



Published by DiscoverSys

Geriatric fractures in single Orthopedic Hospital: The role of domestic fall and comprehensive geriatric assessment



CrossMark

Komang Agung Irianto,^{1,2*} Dionisius Rianto,¹ William Putera Sukmajaya,³ Oen Alina³

ABSTRACT

Background: The geriatric population has continued to grow globally. The incidence of geriatric fractures increases along with the population. The geriatric assessment could be useful to build a warning sign for the fall risk.

Aim: The authors aimed to describe the geriatric fractures; the factors affecting; to further give recommendation regarding its prevention and management.

Methods: This is a cross-sectional study involving 741 patients with geriatric fractures admitted to Surabaya Orthopedics and Traumatology Hospital from 2012-2017. All data acquired from medical records.

Results: The number of female patients in our study are three times the male patients. The distribution of the cases across ethnicity,

gender, and different age group were quite similar. The case of vertebral and hip fracture was significantly higher. Domestic accident was the mechanism of injury in 80% of all cases, and this MOI is significant across all fracture types. Only 32% patients do not have confounding disease. However 25% has diabetes mellitus, and 42% has hypertension. Although patients with diabetes mellitus, hypertension, moderate to severe anemia, and hyponatremia were more frequent but not significant to be the risk factor for certain fracture type.

Conclusion: Domestic accident, female, and cofounding disease were the most common factors found for all type of fractures. The most common geriatric fractures admitted to our institution were hip and vertebral fractures.

Keywords: geriatric fracture; hip fracture; vertebrae fracture; mechanism of injury

Cite this Article: Irianto, K.A., Rianto, D., Sukmajaya, W.P., Alina, O. 2019. Geriatric fractures in single Orthopedic Hospital: The role of domestic fall and comprehensive geriatric assessment. *Bali Medical Journal* 8(2): 480-485. DOI:10.15562/bmj.v8i2.1432

¹Surabaya Orthopedics and Traumatology Hospital

²Faculty of Medicine, Airlangga University

³Internship Doctor, Jombang General Hospital

INTRODUCTION

The United Nations Department of Economic and Social Affairs released a report in World Population Ageing concerning the link of the growing geriatric population on its global economic impact.¹ The global geriatric population is expected to double, from 841 million people in 2013 to more than 2 billion in 2050, which in accord to the changing in the prevalence of diseases. Studying the risk and anticipating the early sign of economic burden chronic diseases is advocated¹

The life expectancy for Indonesian male is 69.8 years and 73.6 years for female. The age-related degenerative disorder, including those involving musculoskeletal system, would be in the top rank of health problem and eventually caused disability.^{2,3} The most common geriatric fractures in USA are those involving the vertebrae, hip, wrist, and proximal humerus, with those in lower extremities more common than in upper extremities. The effect of those fractures on the quality of life may not be the same.⁴

The incidence of different types of fractures are different across age groups, and there were some shifts in recent years.^{5,6} Metabolic diseases, such as diabetes mellitus and hypertension, may contribute

to bone fragility.⁷ Serum electrolyte may also influence the result of traumatic injury and the surgical management of fracture.⁸

The authors aimed to describe the geriatric fractures; the factors that affecting; to further give recommendation regarding its prevention and management.

METHODS

This study is a cross-sectional study to determine geriatric fractures' profile and factors associated with it in a single orthopedic center in Surabaya, East Java. The patients included were all geriatric patients with fractures admitted during 2012 until 2017. The hospital ethics committee has approved this study, with the document number No: 02/PERS-EC/RSOT/XI/2017.

The inclusion criteria were patients aged over 60 years whom admitted for fractures due to injury. The exclusion criteria were pathological fractures, including fractures caused by malignancies and infection, and neglected fractures.

The data recorded were the mechanism of injury (MOI) and demographic factors including age, gender, ethnicity, and BMI. Meanwhile, the clinical

*Correspondence to:

Komang Agung Irianto, Surabaya Orthopedics and Traumatology Hospital, Faculty of Medicine, Airlangga University

Received: 2018-12-13

Accepted: 2019-05-14

Published: 2019-08-01

characteristics included were confounding diseases (diabetes mellitus, hypertension) and hematologic findings that were taken on admission (hemoglobin, serum albumin, and serum sodium, potassium, chloride). The fractures were classified according to the location of fractures (vertebral compression fracture, hip fracture, wrist fracture, and proximal humeral fractures)

The comparison of each variable to different fracture site was evaluated using Chi-square test, or Fisher's exact test when the data were not met. The analysis was conducted with SPSS version 22 for Windows.

RESULTS

There was a total of 8362 geriatric patients during the study period, 835 (9.9%) of them was admitted with fracture (traumatic and non-traumatic fractures). Inclusion cases were 741 (8.9%), where 94 cases had to be excluded due to pathological nature of the fractures (malignancy and infection). The number of female patients were 560 (75.6%), three times compared to 181 male patients (24.7%). Only 32% patients do not have confounding disease. Conversely 25% has diabetes mellitus, and 42%

has hypertension. The primary MOI was domestic fall, 82.2% of all cases, followed by traffic accidents (14.2%) and work-related accidents (3.6%). Patients' demographic and clinical characteristics, including the MOI, are presented in [Table 1](#).

The most common anatomical location are vertebrae fracture and hip fracture; each comprising one-fourth of all cases; wherein the female patients comprised 70-80% of each fracture type. The mechanism of injury was more than 90% due to domestic fall in vertebral, hip, wrist and humeral fracture cases. These are the significant factor found ([Table 2](#)). However, the distribution of the cases across ethnicity, gender, and different age group were quite similar. The hematology findings abnormality (hemoglobin value, hypo albumin, and the decrease electrolyte value) were not many and thus, also showed no significant difference ([Table 2](#))

The BMI of the fracture patient was mostly normal and not differ within each fracture type. But among the underweight patients, hip fracture was exceeding; 24/59 cases (40%); among other fracture type. Similar fact was found in the hematology factor where 28/60 (47%) moderate to severe anemia cases was hip fracture.

Table 1 Demographic characteristics (n=741)

Baseline Characteristics	N (%)
Sex	
- Male	181 (24.4%)
- Female	560 (75.6%)
Age Group	
- 60-69 years old	287 (38.7%)
- 70-79 years old	277 (37.4%)
- >80 years old	177 (23.9%)
Ethnicity	
- Non-Chinese	417 (56.2%)
- Chinese	324 (43.8%)
BMI	
- Underweight (<18.5)	59 (8.0%)
- Normal (18.5-24.9)	542 (73.1%)
- Overweight (25-29.9)	103 (13.9%)
- Obese (>30)	37 (5.0%)
Fracture Site	
- Vertebrae	185 (25%)
- Hip	178 (24%)
- Wrist	101 (13.6%)
- Proximal Humerus	53 (7.2%)
- Other Site	224 (30.2%)

Table 1 *Continue*

Baseline Characteristics	N (%)
Mechanism of Injury (MOI)	
- Domestic Accident	609 (82.2%)
- Traffic Accident	105 (14.2%)
- Work Accident	27 (3.6%)
Cofounding Disease	
- Diabetes Mellitus	187 (25.2%)
- Hypertension	311 (42%)
- None	243 (32.8%)
Hematologic Findings	
- Moderate-severe Anemia	60 (8.1%)
- Mild Anemia	231 (31.2%)
- Normal Hb value	450 (60.7%)
- Hypoalbuminemia	66 (8.9%)
- Hypokalemia	74 (10.0%)
- Hyponatremia	79 (10.7%)
- Hypochloremia	45 (6.1%)
- Normal electrolyte	477 (64.4%)

Table 2 Descriptive variables to each fracture site

Variables	Fracture Site				
	Vertebrae	Hip	Wrist	Proximal Humerus	Others
Sex					
- Male	40 (21.9%)	51 (28.7%)	21 (20.6%)	11 (20.8%)	58 (25.8%)
- Female	143 (78.1%)*	127 (71.3%)*	81 (79.4%)*	42 (79.2%)*	167 (74.2%)*
Age Group					
- 60-69	69 (37.7%)	62 (34.8%)	40 (39.2%)	17 (32.1%)	99 (44.0%)
- 70-79	73 (39.9%)	65 (36.5%)	38 (37.3%)	20 (37.7%)	81 (36.0%)
- >80	41 (22.4%)	51 (28.7%)	24 (23.5%)	16 (30.2%)	45 (20.0%)
Ethnic					
- Other	111 (60.7%)	95 (53.4%)	64 (63.4%)	25 (47.2%)	120 (53.6%)
- Chinese	72 (39.3%)	83 (46.6%)	37 (36.6%)	28 (52.8%)	104 (46.4%)
BMI (Body Mass Index)					
- Underweight	10 (5.5%)	24 (13.5%)*	6 (6.9%)	5 (9.4%)	14 (6.2%)
- Normal	144 (78.7%)	124 (69.7%)	80 (78.4%)	34 (64.2%)	160 (71.1%)
- Overweight	23 (12.6%)	23 (12.9%)	14 (13.7%)	9 (17.0%)	34 (15.1%)
- Obese	6 (3.2%)	7 (3.9%)	2 (2.0%)	5 (9.4%)	17 (7.5%)
MOI (Mechanism Of Injury)					
- Domestic	176 (96.2%)*	164 (92.1%)*	92 (90.2%)*	51 (96.2%)*	126 (56.0%)
- Traffic	6 (3.3%)	12 (6.7%)	8 (7.8%)	1 (1.9%)	78 (34.7%)
- Work	1 (0.5%)	2 (1.2%)	2 (2.0%)	1 (1.9%)	21 (9.3%)

Table 2 Continue

Variables	Fracture Site				
	Vertebrae	Hip	Wrist	Proximal Humerus	Others
Cofounding Disease					
- Diabetes Mellitus	34 (18.6%)	56 (31.5%)	19 (18.6%)	18 (34.0%)	60 (26.7%)
- Hypertension	60 (32.8%)*	92 (51.7%)*	39 (38.2%)	24 (45.3%)	96 (42.7%)
- None	89 (48.6%)	30 (16.8%)	44 (43.2%)	11 (20.7%)	69 (30.6%)
Hematologic Findings					
- Moderate-severe Anemia	4 (2.2%)	28 (15.8%)*	4 (3.9%)	8 (15.1%)	16 (7.1%)
- Mild Anemia	66 (36.1%)	52 (29.2%)	26 (25.5%)	12 (22.6%)	76 (33.8%)
- No Anemia	113 (61.7%)	98 (55%)	72 (70.6%)	33 (52.3%)	133 (59.1%)
- Hypoalbuminemia	11 (6.0%)	22 (12.4%)	4 (3.9%)	8 (15.1%)	21 (9.3%)
- Hypokalemia	10 (5.5%)	26 (14.6%)	6 (5.9%)	5 (9.4%)	27 (12.0%)
- Hyponatremia	12 (6.6%)	31 (17.4%)*	5 (4.9%)	10 (18.9%)	21 (9.3%)
- Hypochloremia	8 (4.4%)	18 (10.1%)	3 (2.9%)	5 (9.4%)	11 (4.9%)

* p value < 0.005

DISCUSSION

Indonesia has a fair share of geriatric population, the fifth highest among countries in the world.^{3,4} The aging population increased the risk of musculo-skeletal and other types of injury.⁶ Geriatric patients generally has worse outcomes than younger patients due to comorbidities and frailty syndrome.⁷ Frailty impairs homeostasis and increases the risk of fall in the elderly population.⁸ As high as one-third of 65 years or older and one-half of those over 80 years of age were at risk of fall every year.

In our study, the most common anatomical locations of the fractures are vertebrae and hip, both of which are osteoporotic fractures. This finding is similar with some studies in developed countries. Epidemiological study in the United States and Japan also reported that the vertebral compression fractures and hip fractures are two of the most prevalent fractures in the elderly, followed by wrist fracture which usually occurs due to falling on outstretched hand.^{4,9} hip and lower spine

Vertebral and hip fractures are common osteoporotic fracture.¹⁰burden, and treatment of osteoporosis in the 27 countries of the European Union (EU27 Osteoporosis and osteoporotic fractures are more common in women than men as women rapidly lose bone density since menopause.^{11,12} This may explain why the number of female patients in our study was three times more than the male patients as both of those osteoporotic fractures comprised almost 50% of total cases.

In our study, hip fracture was more common in underweight patients, shown by the significant difference in the statistical analysis. It is further

supported by previous study by Hsieh et al. which found underweight patients more prone to injury compared to obese patients even though the outcome of the injuries varied.¹³ Another study also reported that patients with extreme BMI, either low or high, are more prone to complication. Thus both obese and underweight patients require careful planning in their management.¹⁴in the elderly patients, obesity has been described as a protective factor. This article set out to examine the effect of body mass index (BMI) Several study also reported that overweight and obesity had some protective effect to hip fractures. Some described that it is due to the protective role of estrogen and the fat pad as shock-absorber.¹⁵⁻¹⁷but there is little information on their combined effects. We report on the separate and combined effects of body mass index (BMI)

However, other studies also reported that abdominal obesity increases the risk of hip fracture even though in male with lower BMI.^{18,19} Future studies may focus on this finding to assess the effect of abdominal obesity and BMI in our local population. Moreover, fall risk is greater in those with lower BMI.²⁰

Domestic fall was the mechanism of injury in four-fifths of all cases. Several studies also reported domestic fall as the leading cause of fracture in the elderly, most commonly occurring in the bathroom and the kitchen.^{21,22} Fall in the elderly is of complex nature which is affected by many factors.²³ Also, patients who have fallen or have a gait or balance problem are at higher risk of having a subsequent fall and losing independence. Thus, comprehensive

management to prevent fall in geriatric population is mandatory. Some suggestions from a systematic review by Crandall et al. includes vitamin D supplementation, hip protector, exercise, frailty screening and stratification of fall risk.²⁴ A sophisticated measure such as inertia sensor is also in development.²⁵ Frailty syndrome is one of the precipitating factors of fall in geriatric patients, thus making frailty screening and management an important aspect in comprehensive management of geriatrics.^{26,27} Future studies may include frailty assessment as it is one of the important aspects of geriatric health assessment.

Diabetes mellitus and hypertension were significant factors in vertebral and hip fractures, both of which are osteoporotic fractures. Recent meta-analysis stated that diabetes mellitus increased the risk of fracture of any types.^{28,29} Hypertension also plays a role in bone mineral density (BMD) reduction, either by reducing local blood supply of the bone or by the effects of antihypertensive medication taken by the patients.³⁰ These factors may explain why these comorbidities were significant for these osteoporotic fractures.

Anemia also affected the osteoporotic fractures aforementioned in our study. Anemia has been described as an independent risk factor of osteoporosis. Several mechanisms have been proposed including decreased synthesis of collagen, expression of acidosis-induced transcription factors which promotes osteoclast maturation, and an increase in erythropoietin level.³¹⁻³³ Potassium plays an important role in bone metabolism as it is one of the contributors to acid-base balance, and systemic acidosis was known to induce osteoclast activation.^{34,35} In our findings, hypokalemia, and hypocalcemia although present yet could not arise as a risk factor.

Hyponatremia was also significant in hip fractures. Hyponatremia is one of the independent risk factors of osteoporosis and fractures.^{36,37} SETTING, AND PARTICIPANTS:: Osteoporosis (n = 30 517 However, the number of patients who had hyponatremia in our study was only 79 cases which 31 (39%) were hip fractures; the small number of cases may cause the insignificant statistic result.

The authors realized the limitations of this study. There are many factors affecting fractures in geriatric population. A comprehensive management including fall-risk assessment and prevention; nutritional status assessment; and nutritional supplementation are required to address geriatric-related fracture problems. All these factors should be integrated into the history and physical examination of all geriatric patients. Clinicians caring for older patients need to routinely inquire about falls, assess for fall risk, and address modifiable underlying risk factors.

A number of the physical conditions and environmental situations that predispose to falls are modifiable. Future studies should address this issue to improve geriatric health care further. Nevertheless, this study may provide some insight regarding the prevalence of geriatric fractures in our population and hopefully may be used to aid future studies.

CONCLUSION

Domestic accident is the primary mechanism of injury. Geriatric fracture is more frequent in female than male group. Both vertebral and hip fracture were the most common fracture types in this study. Comprehensive geriatric assessment is mandatory to address fracture-related problems in the elderly.

CONFLICT OF INTEREST

The authors declare there is no conflicts of interest regarding this study. The author received no funding for this work.

ACKNOWLEDGMENT

The Author would like to appreciate all the helpful staff from Surabaya Orthopedic and Traumatology Hospital. All of the contributing authors were contributed in article writing equally.

REFERENCES

1. United Nations, Department of Economic and Social Affairs, Population Division (2013). *World Population Ageing 2013*. ST/ESA/SER.A/348.
2. Institute for Health Metrics and Evaluation. Indonesia. <http://www.healthdata.org/indonesia>. Accessed December 12, 2018.
3. Ageing population in Indonesia | HelpAge. <http://ageingasia.org/ageing-population-indonesia/>. Accessed December 16, 2018.
4. Baidwan NK, Naranje SM. Epidemiology and recent trends of geriatric fractures presenting to the emergency department for United States population from year 2004-2014. *Public Health*. 2017;142:64-69.
5. Amin S, Achenbach SJ, Atkinson EJ, et al. Trends in fracture incidence: a population-based study over 20 years. *J Bone Miner Res*. 2014; 29:581-589
6. Reske-Nielsen C, Medzon R. Geriatric Trauma. *Emerg Med Clin North Am*. 2016;34(3):483-500.
7. Kozar RA, Arbabi S, Stein DM, et al. Injury in the aged: Geriatric trauma care at the crossroads. *J Trauma Acute Care Surg*. 2015;78(6):1197-1209.
8. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet* (London, England). 2013;381(9868):752-762.
9. Tsuda, Takayuki. Epidemiology of fragility fractures and fall prevention in the elderly: a systematic review of the literature. *Current Orthopedic Practice*. 2017;28(6):580-585.
10. Hernlund E, Svedbom A, Ivergard M, et al. Osteoporosis in the European Union: medical management, epidemiology and economic burden. A report prepared in collaboration with the International Osteoporosis Foundation (IOF) and the European Federation of Pharmaceutical Industry Associations (EFPIA). *Arch Osteoporos*. 2013;8:136.

11. Johnell O, Kanis JA. An estimate of the worldwide prevalence and disability associated with osteoporotic fractures. *Osteoporos Int*. 2006;17:1726-1733.
12. Wong CC, McGirt MJ. Vertebral compression fractures: A review of current management and multimodal therapy. *J Multidiscip Healthc*. 2013;6:205-214.
13. Hsieh C, Lai W, Wu S, et al. Trauma injury in adult underweight patients. *Medicine*. 2017;96:10.
14. Akinleye SD, Garofolo G, Culbertson MD, Homel P, Erez O. The Role of BMI in Hip Fracture Surgery. *Geriatr Orthop Surg Rehabil*. 2018;9:2151458517747414-2151458517747414.
15. Armstrong MEG, Spencer EA, Cairns BJ, et al. Body mass index and physical activity in relation to the incidence of hip fracture in postmenopausal women. *J Bone Miner Res*. 2011;26(6):1330-1338.
16. Tang X, Liu G, Kang J, et al. Obesity and risk of hip fracture in adults: a meta-analysis of prospective cohort studies. *PLoS One*. 2013;8(4):e55077-e55077.
17. Beck TJ, Petit MA, Wu G, LeBoff MS, Cauley JA, Chen Z. Does obesity really make the femur stronger? BMD, geometry, and fracture incidence in the women's health initiative-observational study. *J Bone Miner Res*. 2009;24(8):1369-1379.
18. Sadeghi O, Saneei P, Nasiri M, Larjani B, Esmailzadeh A. Abdominal Obesity and Risk of Hip Fracture: A Systematic Review and Meta-Analysis of Prospective Studies. *Adv Nutr*. 2017;8(5):728-738.
19. Sogaard AJ, Holvik K, Omsland TK, et al. Abdominal obesity increases the risk of hip fracture . A population-based study of 43 000 women and men aged 60 – 79 years followed for 8 years . Cohort of Norway. 2014. *J Intern Med*. 2015 Mar;277(3):306-317
20. Coutinho ESF, Fletcher A, Bloch K V, Rodrigues LC. Risk factors for falls with severe fracture in elderly people living in a middle-income country: a case control study. *BMC Geriatr*. 2008;8:21.
21. Ferretti F, Lunardi D, Bruschi L. Causes and consequences of fall among elderly people at home. *Fisioter. Mov*. 2013;26(4):753-762.
22. Hefny AF, Abbas AK, Abu-Zidan FM. Geriatric fall-related injuries. *Afr Health Sci*. 2016;16(2):554-559.
23. Sebastiana A, Kalula Z, Uk M, Mphil M. A WHO Global Report on Falls among Older Persons Prevention of falls in older persons: Africa case study. *WHO*.
24. Crandall M, Duncan T, Mallat A, et al. Prevention of fall-related injuries in the elderly: An Eastern Association for the Surgery of Trauma practice management guideline. *J Trauma Acute Care Surg*. 2016;81(1).
25. Howcroft J, Kofman J, Lemaire ED. Review of fall risk assessment in geriatric populations using inertial sensors. *J Neuroeng Rehabil*. 2013;10(1):91.
26. 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):546-551.
27. Chen X, Mao G, Leng SX. Frailty syndrome: an overview. *Clin Interv Aging*. 2014;9:433-441.
28. Jia P, Bao L, Chen H, et al. Risk of low-energy fracture in type 2 diabetes patients: a meta-analysis of observational studies. *Osteoporos Int*. 2017;28(11):3113-3121.
29. Moayeri A, Mohamadpour M, Mousavi SF, Shirzadpour E, Mohamadpour S, Amraei M. Fracture risk in patients with type 2 diabetes mellitus and possible risk factors: a systematic review and meta-analysis. *Ther Clin Risk Manag*. 2017;13:455-468.
30. Ye Z, Lu H, Liu P. Association between essential hypertension and bone mineral density: a systematic review and meta-analysis. *Oncotarget*. 2017;8(40):68916-68927.
31. Toxqui L, Vaquero MP. Chronic iron deficiency as an emerging risk factor for osteoporosis: A hypothesis. *Nutrients*. 2015;7(4):2324-2344.
32. Knowles H. Hypoxic regulation of osteoclast differentiation and bone resorption activity. *Hypoxia*. 2015;3:73.
33. Hiram-Bab S, Liron T, Deshet-Unger N, et al. Erythropoietin directly stimulates osteoclast precursors and induces bone loss. *FASEB J*. 2015;29(5):1890-1900.
34. Weaver CM. Potassium and health. *Adv Nutr*. 2013;4(3):368S-77S.
35. Yuan F, Xu M, Li X, Xinlong H, Fang W, Dong J. The Roles of Acidosis in Osteoclast Biology. *Front Physiol*. 2016;7(June):1-8.
36. Usala RL, Fernandez SJ, Mete M, et al. Hyponatremia Is Associated With Increased Osteoporosis and Bone Fractures in a Large US Health System Population. *J Clin Endocrinol Metab*. 2015;100(8):3021-3031.
37. Upala S, Sanguankeo A. Association Between Hyponatremia, Osteoporosis, and Fracture: A Systematic Review and Meta-analysis. *J Clin Endocrinol Metab*. 2016;101(4):1880-1886.



This work is licensed under a Creative Commons Attribution