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Bone Mineral Density in Elderly Black Men Attending Parirenyatwa Hospitalin Harare

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Abstract: The aim of this study was to describe bone density characteristics in elderly Black Zimbabwean men aged at least 50 years and above attendingParirenyatwa Hospital. An exploratory study was donein the x-ray department, excluding men who had a history of a disease known to affect bone density. Convenience sampling was used to recruit 51 men within one month period. Data was collected by using a questionnaire and DXA scans of the left hip joint and lumbar spine.Microsoft excel and SPSS version 16.0 were used for data capture and analysis.Thebone mineral density measurements ranged from 0.620g/cm^2 to 1.222g/cm^2- with an average of 0.954g/cm^{2}for the hip and from 0.625 to 1.208g/cm^2- with an average of 0.952g/cm^{2}for the lumbar spine. There was no evidence of an association between age and bone mineral density for both the total hip and the lumbar spine even after adjusting for weight or body mass index (BMI). There was evidence of association between age and bone mineral density for the femur neck before (p value = 0.025) and after adjusting for BMI (p value = 0.047). Both weight and BMI had a strong positive correlation with bone mineral density with p-values less than 0.001. The conclusion wasthat weight and BMI both had a significant association with bone mineral density and that there was a higher prevalence of osteoporosis with the lumbar spine as compared to the proximal femur for the men in this study. We recommend a further study, with a greater sample size from which more conclusions can be drawn.

Key words: Bone mineral density · Osteoporosis · Dual energy x-ray absorptiometry (DXA)

INTRODUCTION

Bone mineral density has been shown to increase with age from the time a person is born until it reaches its peak in youth and early adulthood and then it naturally starts to decline. Studies done in America have shown that the peak bone mass is around the 20s and is consistent henceforth until the 40s [1]. Bone mass decreases after 35 years of age and bone loss occurs faster in women than men especially due to the effects of menopause [2]. The condition that occurs when bone density becomes too low that bones can easily fracture, is described as osteoporosis. Osteoporosis is the most common metabolic disease of bone and it is characterised by a decrease in bone mineral density and skeletal micro destruction [3]. It weakens bone and increases the risk of bone breaking or the occurrence of a fracture even after low or simple trauma fracture. The diagnosis of osteoporosis can be confirmed by bone densitometry, with dual energy x-ray absorptiometry currently being considered as the gold standard. Osteoporosis does not present with any symptoms. Therefore, patientsmay not be aware of their osteoporosis until they suffer a painful fracture [10]. These low trauma fractures are an increasing public health issue worldwideand their medical and social costs are also expected to increase unless effective prevention and treatment methods are developed [4, 11]. Studies have shown that hip fracture is the most severe complication of osteoporosis, placing the greatest demand on resources and having the greatest impact on patients because of increased mortality, long term disability and loss of independence [4]. Early diagnosis of osteoporosis by assessment of bone density can prevent its complications, especially fractures [5]. Bone mineral

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density depends on age, genetics, nutrition, lifestyle factors such as diet and exercise, metabolism, body hormones, race, environmental factors and gender [2, 9]. Although, more bone density studies have been done forwomen as compared to men due topostmenopausal osteoporosis, a high prevalence of fractures and low bone mineral density in men older than 50years has been reported, (30% of hip and 33% of vertebral osteoporotic fractures) in inAddenbrooke's Hospital, Cambridge [6]. In America there has been data established on the fact that after fracture, mortality (due to pulmonary thrombo-embolism and nosocomical infections), is higher in men than in women. Over ten millions of Americanhaveosteoporosis, out of which, about three million are men. [7]. In Europe alone, osteoporotic vertebral fracture incidence has increased from 300 to 400% for women and more than 400% for men during the last 30 years. These data are age related and suggest that there is a decrease in bone mass or bone quality from generation to generation [5].

Most of the studies that have been done on bone density changes in men have been done dominantly in first world countries hence there is insufficient information to be used for the African men. To arrest or reverse the increases of low trauma fractures due to decreased bone mineral density, effective general preventive measures (such as exercise and calcium and vitamin D supplements) must be established [9, 19]. However in order to do so, basic understanding of bone mineral density is crucial.

MATERIALS AND METHODS

The aim of this research was to describe the bone density characteristics in black elderly men aged 50 years old and above attending Parirenyatwa hospital. The objectives were to calculate bone density values for men aged 50 years old and above and to compare the bone mineral densityvalues of these men to those for the Caucasian and black African American men. This was an Exploratory Cross sectional study. The population studied on was black Zimbabwean males aged 50 years old and above. The inclusion criterion was black Zimbabwean, male and at least 50years old. Excluded from the study were those who had a clinical history of a low trauma fracture or osteoporosis or any other disease known to affect bone mineral density and those who had had a spine or both hip surgery before.Approval for this research was sought and obtained from the Joint Parirenyatwa and College of Health Sciences Ethics Committee (JREC). Participants were selected through convenience sampling technique. Subjects visiting the Parirenyatwa X-ray department aged 50 years old or more were identified and asked to volunteer for the study. Each participant gave a written informed consent. The study included a total of 51 men recruited over a period of one month. The participant's age, sex, race, height, weight and body mass index (BMI) and other lifestyle and clinical factors were recorded on a researcher administered questionnaire. Questions were set to check for any contraindications as regarding to DXA scanning, to confirm inclusion criteria and to assess lifestyle in terms of physical activity, dietary habits, smoking and alcohol intake. For each participant, DXA scans were done for the hip joint and lumbar spine using a Hologic QDR Wi model. Data was entered and analysed using Microsoft Excel and SPSS version 16.0. Results were reported and presented in the form of tables and graphs. Centile curves were created to show the distribution of femoral and lumbar spine bone mineral density with age, using the LMS method as suggested by Cole TJ & Green PJ in 1992. [15].

RESULTS AND DISCUSSION

A total of 51 participants were included in the study. There was only 1 participant in the 90 to 99 age range therefore this age group was excluded from analysis. The remaining sample had a mean age of 65years, a mean weight of 65kgs, a mean height of 172cm and 22kg/m^2 for mean BMI. The table below shows the distribution of age, weight, height and BMI according to 10 year age bands.

The total hip/femur bone mineral density for these men ranged from 0.620 to 1.222 with amean of 0.954 and a Standard deviation of 0.13. Table 2 shows the femoral mean bone mineral density values per decade age group to generally decrease with an increase in the age of the age group. For the lumbar spine however there was an initial decrease until age 70 to 79 where mean bone mineral density was higher before it declined again with the next decade age group (80to89years). The differences in sample size or the small sample sizes used in this study could have accounted for some of the results. Another possible explanation is the increase in lumbar spine bone mineral density as a result of degenerative disease in older populations.However, a one way analysis of variance was done to test for significance in the difference in mean bone mineral density for the different decade age groups and there was no evidence of statistically significant differences at the 0.05 level.

Table 1: Distribution of age, weight, height and BMI.

AGE GROUP	NUMBER	*AGE(yrs)	*WEIGHT(kgs)	*HEIGHT(cm)	*BMI(kg/m^2)
50 - 59	18	54(3.6)	67.3(14.3)	173.3(5.1)	22.4(22.4)
60 - 69	15	64(3.5)	65.3(18.2)	173.7(7.8)	21.6(5.6)
70 - 79	12	74(2.4)	65.8(9.8)	169.7(7.4)	22.9(4.0)
80 - 89	5	83(2.6)	54.7(7.6)	168.2(5.1)	19.3(2.1)
50 - 89	50	65(11.0)	65.0(14.2)	172.0(6.7)	22.0(4.6)

**Data is presented as Mean(Standard Deviation)*

Mean BMD in g/cm^2 and standard deviations were calculated for the whole study population and for each ten year age group. This was done for each of the measurement sites

Table 2: Distribution of bone mineral density per decade age group for each measurement site

Femur	AGE GROUP	NUMBER	*Trochanter BMD	*IntertrochanterBMD	*Femoral neck BMD	*Ward's AreaBMD	*Total femur BMD
	50 - 59	18	0.702(0.09)	1.172(0.16)	0.813(0.09)	0.585(0.11)	0.957(0.10)
	60 - 69	15	0.692(0.14)	1.129(0.17)	0.805(0.15)	0.582(0.18)	0.951(0.15)
	70 - 79	12	0.801(0.27)	1.134(0.14)	0.779(0.13)	0.578(0.15)	0.976(0.12)
	80 - 89	5	0.663(0.17)	1.043(0.15)	0.697(0.14)	0.475(0.17)	0.901(0.16)
	50 - 89	50	0.719(0.17)	1.137(0.16)	0.791(0.13)	0.571(0.15)	0.954(0.13)
Lumbar Spine	AGE GROUP	NUMBER	*L1 BMD	*L2 BMD	*L3 BMD	*L4 BMD	*Lumbar Spine BMD
	50 - 59	18	0.915(0.14)	0.956(0.14)	0.979(0.13)	0.977(0.14)	0.958(0.13)
	60 - 69	15	0.858(0.17)	0.959(0.23)	0.969(0.18)	0.981(0.17)	0.943(0.18)
	70 - 79	12	0.909(0.15)	1.013(0.18)	0.996(0.18)	1.065(0.20)	1.000(0.17)
	80 - 89	5	0.749(0.24)	0.831(0.24)	0.866(0.23)	0.932(0.20)	0.851(0.85)
	50 - 89	50	0.880(0.17)	0.956(0.19)	0.969(0.17)	0.995(0.17)	0.952(0.16)

**Data is presented as Mean(Standard Deviation).*

BMD is presented in g/cm^2

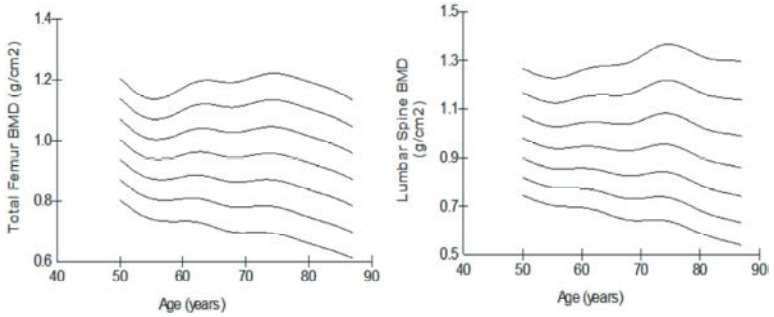

Fig. 1&2: Centile curves to show distribution of bone mineral density (BMD) with age for the total femur (Fig 1.) and for the lumbar spine (Fig 2.).

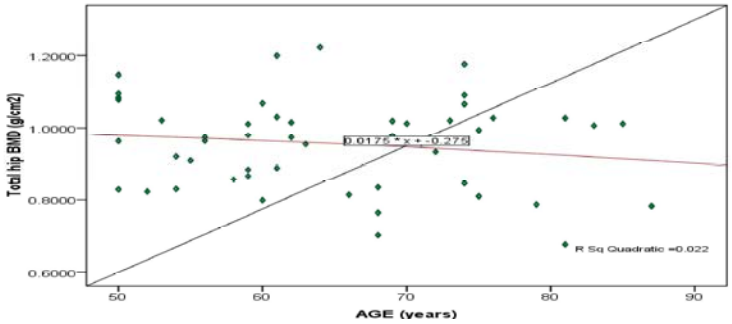

Fig. 3: Scatter plot to show correlation between age and total hip bone mineral density (BMD).

There appeared to be no relationship between age and bone mineral density from the scatter plots. To determine whether there was any linear relationship between age and bone mineral density. Pearson's correlations were calculated and showed no evidence of a linear association between age and total hip bone mineral density and between age and lumbar spine BMD with p values of 0.306 and 0.509 respectively. However adding a quadratic best fit line (**Fig 3&4**) and plotting centile curves (**Fig 1&2**) showed a general slight decline

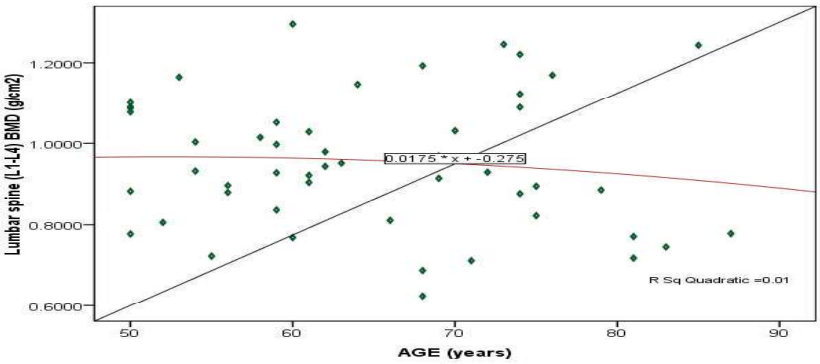

Fig. 4: Scatter plot to show correlation between age and lumbar spine bone mineral density (BMD).

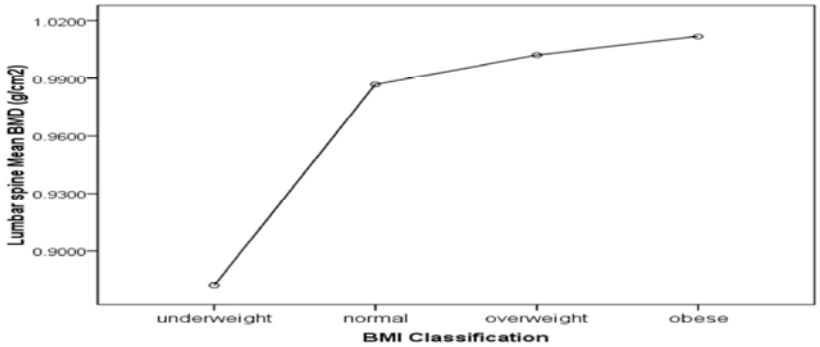

Fig. 5: Line graph to show distribution of mean BMD per BMI classification.

of BMD with age. The centile curves were created using the LMS method as described by Cole TJ and Green PJ in 1992 [15] and they show bone mineral density by age at the 3rd, 10th, 25th, 50th, 75th, 90th and 97th percentile. This relationship is synonymous with literature that says that BMD decreases with age from the age of around 40 years and continues to decrease with advancing age [2]. Almost the same trend was seen for the Spine bone mineral density as for the proximal femur/hip bone mineral density. For the total study population lumbar spine bone mineral densityvaluesare however generally lower than proximal femur/hip bone mineral density values, even with an average of 0.952 compared with 0.954 of total femur average. This has been reported in literature before, that bone mineral density may or often differs for the two regions [8].

There was a statistically significant correlation between weight and bone mineral density and also between body mass index (kg/m^2) and bone mineral density. There was no evidence of a correlation between height and bone mineral density. Pearson's correlation for bone mineral density with age being the factor was again calculated, taking the effect of weight and BMI on bone mineral density into consideration and there was still no evidence of an association between bone mineral density and age, even after adjusting for weight and BMI for the total hip and lumbar spine. However for the femoral neck, age was significantly correlated to bone mineral density both before (p value = 0.025) and after adjusting for BMI (p value = 0.047)but not significantly correlated after adjusting for weight (p value = 0.098).

Figure 5 and 6 show mean bone mineral density plotted against each group or classification of body mass index for the lumbar spine and proximal femur respectively. There is a clear increase in the mean bone mineral density of each group with an increase in BMI for the lumbar spine. A one way analysis of variance done to test whether the differences in bone mineral density between the groups was significant showed a significant difference between groups for the proximal femur (p value = 0.003) but there was no evidence of a significant difference between groups for the lumbar spine (p value = 0.147). There was also a significant difference between groups for all the other femoral sites (trochanter, intertrochanter, ward's area and femoral neck) with p values of less than 0.01. A post hoc analysis of the differences between groups/classes of BMI for the proximal femur showed especially a significant difference between the group classified as obese and all the other three groups (underweight, normal, overweight). Obesity

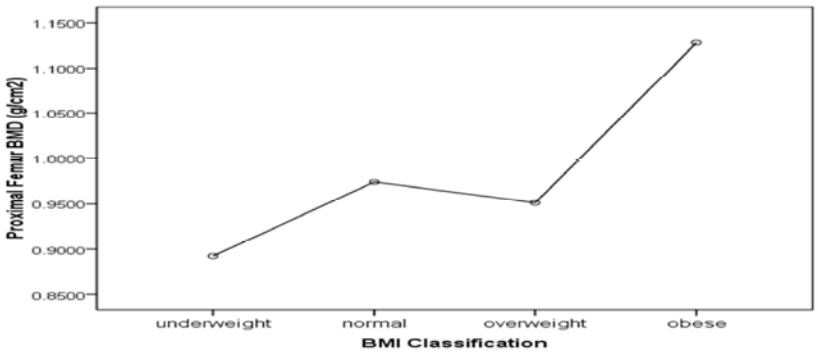

Fig. 6: Line graph to show distribution of mean bone mineral density per body mass index classification.

Table 3: WHO classification of T-scores using Caucasian and Black reference data

	Total hip			Lumbar Spine		
Reference database	Normal (%)	Osteopenia (%)	Osteoporosis (%)	Normal (%)	Osteopenia (%)	Osteoporosis (%)
Caucasian	51	43	6	43	33	24
Black	51	41	8	44	27	29

has been reported to have some sort of protective factor on bones, with bone mineral density being higher and fracture rates being lower in people that were obese [14]. However some authors have argued that there is an increased risk of osteoporotic fracture in people with an increased weight or BMI because there will be a greater force exerted when such people fall [13].

The different age groups had different number of entities thus an unfair distribution which could obviously affect the averages of bone mineral density for each decade age group. Other studies done to assess bone mineral density like the NHANES [16] study were conducted with thousands of participants.Apart from the differences in bone mineral density accounted for by differences in populations, lifestyle, genetics, geographical location among other factors,the design of this study may have also affected the findings and the conclusions drawn from those findings. Our participants did not go through a medical examination by a physician and clinical history was self-reported therefore it is possible that some may just not have been aware yet or diagnosed of some diseases (such as diabetes, arthritis, hyperthyroidism etc) that they could have that are related to poor bone health. The conclusions made from these results may not be so much as would have been were there more participants recruited. Also this may not be a true representation of the 'healthy' population of Zimbabwean men. For exploratory purposes though, the researchers found this sample to be adequate.

DXA results are presented in the form of T and Z scores, with T-score representing the number of standard deviations from the young adult gender matched bone mineral density value whilst the Z-score represents the number of standard deviations from the age and gender matched bone mineral density value [12]. The T-scores for each participant were classified according to the World Health Organisation criteria which classifies a T-score of greater than -1 as normal, a T-score 0f between -1 and -2.5 as osteopenic and a T-score of less than -2.5 as osteoporotic.

Table 3 shows the classification of T-Scores for the participants in this study according to WHO criteria using Caucasian and then the Black ethnicity reference data as according to the Hologic QDR Wi model with Apex software version 3.0. We report a higher prevalence of osteoporosis (24% or 29%) for the lumbar spine as compared to the proximal femur (6% or 8%). There were differences in classification for the lumbar spine with 29% being classified as osteoporotic according to black reference whereas 24 were classified as osteoporotic according to white reference. To the researchers' knowledge, there is no black Zimbabwean reference database for men that this classification could be compared to. The description of what is normal, osteopenic or osteoporotic in this population however remains a question that is of ongoing concern. Using the Caucasian reference may not be ideal because of the differences in ethnicity, genetics, bone geometry amongst

other factors. Black reference, in this case Black American reference may also not be ideal because of the reported differences in bone mineral density between Black African Americans and Black African showing that bone mineral density in Black African Americans is higher than in Caucasians whereas bone mineral density in Black Africans (South Africa and Gambia) may be either slightly higher, equal to or lower than that for Caucasians. [14, 17, 18]

CONCLUSION&RECOMMENDATION

We concluded that bone mineral density decreased gradually with age especially for the femoral neck even though there was no strong evidence of a correlation between age and BMD, that weight and BMI both had a significant association with bone mineral density and that there was a higher prevalence of osteoporosis with the lumbar spine as compared to the proximal femur for the men in this study. Because of the small sample size in this study, the researchers acknowledge the limitations in the conclusions that can be drawn from the results. The researchers therefore recommend a study with a larger sample to describe bone mineral density in Black Zimbabwean men.

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