

Prevalence of postoperative pressure ulcer: A systematic review and meta-analysisVida Shafipour¹, Ensieh Ramezanpour², Mohammad Ali Heidari Gorji¹, Mahmood Moosazadeh³

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Type of article: Meta-analysis**Abstract**

Introduction: A pressure ulcer is a serious safety issue in healthcare systems. The patient's rate of infection with an ulcer, especially a postoperative ulcer, is critical, as it is dictated by factors such as being in a fixed position during surgery, the type of anesthesia used, the duration of surgery, and patient-related factors. The present study was conducted to carry out a systematic assessment of the prevalence of a postoperative pressure ulcer and to find its general prevalence using a meta-analysis.

Methods: The researchers searched databases, including PubMed, Google Scholar, Scopus, Science Direct, the Thomson Reuters' Web of Science (WOS). For English articles published online between January 2000 and October 2015 on the subject of a pressure ulcer, a total of 19 articles were ultimately selected based on the study inclusion criteria. Then results were analyzed in Stata-11.

Results: The 19 articles qualified for entering the meta-analysis examined a total of 9527 patients. The studies estimated the general prevalence of a postoperative pressure ulcer as 18.96% (CI 95%: 15.3–22.6); the prevalence by gender was reported as 10.1% (CI 95%: 7.2- 13.01) in men and 12.8% (CI 95%: 8.3-17.2) in women. Stage 1 ulcer had a 17.02% prevalence (CI 95%: 11.04- 22.9), stage 2 a 6.7% prevalence (CI 95%: 3.8- 9.7), stage 3 a 0.9% prevalence (CI 95%: 0.2-1.6), and stage 4 a 0.4% (CI 95%: -0.05-0.8) prevalence.

Conclusion: The prevalence of a postoperative pressure ulcer is high among the entire population; however, it is still higher in women than in men. The prevalence of a stage 1 ulcer is higher than the prevalence of the other stages of an ulcer.

Keywords: Pressure ulcer, Prevalence, Risk factors, Surgical patients

1. Introduction**1.1. Background**

A pressure ulcer is a serious safety issue in healthcare systems (1) and adversely affects patients due to the pain it causes and the time it takes to heal. These ulcers also increase the workload of health care professionals and, as a consequence, increase health care costs dramatically. In extreme situations, pressure ulcers can cause death. National programs have been initiated to manage this problem and to stimulate preventive actions (2). The National Pressure Ulcer Advisory Panel (NPUAP) defines a pressure ulcer as the impaired integrity of the skin caused by the compression of the soft skin tissue between the bony processes and an external surface. This ulcer is caused by an impaired tissue perfusion and a subsequent partial loss of the body cells progressively destroying the underlying layers (3, 4). The duration of compression that the skin tolerates until it breaks down varies from one patient to another; in many incapable patients, tissue damage occurs within less than two hours (5). In terms of severity, the NPUAP has defined four stages for a pressure ulcer. A stage 1 pressure ulcer consists of a reddened spot that does

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not blanch by pressing and may be accompanied with edema. A stage 2 pressure ulcer consists of damage to the surface layers of the skin, i.e., the epidermis or the dermis or even both; a stage 2 ulcer is often superficial and presents as a painful scratch, blister, or small cavity. In a stage 3 ulcer, the skin thickness is completely lost, and the subcutaneous tissue damage extends deep into the muscle tissue. At this point, the ulcer is clinically observed as a deep cavity that might extend to the surrounding tissues and take months to heal. A stage 4 ulcer involves the complete loss of the skin together with an extensive skin destruction and necrosis and the involvement of the muscles, bones, and tendons. Secretory sinuses also may occur at this stage (5). This classification involves an unclassified stage as well, in which the tissue thickness is completely lost, and the ulcer is covered with a yellow, gray, green, or brown tissue, which has to be removed for the depth and stage of the ulcer to be determined (3, 6). Study question: What is the prevalence of a postoperative pressure ulcer by gender and ulcer stages?

1.2. Statement of the Problem

The rate of infection with an ulcer, especially a postoperative ulcer, is important due to factors such as being in a fixed position during surgery, the method of anesthesia used, the duration of surgery, and patient-related factors such as age, gender, underlying diseases (diabetes, heart failure, etc.). A postoperative pressure ulcer is one of the causes of prolonged hospital stays and increased costs and workloads within the healthcare system (7). The treatment of a pressure ulcer costs between \$2000 and \$70,000 per patient according to the intensity and stage of the ulcer, and the annual cost of treating pressure ulcer incurred by hospitals is between \$400,000 and \$700,000 (8). In the United States, approximately 1.6 billion patients develop health care associated pressure ulcers at an annual cost of \$2.2 billion to \$3.6 billion (9).

1.3. Objective of Research

Implementing preventive measures therefore requires the identification of patients at risk for developing a pressure ulcer and the investigation of its postoperative prevalence. The initial search carried out in this study revealed the prevalence of a pressure ulcer to range from 8.1% to 27.3% in the United States (10, 11) and from 11.1% to 54.8% in Turkey (12, 13) and to be 21.3% in Iran (14). Given the substantial difference in the prevalence rates reported for pressure ulcers in different studies, the present study seeks to integrate the results obtained from the initial studies examined through a meta-analysis and a systematic review and to present credible evidence on the subject. This study thus examines the prevalence of a postoperative pressure ulcer in general and by gender and ulcer stage.

2. Material and Methods

2.1. Study type

The present study was conducted to investigate the prevalence of a postoperative pressure ulcer in general and by gender and ulcer stage using a systematic review and a meta-analysis.

2.2. Search Strategy

To access English articles published online between January 2000 and October 2015 on the subject of pressure ulcers, databases including the PubMed, Google Scholar, Scopus, Science Direct, and the Thomson Reuters' Web of Science (WOS) were searched. The search was carried out between August 23 and October 23, 2015, of article abstracts and titles using a combination of major English keywords on the subject, including pressure ulcer, prevalence, risk factors, and surgical patients. To increase the sensitivity of the search and enable a greater choice of articles that could not be retrieved through the databases, the list of references inserted in these articles was also examined. The retrieved articles were evaluated by two of the researchers at random, and no articles were excluded.

2.3. Article selection

The full text or the abstract of all the articles, documents, and reports yielded by the advanced search were extracted, and repeated items were excluded. Irrelevant articles also were excluded with a review of the title, abstract, and full text of the articles as well as the authors' names, publication year, and journal number and title. To prevent reprint bias (transverse and longitudinal bias), the results were examined by the researchers to identify and eliminate repeated articles. All the articles written in English and examining the prevalence of postoperative pressure ulcers in adults entered the systematic review and meta-analysis once they were evaluated and reported to meet the minimum requirements. The articles that did not report the prevalence of a pressure ulcer or were conducted on children, control-case or interventional studies, or studies that did not receive the required score according to the checklist were excluded from the study.

2.4. Quality assessment

After identifying the articles that were relevant in terms of title and content, their quality was assessed using a checklist used in previous studies (15) and developed according to the strengthening the reporting of observational studies in an epidemiology (STROBE) checklist. The checklist consists of 12 questions that examine different methodological aspects of a study, including appropriate sample size, type of study, sampling method, study population, data collection method, variable definition, sample assessment method, data collection tools, statistical tests employed, study objectives, and the appropriate presentation of the results in accordance with the study objectives. One point is allocated to each question and any article receiving a score of 12 thus entered the meta-analysis (15).

2.5. Data extraction

The data pertaining to each article was extracted by title, the corresponding author's name, study year, study setting, sample size, sample size by gender, the prevalence of pressure ulcer in general and by gender and ulcer stage, study type, sampling method, and study method. The data were entered into an Excel spreadsheet by two of the researchers.

2.6. Analysis

Data were analyzed in Stata. The binomial distribution formula was used to calculate the standard error in the prevalence of pressure ulcer reported in each article. The heterogeneity index was then determined using Cochran's Q test. Based on the results obtained, the randomized effect model was used in the meta-analysis using the meta command for estimating the prevalence of a postoperative pressure ulcer. In addition, to minimize the randomized distribution of the point estimates of the articles, the data obtained from all the articles were adjusted using Bayesian analysis. The meta-regression command was then used in Stata-11 to examine the effects of the variables suspected as potential sources of heterogeneity. The point estimate of the prevalence of a pressure ulcer was calculated in forest plots with a 95% confidence interval; in this plot, the size of the square indicates the weight of each article, and the lines on the sides show a 95% confidence interval.

3. Results

The initial search in international databases led to the identification of 103 articles. Imposing further constraints and increasing the specificity of the search then reduced the number of nearly relevant articles to 90, 30 of which were repetitive due to the overlap between databases. The titles and abstracts of the remaining 60 articles were reviewed, and 15 were excluded due to being irrelevant to the objectives of the review study. The review of the full text of the remaining 45 articles led to the selection of 30, 15 of which ultimately entered the study after they were fully assessed in terms of meeting the inclusion and exclusion criteria and the minimum quality requirements. The article references also were reviewed and thus led to the identification of four additional articles relevant to the subject. A total of 19 articles ultimately entered the meta-analysis and systematic review stages of the study (Figure 1). All 19 articles selected were descriptive, analytical and cross-sectional and reported the general prevalence of postoperative pressure ulcer. Eight articles reported this prevalence in men and eight reported it in women. Ten articles reported the prevalence of stage 1 ulcer, 11 the prevalence of stage 2 ulcer, five the prevalence of stage 3 ulcer, and four the prevalence of stage 4 ulcer (Table 1).

3.1. General prevalence of postoperative pressure ulcer

All 19 articles (Figure 2) reported the general prevalence of postoperative pressure ulcer and examined a total of 9527 patients. The general prevalence of postoperative pressure ulcer varied from 5.1% in the study by Shaw (6) with a sample size of 297 to 64.1% in the study by Feuchtinger (17) with a sample size of 53 (Table 1). Due to the presence of heterogeneity, the randomized effect model was used to report the general prevalence of the ulcer, which is estimated as 18.96% (15.3, 22.6) (Table 2).

3.2. Prevalence of postoperative pressure ulcer by gender

The minimum prevalence of pressure ulcer was reported as 4.5% in men in the study by Pokorny et al. conducted on a sample of 222 men (18), and its maximum was reported as 18.5% in the study by Lumbley et al., which was conducted on a sample of 553 men (10). In the present study, the review of the eight articles that examined a total of 3632 men showed the prevalence of an ulcer to be 10.1% (7.2, 13.01) in men. The minimum prevalence of postoperative pressure ulcer was reported as 4.8% in women in a study by Primiano et al. conducted on a sample of 147 women (9), and its maximum was reported as 40% in a study by Shadedi et al. conducted on a sample of 100

women (19). In the present study, the review of the eight articles that examined a total of 2540 women showed the prevalence of ulcer to be 12.8% (CI 95%: 8.3-17.2) in women (Table 2).

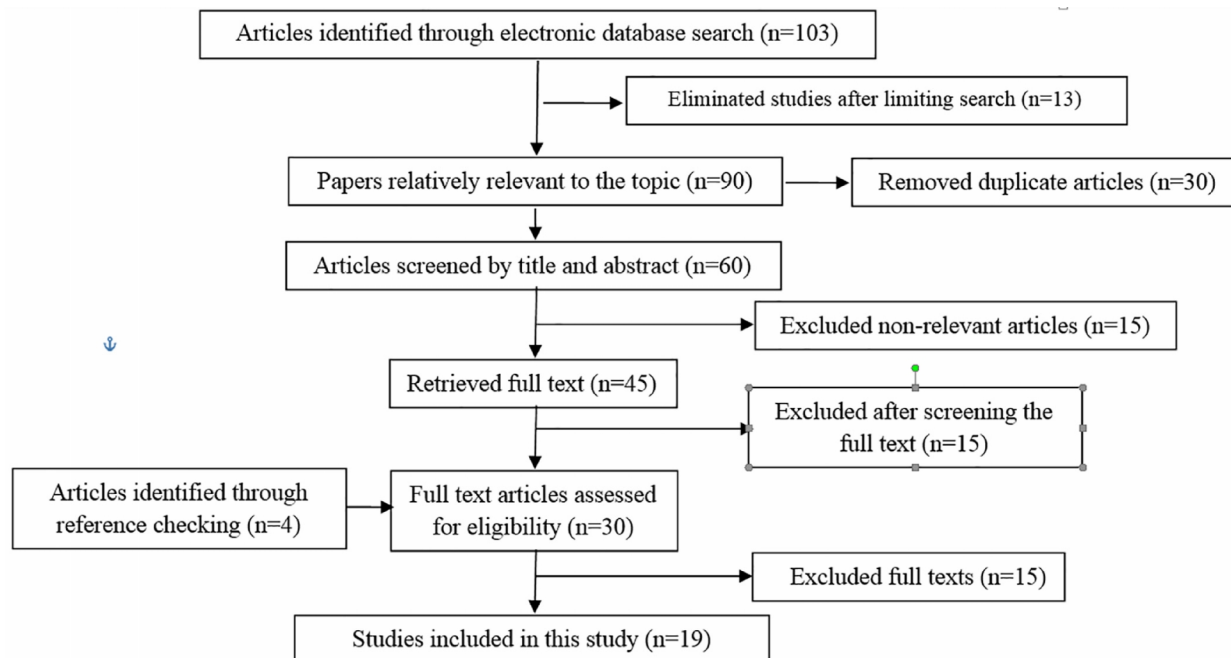


Figure 1. Literature search and review flow chart for selection of primary studies.

Table 1. Prevalence of pressure ulcer (%) by articles entering the meta-analysis

First author	n		Total P ³	MP ⁴	FP ⁵	p-stage 1	p-stage2	p-stage 3	p-stage 4
	M ¹	F ²							
Schoonhoven	136	72	21.1			11	10.1		
Pokorny	222	129	7	4.5	10.8	4.3	1.99	0.28	0.28
Lindgren	157	129	14.3	7.6	22.5	9.79	3.5	1	
Nixon	38	59	15.5				13.4		1.7
Karadag			54.8			54.8			
Sewchuk	100	50	11.3			3.33	5.3	2	1.3
Feuchtinger	31	22	64.1			62.2	1.8		
Rademarkers	171	551	30				27.5	2.07	
Scarlatti	101	98	20.6			13	7	0.28	0.28
KAMpbell	28	44	17			3	7		
Tschanen	1681	1161	12	13.6	13.2				
Shen			16.4			16.08	0.35		
Primiano	108	147	8.1	12.03	4.8				
Esoppi	1025	604	11.1	12.2	9.3				
Lumbley			27.3	18.5	8.7				
Shadedi	115	100	27.9	17.3	40				
Honglinchen	160	126	16.4			16	0.35		
Shaw	162	135	9.8	9.8	9.6				
Shaw	162	135	5.1	6.1	3.7				

1: male; 2: female; 3: total prevalence; 4: male prevalence; 5: female prevalence

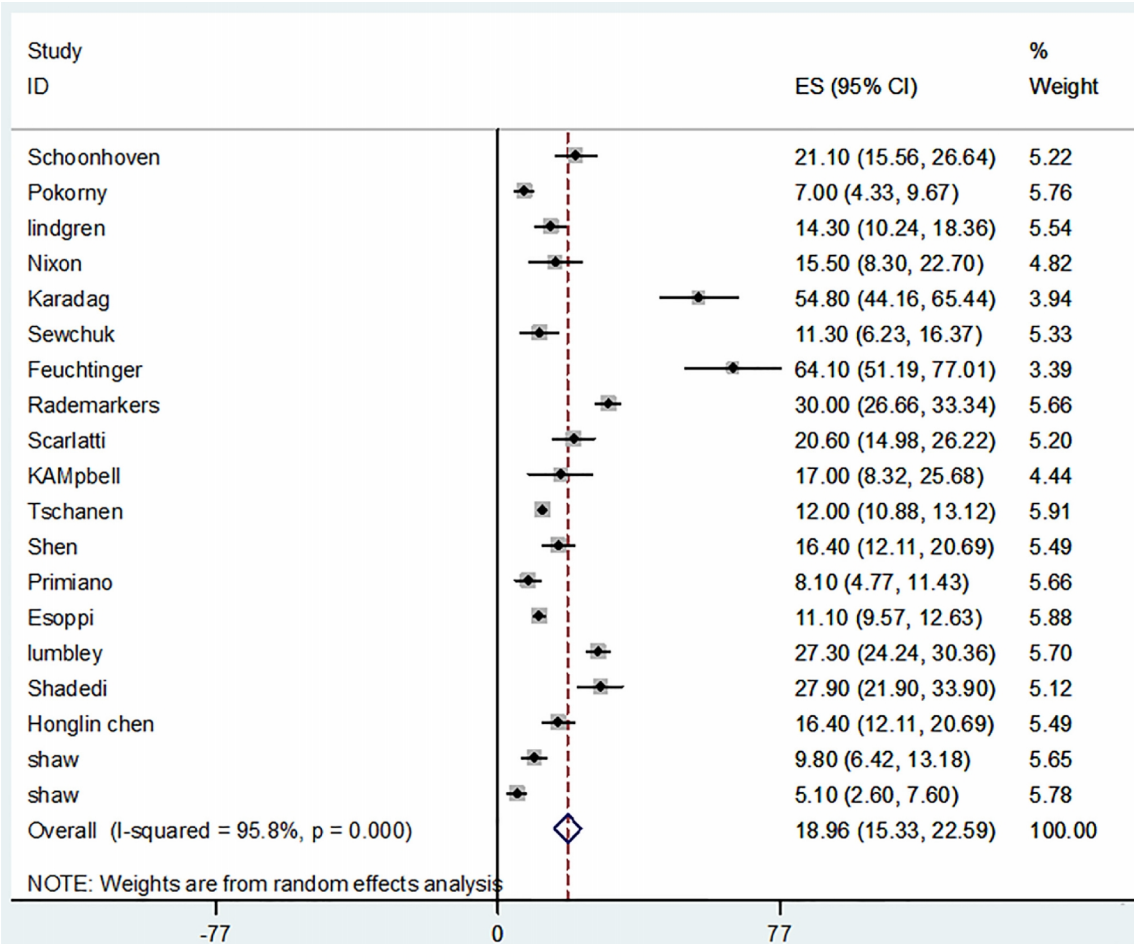


Figure 2. General prevalence of postoperative pressure ulcer in each article and the overall estimate.

Table 2. Prevalence of postoperative pressure ulcer based on the meta-analysis

Prevalence	Number of primary studies	Sample size	Prevalence	CI 95%	Heterogeneity		
					Q	I-squared	p-value
Total	19	9527	18.96	15.3-22.6	425.9	95.8	<0.001
Male	8	3632	10.1	7.2-13.01	45.8	84.7	<0.001
Female	8	2540	12.8	8.3-17.2	83.3	91.6	<0.001
Stage 1	10	1975	17.02	11.04-22.9	202.2	95.5	<0.001
Stage 2	11	2710	6.7	3.8-9.7	316.02	96.8	<0.001
Stage 3	5	1708	0.9	0.2-1.6	11.6	65.6	0.02
Stage 4	4	797	0.4	-0.05-0.8	2.2	0	0.5

3.3. Prevalence of postoperative pressure ulcer by stage of ulcer

Ten articles examined the prevalence of a stage 1 ulcer in a sample of 1975 patients and reported it as 17.02% (CI 95%: 11.04- 22.9); 11 articles examined the prevalence of a stage 2 ulcer in a sample of 2710 patients and reported it as 6.7% (CI 95%: 3.8- 9.7); five articles examined the prevalence of a stage 3 ulcer in a sample of 1708 patients and reported it as 0.9% (CI 95%: 0.2-1.6 and four articles examined the prevalence of a stage 4 ulcer in a sample of 797 patients and reported it as 0.4% (CI 95%: -0.05-0.8) (Table 2).

3.4. Risk factors associated with the pressure ulcers

The present study also examined some of the preoperative factors associated with the development of a pressure ulcer, including age, gender, BMI, and underlying diseases such as heart failure and diabetes. Age was found to be a significant factor in four of the reviewed studies (11, 18, 20), gender in two (18, 20), BMI in two (11, 20), serum albumin levels in one (20), and each underlying disease also in one (heart failure (18), musculoskeletal disorders

(20), diabetes (11), and smoking (16). Other factors also were each found in one article to contribute significantly to the development of pressure ulcer, including the number of surgeries since admission (11), the duration of hospitalization until the surgical operation (18), the risk of mortality (11), and the preoperative Braden Score (11). Some operative factors also were found to contribute significantly to the development of a pressure ulcer, including the body position during surgery (21), the duration of surgery (11, 21, 22), and the type of anesthesia used (20). The postoperative factors that contributed significantly to the development of pressure ulcer included the postoperative Braden Score (18), postoperative urinary tract infection (17), and prolonged hospital stay after the surgery (17).

4. Discussion

Meta-analysis of the studies conducted on a total 9527 surgery patients showed the prevalence of postoperative pressure ulcer to be 18.96%. The prevalence of a pressure ulcer was reported as 12.8% in women according to the sample of 2540 women examined, and as 10.1% in men according to the sample of 3632 men examined. Despite the larger number of men who had developed this ulcer, the prevalence of a pressure ulcer was deemed to be higher in women than in men, which is consistent with the results of some studies (18, 20) and inconsistent with the results of others (9,11, 16), which reported the prevalence to be higher in men. In the present study, the prevalence of a stage 1 ulcer was 17.02%, which is higher than the prevalence of the other stages of an ulcer. This finding is consistent with the results of some studies (12, 22, 23) and inconsistent with the results of others (24-26), which reported the prevalence of a stage 2 ulcer to be higher. The personal risk factors associated with the development of postoperative pressure ulcer included age, gender, BMI, underlying diseases such as diabetes, heart failure, musculoskeletal disorders, and smoking, as well as the number of surgeries since admission (11), the duration of hospitalization until the time of surgical operation (19), the risk of mortality (11), and the preoperative Braden Score (11). The operative factors affecting the development of an ulcer included the body position during surgery (11), the duration of surgery (11, 22, 23), and the type of anesthesia used (24); the postoperative factors contributing to the development of an ulcer included the postoperative Braden Score (18), postoperative urinary tract infection (17) and prolonged hospital stay after the surgery (17). According to the results obtained, women are more prone to developing postoperative pressure ulcer than men, with older patients and those with underlying diseases such as diabetes, heart failure, and musculoskeletal disorders, and lower Braden Scores also being at a greater risk for developing this ulcer. Patients with a prolonged duration of surgery and those experiencing postoperative urinary tract infection also are at a greater risk of developing pressure ulcer.

5. Conclusions

Our studies show that prevalence of a postoperative pressure ulcer is 18.96%, and patients with a prolonged duration of surgery and those experiencing postoperative urinary tract infection also are at a greater risk of developing a pressure ulcer. The results of the present study can be used by policymakers for improving prevention programs implemented before, during, and after surgery, on the one hand, and, on the other, for identifying patients at a greater risk of developing an ulcer, so as to help prevent its incidence and reduce hospital stays and treatment costs.

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Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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