

Research Article

The prevalence of osteoporosis in patients referred for DEXA scans at a tertiary academic center in Johannesburg, South Africa

K Anavi^{1*}, R Daya^{1,2}, Z Bayat^{1,2}¹Division of Endocrinology and Metabolism, Department of Internal Medicine, Faculty of Health Sciences, School of Clinical Medicine, University of the Witwatersrand, Johannesburg, South Africa²Division of Endocrinology and Metabolism, Department of Internal Medicine, Helen Joseph Hospital, 1 Perth Road, Rossmore, Johannesburg, South Africa*Corresponding Author:* karli.anavi.21@gmail.com

ABSTRACT

Purpose: Osteoporosis and fragility fractures are expected to rise in a rapidly aging South African population. However, currently, there are limited prevalence studies available for this population.

Methods: We assessed the prevalence of osteoporosis from all Dual-energy X-ray absorptiometry (DEXA) scans on referral to a tertiary academic hospital in Johannesburg, South Africa. All DEXA scans were analyzed between January 01, 2006, and December 31, 2021. The World Health Organization (WHO) criteria were used to diagnose osteoporosis.

Results: Of the 2264 DEXA scans analysed, 880 were osteoporotic (96.4% females, 3.6% males), with an overall osteoporosis prevalence of 38.8% (CI 38.6–40.8). The prevalence increased with age. Bone mineral density T-scores were lower in subjects with lower body mass index. The vertebral body with the highest prevalence of fractures was thoracic level T12. There were no significant differences when comparing T-scores by various bony regions between males and females above age 50.

Conclusion: In those referred for DEXA scans, this study found a high prevalence of osteoporosis, especially in the older South African population, with notable levels in postmenopausal women. Being underweight was associated with increased severity. We also found a higher incidence of vertebral deformities with increasing age.

Keywords: bone mineral density; dual-energy X-ray absorptiometry (DEXA); osteoporosis; osteopenia, vertebral fractures.

INTRODUCTION

Osteoporosis is the most common skeletal disorder seen in adults.(1) It is characterized by low bone mass, which predisposes it to fragility fractures.(2) Osteoporosis is becoming a significant public health concern with ageing populations.(2) It has recently been labelled as “the silent epidemic,” as bone loss generally develops without signs or symptoms.(3) For decades, osteoporosis has been assumed to be rare in sub-Saharan Africa (SSA), and data is limited in this region.(4) Scarce resources and poor social infrastructure further complicate healthcare in SSA.(5) A recent report on aging trends by the United Nations (UN) noted that the older adult population in Africa will triple from 74.1 million in 2020 to 235.1 by 2050.(6)

Osteoporosis often goes undetected until there is a complication, typically a fracture.(2) Fractures hugely impact patients’ quality of life and have significant cost

implications for patients and the public health care system.(7) Hip fractures have devastating outcomes in South Africa (SA), with high one-year post-fracture mortality rates of approximately 30% compared to international rates of 20%.(8,9) More than 50% of patients do not return to pre-fracture levels of independence, and 15%–29% are admitted into frail care.(8) Despite its consequences, osteoporosis remains a neglected disease.(10) A lack of awareness from healthcare workers and the general population further conceals the extent of the condition.(10)

SA is a multi-ethnic population with a two-tiered health care system (private and public services), and the use of facilities varies by socioeconomic status.(4) Furthermore, within the public sector, imaging techniques are unavailable outside of tertiary institutions.(6) Specific risk factors identified in South African studies include having more than three pregnancies, low physical exercise,

socioeconomic factors, type of contraceptive use, calcium and fat intake, and differences in bone geometry and genetics.(10) Importantly, there are marked ethnic differences in body weight and bone geometry, and previous studies have noted that higher bone mineral density (BMD) measurements in the black population correlate to weight.(5) The South African healthcare system must screen and diagnose osteoporosis routinely to prevent complications. The World Health Organization (WHO) has also prioritized these efforts.(11)

According to the National Osteoporosis Foundation of South Africa (NOFSA) guidelines, women older than 65 and men older than 70 should be screened for osteoporosis, regardless of additional risk factors.(12) Other indications for screening include known secondary causes of osteoporosis, previous individual or family history of fragility fractures, or strong clinical predictors.(12)

Dual-energy X-ray absorptiometry (DEXA) is the gold standard and most widely used approach to measure BMD for diagnosing osteoporosis.(13) T scores are calculated from BMD values, and a diagnosis is made using the standard deviation (SD) from the mean reference population.(14) The reference population is based on data from the National Health and Nutrition Examination Survey (NHANES) for Caucasian females aged 20–29, using femoral neck BMD, which is the recommended standard by the WHO.(15) T scores of less than -2.5 are diagnostic of osteoporosis.(16) T scores are used in postmenopausal women, while Z scores are used in premenopausal women and men below the age of 50 years.(12)

A few South African studies have highlighted a higher incidence of hip fractures in White and Indian populations compared to the Coloured and African populations.(4) A recent study by Paruk et al. investigating the prevalence of hip fractures amongst black South Africans showed age-adjusted hip fracture rates of 69.2 per 100,000 per annum for women and 73.1 per 100,000 per annum for men.(4) Vertebral fractures found on DEXA scans may be the only sign of established osteoporosis and are essential in predicting future fracture risks.(12) In a study by Conradie et al., vertebral fractures occurred at a similar rate in black (9%) and white (5.1%) women.(5)

Very few South African-specific osteoporosis prevalence studies have been published. We thus aimed to determine the prevalence of osteoporosis and the profile of vertebral deformities at a tertiary hospital in South Africa.

METHODS

Study design and setting

This study used a retrospective cross-sectional design to analyze data from all patients referred for DEXA scans at Helen Joseph Hospital, a referral center for the greater central Johannesburg region in Johannesburg, SA. The study period was 16 years (January 2006 to December 2021) and included male and female patients above 18 years referred

for a DEXA scan. Only those diagnosed with osteoporosis (postmenopausal females used a BMD T score of ≤ -2.5 on DEXA, while premenopausal females and males under 50 used a BMD Z score < 2.0 to highlight low bone density) underwent further analysis. Exclusion criteria encompassed incomplete data records, a diagnosis of osteopenia (BMD T score between -1.0 and -2.5), and a diagnosis of normal bone density (BMD T score within 1 SD of 1.0). The study protocol received approval from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (HREC ref R14/49).

Data collection

For all scans, the DEXA machine Hologic Discovery W, serial number 82016, with QDR System Software version 12.5, was performed by trained radiographers with daily quality control scans to ensure accuracy before formal scans. Data regarding demographic characteristics, including age, sex, weight, and height, were gathered. Once an individualized radiation dose is given to patients based on their body parameters, the automated system generates a report of the calculated T and Z scores at each bony region. It also performs a lateral vertebral assessment on individual vertebral bodies between T6-L4 to identify vertebral body deformities.

Demographic information and scan data were obtained from each report. Body mass index (BMI) was calculated by dividing the weight in kilograms by the square of the height in meters (kg/m^2). BMI values were categorized based on the WHO classification: underweight ($\leq 18.49 \text{ kg}/\text{m}^2$), normal weight ($18.5 - \leq 24.99 \text{ kg}/\text{m}^2$), overweight ($25 - \leq 29.99 \text{ kg}/\text{m}^2$), and obese ($\geq 30 \text{ kg}/\text{m}^2$).(17) Vertebral evaluations from T6-L4 were collected, and each vertebral level was characterized as normal or deformity. If a deformity was found, it was further classified by sub-type (wedge or biconcave) and by severity (mild, moderate, or severe).(18)

BMD measurements

For all the participants, computerized BMD values at various bony regions, including the AP spine, the left and right femoral necks, total hip, and bilateral averages of total hip were measured and converted into T and Z-scores based on their SD from the mean. The T-score is calculated by comparing the BMD to the reference healthy population of the same sex, while the Z-score is calculated by comparing the BMD to the average BMD of the same age, sex, and size.(12)

Criteria for diagnosing osteoporosis

Osteoporosis diagnosis followed the standard guidelines outlined by the WHO.(10) Osteoporosis was classified based on a T score of ≤ -2.5 standard deviations (SDs) from the reference mean value, with the most negative value selected from the accepted skeletal sites.(12)

Statistical Analysis

The software Statistical Product and Service Solutions (SPSS) version 25 was utilized for statistical analysis. The study used descriptive statistics to summarize categorical variables (sex, age group, BMI categories, and vertebral evaluation) and continuous variables (age, T scores, height, and weight). Continuous variables were represented using mean $\pm$ SD. Prevalence rates were described using percentages (%) with a 95% confidence interval (CI). Comparison of osteoporosis by skeletal region according to BMI and sex was done using a chi-square independence test. A t-test was employed to compare continuous variables such as weight, height, and age. One-way analysis of variance compared mean values across multiple categories (e.g., BMI categories). Statistical significance was defined as a p-value of < 0.05 .

RESULTS

The DEXA scans of 2853 patients were analysed. Of these, 587 were excluded due to incomplete data. Two males were excluded from the remaining 2266 patients for being under 18. Thus, of the 2264 (2166 female and 98 male) scans, 880 were osteoporotic. Nine hundred forty-four were osteopenic, and 442 had normal DEXA scans (Figure 1).

The overall prevalence of osteoporosis was 38.8% (95% CI 36%–40.8%). Of the 2166 women, the prevalence of osteoporosis was 39.1% (95% CI 37%–41.1%). The prevalence in the 98 men was 32.3% (95% CI 23.1%–41.5%).

Of the 880 osteoporotic patients, 848 were female (96.4%) and 32 male (3.6%). The overall mean age of the patients was 71.9 ± 12.5 years, with women having a mean age of 72.1 ± 12.4 years and men having a mean age of 66.4 ± 14.5 years. Most of the osteoporotic patients [792 patients (90%)] were aged 50 or older, and 609 patients (69.2%) were over 60 years. With increasing age, the prevalence of osteoporosis showed an increasing trend in both sexes ($p < 0.003$). Regardless of sex, more than half of the osteoporotic patients (56.3%) were categorized as overweight or obese. The demographic data is highlighted in Table 1.

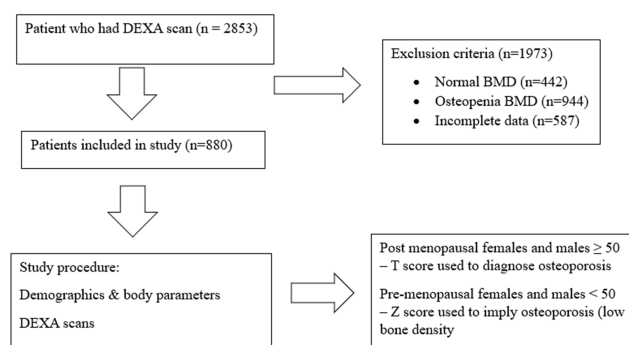


Figure 1: Flow chart of included subjects

Analysis of the T score was only conducted on patients who were above the age of 50. Eighty-eight patients under 50 were removed from the related statistical analysis. According to sex, the mean BMD was analysed at each skeletal site (Table 2). Sex comparison revealed no statistically significant differences. The most severe T scores were noted in the AP spine region, with mean T scores of -2.8 ± 1.2 and -2.7 ± 1.1 in women and men, respectively. The bilateral hip average regions were equally affected in women and men.

Overall, as BMI decreased toward the underweight category, the severity of osteoporosis increased, p-value < 0.001 (Table 3). The underweight osteoporotic patients' most affected skeletal site was the AP spine, followed by the total hip regions. Despite over half of the patients being overweight or obese, those who were underweight had more severe osteoporosis. The AP spine region was also the most affected in the obese category of osteoporotic patients.

An analysis of vertebral deformities in osteoporotic patients is shown in Figure 2. 115 of the osteoporotic patients did not have any vertebral fracture data available. Amongst the osteoporotic patients with any vertebral data available, the overall prevalence of vertebral fractures was 43.9% (336 of 765). The most affected vertebrae were the twelfth thoracic level, with a total of 15.8% (118 of 747), and the first lumbar vertebrae, with a total of 13.2% (99 of 751). The T12 level comprised 118 fractures with 8.6% (64) wedge type and 7.2% (54) biconcave type. Wedge deformities occurred more often at T12, T8, and T7 levels, compared to biconcave deformities, which were seen in lower lumbar vertebrae L1- L3 levels. The L1 vertebrae had the most severe biconcave deformities at all levels, with 15.1% (15 of 99) fractures.

Age group comparison shown in Figure 3 showed that vertebral fracture frequency increased with age. Level T7 was significant as there is a higher proportion of deformities in the ≥ 80 age group (19.8%) compared to other groups ($p < 0.009$). A statistically significant proportion of deformities among those ≤ 39 years compared to different age groups at levels L1 and L4 with 23.8% and 21.1%, respectively. However, the sample size of this group ($n=55$) was very small.

DISCUSSION

This study, which assessed all patients referred for DEXA scans over 16 years, showed a prevalence of 38.8% of osteoporosis. The global prevalence is reported at 19.7% based on a recent meta-analysis by Xiao et al., which covers six continents and 37 countries.(9) The highest prevalence was in Africa at 26.9%, though this only comprised three North and East African countries.(9) Similarly, Salari et al. meta-analysis found a global prevalence of 18.3%.(19) The higher prevalence rate in this study may be related to selection bias with patient referrals for DEXA scans to a single

Table 1: Demographics of the study subjects

	Total (n=880)	Women (n=848)	Men (n=32)	P value
	mean (SD), count (%)	mean (SD), count (%)	mean (SD), count (%)	
Age, year	71.9 (12.5)	72.1 (12.4)	66.4 (14.5)	0.036
Height, m	1.5 (0.1)	1.5 (0.1)	1.6 (0.3)	0.027
Weight, kg	65.0 (19.1)	64.6 (18.6)	76.2 (28.1)	0.001
Age Group	≤39	55 (6.3)	48 (5.7)	0.001
	40–49	33 (3.8)	29 (3.4)	
	50–59	183 (20.8)	175 (20.6)	
	60–69	298 (33.9)	290 (34.2)	
	70–79	233 (26.5)	230 (27.1)	
	≥80	78 (8.9)	76 (9)	
Menopause	Pre & peri (age <50)	77 (9.1)		0.917
	Post (age ≥50)	771 (90.9)		
BMI Categories	Underweight	70 (8)	68 (8)	
	Normal	315 (35.7)	302 (35.5)	
	Overweight	272 (30.9)	262 (31)	
	Obese	223 (25.4)	216 (25.5)	

Table 2: T scores of regions of osteoporotic subjects by sex

Bone region	Total (n=792) mean (SD)	Women (n=771) mean (SD)	Men (n=21) mean (SD)	P-value
AP spine	-2.8 (1.2)	-2.8 (1.2)	-2.7 (1.1)	0.594
Left femoral neck	-2.3 (1.2)	-2.3 (1.3)	-2.4 (0.6)	0.697
Right femoral neck	-2.4 (0.8)	-2.4 (0.8)	-2.3 (0.6)	0.428
Left total hip	-1.7 (1.5)	-1.7 (1.5)	-1.8 (0.7)	0.928
Right total hip	-1.9 (1.0)	-1.9 (1.0)	-1.6 (0.7)	0.280
Bilateral total hip average	-1.8 (1.1)	-1.8 (1.1)	-1.7 (0.7)	0.673

Table 3: T scores of regions of osteoporotic subjects by weight category

Bone region	Total (n=880) mean (SD)	Underweight (n=70) mean (SD)	Normal (n=315) mean (SD)	Overweight (n=272) mean (SD)	Obese (n=223) mean (SD)	P-value
AP spine	-2.8 (1.2)	-3.2 (1.0)	-3.0 (1.2)	-2.8 (1.0)	-2.5 (1.3)	0.001
Left femoral neck	-2.3 (1.2)	-3.1 (0.9)	-2.6 (0.8)	-2.1 (1.6)	-2.0 (1.2)	0.001
Right femoral neck	-2.4 (0.8)	-3.1 (0.7)	-2.6 (0.7)	-2.3 (0.7)	-2.1 (0.9)	0.001
Left total hip	-1.7 (1.5)	-2.9 (0.7)	-2.1 (0.9)	-1.6 (1.8)	-1.1 (1.7)	0.001
Right total hip	-1.9 (1.0)	-2.9 (0.7)	-2.2 (0.9)	-1.7 (0.8)	-1.3 (1.0)	0.001
Bilateral total hip average	-1.8 (1.1)	-3.0 (0.7)	-2.2 (0.9)	-1.7 (1.1)	-1.2 (1.1)	0.001

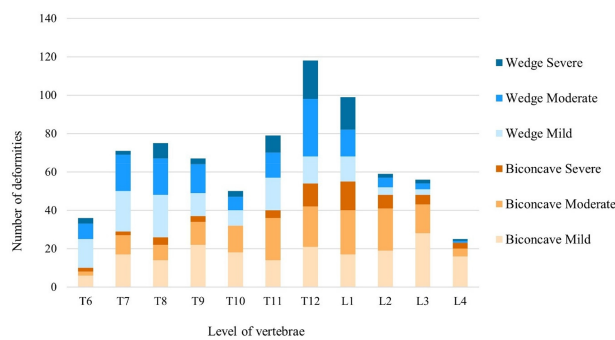


Figure 2: Vertebral deformity types amongst osteoporotic subjects

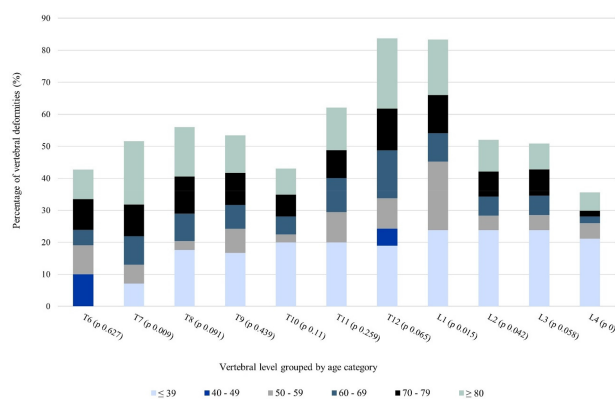


Figure 3: Analysis of vertebral deformities by age group among osteoporotic subjects

tertiary academic hospital in Johannesburg, South Africa, catering to a large drainage area.

We observed a rise in the prevalence of osteoporosis as age advanced. Age is widely acknowledged as a significant risk factor for osteoporosis. In this study, 8.9% of the patients were over 80, emphasising age as a risk factor and the likelihood of the elderly being referred for DEXA scans.

In our study, the prevalence of osteoporosis amongst women was 39.1%, the majority of whom were postmenopausal. This is in keeping with global studies, which found prevalence rates of osteoporosis in 24.8% of women and 27.4% of postmenopausal women.(9) Menopause occurs at approximately 51 years old in developed societies.(20) The global prevalence of osteoporosis among men is estimated at 11.7%.(19) In this study, the prevalence of osteoporosis among males was 32.3%, a notably high rate. We hypothesize that the elevated prevalence observed in our study may result from selection bias, as men suspected of having osteoporosis are more likely to be referred for DEXA scans. Other regional studies have shown higher rates of male osteoporosis compared to the global rate. A study of 51 Zimbabwean men found

the prevalence of osteoporosis to be 24% in the lumbar region and 6% in the femoral region.(10) A South African study by Siwela et al. reported that 18.5% of men had osteoporosis using opportunistic CT scans to analyse BMD.(21)

Our study aligns with former studies documenting the impact of low BMI (<18.5) on osteoporosis risk and its increased severity.(9) Paruk et al. found compelling evidence of a negative association between osteoporosis and body mass index (BMI) across both sexes.(10) Excessive leanness is an established risk factor for osteoporosis, as reported in a meta-analysis.(12) Interestingly, most of our study sample were either classified as overweight or obese (>56.3%), which is an unusual finding.

Developing countries have significantly higher osteoporosis prevalence rates than developed countries. Socioeconomic status, healthcare infrastructure, and education contribute to the higher prevalence rate.(9) The exact prevalence of osteoporosis in SA remains unclear. In 1994, Kalla et al. provided local reference BMD values for fracture risk assessment highlighting that American data are inappropriate for use in the SA population.(22) With regards to race, a misconception exists that osteoporosis is a disease of older Caucasian women. However, Conradie et al. reported that black women have similar rates of vertebral fractures to white women.(23)

Vertebral fractures are clinically silent and are often not included in the differential diagnosis of back pain and, therefore, frequently underdiagnosed.(19,24) Vertebral fractures on DEXA scans may be the only sign of established osteoporosis and are essential in predicting future fracture risks.(12,25) The vertebral evaluation on DEXA scans has a sensitivity of 68% in comparison to X-ray interpretation.(26) Our study found an overall prevalence of 43.9% of vertebral fractures among those with osteoporosis. The majority of vertebral fractures occurred at the twelfth thoracic level, with a prevalence rate of 15.8%, followed by the first lumbar level (13.2%). Similarly, a South African study by Esaadi et al. found frequent fractures at levels T11, T12, and L1 with an overall fracture rate of 20.8%.(27) Age group analysis showed a higher incidence of vertebral deformities with increasing age at all vertebral levels. The seventh thoracic level was significant as there is a higher proportion of deformities in the ≥ 80 age group (19.8%) compared to other age groups.

Studies describing vertebral fractures are heterogeneous. In Mexico, a prevalence rate of 19.35% was found in females over 50 using DEXA to measure BMD.(24) In Ethiopia, prevalence rates of 8.9% among women and 9.5% among men using DEXA scans.(6) Conradie et al. found a similar prevalence of vertebral fractures using thoracolumbar radiographs among older South African women of 9.1% and 5% in black and white women, respectively.(23)

LIMITATIONS:

The current study has several limitations. Firstly, there is a sample bias as the data was collected from patients referred for DEXA scans at a tertiary hospital, where the likelihood of suspected disease is high, impacting the generalizability of the findings. Moreover, the study was conducted at a single site in Johannesburg, and the analysis did not include an assessment of ethnic differences due to insufficient data, further limiting the extrapolation of the results to the broader population.

Another limitation was the exclusion of patients with osteopenia from the study. Thus, patients who had osteopenia and had a vertebral fracture (which would have been classed as osteoporotic) were excluded from the analysis. The study design, therefore, limited the opportunity to obtain a more accurate prevalence rate among those referred for DEXA scans.

The study's strengths include a large sample size consistency in body parameters and measurements with the same DEXA machine, making the data standardized.

CONCLUSION

This study demonstrated a high prevalence of osteoporosis among patients referred for a DEXA scan, particularly in the elderly, with the highest rates observed in postmenopausal women. Being underweight was associated with increased severity of osteoporosis. We also found a higher prevalence of vertebral deformities with increasing age. Further studies identifying the indications and risk factors in these patients will aid in understanding the epidemiology of osteoporosis in South Africa. Integrating routine screening programs, alongside enhanced data collection and the development of a fracture liaison service, is crucial for improving bone health outcomes in South Africa.

STATEMENTS AND DECLARATIONS

Author Contributions

All authors read and approved the final manuscript. ZB and RD led the outline and design of the study and contributed to reviewing and editing the final manuscript. KA collected and managed the data and drafted and edited the manuscript.

Conflicts of interest

The authors declare no conflicts of interest regarding this study's research, authorship, and publication.

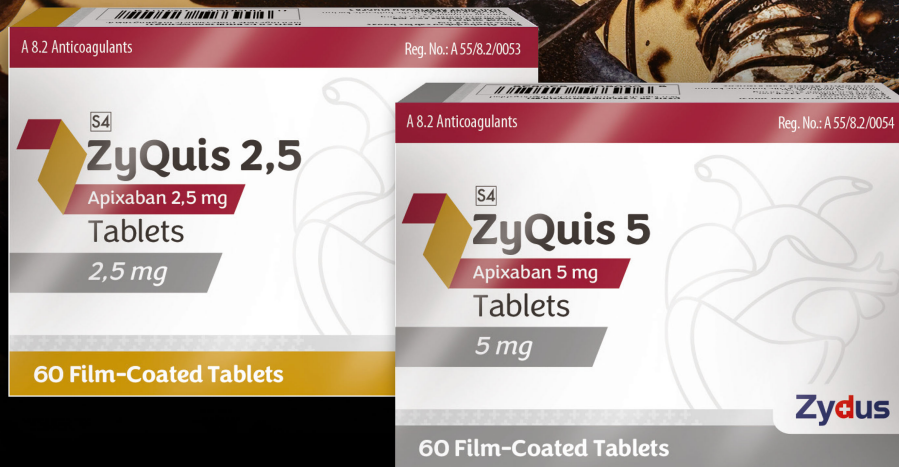
REFERENCES

1. LeBoff MS, Greenspan SL, Insogna KL, et al. The clinician's guide to prevention and treatment of osteoporosis. *Osteoporos Int.* 2022; 33(10):2049–2102. Erratum in: *Osteoporos Int.* 2022; 33(10):2243.
2. Rosen HN, Drezner MK. Clinical manifestations, diagnosis, and evaluation of osteoporosis in postmenopausal women. *UpToDate.* [Internet]. Available from: https://www.uptodate.com/contents/clinical-manifestations-diagnosis-and-evaluation-of-osteoporosis-in-postmenopausal-women?search=clinical%20manifestations%20osteoporosis&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1. Accessed July 10, 2022.
3. Liu JJ, Fu SB, Jiang J, Tang XL. Association between outdoor particulate air pollution and the risk of osteoporosis: a systematic review and meta-analysis. *Osteoporos Int.* 2021; 32(10):1911–1919.
4. Dela SS, Paruk F, Brown SL, et al. Ethnic and gender-specific incidence rates for hip fractures in South Africa: a multi-centre study. *Bone.* 2020; 133:115253.
5. Conradie M, Conradie MM, Kidd M, Hough S. Bone density in black and white South African women: contribution of ethnicity, body weight, and lifestyle. *Arch Osteoporos.* 2014; 9:193.
6. El Miedany Y, Paruk F, Kalla A, et al. Consensus evidence-based clinical practice guidelines for the diagnosis and treat-to-target management of osteoporosis in Africa: an initiative by the African Society of Bone Health and Metabolic Bone Diseases. *Arch Osteoporos.* 2021; 16(1):176.
7. Lane NE. Epidemiology, etiology, and diagnosis of osteoporosis. *Am J Obstet Gynecol.* 2006; 194(2):S3–S11.
8. Bateman C. South Africa under-prioritises osteoporosis. *S Afr Med J.* 2006; 96(1):19–20.
9. Xiao PL, Cui AY, Hsu CJ, et al. Global, regional prevalence, and risk factors of osteoporosis according to the World Health Organization diagnostic criteria: a systematic review and meta-analysis. *Osteoporos Int.* 2022; 33(10):2137–2153.
10. Paruk F, Tsabasvi M, Kalla AA. Osteoporosis in Africa—where are we now. *Clin Rheumatol.* 2021; 40(9):3419–3428.
11. Paruk F, Matthews G, Gregson CL, Cassim B. Hip fractures in South Africa: mortality outcomes over 12 months post-fracture. *Arch Osteoporos.* 2020; 15(1):76.
12. Hough FS, Ascott-Evans B, Brown SL, et al. National Osteoporosis Foundation of South Africa (NOFSA) guideline for the diagnosis and management of osteoporosis. *J Endocrinol Metab Diabetes South Afr.* 2010; 15(3):1–188.
13. Kruger MJ, Nell TA. Bone mineral density in people living with HIV: a narrative review of the literature. *AIDS Res Ther.* 2017; 14(1):35.
14. Dobbs MB, Buckwalter J, Saltzman C. Osteoporosis: the increasing role of the orthopaedist. *Iowa Orthop J.* 1999; 19:43–52. PMID: 10847516.
15. Davey DA. Osteoporosis, osteopenia, and fracture risk: widening the therapeutic horizons. *S Afr Med J.* 2012; 102(5):285–288.
16. Roux C, Briot K. Current role for bone absorptiometry. *Joint Bone Spine.* 2017; 84(1):35–37.
17. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000; 894:i–xii, 1–253. PMID: 11234459. Available from: <https://apps.who.int/iris/handle/10665/42330>.
18. Genant HK, Wu CY, van Kuijk C, Nevitt MC. Vertebral fracture assessment using a semiquantitative technique. *J Bone Miner Res.* 1993; 8(9):1137–1148.
19. Salari N, Ghasemi H, Mohammadi L, et al. The global prevalence of osteoporosis in the world: a comprehensive

- systematic review and meta-analysis. *J Orthop Surg Res.* 2021; 16(1):609.
20. Weismiller DG. Menopause. *Prim Care Clin Office Pract.* 2009; 36(1):199–226.
21. Siwela L, Khan N, Mudau A. A radiological assessment of the prevalence of osteoporosis in male patients seen in a South African hospital: a retrospective analysis. *J Osteoporos.* 2022; 2022:1238927.
22. Kalla AA, Fataar AB, Bewerunge L. Assessment of age-related bone loss in normal South African women by means of the Hologic QDR 1000 system. *S Afr Med J.* 1994; 84(7):398–404.
23. Conradie M, Conradie MM, Scher AT, Kidd M, Hough S. Vertebral fracture prevalence in black and white South African women. *Arch Osteoporos.* 2015; 10:203.
24. Handa R, Kalla A, Maalouf G. Osteoporosis in developing countries. *Best Pract Res Clin Rheumatol.* 2008; 22(4):693–708.
25. Lems WF, Paccou J, Zhang J, et al. International Osteoporosis Foundation Fracture Working Group. Vertebral fracture: epidemiology, impact and use of DXA vertebral fracture assessment in fracture liaison services. *Osteoporos Int.* 2021; 32(3):399–411.
26. Lipschitz S. National Osteoporosis Foundation of South Africa. Instant vertebral assessment/lateral vertebral assessment: an integral and essential part of osteoporosis assessment. *S Afr Med J.* 2004; 94(12):967–968.
27. Esaadi M, Paruk F, Cassim B. Prevalence and clinical risk factors for morphometric vertebral fractures in older subjects in KwaZulu-Natal. *J Endocrinol Metab Diabetes S Afr.* 2021; 26(1):29–33.

IT'S A BATTLE BETWEEN LIFE AND DEATH!

DOUBLE YOUR DEFENCE!



 **ZYQUIS** ^{2,5}/₅
Apixaban 2,5 mg / 5 mg

[S4] ZYQUIS 2,5 mg film-coated tablets. Reg. No: A55/8.2/0053. Each film-coated tablet contains 2,5 mg apixaban. [S4] ZYQUIS 5 mg film-coated tablets. Reg. No: A55/8.2/0054. Each film-coated tablet contains 5 mg apixaban. For full prescribing information refer to the approved package insert. Zydus Healthcare SA (Pty) Ltd. Block B, Southdowns Office Park, 22 Karee Street, Centurion, 0157. Tel: +27 (0)12 748 6400. GF/09/21. ZYQ/05/24.

zydus
Dedicated To Life