



Predictors of Mortality after Hip Fracture: A Systematic Overview of Secondary Studies

Khadijeh Kalan Farmanfarma¹, Esmaeil Fakharian^{2*}, Robbert J Gobbens^{3,4,5,6}, Soudabeh Yarmohammadi¹, Mehrdad Mahdian¹, Masoumeh Abedzadeh- Kalaroudi⁷, Reza Fadaei Vatan⁸, Gholamreza Reza Khosravi¹, Mohammad Reza Fazel¹, Mojtaba Sehat^{9*}

¹ Trauma Research Center, Kashan University of Medical Sciences, Kashan, Iran.

² Trauma Research Center, Department of Neurosurgery, Kashan University of Medical Sciences, Kashan, IR Iran.

³ Faculty of Health, Sports and Social Work, Inholland University of Applied Sciences, Amsterdam, the Netherlands

⁴ Zonnehuisgroep Amstelland, Amstelveen, Netherlands.

⁵ Department Family Medicine and Population Health, Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium.

⁶ Tranzo, Tilburg University, Tilburg, the Netherlands

⁷ Trauma Nursing Research center Kashan University of Medical Sciences, Kashan, Iran

⁸ Iranian Research Center on Ageing, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran.

⁹ MD, PhD in Epeidemiology, Trauma Research Center, Department of Community Medicine, Faculty of Medicine, Kashan University of Medical Sciences, Kashan, Iran.

***Corresponding Authors:** Mojtaba Sehat¹, Esmaeil Fakharian²: ¹Trauma Research Center, Department of Community Medicine, Faculty of Medicine, Kashan University of Medical Sciences, Kashan, Iran; Tel: +98 9131622007; E-mail: mojtabasehat982@gmail.com.; ²Trauma Research Center, Department of Neurosurgery, Kashan University of Medical Sciences, Kashan, IR Iran; ; Tel: +98 9131614294; E-mail: efakharian@gmail.com

Received 2023-07-06; Accepted 2024-07-25; Online Published 2024-08-29

Abstract

Introduction: Hip fractures in patients are often accompanied by mortality and considerable complications. Accordingly, the aim of this study has dealt with a systematic review of mortality predictors following hip fracture.

Methods: The study collected and examined all systematic review and meta-analysis studies published in English between 2000 and 2023, obtained from international databases such as the Cochrane Library, PubMed, and Web of Science. The search strategy involved using MeSH terms matching the keywords (predictor AND mortality AND hip fractures AND systematic review). The inclusion criteria were systematic and meta-analysis studies, while the exclusion criteria consisted of observational studies, letters to the editor, conference abstracts, commentaries, and case series.

Results: In the studies that were examined, risk factors, body organs, and certain diseases were found to have a significant correlation with mortality. On the other hand, depression and low serum albumin had no significant association with mortality. In the examined studies, the relationship between other post hip fracture mortality predictors had not been reported.

Conclusion: It is crucial to focus on the most significant predictors of mortality following hip fractures in this study. This knowledge can potentially contribute to a reduction in post-hip-fracture mortality rates, and it underscores the importance of long-term collaboration among experienced multidisciplinary medical professionals and specialized healthcare providers to improve survival outcomes after hip fracture.

Keywords: Predictors, Mortality, Hip Fracture, Overview.

Introduction

With increase in the older persons population worldwide, the trend of hip fracture has also become ascending; it is estimated that by 2050, the number of hip fractures would exceed 6 million cases.¹ There is a

direct relationship between incidence of hip fracture and age. Indeed, more than 86% of fractures occur in those above 65 years of age.² In the Middle East in

1990, 52000 hip fractures were recorded, and it is estimated to reach 435000 by 2050.³

A systematic review and meta-analysis showed that between 24.5 and 60% of patients die within one year post-fracture.⁴ A number of factors may predict post hip fracture mortality including Alzheimer's disease, cardiovascular disease, hypertension, frailty⁵ or factors such as age and gender⁶ plus pre-operative functional capability.⁷

Considering the growing trend of elderly population in Iran and in turn increasing incidence of hip fracture, it is essential to identify the factors that affect fracture-induced mortality, so that targeted preventive measures could be taken for reducing the adverse consequences such as chronic disease. Accordingly, the present study aimed to identify and present the factors affecting post hip fracture mortality by collecting systematic studies in this area.

Methods

Data sources & Search strategy

In the present research, all systematic review and meta-analysis studies published in English between 2000 and 2023 were collected. The papers were chosen from international information banks (Cochrane Library, Pubmed, Web of Science). The search strategy with keywords matching MeSH included:

((("predictor"[All Fields] OR "predictors"[All Fields]) AND ("mortality"[MeSH Terms] OR "mortality"[All Fields] OR "mortalities"[All Fields] OR "mortality"[MeSH Subheading]) AND ("hip fractures"[MeSH Terms] OR ("hip"[All Fields] AND "fractures"[All Fields]) OR "hip fractures"[All Fields] OR ("hip"[All Fields] AND "fracture"[All Fields]) OR "hip fracture"[All Fields]) AND ("systematic review"[Publication Type] OR "systematic reviews as topic"[MeSH Terms] OR "systematic review"[All Fields])) AND (2000:2023[pdat])

Selection of studies

Title, abstract, and full text of papers were examined, by two researchers (**KFF and SM**) and the information was recorded in a prepared checklist (Table1).

Methodological quality

The Joanna Briggs Institute (JBI) critical appraisal checklist for Systematic Reviews and Research Syntheses was utilized to evaluate the quality of the records.⁸ (Table2)

Eligibility criteria

Inclusion criteria:

Systematic and meta-analysis studies.

Exclusion criteria:

Observational studies, letters to the editor, conference abstracts, commentaries, and case series

Results

In the present research, based on PRISMA standards¹⁶ according to the preliminary investigation, 84 studies were identified. Out of those, 60 were considered potentially eligible and their full-text papers were reviewed. Finally, 9 studies met the inclusion criteria for the study. (Figure 1). The inclusion criteria consisted of systematic and meta-analysis studies, and the exclusion criteria consisted of all observational studies, letters to the editor, conference abstracts, commentaries, and case series.

In the studies that were examined, risk factors, body organs, and certain diseases were found to have a significant correlation with mortality. On the other hand, depression and low serum albumin had no significant association with mortality. In the examined studies, the relationship between other post hip fracture mortality predictors had not been reported.

Risk factors: residential status [OR=1.97 (95%CI:1.02–3.78)], time to surgery [OR= 1.91(95%CI: 1.14–3.18)]⁹, geriatric nutritional [OR=3.12(95%CI:1.47-6.61)]¹⁴ and poor mental state [HR= 1.78(95%CI: 1.45-2.20)]¹⁵ increased age[OR=1.25(95%CI:1.11-1.40)], male sex [OR= 95%CI:2.22(2.00-2.47)]¹⁰ , abnormal ECG [RR=2.00(95%CI:1.45-2.76)], high ASA grade [RR=0.44(95%CI:0.35-0.56)] , high Charlson comorbidity score [RR=0.59(95%CI :0.56-0.61)]⁶, pre-fracture mobility [RR=0.13(95%CI:0.05-0.34)]⁶, frailty [RR=2.93(95%CI: 2.56–3.34)]⁵ ,

Body organs: Intra-capsular fracture [RR=0.77(95%CI:0.63-0.95)]⁶

Diseases: Cardiovascular disease [OR= 1.14(95%CI:1.03–1.26)], pulmonary disease [OR= 1.52(95%CI:1.37–1.69)], malignancy [OR=2.99(95%CI:1.14–7.83)]⁹, chronic respiratory diseases [OR=2.42(95%CI: 1.82-3.24)]¹⁰, cognitive impairment [RR=1.91(95%CI:1.35-2.70)]⁶, dementia [HR=1.89(95%CI:1.51-2.37)], diabetes [HR= 1.44(95%CI: 1.13-1.82)]¹⁵

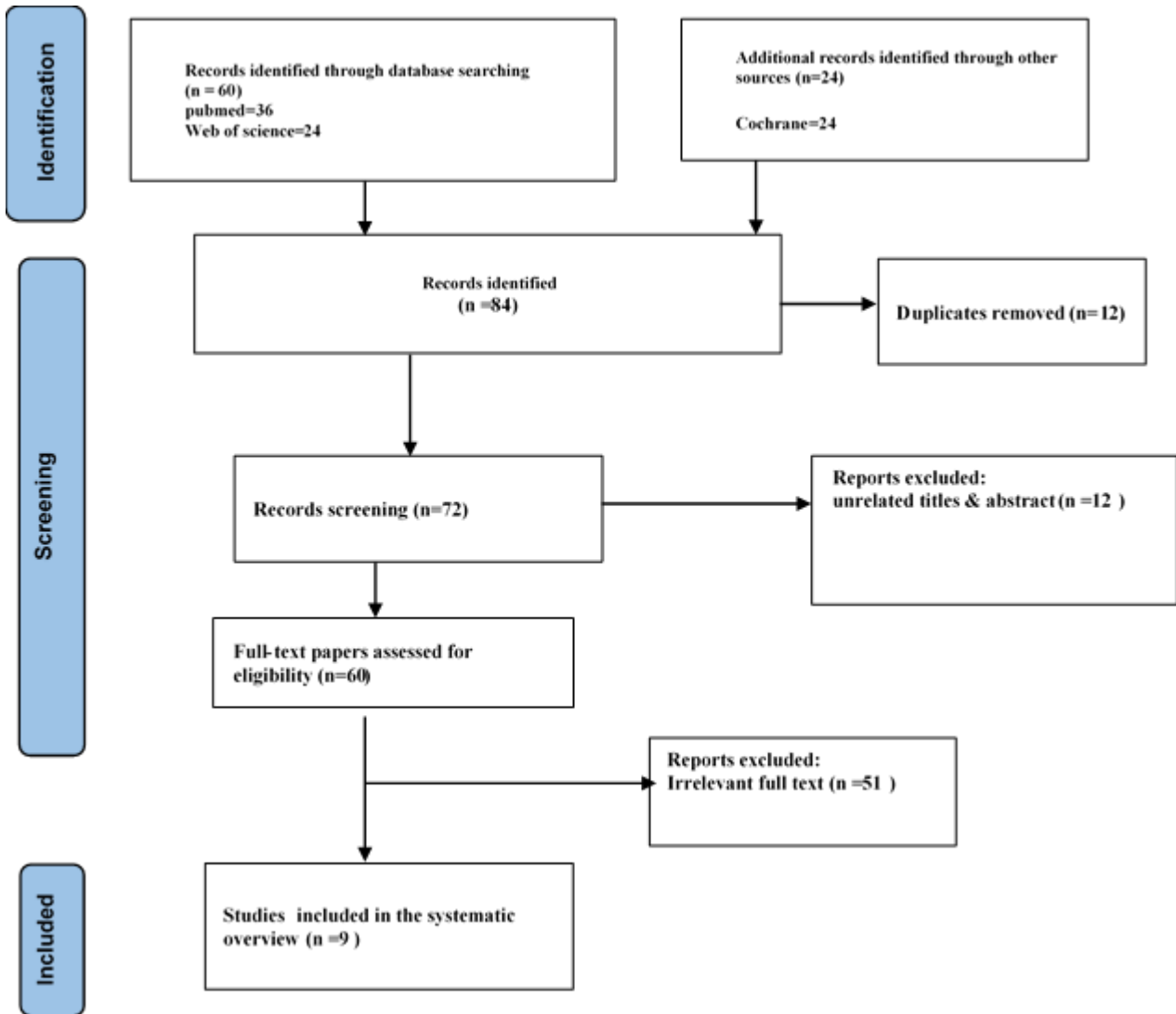


Figure 1: Flowchart of the included eligible studies

Table 1: Predictors of mortality after hip fracture.

Article	Country	Predictors of mortality	Age	Study design	Treatment	Prevalence	OR(Odds ratio)	HR(Hazard ratio)	RR(relative risk)
Chang et al(2018) ⁹	China	time to surgery (> 2days/ < 2days)	≥40	systematic review and meta-analysis	surgery		1.91(1.14–3.18)		
		Residential status					1.97 (1.02–3.78)		
		cardiovascular disease					1.14(1.03–1.26)		
		pulmonary disease					1.52(1.37–1.69)		
		diabetes					1.41(1.19–1.67)		
		malignancy					2.99(1.14–7.83)		
Sang Hee Lee (2022) ¹⁰	Republic of Korea	Postoperative Pneumonia	≥45	systematic review and meta-analysis	surgery	5.0%			
		delayed surgery					1.84 (1.29-2.63)		
		low serum albumin					2.34(82.0-6.73)		
		chronic respiratory diseases					2.42(1.82-3.24)		
		increased age					1.25(1.11-1.40)		
		male sex					2.22(2.00-2.47)		
T. Smith et al.(2014) ⁶	UK	abnormal ECG		systematic review and meta-analysis					2.00(1.45-2.76)
		cognitive impairment							1.91(1.35-2.70)
		age >85 years							0.42(0.20-0.90)
		pre-fracture mobility							0.13(0.05-0.34)
		Male gender							0.68(0.62-0.76)
		being resident in a care institution							0.57(0.43-0.72)
		intra-capsular fracture type							0.77(0.63-0.95)
		high ASA grade (1/2 versus 3/4)							0.44(0.35-0.56)
		high Charlson comorbidity score on admission							0.59(0.56-0.61)
		Depression							1.27(0.36-4.54)
Hou M(2021) ¹¹	China	dementia	≥60	systematic review & meta-analysis			mortality1 month after surgery:1.56(1.24-1.97)		
							Mortality3 month after surgery:1.50(1.39-1.62)		
							Mortality6 month after surgery:2.36(1.83-3.04)		

						mortality1 year after surgery:2.10(1 .74-2.54)		
						Mortality2 year after surgery:2.44(1 .49-3.98)		
Martinez- Reig(2012) (12)	Austral ia	age	Systematic Review					
		pressure ulcers,						
		pneumonia						
		Male gender						
		disability						
		coronary artery disease						
		pre-surgery anemia						
		IDC(indwelling urinary catheters)at time of NHA(nursing home admission)						
Xu BY(2019) ⁽¹³⁾	Singap ore	age	Systematic Review					
		Male gender						
		Institutional care homes residence						
		higher ASA score						
		Pre-fracture functional status						
		Functional level at discharge						
		Cardiac diseases						
		Frailty						
		cancer						
		Renal failure						
		Cerebrovascular accident						
		Delirium						
		Diabetes mellitus						
		Malnutrition						
		lower hemoglobin level						
		delay in surgery						
		non-operative management						
		extra-capsular fractures						
		perioperative fractures						
		lower case-volume centers						
poor nurse staffing								
inappropriate medication prescribing								

Ma Y(2022) (13)	China	frailty	>50	systematic review and meta-analysis					hospital mortality :2.93(2.56–3.34)	
									30-day mortality:2.85(1.67-4.85)	
N.Liu(2023) (14)	China	prognostic nutritional index (PNI)		systematic review and meta-analysis					1.42(0.86-2.32)	
		geriatric nutritional risk index (GNRI)							3.12(1.47-6.61)	
		mini-nutritional assessment-short form (MNA-SF)							3.61(1.70-7.70)	
Hu F(2012) (15)	China	advanced age >80 years controlled to <80 years	>55	systematic review and meta-analysis					2.15(1.65-2.80)	
		male gender							1.70(1.42-2.04)	
		nursing home or facility residence							-	
		poor preoperative walking capacity							-	
		poor activities of daily living,							-	
		higher ASA (American Anaesthetists Society score)grading for 3–4 grades controlled to 1–2 grades							1.73(1.53-1.96)	
		poor mental state,							1.78(1.45-2.20)	
		multiple comorbidities							-	
		dementia or cognitive impairment							1.89(1.51-2.37)	
		diabetes							1.44(1.13-1.82)	
		cancer							-	
		cardiac disease.							-	
		moderate evidence mortality predictors							intertrochanteric fracture (versus femoral neck fracture),	-
									low body mass index	-
low serum albumin or malnutrition	-									
low haemoglobin	-									
high serum creatinine	-									
chronic renal disease	-									

limited evidence mortality predictors	chronic pulmonary disease								-	
	living alone								-	
	previous year hospital admission								-	
	poor social function								-	
	smokers								-	
	low blood lymphocyte count								-	
	high serum potassium								-	
	high serum troponin T								-	
	high heart rate at admittance								-	
	cerebrovascular disease								-	
	digestive disease								-	
	delirium and depression								-	

Table 1: quality assessment of the studies(JBI).

First author (year)/reference	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Chang et al(2018) ⁽⁹⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Sang Hee Lee(2022) ⁽¹⁰⁾	Y	U	Y	Y	Y	Y	U	Y	N	N
T. Smith et al.(2014) ⁽⁶⁾	Y	Y	Y	Y	Y	Y	N	Y	Y	U
Hou M(2021) ⁽¹¹⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Martinez-Reig(2012) ⁽¹²⁾	Y	Y	Y	Y	N	N	U	U	N	N
Xu BY(2019) ⁽¹³⁾	Y	Y	Y	Y	Y	Y	U	U	N	N
Ma Y(2022) ⁵	Y	Y	Y	Y	Y	Y	Y	Y	N	N
N.Liu(2023) ⁽¹⁴⁾	Y	Y	Y	Y	Y	Y	Y	Y	N	U
Hu F(2012) ⁽¹⁵⁾	Y	Y	Y	Y	Y	Y	Y	Y	N	U

***Y - Yes, N - No, U - Unclear

Discussion

The present study aimed to identify and present the factors affecting post hip fracture mortality by collecting systematic studies in this area. Time to surgery in those above 60 years of age, male gender, and one underlying disease have a greater association with post hip fracture mortality.^{3, 17} Residence in care homes would also increase the risk of post hip fracture mortality due to reasons such as lack of independence, anticipation of death, and sense of loneliness.⁹ Meanwhile, respiratory and pulmonary diseases are among the most common causes of re-admission after hospital discharge due to

hip fracture surgery.¹⁸ The above-mentioned diseases are more prevalent in men, which itself can justify the high post-fracture mortality among men.¹⁹ In the study by Roche et al., medical evaluation of cardiovascular disease as well as chest infection on reduction of post-fracture mortality have been emphasized.²⁰ This is because the total incidence of post hip fracture mortality is twice as large in men and women with heart failure,²¹ also, mortality within one year post-fracture also is six times greater in HF patients compared to those with no cardiovascular disease.²² Meanwhile, abnormal ECG has an effective role in incidence of heart failure.⁶ Age,

post-operative complications, and level of HbA1c can be the reasons of diabetes-induced mortality. This is because poor blood glucose control and the effect of hyperglycemia in incidence of impairments in the course of fracture healing as well as increased level of infection play a key role in inducing post hip fracture mortality.²³ The risk of mortality resulting from cancer post-fracture can be due to the pathogenicity of some secondary hip fractures due to bone metastases.²⁴ The relationship between high ASA score and mortality has also been confirmed in some studies, since the ASA score is determined based on related diseases and their degree of involvement and reflects the general status of the patient.^{25, 26} Meanwhile, investigations have shown that increase in the Charlson comorbidity score is associated with re-hospitalization of patients and higher frailty with post-operative mortality.²⁷ Frailty develops due to diminished physiological reserve and reduced capacity of the body in response to physiological stress.²⁸ Post-fracture pain and performance decline cause stress in patients and exacerbates the severity of frailty and eventually post-fracture mortality.²⁹ The effect of cognitive impairment in incidence of mortality can be due to lack of person's independence in doing their daily activities.³⁰ Note that dementia functions as a risk factor in incidence of pulmonary infections,³¹ which can increase the risk of hip fracture-induced mortality. Also, depression, due to reduced involvement in rehabilitation activities, causes delay in physical functioning of the patients within the short-term,³² which somehow justifies the lack of relationship with post hip fracture mortality. The relationship between pre-fracture mobility and mortality is due to the low ability of the body before the fracture, to such an extent that the patients do not regain their previous activity level even with long-term rehabilitation.³³ Those with extra-articular fracture are hospitalized longer than those with intra-capsular fracture, and hence the former is at higher risk of developing infection,⁶ which is not in line with the results of this study, and necessitates more extensive studies in this regard. The relationship between mortality and geriatric nutrition can be due to the individual's malnutrition post-fracture and the body adopting a catabolic state, which is associated with decreased muscle mass and body power. Meanwhile, hepatitis causes mortality thorough reduction in protein synthesis and eventually decline of albumin level.¹⁴

As the limitation of this study, due to exclusive collection of systematic studies, this research cannot be a comprehensive conclusion of all studies conducted in this regard. Meanwhile, it can provide a general view on the most important post hip fracture mortality predictors.

Conclusion

Awareness of risk factors such as ageing, male gender or comorbidities can be helpful physicians in diagnosis of those at risk of mortality.³⁴ The significant relationship of post hip fracture mortality predictors in the present research necessitates long-term collaboration between well-qualified physicians with a multidisciplinary approach as well as specialized healthcare provision for improving post hip fracture survival.

Acknowledgments

None.

Conflict of Interest Disclosures

The authors declare no competing interest.

Funding Sources

This work was conducted as part of the NIMAD project (Design, Implementation and Evaluation of a Comprehensive Model of Post-Hospital Care Management for Patients with Hip Fracture, Focusing on Frailty and Disability (Grant no.984322).

Authors' Contributions

Funding acquisition: Esmaeil Fakharian, Mehrdad Mahdian, Masoumeh Abedzadeh-Kalahroudi, Soudabeh Yarmohammadi, Reza Fadaei Vatan, Gholamreza Reza Khosravi, Mohammad Reza Fazel. data curation: Khadijeh Kalan Farmanfarma. Investigation: Khadijeh Kalan Farmanfarma, Mojtaba Sehat. Conceptualization: Khadijeh Kalan Farmanfarma. writing—original draft; writing—review and editing: methodology; project administration; validation: Khadijeh Kalan Farmanfarma, RobbertJGobbens, Mojtaba Sehat.

Ethical Statement

The institutional review board of research ethics at Baqiyatallah University of Medical Sciences approved

the protocol of this study.

References

- Malik AT, Panni UY, Masri BA, Noordin S. The impact of surgeon volume and hospital volume on postoperative mortality and morbidity after hip fractures: a systematic review. *Int J Surg.* 2018; 54:316-27.
- Maharlouei N, Jafarzadeh F, Rezaianzadeh A, Janfada M, Mesbahi A, Namazi H, et al. Survival analysis of patients with hip fracture, Shiraz, Iran. *Arch. Osteoporos.* 2020; 15:1-7.
- Abdelnasser MK, Khalifa AA, Amir KG, Hassan MA, Eisa AA, El-Adly WY, et al. Mortality incidence and its determinants after fragility hip fractures: a prospective cohort study from an Egyptian level one trauma center. *Afr. Health Sci.* 2021;21(2):806-16.
- Loggers SA, Van Lieshout EM, Joesse P, Verhofstad MHJ, Willems HC. Prognosis of nonoperative treatment in elderly patients with a hip fracture: a systematic review and meta-analysis. *Injury.* 2020;51(11):2407-13.
- Ma Y, Wang A, Lou Y, Peng D, Jiang Z, Xia T. Effects of frailty on outcomes following surgery among patients with hip fractures: a systematic review and meta-analysis. *Front. Med.* 2022; 9:82976.
- Smith T, Pelpola K, Ball M, Ong A, Ong A, Myint PK. Pre-operative indicators for mortality following hip fracture surgery: a systematic review and meta-analysis. *Age Ageing.* 2014;43(4):464-71.
- Jamal Sepah Y, Umer M, Khan A, Ullah Khan Niazi A. Functional outcome, mortality and in-hospital complications of operative treatment in elderly patients with hip fractures in the developing world. *Int Orthop.* 2010; 34:431-5.
- Aromataris E, Fernandez RS, Godfrey C, Holly C, Khalil H, Tungpunkom P. Methodology for JBI umbrella reviews. 2014. Faculty of Science, Medicine and Health - Papers: part A. 3344.
- Chang W, Lv H, Feng C, Yuwen P, Wei N, Chen W. Preventable risk factors of mortality after hip fracture surgery: Systematic review and meta-analysis. *Int J Surg.* 2018; 52:320-8.
- Lee SH, Kim KU. Risk Factors for Postoperative Pneumonia in the Elderly Following Hip Fracture Surgery: A Systematic Review and Meta-Analysis. *Geriatr. Orthop. Surg. Rehabil.* 2022; 13:21514593221083825.
- Hou M, Zhang Y, Chen AC, Liu T, Yang H, Zhu X. The effects of dementia on the prognosis and mortality of hip fracture surgery: a systematic review and meta-analysis. *Aging Clin Exp Res.* 2021;33(12):3161-72.
- Martinez-Reig M, Ahmad L, Duque G. The orthogeriatrics model of care: systematic review of predictors of institutionalization and mortality in post-hip fracture patients and evidence for interventions. *J Am Med Dir Assoc.* 2012;13(9):770-7.
- Xu BY, Yan S, Low LL, Vasanwala FF, Low SG. Predictors of poor functional outcomes and mortality in patients with hip fracture: a systematic review. *BMC musculoskelet Disord.* 2019;20(1):1-9.
- Liu N, Lv L, Jiao J, Zhang Y, Zuo XL. Association between nutritional indices and mortality after hip fracture: a systematic review and meta-analysis. *Eur. Rev. Med. Pharmacol. Sci.* 2023;27(6):2297-304.
- Hu F, Jiang C, Shen J, Tang P, Wang Y. Preoperative predictors for mortality following hip fracture surgery: a systematic review and meta-analysis. *Injury.* 2012;43(6):676-85.
- Gregory AT, Denniss AR. An introduction to writing narrative and systematic reviews—Tasks, tips and traps for aspiring authors. *Heart, Lung and Circulation.* 2018;27(7):893-8.
- Beaupre L, Khong H, Smith C, Kang S, Evens L, Jaiswal PKI. The impact of time to surgery after hip fracture on mortality at 30-and 90-days: Does a single benchmark apply to all? *Injury.* 2019;50(4):950-5.
- Ali AM, Gibbons CE. Predictors of 30-day hospital readmission after hip fracture: a systematic review. *Injury.* 2017;48(2):243-52.
- Wehren LE, Hawkes WG, Orwig DL, Hebel JR, Zimmerman SL, Magaziner J. Gender differences in mortality after hip fracture: the role of infection. *J. Bone Miner. Res.* 2003;18(12):2231-7.
- Roche J, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *Bmj.* 2005;331(7529):1374.
- Carbone L, Bůžková P, Fink HA, Lee JS, Chen Z, Ahmed A, et al. Hip fractures and heart failure: findings from the Cardiovascular Health Study. *Eur. Heart J.* 2010;31(1):77-84.
- Van Diepen S, Majumdar SR, Bakal JA, McAlister FA, Ezekowitz JA. Heart failure is a risk factor for orthopedic fracture: a population-based analysis of 16 294 patients. *Circ.* 2008;118(19):1946-52.
- Gulcelik N, Bayraktar M, Caglar O, Alpaslan M, Karakaya J. Mortality after hip fracture in diabetic patients. *Exp Clin Endocrinol Diabetes.* 2011;119(07):414-8.
- Koh GC-H, Tai B, Ang L-W, Heng D, Yuan JM, Koh WP. All-cause and cause-specific mortality after hip fracture among Chinese women and men: The Singapore Chinese Health Study. *Osteoporos Int.* 2013; 24:1981-9.
- Kilci O, Un C, Sacan O, Gamli M, Baskan S, Baydar M, et al. Postoperative mortality after hip fracture surgery: a 3 years follow up. *PLoS One.* 2016;11(10):e0162097.
- Clague JE, Craddock E, Andrew G, Horan MA, Pendleton N. Predictors of outcome following hip fracture. Admission time predicts length of stay and in-hospital mortality. *Injury.* 2002;33(1) :1-6.
- Chen C-L, Chen C-M, Wang C-Y, Ko PW, Chen CH, Hsieh CP, et al. Frailty is associated with an increased risk of major adverse outcomes in elderly patients following surgical treatment of hip fracture. *Sci Rep.* 2019;9(1):19135.
- Vasu BK, Ramamurthi KP, Rajan S, George M. Geriatric patients with hip fracture: frailty and other risk factors affecting the outcome. *Anesth, essays res.* 2018;12(2):546-51.
- Jorissen RN, Lang C, Visvanathan R, Crotty M, Inacio MC. The effect of frailty on outcomes of surgically treated hip fractures in older people. *Bone.* 2020; 136:115327.
- González-Marcos E, González-García E, Rodríguez-Fernández P, González-Bernal JJ, Sánchez-González E, González-Santos J. Predictors of Moderate or Severe Cognitive Impairment at Six Months of the Hip Fracture in the Surgical Patient over 65 Years of Age. *J. Clin. Med.* 2022;11(9):2608.
- Ha Y-C, Cha Y, Yoo J-I, Lee J, Lee YK, Koo KH. Effect of dementia on postoperative mortality in elderly patients with hip fracture. *J. Korean Med. Sci.* 2021;36(38): e238.
- Kelly-Pettersson P, Samuelsson B, Unbeck M, Muren O, Magníli M, Gordon M, et al. The influence of depression on patient-reported outcomes for hip-fracture patients 1 year after surgery: a prospective cohort study. *Aging Clin Exp Res.* 2020; 32:247-55.

33. Williams A, Jester R. Delayed surgical fixation of fractured hips in older people: impact on mortality. *J. Adv. Nurs.* 2005;52(1):63-9.
34. Mitchell R, Harvey L, Brodaty H, Orlandi Magli A, Gazineo D, D' Alessandro F, et al. One-year mortality after hip fracture in older individuals: the effects of delirium and dementia. *Arch. Gerontol. Geriatr.* 2017; 72:135-41.