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Impact of multifaceted interventions on pressure injury prevention: a systematic review

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Abstract

Background Pressure injuries are a significant concern in healthcare settings, leading to increased morbidity, healthcare costs, and patient suffering. This systematic review aims to evaluate the impact of multifaceted interventions on the prevention of Pressure injuries and improvements in nursing practices.

Methods A systematic search was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines across multiple databases, including studies from Google Scholar (332), Science Direct (14), grey literature sources (45), PubMed (0), Cochrane Library (437), and Hinari (322). Studies included in the review examined the effectiveness of various interventions, including educational programs, care bundles, and positioning strategies, on Pressure injury prevention.

Results The interventions significantly reduced Pressure injury prevalence from 60.9 to 28.7%, with hospital-acquired injuries decreasing from 52.9 to 21.3%. The mean national prevalence of Pressure injuries was 17.6%, with 58.1% being community-acquired. Educational programs greatly enhanced nurses' knowledge and practices, particularly regarding the Braden scale and wound care protocols. Key risk factors identified were patient age, sex, and chronic diseases. Effective strategies included the use of air cushions and specific positioning techniques. Care bundles were found to prevent pressure ulcers in 90% of patients in the study group, and medical device-related Pressure Injuries were reduced to 5.01%.

Conclusion Multifaceted interventions, including education, care bundles, and positioning strategies, are highly effective in reducing the prevalence of Pressure Injuries and improving nursing practices. Implementing comprehensive prevention strategies is essential for mitigating Pressure Injury risks in healthcare settings.

Keywords Pressure injuries, Multifaceted interventions, Nursing practices, Educational programs, Care bundles, Positioning strategies, Risk factors, Prevention strategies

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Introduction

Pressure Injuries, represent a pervasive challenge within healthcare systems globally. These injuries result from prolonged pressure on the skin and underlying tissues, often occurring in individuals with limited mobility or those confined to bed or chairs for extended periods. Pressure Injuries manifest as localized areas of tissue damage, ranging from mild erythema to deep, open wounds, posing significant clinical, economic, and psychosocial burdens. Despite advancements in healthcare, Pressure Injuries persist as a prevalent and distressing issue, necessitating concerted efforts for prevention and management [1, 2].

The significance of addressing Pressure Injuries lies in their multifaceted impact on patients, healthcare systems, and society at large. Primarily, Pressure Injuries inflict substantial physical discomfort and pain upon affected individuals, impairing their quality of life and prolonging recovery periods. Moreover, these wounds increase patients' susceptibility to infections, leading to complications such as sepsis or osteomyelitis, thereby exacerbating morbidity and mortality rates. Beyond the individual level, Pressure Injuries impose considerable financial strains on healthcare institutions, accruing substantial treatment costs and prolonging hospital stays. Furthermore, they engender ethical concerns regarding patient care standards and healthcare resource allocation [3, 4].

Understanding the etiology and epidemiology of Pressure Injuries is essential for devising effective prevention and management strategies. Pressure Injuries typically arise due to a combination of extrinsic factors, including pressure, shear, friction, and moisture, alongside intrinsic patient-related factors such as immobility, malnutrition, and comorbidities like diabetes or vascular disease. Additionally, advancing age, sensory deficits, and impaired tissue perfusion contribute to heightened vulnerability to Pressure Injuries. The prevalence of Pressure Injuries varies across healthcare settings, with acute care facilities, long-term care facilities, and home care environments all witnessing significant burdens [5, 6].

Given the multifactorial nature of Pressure Injuries prevention remains paramount in mitigating their occurrence and severity. Prevention strategies encompass a holistic approach involving risk assessment, patient repositioning, skincare protocols, support surface selection, and staff education. Interventions aimed at reducing pressure, redistributing weight, maintaining tissue perfusion, and optimizing nutritional status are integral components of comprehensive prevention programs. Furthermore, promoting patient and caregiver awareness, fostering interdisciplinary collaboration, and implementing evidence-based guidelines are crucial for enhancing prevention efforts [1, 7, 8].

Nurses play a pivotal role in the prevention, early detection, and management of Pressure Injuries, given their frontline position in patient care. As primary caregivers, nurses are responsible for conducting regular skin assessments, implementing preventive measures, and coordinating interdisciplinary interventions. Moreover, nurses serve as educators, advocates, and leaders in promoting a culture of patient safety and quality improvement within healthcare settings. Consequently, investing in nursing education, training, and professional development is essential for optimizing Pressure injury prevention pressure injury prevention and management practices [9, 10].

This systematic review aims to evaluate the impact of multifaceted interventions on the prevention of Pressure Injuries and improvements in nursing practices. By synthesizing existing evidence and identifying effective strategies, this review seeks to inform clinical practice, policy development, and future research initiatives in the field of Pressure Injuries prevention and management. Through a comprehensive analysis of educational programs, care bundles, positioning strategies, and other interventions, this review aims to elucidate best practices and promote continuous quality improvement in healthcare settings. Ultimately, the overarching goal is to minimize the burden of Pressure Injuries, enhance patient outcomes, and optimize resource utilization within healthcare systems [11–13].

Study setting

This systematic review included only studies conducted in different countries as per available data.

Search strategies

The search strategy employed a systematic approach to identify relevant literature on Pressure Injuries and interventions targeting nurses and healthcare professionals from 2020 to 2024. Utilizing multiple databases including Google Scholar, PubMed, Science Direct, Cochrane Library, and Hinari, alongside Gray Literature sources, the search incorporated a combination of keywords such as “Braden scale,” “Pressure sore,” “Pressure ulcer,” “Decubitus ulcer,” “Nurses,” “Staff Nurses,” “Knowledge,” “Practice,” “Health professionals,” and “Prevalence.” Boolean operators such as “AND” and “OR” were utilized to refine and expand search results as necessary. The inclusion criteria focused on studies examining interventions aimed at nurses or healthcare professionals and their impact on pressure injury prevention, management, or prevalence. By employing this comprehensive search strategy, the aim was to gather recent and relevant literature to inform the systematic review on pressure injury prevention and management (Table 1).

Table 1 Search strategy on impact of multifaceted interventions on pressure injury prevention

Sl.No	Databases	Applied keywords and Boolean operators
1.	Google scholar-332	
2.	PubMed-0	"Braden scale" OR "Pressure sore" OR
3.	Science Direct-14	"Pressure ulcer" OR "Decubitus ulcer"
4.	Cochrane Library-437	AND "Nurses" OR "Staff Nurses" AND
5.	Hinari-322	"knowledge" AND "Practice"
6.	Gray Literature-45	AND "Health professionals"

Eligibility criteria

The search strategy, conducted by URK, focused on identifying studies that utilized the Braden Scale as a research instrument. To ensure the relevance and reliability of the selected literature, stringent eligibility criteria were applied. Only full-text articles published in English and accessible through open-access platforms were included. The study period was restricted to publications from 2020 to 2024 to ensure up-to-date findings reflecting recent advancements in pressure injury prevention and management. This approach aimed to capture high-quality studies providing valuable insights into interventions targeted at nurses and healthcare professionals for the prevention and management of pressure injuries. Studies such as reviews, commentaries, case studies, presentations, and those published in languages other than English were excluded.

Outcome measurement

The outcome measurement for the systematic review on pressure injury prevention and nursing practice improvement includes assessing Pressure injury prevention prevalence, nursing practice enhancement, patient outcomes, healthcare costs, and knowledge acquisition among healthcare professionals. These metrics aim to evaluate the effectiveness of multifaceted interventions in reducing Pressure Injuries, enhancing nursing practices, improving patient outcomes, reducing healthcare costs, and increasing knowledge retention.

Screening and data extraction

The data extraction process followed a systematic approach, beginning with the identification of relevant articles through keyword searches and Boolean operators across various databases. The articles were then exported to EndNote version 20 to facilitate duplicate removal. Subsequently, titles and abstracts underwent screening by the independent reviewer to determine eligibility based on predetermined inclusion criteria. Following this initial screening, the final articles were subjected to a more rigorous evaluation to confirm eligibility. A standardized data extraction sheet was prepared, featuring key headings such as Author, Year, Country, Setting,

Duration, Study Design, Sample Size, Sample Technique, Research Instruments, Scale/Tools, and Results. This structured approach ensured consistency and thoroughness in extracting relevant information from each selected article, enabling a comprehensive synthesis of data for analysis and interpretation (Table 2).

Data synthesis and reporting

The systematic review titled "Effectiveness of Multifaceted Interventions on Pressure Injury Prevention and Nursing Practices" follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for transparent reporting. The PRISMA flow diagram [14] (Figure-1) visually represents the review process, illustrating the flow of information from initial identification to final inclusion of studies, along with reasons for exclusions at each stage. Additionally, the review includes a supplementary PRISMA checklist (Supplementary File-1), ensuring adherence to PRISMA guidelines in reporting. This checklist provides a comprehensive outline of essential items to include in the review, facilitating transparency, and enhancing the completeness and quality of reporting. Together, these components contribute to the systematic and transparent reporting of the review process, enabling readers to assess the rigor and reliability of the findings.

Quality assessment

Utilizing a range of study designs aligned with the Critical Appraisal Skills Programme (CASP) checklist for experimental studies, and New Castle Ottawa Scale (NCOS) for descriptive studies, this systematic review aims to comprehensively evaluate pressure injury prevention interventions and nursing practices across healthcare settings. The selected designs include multi-centre observational studies, Cross-Sectional Research Designs (CSR), prospective quasi-experimental designs, retrospective hospital-based studies, and descriptive observational studies, among others. Each design will be assessed based on the CASP criteria for experimental studies and NCOS for descriptive studies and ensuring methodological rigor, validity, and reliability in data collection and analysis. By applying the CASP checklist and NCOS to diverse study designs, this systematic review seeks to provide a robust synthesis of evidence on pressure injury prevention and nursing practices, informing clinical practice, policy development, and future research initiatives in the field.

Data analysis

The process, conducted independently by URK, included both statistical and qualitative analyses to ensure a comprehensive exploration of pressure injury prevention and nursing practices. Qualitative analysis, in particular, plays a pivotal role in examining nuanced aspects of

Table 2 Impact of multifaceted interventions on pressure injury prevention

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Bassam Alshahrani [15]	2024	Australia	Critical care units in three hospitals	May 2021 and April 2022	Multi-centre observational study (Prepost intervention study)	181 patients		Braden scores	PI prevalence was 60.9% at the outset, with 52.9% hospital-acquired, 37.9% unit-acquired and 23.0% medical device-related. Post-intervention prevalence decreased significantly to 28.7%, including 21.3% hospital-acquired, 14.9% unit-acquired, and 8.5% medical device-related.
Talal AlFadhlah [21]	2024	Kuwait	Public general hospitals, 54 medical wards	December 2021 to March 2022	Cross-sectional research design	1,186 patients		Braden scale	The mean national prevalence of PI was 17.6% (95% CI: 11.3–23.8). Purely community-acquired PI represent the majority of PI nationally (58.1%).
Habtamu Bekele [27]	2024	Ethiopia	Specialized hospitals in the Northwest Amhara Region	June 15 to June 19, 2022	Institution-based, cross-sectional study	480 patients	Systematic random sampling technique	The Braden RAS includes; sensory perception, moisture, activity, friction/shear, mobility, and nutrition. Braden Scores	A total of 49 pressure ulcers were detected among 480 patients. a prevalence rate of 10.2%, 95% CI (7.7, 12.9).
Lindsey Stevens [47]	2024	New York, United States	Neurology stepdown unit in a large teaching hospital	January to March 2022	Prospective, quasiexperimental, single group design	35 Nurses			Nurses showed increased comprehension after the educational intervention from T1 to T3.
Mohammad Y. N. Saleh [23]	2023	Jordan	3 Jordanian medical settings		A prospective approach	Adult patients	Convenience sample	Braden scale	Prevalence of MDRPI was 5.01% (15/299) with 41 injuries, 27/41 (65.8%) were skin injuries and 14/41 (34.2%) were mucosal.
Esraa Mohammed alhussin Abdelhalim [17]	2023	Saudi Arabia	King Fahad Hospital	2019 to 2021	Retrospective hospital-based study	Hospitalized patients		Braden Scale used for Predicting Pressure Sore Risk.	Significant reduction of HAPUs from 1.97% in 2018 to 1.4% in 2019 and 0.53% in 2020 to 0.14% in 2021.
Zhenyu Luo [28]	2023			1 July 2022 and ends on 1 August 2022.	Descriptive observational study	6 PI specialist nurses	Convenience sampling.	MDRPI and Braden Scale sessions	The mean referral time among participants was 2.26 ± 0.26 h, the mean Braden score was 15.32 ± 2.06, 53.46% (n = 54) of participants were conscious, 73.26% (n = 74) were in the supine position, 23.76% (n = 24) were in the semirecumbent position, and only 3 (2.9%) were in the lateral position.
Fatma Mohamed Elesawy [33]	2023	Egypt	South Valley University Hospital.		Quasiexperimental design	36 nurses and 8 patients		Structured interview questionnaire; nurses' pressure ulcer preventive practices observational checklist, comprehensive skin assessment tool, and Braden Scale	Nurses' knowledge and practices were significantly improved towards pressure ulcer prevention after program implementation

Table 2 (continued)

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Hanaa E. Elsayad [36]	2023	Egypt	Orthopaedic department at Menoufia University Hospital.		Quasiexperimental design,	Consecutive sample of 118 immobilized adult patients of both genders.	Convenience sampling method.	Instrument I: Structured Interview questionnaire, Instrument II: Comprehensive skin assessment observation checklist, Instrument III: Braden Risk Assessment Scale.	It was described that 49.2% of the study group and 35.6% of the control group was in the category of age between 50 < 60 years old and around half of both study and control groups (50.8% and 54.2% respectively) was male.
Rekha Pant [41]	2023	India	Teerthanker Mahaveer University Hospital of Moradabad.			80 staff nurses	Convenience sampling method.		Out of 80 samples, 49 (61.2%) of staff nurses had inadequate knowledge, 25 (31.3%) were had moderate knowledge & 6 (7.5%) were had adequate knowledge with respect to pre-test attitude within staff nurses, among 80 samples, 53(66.3%) were having unfavourable attitude and 27(33.7%) were having favourable attitude.
Shenda Maulina Wulandari [43]	2023				Correlative descriptive method with a cross-sectional approach	46 respondents	Total sampling technique	Braden Q scale, Nurses knowledge assessment tool	The results of this study showed that more than half of the nurses had sufficient knowledge both regarding the Braden Q scale.
Tuba Sengul [26]	2022	Turkey	Private hospital administered by a foundation in Istanbul.	August 1 and December 31, 2021	Cross-sectional and descriptive study	COVID-19 patients		Braden Risk Assessment Scale	The mean of Braden scale total score of the patients with PI was found to be 16.50 ± 3.83 and 20.05 ± 3.07 for those without PI.
Gulay Yazici [24]	2022	Turkey	State university hospital in Ankara	17–23 December, 2018.	Descriptive study	23 patients		Braden score/scale	The prevalence of Pressure Injuries in the patients followed up within the scope of this study was 17.4%; 85.71% of them were hospital-acquired injuries; 57.14% of them were stage 1; and 71.4% of them were related to medical devices.
Lei Ding [18]	2022	China	Four medical centres in China.	January 2014 to December 2018	Mixed case-control study.	1977 patients		Braden scale	Age, sex, Braden rating and diabetes were found to be independent risk factors for CAPressure Injuries, as evidenced by the corresponding OR and 95% CI values of 1.031 (1.026 to 1.036), 0.810 (0.698 to 0.941), 1.235 (1.167 to 1.307) and 2.059 (1.332 to 3.184), respectively. Purely CAPressure Injuries represent the majority of PI nationally (58.1%).

Table 2 (continued)

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Busra Ipek [48]	2022	Turkey			Cross-sectional, descriptive, prospective design.		Purposive sampling method	Sociodemographic and Clinical Characteristics Form and 3 S-IRAS for PI and Braden Scale	IAP occurred in 18.0% of participants. Although the risk of PI was higher in women, those with chronic disease, those with major surgery, and those with chronic disease, this risk was weaker.
Ruth Alexandra Castiblanco-Montanez [31]	2022				Descriptive cross-sectional study	50 medical records		Braden scale.	The most frequent type of skin lesion is pressure ulcers with 24 cases (40%), the most reported anatomical site of injury was the sacral region with 40% followed by 30% with more than one location.
Kawther Badry Mobed [32]	2022	Egypt	Trauma and emergency department at Assiut university Hospital		Quasi experimental research design	33 male and 27 female		Skin assessment observation check list and Braden scale	Skin integrity care bundle had a positive effect in preventing the development of pressure ulcer among studied patients in the study group where the majority (90%) of the patients showed no pressure ulcers or no sign of pressure ulcer after application of the nursing intervention
Gehan Abd Elfattah Atia Elasrag [34]	2022	Egypt	ICU at Menoufia University Hospital		Experimental research design	Control and study group 50 patients	Purposive sample	1st tool: Predesigned questionnaire which contained two parts, 2nd tool: Braden Scale and 3rd tool: EPUAP and 4th tool: PUSH	Presented that 56% and 18% of control group had moderate risk and high risk for pressure ulcer, while 54% and 20% of study group had moderate and high risk.
Doaa Mohamed Mahmoud [38]	2022	Egypt	Benha University Hospitals orthopaedic unit		Quasiexperimental I research approach (study and control groups).	60 adult patients	Purposive sample	Comprehensive skin assessment sheet, Braden Risk Assessment Scale.	There was a statistically significant variation in patients' Outcomes regarding pressure ulcers following application of evidencebased practises guidelines between the study and control groups.
Ebtsam Saad Soliman [16]	2022	Egypt	Mansoura University and emergency hospitals.		Quasiexperimental I, pre-test and posttest intervention study design	50 nurses, 80 patients	Convenient sample	Interview questionnaire, Observational check list for nurses' practice, Braden Scale, Patient's assessment questionnaire	Total knowledge level and total practice level mean scores immediate post and after one month follow up of the program implementation were higher statistically significant than preprogram.
E.S.S. Saad [40]	2022	Egypt	Orthopedic department of Benha University Hospital.		Convenient sample	50 nurses, 80 patients		I-Interview Questionnaire, II- Observational check list for nurses' practice, III-Braden Scale & Inpatient's Assessment questionnaire	This study showed only 22%, 20 of studied nurses had good level of total (knowledge, practice) about pressure ulcer at pre implementation of program.

Table 2 (continued)

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Fitri Anita [42]	2022				Quasiexperimental method with pre and post-test	17 patients for each group (intervention and control).		Assessment of the risk of PI using the Braden scale, and monitoring of changes in position using the observation sheet.	Data analysis showed that the combination of an air cushion and a 30° position effectively reduced the risk of injury p-value of 0.035 (< 0.05).
Masoud Hatefi [44]	2022	Iran			Cross-sectional descriptive study	Sample size = 220		Demographic profile form and the Braden Scale for Predicting PU Risks.	It showed most of the patients achieved scores in poor and low risk status. Also, the overall score for risk of Pus was low, moderate, and high, and very high in 28 (12.7%), 81 (36.7%), 105 (47.7%), and 6 (2.7%) of cases, respectively.
Fatma Magdi Ibrahim [45]	2022	UAE	ICUs of the General Mansoura Hospital, Specialized Medical Hospital, and Emergency Hospital in Dakhalla governorate		Quasiexperimental study	69 nurses.		Braden Scale and a 2-part structured interview schedule sheet.	Following the educational film, the nurse's practice and knowledge increased, plus there was an enhancement in wound healing of pressure ulcers for older adults.
Amany Elberdan [46]	2022	Egypt	Intensive Care Unit		Quasiexperimental study	51 nurses and 80 patients		Structured interview sheet, observational checklist, Braden Scale	The study revealed that nurses' knowledge and practices significantly improved towards pressure ulcers post-program implementation when compared to pre-program (with P value less than 0.05)
Asmaa Nasr ELdin Mosbeh [49]	2022	Egypt	NICUs at El-Fayoum University Hospital and El-Fayoum Public Hospital.		A descriptive design	80 nurses		Predefined Questionnaire format to assess characteristics of the studied nurses and their knowledge regarding skin care and Braden Q Scale.	The mean experience years 7.3 ± 1 , more than one-third of them had good total knowledge and more than half of them had incompetent total practice about skin care in NICU.
Heba Mohamed Tawfik [19]	2021	Egypt	Ain Shams University Hospitals and in Suez Canal University Hospitals.		Case control study	100 elderly male and female patients		Checklist and Braden scale	Braden scale was highly sensitive for the occurrence of pressure ulcers (cutoff point ≤ 17) with 77.4% positive predictive value and 97.3% negative predictive value.

Table 2 (continued)

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Despina Georgieva [29]	2021	Egypt	General hospitals, in Ismailia City	May and November 2019.	Quasiexperimental control group using pre-post	120 hospitalized patients	120 hospitalized patients	Braden scale	50, 83% of the respondents have got quite a risk of decubitus wounds occurring, 26.67% are at great risk, and 14.17% are at moderate risk. Only 8, 33% of all patients tested are at light risk.
Samia Gaballah [25]	2021	Egypt	General hospitals, in Ismailia City		Quasiexperimental control group using pre-post	Nurses and patients	Thirty nurses and fifty Patients	Nurse's demographic data sheet, PI knowledge questionnaire, PI care observational checklist, Patient's demographic and medical profile data sheet, The Braden Scale, and Patients' PI wound healing outcomes tool	The study revealed that nurses' knowledge and practices, were significantly improved towards PI care post program implementation when compared to pre-program.
Mona Mohamed Ibrahim [35]	2021	Egypt	8 orthopaedic departments of one of the governmental hospitals in Egypt		Quasiexperimental research design	Patients in each intervention and control groups).	80 (40 patients in each intervention and control groups).	Purposeful sample technique	Stated that, 52.5% of the patients who were cared through implementing care bundle elements did not develop pressure ulcers after four days
Vanessa Leal de Lima Moura [50]	2021	Brazil.		November 2020			27 nurses	Braden scale application	There was a prevalence of participation of nurses working in ICU ($n = 8; 29.63\%$), and in hospitalization units ($n = 5; 18.52\%$).
Edward, M.I. [51]	2021	Nigeria	University of Medical Sciences Teaching Hospital, Akure and University of Medical Sciences Teaching Hospital, Ondo.		Crosssectional descriptive nonexperimental design			Braden scale in predicting PI risk, questionnaire	Results showed that the majority of nurses have good knowledge of Braden scale but had poor perception towards its use in predicting pressure ulcer.
Pramila Baral [30]	2020		Nepal Medical College Teaching Hospital	August 2019 to January 2020.	Crosssectional descriptive study	272 patients	272 patients		

Table 2 (continued)

Author	Year	Country	Setting	Duration	Design	Sample Size	Technique	Scale/Tools	Results
Na, Hyung-Ju [20]	2020		Medium-sized hospital, located in Seoul	December 18, 2017 to February 28, 2018		100 Patients	Randomization	Braden scale for risk assessment and the 6-stage pressure ulcer classification system	Total score on the Braden scale, the ICC was 0.85 and the Po was 0.29.
AAbiru Neme [22]	2020	Ethiopia	Public hospitals	March 13-April 12, 2017	Institution based cross sectional study design	356 Hospitalized patients	Multistage sampling technique	Braden scale	A total of 56 Patients were Develop pressure ulcer from 356 admitted in Public Hospitals, with the prevalence rate of 15.7%; from which 6 (1.7%), 34 (9.6%), and 16 (4.5%) were Medical Device Related Pressure Ulcers and Routine Pressure Ulcers.
Mona Mohamed Ibrahim [35]	2020	Egypt	Neurological units (A and B) at Mansoura University Hospital.		Quasiexperimental study pre-post test assessment	40 nurses	Convenience sample	Interview Questionnaire Sheet, The PZPUKT, Facility Assessment Checklist, Moore & Price attitude scale, Sociodemographic and medical clinical base line data for patients and Braden Scale.	The result revealed a positive association between pressure ulcer educational protocol prevention and nurses' knowledge, attitude and practice to ward pressure ulcer prevention.
Manal Tharwat AbouZaid [39]	2020	Egypt	Mansoura University hospitals.			Nurses and patients 207 patients		A structured interview, wound care observational checklist, Braden scale, wound assessment tool.	A statistically significant improvement in nurses' practice regarding wound care after implementing wound care protocol with (Pvalue=0.014 and 0.000 respectively).

Key: PI, Pressure Injury; RAS, Risk Assessment Scale; MDRPI, Medical Device-Related Pressure Injury; HAPUs, Hospital-Acquired Pressure Ulcers; CAPI, Community-Acquired Pressure Injuries; 3 S-IRAS, 3 S Intraoperative Risk Assessment Scale; IAPI, Incontinence-Associated Pressure Injury; ICU, Intensive Care Units; EPUAP, European Pressure Ulcer Advisory Panel; PUSH, Pressure Ulcer Scale for Healing; NICU, Neonatal Intensive Care Unit; PZPUKT, Pieper Zulkowski-Pressure Ulcer Knowledge Test

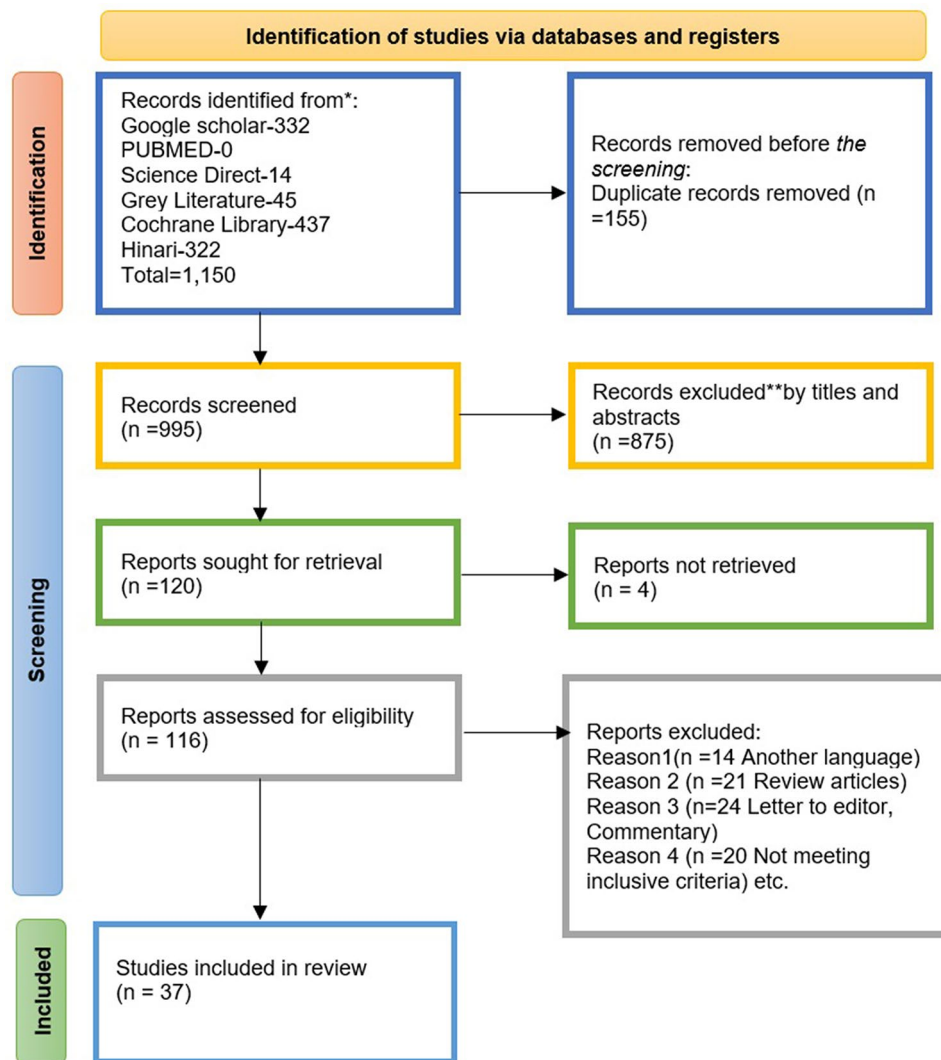


Fig. 1 PRISMA flow diagram on Multifaceted Interventions on pressure injury prevention

care, especially when investigating subgroup differences within study populations. This method involves systematically interpreting non-numerical data, such as interviews, focus group discussions, and open-ended survey responses, to identify underlying themes, patterns, and insights. Subgroup analysis within qualitative research focuses on disaggregating data based on specific characteristics or variables, such as age, gender, clinical settings, or intervention types. This approach enables a deeper exploration of differential experiences, perceptions, and outcomes among various subgroups. By uncovering contextual factors, barriers, facilitators, and variations, subgroup analysis provides valuable insights into the complexities of pressure injury prevention and nursing practices. Through this approach, the systematic review aims to offer a nuanced understanding that addresses the diverse needs and contexts of healthcare settings and patient populations.

Ethics approval and consent to participate

Given that this study constitutes a systematic review, ethical approval and consent to participate are not applicable. As the research does not involve the direct collection of data from individuals, but rather synthesizes findings from previously published articles, no interaction with human participants occurs. Therefore, ethical considerations such as obtaining informed consent and seeking ethics approval from institutional review boards are not required for this study.

Result

The results introduction outlines the systematic process employed in gathering and synthesizing data from various sources. Initially, an extensive search strategy was implemented across multiple databases to retrieve relevant articles on pressure injury prevention and nursing practices. Duplicates were subsequently removed to

ensure the integrity of the dataset. Following this, titles and abstracts of the retrieved articles were meticulously screened to identify potentially eligible studies. A total of 37 articles met the inclusion criteria and were included in the final analysis. Data extraction was performed using a standardized format, facilitated by an Excel file, to systematically capture key information from each eligible study. This comprehensive approach allowed for the extraction of relevant data pertaining to pressure injury prevalence, nursing interventions, risk factors, outcomes, and other pertinent variables across the included studies.

Subgroup analysis

Authors

The study was conducted by a diverse group of authors, including Bassam Alshahrani [15] Ebtsam Saad Soliman [16], Esraa Mohammedalhussein Abdelhalim [17], Lei Ding [18], Heba Mohamed Tawfik [19], Na, Hyung-Ju [20], Talal ALFadhalah [21], AAbiru Neme [22], Mohammad Y. N. Saleh [23], Gulay Yazıcı [24], Samia Gaballah [25], Tuba Sengul [26], Habtamu Bekele [27], Zhenyu Luo [28], Despina Georgieva [29], Pramila Baral [30], Ruth Alexandra Castiblanco-Montanez [31], Kawther Badry Mobed [32], Fatma Mohamed Elesawy [33], Gehan Abd Elfattah Atia Elasrag [34], Mona Mohamed Ibrahim [35], Hanaa E. Elsayad [36], Mona Mohamed Mayhob [37], Doaa Mohamed Mahmoud [38], Manal Tharwat Abouzaid [39], E.S.S.Saad [40], Rekha Pant [41], Fitri Anita [42], Shenda Maulina Wulandari [43], Masoud Hatefi [44], Fatma Magdi Ibrahim [45], Amany Elberdan [46], Lindsey Stevens [47], Busra İpek [48], Asmaa Nasr ELdin Mosbeh [49], Vanessa Leal de Lima de Moura [50], Edward, M.I [51], Esraa Mohammedalhussein [52].

Study year

The study was conducted across multiple years, spanning from 2020 to 2024. This timeframe reflects the recent nature of the research and allows for the inclusion of up-to-date findings and developments in pressure injury prevention and nursing practices. Specifically, the study included data and findings from the years 2024 [15, 21, 27, 47], 2023 [10, 13, 18, 25, 30, 33, 37], 2022 (35, 16, 21, 6, 31, 20, 15, 8, 2, 9, 15, 25, 13, 4, 5), 2021 (20, 7, 33, 28, 37, 10), 2020 [3, 24, 27, 29, 30]. By incorporating research conducted over several years, the study aims to capture the evolution and effectiveness of interventions and practices in addressing PI within healthcare settings.

Countries

The study encompassed a diverse range of countries, reflecting the global significance of pressure injury prevention and nursing practices. These countries include Australia-1 [15], Kuwait-1 [21], Ethiopia-2 [3, 18], New York, United States-1 [47], Jordan-1 [23], Saudi Arabia-1

[52], Egypt-14 [2, 4, 5, 8, 9, 14, 16, 19–21], India-1 [41], Turkey-3 [6, 17, 36], China-1 [18], Iran-1 [44], UAE-1 [33], Brazil-1 [50], Nigeria-1 [51]. The inclusion of such a varied set of countries allows for a comprehensive examination of pressure injury prevention strategies and nursing practices across different healthcare systems, cultural contexts, and resource settings. By considering the experiences and approaches of multiple countries, the study aims to provide insights that are applicable and relevant to a broad spectrum of healthcare settings worldwide.

Study setting

The study was conducted across a diverse range of healthcare settings, reflecting the breadth and depth of research on pressure injury prevention and nursing practices. These settings include Critical care units in 3 hospitals [15], Public general hospitals, 54 medical wards [21], Specialized hospitals in the Northwest Amhara Region [27], Neurosurgery stepdown unit in a large teaching hospital [47], Three Jordanian medical settings [23], King Fahad Hospital [52], South Valley University Hospital [33], Orthopaedic department at Menoufia University Hospital [36], Teer thanker Mahaveer University Hospital of Moradabad [41], Private hospital administered by a foundation in Istanbul [26], State university hospital in Ankara [24], Four medical centres in China [18], Trauma and emergency department at Assiut University Hospital [32], Intensive care units (ICU) at Menoufia University Hospital [34], Benha University Hospital's orthopaedic unit [38], Mansoura University and emergency hospitals [16], Orthopaedic department of Benha University Hospital [40], ICU of the General Mansoura Hospital, Specialized Medical Hospital, and Emergency Hospital in Dakhalia governorate [45], ICU [46], Neonatal Intensive Care Unit (NICUs) at El-Fayoum University Hospital and El-Fayoum Public Hospital [49], Ain Shams University Hospitals and in Suez Canal University Hospitals [19], General hospitals, in Ismailia City [25], 8 orthopaedic departments of one of the governmental hospitals in Egypt [35], University of Medical Sciences Teaching Hospital (UMSTH), Akure and UMSTH, Ondo [51], Nepal Medical College Teaching Hospital [30], Medium-sized hospital, located in Seoul [20], Public hospitals [22], Neurological units (A and B) at Mansoura University Hospital, and emergency hospitals (35, 39).

Study duration

The study duration varied across the included research, spanning from specific date ranges to broader periods. These durations include May 2021 and April 2022 [15], December 2021 to March 2022 [21], June 15 to June 19, 2022 [27], January to March 2022 [47], 2019 to 2021 [17], 1 July 2022 and ends on 1 August 2022 [28], August 1 and December 31, 2021 [26], 17–23 December, 2018 [24],

January 2014 to December 2018 [18], May and November 2019 [29], November-2020 [50], August 2019 to January 2020 [30], December 18, 2017 to February 28, 2018 [20], March13-April 12, 2017 [22]. These varied durations reflect the different timelines of data collection, intervention implementation, and study periods across the included research studies.

Study design

The study designs encompass a wide range of methodologies, reflecting the diverse approaches used in research on pressure injury prevention. Multiple Components on One System (MCOS) (Prepost intervention study) [15], CSRD examining pressure injury prevalence and nursing practices across different healthcare settings [21], Institution-based, cross-sectional study focusing on specific institutions [3, 18], Prospective, quasi-experimental, single-group designs for evaluating interventions' effectiveness [47], Prospective approach [23], Regression-Based Historical Benchmarking System (RHBS) for analysing historical data [52], Description of Observed Situations (DOS) for documenting practices without interventions [28], Quasi-experimental design [4, 13, 14, 19, 21, 28], Correlative descriptive method with a cross-sectional approach [43], Cross-sectional and descriptive study [25, 30, 32, 36], Descriptive study [5, 17], Mixed case-control studies for comparing individuals with and without Pressure Injuries [18], Cross-sectional, descriptive, prospective design [48], Experimental research design [34], Quasi-experimental research approach (study and control groups) [8, 33], Quasi-experimental, pre-test, and post-test intervention study design [2, 15, 27], Case-control study [19], Cross-sectional descriptive non-experimental design [51] are employed to assess interventions' impacts. These varied study designs offer complementary insights into pressure injury prevention and nursing practices, contributing to a comprehensive understanding of the field.

Study sample

The sample sizes varied across the studies, reflecting the diversity of research approaches and objectives in pressure injury prevention and nursing practices. These included samples of 181 patients [15], 1,186 patients [21], 480 patients [27], Participants were 329 adult patients [23], Hospitalized patients [17], Thirty-six nurses and eighty patients were recruited [33], Consecutive sample of 118 immobilized adult patients of both genders [36], Corona virus Disease 2019 (COVID19) patients [26], Patients [17, 22], 50 medical records [31], 33 male and 27 female [32], Control and study group 50 patients [34], sixty adult patients [38], 50 nurses, 80 patients [2, 9], 17 patients for each group (intervention and control) [42], Elderly male and female patients [19], 120 hospitalized

patients [29], Thirty nurses and fifty patients [25], 80 (40 patients in each intervention and control groups) [35], 272 patients [30], Patients [20], Hospitalized patients [22], 40 nurses [35], Nurses and patients [39]. The inclusion of different sample sizes and participant groups allows for a comprehensive exploration of pressure injury prevention strategies and nursing practices across diverse populations and settings.

Study sample size

The study sample sizes varied significantly, ranging from smaller cohorts to larger populations. These included samples of 181 patients [15], 1,186 patients [21], 480 patients [27], 35 Nurses [47], 329 adult patients [23], 21,400 admitted patients [17], 6 Pressure injury specialist nurses [28], 80 staff nurses [41], 46 respondents [43], 345 patients [26], 23 patients [24], 1977 patients [18], Hospitalized. Patients [31], 60 patients [32], 220 Sample size [44], 69 nurses [45], 51 nurses and 80 patients [46], 80 nurses [49], 100 patients [19], 120 hospitalized patients [29], 30 nurses and 50 patients [25], 80 (40 patients in each intervention and control group) [35], 27 nurses [50], 272 patients [30], 100 patients [20], 356 subjects [22], 55 nurses, 207 patients [39]. The diversity in sample sizes reflects the scope and objectives of the research, accommodating investigations across various healthcare settings and populations.

Sampling technique

The sampling techniques employed in the studies varied, reflecting different approaches to participant selection and recruitment. These included a systematic random sampling technique [27], Convenience sample (22, 27, 40, 15, 45, 48, 34), Total sampling technique [43], Purposive sampling method [18, 33, 34, 37, 47], Random sampling technique [20], Multistage sampling technique [22]. The diversity in sampling techniques reflects the researchers' considerations of feasibility, accessibility, and study objectives in pressure injury prevention and nursing practices.

Study instruments

The instruments used in the studies varied, encompassing a range of tools and scales related to pressure injury prevention and assessment. These included Braden scores/Braden Risk Assessment Scale (BRAS) [14, 17, 20–23, 25, 28, 30, 46, 49], includes; Sensory perception, moisture, activity, friction /shear, mobility, and Nutritional Blood Sugar (nut BS) used for Predicting Pressure Sore Risk [17], Medical Device-Related Pressure Injury (MDRPI) and Braden score sessions [28], Structured interview questionnaire; nurses' pressure ulcer preventive practices observational checklist, comprehensive skin assessment tool, and Braden score [33], Instrument

I: Structured Interview questionnaire, Instrument II: Comprehensive skin assessment observation checklist, Instrument III: BRAS [36], Braden Q scale (Q stands for “Quick” or “Quality”), Nurses knowledge assessment tool [43], Sociodemographic and Clinical Characteristics Form and 3 S intraoperative risk assessment scale (3 S-IRAS) for Pressure Injury and Braden score [48], Skin assessment observation check list and Braden score [32], 1st tool: Predesigned questionnaire which contained two parts, 2nd tool: Braden score and 3rd tool: European Pressure Ulcer Advisory Panel (EPUAP) and 4th tool: The Pressure Ulcer Scale for Healing (PUSH) [34], Comprehensive skin assessment sheet, BRAS [38], Interview questionnaire, Observational check list for nurses’ practice, Braden score, Patient’s assessment questionnaire [16], Interview Questionnaire, II Observational check list for nurses’ practice, III Braden score & Inpatient’s Assessment questionnaire [40], Assessment of the risk of Pressure injury using the Braden score, and monitoring of changes in position using the observation sheet [42], Demographic profile form and the Braden score for Predicting pressure ulcer Risks [44], Braden score and a two-part structured interview schedule sheet [45], Structured interview sheet, observational checklist, Braden score [46], Predesigned Questionnaire format to assess characteristics of the studied nurses and their knowledge regarding skin care and Braden Q Scale [49], Checklist and Braden score [19], Nurse’s demographic data sheet, Pressure injury knowledge questionnaire, Pressure injury care observational checklist, Patient’s demographic and medical profile data sheet, The Braden score, and Patients’ Pressure injury wound healing outcomes tool [25], Patient assessment tool, BRAS [35], Braden score in predicting Pressure injury risk, questionnaire [51], Brief Symptom Rating Scale (BSRS) and the 6stage pressure ulcer classification system [20], Interview Questionnaire Sheet, The Pieper Zulkowski-Pressure Ulcer Knowledge Test (PZPUKT), Facility Assessment Checklist, Moore & Price attitude scale, Socio-demographic and medical clinical base line data for patients and Braden score [35], A structured interview, wound care observational checklist, Braden score, wound assessment tool [39]. The diversity in instruments reflects the comprehensive approach adopted by researchers to assess Pressure injury risk, preventive practices, and patient outcomes.

Research findings from included studies

The results of the studies highlighted various aspects related to Pressure injury prevalence, nursing practices, risk factors, and the effectiveness of interventions. Pressure injury prevalence was observed to decrease significantly post-intervention, with HAIs decreasing from 52.9 to 21.3%. The mean national prevalence of Pressure Injuries was reported as 17.6%, with a majority of injuries

being community-acquired. Specific prevalence rates ranged from 10.2 to 60.9%, depending on the study population and setting. Educational interventions were found to improve nurses’ comprehension and practices, leading to a reduction in hospital-acquired pressure ulcers. The prevalence of medical device-related Pressure injury was reported as 5.01%. Risk factors such as age, sex, Braden rating, and diabetes were identified as independent predictors of Pressure injury. Additionally, the effectiveness of skin integrity care bundles and wound care protocols in preventing pressure ulcers was highlighted, with positive outcomes observed among the study groups. Overall, the results underscored the importance of educational interventions, evidencebased practices, and comprehensive care protocols in mitigating Pressure injury risks and improving patient outcomes (Table 2).

According to a study conducted by Bassam Alshahrani and colleagues in 2024, the initial prevalence of Pressure injury was alarmingly high at 60.9%. This included 52.9% of cases being hospitalacquired, 37.9% originating within specific units, and 23.0% linked to medical devices. However, a significant reduction in these numbers was observed post-intervention. The overall prevalence dropped to 28.7%, with hospital-acquired cases decreasing to 21.3%, unit-acquired cases to 14.9%, and medical device-related cases to 8.5% [15].

In a revealing study by Talal ALFadhlah et al. (2024), the national prevalence of PI was found to be 17.6% on average (95% CI: 11.3–23.8). Surprisingly, the majority of these cases, 58.1%, were community-acquired, emphasizing the need for increased focus on preventative measures and education outside of hospital settings [21].

In a detailed study by Habtamu Bekele et al. (2024), pressure ulcers were identified in 49 out of 480 patients, resulting in a prevalence rate of 10.2% (95% CI: 7.7–12.9). This finding highlights a significant concern in patient care, where approximately one in ten patients was affected by this condition, emphasizing the ongoing need for effective prevention and management strategies [27].

In an insightful study by Lindsey Stevens et al. (2024), nurses exhibited a marked improvement in comprehension following an educational intervention. The data revealed a significant increase in understanding from the initial assessment (T1) to the third evaluation point (T3), underscoring the effectiveness of the training program in enhancing nursing knowledge and skills [47].

In an illuminating study by Mohammad Y. N. Saleh et al. (2023), the prevalence of MDRPI was found to be 5.01%, with 15 out of 299 patients affected. Among the 41 documented injuries, a significant 65.8% (27 injuries) were skin-related, while 34.2% (14 injuries) impacted mucosal tissues. This data highlights the diverse nature of MDRPI and the critical need for targeted prevention strategies [23].

In a compelling study by Esraa Mohammedal husin Abdelhalim et al. (2023), a remarkable decline in HAPUs was observed over a four-year period. The prevalence decreased from 1.97% in 2018 to 1.4% in 2019, and continued to plummet to 0.53% in 2020, ultimately reaching an impressive low of 0.14% in 2021. This significant downward trend underscores the effectiveness of enhanced preventive measures and quality care initiatives in hospitals [17].

In a study conducted by Zhenyu Luo et al. (2023), fascinating insights were revealed about patient conditions and referral times. On average, participants were referred within 2.26 ± 0.26 h. The mean Braden score among participants stood at 15.32 ± 2.06 , indicating a moderate risk of pressure ulcers. Additionally, 53.46% ($n=54$) of the participants were conscious, with a majority of 73.26% ($n=74$) positioned supine. Meanwhile, 23.76% ($n=24$) were in a semi-recumbent position, and a mere 2.9% ($n=3$) were in the lateral position. These findings provide valuable data for optimizing patient care strategies and positioning protocols [28].

In a transformative study by Fatma Mohamed Elsayy et al. (2023), the implementation of a targeted educational program led to a substantial enhancement in nurses' knowledge and practices regarding pressure ulcer prevention. The program's impact was profound, significantly boosting the competence and proactive measures of nursing staff in mitigating the risk of pressure ulcers. This highlights the pivotal role of continuous education in elevating healthcare standards and patient outcomes [33].

In a captivating study by Hanaa E. Elsayad et al. (2023), intriguing demographic patterns emerged. Within the study group, 49.2% fell within the age bracket of 50 to 60 years, while 35.6% of the control group shared this age range. Notably, gender distribution revealed a near balance, with approximately half of both the study (50.8%) and control (54.2%) groups comprising males. These findings shed light on the diverse demographic landscape under study, offering valuable insights into potential correlations with health outcomes [36].

In a comprehensive investigation spearheaded by Rekha Pant et al. (2023), a detailed examination of staff nurses' knowledge and attitudes unveiled a nuanced picture. Among the 80 sampled staff nurses, 49 (61.2%) were identified as having inadequate knowledge, while 25 (31.3%) exhibited moderate knowledge levels. Surprisingly, only 6 (7.5%) nurses possessed adequate knowledge. Furthermore, in terms of attitudes, the majority of respondents, comprising 53 (66.3%) individuals, harboured unfavourable perspectives, while a noteworthy minority of 27 (33.7%) nurses held favourable attitudes. These findings emphasize the imperative for tailored educational initiatives aimed at bolstering both knowledge

acquisition and attitude transformation within nursing staff, thus fostering enhanced patient care practices [41].

In a captivating study led by Shenda Maulina Wulandari et al. (2023), intriguing findings emerged regarding nurses' proficiency with the Braden Q scale. The research unveiled a heartening revelation: more than half of the nurses exhibited a commendable level of knowledge concerning this scale. This highlights a promising trend in healthcare education, suggesting a strong foundation among nursing professionals in assessing and managing patients' risk for pressure ulcers using the Braden Q scale [43].

In a pioneering study led by Tuba Sengul et al. (2022), an insightful analysis of the Braden score total scores among patients yielded compelling results. Among those with Pressure injury, the mean score stood at 16.50 ± 3.83 , reflecting a moderate risk level. Conversely, for patients without Pressure injury, the mean score was notably higher at 20.05 ± 3.07 , indicating a lower risk profile. This nuanced comparison underscores the critical role of risk assessment tools like the Braden score in identifying and mitigating the occurrence of Pressure injury among patients, thereby facilitating proactive healthcare interventions [26].

In a groundbreaking study led by Gulay Yazıcı et al. (2022), an insightful exploration into the prevalence and characteristics of Pressure injury among patients revealed compelling findings. Within the scope of this research, Pressure injury were detected in 17.4% of the patients under observation. Strikingly, a substantial majority (85.71%) of these injuries were acquired within the hospital setting, highlighting the critical need for preventive measures within healthcare facilities. Among the detected Pressure Injuries, 57.14% were categorized as stage 1, emphasizing the importance of early detection and intervention. Furthermore, a significant portion (71.4%) of these injuries were attributed to medical devices, shedding light on a potential area for targeted intervention and improvement in patient care practices. These findings underscore the multifaceted nature of PI and the importance of comprehensive strategies to mitigate their occurrence and impact on patient well-being [24].

In an illuminating study conducted by Lei Ding et al. (2022), independent risk factors for Community-Acquired Pressure Injuries (CAPI) were unveiled, shedding light on key contributors to this prevalent healthcare concern. Age emerged as a significant factor, with each year increment correlating with a 3.1% increase in CAPI risk. Conversely, gender exhibited a protective effect, with females showing a decreased risk (OR=0.810). The Braden rating, a widely used risk assessment tool, demonstrated its predictive power, with higher scores associated with elevated CAPI risk (OR=1.235). Notably,

diabetes emerged as a substantial independent risk factor, more than doubling the odds of CAPI occurrence (OR=2.059). These insights underscore the multifaceted nature of CAPI and emphasize the importance of tailored preventive strategies addressing demographic factors and underlying health conditions [18].

In a groundbreaking study led by Busra İpek et al. (2022), an intriguing discovery emerged regarding the occurrence of Immobility-Associated Pressure Injuries (IAPI) among participants. Surprisingly, IAPI affected 18.0% of the participants, highlighting its significant prevalence in healthcare settings. While traditionally, women, individuals with chronic diseases, and those who underwent major surgery were considered at higher risk, the study found that this risk was somewhat mitigated in these populations. This unexpected finding challenges conventional assumptions and underscores the need for nuanced risk assessment and preventive strategies tailored to individual patient profiles [48].

In a pioneering study led by Kawther Badry Mobed et al. (2022), an insightful exploration into skin lesions unveiled intriguing findings. Among the various types of skin lesions, pressure ulcers emerged as the most prevalent, accounting for 40% of the reported cases. Furthermore, when examining the anatomical sites of injury, the sacral region stood out as the most commonly affected area, representing 40% of the cases. Notably, 30% of the cases exhibited lesions in more than one location, indicating the multifaceted nature of these injuries. These findings shed light on the distribution and characteristics of skin lesions, providing valuable insights for healthcare professionals to tailor preventive and management strategies effectively [31].

In an innovative study led by Gehan Abd Elfattah Atia Elasrag et al. (2022), a novel approach to skin integrity care demonstrated remarkable success in preventing pressure ulcer development among patients in the study group. The implementation of a comprehensive care bundle resulted in a striking outcome, with an impressive 90% of patients exhibiting either no pressure ulcers or no signs of pressure ulcer following the nursing intervention. This signifies a significant positive impact on patient outcomes and underscores the efficacy of tailored nursing interventions in preserving skin integrity and enhancing overall patient well-being [32].

In a compelling study by Doaa Mohamed Mahmoud et al. (2022), the assessment of pressure ulcer risk levels unveiled intriguing patterns. Within the control group, 56% of participants were identified as having a moderate risk, while 18% were classified as high risk. Interestingly, the study group exhibited similar trends, with 54% presenting moderate risk and 20% categorized as high risk. These findings suggest a comparable distribution of risk levels between the control and study groups, highlighting

the need for targeted interventions to mitigate pressure ulcer risk across both cohorts [34].

In a groundbreaking study led by Ebtsam Saad Soliman et al. (2022), the implementation of evidence-based practice guidelines demonstrated a remarkable impact on patients' outcomes regarding pressure ulcers. A statistically significant variation was observed between the study and control groups, indicating the efficacy of evidence-based practices in improving patient outcomes. This finding underscores the transformative potential of structured guidelines in enhancing healthcare delivery and highlights the importance of adhering to evidence-based approaches to optimize patient care [38].

In a groundbreaking study by E.S.S. Saad et al. (2022), the impact of a program implementation on participants' knowledge and practice levels regarding a specific topic was evaluated. Remarkably, both immediate post-implementation and one-month follow-up assessments revealed statistically significant increases in total knowledge and practice level mean scores compared to pre-program levels. This signifies not only the effectiveness of the program but also the sustainability of its impact over time. These findings underscore the transformative potential of structured educational initiatives in fostering long-term improvements in knowledge and practice within healthcare settings [16].

In a thought-provoking study led by Fitri Anita et al. (2022), an examination of nurses' knowledge and practices concerning pressure ulcers unveiled compelling insights. Prior to the implementation of the program, only a modest 22% of the studied nurses demonstrated a commendable level of proficiency in total knowledge and practice regarding pressure ulcers. This underscores the crucial need for targeted interventions to enhance healthcare professionals' understanding and application of preventive measures. These findings serve as a catalyst for the development of tailored educational programs aimed at bridging gaps in knowledge and fostering improved patient care practices [40].

In a groundbreaking study by Masoud Hatefi et al. (2022), an innovative combination of interventions emerged as a potent strategy in mitigating the risk of injury. Through meticulous data analysis, it was revealed that the utilization of both an air cushion and positioning at a 30° angle resulted in a statistically significant reduction in injury risk, with a p-value of 0.035 (less than the conventional threshold of 0.05). This novel finding underscores the potential of synergistic approaches in enhancing patient safety and highlights the importance of exploring multifaceted interventions in healthcare settings [42].

In a pioneering study led by Fatma Magdi Ibrahim et al. (2022), an intriguing pattern emerged regarding the risk status of pressure ulcers among patients. The analysis

revealed that a significant majority of patients attained scores indicating poor and low risk status. Specifically, the overall risk scores for pressure ulcers were distributed as follows: 12.7% fell within the low-risk category, 36.7% within moderate risk, 47.7% within high risk, and a mere 2.7% within the very high-risk category. This comprehensive assessment provides valuable insights into the varying degrees of risk among patients, underscoring the need for tailored preventive strategies to mitigate the occurrence and severity of pressure ulcers [44].

In a transformative study spearheaded by Amany El-berdan et al. (2022), the implementation of an educational film led to remarkable advancements in nursing practice and knowledge. Moreover, this innovative approach resulted in a tangible improvement in the wound healing process of pressure ulcers among older adults. This multifaceted outcome underscores the profound impact of educational interventions not only on healthcare professionals' proficiency but also on the tangible health outcomes of patients. Such findings highlight the potential of multimedia educational tools to drive positive changes in clinical practice and patient care [45].

In an enlightening study conducted by Asmaa Nasr ELdin Mosbeh et al. (2022), the impact of a program on nurses' knowledge and practices regarding pressure ulcers was unveiled. The findings illuminated a significant improvement post-program implementation, with both knowledge and practice levels showing a marked enhancement compared to pre-program levels. Importantly, the statistical analysis underscored the significance of these improvements, with a p-value less than 0.05 indicating the robustness of the observed changes. This highlights the transformative potential of structured educational initiatives in empowering healthcare professionals and elevating the quality of patient care [46].

In a compelling study led by Heba Mohamed Tawfik et al. (2022), an exploration into skin care practices in the Neonatal Intensive Care Unit (NICU) revealed intriguing findings. Despite a mean experience of 7.3 years among the nursing staff, the analysis unveiled a notable discrepancy in knowledge and practice levels. Surprisingly, more than one-third of the nurses exhibited a commendable level of total knowledge, while over half of them demonstrated incompetent total practice in skin care within the NICU setting. These insights shed light on the complex interplay between experience, knowledge acquisition, and practical application in specialized healthcare environments, underscoring the need for tailored interventions to bridge gaps and ensure optimal care for vulnerable neonates [49].

In an insightful study led by Despina Georgieva et al. (2022), the effectiveness of the BS in predicting pressure ulcer occurrence was thoroughly examined. The analysis revealed that the BS demonstrated high sensitivity

in identifying individuals at risk, with a cutoff point of ≤ 17 . Impressively, it exhibited a positive predictive value of 77.4%, indicating its ability to accurately predict the development of pressure ulcers. Equally noteworthy was its remarkable negative predictive value of 97.3%, highlighting its efficacy in ruling out the likelihood of pressure ulcer occurrence among individuals assessed as low risk. These findings underscore the invaluable role of the BS as a reliable tool for risk assessment in clinical practice, facilitating proactive measures to prevent pressure ulcers and optimize patient care [19].

In an insightful study led by Samia Gaballah et al. (2022), a comprehensive assessment of decubitus wound risk among respondents revealed compelling insights. Astonishingly, the majority of respondents, comprising 83%, were identified as being at significant risk of developing decubitus wounds. Furthermore, 26.67% were categorized as being at great risk, while 14.17% fell into the moderate risk category. Interestingly, only a small fraction, 8.33%, of all patients tested were deemed to be at light risk. These findings underscore the pervasive nature of decubitus wound risk and emphasize the importance of proactive preventive measures to mitigate its occurrence and impact on patient well-being [29].

In a groundbreaking study led by Mona Mohamed Mayhob et al. (2021), the impact of a program on nurses' knowledge and practices concerning PI care was unveiled. Through meticulous analysis, it was found that post-program implementation, nurses exhibited a significant improvement in both knowledge and practices related to PI care compared to pre-program levels. This transformative outcome underscores the effectiveness of structured educational interventions in elevating healthcare standards and fostering proactive patient care. These findings serve as a testament to the ongoing commitment to continuous learning and improvement within healthcare settings [25].

In a compelling study led by Vanessa Leal de Lima de Moura et al. (2021), the implementation of a care bundle yielded promising results in pressure ulcer prevention. Remarkably, over half of the patients who received care following the care bundle elements did not develop pressure ulcers within four days, with a significant 52.5% showing no signs of pressure ulcer formation. This finding underscores the effectiveness of a structured and comprehensive approach to patient care, highlighting the potential impact of standardized protocols in reducing adverse outcomes and enhancing overall patient well-being [35].

In a study led by Edward, M.I. (2021) et al., an intriguing pattern emerged regarding the prevalence of nurse participation across different healthcare units. The data revealed that a significant proportion of nurses, comprising 29.63%, were actively engaged in ICUs, underscoring

their crucial role in critical patient care settings. Additionally, a notable presence of nurses, accounting for 18.52%, was observed in hospitalization units, emphasizing their diverse contributions to patient care across various healthcare domains. These findings shed light on the dynamic and multifaceted nature of nursing roles within healthcare systems, highlighting the invaluable contributions of nurses in delivering quality care across different clinical settings [50].

In a thought-provoking study led by Pramila Baral et al. (2020), an intriguing discrepancy was uncovered between nurses' knowledge and perception regarding the Braden score. While the majority of nurses demonstrated a commendable understanding of the Braden score, their perception towards its utility in predicting pressure ulcers was notably poor. This finding underscores the importance of not only educating healthcare professionals on assessment tools but also emphasizing the practical application and significance of these tools in clinical practice. It highlights the need for targeted interventions aimed at enhancing nurses' perception and confidence in utilizing assessment scales to effectively identify and prevent pressure ulcers [51].

In a groundbreaking study led by Na, Hyung-Ju et al. (2020), an innovative analysis of the Braden scale's reliability unveiled compelling insights. The Intraclass Correlation Coefficient (ICC) was reported as 0.85, indicating strong agreement among raters in total scores on the Braden scale. Moreover, the Proportional Odds (Po) ratio was calculated at 0.29, shedding light on the scale's predictive power in assessing pressure ulcer risk across different severity levels. These findings underscore the robustness of the Braden scale as a reliable tool for evaluating pressure ulcer risk and emphasize its utility in clinical practice for effective risk assessment and preventive interventions [20].

In a comprehensive study led by AAbiru Neme et al. (2020), the prevalence and types of pressure ulcers among patients admitted to public hospitals were meticulously examined. Among the 356 patients assessed, a total of 56 individuals developed pressure ulcers, resulting in a prevalence rate of 15.7%. Of these pressure ulcers, 6 cases (1.7%) were attributed to Injuries MDRPI, while Routine Pressure Ulcers accounted for 34 cases (9.6%). Intriguingly, 16 cases (4.5%) were classified as other types of pressure ulcers. These findings provide valuable insights into the multifaceted nature of pressure ulcer etiology and emphasize the importance of targeted preventive measures to reduce their occurrence among hospitalized patients [22].

In a groundbreaking study led by Mona Mohamed Ibrahim et al. (2020), a profound connection was unveiled between the implementation of a pressure ulcer educational protocol and nurses' knowledge, attitude,

and practice towards Pressure injury prevention. The results illuminated a positive association, indicating that the educational intervention had a significant impact on enhancing nurses' understanding, mindset, and implementation of preventive measures for pressure ulcers within ward settings. This transformative finding underscores the pivotal role of structured educational initiatives in empowering healthcare professionals and driving positive changes in patient care practices. It highlights the potential of education as a catalyst for improving healthcare outcomes and underscores the importance of ongoing professional development in enhancing quality of care [35].

In a pivotal study spearheaded by Manal Tharwat AbouZaid et al. (2020), the impact of implementing a wound care protocol on nurses' practice was investigated, yielding transformative results. The findings unveiled a statistically significant improvement in nurses' practice regarding wound care post-implementation of the protocol, with p-values of 0.014 and 0.000, respectively. This marked enhancement underscores the effectiveness of structured protocols in empowering healthcare professionals to deliver high-quality wound care. The study highlights the critical role of standardized protocols in standardizing practice, enhancing patient outcomes, and fostering a culture of excellence in healthcare delivery [39] (Table 2).

Discussion

This study demonstrates the significant impact of multifaceted interventions on reducing PI prevalence, with a marked decrease from 60.9 to 28.7% overall, and from 52.9 to 21.3% in hospital-acquired cases. The mean national prevalence of Pressure Injuries was 17.6%, with 58.1% being community-acquired. Key components included educational programs for nurses, greatly enhancing their knowledge and practices related to the Braden scale and wound care protocols. Effective interventions, such as air cushions and specific positioning techniques, addressed critical risk factors like patient age, sex, Braden score, and chronic diseases. The study's robust methodology, large sample size, and use of established quality assessment tools (CASP and NCOS) bolster the reliability of these results, especially given the study's majority context in Egypt. Limitations, such as the cross-sectional and descriptive design and reliance on convenience sampling, suggest a need for further research using longitudinal and randomized controlled trial designs. Future studies should explore the sustainability of improvements, the impact of interventions across various settings, and emerging technologies in pressure injury prevention. Ultimately, this study supports the implementation of comprehensive pressure injury prevention programs, highlighting the critical

role of ongoing education and targeted interventions in improving patient outcomes and quality of care. The [discussion](#) section of the studies centered on interpreting and contextualizing the findings, addressing their implications, limitations, and potential avenues for future research. Researchers reflected on the observed decrease in Pressure injury prevalence post-intervention, attributing it to the effectiveness of educational programs, care bundles, and improved nursing practices. They highlighted the significance of these multifaceted interventions in reducing Hospital-Acquired Pressure Ulcers (HAPUs) and improving patient care outcomes. Moreover, the discussion emphasized the importance of early detection and prevention strategies, particularly in high-risk populations and healthcare settings. Researchers also examined the identified risk factors for Pressure Injuries, such as age, sex, and chronic diseases, emphasizing the need for targeted interventions and personalized care approaches. Additionally, the discussion underscored the challenges and limitations encountered during the studies, including sample size constraints, data collection issues, and potential biases. Suggestions for future research directions included exploring novel interventions, evaluating long-term outcomes, and implementing standardized protocols across diverse healthcare settings. Overall, the [discussion](#) section provided a comprehensive analysis of the study findings, offering insights into the complex dynamics of pressure injury prevention and nursing practices while outlining strategies for improving patient care and reducing healthcare costs.

Limitations

The studies had several limitations. Many used convenience sampling, limiting generalizability, and small sample sizes reduced statistical power. Retrospective designs and self-reported data introduced recall bias, while variations in healthcare settings and populations made comparisons difficult. Efforts to control confounding variables may not have fully captured the complexity of pressure injury development. Short follow-up periods further limited assessments of long-term outcomes. Despite these limitations, the studies provided valuable insights, emphasizing the need for future research with larger, more representative samples and longer follow-up periods.

Implications

The implementation of multifaceted interventions for pressure injury prevention has significant implications for healthcare. These interventions, which combine risk assessment, skin care, nutritional support, patient repositioning, and specialized equipment, can greatly enhance clinical practice by providing a comprehensive approach to prevention. This leads to improved patient outcomes,

including reduced prevalence and severity of Pressure Injuries, and overall better quality of life for patients. Additionally, the prevention of these injuries translates into substantial cost savings for healthcare systems by reducing the need for extended hospital stays and additional treatments. The success of such interventions also fosters interdisciplinary collaboration, ensuring holistic patient care and effective communication among healthcare professionals. Moreover, the evidence supporting these interventions can inform the development of standardized policies and protocols, driving consistency in care quality. Continuous education and training for healthcare providers are crucial, as is involving patients and their families in prevention efforts. Finally, these interventions offer valuable insights for future research and quality improvement initiatives, promoting ongoing advancements in PI management.

Recommendations

Based on the findings and limitations identified in the studies, several recommendations can be proposed to guide future research and clinical practice in pressure injury prevention and nursing care. Firstly, there is a need to develop and implement standardized protocols for pressure injury prevention and management across healthcare settings. These protocols should encompass comprehensive risk assessment, evidence-based interventions, and regular monitoring of patient outcomes. Secondly, ongoing education and training programs for healthcare professionals, particularly nurses, should be prioritized to enhance their knowledge and skills in pressure injury prevention and care. Additionally, fostering multidisciplinary collaboration among healthcare teams, implementing systems for continuous quality improvement, and encouraging further research into novel interventions and best practices are essential. Moreover, empowering patients and their families to actively participate in pressure injury prevention strategies and conducting studies with longer follow-up periods to assess sustained effectiveness are crucial steps in improving patient outcomes and experiences in pressure injury management.

Conclusion

In conclusion, the studies collectively demonstrated that multifaceted interventions, such as educational programs, care bundles, and improved nursing practices, were effective in reducing pressure injury prevalence and improving patient outcomes. The significant reduction in Hospital-Acquired Pressure Ulcers post-intervention highlights the value of proactive prevention strategies and evidence-based care protocols. Going forward, further research is needed to explore new interventions,

assess long-term outcomes, and establish standardized protocols across diverse healthcare settings.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

URK-The author made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Data availability

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Declarations

Consent for publication

Not applicable.

Competing interests

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Conflict of interest

There is no expressed conflict of interest among the author.

Ethical approval

Not applicable.

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