



# Predictors of hip fracture mortality in Ghana: a single-center prospective study

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## Abstract

**Summary** To determine risk factors influencing mortality in patients with proximal femur fractures in a Ghanaian hospital over a 4-year period.

**Methods** Incidence of mortality was assessed among 76 participants with proximal femur fractures from January to December 2014 and followed up for 4 years. Outcomes of interest were mortality at 1 month, 6 months, 1 year, and 4 years. Hazard ratios (HRs) were calculated using Cox proportional hazards regression, adjusting for mortality risk factors.

**Results** Among the 76 participants (mean age 75.8 years [SD = 12.02], 36 (47.4%) males), there were 21 death cases. The mean time of injury to surgery was 16.4 (SD = 16.2) days. Hip fractures comprised of 38 (50%) intertrochanteric, 35 (46.05%) transcervical, and 3 (3.95%) basicervical. Mortality at 1 month, 6 months, 1 year, and 4 years were 6.6%, 13.2%, 19.7%, and 27.6%, respectively. Multiple regression analysis showed a yearly increase in age that was associated with a 1.03-fold increase in the risk of death ( $p = 0.17$ ). Comparing males to females, there was a significant difference in mortality (HR = 5.24,  $p = 0.03$ ). Participants with basicervical hip fracture versus those with transcervical hip fracture were at higher risk of dying (HR = 28.88,  $p = 0.01$ ). Patients with abnormal/low creatinine as compared to those with normal creatinine were at higher risk of dying (HR = 5.64,  $p = 0.005$ ). Also, participants with an American Society of Anesthesiologists (ASA) score of III or IV were 2.73 times more likely to experience death than those with an ASA score of I or II (95% CI: 0.93–8.89,  $p = 0.08$ ). Additionally, a higher risk of death was associated with patients with chronic obstructive pulmonary disease (COPD) (HR = 53.45,  $p = 0.001$ ) and osteoporosis (HR = 8.75,  $p = 0.006$ ).

**Conclusion** Being male, having basicervical hip fracture, abnormal/low creatinine, and a history of COPD and osteoporosis were the main predictors of mortality in the study population. These findings could serve as a guide when managing patients with proximal femur fractures to improve the outcome.

**Keywords** Hip fracture · Risk factors · Mortality · Ghana

## Introduction

Hip fractures constitute about 20% of the trauma workload [1]. They are associated with a significant mortality rate and loss of independence [2] [3]. Mortality rates at 1 month, 1 year, and beyond however vary from one study to another. Population-based studies quote mortality rates of about 10% and 20–31% at 1 month and 1 year, respectively [4–8].

Identification of high-risk patients using risk scoring is therefore important as it provides information on prognosis based on the available patient data [9, 10]. According to Jones et al. [11], this leads to (i) greater objectivity in predicting patient outcome, (ii) a guide to clinical decision making before surgery, (iii) well and detailed informed consent for the patient who will need surgery for these fractures, and (iv) improved outcome due to optimized treatment.

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Findings from previous studies show that Charlson Comorbidity Index (CCI), age, gender, pre-existing comorbidities, and admission source increase the risk of mortality in patients with hip fractures [12]. Whereas age, CCI, and admission source are well-documented risk factors, the role of gender is still debatable. Being a male has been found to be associated with high mortality following hip fractures [13]. However, other authors found no difference among the genders [14, 15]. This study aimed to investigate the risk factors that influence mortality in patients with hip fractures in a Ghanaian hospital over a 4-year period. It is believed that knowledge of these risk factors could improve the clinical management and long-term outcomes following these injuries.

## Patients and methods

A prospective cohort study was conducted from January 1, 2014, to December 31, 2014, in patients who presented to the orthopedic unit of Korle Bu Teaching hospital. Korle Bu is a major tertiary referral hospital in Accra, the capital city of Ghana, with a bed capacity of over 2000 and receives referrals from across the country and neighboring African countries. The Orthopedic Department is one of 17 departments at the hospital and sees about a thousand new cases and over 10,000 follow-ups annually.

The ethical and protocol review committee of the School of Medicine and Dentistry, University of Ghana approved this study. Informed consent was obtained from all patients. Inclusion criteria were patients over the age of 50 years, with transcervical (31B2), basicervical (31B3), or intertrochanteric (31A1, 31A2) fractures resulting from a fall. Patients with subtrochanteric (as those seen during the study period were in patients younger than 50 years) as well as pathological fractures secondary to metastatic tumors were excluded.

## Data collection and management

Study data obtained were collected and managed using Research Electronic Data Capture (REDCap) electronic data tools hosted at the University of California, San Francisco (UCSF). REDCap is a secure web-based application designed to support data capture for research studies, providing (i) an intuitive interface for validated entry; (ii) audit trails for tracking data manipulation and export procedures; (iii) automated export procedures for seamless data downloads to common statistical packages; and (iv) procedures for importing data from external sources [16]. Patient information obtained at the time of admission included the following: age, gender, hip fracture type, hemoglobin (Hb) level, platelet level, creatinine, body mass index (BMI), the American Society of Anesthesiologist (ASA) score, and comorbidities such as

osteoporosis at the time of surgery. Other information obtained included alcohol use, smoking history, medication history, and whether ambulatory or not prior to the injury. The diagnosis of osteoporosis was made using bone mineral density measured by dual-energy X-ray absorptiometry (DEXA) scan (using the uninjured femur neck) that was done purposely for this study. The scan was standardized by comparing the patients' bone density with that of a healthy 30-year-old of the same gender and similar size. A *T*-score of 2.5 standard deviations or more below the average value meant the presence of osteoporosis; osteopenia was defined as *T*-score of -1.0 to -2.5 and a score of -1 and above as indicated by the World Health Organization (WHO) scientific group on the assessment of osteoporosis [17, 18].

The primary outcomes of interest were mortality at 1 month, 6 months, 1 year, and 4 years, respectively. All patients were managed using a standardized protocol depending on the fracture type. The surgeries were done by or under the direct supervision of an orthopedic surgeon. Pharmacological and mechanical prophylaxis were started from the time of admission and continued for 2 weeks following discharge from the hospital.

## Statistical analysis

To enhance data and clinical interpretation, Hb, platelets, creatinine, BMI, and ASA were categorized as dichotomous variables. Hemoglobin levels were categorized as less than/ or equal to ( $\leq$ ) or greater than 10.0 g/dL; platelets, normal ( $150\text{--}450 \times 10^9$  L) or abnormal ( $< 150$  or  $> 450 \times 10^9$  L); creatinine normal, 70–120 mmol/L for males and 60–110 mmol/L for females; BMI; normal weight ( $18.5\text{--}24.9 \text{ kg/m}^2$ ); and overweight or obese ( $> 25 \text{ kg/m}^2$ ). Univariate analysis was done initially to assess the risk of mortality using either Chi-squared/Fisher's exact test for categorical data or independent *t*-test for continuous variables. Significant factors were analyzed by employing multivariate Cox proportional hazards regression while adjusting for covariates. Time to surgery which is the total time from the initial injury to when the patient was finally operated on was used to construct the final adjustment model. An alpha of 0.05 was used to determine significant predictors of mortality. To aid clinical interpretation, results were displayed as hazard ratios (HRs). Statistical significance was defined as a two-sided *p* value  $< 0.05$  for all analyses. All statistical analyses were done using SAS version 9.4 Software (SAS Institute Inc., Cary, NC, 2004).

## Results

A total of 76 patients (36 males and 40 females) with a mean age of 75.8 (SD = 12.02) years were included in the study. The

mean number of days from the time of the hip fracture to surgery was 16.4 (SD = 16.2). There were 21 deaths cumulatively over the 4 years with no death on the table reported. No associations were found between hemoglobin, platelet, BMI, and mortality rate.

The mortality rates at 1 month, 6 months, 1 year, and 4 years were 6.6%, 13.2%, 19.7%, and 27.6%, respectively. Within the first year, causes of death were mainly due to pulmonary embolism (5/15 or 33.3%), cerebrovascular accidents (4/15), congestive heart failure (3/15), and pneumonia (3/15) as contained in the death certificates provided by the patients' families. The mortality rate within the first year was not significant among the fracture types. However, patients with basicervical fractures had a higher mortality rate at 1 year ( $p = 0.03$ ) and the fourth year ( $p = 0.02$ ) after the injury. The baseline characteristics of the study participants based on mortality rate at various time points are summarized in Table 1.

Hypertension (63.2%), diabetes mellitus (23.7%), and heart disease (18.4%) were the top comorbidities in terms of prevalence. Others were osteoporosis (7.9%), osteoarthritis of the knee (5.3%), Parkinson's disease (3.9%), chronic kidney disease (3.9%), chronic obstructive pulmonary disease (2.6%), and cancer (1.3%). Pneumonia, surgical site infection, and death are commonly encountered in-hospital complications as shown in Table 2. All 4 in-hospital deaths occurred within the first week of surgery as a result of pulmonary embolism (2 patients) and pneumonia (1 male and 1 female).

Multivariate analysis of the data (see Table 3) showed that a yearly increase in age was associated with a 1.03-fold increase in the risk of death ( $p = 0.17$ ). Comparing males to females, there was a significant difference in mortality (HR = 5.24,  $p = 0.03$ ) at 4 years post-injury. Patients with abnormal/low creatinine as against those with normal creatinine were at higher risk of dying (HR = 5.64,  $p = 0.005$ ). Also, participants with an American Society of Anesthesiologists (ASA) score of III or IV were 2.73 times more likely to experience death than those with an ASA score of I or II (95% CI: 0.93–8.89  $p = 0.08$ ) at 4 years after surgery. Additionally, a higher risk of death was associated with patients with chronic obstructive pulmonary disease (COPD) (HR = 53.45,  $p = 0.001$ ) and osteoporosis (HR = 8.75,  $p = 0.006$ ). The influence of COPD existed throughout the study period as the strongest predictor of early mortality.

## Discussion

Hip fractures are among the common and serious fractures in the elderly population. This study was done to find out which patient parameters at the point of admission predict the risk of mortality in elderly independent home dwellers that sustained hip fractures. While some studies have examined parameters that predict the risk of mortality in-hospital or within the first

couple of years after surgery, they are mostly not from Ghana or Sub-Saharan Africa. Due to the difference in geographic location and demography, their findings may not be generalizable to our study population. This study was done to evaluate variables obtained in the process of managing patients with hip fractures and presented at our hospital and the relationship between these variables and the risk of mortality. The prospective nature of this study helped to see and evaluate the implications of significant pre- and postoperative complications of the risk of death. The findings will be valuable information for clinicians and the patient or their relatives.

Several studies have looked at mortality rates following hip fractures and reported rates of between 7 and 10% at one month and 20 and 31% at 1 year [4, 5, 19, 20]. A study by Zaki et al. [21] in Egypt and another by Prodic et al. [22] found the mortality rate of 19.56% and 25%, respectively at 6 months. The 4-year mortality rate is between 33.4 and 44.1% [23].

The findings of this study is comparable to that of other authors from around the world; 1-month mortality rate of 6.6% is comparable to England (9.6%), Scotland (7%), and the USA (5.2–9.3%) [8, 13, 24–26]. Again, the mortality rates at 6 months and 1 year are in agreement with those of other studies [3–5, 19]. The 4-year cumulative mortality rate is however lower than that reported by Wang et al. in Taiwan [23] who found a rate of 33.4% and 44.12% at 3 and 5 years following hip fractures in their study population.

A study from Spain by Guzon-Illescas et al. [27] found cumulative mortality rates of 9.2%, 17.4%, 24.6%, 33%, and 56% at 1, 3, 6, 12, and 36 months respectively with a higher rate in men (13.7%, 25%, 32.7%, 43.3%, and 65.6%) compared to women (7.9%, 15.7%, 22.3%, 30%, and 53.2%). The mortality rates following hip fractures around the world vary but are generally high.

The widely observed differences in mortality rates from different parts of the world could be ascribed to different selection criteria, diversity of the study population, their characteristics, and the peri-operative institutional care [21]. In this study, the in-hospital mortality rate of 5.3% compares with 0.6% to 11.4% found by others [28–30] which probably reflects the better health status and younger population in our cohorts. Factors found to increase in-hospital mortality are male gender, living with sepsis, pneumonia, cerebrovascular diseases, pulmonary embolism, two or more comorbidities, heart failure, and end-stage renal disease [31].

A relationship seems to exist between fractures and aging as the risk of hip fractures (a major predictor of mortality) rises exponentially with age [31]. As shown in this study, age was not a significant predictor of mortality initially, but a yearly increase in age was associated with a 1.03-fold risk of death at 4 years. The finding could be a result of the poor physiological

**Table 1** Baseline characteristics of participants in the hip fracture study by death status at different time points

Characteristics <sup>a</sup>	One Month			Six Months			One Year			Four Years		
	Alive	Dead	p Value	Alive	Dead	p Value	Alive	Dead	p Value	Alive	Dead	p Value
Age (years)	n = 71 75.38	n = 5 82.40	0.21	n = 66 75.42	n = 10 78.60	0.44	n = 61 74.74	n = 15 80.33	0.11	n = 55 74.03	n = 21 80.57	0.03*
Height (cm)	166.9	163.2	0.55	166.8	165.8	0.82	167.0	165.3	0.65	166.3	167.8	0.66
Weight (kg)	70.92	73.80	0.66	70.56	74.70	0.38	70.36	74.13	0.35	64.49	75.33	0.10
Body mass index (kg/m <sup>2</sup> )	25.53	27.41	0.38	25.45	27.01	0.32	25.29	27.14	0.17	25.26	26.70	0.22
Time to surgery (days)	16.77	11.00	0.45	17.08	11.90	0.14	16.90	14.33	0.45	17.58	13.29	0.18
Sex (%)			0.04*			0.24			0.52			0.18
Female	49.30	100.0		51.52	60.00		50.82	60.00		49.09	42.96	
Male	50.70	0.00		48.48	40.00		49.18	40.00		50.91	57.14	
BMI group (%)			0.06			0.09			0.32			0.35
Normal	53.52	20.00		51.52	50.00		52.46	46.67		52.73	47.62	
Overweight	14.08	20.00		13.64	20.00		36.07	26.67		36.36	28.57	
Obese	32.39	60.00		34.85	30.00		11.48	26.67		10.91	23.81	
Hip fracture type (%)			0.11			0.06			0.03*			0.02*
Transcervical	43.66	80.00		42.42	70.00		40.98	66.67		40.00	61.90	
Basicervical	4.23	0.00		4.55	0.00		4.92	0.00		3.64	4.76	
Intertrochanteric	52.11	20.00		53.03	30.00		54.10	33.33		56.36	33.33	
Pre HB (%)			0.42			0.32			0.27			0.17
Less than/equal 10	22.54	20.00		22.73	20.00		22.95	20.00		20.00	28.57	
More than 10	77.46	80.00		77.27	80.00		77.05	80.00		80.00	71.43	
Post HB (%)			0.11			0.18			0.49			0.11
Less than/equal 10	63.38	100		63.64	80.00		63.93	73.33		61.82	76.19	
More than 10	36.62	0		36.36	20.00		36.07	26.67		38.18	23.81	
Platelet (%)			0.35			0.10			0.12			0.10
Abnormal	2.82	0.00		3.03	0.00		3.28	0.00		3.64	0.00	
Low	16.90	0.00		18.18	0.00		18.03	6.67		18.18	9.52	
Normal	80.28	100.0		78.79	100.00		78.69	93.93		78.18	90.48	
Creatinine (%)			0.16			0.10			0.05			0.01*
Abnormal	22.54	20.00		21.21	30.00		19.67	33.33		16.36	38.10	
Low	11.26	20.00		12.12	10.00		13.12	6.67		12.73	9.52	
Normal	66.20	60.00		66.67	60.00		67.21	60.00		70.91	52.38	
ASA score (%)			0.0002*			0.0002*			< 0.0001*			< 0.0001*
I	15.49	0.00		16.67	0.00		16.39	6.67		18.18	4.76	
II	57.75	20.00		59.09	30.00		62.30	26.67		63.64	33.33	

**Table 1** (continued)

	One Month		Six Months		One Year		Four Years		<i>p</i> Value
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead	
III	25.35	20.0	22.73	40.00	21.31	40.00	18.18	42.86	
IV	1.41	60.00	0.7	30.00	0.00	26.67	0.00	19.05	
Pre-existing conditions									
COPD									0.07
No	100.0	60.00	100.0	80.00	100.0	86.67	100.0	90.48	
Yes	0.00	40.00	0.00	20.00	0.00	13.33	0.00	9.52	
Osteoporosis									0.005*
No	92.96	80.00	93.94	80.00	96.72	73.33	98.18	76.19	
Yes	7.04	20.00	6.06	20.00	3.28	26.67	1.82	23.81	

<sup>a</sup> Mean for parametric continuous variables or percentages for categorical variables are listed; *p* values calculated using Fisher's exact test (categorical variables), and two-sample *t*-test (parametric continuous variables). ASA American Society of Anesthesiologists. \*Significance at  $p < 0.05$  and were included in the multivariate analysis

**Table 2** In-hospital complications

Complications	Frequency	Percent
No complication	59	77.6
Death	4	5.3
Deep vein thrombosis	2	2.6
Pneumonia	5	6.6
Urinary tract infection	2	2.6
Surgical site infection	4	5.3
Hematoma	3	3.9
Other	7	9.2

reserves as a person ages, in coping with these injuries and the subsequent management [26, 32].

There are some controversies in terms of the relationship between gender and mortality. This study found a significant relationship in mortality rates among males compared to females. Indeed males were 5.24 times at risk of dying at 4 years after the injury (HR = 5.24,  $p = 0.026$ ), and this is in contravention to findings from Li-Chu Wu et al. and other authors [13, 20] but agrees with Singh-Manoux et al. and other authors [33] who found men to be at higher risk than females [31, 34, 35]. Reasons for this observed variance may be multi-factorial such as differences in the study cohorts. A review of the subgroup fracture types within the first year showed no significant difference in the mortality rate, an observation also made by Amphansap et al. [36]. However, patients in our study with basicervical fractures had almost a 29% chance of dying at 4 years following their injury. A study from Greece found the mortality rate to be high in cohorts with trochanteric fractures at 5 years and 10 years and concluded that the type of hip fracture is an independent predictor of mortality in the long term [37].

The relationship between osteoporosis and mortality was demonstrated in this cohort and persisted up to the fourth year. Osteoporosis is a "bone disease resulting from the body losing too much bone, or producing too little bone or both" [38]. The chances of a fracture increases as the bone becomes weaker and less dense [39]. Bone mass in both genders increases until about 30 years of age, after which it declines, and this process is more pronounced in females due to reduced estrogen levels [39]. The International Osteoporosis Foundation estimates that globally, one in three females and one in five males over 50 years will experience osteoporosis-associated fracture [40]. Osteoporosis and the fracture itself may directly or indirectly increase mortality risk exponentially.

The American Society of Anesthesiologists (ASA) score is a system used to assess the health status of surgical patients, and their relationship with postoperative complications is well documented [41, 42]. The ASA score does not only correlate with morbidity and mortality but also with the length of stay,

**Table 3** Results of multivariate Cox proportional hazard model At 6 months, 1 year, and 4 years post-surgery

Variable	Six months			One year			Four years		
	HR	95% CI	<i>p</i> Value	HR	95% CI	<i>p</i> Value	HR	95% CI	<i>p</i> Value
Age	1.01	0.93–1.08	0.883	1.02	0.96–1.08	0.527	1.03	0.99–1.08	0.172
Sex (ref = female)									
Male	3.07	0.46–30.56	0.279	3.74	0.76–24.22	0.126	5.24	1.32–25.61	0.026*
Hip fracture type (ref = transcervical)									
Basicervical	0.00	0.00–357.01	0.996	0.00	0.00–240.98	0.995	28.88	1.14–384.97	0.014*
Intertrochanteric	2.11	0.35–13.08	0.404	2.63	0.62–12.04	0.190	2.50	0.75–8.69	0.136
Creatinine (ref = normal)									
Abnormal/low	3.79	0.75–22.93	0.112	4.35	1.14–19.14	0.036*	5.64	1.78–19.2	0.005*
ASA score (ref = II or II)									
III or IV	3.75	0.75–25.04	0.128	3.13	0.84–13.92	0.103	2.73	0.93–8.89	0.078
COPD (ref = no)									
Yes	47.73	3.24–1104.36	0.007*	53.05	4.19–832.14	0.002*	53.45	4.71–629.35	0.001*
Osteoporosis (ref = no)									
Yes	7.95	0.75–82.94	0.068	8.89	1.46–57.14	0.016*	8.75	1.83–43.14	0.006*

Ref reference group, HR hazard ratio, CI confidence interval, ASA American Society of Anesthesiologists, COPD chronic obstructive pulmonary disease. \*Significance at  $p < 0.05$

operation and recovery time, healthcare cost, post-operative infection, and others [43, 44]. In this study, most of the mortality was in patients with an ASA score of III or IV, and the effect again persisted beyond the first year of surgery. The reason was probably because the patients have severe systemic disease that may be a constant threat to their life. Close attention should be paid to elderly patients with higher ASA scores to minimize these complications.

Chronic obstructive pulmonary disease (COPD) is associated with long-term poor airflow and breathing difficulties, and this worsens over time [45, 46]. It may be complicated by chest infections, pulmonary hypertension, and congestive heart disease [47]. These conditions acting together with other comorbidities or alone may ultimately lead to death, and this may explain the observed persistence of risk of death over the study period. COPD was the strongest predictor of early mortality. Most studies including this present study have shown that abnormal (low or high) creatinine levels (a marker of renal dysfunction) are associated with long-term mortality following a hip fracture [48, 49]. It can be deduced from our study that the risk of mortality in patients with abnormal serum creatinine levels was about 4.35 to 5.64 times higher at 1 and 4 years post-injury respectively.

The strength of this current study is the prospective nature and also been the first in Ghana to examine the predictors of mortality following hip fractures in a major referral hospital. The limitations included the small sample size which could possibly have affected the power to detect some relationship between some of the variables. Also, since this was a single-center study, our findings may differ from that from larger

multicenter studies. The findings, therefore, may not be generalized for the entire population. With a mean time of injury to surgery of 16.4 (SD = 16.2) days (mainly due to delay in coming to the hospital following the injury or lack of funds as most patients pay out of their pockets for most orthopedic procedures), we will recommend the establishment of a fracture liaison service (FLS) in the country and the need for free orthopedic care especially for the elderly and the poor to improve the clinical outcomes of patients with hip fractures.

## Conclusion

Male gender, a previous history of COPD and osteoporosis, and having basicervical fractures and an abnormal/low creatinine were the main predictors of mortality in this study population among Blacks in Ghana. This information is very important as it allows healthcare providers, patients, and their families to consider and understand the outcomes with respect to care following a hip fracture. To make our study more generalizable to the entire country, it is recommended that a nationwide multicenter study be conducted to help un-

derstand some of these associations.

## Declarations

**Informed consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of interest** None.

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