

REVIEW ARTICLE

Prevalence of pressure ulcer and related factors in orthopaedic wards: A systematic review and meta-analysis

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Abstract

The aim of this systematic review and meta-analysis is to provide an overview of the prevalence of pressure ulcers (PU) in orthopaedic wards. A comprehensive, systematic search was conducted in different international electronic databases, such as Scopus, PubMed, Web of Science, and Persian electronic databases such as Iranmedex, and Scientific Information Database (SID) using keywords extracted from Medical Subject Headings such as “Prevalence”, “Pressure ulcer”, “Pressure sore”, and “Orthopaedics” from the earliest to February 1, 2023. The appraisal tool for cross-sectional studies (AXIS tool) evaluates the quality of the included studies. Finally, 11 studies were included in the final analysis. The results indicated that the prevalence of PU in orthopaedic departments was 18% (ES: 0.18, 95% CI: 0.10–0.26, $Z = 4.53$, $I^2: 99.09\%$). Although the odds ratio of PU was lower in men than women, it was not statistically significant (OR: 0.91, 95% CI: 0.74–1.11, $Z = 0.95$, $I^2: 17.4\%$, $P = .34$). Also, results showed the prevalence of PU was higher among studies with a sample size of more than 200 (ES: 0.19, 95% CI: 0.10–0.28, $Z = 4.07$, $I^2: 99.1\%$), Europe region (ES: 0.20, 95% CI: 0.14–0.26, $Z = 6.7$, $I^2: 93.0\%$) and prospective design (ES: 0.23, 95% CI: 0.18–0.27, $Z = 9.47$, $I^2: 83.3\%$) when compared with other sub-groups. In sum, considering the 18% prevalence of PU in the orthopaedic department, it is recommended to focus on detecting risk factors and design interventions to reduce PU in the patients admitted orthopaedic department.

KEYWORDS

meta-analysis, orthopaedics, pressure sore, pressure ulcer, prevalence

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Key Messages

- the results indicated that the prevalence of PU in orthopaedic departments was 18% (ES: 0.18, 95% CI: 0.10–0.26, $Z = 4.53$, $I^2: 99.09\%$)
- although the odds ratio of PU was lower in men than women, it was not statistically significant (OR: 0.91, 95% CI: 0.74–1.11, $Z = 0.95$, $I^2: 17.4\%$, $P = .34$)
- also, results showed the prevalence of PU was higher among studies with a sample size of more than 200 (ES: 0.19, 95% CI: 0.10–0.28, $Z = 4.07$, $I^2: 99.1\%$), Europe region (ES: 0.20, 95% CI: 0.14–0.26, $Z = 6.7$, $I^2: 93.0\%$), and prospective design (ES: 0.23, 95% CI: 0.18–0.27, $Z = 9.47$, $I^2: 83.3\%$) when compared with other sub-groups
- in sum, considering the 18% prevalence of PU in the orthopaedic department, it is recommended to focus on detecting risk factors and design interventions to reduce PU in the patients admitted orthopaedic department

1 | INTRODUCTION

A pressure ulcer (PU) is defined as a disruption of the integrity of the skin and the continuation of tissue damage because of ischaemia secondary to high external pressure that usually occurs on different parts of the body.^{1–6} PU can be caused by internal and external factors. Internal factors include immobility, cognitive impairment, chronic diseases, improper nutrition, and ageing.^{7,8} On the other hand, people who cannot change position independently are more at risk of developing wounds. This lack of change in position can be because of factors such as fractures and surgery, which are common in orthopaedic patients.^{9,10}

PU can be related to the quality of life, patient performance, death, and health care costs. Because it causes a decrease in the quality of life and performance of the patient, it can also cause an increase in mortality and the cost of health care.¹¹ As it was said, bedsores are more common in people and patients who are not able to move themselves and their organs. For example, in the orthopaedic ward, patients with changes in their activity levels because of fractures, casts, and surgery are prone to PU.^{12,13} On the other hand, orthopaedic patients with PU will experience less mortality than patients without PU. Following this, the risk of infection increases in these patients, and other operations may even be delayed because of these infections.¹⁴ A study reported in Iraq that the prevalence of PU in the orthopaedic ward is influenced by various factors. For example, a successful operation leads to a decrease in the incidence of PU in patients, especially the elderly. On the other hand, the age factor can be effective in increasing the number of patients with PU in the orthopaedic department.¹⁵ Another study showed that in Italy, PU is a relatively common complication in elderly people who have suffered a hip fracture, and this complication is more

common in high-risk patients who undergo special treatments.¹⁶

2 | AIM

Therefore, considering the importance of PU, its complications, and its prevalence in the orthopaedic department and the lack of a review study, the present review study was conducted to investigate the prevalence of PU in the orthopaedic ward.

3 | METHODS**3.1 | Study registration and reporting**

This systematic review and meta-analysis were carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Data S1).¹⁷ Additionally, the current review was not listed in the database of the international prospective register of systematic reviews (PROSPERO).

3.2 | Search strategy

A comprehensive, systematic search was conducted in different international electronic databases, such as Scopus, PubMed, Web of Science, and Persian electronic databases such as Iranmedex, and Scientific Information Database (SID) using keywords extracted from Medical Subject Headings such as “Prevalence”, “Pressure ulcer”, “Pressure sore”, and “Orthopaedics” from the earliest to February 1, 2023. For example, the search strategy was in PubMed/MEDLINE database including (“Prevalence”)

OR (“Outbreak”) AND (“Pressure ulcer”) OR (“Pressure sore”) OR (“Bedsore”) AND (“Orthopaedics”) OR (“Orthopaedic wards”) OR (“Orthopaedic patients”). Iranian electronic databases’ Persian keyword equivalents were also searched. The Boolean operators “OR” and “AND” were used to combine phrases. Independently, two researchers conducted thorough searches. This systematic review and meta-analysis exclude the grey literature, which consists of expert comments, conference presentations, theses, research and committee reports, and ongoing research. The literature that has not acquired the publisher’s consent for commercial publication, whether it is done in print or electronically, is referred to as grey literature.¹⁸

3.3 | Inclusion and exclusion criteria

This systematic review examined cross-sectional research on the prevalence of PUs in orthopaedic wards that were written in Persian and English and published in both languages. Reviews, case studies, conference materials, letters to the editor, court procedures, and qualitative research were excluded.

3.4 | Study selection

For this systematic review, data were managed using EndNote X8. Two researchers independently evaluated the published full texts, study titles, and abstracts, and the electronic and manual removal of duplicate studies based on the inclusion and exclusion criteria. The third researcher resolved any disagreements between the first two researchers while selecting the studies. Finally, references were carefully examined to prevent data loss.

3.5 | Data extraction and quality assessment

The information extracted in this review by the researchers includes the name of the first author, year of publication, location, sample size, age, the prevalence of PU, prevalence of PU in different genders, number of PU, and site of PU. The appraisal tool for cross-sectional studies (AXIS tool) evaluates the quality of the included studies via 20 items with a two-point Likert, including yes (score of 1) and no (score of 0). This tool assesses report quality (7 items), study design quality (7 items), and the possible introduction of biases (6 items). Finally, AXIS rates the quality of studies at three levels: high (70%–100%), fair (60%–69.9%), and low (0%–59.9%).¹⁹

3.6 | Statistical analysis

Analysis was performed in STATA software version 14. To calculate the overall effect size, the sample size and prevalence of PU in each study were extracted. Heterogeneity was assessed based on I^2 statistics. An I^2 value of 25% is considered a low heterogeneity, 50% a moderate heterogeneity, and 75% a high heterogeneity. Because of the high heterogeneity concerning outcomes, the random effects model was used. Subgroup analysis was performed based on sample size, geographical region, and design of studies.

3.7 | Sensitivity analysis

Sensitivity analysis was used to evaluate the impact of omitting each study on the overall effect size of PU prevalence.

3.8 | Publication of bias

Publication of bias was assessed with a Funnel plot and then the Egger test result. The trim and fill method was used to correct the publication of bias.

4 | RESULTS

4.1 | Study selection

As shown in Figure 1, a comprehensive search of electronic resources yielded 2410 studies. Six hundred and twelve articles were left out of the study because they included duplicate content. The remaining 1798 papers were divided into 142 studies that were excluded from the systematic review and meta-analysis because they were not cross-sectional studies and 1601 studies that were excluded because they did not meet the study’s objectives. Following a careful examination of the complete texts of the publications, 25 research articles were deleted because of poor design or findings, and 14 studies were discarded because of insufficient data. Ultimately, 11 studies^{10,15,16,20-27} were included in this meta-analysis and systematic review.

4.2 | Study characteristics

As mentioned in Table 1, a total of 4738 orthopaedic patients participated in 11 cross-sectional studies.^{10,15,16,20-27} Their mean age was 73.12 (SD = 9.35). Of the participants, 64.23% were females. PU was located on the sacrum in 59.36% of patients.

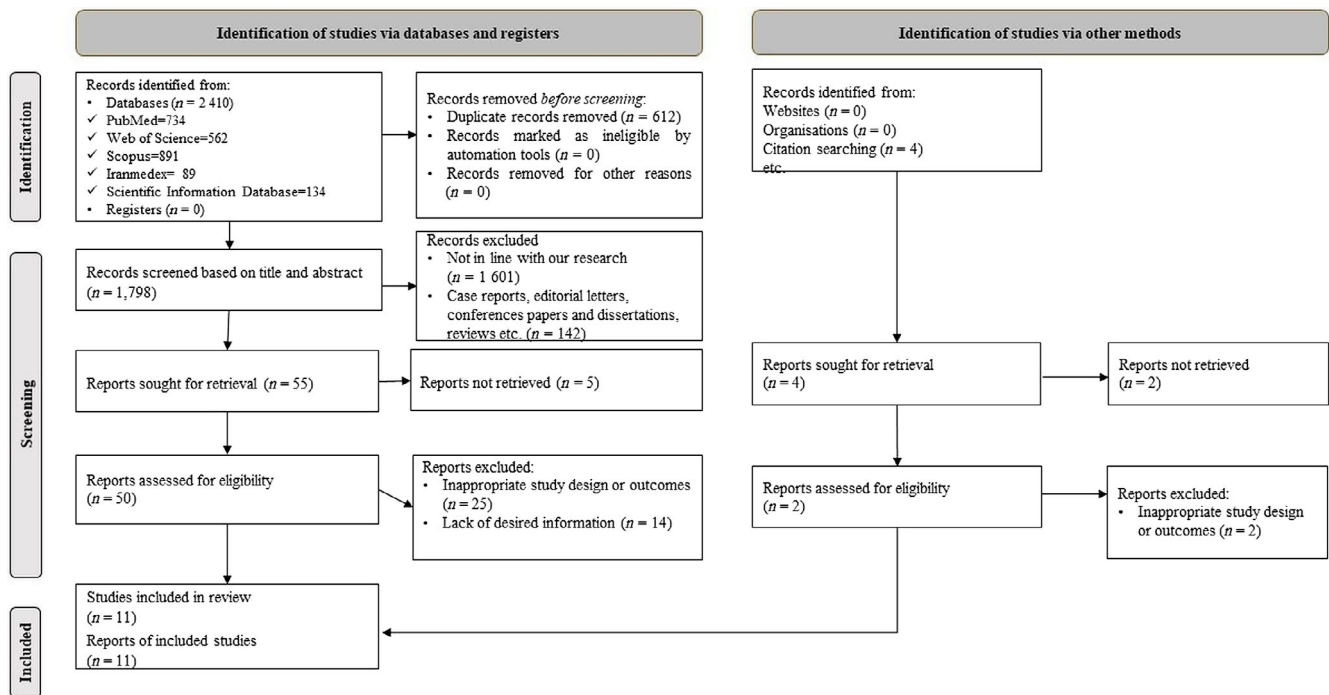


FIGURE 1 Flow diagram of the study selection process.

4.3 | Methodological quality assessment of eligible studies

As shown in Figure 2, all of the studies^{10,15,16,20-27} were of high quality. In addition, one study²⁷ neglected to mention the limitations of the research, and four studies^{15,16,24,27} failed to disclose the funding sources or potential conflicts of interest.

4.4 | Prevalence of PU

The results indicated that the prevalence of PU in orthopaedic departments was 18% (ES: 0.18, 95% CI: 0.10–0.26, $Z = 4.53$, $I^2: 99.09\%$) (Figure 3).

4.5 | Prevalence of PU based on gender

Although the odds ratio of PU was lower in men than women, it was not statistically significant (OR: 0.91, 95% CI: 0.74–1.11, $Z = 0.95$, $I^2: 17.4\%$, $P = .34$) (Figure 4).

4.6 | Sub-group analysis

To detect the source of heterogeneity pooled effect size of PU prevalence in the orthopaedic department, sub-group analysis was conducted based on sample size,

geographic region, and type of study. Heterogeneity was reduced in studies with a sample number of less than 200 and those with cross-sectional and prospective designs (Table 2).

Also, results showed the prevalence of PU was higher among studies with a sample size of more than 200 (ES: 0.19, 95% CI: 0.10–0.28, $Z = 4.07$, $I^2: 99.1\%$), Europe region (ES: 0.20, 95% CI: 0.14–0.26, $Z = 6.7$, $I^2: 93.0\%$), and prospective design (ES: 0.23, 95% CI: 0.18–0.27, $Z = 9.47$, $I^2: 83.3\%$) when compared with other sub-groups (Table 2).

4.7 | Publication bias

Visual inspection of bias based on the Funnel plot showed that there was publication bias (Figure 5). Quantitative analysis based on the Egger test ($P = .001$) showed that there is a significant publication bias. Based on the trim and fill method, there were six missing studies to adjust pooled effect size (ES: 0.03, 95% CI: 0.0–0.10).

4.8 | Sensitivity analysis

The effect of each study on the pooled effect size is shown in Table 3. Removing each study changed the pooled effect size so that lower and upper estimated 0.09 and 0.29, respectively.

TABLE 1 Basic characteristics of the included studies in this systematic review and meta-analysis.

First author, year	Location	Sample size	Age (mean ± SD)	M/F ratio (%)	Prevalence of PU (n [%])	Prevalence of PU in different genders (n [%])	Number of PU	Site of PU (n [%])
Young, 2000 ²⁷	Australia	90	68.00	32.22/67.78	10 (11.11)	N/A	10	<ul style="list-style-type: none"> • Sacrum: 81 (90.00) • Others: 9 (10.00)
Rademakers et al., 2007 ²⁴	Netherlands	722	82.20	23.68/76.32	214 (29.64)	N/A	N/A	N/A
Campbell et al., 2010 ²⁰	UK	150	70.60	30.67/69.33	21 (14.00)	N/A	21	Heel: 21 (100)
James et al., 2010 ²²	Wales	581	N/A	36.14/63.86	81 (13.94)	N/A	N/A	N/A
Molon & Estrella, 2011 ²³	Philippines	40	N/A	77.50/22.50	8 (20.00)	<ul style="list-style-type: none"> • Male: 6 (75.00) • Female: 2 (25.00) 	8	Sacrum: 8 (100)
Al-Shadedi, 2012 ¹⁵	Iraq	215	63.20	53.49/46.51	60 (27.91)	<ul style="list-style-type: none"> • Male: 20 (33.33) • Female: 40 (66.67) 	60	<ul style="list-style-type: none"> • Sacrum: 31 (51.67) • Heel: 16 (26.67) • Other: 13 (21.66)
Chiari et al., 2017 ¹⁰	Italy	1083	84.10 (SD = 7.60)	24.84/75.16	246 (22.71)	<ul style="list-style-type: none"> • Male: 63 (25.61) • Female: 183 (74.39) 	277	<ul style="list-style-type: none"> • Sacrum: 177 (63.90) • Heel: 63 (22.74) • Other: 37 (13.36)
Forni et al., 2018 ¹⁶	Italy	467	83.30 (SD = 8.10)	20.99/79.01	127 (27.19)	<ul style="list-style-type: none"> • Male: 28 (22.05) • Female: 99 (77.95) 	176	<ul style="list-style-type: none"> • Sacrum: 89 (50.57) • Heel: 37 (21.02) • Other: 22 (12.50) • Multiple: 28 (15.91)
Gonzalez et al., 2018 ²¹	Mexico	462	81.36 (SD = 7.07)	28.57/71.43	119 (25.76)	<ul style="list-style-type: none"> • Male: 30 (25.21) • Female: 89 (74.79) 	N/A	N/A
Ueno et al., 2020 ²⁶	Japan	265	60.22 (SD = 14.62)	24.15/75.85	7 (2.64)	<ul style="list-style-type: none"> • Male: 2 (28.57) • Female: 5 (71.43) 	N/A	N/A
Suh et al., 2021 ²⁵	South Korea	663	65.12	41.18/58.82	39 (5.88)	<ul style="list-style-type: none"> • Male: 16 (41.03) • Female: 23 (58.97) 	N/A	N/A

Abbreviation: PU, pressure ulcers.

		Young, 2000	Rademakers et al., 2007	Campbell et al., 2010	James et al., 2010	Molon & Estrella, 2011	Al-Shadedi, 2012	Chiari et al., 2017	Forni et al., 2018	Gonzalez et al., 2018	Ueno et al., 2020	Suh et al., 2021
Introduction	Clear aims	*	*	*	*	*	*	*	*	*	*	*
	Appropriate design	*	*	*	*	*	*	*	*	*	*	*
Methods	Sample size justified	*	*	*	*	*	*	*	*	*	*	*
	Population defined	*	*	*	*	*	*	*	*	*	*	*
	Sample representative of population	*	*	*	*	*	*	*	*	*	*	*
	Selection process representative	*	*	*	*	*	*	*	*	*	*	*
	Measures to address non-responders	-	-	-	-	-	-	-	-	-	-	-
	Appropriate outcome variables	*	*	*	*	*	*	*	*	*	*	*
	Valid measures	*	*	*	*	*	*	*	*	*	*	*
	Defined statistical significance	*	*	*	*	*	*	*	*	*	*	*
	Methods described	*	*	*	*	*	*	*	*	*	*	*
	Results	Results data described	*	*	*	*	*	*	*	*	*	*
Concerns about non-response bias		-	-	-	-	-	-	-	-	-	-	-
Non-responder information described		-	-	-	-	-	-	-	-	-	-	-
Results internally consistent		*	*	*	*	*	*	*	*	*	*	*
Results presented for analyses		*	*	*	*	*	*	*	*	*	*	*
Discussion	Conclusions justified	*	*	*	*	*	*	*	*	*	*	*
	Limitations identified	-	-	*	*	*	*	*	*	*	*	*
Others	Funding sources or conflicts of interests	-	-	*	*	*	*	*	*	*	*	*
	Ethical approval/consent attained	*	*	*	*	*	*	*	*	*	*	*

FIGURE 2 Methodological quality assessment of included studies.

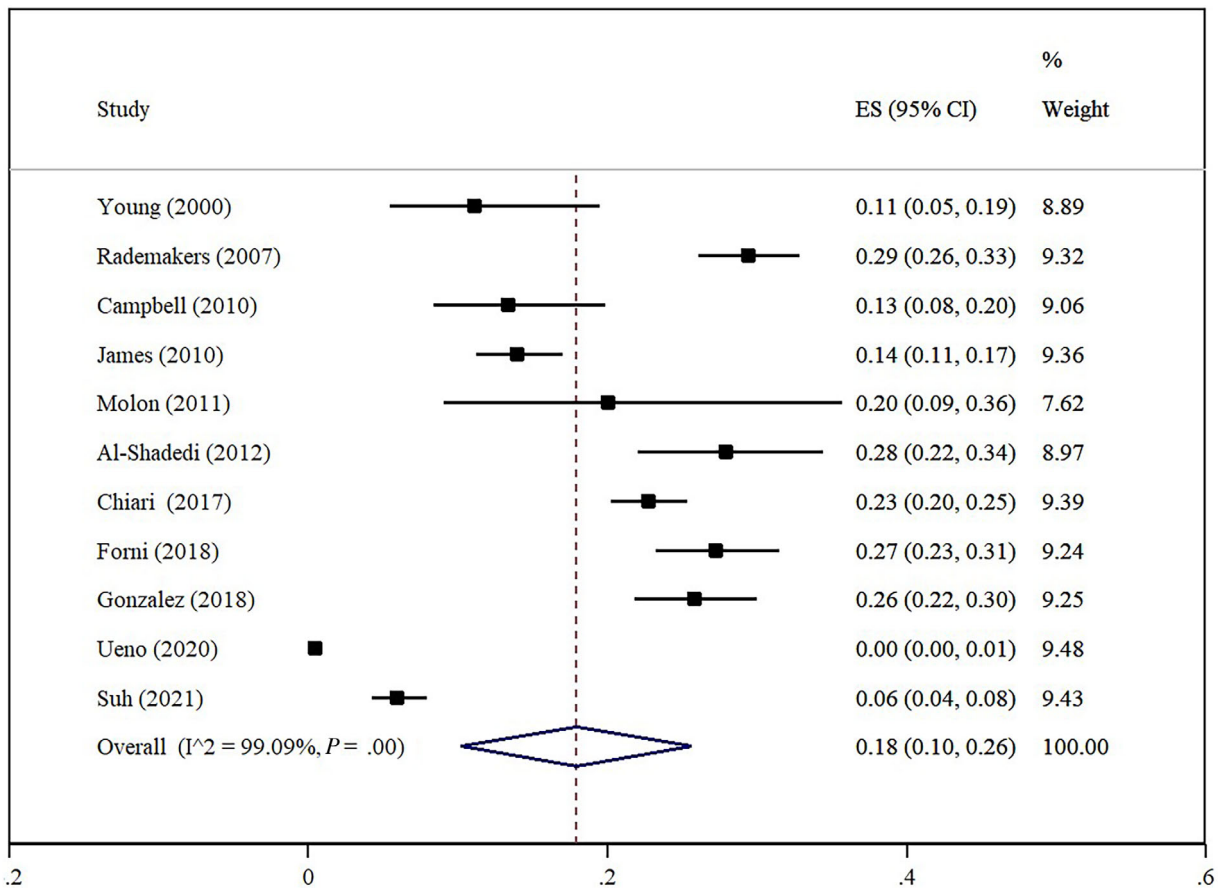


FIGURE 3 Forest plot prevalence of pressure ulcer in orthopaedic patients.

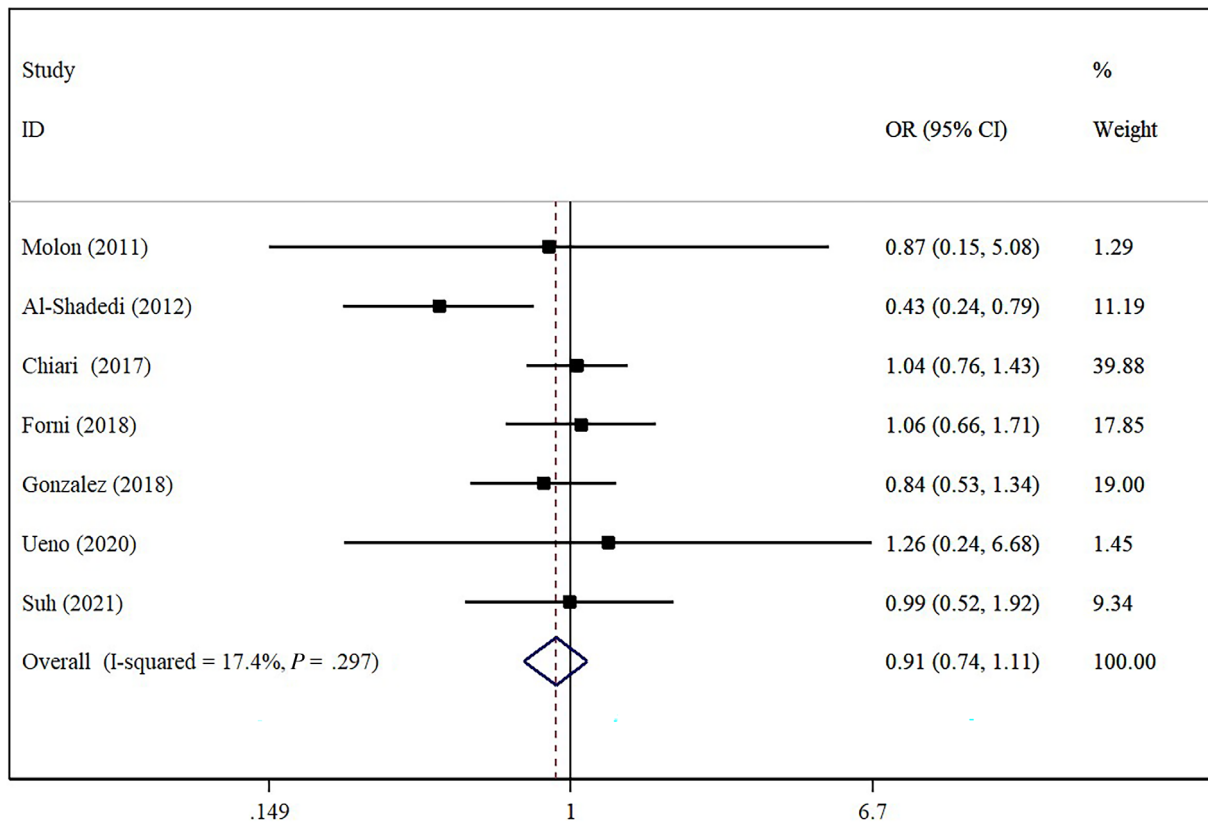


FIGURE 4 Odds ratio of pressure ulcer among male and female.

TABLE 2 Sub-group analysis to detect heterogeneity source.

Source	Sub-categories	Number of studies	Effect size	Lower CI	Upper CI	Z	I ² (%)
Sample size	Less than 200	3	0.13	0.09	0.17	6.54	0.0
	More than 200	8	0.19	0.10	0.28	4.07	99.1
Location	Europe	6	0.20	0.14	0.26	6.70	93.5
	other	5	0.15	0.07	0.24	3.48	98.5
Design	Cross-sectional	4	0.18	0.10	0.26	4.59	84.8
	Retrospective	3	0.12	0.0	0.24	1.96	99.4
	Prospective	4	0.23	0.18	0.27	9.47	83.3

5 | DISCUSSION

The present study aimed to determine the prevalence of PU in patients hospitalised in the orthopaedic department. Finally, the analysis showed that the prevalence of PU was 18% among patients admitted to the orthopaedic department.

One meta-analysis study aimed to determine the prevalence of PU among adult patients admitted to the hospitals and was conducted on 39 studies. As a result, the PU prevalence was estimated at 12.8%, which was lower than

the amount reported in the present study.¹ In this study, the patients who were hospitalised in the medical, surgical, and intensive care units were included in the study. However, our study concentrated on PU prevalence in the orthopaedic department. Patients who are admitted to the orthopaedic department usually experience immobility because of old age and surgery. Therefore, this can be considered an accelerating factor in the orthopaedic department.²⁸ Also, patients tolerated different positions during orthopaedic operations that are also considered another important factor to develop PU. In one study,

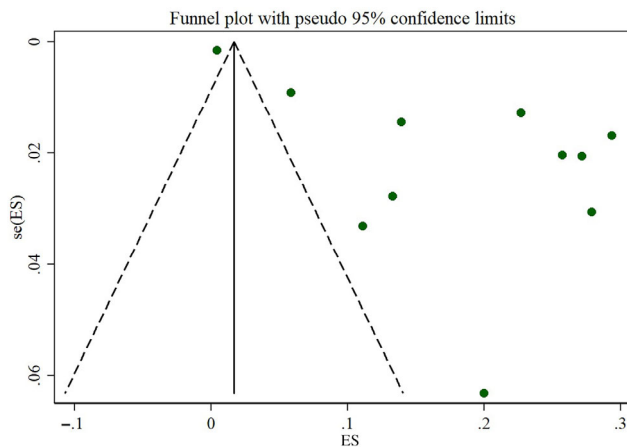


FIGURE 5 Funnel plot of prevalence of pressure ulcer.

TABLE 3 Sensitivity analysis.

Author	ES	LCI	UCI
Young	0.18	0.10	0.26
Rademakers	0.17	0.09	0.24
Campbell	0.18	0.10	0.26
James	0.18	0.10	0.27
Molon	0.18	0.10	0.26
Al-Shadedi	0.17	0.09	0.25
Chiari	0.17	0.10	0.25
Forni	0.17	0.09	0.25
Gonzalez	0.17	0.09	0.25
Ueno	0.20	0.13	0.26
Suh	0.19	0.09	0.29

2.64% of patients who experienced the lateral decubitus position during hip surgery showed various degrees of PUs.²⁶

In another meta-analysis study, PU prevalence was assessed in observational studies at different departments of the hospital. The results of the final 35 studies included in this study showed that PU prevalence was 12%. In this study, four studies were also conducted in the orthopaedic departments. The highest prevalence of PU was estimated in the orthopaedic department at 18.5%. This result was consistent with the finding of the present study, which was reported based on 11 studies and PU prevalence was 18%.⁴ Also, in this study, the level of heterogeneity between studies was reported as I^2 : 97% similar to the present study with I^2 : 99.09%, which showed considerable heterogeneity.

In the present study, the chance of PU among women was higher than among men, although it was not statistically significant. In one study, the prevalence of PU in

women and men patients was reported at 12.8% and 10.1% after surgery, respectively. This result was in line with the results of the present study.²⁹ In the hospital, the Braden scale was used to assess the patients' chance to develop PU and did not consider gender as a risk factor. So, the results of future studies can be a good guide to judging about effects of gender on PU.³⁰

In the current study, the prevalence of PU among European countries was higher than in other geographical regions. The result of a meta-analysis study also showed that the prevalence of PU in some geographical regions of Asia such as Malaysia, Saudi Arabia, and Thailand was higher than in other regions, which was not consistent with the results of the present study.³¹ More studies are required to evaluate the effects of the geographical region on the incidence of PU.

6 | LIMITATIONS

The high heterogeneity between included studies can be considered one of the limitations. However, high heterogeneity is usually an important issue in prevalence meta-analysis. We performed the sub-group analysis to detect the source of heterogeneity. Also, based on the results of publication bias, more studies are required to decide prevalence of PU in the orthopaedic department.

6.1 | Recommendations for future research

In the present study, European countries had a higher prevalence of PU than other geographical areas. More research is necessary to assess how geographic region affects the prevalence of PU for this reason. It is also suggested to conduct experimental studies in the future to investigate the effect of various interventions on the reduction of PU in patients admitted to the orthopaedic department.

7 | CONCLUSION

The present study was conducted to investigate the prevalence of PU among patients hospitalised in the orthopaedic department. The results of 11 final articles showed that the prevalence of PU in the orthopaedic department was 18%. Also, the prevalence among studies with a sample size of more than 200, conducted in the Europe region and with a prospective design, was higher than other studies. Although the chance of PU in men was lower than in women patients, it was not

statistically significant. Considering the 18% prevalence of PU in the orthopaedic department, it is recommended to focus on detecting risk factors and design interventions to reduce PU in the patients admitted to orthopaedic department.

AUTHOR CONTRIBUTIONS

All authors: idea for the review, study selection, data extraction, interpretation of results, and writing of the manuscript. All authors read and approved the final manuscript.

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This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST STATEMENT

We do not have potential conflicts of interest with respect to the research, authorship, and publication of this article.

DATA AVAILABILITY STATEMENT

The datasets used during the current study are available from the corresponding author upon request.

ETHICS STATEMENT

Not applicable to this study.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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