Turkish Journal of Geriatrics
2026; 29(1):116–124

DOI: 10.29400/tjgeri.2026.484

Furkan TONTU[1]
Abdurrahman Engin BAYDEMİR[1]
Payam RAHİMİ[2]
Sinan AŞAR[3]
Bilal Faruk KARADOĞAN[1]
Funda GÜMÜŞ ÖZCAN[1]

[1] Basaksehir Cam and Sakura City Hospital, Anesthesiology and Reanimation, Istanbul, Türkiye

[2] Mehmet Akif Inan Training Hospital, Reanimation, Urfa, Türkiye

[3] Mardin Training Hospital, Reanimation, Mardin, Türkiye

Correspondence

Furkan TONTU
e-mail : furkantontu@gmail.com

Received : Jan 19, 2026
Accepted: Mar 03, 2026

Cite this article as:
Tontu F, Baydemir AE, Rahimi P et al. Impact of Age on Early Mortality and Clinical Outcomes After Emergency Hip Arthroplasty in Elderly Patients. Turkish Journal of Geriatrics 2026; 29(1):116–124. doi: 10.29400/tjgeri.2026.484

ORIGINAL ARTICLE

IMPACT OF AGE ON EARLY MORTALITY AND CLINICAL OUTCOMES AFTER EMERGENCY HIP ARTHROPLASTY IN ELDERLY PATIENTS

Abstract

Introduction: The increasing elderly population has led to a rising number of emergency hip fractures requiring surgical treatment. Evidence regarding early mortality and intensive care outcomes across different elderly age groups remains limited. This study aimed to assess the effect of age on early clinical outcomes in elderly patients undergoing emergency hip arthroplasty.

Materials and Method: This retrospective observational cohort study included 599 patients aged 65–95 years who underwent emergency hip arthroplasty between January 1, 2021, and May 15, 2025. Patients were categorized into three age groups: 65–74 years, 75–84 years, and 85–95 years. Demographic data, comorbidities, perioperative variables, laboratory and arterial blood gas parameters, mortality outcomes, and lengths of hospital and intensive care unit stay were analyzed and compared between groups.

Results: In-hospital and intensive care unit mortality increased significantly from the 65–74 to the 75–84 age group, with no further increase observed in patients aged 85–95 years. Postoperative intensive care unit admission rates increased with age. Hospital and intensive care unit lengths of stay were similar across age groups. Admission laboratory and arterial blood gas parameters were comparable, except for serum albumin levels, which declined significantly with age.

Conclusion: Although age was associated with increased early mortality and higher intensive care unit admission rates, very advanced age was not linked to additional increases in early mortality.

Keywords: Hip Fractures; Arthroplasty; Aged; Mortality; Intensive Care Units.

INTRODUCTION

The elderly population in Türkiye is rapidly increasing and substantially reshaping the demographic structure. According to the 2024 Turkish Statistical Institute report, individuals aged ≥65 years now comprise 10.6% of the population, and this proportion is projected to rise to 13.5% by 2030 and 27% by 2060, particularly driven by growth in individuals aged ≥75 years (1).

As the elderly population continues to grow, an increase in the incidence of hip fractures and demand for hip arthroplasty is inevitable. Surgeons and anesthesiologists often approach surgical intervention in this age group with caution because of the high burden of comorbidities and increased risk of perioperative complications (2). However, increasing life expectancy necessitates that these patients be offered surgical treatment under appropriate conditions. Studies involving octogenarian (80–89 years) and nonagenarian (≥90 years) patients have reported higher mortality rates than those among younger populations; nevertheless, optimization of preoperative and postoperative care has been shown to yield improved outcomes in these age groups (3-6). In nonagenarian cohorts, perioperative mortality has been reported to be lower than expected despite a higher comorbidity burden, and surgery has been associated with meaningful functional gains (3).

In Türkiye, large cohort studies evaluating 1-year survival after hip arthroplasty in patients aged ≥65 years have identified age as a significant risk factor for mortality (7, 8). However, studies specifically examining in-hospital mortality and intensive care unit admission rates are limited (9), and most do not distinguish between elective and emergency surgery. Therefore, the primary purpose of this study was to evaluate the impact of age on in-hospital and ICU mortality in patients undergoing arthroplasty for emergency hip fractures, while the secondary purpose was to assess the effect of age on postoperative ICU admission rates. By addressing these outcomes, this study aimed to provide clinically relevant data to inform decision-making in the management of elderly patients.

MATERIALS AND METHOD

Study Design and Population

This study was designed as a retrospective observational cohort study and was approved by the Ethics Committee of the University of Health Sciences, Başakşehir Çam and Sakura City Hospital (protocol code: 2025-232). All patients aged 65–95 years who were admitted to Başakşehir Çam and Sakura City Hospital between January 1, 2021, and May 15, 2025, with an acute hip fracture and subsequently underwent surgical treatment with either total hip arthroplasty or hemiarthroplasty were screened.

Only patients who underwent arterial blood gas analysis at admission and had complete laboratory and clinical data were included in the study. Patients with missing blood gas parameters or incomplete laboratory data were excluded. Clinical and demographic data were obtained from the electronic hospital information system, with supplementary review of physical medical records when necessary.

Age Stratification

Patients were stratified into three age-based groups according to clinically relevant geriatric thresholds: Group A (65–74 years), Group B (75–84 years), and Group C (85–95 years). This stratification was used to evaluate age-related differences in clinical outcomes across progressively older geriatric subgroups.

The following variables were recorded: demographic characteristics including age and sex; comorbid conditions such as diabetes mellitus, hypertension, chronic heart failure, chronic renal failure, and chronic obstructive pulmonary disease; perioperative outcomes including postoperative intensive care unit admission; clinical outcomes including in-hospital mortality and intensive care unit mortality; length of stay in the hospital and in the intensive care unit; laboratory parameters at admission including urea, creatinine, albumin, procalcitonin, platelet count, hemoglobin, white blood cell count, and glucose; arterial blood gas variables including pH, bicarbonate, lactate, sodium, chloride, anion gap (AG) and albumin-corrected anion gap (AGc).

Statistical Analysis

Statistical analyses were performed after assessing the normality of continuous variables. Depending on whether the data followed a normal distribution, appropriate parametric or non-parametric statistical methods were used.

Categorical variables were expressed as numbers and percentages and compared using the chi-square test, with pairwise comparisons between groups (Group A vs Group B, Group A vs Group C, and Group B vs Group C).

Continuous variables were expressed as mean±standard deviation, and were compared between groups using the Kruskal–Wallis test. When a statistically significant difference was observed, Dunn's multiple comparison post hoc test was performed to identify between-group differences. Time-to-event analyses for in-hospital mortality were performed using the Kaplan–Meier method, and survival curves were compared using the log-rank test.

A *p*-value < 0.05 was considered statistically significant.

RESULTS

Baseline Characteristics and Clinical Outcomes

A total of 727 consecutive patients aged ≥65 years who underwent emergency hip surgery were initially screened for eligibility. After excluding 128 patients because of missing or incomplete clinical, laboratory, or outcome data, the final cohort comprised 599 patients, who were stratified into three age groups: Group A (65–74 years, n = 199), Group B (75–84 years, n = 235), and Group C (85–95 years, n = 165) (see Figure 1 for the study

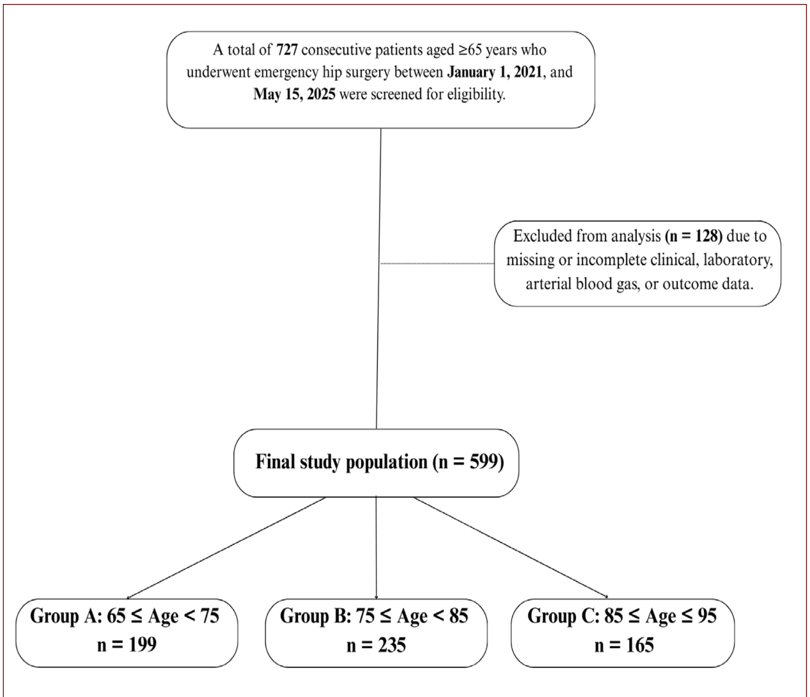

Figure 1. Flow chart of patient selection.

flow chart). Sex distribution was similar across groups, with no statistically significant difference in female predominance. Body mass index (BMI) decreased with advancing age and was lowest in Group C, while the proportion of patients with higher American Society of Anesthesiologists (ASA) physical status classes increased progressively across the groups; the distribution of anesthesia type was comparable among all groups. Regarding procedure type, hemiarthroplasty constituted the majority of surgeries across all age strata (90.9% in Group A, 89.8% in Group B, and 89.0% in Group C), while total hip arthroplasty accounted for 9.1%, 10.2%, and 11.0% of procedures, respectively. The distribution of arthroplasty type did not differ significantly between age groups (Table 1).

Table 1. Baseline characteristics, comorbidities, and clinical outcomes according to age groups

Groups	**A** **65 ≤Age<75**	**B** **75 ≤Age<85**	**C** **85 ≤Age ≤95**
n	199	235	165
Female, n(%)	120 (60%)	152 (65%)	114 (69%)
BMI, kg/m^2	32 ± 4.2	30 ± 3.5	27 ± 3.7*‡
Type of Anesthesia			
General	40 (20%)	42 (18%)	36 (22%)
Regional	159 (80%)	193 (82%)	129 (78%)
Type of Surgery			
Hemiarthroplasty	181 (90.9%)	211 (89.8%)	147 (89%)
Total Arthroplasty	18 (9.1%)	24 (10.2%)	18 (11%)
ASA score			
II	36 (18%)	15 (6%)*	4 (2%)*
III	132 (66%)	178 (76%)*	127 (77%)*
IV	31 (16%)	42 (18%)*	34 (21%)*
Comorbidities			
CHF	12 (6%)	11 (5%)	9 (5%)
COPD	5 (2.5%)	12 (5%)	3 (2%)
CRF	16 (8%)	26 (11%)	15 (9%)
DM	62 (31%)	70 (30%)	50 (30%)
HT	65 (33%)	76 (32%)	59 (36%)
Hospital Mortality, n(%)	13 (6.5%)	29 (12%)*	18 (11%)
ICU Mortality, n(%)	13 (6.5%)	27 (11.5%)*	15 (9%)
ICU Admission, n(%)	76 (38%)‡	131 (56%)	119 (72%)*‡
Stay in hospital, days	12.2 ± 8.2	14.5 ± 10.9	11.2 ± 6.1‡
Stay in ICU, days	4.0 ± 7.1	3.3 ± 5.5	2.7 ± 2.5

CHF, chronic heart failure; COPD, chronic obstructive pulmonary disease; CRF, chronic renal failure; DM, diabetes mellitus; Hb, hemoglobin; HT, hypertension; ICU, intensive care unit; LOS, length of stay.

Data are presented as mean ± standard deviation or number (%), as appropriate. * indicates a statistically significant difference compared with Group A ($p < 0.05$); ‡ indicates a statistically significant difference compared with Group B ($p < 0.05$).

Categorical variables were compared using the chi-square test with pairwise comparisons between groups (A–B, A–C, and B–C). Continuous variables, including BMI, ASA, and hospital and ICU length of stay, were analyzed using the Kruskal–Wallis test, followed by Dunn's multiple comparisons test for post hoc analysis. Variables not marked with symbols indicate no statistically significant difference between groups.

Hospital mortality was significantly higher in Group B compared with Group A (12% vs 6.5%, p = 0.01), while mortality rates were comparable between Group B and Group C (12% vs 11%, p > 0.05). Based on the absence of a significant difference between Groups B and C, time-to-event analysis was limited to the comparison between Groups A and B. Kaplan–Meier survival analysis demonstrated no significant difference in in-hospital survival between patients aged 65–74 years and those aged 75–84 years (hazard ratio 0.96, 95% confidence interval 0.46–2.00; log-rank p = 0.91) (Figure 2). Similarly, ICU mortality was higher in Group B than in Group A (11.5% vs 6.5%, p = 0.02), with no further increase observed in Group C (6.5% vs 9%, p > 0.05). Postoperative ICU admission rates were significantly higher in Group C compared with both Group A and Group B (72% vs 38% and 56%, respectively; p < 0.0001 for A–B, B–C, and A–C comparisons). Despite higher ICU admission rates, ICU length of stay did not differ significantly among age groups (p > 0.05). Hospital length of stay, however, was significantly shorter in Group C compared with Group B (11.2 ± 6.1 vs 14.5 ± 10.9 days, p = 0.01). The prevalence of comorbid conditions, including diabetes mellitus, hypertension, chronic heart failure, chronic renal failure, and chronic obstructive pulmonary disease, was similar across the three age groups (p > 0.05) (Table 1).

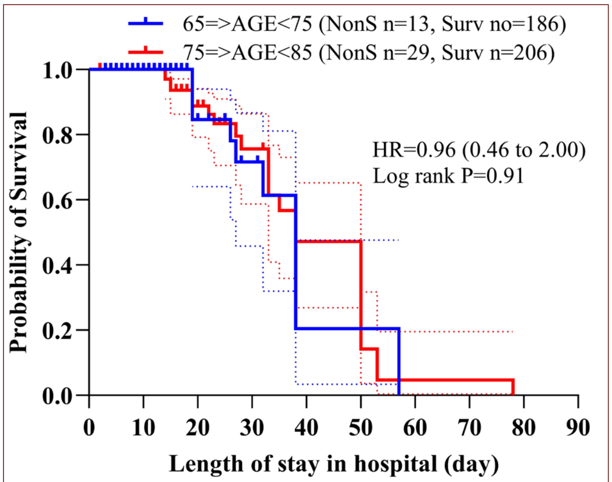

Figure 2. Kaplan–Meier survival curves comparing in-hospital survival between patients aged 65–74 and 75–84 years (hazard ratio: 0.96, 95% confidence interval: 0.46–2.00; log-rank p = 0.91).

Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sequential Organ Failure Assessment (SOFA) scores at ICU admission were comparable across age groups among patients requiring intensive care. Mean APACHE II scores were 20 ± 6 in Group A, 21 ± 7 in Group B, and 22 ± 7 in Group C (p = 0.18). Corresponding SOFA scores were 7 ± 3, 7 ± 3 and 8 ± 3 respectively, with no statistically significant difference between the groups (p = 0.11).

Laboratory and Acid–Base Findings

The laboratory and arterial blood gas parameters at admission were largely comparable across the age groups, with no significant differences in renal function, electrolytes, inflammatory markers, pH, bicarbonate (HCO_3), lactate, anion gap (AG), or albumin-corrected anion gap (AGc). Serum albumin levels declined significantly with age, with the lowest values observed in Group C ($p < 0.0001$) (Table 2).

Association Between Arthroplasty Type and Mortality Within Age Groups

Within each age group, arthroplasty type was not associated with in-hospital mortality. In the 65–74 age group, mortality was 6.2% after hemiarthroplasty and 5.3% after total hip arthroplasty (p>0.99). In the 75–84 age group, mortality rates were 11.0% and 11.1%, respectively (p>0.99). Similarly, in patients aged ≥85 years, mortality was 9.8% after hemiarthroplasty and 10.0% after total hip arthroplasty (p>0.99; Fisher's exact test for all comparisons). These findings indicate that procedure type did not influence mortality within age strata (Table 3).

Table 2. Admission laboratory and arterial blood gas parameters according to age groups

Parameter	A 65 ≤Age<75	B 75 ≤Age<85	C 85 ≤Age ≤95	p
Urea (mg/dL)	51 ± 27	53 ± 28	57 ± 29	0.06
Cr (mg/dL)	1.1 ± 1	1 ± 0.7	0.9 ± 0.5	0.40
Alb (g/dL)	35 ± 5	33 ± 5	32 ± 4*‡	<0.0001
Na (mmol/L)	137 ± 4	137 ± 4	137 ± 4	0.5
Cl (mmol/L)	100 ± 5	101 ± 5	101 ± 4	0.08
Procalcitonin (ng/mL)	0.5 ± 1	0.4 ± 1.6	0.8 ± 1.5	0.36
Platelet (×10³/μL)	291 ± 142	287 ± 106	288 ± 101	0.65
Hb (g/dL)	8.7 ± 4.5	9 ± 3.9	9.1 ± 3.7	0.51
WBC (×10³/μL)	6.7 ± 4.3	6.9 ± 4.5	7 ± 4.9	0.99
Glucose (mg/dL)	152 ± 70	147 ± 63	139 ± 57	0.79
pH	7.42 ± 0.07	7.43 ± 0.06	7.42 ± 0.06	0.12
HCO_3 (mmol/L)	26.3 ± 3.1	26 ± 3.3	27.7 ± 3.3	0.62
Lactate (mmol/L)	1.3 ± 0.6	1.2 ± 0.6	1.3± 0.7	0.7
AG (mmol/L)	9.3 ± 10.3	8.7 ± 9.9	8.6 ± 9.7	0.54
AGc (mmol/L)	11.5 ± 6.2	11.8 ± 3.7	11.4 ± 3	0.46

AG, anion gap; AGc, albumin-corrected anion gap; Alb, albumin; Cl, chloride; Cr, creatinine; Hb, hemoglobin; HCO_3, bicarbonate; Na, sodium; WBC, white blood cell count.

Laboratory parameters were compared using the Kruskal–Wallis test with Dunn's post hoc multiple comparisons. * denotes p < 0.05 versus Group A, and ‡ denotes p < 0.05 versus Group B. Variables without symbols were not statistically different.

Table 3. Association Between Arthroplasty Type and In-Hospital Mortality Within Each Age Group

Age Group	Procedure	Survivors n (%)	Mortality n (%)	p
65–74 years	Hemiarthroplasty	181 (93.8%)	12 (6.2%)	>0.99
	Total Arthroplasty	18 (94.7%)	1 (5.3%)	
75–84 years	Hemiarthroplasty	211 (89.0%)	26 (11.0%)	>0.99
	Total Arthroplasty	24 (88.9%)	3 (11.1%)	
≥85 years	Hemiarthroplasty	147 (90.2%)	16 (9.8%)	>0.99
	Total Arthroplasty	18 (90.0%)	2 (10.0%)	

DISCUSSION

This study evaluated the effect of age on mortality and clinical outcomes in patients aged 65–95 years who underwent arthroplasty for emergency hip fractures. The findings demonstrated that both in-hospital and ICU mortality increased significantly from the 65–74 to the 75–84 age group, whereas no further increase was observed in patients aged 85 years and older. Although crude mortality rates differed between the 65–74 and 75–84 age groups, Kaplan–Meier analysis did not demonstrate an increase in time-dependent mortality risk. In addition, although the likelihood of ICU admission increased markedly with advancing age, hospital and ICU lengths of stay did not increase in the 85–95 age group and were shorter than those observed in the 75–84 age group.

The existing literature consistently demonstrates that advancing age is associated with increased mortality and complication rates following arthroplasty. In a large cohort of 79,557 patients from the Norwegian Arthroplasty Register, age was identified as one of the strongest predictors of perioperative and short-term mortality, with significant increases observed in the 3-day, 30-day, and 90-day mortality rates as age increased (10). Similarly, in an analysis of 66,839 patients by Boniello et al., the 30-day mortality rate was 0.9% in patients aged ≥80 years compared with a rate of 0.1% in those younger than 80 years, with age identified as an independent risk factor for both complications and mortality (odds ratio: 2.02) (11). Nevertheless, the literature includes studies emphasizing that despite higher mortality rates in advanced age groups, arthroplasty remains feasible and may be performed with acceptable risk profiles in appropriately selected patients (2, 12). In octogenarian and nonagenarian cohorts, 30-day mortality increases with age, yet arthroplasty remains feasible at acceptable risk levels when optimal perioperative and postoperative management is provided (2, 12). In this context, Alfonso et al. reported higher 30-day mortality in patients aged >90 years; however, they also noted that surgery remained a feasible treatment option in appropriately selected patients within this population (3). Similarly, Skinner et al. demonstrated that although mortality rates were higher in nonagenarian patients, the complication profile remained acceptable and arthroplasty provided meaningful functional benefits (12). In a large analysis of octogenarian patients, mortality increased with age, and malnutrition, renal disease, and a higher ASA class were identified as factors associated with increased mortality (11). Considering these findings, the prevailing consensus in the literature is that mortality increases with advancing age; however, advanced age alone should not be considered a contraindication to arthroplasty. The benefits of surgery, particularly in terms of early mobilization and prevention of complications, remain evident for most patients (3, 11-13).

One notable finding of this study was that although mortality increased significantly in patients aged 75–84 years, no further increase was observed in patients aged ≥85 years. While advancing age is consistently associated with higher mortality, studies focusing on nonagenarian and very elderly patients suggest that arthroplasty remains feasible with acceptable outcomes in selected patients (2, 6). This observation may reflect a threshold effect or a plateau in risk escalation at very advanced ages; however, this interpretation should be considered hypothesis-generating rather than definitive. This pattern may also reflect selection bias, as only patients deemed suitable for surgical intervention were included in the present cohort. Frailer very elderly individuals who were not considered surgical candidates may therefore not have been captured, and differences in perioperative management practices across age groups may have further influenced outcomes. In addition, stratified analyses did not demonstrate a significant association between arthroplasty type and mortality within age strata, suggesting that variation in procedure type alone is unlikely to account for the observed age-related mortality pattern.

In our cohort, patients aged ≥85 years were admitted to the ICU more frequently. In this context, ICU admission likely reflects differences in illness severity and institutional practices. Similarly, a previous study evaluating patients undergoing hip arthroplasty reported increasing ICU admission rates with advancing age (9).

The shorter hospital and ICU lengths of stay observed in patients aged ≥85 years may be related to clinical practice patterns in this age group, including earlier discharge strategies, more limited rehabilitation goals, or earlier mortality in patients with a fatal course. Elderly patients are more prone to disturbances in acid–base homeostasis due to age-related reductions in physiological reserve and diminished adaptive responses of organ systems (14). The similarity in demographic characteristics, comorbidities, and admission laboratory and arterial blood gas parameters across the three age groups suggests that the observed differences in mortality may be largely attributable to the physiological changes associated with chronological aging.

A progressive decline in serum albumin levels was observed with advancing age, whereas no significant age-related changes were detected in other arterial blood gas or laboratory parameters. Given the well-established association between higher AGc scores and mortality in elderly patients, the observed intergroup differences are more likely attributable to age-related factors rather than to baseline biochemical abnormalities (15, 16). Body mass index also decreased with age, consistent with findings from previous large-scale registry studies in very elderly arthroplasty patients (17).

Age is consistently associated with long-term mortality in population-based studies (7, 9, 18, 19). Following total hip arthroplasty, 25-year survival has been reported to be only 11.6% (18). Therefore, comparisons of long-term mortality across age groups are of limited relevance because the higher long-term mortality observed in patients aged 85–95 years primarily reflects biological aging rather than surgical effects. A recent large-scale study showed that, although mortality increased with age after hip surgery, nonagenarian patients did not exhibit higher mortality than their age-matched counterparts in the general population (2). This finding supports the methodological focus of the present study on early postoperative mortality outcomes.

Limitations

This retrospective study is inherently limited by its observational design, which precludes causal inference. Although conducted at a high-volume tertiary trauma center, enhancing cohort size and data consistency, the single-center setting may limit generalizability. Importantly, detailed data on frailty indices, cognitive status, and pre-fracture functional capacity were unavailable. Chronological age alone may not adequately reflect biological vulnerability, and the absence of these measures limits our ability to differentiate physiological resilience from age-related risk. Consequently, the observed mortality patterns—particularly in the ≥85-year group—should be interpreted with caution, as unmeasured frailty may have influenced both treatment selection and outcomes. ICU admission decisions were based on institutional practices rather than standardized criteria, which may have introduced variability in postoperative monitoring and management. Additionally, only early in-hospital outcomes were evaluated, and laboratory and arterial blood gas parameters were limited to admission values, precluding longitudinal assessment. Finally, the retrospective design and inclusion of only surgically treated patients introduce the possibility of selection bias, particularly among the very elderly. Frailer individuals who were not considered surgical candidates were not captured in this cohort, which may have influenced the observed age-related mortality patterns.

CONCLUSION

Age group was associated with differences in early postoperative mortality among patients undergoing emergency hip arthroplasty, with the 75–84 age group exhibiting a marked increase compared with those aged 65–74 years. Notably, no further increase in mortality was observed in patients aged ≥85 years, despite higher ICU admission rates. This pattern suggests that surgical intervention may still be considered in carefully selected very elderly patients. Nevertheless, given the retrospective design of the study, these findings should be confirmed in prospective investigations.

REFERENCES

1. Kocaman Y. A Theoretical Perspective on the Demographic Transition in Türkiye: From Key Demographic Indicators to Social Outcomes. Senectus 2025;3(2):169-204. doi:10.26650/senectus.2025.3.2.0749.
2. Beckers G, Simon D, Grimberg A, et al. Morbidity and mortality analysis of primary total knee arthroplasty in patients over 90 years of age: Insights from the German Arthroplasty Registry. J Arthroplasty. 2025; [Epub ahead of print]. doi: 10.1016/j.arth.2025.10.120.
3. Alfonso DT, Howell RD, Strauss EJ, et al. Total hip and knee arthroplasty in nonagenarians. J Arthroplasty. 2007;22(6):807-11. doi: 10.1016/j.arth.2006.10.016.
4. Kitridis D, Tsikopoulos K, Givissis P, et al. Mortality and complication rates in nonagenarians and octogenarians undergoing total hip and knee arthroplasty: A systematic review and meta-analysis. Eur Geriatr Med. 2022;13(3):725-33. doi: 10.1007/s41999-022-00610-y.
5. Lee SH, Kim DH, Lee YS. Is there an optimal age for total knee arthroplasty?: A systematic review. Knee Surg Relat Res. 2020;32(1):60. doi: 10.1186/s43019-020-00080-1.
6. Sherman AE, Plantz MA, Hardt KD. Outcomes of elective total hip arthroplasty in nonagenarians and centenarians. J Arthroplasty. 2020;35(8):2149-54. doi: 10.1016/j.arth.2020.03.026.
7. Uzel K, Birinci M, Hakyemez ÖS, et al. Comparison of hemiarthroplasty, total hip arthroplasty, and internal fixation for hip fractures in patients over eighty years of age: Factors affecting mortality: A nationwide cohort study of fifty three thousand, four hundred and ninety five patients from Türkiye. Int Orthop. 2025;49(3):729-36. doi: 10.1007/s00264-025-06412-8.
8. Demirel M, Birinci M, Hakyemez ÖS, et al. Epidemiology, treatment, and mortality of femoral neck fractures in patients over the age of 65 years: A nationwide retrospective cohort study of 83,789 cases in Turkey. Hip Int. 2025;35(3):278-89. doi: 10.1177/11207000241312887.
9. Yılmaz ET, Şahin Y, Keleş BO, et al. Factors associated with thirty-day mortality and intensive care unit admission in patients undergoing hip fracture surgery. Ulus Travma Acil Cerrahi Derg. 2024;30(8):571. doi: 10.14744/tjtes.2024.24186.
10. Dale H, Børsheim S, Kristensen TB, et al. Perioperative, short-, and long-term mortality related to fixation in primary total hip arthroplasty: A study on 79,557 patients in the Norwegian Arthroplasty Register. Acta Orthop. 2020;91(2):152-8. doi: 10.1080/17453674.2019.1701312.
11. Boniello AJ, Simon MS, Emenari CC, et al. Complications and mortality following total hip arthroplasty in the octogenarians: An analysis of a national database. J Arthroplasty. 2018;33(7s):S167-S171. doi: 10.1016/j.arth.2017.08.030.
12. Skinner D, Tadros BJ, Bray E, et al. Clinical outcome following primary total hip or knee replacement in nonagenarians. Ann R Coll Surg Engl. 2016;98(4):258-64. doi: 10.1308/rcsann.2016.0095.
13. Karuppiah S, Banaszkiewicz P, Ledingham W. The mortality, morbidity and cost benefits of elective total knee arthroplasty in the nonagenarian population. Int Orthop. 2008;32(3):339-43. doi: 10.1007/s00264-007-0324-y.
14. Musso CG, Vilas MF. Water, electrolyte, and acid-base disorders in the elderly. In: Musso CG, Jauregui JR, Macías-Núñez JF, Covic A (eds). Clinical Nephrogeriatrics: An Evidence-Based Guide. 1st ed. Springer Nature, Switzerland; 2019. pp. 43-62. doi: 10.1007/978-3-030-18711-8_4.
15. Ahn SY, Ryu J, Baek SH, et al. Serum anion gap is predictive of mortality in an elderly population. Exp Gerontol. 2014;50:122-7. doi: 10.1016/j.exger.2013.12.002.
16. Wang Y, Zhong L, Min J, et al. Albumin corrected anion gap and clinical outcomes in elderly patients with acute kidney injury caused or accompanied by sepsis: A MIMIC-IV retrospective study. Eur J Med Res. 2025;30(1):11. doi: 10.1186/s40001-024-02238-z.
17. Leopold VJ, Krull P, Hardt S, et al. Is elective total hip arthroplasty safe in nonagenarians?: An arthroplasty registry analysis. J Bone Joint Surg Am. 2023;105(20):1583-93. doi: 10.2106/jbjs.23.00092.
18. Schwartsmann CR, Spinelli LdeF, Boschin LC, et al. Correlation between patient age at total hip replacement surgery and life expectancy. Acta Ortop Bras. 2015;23(6):323-5. doi: 10.1590/1413-785220152306148609.
19. Lie S, Havelin L, Furnes O, et al. Failure rates for 4762 revision total hip arthroplasties in the Norwegian Arthroplasty Register. J Bone Joint Surg Br. 2004;86(4):504-9. doi:10.1302/0301-620X.86B4.14799.