Factors associated with osteoporosis among older patients at the Geriatric Centre in Nigeria: a cross-sectional study

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Background: Osteoporosis is a silent disabling clinical condition often attributed to ageing. It is of public health importance because of its complications and attendant morbidity and mortality.

Methods: A cross-sectional study was undertaken of 2401 older patients (60 years and above) at the Geriatric Centre, University College Hospital, Ibadan. Candidate variables such as socio-demographic characteristics, anthropometric indices, physical and lifestyle habits were assessed. Bivariate and multivariate analyses were carried out using SPSS 17®.

Results: The point prevalence of osteoporosis was 56.9% (males = 43.7% and females = 65.8%). The most significant factors associated with osteoporosis on logistics regression analyses were increasing age, female sex, lack of formal education, lack of engagement in occupational activities and living with relatives/friends. Receiving social support from relatives/friends, non-participation in sporting activities at younger ages, prolonged use of medications for peptic ulcer disease, hospitalisation on or after the age of 60 years and asthenic build were also found to be significant. Yearly increase in age shows a 6.9% (95% CI 5.4–8.4%) increase in the odds of having osteoporosis.

Conclusion: The high prevalence of osteoporosis among older persons in this study calls for concerted efforts by the healthcare workers to prevent osteoporosis among older patients.

Keywords: Geriatric centre, Nigeria, older patients, osteoporosis

Background
Osteoporosis is a progressive disease with loss of bone mass which leaves the skeleton vulnerable to fracture. It is a systemic skeletal disease in which there is micro-architectural deterioration of bone tissue. Osteoporosis is operationally defined using the World Health Organization (WHO) criteria as a bone mineral density (BMD) that lies 2.5 standard deviations or more below the average value for young healthy women (a T-score of < –2.5 SD). Dual-energy X-ray absorptiometry (DXA) is commonly used to measure BMD.

The WHO scientific group on the assessment of osteoporosis at the primary healthcare level in the report of the meeting held in Brussels, Belgium in 2004 noted that osteoporosis is a disease that has to be prevented in view of its severe morbidity and associated fragility fractures among the elderly because these cause a huge impact, financial and social, on the health of the community. Osteoporosis is also known to affect the quality of life and independence of the elderly. With increasing life expectancy in Nigeria, the population of the elderly being hospitalised following fractures of the head of the femur is on the rise. The vertebral bodies, distal radius, neck of femur, proximal femur and proximal humerus are the areas of highest prevalence of fractures.

Osteoporosis can be divided into primary osteoporosis, which includes age-related and idiopathic osteoporosis, and secondary osteoporosis. The causes of secondary osteoporosis include but are not restricted to hypogonadism such as arises from hormonal treatment of prostate cancer, lifestyle choices such as a sedentary lifestyle, alcohol and cigarette consumption, gastrointestinal disorders, systemic illnesses and medications such as glucocorticoids.

In the United Kingdom (UK), more than 200,000 fractures are reported each year secondary to osteoporosis. In America, the prevalence rate of osteoporosis is 10.3%, which translates to 28 million people, of which 10 million have osteoporosis and 18 million have low BMD. In Australia, 1.2 million people are reported to have osteoporosis, whilst in India postmenopausal women commonly suffer from osteoporosis, although osteoporosis is as important in men as it is in women. The risk factors associated with osteoporosis include a positive family history of osteoporosis, lack of exercise, vitamin D deficiency and a low-calcium diet. Prolonged amenorrhoea and a history of anorexia or bulimia are also implicated in the development of osteoporosis. Significant increase in total homocysteine (tHcy) with corresponding decreases in folic acid, vitamins B12 and B6 were identified as the risk factors causing a decrease in BMD in osteoporotic Nigerian adults using DXA measurement.

In a case-control study conducted at the National Orthopaedic Hospital Igbobi, Lagos, Nigeria over a 12-month period, 31 patients ranging from 67 to 100 years with a mean age of 79.6 years were recruited. The majority of those in the study group with osteoporosis were female and most were post-menopausal; also virtually all the patients were above 70 years of age. Similarly, in a cross-sectional study among 208 Nigerian women, broadband ultrasound attenuation (BUA) and speed of sound velocity (SOS) were used to calculate the stiffness index.
(SI) of the calcaneus. In this total study group, 9% had T-scores indicative of osteoporosis, based on United States (US) reference data. Among Nigerians living with human immunodeficiency virus (HIV), the BMD values revealed osteoporosis in 31.9% and osteopenia in 46.6%.

To our knowledge, there is a paucity of data on osteoporosis in Nigeria using DXA measurement, as osteoporosis has been sparingly studied. Furthermore, the few studies available were carried out in young and pregnant women. This has left a knowledge gap in the frequency of the condition among elderly patients and the effects of the interventions used in managing this condition. Most healthcare workers and elderly patients become aware of osteoporosis when a fracture has occurred, most often after an innocuous injury. The aim of healthcare workers should be to prevent fractures from occurring in elderly patients as studies have shown high morbidity and mortality following fractures in older persons. This study will increase the knowledge of healthcare workers and increase their awareness of the public health impact of osteoporosis among elderly patients. Additionally, it will serve as a reference point for policymakers in the health sector to understand the magnitude and modifiable factors to be urgently and properly addressed to prevent osteoporosis in elderly people.

Methods

Study site
This study was carried out at the Chief Tony Anenih Geriatric Centre (CTAGC) of University College Hospital (UCH), Ibadan. Ibadan is the capital city of Oyo State in South-Western Nigeria and it has a population of 3.6 million inhabitants, while Oyo State as a whole has 5.6 million people. University College Hospital, Ibadan is the premier teaching hospital in Nigeria with 850-bed capacity. CTAGC was the first purpose-built geriatric centre in West Africa, established on November 17, 2012, to give holistic care to elderly patients seeking care at UCH. CTAGC has recreational facilities, a dietetics unit, a medical social work unit, a physiotherapy unit, a one-stop-shop outpatient clinic, and two operating theatre suites as well as inpatient (ward) services. This study was carried out at the outpatient unit of the CTAGC, UCH.

Aim of the study
The aim of this study was to determine the prevalence of osteoporosis and its associated factors among older patients aged ≥ 60 years in a first-contact care setting.

Study population
Male and female patients aged 60 years and above who presented consecutively at the CTAGC, UCH between February 2013 and August 2014 were included in the study. Those who did not consent or were too ill to participate were excluded. Their ages were determined by direct recall and the use of the table of historical events by Ajayi-Igun.

Study design
This was a cross-sectional study of 2401 older patients aged ≥ 60 years who were selected consecutively as they presented in the clinic. An assumed prevalence of 50%, because there were no local data on prevalence of osteoporosis in older Nigerians, and a precision of 2% were used in calculating the sample size to arrive at 2401 respondents.

Table 1: Socio-demographic characteristics

| Factor                        | Males = 964, n (%) | Females = 1437, n (%) | Total = 2401, n (%) |
|-------------------------------|--------------------|-----------------------|--------------------|
| **Age groups (years)**        |                    |                       |                    |
| 60–64                         | 204 (21.2)         | 312 (21.7)            | 516 (21.5)         |
| 65–69                         | 233 (24.2)         | 374 (26.0)            | 607 (25.3)         |
| 70–74                         | 233 (24.2)         | 335 (23.3)            | 568 (23.7)         |
| 75–79                         | 171 (17.7)         | 260 (18.1)            | 431 (18.0)         |
| ≥ 80                          | 123 (12.8)         | 156 (10.9)            | 279 (11.6)         |
| **Marital status**            |                    |                       |                    |
| Married                       | 819 (85.0)         | 634 (44.1)            | 1453 (60.5)        |
| Widowed                       | 131 (13.6)         | 782 (54.4)            | 913 (38.0)         |
| Separated                     | 7 (0.7)            | 11 (0.8)              | 18 (0.7)           |
| Single                        | 5 (0.5)            | 5 (0.3)               | 10 (0.4)           |
| Divorced                      | 2 (0.2)            | 5 (0.3)               | 7 (0.3)            |
| **Religious groups**          |                    |                       |                    |
| Christianity                  | 618 (64.1)         | 957 (66.6)            | 1575 (65.6)        |
| Islam                         | 339 (35.2)         | 473 (32.9)            | 812 (33.8)         |
| Traditional and others        | 7 (0.7)            | 7 (0.5)               | 14 (0.6)           |
| **Educational attainment**    |                    |                       |                    |
| None                          | 177 (18.4)         | 669 (46.6)            | 846 (35.2)         |
| Primary school                | 163 (16.9)         | 228 (15.9)            | 391 (16.3)         |
| Secondary school              | 276 (28.6)         | 202 (14.1)            | 478 (19.9)         |
| Tertiary school               | 348 (36.1)         | 338 (23.5)            | 686 (28.6)         |
| **Occupational status**       |                    |                       |                    |
| Not engaged in occupational activities | 636 (66.0)  | 925 (64.4)  | 1561 (65.0)  |
| Still engaged in occupational activities | 328 (34.0)  | 512 (35.6)  | 840 (35.0)  |
| **Living arrangements**       |                    |                       |                    |
| Alone                         | 117 (12.1)         | 264 (18.4)            | 381 (15.9)         |
| With spouse                   | 771 (80.0)         | 599 (41.7)            | 1370 (57.1)        |
| With children/grandchildren   | 70 (7.3)           | 548 (38.1)            | 618 (25.7)         |
| With relatives/friends        | 6 (0.6)            | 26 (1.8)              | 32 (1.3)           |
| **Financial support**         |                    |                       |                    |
| Self                          | 383 (39.7)         | 269 (18.7)            | 652 (27.2)         |
| Spouse                        | 67 (7.0)           | 131 (9.1)             | 198 (8.2)          |
| Children/grandchildren        | 487 (50.5)         | 1020 (71.0)           | 1507 (62.8)        |
| Relatives/friends             | 27 (2.8)           | 17 (1.2)              | 44 (1.8)           |
| **Social support**            |                    |                       |                    |
| None                          | 15 (1.6)           | 23 (1.6)              | 38 (1.6)           |
| Spouse                        | 580 (60.2)         | 364 (25.3)            | 944 (39.3)         |
| Children/grandchildren        | 360 (37.3)         | 1021 (71.1)           | 1381 (57.5)        |
| Relatives/friends             | 9 (0.9)            | 29 (2.0)              | 38 (1.6)           |
| **Number of children**        | 0–5                | 487 (50.5)            | 903 (62.8)         |
| > 5                           | 477 (49.5)         | 534 (37.2)            | 1011 (42.1)        |
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Procedure
A semi-structured interviewer-administered questionnaire which was pre-tested before the actual study was used. The BMD was measured in the right wrist (radial and ulnar bones) using a Dual Energy X-ray Absorptiometry (DXA) OsteoSys machine (EXA 3000®) (Medical ECONET GmbH, Oberhausen, Germany). It provides BMD in g/cm² (gold standard) and the T-score within five seconds. This ensures speed, maximum reduction in patients’ radiation dose, detailed imaging and analysis as well as excellent precision. Osteoporosis was defined based on the quantitative assessment of BMD using the WHO operational definition of osteoporosis by DXA machine. Respondents with a T-score of < –2.5 were classified as having osteoporosis.

Table 2: Socio-demographic characteristics by prevalence of osteoporosis

| Factor                        | Yes = 1366, n (%) | No = 1035, n (%) | Total = 2401, n (%) |
|-------------------------------|-------------------|------------------|---------------------|
| Age groups (years)            |                   |                  |                     |
| 60–64                         | 205 (39.7)        | 311 (60.3)       | 516 (100.0)         |
| 65–69                         | 300 (49.4)        | 307 (50.6)       | 607 (100.0)         |
| 70–74                         | 341 (60.0)        | 227 (40.0)       | 568 (100.0)         |
| 75–79                         | 309 (71.7)        | 122 (28.3)       | 431 (100.0)         |
| ≥ 80                          | 211 (75.6)        | 68 (24.4)        | 279 (100.0)         |
| Sex                           |                   |                  |                     |
| Males                         | 421 (43.7)        | 543 (56.3)       | 964 (100.0)         |
| Females                       | 945 (65.8)        | 492 (34.2)       | 1437 (100.0)        |
| Marital status                |                   |                  |                     |
| Not currently married         | 640 (67.5)        | 308 (32.5)       | 948 (100.0)         |
| Currently married             | 726 (50.0)        | 727 (50.0)       | 1453 (100.0)        |
| Religious groups              |                   |                  |                     |
| Christianity                  | 851 (54.0)        | 724 (46.0)       | 1575 (100.0)        |
| Islam                         | 509 (62.7)        | 303 (37.3)       | 812 (100.0)         |
| Traditional and others        | 6 (42.9)          | 8 (57.1)         | 14 (100.0)          |
| Educational attainment        |                   |                  |                     |
| None                          | 610 (72.1)        | 236 (27.9)       | 846 (100.0)         |
| Primary school                | 220 (56.3)        | 171 (43.7)       | 391 (100.0)         |
| Secondary school              | 237 (49.6)        | 241 (50.4)       | 478 (100.0)         |
| Tertiary school               | 299 (43.6)        | 387 (56.4)       | 686 (100.0)         |
| Occupational status           |                   |                  |                     |
| Not engaged in occupational activities | 933 (59.8) | 628 (40.2) | 1561 (100.0) |
| Still engaged in occupational activities | 433 (51.5) | 407 (48.5) | 840 (100.0) |
| Living arrangements           |                   |                  |                     |
| Alone                         | 223 (58.5)        | 158 (41.5)       | 381 (100.0)         |
| With spouse                   | 689 (50.3)        | 681 (49.7)       | 1370 (100.0)        |
| With children/grandchildren   | 431 (69.7)        | 187 (30.3)       | 618 (100.0)         |
| With relatives/friends        | 23 (71.9)         | 9 (28.1)         | 32 (100.0)          |
| Financial support             |                   |                  |                     |
| Self                          | 251 (38.5)        | 401 (61.5)       | 652 (100.0)         |
| Spouse                        | 93 (47.0)         | 105 (53.0)       | 198 (100.0)         |
| Children/grandchildren        | 1001 (66.4)       | 506 (33.6)       | 1507 (100.0)        |
| Relatives/friends             | 21 (47.7)         | 23 (52.3)        | 44 (100.0)          |
| Social support                |                   |                  |                     |
| None                          | 17 (44.7)         | 21 (55.3)        | 38 (100.0)          |
| Spouse                        | 465 (49.3)        | 479 (50.7)       | 944 (100.0)         |
| Children/grandchildren        | 868 (62.9)        | 513 (37.1)       | 1381 (100.0)        |
| Relatives/friends             | 16 (42.1)         | 22 (57.9)        | 38 (100.0)          |
| Number of children            |                   |                  |                     |
| 0–5                           | 802 (57.7)        | 588 (42.3)       | 1390 (100.0)        |
| > 5                           | 564 (53.8)        | 447 (46.2)       | 1011 (100.0)        |

*p<0.05* Significant at 5% level of significance.
Detailed information on the risk factors for osteoporosis such as socio-demographic characteristics, lifestyle habits, family functionality, previous hospitalisation (age at first hospital admission and number of hospital admission), healthcare utilisation, morbidities and pattern of medications used in the past one year prior to this study were obtained. Comprehensive physical examination and anthropometric measurements of height, weight, waist and hip circumferences were carried out by the researchers. Body mass index (BMI) was calculated by dividing weight (kilogrammes) by height in meters squared and this was graded using the WHO anthropometric classification. Underweight was defined as BMI < 18.4 kg/m² with 18.5–24.9 kg/m² as normal. Overweight was a BMI of 25.0–29.9 kg/m² and obesity a BMI ≥ 30.0 kg/m². The average distance walked by the respondents was estimated from the number of electric poles they walk daily (50 metres between two poles). The administration of the questionnaire was carried out in the English language and Yoruba language (the local dialect of most respondents) and it took about 45 minutes to be administered to each respondent.

**Consent for the study**

Approval for the study was obtained from the University of Ibadan/University College Hospital Institutional Ethical Review Board. Informed consent of each respondent was obtained before administration of questionnaires.

Respondents’ follow-up: Those who were diagnosed with osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement. The administered osteoporosis were treated with bisphosphonate (alendronate oribandronate) and calcium supplement.

**Results**

There were 2401 respondents in this study with a male to female ratio of 1:1.49. The mean ± SD age of the respondents was 70.8 ± 7.7 years (males > females = 71.1 ± 7.9 > 70.6 ± 7.5 years) without a statistical difference (t = 1.533, p = 0.125). The median income of the respondents was 40,000 Naira (IQR 35,000 – 60,000) with the men significantly earning more than the women (45,000 Naira [IQR 40,000–70,000] vs. 40,000 Naira [IQR 30,000–45,000], Z = 11.098, p < 0.0001). The majority of the men (85.0%) were still married while the majority of the women (54.4%) were widowed. A higher proportion of the men (81.6%) had formal education compared with the women (53.5) (Table 1). The

**Figure 1:** Point prevalence of osteopenia and osteoporosis using Dual Energy X-ray Absorptiometry (DXA).

**Table 3:** Medical history and lifestyle habits by prevalence of osteoporosis

| Factor | Osteoporosis | Total = 2401, n (%) |
|--------|--------------|---------------------|
|        | Yes = 1366, n (%) | No = 1035, n (%) |
| Do you engage in physical activities now? | | |
| Yes | 908 (54.1) | 769 (45.9) | 1677 (100.0) | 17.132 |
| No | 456 (63.3) | 266 (36.7) | 724 (100.0) | 0.0001* |
| Do you take alcohol? | | |
| Yes | 9 (45.0) | 11 (55.0) | 20 (100.0) | 1.163 |
| No | 1357 (57.0) | 1024 (43.0) | 2381 (100.0) | 0.281 |
| Do you take tobacco? | | |
| Yes | 0 (0.0) | 5 (100.0) | 5 (100.0) | 0.010† |
| No | 1366 (57.0) | 1030 (43.0) | 2396 (100.0) | |
| Do you take vitamins and mineral supplements? | | |
| Yes | 443 (59.2) | 305 (40.8) | 748 (100.0) | 2.408 |
| No | 923 (55.8) | 730 (44.2) | 1653 (100.0) | 0.121 |
| Did you engage in sporting activities when you were in school or young? | | |
| Yes | 381 (44.0) | 485 (56.0) | 866 (100.0) | 0.91878 |
| No | 985 (64.2) | 550 (35.8) | 1535 (100.0) | 0.0001* |
| Are you on steroid therapy? | | |
| Yes | 27 (69.2) | 12 (30.8) | 39 (100.0) | 2.851 |
| No | 1315 (56.8) | 1001 (43.2) | 2316 (100.0) | 0.240 |
| Can’t remember | | |
| Yes | 24 (52.2) | 22 (47.8) | 46 (100.0) | 0.0001* |
| No | 1366 (57.0) | 1030 (43.0) | 2396 (100.0) | |
| Do you have thyroid disease? | | |
| Yes | 8 (88.9) | 1 (11.1) | 9 (100.0) | 0.052† |
| No | 1358 (56.8) | 1034 (43.2) | 2392 (100.0) | 0.052† |
| Do you have any form of cancer? | | |
| Yes | 8 (72.7) | 3 (27.3) | 11 (100.0) | 0.288† |
| No | 1358 (56.8) | 1032 (43.2) | 2390 (100.0) | 0.028† |
| Do you have family history of fracture? | | |
| Yes | 5 (71.4) | 2 (28.6) | 7 (100.0) | 0.437|
| No | 1361 (56.9) | 1033 (43.1) | 2394 (100.0) | 0.437|
| Are you on anticonvulsant medications? | | |
| Yes | 10 (47.6) | 11 (52.4) | 21 (100.0) | 0.743 |
| No | 1356 (57.0) | 1024 (43.2) | 2380 (100.0) | 0.389 |
| Are you on peptic ulcer disease medications? | | |
| Yes | 104 (66.7) | 52 (33.3) | 156 (100.0) | 6.496 |
| No | 1262 (56.9) | 983 (43.1) | 2245 (100.0) | 0.011* |
| Do you have chronic joint pains? | | |
| Yes | 662 (57.2) | 496 (42.8) | 1158 (100.0) | 0.069 |
| No | 704 (56.6) | 539 (43.4) | 1243 (100.0) | 0.793 |
| Your first admission to a hospital | | |
| Never been admitted | 857 (59.3) | 588 (40.7) | 1445 (100.0) | 32.544 |
| Before the age of 60 years | 198 (44.8) | 244 (55.2) | 442 (100.0) | 0.0001* |
| After the age of 60 years | 311 (60.5) | 203 (39.5) | 514 (100.0) | 0.0001* |

*Significant at 5% level of significance.
†Fisher’s exact test.
The model explained 29.6% (Nagelkerke R²) of the variance in osteoporosis, with a point prevalence of osteoporosis of 56.9%. This is described by a logistic regression analysis. The prevalence of osteoporosis was higher among the female respondents compared with their male counterparts (65.8% vs. 43.7%; p < 0.0001). The prevalence of osteoporosis was significantly associated with respondents who were not currently married, and had no formal education, non-engagement in occupational activities and were living with relatives/friends and being supported socially as well as financially by children or grandchildren.

Table 3 shows the medical history and lifestyle habits by prevalence of osteoporosis. The prevalence of osteoporosis was significantly associated with non-engagement in physical activities (χ² = 17.132, p < 0.0001), non-participation in sporting activities during school years (χ² = 9.187, p < 0.0001), usage of peptic ulcer medications (χ² = 6.498, p = 0.011) and being admitted to the hospital for the first time at or after the age of 60 years (χ² = 32.544, p < 0.0001).

Anthropometric measurements showed that the males were significantly taller than females (163.6 ± 7.4 cm > 153.2 ± 6.5 cm; t = 36.649, p < 0.0001) and significantly heavier (68.1 ± 14.9 kg > 66.4 ± 15.8 kg; t = 2.648, p = 0.008) than the females. However, the female respondents had higher mean ± SD waist circumference (98.6 ± 13.1 cm vs. 95.2 ± 12.4 cm; t = 6.530, p < 0.0001), hip circumference (106.1 ± 12.9 cm vs. 100.0 ± 30.5 cm; t = 6.739, p < 0.0001) and body mass index (28.3 ± 6.5 vs. 25.4 ± 5.0; t = 11.848, p < 0.0001) compared with the male respondents. Table 4 shows the anthropometric measurements by prevalence of osteoporosis. In both sexes, osteoporosis was significantly associated with having normal waist circumference (p < 0.0001) and being non-obese (p < 0.0001). The prevalence of osteoporosis was observed to have an inverse association with different categories of body mass index (BMI). This is shown in Figure 2.

Logistic regression analysis was carried out on significant variables associated with osteoporosis and this is shown in Table 5 (effect of age, sex, marital status, occupational activities, living arrangements, social and financial support, sporting activities while in school, first hospital admission, waist circumference, educational status, obesity and physical activities on the likelihood that the participants have osteoporosis). The logistic model was statistically significant, χ² (19) = 598.702, p < 0.0001. The model explained 29.6% (Nagelkerke R²) of the variance in osteoporosis and correctly classified 72.3% of cases. The most significant variables associated with osteoporosis were age (OR = 1.069 [95% CI 1.054–1.084] p < 0.0001), female sex (OR = 4.061 [95% CI 3.133 – 5.263], p < 0.0001), non-engaged in occupational activities (OR = 1.246 [95% CI 1.018–1.526], p = 0.037), receiving social support from relatives and friends (OR = 2.712 [95% CI 1.254–5.864], p = 0.011), receiving social support from children or grandchildren (OR = 3.482 [95% CI 1.553–7.805], p = 0.002), non-participation in sporting activities while at school (OR = 1.453 [95% CI 1.168–1.808], p = 0.001), using peptic ulcer disease medications (OR = 1.780 [95% CI 1.212–2.613], p = 0.003), hospitalisation after the age of 60 years (OR = 1.410 [95% CI 1.130–1.805], p = 0.006), normal waist circumference (OR = 1.953 [95% CI 1.495–2.551], p < 0.0001), having no formal education (OR = 1.376 [95% CI 1.088–1.740], p = 0.008) and not being obese (OR = 3.310 [95% CI 2.647–4.141], p < 0.0001). Each increase of one year in age produced a 6.9% (95% CI 5.4–8.4%) increase in the odds of having osteoporosis.

**Discussion**

Osteoporosis is a common metabolic bone disease that has attracted little attention and even less action in many developing countries including Nigeria and there are several reasons for this state of neglect. These include the erroneous belief that osteoporosis is a disease limited to the developed countries and the acceptance of osteoporosis as an inevitable consequence of ageing. This was a large study carried out among elderly respondents in the premier Geriatric Centre established in Nigeria.

Osteoporosis was found in more than half of the older patients in our setting. The prevalence of osteoporosis varies widely due to the differences in instruments used in measuring and the bones measured. Our prevalence was higher than that of adults aged 50 years and older in the US/European reference (38.3–47.7%). Saudi Arabia (30.5–49.6%), China (31%) and India studies (20.3%). Differences in the cut-off ages of adults in these studies could account for the disparities in prevalence values.

### Table 4: Anthropometric measurements by prevalence of osteoporosis

| Factor                      | Osteoporosis                                      | Total = 2401, n (%) |
|-----------------------------|---------------------------------------------------|---------------------|
|                             | Yes = 1366, n (%)                                 | No = 1035, n (%)    |
|                             |                                                   |                     |
| Waist–hip Ratio (WHR)       |                                                   |                     |
| Males                       |                                                   |                     |
| < 1.00                      | 334 (45.1)                                        | 406 (54.9)          | 740 (100.0)               |
| ≥ 1.00                      | 87 (38.8)                                         | 137 (61.2)          | 224 (100.0)               |
| χ² = 2.771 df = 1; p = 0.096|                                                   |                     |
| Females                     |                                                   |                     |
| < 0.85                      | 90 (65.7)                                         | 47 (34.3)           | 137 (100.0)               |
| ≥ 0.85                      | 855 (65.8)                                        | 445 (34.2)          | 1300 (100.0)              |
| χ² = 0.000 df = 1; p = 0.986|                                                   |                     |
| Body mass index (BMI)       |                                                   |                     |
| Males                       |                                                   |                     |
| Non-obese (< 30 kg/m²)      | 385 (47.7)                                        | 422 (52.3)          | 807 (100.0)               |
| Obese (≥ 30 kg/m²)          | 36 (22.9)                                         | 121 (77.1)          | 157 (100.0)               |
| χ² = 32.801 df = 1; p < 0.0001|                                                   |                     |
| Females                     |                                                   |                     |
| Non-obese (< 30 kg/m²)      | 710 (78.1)                                        | 199 (21.9)          | 909 (100.0)               |
| Obese (≥ 30 kg/m²)          | 235 (44.5)                                        | 293 (55.5)          | 528 (100.0)               |
| χ² = 167.500 df = 1; p < 0.0001*|                                                   |                     |
| Waist circumference (WC)    |                                                   |                     |
| Males                       |                                                   |                     |
| Normal (< 94 cm)            | 259 (53.3)                                        | 209 (44.7)          | 468 (100.0)               |
| Above normal (≥ 94 cm)      | 162 (32.7)                                        | 334 (67.3)          | 496 (100.0)               |
| χ² = 50.354 df = 1; p < 0.0001*|                                                   |                     |
| Females                     |                                                   |                     |
| Normal (< 80 cm)            | 66 (88.0)                                         | 9 (12.0)            | 75 (100.0)                |
| Above normal (≥ 80 cm)      | 879 (64.5)                                        | 483 (35.5)          | 1362 (100.0)              |
| χ² = 17.380 df = 1; p < 0.0001*|                                                   |                     |

※Significant at 5% level of significance.
Globally, osteoporosis has been reported to be more prevalent among older females compared with males due to their postmenopausal state. We found female sex to be an independent risk factor for developing osteoporosis with a fourfold risk among the older women. This was also reported in a Nigerian study in which a majority of those in the study group with osteoporosis were female.1 The prevalence of osteoporosis among the female respondents (65.8%) was higher than that reported among the Moroccan older women (35.7%).22

We found a 6.9% increase in the risk of developing osteoporosis with each one-year increase in age. The association between age and osteoporosis was similarly reported in a hospital study in South-Western Nigeria. 1 Generally, bone formation and bone resorption processes are well balanced with no net change in the bone mass; however, bone formation exceeds bone resorption in the childhood and early adulthood periods. Between the ages of 30 and 40 years, the BMD plateaus, after which bone resorption exceeds bone formation with a decline in BMD throughout the rest of life, which in turn may lead to osteoporosis.9

Low education has been reported as an independent risk factor for the development of osteoporosis23 and this was not different in our study as respondents without formal education had 1.4 times the risk of developing osteoporosis. Lifestyle habits of tobacco smoking and alcohol consumption in the respondents were not independently associated with osteoporosis. We could not draw any conclusion on this as few of the respondents engaged in these lifestyle habits. Also, the amount of alcohol consumed by the respondents was not ascertained. Studies have shown a dose–response relationship between tobacco smoking and osteoporosis.24 However, the relationship between alcohol consumption and osteoporosis is unclear.25

Body size has been found to strongly influence bone mineral density and by extension the development of osteoporosis. Generally, obesity was thought to be protective against osteoporosis and fragility fracture, but a recent review has challenged this assumption. Obesity causes increased mechanical loading from bodyweight and increases pancreatic secretion of hormones promoting bone homeostasis and formation. In our study, however, obese respondents were at three times less risk of developing osteoporosis compared with those with normal body mass index.

### Table 5: Logistic regression analysis of significant variables associate with osteoporosis

| Factor                          | B    | Wald   | p     | OR   | 95% CI for OR |
|--------------------------------|------|--------|-------|------|---------------|
| Age                            | 0.066| 84.789 | 0.001*| 1.069| 1.054 1.084   |
| Sex (females)                  | 1.401| 112.076| 0.001*| 4.061| 3.133 5.263   |
| Currently married              | -0.297| 2.257  | 0.133 | 0.743| 0.505 1.095   |
| Not engaged in occupational    | 0.220| 4.554  | 0.033*| 1.246| 1.018 1.526   |
| Living arrangement             | 4.909| 0.179  |       |      |               |
| With spouse                    | 0.053| 0.058  | 0.809 | 1.054| 0.687 1.618   |
| With children/grandchildren    | -0.052| 0.110  | 0.740 | 0.949| 0.697 1.293   |
| With relatives and friends     | 0.995| 4.330  | 0.037*| 2.705| 1.060 6.908   |
| Social support                 | 11.475| 0.009* |       |      |               |
| From spouse                    | 0.654| 1.449  | 0.229 | 1.924| 0.663 5.582   |
| From children/grandchildren    | 1.247| 9.173  | 0.002*| 3.482| 1.553 7.805   |
| From relatives and friends     | 0.998| 6.432  | 0.011*| 2.712| 1.254 5.864   |
| Did no sporting activities while in school | 0.374| 11.252| 0.001*| 1.453| 1.168 1.808   |
| Using medication for peptic ulcer disease | 0.576| 8.656  | 0.003*| 1.780| 1.212 2.613   |
| First hospital admission       | 7.651| 0.022* |       |      |               |
| Before the age of 60 years     | 0.128| 1.125  | 0.289 | 1.138| 0.897 1.441   |
| After the age of 60 years      | 0.344| 7.482  | 0.006*| 1.410| 1.103 1.805   |
| Waist circumference (normal)   | 0.669| 24.075| 0.001*| 1.953| 1.495 2.551   |
| Had no formal education         | 0.319| 7.077  | 0.008*| 1.376| 1.088 1.740   |
| Financially supported by others| 0.511| 20.954| 0.001*| 1.667| 1.339 2.075   |
| Not obese (BMI < 30 kg/m²)      | 1.197| 109.909| 0.001*| 3.310| 2.647 4.141   |
| Not engaged in physical activities| 0.083| 0.602  | 0.438 | 1.087| 0.881 1.341   |
| Constant                       | -5.632| 72.056 | 0.000 | 0.000| 0.004         |

*Significant at 5% level of significance.

### Figure 2: Body mass index by prevalence of osteoporosis.
Certain medications have been associated with the development of osteoporosis. We found a 1.8 increased risk of developing osteoporosis in respondents taking anti-peptic ulcer medications, which include antacids and proton pump inhibitors (PPIs), for long periods of time. Though studies varied on the pathogenesis of osteoporosis among persons taking PPIs, data have suggested a direct inhibitory effect on bone metabolism.27

Conclusions
The prevalence of osteoporosis was high among older patients in our settings with risk factors such as age, female sex, low education and prolonged use of peptic ulcer disease medications. Further longitudinal and community-based studies are needed to evaluate the predictive factors for developing osteoporosis.

Limitations
This study was hospital based, thus it is difficult to generalise its findings.

Authors' contributions – TA, LA and AO conceived the study. LA, OO and AO drafted the manuscript. ML, WB, VOA and TA critically reviewed the manuscript and made conceptual constructs. The final version of the manuscript was read and approved by all the authors.

References
1. Jimoh OR, Onabowale BO, Musa OL. Determinants and prognostic factors in fracture neck of femur sequel to osteoporosis in a South Western state of Nigeria. Res J Med Sci. 2008;2(5):244–7.
2. Rizzoli R, Bonjour J-P, Ferrari SL. Osteoporosis, genetics and hormones. J Mol Endocrinol. 2001;26:79–94. https://doi.org/10.1677/jme.0.0260079
3. World Health Organization. WHO scientific group on the assessment of osteoporosis at primary health care level. Summary meeting report held at Brussels. Belgium: Author; 2004. p. 5–7.
4. Kanis JA. Osteoporosis. J Med Sci. 2008;3(3):124–30.
5. Pasco JA, Kotowicz MA. Osteopenia – a marker of low bone mass and fracture risk. Hard tissue. 2013;2(1):10.
6. Khosla S, Amin S, Orwoll E. Osteoporosis in Men. Endocr Rev. 2008;29(4):441–64. https://doi.org/10.1210/er.2008-0002
7. Statistics by country for osteoporosis. 2013. [cited 2013 Oct 12]. Available from: http://www.rightdiagnosis.com/o/osteoporosis/stats-country.htm
8. Ebeling PR, Daly RM, Kerr DA, et al. Building healthy bones throughout life: an evidence-informed strategy to prevent osteoporosis in Australia. Med J Aust. 2013;199(7 suppl):S1–4.
9. Indumati V, Vidya S, Rama J. Hospital based preliminary study on osteoporosis in postmenopausal women. Indian J Clin Biochem. 2007;22(2):96–100. https://doi.org/10.1007/BF02933223
10. Ebesunun MO, Umahoin KO, Alonge TO, et al. Plasma homocysteine, B vitamins and bone mineral density in osteoporosis: a possible risk for bone fracture. Afr J Med Med Sci. 2014 Mar;43(1):41–7.
11. VanderJagt DJ, Bond B, Dulai R, et al. Assessment of the bone status of Nigerian women by ultrasound and biochemical markers. Calcif Tissue Int. 2001;68(5):277–84. https://doi.org/10.1007/BF02390834
12. Alonge TO, Okoje-Adesomoju VN, Atabali OM, et al. Prevalence of abnormal bone mineral density in HIV-positive patients in Ibadan, Nigeria. J West Afr Coll Surg. 2013 Oct;3(4):1–14.
13. National Population Commission of Nigeria. National and states population and housing tables. 2006 population and housing census of the Federal Republic of Nigeria. 2009. [cited 2011 Feb 14] Available from: www.population.gov.ng
14. Oggunniyi A, Osuntokun BO. Determination of ages of elderly Nigerians through historical events: validation of Ajayi-Igun 1963 listing. West Afr J Med. 1993 Oct–Dec;12(4):189–90.
15. EXA 3000-OsteoSys. Medical econet GmbH. [cited 2015 Sep 12] Available from: www.medical-econet.com
16. National Osteoporosis Guideline Group. Guideline for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK. [cited 2013 Nov 13] Available from: www.shef.ac.uk/NOGG/NOGG_pocket_guide_for_healthcare_professionals
17. World Health Organization. Physical status: the use and interpretation of anthropometry. Technical Report Series no. 854. Geneva: Author; 1995.
18. Haida R, Kalla AA, Mahlouf G. Osteoporosis in developing countries. Best Practice & Research Clinical Rheumatology 2008;22(4):693–708.
19. Maalouf G, Gannagé-Yared MH, Ezzedine J, et al. Middle East and North Africa consensus on osteoporosis. J Musculoskeletal Neuronal Interact. 2007 Apr–Jun;7(2):131–43.
20. Cheng XG, Yang DZ, Zhou Q. Age-related bone mineral density, bone loss rate, prevalence of osteoporosis, and reference database of women at multiple centers in China. J Clin Densitom. 2007;10:276–84. https://doi.org/10.1016/j.jcd.2007.05.004
21. Sharma S, Tandon VR, Mahajan A. Preliminary screening of osteoporosis and osteopenia in urban women from Jammu using calcaneal QUS. Indian J Med Sci. 2006;60:183–9. https://doi.org/10.4103/0019-5359.25679
22. Elmaataoui A, Elmachtani Idrissi S, Dami A, et al. Association between bone turnover markers, bone mineral density and vitamin D in Moroccan postmenopausal women. Pathol Biol (Paris). 2014 Feb;62(1):49–54. https://doi.org/10.1016/j.patbio.2013.11.001
23. Allali F, Rostom S, Bennani L, et al. Educational level and osteoporosis risk in postmenopausal Moroccan women: a classification tree analysis. Clin Rheumatol. 2010 Nov;29(11):1269–75. https://doi.org/10.1007/s10067-010-1535-y
24. Ayo-Yusuf OA, Olutola BG. Epidemiological association between osteoporosis and combined smoking and use of snuff among South African women. Niger J Clin Pract. 2014 Mar-Apr;17(2):174–7. https://doi.org/10.4103/1119-3077.127542
25. El Maghraoui A, Ghazi M, Gassim S, et al. Risk factors of osteoporosis and combined smoking and use of snuff among South African women. Niger J Clin Pract. 2014 Mar-Apr;17(2):174–7. https://doi.org/10.4103/1119-3077.127542
26. Patel R, Rodriguez A, Yasmeen T, et al. Impact of obesity on osteoporosis: limitations of the current modalities of assessing osteoporosis in obese subjects. Clin Rev Bone Mineral Metab. 2015;13:36–42. https://doi.org/10.1007/s12018-015-9179-8
27. O’Connell MB, Borgelt L, Bowles SK, et al. Drug-induced osteoporosis in the older adult. Aging Health. 2010;6(4):501–18. https://doi.org/10.2217/ah.10.42

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