Gender differences in osteoporotic hip fractures in Sarawak General Hospital

Sharifah Aishah Wan, MRCP[1], Tiong Ing Khieng, MRCP[2], Chuah Seow Lin, MRCP[1], Cheong Yaw Kiet, MRCP[1], Benjamin Sachdev Manjit Singh, MRCP[1], Lee Kar Hoo, MRCP[1], Lee Wendy Wan Hui, MRCP[1], Teh Cheng Lay, MRCP[1], Tiong Jeh Kiong, MRCP[2], Affizal Samsudin, MRCP[3], Ahmad Tirmizi Jobli, MMEd[4]

[1]Rheumatology Unit, Sarawak General Hospital, Sarawak, Malaysia, [2]Geriatrics Unit, Sarawak General Hospital, Sarawak, Malaysia, [3]Geriatrics Unit, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia, [4]Department of Radiology, Faculty of Medicine and Health Sciences, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia

ABSTRACT

Introduction: Osteoporosis and osteoporotic fracture pose a major public health problem in our ageing population, and particularly concerning is the increased morbidity and mortality associated with osteoporotic hip fractures. While overall diagnosis and treatment for osteoporosis have improved, osteoporosis in men remains underdiagnosed and undertreated. We aim to describe the difference in clinical characteristics between elderly men and women with osteoporotic hip fractures in Sarawak General Hospital.

Materials and Methods: All patients diagnosed with osteoporotic hip fracture admitted to Sarawak General Hospital from June 2019 to March 2021 were recruited, and demographic data and clinical features were obtained.

Results: There were 140 patients with osteoporotic hip fracture, and 40 were men (28.6%). The mean age for males was 74.1 ± 9.5 years, while the mean age for females was 77.4 ± 9.1 years (p=0.06). The types of fracture consisted of neck of femur=78, intertrochanteric=61 and subtrochanteric=1. More men were active smokers (15% vs 1%, *p*<0.001). There were 20 men with secondary osteoporosis (50%), while 13 women (13%) had secondary osteoporosis (*p*<0.001). The causes of secondary osteoporosis among the men were hypogonadism, COPD, glucocorticoid-induced osteoporosis, renal disease, androgen deprivation therapy, thyroid disorder, prostate cancer and previous gastrectomy. There were two deaths among the men and four deaths among the women during the inpatient and 3 months follow-up period. There was no statistical significance between the mortality rates between male patients (5%) and female patients (4%) (*p*=0.55).

Conclusion: There were more females with osteoporotic hip fractures, and there were significantly more males with secondary osteoporotic hip fractures.

KEYWORDS:
Osteoporosis, hip fracture, secondary osteoporosis, gender difference

INTRODUCTION

Osteoporosis is an important public health issue globally, particularly in our ageing population. The main complication of osteoporosis is osteoporotic fractures, with osteoporotic hip fractures associated with increased morbidity and mortality. The rising cost of treatment of osteoporotic hip fractures will also result in an increased economic burden on healthcare systems. Cheung et al[1] studied the number of hip fractures in Asiaand projected the number of hip fractures in Asia will increase from 1,124,060 in 2018 to 2,563,488 in 2050, a 2.28-fold increase, with a rise in the direct cost of hip fractures increasing from 9.5 billion USD in 2018 to 15 billion USD in 2050, a 1.59-fold increase.[1]

While awareness of post-menopausal osteoporosis in women is increasing, along with developments in the treatment of the condition, male osteoporosis continues to be under-recognized and under-treated. There appears to be differences between male and female osteoporosis. The incidence of osteoporotic fractures in both men and women increased with ageing; however, in men the osteoporotic fractures happened about 10 years later than women.[2] The prevalence of osteoporosis in United States (US) men >50 years old was 3–6% whereas in women >50 years old it was 13–18%.[3] The biggest impact of osteoporosis is obviously the incidence of osteoporotic fractures, especially spinal and hip fractures. Hip fractures carry a high morbidity and mortality. For men, the incidence of hip fractures in the US ranged from 0.56 per 1000 patients per year at age 60 years to 13 per 1000 patients per year by age 85 years.[4]

Even though the prevalence of osteoporosis and osteoporotic hip fractures is higher in women, men seem to have a worse outcome and mortality after a hip fracture.[5] Haentjens et al[6] studied the excess mortality after a hip fracture in older men and women and concluded that older adults have a 5–8-fold increased risk for all-cause mortality during the first 3 months after a hip fracture.[6] Of particular interest is the fact that even though the excess annual mortality is high in both men and women, at any given age, the excess annual mortality post-hip fracture is higher in men compared to women.[6] The reason for the higher mortality in men after a hip fracture was likely due to men having more co-morbid conditions and men being older with more post-operative complications. Simunovic et al[7] reviewed the risk of death and post-operative complications among patients with hip fractures in fivestudies and found that hip fractures were associated with 14–36% 1-year mortality rate.[7] They also found that earlier surgery significantly reduced the risk of mortality.[7]

This article was accepted: 26 February 2023
Corresponding Author: Ahmad Tirmizi Jobli
Email: jatirmizi@unimas.my

During menopause, the abrupt loss of oestrogen causes rapid bone loss in menopausal women leading to an increased osteoporotic fracture incidence. Compare this with men, who experience a gradual decline in testosterone with ageing, resulting in gradual bone loss and subsequently having osteoporotic fractures almost 10 years later than women. The bone loss that increases with advancing age in men was demonstrated by the Osteoporotic Fractures in Men (MrOs) study, which showed that there was an increase in average bone mineral density (BMD) loss at the femoral neck with increasing age.[8] The authors of the MrOs also showed that lower BMD is associated with higher fracture risk in men; each standard deviation (SD) decrease in hip BMD increased the risk of hip fracture by 3.2-fold.[8] The age-adjusted annual rate of hip and nonvertebral fracture was 2.4 and 14 per 1000 person-years, respectively, on 4.4 years of follow-up.[8] The risk factors for low BMD and fractures in men are low weight, low physical activity, medications (selective serotonin reuptake inhibitors, anti-epileptic drugs) and medical conditions (abdominal aortic aneurysm, Parkinson's disease, poor renal function, chronic obstructive pulmonary disease, diabetes mellitus, diffuse idiopathic skeletal hyperostosis, certain ethnicity, vitamin D deficiency and hyperparathyroidism).

Secondary osteoporosis may be present in both men and women, but some studies stated that secondary osteoporosis wasmore common in men than women.[2] Identification of causes of secondary osteoporosis is useful as treatment of the underlying condition will usually improve the treatment of osteoporosis as well.[9] The most common causes of secondary osteoporosis are glucocorticoid excess, hypogonadism and excessive alcohol consumption. Other causes are gastrointestinal malabsorption syndrome, renal insufficiency, chronic respiratory disorders, rheumatoid arthritis, malignancy, anaemia, hyperthyroidism or excess thyroxine, hyperparathyroidism, anticonvulsants, smoking and immobilization.[10,11] Therefore, a careful history, physical examination and appropriate blood investigation (such as a full blood count, renal profile, liver profile, calcium, thyroid-stimulating hormone (TSH), 25-hydroxyvitamin D and testosterone) is needed during an evaluation of patients with osteoporotic risk factors and/or osteoporotic fractures.

The Malaysian hip fracture national registry in 2008–2009 from selected government healthcare facilities reported 510 cases of hip fractures, of which 165 patients were men (32%).[12] Trivial falls were the main mechanism of hip fractures.[12-14] The risk factors associated with osteoporosis were advanced age, certain ethnicity, the female gender, family history, low body mass index, sedentary lifestyle, smoking, alcohol, low calcium and vitamin D intake.[15] Malaysia would expect to have an increased incidence of osteoporotic fractures as life expectancy improves. Increased awareness about this condition will hopefully result in improved screening, diagnosis and treatment of the condition in both men and women.

We aimed to describe the gender difference in clinical characteristics in elderly patients with osteoporotic hip fractures in Sarawak General Hospital in this study.

MATERIALS AND METHODS

This was a prospective, observational study. This study, titled 'Osteoporotic hip fractures in Sarawak General Hospital' was registered in the Malaysian National Medical Research Register (NMRR) and received approval from the Malaysian Medical Research and Ethics Committee (MREC) (NMRR-19-323-46068 IIR) and was performed in accordance with the Declaration of Helsinki. All patients with osteoporotic hip fractures admitted to the Orthopaedics Ward, Sarawak General Hospital from June 2019 until March 2021 were recruited into the study after giving informed consent. A low trauma hip fracture is diagnosed as a presumptive osteoporotic fracture. Data regarding demographics, type of fractures, surgery, health co-morbidities, investigation results, dual energy x ray absorptiometry (DXA) and treatments were collected. All patients were assessed for causes of secondary osteoporosis clinically and additional blood investigations as necessary. All treatments for osteoporosis were according to the standard of care. The patients were subsequently followed up in the osteoporosis or geriatric clinics 3 months later, and further clinical data were collected among those who attended the clinics, including the death outcome. This study estimates the prevalence of male osteoporotic hip fracture is at 10%. With a margin of error of 5%, the minimum required sample was 138 based on a 95% confidence interval. This is quoted using Epi Info software by CDC.

Statistical analysis was performed using IBM SPSS Statistics version 25 software. Descriptive data areexpressed as mean ± SD. ANOVA is used for the comparison of means between groups. Categorical data are presented as frequency and percentage and analysed using Chi-square or Fisher's exact test. A value of $p < 0.05$ is considered statistically significant.

RESULTS

The demographics and clinical data of all patients are presented in Table I. There were 140 patients with osteoporotic hip fracture recruited in this study, with 40 male patients (28.6%). The mean age for males was 74.1 ± 9.5 years, while the mean age for females was 77.4 ± 9.1 years, and the difference was not statistically significant (p=0.06). The majority were non-smokers (77.9%). More men were active smokers compared to women (15% vs 1%, p<0.001). The ethnicity data did not show any statistical significance (p=0.49), but there seems be less Malay men compared to Malay women (12.5% men vs 21% women) among the patients with osteoporotic hip fractures, and more Bidayuh men compared to Bidayuh women (15% men vs 9% women) with osteoporotic hip fractures.

The co-morbidities that were present before the diagnosis of osteoporotic hip fracture were hypertension, diabetes mellitus, dyslipidemia, asthma, COPD, rheumatoid arthritis, malignancy, chronic kidney disease and thyroid disease (Table I). There were statistically significant differences between the number of men and women with diabetes mellitus (17.5% vs 41%, p=0.01), COPD (10% vs 2%,p=0.03) and chronic kidney disease (12.5% vs 3%, p=0.03). 65% of men and women had more than one co-morbidities (p=0.54). 15 women (15%) and 3 men (7.5%) had a previous osteoporotic fracture. Among those with a previous

Table I: Demographic and clinical data of patients with osteoporotic hip fracture

Clinical characteristics	Number of female patients (%), n=100	Number of male patients (%), n=40	*p* value
Number of patients	100(71.4)	40 (28.6)	n/a
Mean age	77.4 ±9.1 years	74.1±9.1 years	0.06
Ethnicity			
Chinese	58.0	22 (55)	0.49
Malay	21.0	5 (12.5)	
Iban	11.0	7 (17.5)	
Bidayuh	9.0	6 (15)	
Indian	1.0	0(0)	
Smoking history			
Non smoker	93.0	16(40)	**<0.001**
Ex smoker	6.0	18(45)	
Current smoker	1.0	6(15)	
Co-morbidities before fracture			
Hypertension	78.0	32(80)	0.79
Diabetes mellitus	41.0	7(17.5)	**0.01**
Dyslipidemia	38.0	16(40)	0.82
Asthma	3.0	0(0)	0.26
COPD	2.0	4(10)	**0.03**
Rheumatoid arthritis	3.0	0(0)	0.27
Malignancy	4.0	4(10)	0.17
Chronic kidney disease	3.0	5(12.5)	**0.03**
Thyroid disease	4.0	5(12.5)	0.82
Previous osteoporotic fracture	15(15)	3(7.5)	
More than one co-morbidity	65.0	26 (65)	0.54
Type of hip fracture			
Neck of femur	54.0	24 (60)	0.69
Intertrochanteric	45.0	16 (40)	
Subtrochanteric	1.0	0(0)	
Management of hip fracture			
Conservative management	21.0	15(37.5)	0.22
Proximal femoral nail antirotation (PFNA)	24.0	5 (12.5)	
Dynamic hip screw (DHS)	19.0	7(17.5)	
Thompson hemiarthroplasty	19.0	5(12.5)	
Total hip replacement (THR)	17.0	8 (20)	
DXA			
Mean neck of femur BMD	0.491(±0.10), n=21	0.583(±0.07), n=4	0.11
Secondary osteoporosis	13.0	20(50)	**<0.001**
Secondary osteoporosis detected after screening	2.0	7(5)	**<0.001**
Outcome			
Alive	96.0	38(95)	0.55
Dead	4.0	2(5)	

Table II: List of osteoporosis treatment started post-fracture

Treatment started post-fracture	Number of female patients (%), n=100	Number of male patients(%), n=40	*p* value
Treatment started post-fracture			
Calcium	100.0	40(100)	n/a
Vitamin D	100.0	40(100)	n/a
Bisphosphonates	34.0	6(15)	**0.03**
Denosumab	3.0	0	0.5
Patients still on active treatment	23.0	5(12.5)	0.26

Table III: Causes of secondary osteoporosis among all patients with osteoporotic hip fractures

Causes of secondary osteoporosis among female patients, n=13 , number (%)		Causes of secondary osteoporosis among male patients, n=20, number (%)	
Thyroid disorders	4(30.8)	Hypogonadism	6(30.0)
Rheumatoid arthritis	3(23.1)	COPD	4(20.0)
CKD/ESRF	2(15.4)	GIOP	3(15.0)
COAD	2(15.4)	CKD/ESRF	3(15.0)
Early menopause	1(7.7)	ADT	1(5.0)
Letrozole	1(7.7)	Thyroid disorders	1(5.0)
		Prostate cancer	1(5.0)
		Previous gastrectomy	1(5.0)

osteoporotic fracture, only seven were on calcium and vitamin D supplementation, while none were on bisphosphonate or denosumab.

Most of the patients sustained neck of femur fracture(55.7%) followed by intertrochanteric(43.6%) and subtrochanteric (0.7%). Surgical intervention was the mainstay of treatment in 74.2% while conservative treatment was administered in 25.7%. There is a trend of less men receiving surgical treatment after sustaining a fracture (37.5% men vs 21% women), but this is not statistically significant (p=0.22).

Only 21 patients had DXA scans performed (17 women and 4 women). The mean neck of femur BMD was 0.491(±0.10) in women and 0.583 (±0.07) in men (p=0.11).

The treatment started during admission post-fracture is presented in Table II. All patients received calcium and vitamin D on admission, while bisphosphonate and denosumab were started during follow-up. Forty patients received bisphosphonate while three patients received denosumab. However, many patients defaulted follow-up, and only 23 women (23%) and 5 men (12.5%) are still on active follow-up. Among those who defaulted follow-up, the average duration of treatment was 2.60 months (±3.65).

The secondary osteoporosis causes that were identified among all patients were COPD, hypogonadism, thyroid disorders, chronic kidney disease (CKD)/End stage renal failure (ESRF), glucocorticoid-induced osteoporosis (GIOP), rheumatoid arthritis, androgen deprivation therapy (ADT), asthma, early menopause, aromatase inhibitor therapy, malnutrition from previous gastrectomy and prostate cancer. 50% of the male patients had an identifiable causes of secondary osteoporosis, while only 13% of the female patients had secondary osteoporosis (p<0.001). After screening for secondary osteoporosis, 5% of men and 2% of women were discovered to have an identifiable cause of secondary osteoporosis (p<0.001) (Table I). The serum calcium result was available for 131 patients (95 women and 36 men), and the mean serum calcium level was 2.26 (±0.13) mmol/L in women and 2.28±0.17 mmol/L inmen.

Table III shows the causes of secondary osteoporosis in both men and women. The main causes of secondary osteoporosis in men were hypogonadism (30%) followed by COPD, GIOP and CKD.

During the inpatient and 3-month follow-up period, twomen and fourwomen died. Four patients died during admission, while two patients died during the 3-month follow-up period. Three patients died from sepsis, while one patient died from COAD. There was no statistical significance in the mortality rates between male patients (5%) and female patients (4%) (p=0.55). The mortality rate between those who underwent surgery (2.9%) and those who opted for conservative treatment (8.3%) was not statistically significant (p=0.6).

DISCUSSION

Even though we are facing an ageing population with an expected rise in cases of osteoporotic hip fractures, there is still poor awareness regarding osteoporosis. Male osteoporosis, being less common than female osteoporosis, continues to receive little attention in terms of screening, diagnosis and treatment. This can hopefully be remedied by increased clinical data in the field of osteoporosis. The Malaysian clinical guidance for the management of osteoporosis included some data regarding the incidence and treatment for male osteoporosis.[16] Data from other Asian countries are available as well, with the Asian Osteoporosis comparing hip fracture data from Hong Kong SAR, Singapore, Malaysia and Thailand (Chiang Mai) in 1997.[17] The study reported the age-adjusted incidence rate for men and women as follows (per 100,000): Hong Kong 180 and 459, Singapore 164 and 442, Malaysia 88 and 218, Thailand 114 and 289; compared with US Whites 187 men and 535 women. In our study, the incidence of male osteoporotic hip fracture was 28.6%, which was similar to other studies. In our study, as expected, the proportion of women with osteoporotic hip fractures outnumbered the men. Both groups have a mean age of >70 years. However, there was no statistically significant difference in mortality rates among the men and women in our study. This may be due to both groups being in the elderly group with co-morbidities.

Our current study showed that 50% of our male patients and 13% of female patients had secondary osteoporosis. This finding is consistent with reported data that 30% of post-menopausal women and 50–80% of men were found to have secondary osteoporosis.[18] It is worthwhile to consider secondary osteoporosis, as the treatment may be different for certain underlying conditions, and certain conditions and medications may need bone health issues to be addressed.[18] Ryan et al[19] examined 234 men diagnosed with osteoporosis via DXA and measured 25-OH-vitamin D, testosterone, luteinizing hormone, follicular stimulating hormone (FSH), thyroid stimulating hormone (TSH) and spot urinary calcium-to-creatinine.[19] 75% had secondary osteoporosis including hypogonadism, vitamin D deficiency, hypercalciuria, subclinical hyperthyroidism and hyperparathyroidism.[19] The authors showed that with history, physical examination and basic laboratory investigationswill help to identify osteoporotic men with secondary osteoporosis.[19] Colangelo et al[20] proposed that after history and physical examination, a first-level laboratory test of full blood count, erythrocyte sedimentation rate (ESR), serum calcium, phosphorus, creatinine, alkaline phosphatase, total protein with electrophoresis and a 24-hour urinary calcium should be performed.[20] Other laboratory investigations such as ionised calcium, parathyroid hormone (PTH), 25-OH-vitamin D, TSH, dexamethasone suppression test, serum and urinary immunofixation, anti-transglutamase antibodies, testosterone in men, serum tryptase and ferritin, should be considered clinically if indicated.[20]

There were three men on glucocorticoids and one man on androgen deprivation therapy (ADT) in our study. Patients on these medications are recommended for osteoporosis evaluation (including Fracture Risk Assessment Tool (FRAX), BMD), calcium and vitamin D supplementation and treatment with bisphosphonate, denosumab or teriparatide as appropriate.[20] Adler et al[21] examined 115 men on ADT referred for DXA and found 33% would need osteoporosis treatment. Clinicians should be more aware of osteoporosis evaluation when prescribing medications such as ADT and glucocorticoids.

There has been much development in the treatment of post-menopausal osteoporosis, but data for male osteoporosis treatment are notable as well. There is less evidence for the treatment efficacy of male osteoporosis due to the smaller number of male participants compared to women in clinical trials. Evidence-based treatments for male osteoporosis are bisphosphonates (alendronate, risedronate, zoledronic acid), denosumab and teriparatide.[22-28] There is compelling evidence that current osteoporosis treatment is equally effective in men and women, not only to increase BMD but also to prevent osteoporotic fractures.[29] Effective treatment for GIOP for men and for male osteoporosis on ADT includes bisphosphonates, denosumab and teriparatide.[26,30-31] Testosterone replacement is indicated for symptomatic hypogonadal men, but data on its efficacy for fracture prevention arelacking. Thus, additional osteoporosis treatment may be needed, especially in men with very low testosterone who are at high risk of bone loss and/or men not able to receive testosterone replacement.[32]

However, there still exists a treatment care gap between men and women. The Canadian Multicentre Osteoporosis Study found that between 1996 until 2002, 90% of men with fragility fractures remained undiagnosed and untreated for osteoporosis.[33] Yeap et al[34] found that following a hip fracture, only 36.8% of patients (men and women) received treatment, but out of these, 24.2% were on calcium and vitamin D only.[34]

There is a need to increase awareness of male osteoporosis among clinicians, so a diagnosis is made, and appropriate treatment administered, especially among those with fragility fractures and those at risk of secondary osteoporosis. There are guidelines that recommendbone health assessment, obtaining DXA and FRAX in those at risk of osteoporosis, and starting appropriate treatment.[35,36] The Canadian Osteoporosis Society recommends screening men >65 years old for osteoporosis, while the National Osteoporosis Foundation and International Society for Clinical Densitometry and the Endocrine Society recommend screening all men >70 years old or men aged 50-69 years old with risk factors.[36] Alswat et al[37] analysed the rate of osteoporosis screening between men and women in primary care, and men had a screening rate of 18.4% compared to females screening rate of 60%.[37] De Martinis and colleagues[38] also highlighted the gender bias in osteoporosis screeningand found that among those referred for osteoporosis screening at their centre, 94.5% were women while only 5.4% were men. They also found that men were under-screened for osteoporosis, exhibited secondary osteoporosis more frequently and had a higher calculated risk for hip fractures compared to women.[38]

LIMITATIONS

The death outcome was collected at inpatient and at 3-month follow-up visit only. This may not reflect the 1-year mortality rate. The difference in mortality rates between those who had surgery and those who opted for conservative treatment is likely affected by this factor as well. Data collection was temporarily halted during the height of the Coronavirus Disease 2019 (COVID-19) pandemic as the fracture liaison services were temporarily stopped. The number of cases in this study may not reflect the true incidence of male osteoporotic hip fractures. Some investigation results were not available for the secondary osteoporosis screening, and the number of secondary osteoporosis may not be truly reflected. Some patients may have been treated in private healthcare facilities, and our patient cohort may not be reflective of the population in Kuching and its surrounding areas.

CONCLUSION

The gender differences in osteoporotic hip fractures in the elderly are the increased proportion of women compared to men, and men havesignificantly increased incidence of secondary osteoporosis. Men had more CKD and COPD, and more men were smokers, while more women had diabetes mellitus. There does not seem to be a difference in mortality rates between men and women in this study. Clinicians should be more aware of the importance of screening, diagnosis and treatment of osteoporosis, especially in the context of an ageing population.

ETHICS APPROVAL

This study received ethics approval from the Malaysian Medical Research and Ethics Committee (NMRR-19-323-46068 IIR).

INFORMED CONSENT

All participants in this study provided informed consent to participate.

ACKNOWLEDGEMENTS

The authors would like to thank Dr Mohd Adam bin Bujang, Research Officer, Clinical Research Centre, Sarawak General Hospital, for his guidance and advice regarding the statistical analysis in this study. We would like to thank the Director General of Health Malaysia for his permission to publish this article. We would like to thank Universiti Malaysia Sarawak for their support.

COMPETING INTERESTS

The authors declare that they have no competing interests inthis study.

REFERENCES

1. Cheung CL, Ang SB, Chadha M, Chow ESL, Chung YS, Hew FL, et al. An updated hip fracture projection in Asia: The Asian Federation of Osteoporosis Societies study. Osteoporosis Sarcopenia 2018; 4: 16-21
2. Adler RA. Osteoporosis in men: a review. Bone Res 2014; 2: 14001
3. Walsh JS, Eastell R. Osteoporosis in men. Nat Rev Endocrinol 2013; 9(11): 637-45.

4. Willson T, Nelson SD, Newbold J, Nelson RE, LaFleur J. The clinical epidemiology of male osteoporosis: a review of the recent literature. Clin Epidemiol 2015; 7: 65-76.
5. Cawthon PM. Gender differences in osteoporosis and fractures. Clin Orthop Relat Res 2011; 469: 1900-5.
6. Haentjens P, Magaziner J, Colón-Emeric C, Vanderschueren D, Milisen K, Velkeniers B et al. Meta analysis: excess mortality after hip fracture among older men and women. Ann Intern Med 2010; 152(6): 380-90.
7. Simunovic N, Devereaux PJ, Sprague S, Guyatt GH, Schemitsch E, DeBeer J et al. Effect of early surgery after hip fracture on mortality and complications: systematic review and meta-analysis. CMAJ 2010; 182(15): 1609-16.
8. Cawthon PM, M Shahnazari, Orwoll ES, Lane NE. Osteoporosis in men: findings from the osteoporotic fractures in men study (MrOs). Ther Adv Musculoskel Dis 2016; 8(1): 15-27.
9. Gielen E, Vanderschueren D, Callewaert F, Boonen S. Osteoporosis in men. Best Practice Res Clin Endocrinol Metab 2011; 25: 321-35.
10. Adler RA. Update on osteoporosis in men. Best Practice Res Clin Endocrinol Metab 2018; 32(5): 759-72.
11. Ebeling PR. Osteoporosis in men. Curr Opin Rheumatol 2013; 25: 542-52.
12. Mohammad Anwar Hau Abdullah, Ahmad Tajuddin Abdullah (Eds). Annual Report of the NORM-Registry 2009. Kuala Lumpur, Malaysia: National Orthopaedic Registry Malaysia, 2009.
13. I Isnoni, Mohd Adam B, M Murallitharam, Tajuddin A, Jaya Purany SP, Manmohan S et al. Pre-injury demographic patterns of patients sustaining hip fractures in Malaysia. Mal Orthop J 2012; 6(4): 11-5.
14. Sabarul AM, Current scenario of hip fracture cases in Malaysia. Res Updates Med Sci (RUmeS) 2015; 3(3): 1-2
15. Ahmad MS, Mohamed IN, Mokhtar SA, Shuid AN. Review of the risk factors of osteoporosis in the Malaysian population. Res Updates Med Serv (RUmeS) 2015; 3(1): 77-82.
16. Yeap SS, Hew FL, Damodaran P, Chee W, Lee JK, Goh EML et al. A summary of the Malaysian Clinical Guidance on the management of postmenopausal and male osteoporosis, 2015. Osteoporosis Sarcopenia 2016; 2: 1-12.
17. Lau EMC, Lee JK, Suriwongpaisal P, Saw SM, Das de, Khir A et al. The incidence of hip fracture in four Asian countries: The Asian osteoporosis study. Osteoporos Int 2001; 12: 239-43.
18. Mirza F, Canalis E. Secondary osteoporosis: pathophysiology and management. Eur J Endocrinol 2015; 173(3): R131-R151.
19. Ryan CS, Petkov VI, Adler RA. Osteoporosis in men: the value of laboratory testing. Osteoporos Int 2011; 22: 1845-53.
20. Colangelo L, Biamonte F, Pepe J, Cipriani C, Minisola S. Understanding and managing secondary osteoporosis. Expert Rev Endocrinol Metab 2019; 14(2): 111-22.
21. Adler RA, Hastings FW, Petkov VI. Treatment thresholds for osteoporosis in men on androgen deprivation therapy: T score vs FRAX. Osteoporos Int 2010; 21: 647-53.
22. Khan AA, Hodsman AB, Papaionnaou A, Kendler D, Brown JP, Olszynski WP. Management of osteoporosis in men: an update and case example. CMAJ 2007; 176(3): 345-8.
23. Giusti A, Bianchi G. Treatment of primary osteoporosis in men. ClinInterv Aging 2015; 10: 105-15.
24. Kaufman JM, Reginster JY, Boonen S, Brandi ML, Cooper C, Dere W, et al. Treatment of osteoporosis in men. Bone 2013; 134-44.
25. Korpi-Steiner N, Milhorn D, Hammet-Stabler C. Osteoporosis in men. Clin Biochem 2014; 47(10-11): 950-59.
26. Watts NB, Adler RA, Bilezikian JP, Drake MT, Eastell R, Orwoll ES et al. Osteoporosis in men: an endocrine society clinical practice guideline. J Clin Endocrinol Metab 2012; 97: 1802-22.
27. Zeng LF, Pan BQ, Liang GH, Luo MH, Cao Y, Guo D et al. Does routine anti-osteoporosis medication lower the risk of fractures in male subjects? An updated systematic review with meta analysis of clinical trials. Front Pharmcol 2019; 10: 882.
28. Porcelli T, Maffezzoni F, Pezzaioli LC, Delbarba A, Cappelli C, Ferlin A. Male osteoporosis: diagnosis and management- should the treatment and the target be the same as for female osteoporosis? Eur J Endocrinol 2020; 183: R75-R93.
29. Laurent M, Gielen E, Claessens F, Boonen S, Vanderschueren D. Osteoporosis in older men: Recent advances in pathophysiology and treatment. Best pract Res Clin Endocrinol Metab 2013; 27(4): 527-39.
30. GlüerCC, Marin F, D Ringe J, Hawkins F, Moricke R, Papaioannu N et al. Comparative effects of teriparatide and risedronate in glucocorticoid-induced osteoporosis in men: 18-month results of the EuroGIOPs trial. J Bone Mineral Res 2013; 28(6): 1355-68.
31. Mosekilde L, Vestergaard P, Rejnmark L. The pathogenesis, treatment and prevention of osteoporosis in men. Drugs 2013; 73: 15-29.
32. Rochira V, Antonio L, Vanderschueren D. EAA clinical guideline on management of bone health in the andrological outpatient clinic. Andrology 2018; 6: 272-85.
33. Papaioannou A, Kennedy CC, Ioannidis G, Gao Y, Sawka AM, Goltzman D, et al. The osteoporosis care gap in men with fragility fractures: the Canadian Multicentre Osteoporosis Study. Osteoporos Int 2008; 19: 581-87.
34. Yeap SS, Nur Fazirah MFR, Nur Aisyah C, Sham SYZS, Samsudin IN, Thambiah SC et al. Trends in post osteoporotic hip fracture care from 2010 to 2014 in a private hospital in Malaysia. Osteoporosis and Sarcopenia 2017; 3(2): 112-6.
35. Qaseem A, Snow V, Shekelle P, Hopkins RJ, Forciea MA, Owens DK. Screening for osteoporosis in men: A clinical practice guideline from the American College of Physicians. Ann Int Med 2008; 148: 680-4.
36. Alswat KA. Gender disparities in osteoporosis. J Clin Med Res 2017; 9(5): 382-87.
37. Alswat K, Myers Adler S. Gender differences in osteoporosis screening: retrospective analysis. Arch Osteoporos 2012; 7: 311-13.
38. De Martinis M, Sirufo MM, Polsinelli M, Placidi G, Di Silvestre D, Ginaldi L. Gender difference in osteoporosis: a single center observational study. World J Mens Health 2021; 39(4): 750-59.