

Age relationship with incidence of proximal femur fracture at PKU Muhammadiyah Yogyakarta Hospital in 2022

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Abstract. Femoral fracture is a condition where there is a disturbance in the discontinuity of the femur bone which can be caused by accidents, degenerative and pathological processes. Based on Riskesdas data (2018), femoral fractures have the highest prevalence in cases of lower extremity fractures. Of the 92.976 cases that occurred, as many as 19.754 people suffered femoral fractures. With age, the risk of femoral fracture will increase, especially in the incidence of proximal femoral fractures. This study used an analytical descriptive method with a cross-sectional research design and a retrospective study. The subjects in the study were taken by total sampling method with a minimum number of 101 samples in the medical record. The analysis used in this study was univariate analysis with tabulation presentation (table) and bivariate analysis using a chi-square test. The results showed that the incidence of proximal femur fractures occurred most often in the age group over 40 years, which was 87 subjects (73,7%). There is a significant relationship between age and sex with the incidence of proximal femoral fracture at PKU Muhammadiyah Hospital Yogyakarta.

1 Introduction

Fracture is a condition where there is a disruption in bone discontinuity which can be caused by accidents, degenerative and pathological processes. The most frequent fracture cases are femur fractures at around 39%, followed by 15% humerus fractures, and 11% tibia and fibula fractures. Femur fractures, especially proximal femur fractures, can cause high mortality, morbidity, and disability which can affect a person's quality of life [2].

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According to the World Health Organization (WHO), the incidence of fractures will increase every years. In 2008, the incidence of fractures in the world was around 18 million people with a prevalence of 2.7%. Then, in 2009 the incidence of fractures increased to 19 million people with a prevalence of 4.2% and there was another increase in 2010 to 21 million people with a prevalence of 3.5%. In 2018, there were around 13.3 million fracture cases in the world with a prevalence of 22.7%. Then, there was another increase in 2019 with a prevalence of 44.2%, namely approximately 18.7 million people with fractures. In 2020, the increase in fracture cases was 21.6 million with a prevalence of 69.5% [4].

In Indonesia, the most common incidence of fractures is fractures of the lower extremities. This incident can be caused by injury due to an accident and can also be caused by a decrease in bone mass in the elderly. According to (Riskasdas, 2018), fractures of the lower extremities have the highest prevalence in Indonesia compared to other fractures, namely around 67.9%. Of the 92,976 cases that occurred, 19,754 people had femur fractures, 14,027 had crucis fractures, 3,775 had tibia fractures, 970 had fractures in the small bones of the feet and the remaining 337 had fractures in the fibula [5]. Based on research by The National Database of Health Insurance Claims and Specific Health Checkups of Japan, it was found that 17.7% of proximal femur fracture cases were caused by osteoporosis. Where this case is more often found in women with a total of 70,937 cases with a prevalence of 82.2%. In men, there were 15,402 cases with a prevalence of 17.8%. This was proven in research conducted by The National Osteoporosis Foundation (NOF), which found that osteoporosis cases occurred in 9.1 billion women and 2.8 billion in men. Another cause of fracture cases can be traumatic injuries such as accidents. In motor accident cases, 147,348 fracture cases occurred in the lower extremities with a case presentation of 60% in men and 40% in women [6].

The incidence of fractures generally occurs in productive ages between 25 – 65 years. In general, femur fracture cases occur in men under 30 years of age caused by high-energy trauma such as falls from heights or traffic accidents [7]. Meanwhile, in women, fractures can occur at older ages over 40 years due to low-energy injuries such as falls. In old age, fracture cases that often occur include proximal femur fractures. As age increases, the risk of proximal femur fracture increases. Where almost 90% of fracture cases are caused by predisposing factors for osteoporosis which can be seen in elderly patients with fractures that occur due to falls [8]. Femur fractures can cause complications, long-term morbidity, and disability if they do not receive good treatment. Complications that arise due to femur fractures include bleeding, wound infection, internal organ injury, and respiratory syndrome. This complication arises because the femur is the longest, strongest, and heaviest bone in the human body and functions as a support for the human body. Apart from that, the femur bone has large blood vessels so if an injury occurs to the femur it will be fatal.

Femur fracture is an emergency that must receive special attention in terms of the number of cases that occur along with the factors that support the occurrence of fractures and the treatment carried out for cases of proximal femur fractures. Based on the things mentioned above, it was found that the incidence of femur fractures in productive age is more common in men. Meanwhile, cases of femur fractures above the age of 40 years are more common in women. Therefore, researchers are interested in raising the topic of the relationship between age and gender with the incidence of proximal femur fractures.

2 Material and Methods

The research carried out was quantitative research with a descriptive-analytical nature with a cross-sectional research design and used secondary data from PKU Muhammadiyah Hospital Yogyakarta. The population in this study were femur fracture patients who were hospitalized at PKU Muhammadiyah Hospital Yogyakarta in 2022. Sampling in this study used a total

sampling technique according to certain criteria. In calculating the number of samples, this study used the Yamane Formula. The Yamane formula used to determine the sample size is as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Information:

n = Number of samples required

N = Total population

e = Sample error rate / sampling error = 5%

So samples are needed:

$$n = \frac{136}{1 + 136(0.05)^2}$$

$$n = \frac{136}{1 + 0.34}$$

$$n = 101$$

So the minimum number of samples required is 101 samples that meet the inclusion and exclusion criteria.

1. Conditions for patients who can be included in the inclusion criteria and will be the sample in this study are inpatients at the PKU Muhammadiyah Hospital in Yogyakarta and diagnosed with a femur fracture who have complete medical record data.
2. The conditions for patients included in the exclusion criteria in this study are patients with femur fractures but incomplete medical record data, patients age under 12 years and over 90 years, and patients who have experienced multiple fractures.

In this study, the variables that will be examined are the risk factors that cause proximal femur fractures, namely: age and gender. In this study, the instrument used was secondary data from patient medical records at PKU Muhammadiyah Hospital, Yogyakarta. The tools used in this research are stationery, laptops, and software in the form of Microsoft Excel and statistical data processing (SPSS) version 26.0.

3 Results and Discussion

3.1 Analysis Results

Based on the results of the analysis of patient characteristics, they are presented in the following Table 1.

Table 1. Characteristics of Research Subjects

Variable	n (118)	%
Age		
< 40 y.o	21	17.8
≥ 40 y.o.	97	82.2
Gender		
Men	37	31.4
Woman	81	68.6
Fracture Types		
Fracture <i>femur proximal</i>	89	75.4
Fracture <i>femur distal</i>	29	24.6

Based on Table 1, it was found that the highest number of patients with a diagnosis of femur fracture at PKU Muhammadiyah Hospital Yogyakarta were aged more than 40 years with the number of patients being 97 or 78.8%. Meanwhile, at the age of less than 40 years, the number of patients who experienced femur fractures was 21 patients or 21.2%. In cases of femur fractures, the majority of patients were female, 81 patients or 68.6, while 37 patients were male or 31.4%. There were 89 patients with proximal femur fractures or 75.4%, while there were 29 patients with distal femur fractures, or 24.6%.

Table 2. Relationship between age range 12 – 90 years with the incidence of proximal femur fracture

Age	Types of Femur Fractures						P Value
	Fracture Femur Proximal		Fracture Femur Distal		Total		
	n	%	n	%	n	%	
<40 y.o.	2	1.7	19	16.1	21	17.8	0.000
≥40 y.o.	87	73.7	10	8.5	97	82.2	
Total	89	75.4	29	24.6	118	100.0	

Based on Table 2, it was found that after testing 118 samples using the chi-square test, the p-value was 0.000. The relationship between variables or the relationship between variables is said to be significant if the p-value is <0.05, whereas if the p-value is ≥0.05 then there is a relationship that is not significant. In the research that has been carried out, the p-value is 0.000 so it can be said that there is a significant relationship between variables.

Table 3. Relationship between gender and the incidence of proximal femur fracture

Gender	Types of Femur Fractures						P Value
	Fracture Femur Proximal		Fracture Femur Distal		Total		
	n	%	n	%	n	%	
Man	22	18.6	15	12.7	37	31.4	0.013
Woman	67	56.8	14	11.9	81	68.6	
Total	89	75.4	29	24.6	118	100.0	

Based on Table 3, it was found that after testing 118 samples using the chi-square test, the p-value was 0.013. The relationship between variables or the relationship between variables is said to be significant if the p-value is <0.05, whereas if the p-value is <0.05 then there is an insignificant relationship between the variables. In the research that has been conducted, the p-value is 0.013 so it can be said that there is a significant relationship.

Table 4. Combined Crosstab

Age	Gender	Types of Femur Fractures					
		Fracture Femur Proximal		Fracture Femur Distal		Total	
		n	%	n	%	n	%
<40 y.o.	Man	1	4.8	11	52.4	12	57.1
	Woman	1	4.8	8	38.1	9	42.9
	Total	2	9.5	19	90.5	21	100.0
≥40 y.o.	Man	21	21.6	4	4.1	25	25.8
	Woman	66	68.0	6	6.2	72	74.2
	Total	87	89.7	10	10.3	97	100.0
Total	Man	22	18.6	15	12.7	37	31.4
	Woman	67	56.8	14	11.9	81	68.6
	Total	89	75.4	29	24.6	118	100.0

Based on Table 4, it can be seen that those aged <40 years and males who experienced a proximal femur fracture were 1 person (4.8%), while 11 people (52.4%) experienced a distal femur fracture. Then, for those aged <40 years and female, 1 person (4.8%) experienced a proximal femur fracture, while 8 people (38.1%) experienced a distal femur fracture. It can also be seen that for those aged ≥ 40 years with male gender, 21 people (21.6%) experienced proximal femur fractures, while 4 people (4.1%) experienced distal femur fractures. Then for those aged ≥ 40 years with female gender, 66 people experienced proximal femur fractures (68.0%), while those who experienced distal femur fractures were 6 people (6.2%).

3.2 Discussion

Based on the research results, 118 patients were sampled with a diagnosis of femur fracture. Based on Table 4, the highest number of patients with femur fractures was 89 patients with proximal femur fractures. In this case, the most proximal femur fractures are in women aged over 40 years. And the incidence of distal femur fractures occurred in 29 patients with the most incidents being under 40 years of age.

The results of this study are in line with research from Riswanda et al (2017) that proximal femur fractures often occur in women over the age of 40 because the bone loss has begun to occur. This is referred to as an osteoporotic fracture. Older women who experience fractures are associated with the onset of menopausal osteoporosis. Based on epidemiological studies conducted on Chinese citizens, the incidence of fractures in the lower extremities increases with age. In women, the highest incidence of fractures occurs at the age of over 80 years with 398 out of 100,000 population per year, then at the age of 75 - 79 years it is 179.5 out of 100,000 population per year and at the age of 65 - 69 years it is 161.3 out of 100,000 population per year [9].

The risk of osteoporosis is related to increasing age which can cause bones to become more susceptible to fracture. As a person ages, the risk of falling may also increase. Lack of bone density occurs in one in five women aged 45 – 49 years, up to almost half of those aged 85 years and over. Meanwhile, one in three elderly men can also experience a fracture due to reduced bone density.

In this study, almost the entire population of proximal femur fractures experienced fractures with a low-energy trauma mechanism. The mechanism experienced by the population occurs as a result of falling from an upright position, either falling or slipping. This is in line with research by Rachman, Rahmadian, Rusjdi (2023) that increasing age can result in fractures with low energy mechanisms. In this study, 63 patients with a percentage of 66.32% experienced fractures with a low energy mechanism, and several patients had a history of osteoporosis, osteosarcoma, and secondary metastases.

Normally, patients who experience low-energy trauma will not cause a fracture. However, in the case of primary bone tumors, metastases secondary, hematological malignancies (such as lymphoma, leukemia, and myeloma), osteomyelitis, and metabolic diseases such as osteomalacia, and osteoporosis cause bones to become weak or reduce bone density which can be the cause of pathological fractures. This pathological fracture can occur when under normal pressure the bone is unable to withstand and fractures [10].

In this study, the gender distribution is presented in Table 4. There were 37 male patients in this study while there were 81 female patients. The results of this study indicate that the comparison between male and female proximal femur fracture patients is not balanced or there is a difference. The results of this study are in line with research by Taufik and Rizki (2020) that the incidence of femur fractures in women was 54 with a percentage of 56.8% and in men 41 with a percentage (43.2%). Taufik and Rizki's research (2020) stated that there is a difference in the number of femur fracture patients between men and women. This is because when women experience menopause the hormone estrogen will experience a

deficiency which can cause the accumulation of HIF1 α protein in osteoclasts. With accumulation, the performance of osteoclasts will be activated, causing a reduction in bone mass [11].

In an epidemiological study in Brazil, it was found that the incidence of fractures was more common in women with a percentage of 66.8% compared to men. The incidence of fractures experienced by men is 33.2%. Women are more susceptible to fractures because they have risk factors for faster bone loss when entering menopause or in the fifth and sixth decades of age [12].

This study examines the types of femur fractures which are divided into proximal femur fractures and distal femur fractures. Of the 118 samples, 89 patients had proximal femur fractures and 29 patients had distal femur fractures. Most of the fracture locations in this study were found to be the proximal femur. This is in line with a study conducted in Sweden in 2020 that during four years, proximal femur fractures were included in the top five most frequently occurring fracture locations 13. Meanwhile, more specifically, the most common proximal femur fracture location in this study was a femoral neck fracture. (38.1%), followed by intertrochanteric femur fractures (33.1%) and the least common are subtrochanteric femur fractures (4.2%). Overall, in this study, distal femur fractures were in third place with a percentage of 24.6%. This is in line with research by Taufik and Rizki (2020) that the most frequent femur fractures are the collar of the femur (30.5%), followed by the corpus femur (31.6%), intertrochanteric femur (23.2%), distal femur (9.5%), subtrochanter of the femur (4.2%), and head of the femur (1%) 1. In Anyaehie's (2015) study in Nigeria, the most frequent cases of femur fracture were the distal femur (26.5%), followed by the collum femur (30.5%) and the fewest femur fractures were femoral head fractures (0.9%) [14].

In several studies of fractures that occurred as a result of traffic accidents in several hospitals in Indonesia, it was found that the highest incidence of femur fractures in traffic accident patients was distal femur fractures [15]. The femur is the longest bone in the human body and is divided into proximal and distal parts. The location of the fracture depends on the strength, point of impact, and the mechanism of trauma that occurs. This is due to the structure and strength of the bones one can also determine the location of the fracture [16].

The results of research at PKU Muhammadiyah Hospital Yogyakarta showed that 89% of 118 samples experienced proximal femur fractures. Specifically, 93 patients (78.8%) aged over 40 years experienced proximal femur fractures. Age in this study is one of the risk factors that can cause femur fractures. Meanwhile, no data was obtained for other factors such as pathological conditions so they cannot be measured using statistical tests. Based on the bivariate test carried out using the chi-square method in Table 5, a p-value of 0.000 was obtained. If the p-value is <0.05 then the results of this research can be declared related or significant. After conducting a bivariate test and obtaining a p-value of <0.05 , it can be concluded that there is a significant relationship between the age range of 12 - 90 years and the incidence of proximal femur fractures at PKU Muhammadiyah Hospital Yogyakarta in 2022.

This research is in line with research conducted by Asagabe and Rico (2021) that the results of the distribution of patients who experienced proximal femur fractures were mostly at the age of 60 - 80 years with a total of 10 people, followed by 9 people with an age range of 41 - 60 years and the least occurred in the age range 18 - 40 years, namely 3 people. Asagabe and Rico (2020) stated that there is a relationship between age and the incidence of proximal femur fractures. Incidence of proximal femur fracture It is estimated that it will increase in the next 25 years with the most common occurrence in people over 65 years of age. Ida's research (2019) states that the most common causes of proximal femur fractures are osteoporosis and trauma, especially in the elderly. This proximal femur fracture can occur at the age of 61 - 74 years [17].

Similar results were also obtained from research by Hye-Young Kang et al (2010) that 7,106 of the 9,817 samples were elderly people aged over 70 years. In addition, the incidence of proximal femur fractures of 6.74 per 100,000 occurs in the 50-54 year age group and increases to 686.82 per 100,000 in the age range over 85 years 18. As we age, structural damage and bone loss can cause osteoporosis. This condition is characterized by low bone mass and deficits in bone geometry. A person with osteoporosis tends to fall more easily, resulting in increased vulnerability to bone fractures which is associated with a person's age. This condition is known as a fragility fracture. The increase in the incidence of fractures by 2 million per year is caused by osteoporosis. Low bone mass, a history of previous fractures, and the patient's advanced age are strong risk factors that can cause fractures in almost any location [19].

The results of this study are not in line with research by Tasya and Heru (2022) conducted at Haji Adam Malik General Hospital, Medan, which showed that the highest incidence of femur fractures was at the age of 18 - 60 years, which occurred as a result of traffic accidents. The incidence of fractures that occur at a young age is related to the incidence of accidents due to activities outside the home which are quite high, driving behavior, and fast movements which can cause an increased risk of fractures due to impacts or accidents. 20. Meanwhile, in old age, bone loss begins to occur which causes fractures. osteoporosis [21].

This study examines one of the risk factors that can influence the incidence of femur fracture, namely gender. Specifically, 81 patients (68.6%) were female, while 37 (31.4%) male patients had femur fractures. The incidence of proximal femur fractures occurred mostly in women, as many as 67 people aged over 40 years. Based on the bivariate test carried out using the chi-square method in Table 6, the p-value was 0.013. After carrying out a bivariate test and obtaining a p-value of 0.05, it can be concluded that there is no significant relationship between types. Gender with the incidence of proximal femur fractures at PKU Muhammadiyah Hospital Yogyakarta in 2022. The results of this study are in line with research by Jon-Won et al (2014) in South Korea which states that of 247 cases, 74.4% of patients were female, while 25.6% of patients were male [22]. Patients with female gender related to the onset of menopause. An increased risk of femur fracture can be caused by bone loss so that low-energy trauma such as slipping can cause a fracture.

The results of this study are not in line with research by Valizadeh et al which states that the incidence of fractures is highest in men. When compared with Western countries, male and female patients have lower bone mass density (BMD). In the elderly, with more conducive environmental factors, the incidence of fractures can be reduced because the risk of falls decreases. In Iran, the most important characteristic of interiors is the use of rugs which is considered a conducive environmental condition. In this country, most elderly people live with their families, so they are given more attention compared to elderly people who live alone [23]. In Tasya and Heru's (2022) research, it was stated that 81 cases of male patients experienced femur fractures, while 23 cases of female patients occurred. This fracture was caused by a traffic accident. This high number of cases is due to the behavior of driving with higher force which is often carried out by men so that it can cause fatal accidents compared to women.

4 Conclusion

Based on the results of the research that has been conducted, it can be concluded that the incidence of proximal femur fracture in the elderly at PKU Muhammadiyah Hospital Yogyakarta is higher than that of distal femur fracture. The results of the bivariate analysis found that there was a relationship between age and the incidence of proximal femur fracture at PKU Muhammadiyah Hospital Yogyakarta. The older you get, the higher the risk of fractures that can be related to pathological factors.

References

1. T. Rachman, Rahmadian. Pola Penatalaksanaan Fraktur Femur Di RSUP Dr. M. Djamil Padang tahun 2020. *J. Ilmu Kesehatan. Indones.* **4**, 81–87 (2023). doi: <https://doi.org/10.25077/jikesi.v4i2.624>
2. A. Ariyanti, Skripsi November 2020 Karakteristik Pasien Fraktur Femur Di Rsup Dr . Wahidin Sudirohusodo Makassar Periode Januari - Desember 2018 Oleh : Ade Ariyanti Batti C011171049 Dosen Pembimbing : *Skripsi* (2020).
3. WHO. Age Classification According. (2014).
4. V. C. Sagar, M. Manjas, R. Rasyid, Distribusi Fraktur Femur Yang Dirawat Di RumahSakit Dr.M.Djamil, Padang (2010-2012). *J. Kesehatan. Andalas* **6**, 586 (2018). doi: <https://doi.org/10.25077/jka.v6.i3.p586-589.2017>
5. H. Platini, R. Chaidir, U. Rahayu, Karakteristik Pasien Fraktur Ekstermitas Bawah. *J. Keperawatan 'Aisyiyah* **7**, 49–53 (2020). doi: <https://doi.org/10.33867/jka.v7i1.166>
6. N. S. B. Suhail Ahmad, R. Rahmadian, D. Yulia, Gambaran Kejadian Fraktur Femur di RSUP Dr. M. Djamil Padang Tahun 2016-2018. *J. Ilmu Kesehatan. Indonesia.* **1**, 358–363 (2021). doi: <https://doi.org/10.25077/jikesi.v1i3.82>
7. G. R. Kenmegne, C. Zou, Y. Fang, X. He, Y. Lin, Yin, Y.. Femoral neck fractures in non-geriatric patients: femoral neck system versus cannulated cancellous screw. *BMC Musculoskelet. Disord.* **24**, 1–8 (2023). doi: <https://doi.org/10.1186/s12891-023-06140-3>
8. I. M. B. Wirawan, Laporan Kasus Fraktur Intertochanter Femur. *Dep. Ilmu Bedah Univ. Udayana* **41**, 144–150 (2019).
9. Y. Zhu, S. Liu, W. Chen, B. Liu, F. Zhang, Lv, H., Y. Zhang, Epidemiology of low-energy lower extremity fracture in Chinese populations aged 50 years and above. *PLoS One* **14**, 1–12 (2019). doi: <https://doi.org/10.1371/journal.pone.0209203>
10. P.R. O'Connell, A.W. McCaskie, and N. S. Williams, Short Practice of Surgery. in *Bailey & Love's Short Practice of Surgery, 27th Edition* 1632 (29 March 2018, 2018). doi: <https://doi.org/10.1201/9781315111087>
11. T. Miyamoto, Mechanism underlying post-menopausal osteoporosis: HIF1 α is required for osteoclast activation by estrogen deficiency. *Keio J. Med.* **64**, 44–47 (2015). Doi: <https://doi.org/10.2302/kjm.2015-0003-RE>
12. M. Singh, S. Arora, A. Kaur, S. Ghildiyal, R. Kumar, Patterns of age- and sex-related variations in bone mineral density of lumbar spine and total femur: A retrospective diagnostic laboratory-based study. *J. Midlife. Health* **9**, 155–161 (2018). doi: https://doi.org/10.4103/jmh.JMH_95_18
13. C. Bergh, D. Wennergren, M. Möller, H. Brisby, Fracture incidence in adults in relation to age and gender: A study of 27,169 fractures in the Swedish Fracture Register in a well-defined catchment area. *PLoS One* **15**, 1–18 (2021). doi: <https://doi.org/10.1371/journal.pone.0244291>
14. Anyaehie UE. Pattern of femoral fractures and associated injuries in a Nigerian tertiary trauma center. (2015) doi: <https://doi.org/10.4103/1119-3077.151761>
15. T. E. Sembiring, Karakteristik Penderita Fraktur femur akibat kecelakaan lalu lintas di RSUP Haji Adam Malik Medan pada tahun 2016-2018 Characteristic of femoral fracture caused by traffic accidentin Haji Adam Malik General Hospital Medan in 2016-2018. **21**, 123–128 (2022). doi: <https://doi.org/10.30743/ibnusina.v21i1.244>
16. Keyak JH. Effect of force direction on femoral fracture load for two types of loading conditions. (2001) doi: [https://doi.org/10.1016/S0736-0266\(00\)00046-2](https://doi.org/10.1016/S0736-0266(00)00046-2)
17. I. B. Gede Arimbawa, P. Astawa, I. W. Suryanto Dusak, I. K. Suyasa, Time to surgery increases pre-operative il-6 and fibrinogen levels in elderly patient with proximal femoral fracture. *J. Orthop. dan Traumatol. Indones.* **2**, 15–19 (2019). doi: <https://doi.org/10.31282/joti.v2n1.31>

18. S. Hong, K. Han, The incidence of hip fracture and mortality rate after hip fracture in Korea: A nationwide population-based cohort study. *Osteoporos. Sarcopenia* **5**, 38–43 (2019).doi: <https://doi.org/10.1016/j.afos.2019.06.003>
19. D. P. Rahayu, M. Muzada Elfa, L. Rosida, Literature Review: Perbedaan Karakteristik Lanjut Usia Dengan Osteoporosis Dan Non Osteoporosis. *Homeostasis* **4**, 203–210 (2021).
20. K. T. P. Kartika, I. W. Subawa, N. A. A. Wiguna, Profil Kasus Fraktur Leher Femur Yang Dilakukan Tindakan Operasi Di Rsup Sanglah Denpasar Periode Maret 2016- Agustus 2017 Ketut. *J. Med.* **7**, 1–6 (2018).
21. E. A. W. Wattie, A. Monoarfa, H. P. Limpeleh, Profil fraktur diafisis femur periode Januari 2013 – Desember 2014 di RSUP Prof. Dr. R. D. Kandou Manado. *e-CliniC* **4**, (2016).doi: <https://doi.org/10.35790/ecl.4.1.2016.11289>
22. C. J. C. Yeoh, M. A. Fazal, ASA Grade and Elderly Patients With Femoral Neck Fracture. *Geriatr. Orthop. Surg. Rehabil.* **5**, 195–199 (2014). doi: <https://doi.org/10.1177/2151458514560471>
23. M. Valizadeh, S. Mazloomzadeh, R. Azizi, Epidemiology of hip fractures in Zanjan, Iran. 889/Oamjms.2022.9482.