lestarini D, Mutmainnah E, Legiawati L, Astriningrum R, Kusumahapsari RW. Dermatological emergency cases in geriatric patients: a 3-year multicenter study of three national referral hospitals in Indonesia. *Open Access Maced J Med Sci.* 2022;10(B):1774–8.
20. Chen J, Wang X, Qian H, Ye J, Qian J, Hua J. Correlation between common postoperative complications of prolonged bed rest and quality of life in hospitalized elderly hip fracture patients. *Ann Palliat Med.* 2020;9(3):1125–33.
21. Ahmedov A, Ahmedov Y. Follow-up of geriatric patients with pressure ulcers by plastic, reconstructive and aesthetic surgery in intensive care conditions. *Clin Exp Health Sci.* 2022;12(1):107–12.
22. Galivanche AR, Kebaish KJ, Adrados M, Ottesen TD, Varthi AG, Rubin LE, et al. Postoperative pressure ulcers after geriatric hip fracture surgery are predicted by defined preoperative comorbidities and postoperative complications. *J Am Acad Orthop Surg.* 2020;28(8):342–51.
23. Hyun S, Moffatt-Bruce S, Newton C, Hixon B. Hospital-acquired pressure injury: clinical characteristics and outcomes in critical care. *Int J Adv Cult Technol.* 2019;7(2):28–33.
24. Simões JL, Sa-Couto P, Voegeli D. Factors predicting pressure injury incidence in older adults following elective total hip arthroplasty: a longitudinal study. *Adv Skin Wound Care.* 2022;35(1):48–55.
25. Aygör HE, Sahin S, Sözen E, Baydal B, Aykar FS, Akçiçek F. Features of pressure ulcers in hospitalized older adults. *Adv Skin Wound Care.* 2014;27(3):122–6.
26. Hu Y, Wang L, Cao ZD, Wang Y. The incidence of pressure ulcer in the elderly in China between 2009 and 2019: a meta-analysis. *Med Data Min.* 2020;3(3):110–8.
27. Primiano M, Friend M, McClure C, Nardi S, Fix L, Schafer M, et al. Pressure ulcer prevalence and risk factors during prolonged surgical procedures. *AORN J.* 2011;94(6):555–66.
28. Abed Elahad J, McCarthy MW, Goverman J, Kaafarani HM. An overview of sacral decubitus ulcer. *Curr Trauma Rep.* 2018;4:263–72.
29. Wong D, Holtom P, Spellberg B. Osteomyelitis complicating sacral pressure ulcers: whether or not to treat with antibiotic therapy. *Clin Infect Dis.* 2019;68(2):338–42.
30. Polancich S, Hall AG, Miltner R, Poe T, Enogela EM, Montgomery AP, et al. Learning during crisis: the impact of COVID-19 on hospital-acquired pressure injury incidence. *J Healthc Qual.* 2021;43(3):137–44.
31. Varga E, Kay SI, Zbeidy RA, Souki FG. Facial pressure ulcers: unsightly complication of prone positioning. *Anesthesiology.* 2022;136(5):827–8.
32. Oomens CW, Broek M, Hemmes B, Bader DL. How does lateral tilting affect the internal strains in the sacral region of bed ridden patients? - A contribution to pressure ulcer prevention. *Clin Biomech (Bristol, Avon).* 2016;35:7–13.
33. Karacabay K, Savci A, Dalkılıç M, Kabu Hergül F. Determining the incidence and risk factors of medical device-related pressure injury in intensive care patients. *J Tissue Viability.* 2023;S0965-206X(23)00097–9.
34. Su S, Ding X, Zou H, Lin Y, Huang J, Xiong D, et al. Wound management of multi-site pressure ulcer at different stages in elderly patients. *Clin Cosmet Investig Dermatol.* 2021;14:747–51.
35. Kohara HT, Ikeda M, Okawa M. Relationship between pressure ulcers in elderly people and physiological indices of the skin. *Acta Med Okayama.* 2021;75(5):557–65.
36. Okamoto S, Ogai K, Mukai K, Sugama J. Association of skin microbiome with the onset and recurrence of pressure injury in bedridden elderly people. *Microorganisms.* 2021;9(8):1603.
37. Broussard KC, Powers JG. Wound dressings: selecting the most appropriate type. *Am J Clin Dermatol.* 2013;14(6):449–59.
38. Zhao N, Tian Z, Li Y, Yu H, Yang Y. Virtual reality-based analysis of pressure ulcer care information related to medical equipment for the prevention of pressure ulcer skin foam dressings in the elderly. *J Healthc Eng.* 2021;2021:6389001.
39. Jeong HS. Non-surgical treatment for pressure ulcer. *J Korean Med Assoc.* 2021;64(1):26–33.
40. Shao R, Du T, Zhang Y, Li Y, Zhang Q. The effectiveness of drugs combined with individualized management for elderly patients with stage III pressure ulcers. *J Cosmet Dermatol.* 2022;21(11):5984–9.
41. Lovegrove J, Fulbrook P, Miles S, Steele M. Effectiveness of interventions to prevent pressure injury in adults admitted to intensive care settings: a systematic review and meta-analysis of randomised controlled trials. *Aust Crit Care.* 2022;35(2):186–203.
42. Dhivya S, Padma VV, Santhini E. Wound dressings - a review. *Biomedicine (Taipei).* 2015;5(4):22.
43. Deutsch CJ, Edwards DM, Myers S. Wound dressings. *Br J Hosp Med (Lond).* 2017;78(7):C103–9.
44. Norman G, Dumville JC, Moore ZE, Tanner J, Christie J, Goto S. Antibiotics and antiseptics for pressure ulcers. *Cochrane Database Syst Rev.* 2016;4(4):CD011586.
45. Jaul E, Factor H, Karni S, Schiffmiller T, Meiron O. Spasticity and dementia increase the risk of pressure ulcers. *Int Wound J.* 2019;16(3):847–51.

46. Schultz A, Bien M, Dumond K, Brown K, Myers A. Etiology and incidence of pressure ulcers in surgical patients. *AORN J.* 1999;70(3):434, 437-40, 443-9.
47. Rondinelli J, Zuniga S, Kipnis P, Kowar LN, Liu V, Escobar GJ. Hospital-acquired pressure injury: risk-adjusted comparisons in an integrated healthcare delivery system. *Nurs Res.* 2018;67(1):16-25.
48. He M, Tang A, Ge X, Zheng J. Pressure ulcers in the intensive care unit: an analysis of skin barrier risk factors. *Adv Skin Wound Care.* 2016;29(11):493-8.
49. Padula WV, Delarmente BA. The national cost of hospital-acquired pressure injuries in the United States. *Int Wound J.* 2019;16(3):634-40.
50. Robineau S, Nicolas B, Mathieu L, Duruflé A, Leblong E, Fraudet B, et al. Assessing the impact of a patient education programme on pressure ulcer prevention in patients with spinal cord injuries. *J Tissue Viability.* 2019;28(4):167-72.
51. Song YP, Shen HW, Cai JY, Zha ML, Chen HL. The relationship between pressure injury complication and mortality risk of older patients in follow-up: a systematic review and meta-analysis. *Int Wound J.* 2019;16(6):1533-44.
52. Gaspar S, Peralta M, Marques A, Budri A, Gaspar de Matos M. Effectiveness on hospital-acquired pressure ulcers prevention: a systematic review. *Int Wound J.* 2019;16(5):1087-102.