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Research Article

Prevalence of Osteoporosis in Males: A Retrospective Study in a Tertiary Referral Center

Abstract

Background: Osteoporosis in men had been noted to cause significant morbidity and mortality-associated fractures. However, they are under diagnosed and under treated with limited studies up to date.

Objectives: This study aims to determine the prevalence of osteoporosis among males, their demographic profile as well as identify risk factors that contributed to their bone health.

Methodology: A retrospective analytical study was conducted among male patients at the University of Santo Tomas Hospital (USTH). Age, Body Mass Index (BMI), co-morbidities, tobacco smoking history, physical inactivity, medication intake, history of trauma or fractures, Osteoporosis Self-Assessment Tools for Asians (OSTA) and FRAX scores were gathered and analyzed.

Results: A total of 219 males who underwent DXA scan were included in the study where the majority are Filipinos (77.6%), with age ranges 22 to 92 years old and an average age of 64.58 years old SD 14.42 years. The average BMI score was 24.78 kg/m^2, where more than a third was overweight (33.3%) and a few were obese (11%). More than half were aged more than 70 years old (64.8%). The average BMD score was -1.65 ± 1.30 or osteopenia. There was 39.7% who have low bone mass or osteopenia, 26% have osteoporosis and 19.2% had severe osteoporosis. Among the risk factors, 9 patients had weight loss of more than 10% (30%), smokers (32%), had inadequate calcium intake (33.3%), 4.6% had a family history of osteoporosis and 21.5% have history of traumatic fractures. In terms of medications, 53% were on steroids, while 1.8% had androgen deprivation therapy. Among these risk factors, age, family history of osteoporosis and history of fracture showed significant differences.

Conclusion: The prevalence of osteoporosis among men in this study is 26% with 95% confidence interval of (0.202, 0.318). Age and BMI were contradicting risk factors that had significant effect on osteoporosis. Age, history of fractures and family history of osteoporosis showed increase fracture risk.

Keywords: Osteoporosis • BMD • Male • Fracture

Imee Lynne C Esquibel*, Julie T Li-Yu

Department of Medicine, University of Santo Tomas Hospital, Manila, Philippines

***Author for correspondence:**

Zhangw56@fudan.edu.cn

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Introduction

Bone is constantly changing, that is old bone is removed and replaced by new bone. For most people, bone mass peaks during the third decade of life. By this age man have typically accumulated more bone mass than women. Men in their fifties do not experience the rapid loss of bone mass that women do in the years following menopause. By age 65 or 70, however, men and women are losing bone mass at the same rate [1].

Osteoporosis is a chronic, progressive disease characterized by low bone mass, bone deterioration and decreased bone strength resulting in bone fragility and increased fracture risk. Osteoporosis increasingly is being recognized as an important cause of morbidity and mortality in older men [2]. It has also been a tremendous economic burden worldwide. Despite the advancement in technology, the Philippines as well as other third world countries has been limited in the maximal utilization of bone mineral density measurement [3].

Dual X-ray Absorptiometry (DXA) is the gold standard for detecting osteoporosis which measures bone densitometry based on differential absorption of two x-ray beams by bone and soft tissues. It is a useful tool in early diagnosis of osteoporosis for effective therapeutic and preventive measure initiation [4].

Low bone mass is the most important predictor of fragility fracture. Bone measurements may vary among people of different racial background living in specific geographic areas with differences in climate, exposure to sunlight and dietary habits. A contribution by the genetic potential to variability in bone mass may be observed comparing measurements in people of African origin and Caucasians. It's well known that, even when matched for age and weight, blacks attain a higher peak bone mass, have higher bone density and fewer osteoporotic fractures than whites [5].

Globally, about one third of hip fractures occur in men. And according to the World Health Organization (WHO) estimate, in the next 50 years, 50% of hip fracture incidence will be in Asia and thus an increasingly important public health issue [6]. Men suffer osteoporotic fractures about 10 years later in life than women, but life expectancy is increasing faster in men than in women. And with this, men live long enough to be in high risk of having fractures especially those who had fragility fracture, on oral steroids or those on treatment with prostate cancer.

In the Philippines, 11.4% of men aged between 60-69 years are considered at high risk for osteoporosis. According to the osteoporosis self-assessment tool for prevalence of low bone mass (T-score ≤ 2.0) in Filipino women aged over 50 years was 65.2% and 68.8% in men. The IOF hip fracture incidence map indicates the Filipino hip fracture incidence is 93/100,000 per year (133/100,000 per year in women and 48/100,000 per year in men) [7].

Materials and Methods

This was a retrospective single center analytical review conducted at the University of Santo Tomas Hospital (USTH). The Institutional Review Board (IRB) of the hospital approved the study design. Adult Filipino men were included in the study and data on age, diagnosis, height, weight, BMI, co-morbidities, tobacco smoking history, physical inactivity, medication intake, history of trauma or fractures were collected from patient records.

The DXA scan was used in determining the BMD of the patients that involved the following sites: Lumbar spine, proximal femur and distal forearm. Osteoporosis and osteopenia were diagnosed based on the WHO criteria. The center uses the lunar DPX-IQ (general electric's healthcare, little Chalfont, UK) densitometer that comes with automated clinical software for anterior-posterior spine, femur, total body and tissue quantification. Precision error of the machine were as follows 0.95% Coefficient of Variation (CV), 1.71% CV and 1.02% CV for the lumbar spine, femur and forearm respectively. Fragility fracture was defined as a fall from standing height or less. Results from male patient who underwent DXA scan from January 1, 2010 to December 31, 2016 for baseline examination were gathered and analyzed. Out of the 291 records reviewed, 72 were excluded because they have already been diagnosed with osteoporosis and receiving treatment. Osteoporosis Self-Assessment Tools for Asians (OSTA) score and Fracture Risk Assessment Tool (FRAX) score were recorded. OSTA score was developed in 2011 used for increased risk of osteoporosis having a sensitivity of 90% and specificity of 45%. It is categorized as follows: low risk (≤ 1), intermediate risk (-1 to 4) and high risk (≥ 4). On the other hand, FRAX is a web based calculator that uses age, sex, race/ethnicity, Body Mass Index (BMI), paternal history of hip fracture, smoking, alcohol consumption, use of glucocorticoids, history of rheumatoid arthritis and history of secondary causes of osteoporosis to predict risk of a hip fracture or a major osteoporotic fracture. A 10-year risk of major osteoporotic fracture of 9.3% or greater is defined as the screen group while a score of 6 or less comprises the do-not-screen group.

Data were analyzed using the SPSS software. Descriptive statistics such as the mean, standard deviation, the median, minimum and maximum will be used to describe the patients in terms of their bone densities and body size measurements. Frequency and percentage distributions were used to profile the respondents according to their demographic characteristics. ANOVA whichever is appropriate, was used to compare the average bone mineral densities of patients across categories of demographic variables. Pearson's correlation coefficients had been used to determine the magnitude and direction of the association/relationship of bone densities and body size measurements. Regression analysis had been used to determine significant factors affecting bone density.

Results

Demographic and clinical pro ile

A total of 219 males who underwent Dual X-ray Absorptiometry (DXA) scan were included in this study. Majority of these patients are Filipinos (77.6%), with age ranges from 22 to 92 years old, mostly aged at least 60 years old (70.3%).

The average age of these patients is 64.58 years with a standard deviation of 14.42 years. With an average BMI score of 24.78 (normal). In fact, 46.6% are classified as normal while more than a third of these patients were classified as either overweight (33.3%) or obese (11.0%). Tables 1 and 2 show these statistics.

Table 1: Distribution of respondents based on their demographic profile and BMI.

Profile	(n=219)	%
Age Group		
Less than 60	65	29.7
60-69	71	32.4
70-79	52	23.7
80 and above	31	14.2
Nationality		
Filipino	170	77.6
Chinese	29	13.2
Filipino-Chinese	12	5.5
Others	8	3.7
Body Mass Index (BMI)		
Underweight	20	9.1
Normal	102	46.6
Overweight	73	33.3
Obese	24	11

Table 2: Descriptive summary of age and anthropometric measurements.

Characteristics	N	Mean	SD	Median	Minimum	Maximum
Age	219	64.58	14.42	66	22	92
Weight (kg)	218	68.05	14.89	67	34	122
Height (m)	219	1.66	0.07	1.65	1.45	1.88
BMI (kg/m^2)	219	24.78	4.65	24.75	12.6	44.08

Table 3 below shows the risk factors of osteoporosis present in these sets of patients. More than half (64.8%) aged more than 70 years old and 53.4% have BMI categorized as not normal. Nine patients reported weight losses of more than 10% while almost a third posted physical inactivity (30.6%), smoking (32.0%) and inadequate calcium intake (33.3%).

Only 10 or 4.6% have family history of osteoporosis while 21.5% have history of traumatic fractures or spinal cord injuries. In terms of medication, 116 patients (53.0%) were taking medications like steroids (14.6%) androgen deprivation therapy (1.8%) and/or other medications (45.2%).

Table 3: Distribution of patients based on possible risk factors and medication.

Profile	n	%
Age>70	142	64.8
BMI not normal		
Underweight	20	9.1
Overweight	73	33.3
Obese	24	11
Weight loss>10%	9	4.1
Physical inactivity	67	30.6
Smoking	70	32
Alcohol intake	1	0.5
Inadequate calcium intake	73	33.3
Family history of osteoporosis	10	4.6
History of traumatic fracture/ spinal cord injury	47	21.5
Medication		
Steroids	32	14.6
Androgen deprivation therapy	4	1.8
Other medications	99	45.2

BMD and the prevalence of osteoporosis

Based on the Osteoporosis Self-Assessment (OSTA) score of these patients, majority were classified as having low risk of osteoporosis (57.5%) while 37.9% have either medium risk (24.7%) or high risk (13.2%) of having this disease. Now, based on their dual x-ray absorptiometry scans, the average BMD is -1.65 ± 1.30 which is interpreted as low bone mass or osteopenia. Among the 219 male patients, 39.7% (n=87) have osteopenia of the lumbar spine at 17.3% (n=38) while 22.4% (n=49) of the femoral neck. On the other hand, more than a quarter (26.0%) have either osteoporosis (19.2%) or severe osteoporosis (6.8%). Osteoporosis from the lumbar spine was slightly higher at 13.7% (n=30) compared with the femoral neck at 12.7% (n=28). Thus, the overall prevalence rate of osteoporosis is 26.0% with 95% confidence interval of (0.202, 0.318), which means that at least 20% of the population were these males were sampled, may have osteoporosis (Table 4).

Table 4: Distribution of respondents based on their demographic and clinical profile.

Profile	n	%
Bone Mineral Density (BMD)		
Normal	75	34.2
Low bone mass	87	39.7
Osteoporosis	42	19.2
Severe osteoporosis	15	6.8
OSTA screening		
Low	126	57.5
Medium	54	24.7
High	29	13.2
No data	10	4.6

Table 5 below shows the average BMD T-scores at the lumbar, femoral neck and radius levels, together with other descriptive statistics. These T-scores together with the total BMD score will be used to compare different categories of the demographic profile and risk factors. Using the WHO definition of osteoporosis, the average T-scores taken in the lumbar spine, left and right femoral neck, all suggest low bone density, *i.e.,* patients have on average osteopenia.

It also includes the average FRAX scores of the patients which estimate their 10-year probability of fracture risk. On average, the hip FRAX score is 1.50 ± 2.21 and the major fracture FRAX score is 3.08 ± 2.88, which means that in 10 years, there is a 1.50% chance of having a hip fracture and a 3.08% chance of having a major fracture. These fracture risks range from 0.00 to 16.0% for the hip and 0.2% to 18.0% for the major fracture.

Table 5: Descriptive summary of densitometric measurements and risk of fracture associations between BMI and BMD and fracture risk.

Variables	N	Mean	SD	Median	Minimum	Maximum
Total BMD	219	-1.65	1.3	-1.6	-6.5	1.5
Lumbar spine T-score	191	-1.03	1.62	-1.2	-5.8	4.2
Left femoral neck T- score	162	-1.19	1.33	-1.2	-4.9	2.8
Right femoral neck T-score	62	-1.6	1.21	-1.45	-6.5	0.6
Left radius T-score	18	-0.42	1.57	-0.25	-3.6	2
FRAX Score						
Hip	219	1.5	2.21	0.8	0	16
Major fracture	219	3.08	2.88	2.1	0.2	18

We assess the relationship of BMI and BMD, as well as the association of BMI with the 10-year risk of fracture. Table 6 below shows the correlation coefficients between the densitometric variables (BMD, lumbar spine BMD, left and right femoral neck BMD and left radius BMD) and anthropometric variables such as the height, weight, BMI and age.

Table 6: Pearson r coefficients between densitometric and anthropometric measurements.

Variables	BMI		Height		Weight		Age	
	r	p	r	p	r	p	r	p
Total BMD	0.437**	<0.001	0.222**	0.001	0.482**	<0.001	-0.109	0.107
Lumbar spine T-score	0.411**	<0.001	0.119	0.101	0.411**	<0.001	-0.052	0.473
Left femoral neck T- score	0.479**	<0.001	0.272**	<0.001	0.493**	<0.001	0.246**	0.002
Right femoral neck T- score	0.506**	<0.001	0.391**	0.002	0.569**	<0.001	-0.306*	0.016
Left radius T-score FRAX score	0.152	0.548	-0.176	0.484	0.092	0.717	-0.145	0.566
FRAX score hip	- 0.335**	<0.001	-0.162*	0.017	-0.342**	<0.001	-0.035	0.61
Major fracture	-0.271**	<0.001	-0.124	0.067	-0.272**	<0.001	-0.009	0.898
** Significant at 1%; * Significant at 5%								

There are significant positive and low to moderately low associations between the BMD scores of male patients and their BMI (r=0.437, p<0.001). This means that male patients with higher BMI score tends to have higher total BMD score, *i.e.,* male patients who are overweight tends to have normal BMD scores while those who are underweight may have higher chance of having lower BMD scores which translates to lower bone mass. In fact, when patients were categorized according to their BMI, significant differences in the BMD scores were observed (F=16.533, p<0.001) and shown in Table 7. In particular, obese males (-0.97 ± 0.21) have significantly higher average BMD score than those who are underweight (-3.13 ± 1.43) and those with normal BMI (-1.81 ± 1.19) while overweight patients (-1.25 ± 1.08) have significantly higher average BMD score than underweight patients and those with normal BMI but not with those who were obese.

The BMI score of patients also have positive and moderate low associations with the lumbar spine BMD (r=0.411, p<0.001), the left femoral neck BMD (r=0.479, p<0.001) and right femoral neck BMD scores (r=0.506, p<0.001). In particular, obese and overweight male patients have significantly higher BMD scores in their lumbar spine and left and right femoral neck, than those who are underweight as shown in Table 7.

Weight also has a significantly positive and moderate associations with the total BMD (r=0.482, p<0.001) and with all other densitometry measurements in Table 5 (all p-values are less than 0.001). Height, on the other hand, has significantly positive but low association with the total BMD (r=0.222, p=0.001), but has a moderately low association with BMD scores on the left (r=0.272, p<0.001) and right femoral neck (r=0.391, p=0.002). No significant associations were observed between the height and the lumbar spine BMD of patients (r=0.119, p=0.101) and the left and right radius BMD. Notice, however, that the association between weight and these densitometry measurements are stronger than the association of height and the BMDs. This may suggest that weight has more influence than the height of patients in diagnosing osteoporosis.

Table 7: Densitometric measurements and risk of fracture by BMI group.

Characteristics	Underweight		Normal		Overweight		Obese		F	p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Total BMD	-3.13[a]	1.43	-1.81[b]	1.19	-1.25[c]	1.08	-0.97[c]	1.21	16.533**	<0.001
Lumbar spine T-score	-2.73[a]	1.75	-1.27[b]	1.32	-0.54[c]	1.62	-0.18[c]	1.43	12.772**	<0.001
Left femoral neck T- score	-2.95[a]	1.11	-1.44[b]	1.29	-0.80[c]	1.07	-0.35[c]	1.08	15.571**	<0.001
Right femoral neck T- score	-2.99[a]	1.83	-1.57[b]	1.09	-1.24[b]	0.69	-0.53[b]	0.25	6.066**	0.001
Left radius T-score	-1.97	1.03	0	1.72	-0.3	0.8	-0.8	0	1.324	0.306
FRAX score Hip	3.84[a]	4.23	1.56[b]	1.83	1.05[b]	1.78	0.60[b]	0.65	9.160**	<0.001
Major fracture	5.45[a]	5.1	3.18[b]	2.75	2.74[b]	2.19	1.70[b]	1.33	7.208**	<0.001

[a,b,c] Means with the same superscripts are not significantly different at 5%; **Significant at 1%; *Significant at 5%

Furthermore, the age of the patients is significantly correlated with the left femoral neck BMD score (r=-0.246, p=0.002) and the right femoral neck BMD score (r=-0.306, p=0.016) but not with other densitometric measurements (all p-values are greater than 0.05). The associations of age with the left and right femoral neck BMDs are negative and moderately low which implies that older patients tend to have lower BMD score or lower bone mass. Specifically, male patients aged less than 70 years have significantly higher average BMD score at the left and right femoral neck than those aged 80 to 100 years (Table 8). Now, although the total BMD is not significantly associated with age as shown in Table 5, it was observed in Table 8 that the total BMD significantly differs across age group (F=3.193, p=0.024). In particular, older patients (80 to 100 years old) have significantly lower average total BMD score than younger patients (less than 70 years old).

Table 8: Densitometric measurements and risk of fracture by age group.

Characteristics	<60		60-69		70-79		80-100		F	p-value
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Total BMD	-1.50[a]	1.09	-1.43[a]	1.31	-1.83[a,b]	1.27	-2.18[b]	1.57	3.193*	0.024
Lumbar spine T-score	-1.16[a]	1.26	-0.80[a]	1.78	-0.99[a]	1.77	-1.51[a]	1.67	1.171	0.322
Left femoral neck T-	-0.88[a]	1.02	-0.98[a]	1.4	-1.55[a,b]	1.4	-1.82[b]	1.41	3.930*	0.01
Right femoral neck T-	-1.13[a]	0.93	-1.22[a]	0.77	-1.87[a,b]	1.03	-2.55[b]	1.79	3.305*	0.035
Left radius T-score	0.03[a]	0.85	0.35[a]	2.05	-0.72[a]	1.95	-0.59[a]	1.58	0.289	0.832
FRAX score hip	1.40[a]	2.36	1.44[a]	2.51	1.25[a]	1.13	2.15[a]	2.51	1.177	0.323
Major fracture	2.85[a]	2.74	3.25[a]	2.89	2.75[a]	1.77	3.73[a]	4.33	0.812	0.491

[a,b,c] Means with the same superscripts are not significantly different at 5%; ** Significant at 1%; * Significant at 5%

In analyzing the FRAX scores, it was observed that the hip and major fracture risk scores have negative associations with the BMI, height and weight and age of the patients. However, only the associations of these FRAX scores with BMI and weight are highly significant. This suggests that patients with higher BMI and weight tends to have lower FRAX scores. In Table 7, underweight patients significantly have higher hip and major fracture average risk scores than those with normal and above normal BMIs, which means underweight patients are more at risk of having fracture in the next 10 years than those with normal or above normal BMI. On the other hand, age is not significantly associated with FRAX scores and no significant differences in the average FRAX scores were observed across age groups.

Associations between other risk factors and BMD and fracture risk

Tables 9 and 10 shows the average BMI, BMD and FRAX scores when patients are categorized according to other possible risk factors. Among these risk factors, only age, family history of osteoporosis and history of traumatic fracture or spinal cord injury posted significant differences in terms of BMD scores. In particular, patients older than 70 years significantly have lower BMD score than those who are younger (t=2.547, p=0.012). This means that older respondents have lower average bone mass than younger respondents. Patients with family history of osteoporosis also have lower average BMD score than those without family history (t=2.029, p=0.044) and those who experienced traumatic fracture in the past or any spinal cord injury also have lower average BMD score (t=3.936, p<0.001). No other risk factors significantly affect the average BMD scores.

Table 9: Average BMI and BMD scores across risk factors.

Risk Factors	n	BMI				BMD			
		Mean	SD	t	p	Mean	SD	t	p
Age>70									
Yes	77	23.42	4.64	3.257**	0.001	-1.97	1.44	2.547*	0.012
No	142	25.51	4.49			-1.48	1.18		
Weight loss>10%									
Yes	9	17.9	4.44	4.752**	<0.001	-2.83	2.06	1.783	0.111
No	210	25.07	4.43			-1.6	1.24		
Physical inactivity									
Yes	67	25.01	5.06	-0.485	0.628	-1.69	1.2	0.32	0.749
No	152	24.68	4.46			-1.63	1.34		

Smoking									
Yes	70	24.56	4.48	0.476	0.635	-1.74	1.3	0.69	0.491
No	149	24.88	4.73			-1.61	1.3		
Inadequate calcium intake									
Yes	73	24.46	4.03	0.713	0.477	-1.53	1.4	-0.919	0.36
No	146	24.94	4.93			-1.71	1.24		
Family history of osteoporosis									
Yes	10	25.34	4	-0.393	0.694	-2.46	1.1	2.029*	0.044
No	209	24.75	4.68			-1.61	1.3		
History of traumatic fracture/spinal cord injury									
Yes	47	23.36	4.41	2.386*	0.018	-2.29	1.24	3.936**	<0.001
No	172	25.16	4.65			-1.48	1.26		
Medication steroids									
Yes	32	24.51	4.81	0.355	0.723	-1.71	1.26	0.272	0.786
No	187	24.82	4.63			-1.64	1.31		
ADT									
Yes	4	24.29	3.53	0.212	0.832	-1.65	0.79	-0.002	0.998
No	215	24.79	4.67			-1.65	1.31		
Other meds									
Yes	99	25.14	5.22	-1.032	0.303	-1.72	1.3	0.741	0.46
No	120	24.48	4.11			1.13	2.15[a]		

In terms of the FRAX scores, there are significant differences in the hip FRAX scores and the major fracture FRAX scores when patients are grouped according to weight loss (t=-2.511, p=0.036; t=-2.902, p=0.019) and history of traumatic fracture (t=-2.220, p=0.030; t=-3.005, p=0.003). Specifically, patients who loss more than 10% of their weights have significantly higher risk of hip fracture (5.46 ± 4.93) and major fracture (7.43 ± 4.66) than those who haven't (1.31 ± 1.86; 2.89 ± 2.64). Same is true for patients with history of traumatic fracture or any spinal cord injury, *i.e.,* those with past traumatic fractures have higher risk of hip and major fracture than those without history. Aside from weight loss and history of traumatic fracture, smoking (t=2.918, p=0.004) and inadequate calcium intake (t=2.555, p=0.011) may also affect the average FRAX scores for major fracture of patients. Interestingly, patients who were recorded to smoke (2.40 ± 1.81) have lower average FRAX score than patients who do not smoke (3.40 ± 3.22) while patients who reportedly have inadequate calcium intake (2.46 ± 2.19) also have lower average risk of major fracture than those with adequate intake (3.39 ± 3.14).

Table 10: Average FRAX scores across risk factors.

Risk factors	n	BMI		t	p	BMD		t	p
		Mean	SD			Mean	SD		
Age>70									
Yes	77	1.61	1.88	-0.63	0.53	3.12	3.12	-0.154	0.877
No	142	1.41	2.38			3.06	2.76		
Weight loss>10%									
Yes	9	5.46	4.93	2.511*	0.036	7.43	4.66	2.902*	0.019
No	210	1.31	1.86			2.89	2.64		
Physical inactivity									

Yes	67	1.19	1.68	1.293	0.197	2.71	2.5	1.251	0.212
No	152	1.61	2.41			3.24	3.03		
Smoking									
Yes	70	1.16	1.46	1.773	0.078	2.4	1.81	2.918**	0.004
No	149	1.64	2.48			3.4	3.22		
Inadequate calcium intake									
Yes	73	1.16	1.57	1.539	0.125	2.46	2.19	2.555*	0.011
No	146	1.65	2.46			3.39	3.14		
Family history of osteoporosis									
Yes	10	1.31	0.64	0.253	0.8	3.24	1.92	-0.181	0.857
No	209	1.49	2.26			3.07	2.93		
History of traumatic fracture/spinal cord injury									
Yes	47	2.23	2.75	2.220*	0.03	4.18	3.5	3.005**	0.003
No	172	1.28	2.01			2.78	2.62		
Medication steroids									
Yes	32	1.87	2.4	-1.056	0.292	3.8	3.14	-1.536	0.126
No	187	1.42	2.18			2.96	2.83		
ADT									
Yes	4	2	1.61	-0.47	0.639	3.8	2.09	-0.504	0.615
No	215	1.47	2.23						
Other meds									
Yes	99	1.54	2.56	-0.356	0.722	2.94	2.87	0.657	0.512
No	120	1.43	1.9			-1.6	1.24		

Regression analysis on factors affecting BMD

Among those factors considered in this study that may affect BMD, it was shown that BMI, age, family history of osteoporosis and history of trauma are the only variables that are univariate related or associated with BMD. To determine which among these variables greatly influenced the bone mass density of male patients, a regression analysis was performed and the results are presented in Table 11.

The model generated was found to be significant ($F=18.316$, $p<0.001$) and all assumptions were satisfied. Using this model, the four predictors accounted for 25.5% of the variability in the BMD scores. However, among the four predictors, age group is the only predictor that is not significant ($t=-0.325$, $p=0.746$). Among those significant predictors, BMI is observed to be the most important predictor (Std B=0.395, $p<0.001$) followed by history of traumatic fracture (Std. B=-0.184, $p=0.002$) and family history of osteoporosis (Std B=-0.154, $p=0.010$).

Interpreting the coefficients, the BMI of the patients posted a positive effect on their BMD score. In particular, there is an increase of 0.110 point in the BMD score in every point increase in the BMI score of the patients controlling for other variables in the model. This means that patients with higher BMI scores have higher BMD score which is consistent with the earlier conclusions. Family history of osteoporosis and history of traumatic fracture or spine injury have negative effect on bone mass density. According to the model generated, patients with family history of osteoporosis have an average BMD that is 0.955 point lower than those without history while patients with history of traumatic fracture have average BMD that is 0.582 point lower than those without history of traumatic fracture or injury.

Table 11: Estimated regression coefficients for BMD score.

Predictors	B	SE	Std. beta	t	p-value
Intercept	-4.142	0.451		-9.193**	<0.001
BMI score	0.11	0.017	0.395	6.473**	<0.001
History of traumatic fracture/injury	-0.582	0.19	-0.184	-3.064**	0.002
Family history of osteoporosis	-0.955	0.367	-0.154	-2.601*	0.01
Age>70	-0.212	0.166	-0.078	-1.278	0.203
R^2=0.255; F=18.316, p<0.001					

Regression analysis on factors affecting risk of fracture

Table 12 shows the regression coefficients of the three significant predictors of hip fracture risk in the univariate analysis earlier. In the model generated, 22.6% of the variability in the hip fracture risks of male patients can be explained by BMI score, history of traumatic fracture or injury and weight loss of more than 10% (F=20.582, p<0.001). This model used the natural log transformation of the dependent variable in order to meet the assumptions of the linear model. After meeting the assumptions, the three predictors are all found to be significant (all p-values are less than 0.01). In particular, BMI score is the most important predictor among the three (Std. B=-0.315, p<0.001), but it has a negative effect on the hip fracture risk of patients (B=-0.076, SE=0.015). Furthermore, computing for the antilog of the coefficient yields to a meaningful interpretation that for every increase in the BMI score, there is a 7.3% decrease in the risk of hip fracture, controlling for other variables.

Patients with history of traumatic fracture or spine injury have hip fracture risk that is 1.723 times higher than those without history of traumatic fracture or injury, controlling for BMI and weight loss. On the other hand, patients who had lose weight of more than 10% have hip fracture risk that is 2.529 times that of those without this risk factor.

Table 12: Estimated regression coefficients for risk of hip fracture.

Predictors	B	SE	Exp (B)	Std. beta	t	p-value
Intercept	1.496	0.398	4.464		3.755**	<0.001
BMI score	-0.076	0.015	0.927	-0.315	-4.904**	<0.001
History of traumatic fracture/injury	0.544	0.163	1.723	0.204	3.332**	0.001
Weight loss>10%	0.928	0.35	2.529	0.169	2.648**	0.009
R^2=0.226; F=20.582, p<0.001						

Table 13 shows the corresponding regression coefficient for the risk of major fracture. In this model, BMI, history of traumatic fracture or injury, inadequate calcium intake, weight loss and smoking are the predictors included. Again, to meet assumptions of this linear model, the dependent variable was transformed using natural log function. The model generated is found to be significant (F=11.706, p<0.001) with 21.6% of the variability in the FRAX scores on major fracture explained by the 5 predictors. BMI is still the most important predictor (Std. B=-0.227, p=0.001), followed by history of traumatic fracture or injury (Std. B=0.188, p=0.003) and inadequate calcium intake (Std. B=-0.173, p=0.006).

Consistently, an increase in the BMI score tends to have a decrease in the fracture risk, holding other variables constant. Specifically, there is a 3.7% decrease in the fracture risk in every increase in the BMI. Patients with history of traumatic fracture or injury have risk of having major fracture that is 1.425 times higher than those without this characteristic. The same is true for those who had weight loss of more than 10% i.e., there is a 93.5% increase in the risk of fracture than those without this factor. Patients with inadequate calcium intake and who smokes have risk of major fracture that is 1.297 and 1.328 times lower than those without these characteristics, respectively.

Table 13. Estimated regression coefficients for risk of major fracture.

Predictors	B	SE	Exp (B)	Std. beta	t	p-value
Intercept	1.824	0.291	6.197		6.265**	<0.001
BMI score	-0.038	0.011	0.963	-0.227	-3.489**	0.001
History of traumatic fracture/injury	0.354	0.117	1.425	0.188	3.015**	0.003
Inadequate calcium intake	-0.284	0.102	0.753	-0.173	-2.786**	0.006
Weight loss>10%	0.66	0.251	1.935	0.17	2.635**	0.009
Smoking	-0.26	0.102	0.771	-0.157	-2.544*	0.012
R^2=0.216; F=11.706, p<0.001						

Discussion

Osteoporosis has been under diagnosed due to its lack of evident symptoms especially among the elderly until the individual experiences fracture. Approximately 25% of men over the age of 50 will have at least 1 osteoporosis related fracture in their lifetime [8]. By 2030, functional impairment brought about by fracture secondary to osteoporosis is expected to increase among men than women [9]. This study showed that even men less than 60 years old has somewhat comparable prevalence to those more than 70 years old. This suggests that Filipino has lower threshold for screening Filipino men. As was also seen in the study by Mendoza among Filipinos where men aged 50-69 years old have same prevalence to those aged more than 70 years old [10].

National Health and Nutrition Examination Survey (NHANES) III data on prevalence of osteoporosis among men is around 3.6%. In this study, the overall prevalence of osteoporosis was 26% while osteopenia was at 39% depending on their age, BMI and BMD results. Another study in Brazil, osteoporosis prevalence was 6.4%-16.1% while in Denmark it was estimated at 17.7%. On the other hand, osteopenia in Brazil was present in 33.3%-57.4% [11]. In Saudi osteoporosis prevalence was 4.9%-23.5% while osteopenia was noted at 34%-41.5%. This was attributed to lifestyle factors such as poor intake of calcium, vitamin D deficiency and physical inactivity [12]. Particularly in this study, osteoporosis was slightly higher on the lumbar spine (13.6%) compared to the femoral neck (12.7%). Contrary to a study done in United Kingdom where 6% of healthy men aged 50 years and older was noted to have femoral neck osteoporosis.

BMI has been noted to be an important risk factor for osteoporosis. BMI is positively correlated with BMD and the risk of osteoporosis is lower in subjects with higher BMI compared to those with lower BMI. As shown with this study in Table 7, obese and overweight males were noted to have higher BMI than those normal or underweight. This had been noted also with other studies which can be explained to the loading effect of weight on bone particularly the fat mass and lean body which are both are components of weight [12].

In terms of the osteoporosis risk measures, OSTA index can be a valuable tool in the diagnosis of osteoporosis. As seen in a study among Chinese men where OSTA index had

been shown to be of better diagnostic value for osteoporosis in the high risk group (OSTA index ≤ -4) with sensitivity at 52% and specificity of 87%. In this study, it showed that among 219 men there were 13.2% high risk of osteoporosis while 24.7% have medium risk.

Age is an important cause of low BMD wherein it is inversely correlated with low BMD and osteoporosis [13]. In men, increase prevalence of osteoporosis was noted at the age of 80 years old with rate of osteoporosis that doubled. Consistent with the result in this study that males aged less than 70 had higher femoral neck BMD than those 80- 100 years old. Moreover, age was more noted to be correlated with low femoral neck BMD score and not by the lumbar spine. This has also been noted with studies by Sharma wherein osteopenia (41%) and osteoporosis (7.5%) were more prevalent with femoral neck BMD. In contrast to a study in Singaporean men over 50 years old, where spine BMD had marginally higher prevalence than femoral neck osteoporosis. This can be due to the fact that the estimated annual bone loss at the femoral neck is 0.82% per year in men while there was no significant loss on the lumbar spine which could likely be contributed by a possible osteoarthritis [14,15].

Before the age of 50, men tend to have more fractures than women due to high frequency of trauma from sport activities usually involving the limbs. Estimated lifetime risk for men was at 20.7% as seen in a study that evaluated the gender specific fracture site among adults. In the same study, vertebral fractures in men were noted to increase rapidly at 65 years old while for hip fracture it was noted to be at 75 years old. This can be due to the larger bones in men that may somehow be protective and increase their bone strength. Considering BMI, BMD and FRAX scores the study noted that among the risk factors identified in this study only age (p 0.012), family history of osteoporosis (p 0.044) and history of trauma ($p<0.001$) showed significant differences. A study in India showed that age increased risk for fracture risk (RR 1.9), family history of osteoporosis showed significant increase in any facture (RR 1.18) for both men and women, while history of fracture increased to fourfold the risk of future fracture [16]. In another study by Edwards, he showed that history of fracture is considered to be the most important clinical risk factor that would estimate increase fracture risk with hazards ratio of 2.75 [17].

Conclusion

As observed in this study, osteoporosis was much more prevalent in men with increasing age but can also be seen in those younger than 70 years old. The prevalence of osteoporosis among men seen at UST hospital is 26% with 95% confidence interval of (0.202, 0.318). Age and BMI are opposing factors that affecting osteoporosis. OSTA index score can be utilized for osteoporosis diagnosis whereas FRAX score can be used as a guide for treatment plans by the attending physician. Among other risk factors, weight loss of more than 10%, family history of osteoporosis and history of fracture increases hip fracture. Whereas, inadequate calcium intake, smoking, weight loss of more than 10% and history of trauma contributes to the risk of major risk fracture. With this study, modifiable risk factors were observed and must be taken into consideration for better assessment of men at risk for osteoporosis. In addition, early screening can be done in men with those risk factors to prevent future fracture occurrence.

Declaration of Interest

No conflict of interest among authors.

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