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Prevalence of osteoporosis and osteopenia among persons aged 60 years and above: A cross-sectional study

Uchenna Cosmas Ugwu[1], Osmond Chukwuemeka Ene[1]

[1]Department of Human Kinetics and Health Education, Faculty of Education, University of Nigeria, Nsukka, Enugu, Nigeria.

***Corresponding author:**
Uchenna Cosmas Ugwu, Department of Human Kinetics and Health Education, Faculty of Education, University of Nigeria, Nsukka, Enugu, Nigeria.

uchennacos.ugwu@unn.edu.ng

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ABSTRACT

Objectives: Worldwide, bone diseases are considered significant threats to individuals in advanced age. The purpose of this study is to determine the prevalence of osteoporosis and osteopenia among persons aged 60 years and above. Also, it aims to determine the association and correlation between osteoporosis and osteopenia with demographic variables.

Material and Methods: It was a cross-sectional survey, carried out from the representative large-scale sample of older adults in Nigeria, from April 2023 to July 2023. A total of 8,140 older adults were recruited for the study. A semi-structured questionnaire with 0.81 reliability index was used for data collection. Statistical computation was through International Business Machine -Special Package for the Social Sciences version 22. Using frequency counts, percentage scores, odds ratio estimates and independent chi-square statistics, data analysis was completed. Results were significant at p-value<.05.

Results: A total of 6,820(92.2%) valid copies of the questionnaire were analyzed. Osteoporosis (72.2%) and osteopenia (27.8%) were prevalent among persons aged 60 years and above. Female older adults had high prevalence of osteoporosis (73.8%), while osteopenia (30.0%) was high in the male counterparts. Significant association existed between osteoporosis and osteopenia with gender, age, education, tobacco use and location (p-value<0.05) while none was observed with marital status and alcohol consumption (p-value>0.05) respectively. Also, there was positive correlation between osteoporosis and osteopenia with age and alcohol intake (OR≥1) while negative correlation existed on gender, marital status and location (OR≤1) respectively.

Conclusion: Both osteoporosis and osteopenia are prevalent among persons aged 60 years and above in Nigeria. Bone diseases are associated and correlated with demographic characteristics. Considering the severe health consequences such as bone fragility fracture, intervention approaches are paramount.

Keywords: Bone diseases, Cross-sectional survey, Demographic variables, Elderly population, Prevalence

INTRODUCTION

Worldwide, the population of persons aged 60 years and above is significantly increasing and is projected to reach two billion in the next decades, with predictions of bone diseases.[1,2] The decline in mortality rate due to advances in healthcare services provision, medical sciences, health education, life expectancy, and longevity was a key indicator.[2] Osteoporosis and osteopenia are medical terms describing the status of bone mineral and disorders in the bone tissues which are diagnosed using bone scans.[3,4] The decrease in bone mineral density (BMD) below the normal reference values of −1−−2.5 depicts osteopenia, while osteoporosis is diagnostic when the reference values are <−2.5.[2-4] The variation in reference values of BMD represents a micro-architectural disruption of the bone as well as the disorders of the bone mineral. Bone diseases

are age-related disorders characterized by a high risk of bone fragility fractures, particularly in persons over 60 years.[3,4] A person's bone mass is affected by low intake of calcium, age, genetic composition, gender, and race.[3]

Globally, more than 200 million persons are osteoporotic,[5] with a ratio of 1:5 men and 1:3 women over 50 years having fractured bones.[6] Low BMD is associated with high morbidity and mortality, increased healthcare costs, medical expenses,[7] and high economic burdens.[8] Bone diseases, which are preventable and curable are significant health threats to elderly persons.[9] Osteoporotic fracture presents severe health consequences relating to distal radius, pelvic, and vertebrae fractures.[3] The description, evaluation, and management of bone diseases primarily rely on dual-energy X-ray absorptiometry (DEXA) bone scans application by professionals.[3]

A good number of studies have focused on osteoporosis and osteopenia prevalent rates using different group cohorts and locations.[1,3-5,7,8] In Nigeria, such studies are scarce and none was reviewed.[2] Considering the high prevalence of bone fragility fractures and the vulnerability of older adults to osteoporosis and osteopenia,[2] a study of this kind becomes essentially important in Nigeria. Second, no reviewed studies had explored the association and correlation of osteoporosis and osteopenia with demographic variables of older adults in the Nigerian context and thus, the gap justifying the uniqueness of this present study. The purpose of this study is to determine the prevalence of osteoporosis and osteopenia among persons aged 60 years and above. Furthermore, it aims to determine the association and correlation between osteoporosis and osteopenia with demographic variables. Since bone diseases are preventable and curable, the outcome of this study is expected to form a viable framework for reducing cases of bone fragility fractures and disabilities in an elderly population through health education, awareness campaigns, and mass sensitization, particularly in Nigeria.

MATERIAL AND METHODS

Design, population, and study setting

It was a cross-sectional survey carried out from the representative large-scale sample of members of the Nigeria union of pensioners (NUP) in 37 branches in Nigeria, from April 2023 to July 2023. The NUP is an association of retirees, registered as a full-fledged trade union as approved by the registrar of trade union since 1978.[10] The primary objective of NUP is to improve the welfare of its members and also to secure their entitlements as a group.[10] A total of 8140 registered members of NUP aged 60 years and above were recruited based on the suggestion of scholars regarding large-scale sample sizes.[11] Only 740 out of 8140 recruited members did not meet the eligibility requirements; thus, 7,400 eligible participants were investigated. A maximum of 200 participants sampled per branch in the 37 branches were approached and surveyed by the investigators.

Eligibility criteria

(a) Must be a registered member of NUP, (b) must be 60 years and above, and (c) must declare willingness to participate in the study by signing the consent form.

Exclusion criteria

(a) Non-registered members of the union, (b) those below 60 years of age, and (c) those who did not sign the consent form, were excluded from the study.

Data collection

A semi-structured instrument titled "Prevalence of Osteoporosis and Osteopenia Questionnaire (POOQ)" with 0.81 reliability index was used for data collection. The internal consistency score of 0.81 was adjudged appropriate based on expert recommendation.[12] The POOQ was adapted from well-validated questionnaires used in conducting similar studies by various researchers.[13,14] The face and content validity of POOQ was determined by seven experts from the Gerontology and Geriatric Units and Public Health Education Department, all from the University of Nigeria Nsukka. The contents of POOQ were prepared using simple English language, which is also the acceptable language of instruction and communication in all the schools in Nigerian, and public service sectors. The adapted POOQ, which can be completed in <10 min, was organized into three major sections (A to C). Section A contained demographic information of the participants, such as gender, marital status, tobacco use, personal age, daily living, denomination, university degree, alcohol intake, living arrangement, and geographical location. The section B contained information on the prevalence of osteoporosis. The section C provided data on the prevalence of osteopenia among older adults. Here, osteoporosis is defined as the structural changes in bone tissue with reduced BMD and bone mass, while osteopenia is the loss of BMD and remains the stage before osteoporosis.[4] Both osteoporosis and osteopenia increase the risk of bone fracture, particularly in old age. The items of POOQ were organized to attract "YES" or "NO" response options, representing the presence of the disorders or their absence. With the consent of the chairman of NUP and the approval obtained from all the 37 branch chairmen, the participants were accessed during their monthly meetings. The services of seven research assistants (RAs), who were properly briefed on the modalities for the administration and retrieval of the questionnaire were employed. The copies of POOQ were distributed to the participants and retrieved on the spot in their meeting arena. Those who encountered

difficulty in reading and understanding the content of POOQ received immediate assistance from the investigators and the RAs.

Statistical analysis

The International Business Machine-Special Package for the Social Sciences version 22[15] was used for all data computation. The participants' demographic characteristics as well as osteoporosis and osteopenia prevalent rates were arranged as proportions and further analyzed using frequency counts and percentage scores. Furthermore, the association and correlation of osteoporosis and osteopenia with the demographic characteristics of the study participants was analyzed using independent Chi-square statistics and odds ratio estimates, respectively. Results were significant at $P \leq 0.05$.

Ethical statement

The Ethics Committee of University of Nigeria, Nsukka granted approval for the study in accordance with the stipulated ethical principles and guidelines.[16] Before data collection, the prospective participants declared willingness to participate in the study by signing the informed consent form. The submission, review, and possible publication of the study outcomes in a journal were unanimously approved by the participants. Moreover, no payment was made to the participants, and thus, their responses were not compromised.

RESULTS

A total of 7400 eligible participants were investigated; 245 (3.3%) of them declined for personal reasons, and 335 (4.5%) copies of the questionnaire were discarded due to incomplete responses. Therefore, 6820 (92.2%) valid copies were used for statistical analysis. Slightly above one-third of the participants (39.1%) were male, with about 81.1% married. More than one-third of them (38.9%) used tobacco, and the majority (71.6%) were 70 years and above, with about 62.0% of them depending on others for daily living. Only 29.5% of them were Muslims, with approximately 60% having university degrees. More than half of the participants (66.2%) consume alcohol, with approximately two-thirds (60.1%) living with their families. Only 33.5% of the participants resident/live/reside in urban area [Table 1].

Table 1: Profile information of the study participants (n=6,820).

Demographics	Variables	Frequency	Percentage
Gender	Male	2,665	39.1
	Female	4,155	60.9
Marital status	Married	5,533	81.1
	Others	1,287	18.9
Tobacco use	Yes	2,654	38.9
	No	4,166	61.1
Personal age	70 years plus	4,886	71.6
	60–69 years	1,934	28.4
Daily living	Dependent	4,229	62.0
	Independent	2,591	38.0
Denomination	Muslim	2,009	29.5
	Christianity	4,811	70.5
University degree	Yes	3,812	55.9
	Others	3,008	44.1
Alcohol intake	Yes	2,654	38.9
	No	4,166	61.1
Personal age	70 years plus	4,886	71.6
	60–69 years	1,934	28.4
Daily living	Dependent	4,229	62.0
	Independent	2,591	38.0
Denomination	Muslim	2,009	29.5
	Christianity	4,811	70.5
University degree	Yes	3,812	55.9
	Others	3,008	44.1
Alcohol intake	Yes	4,512	66.2
	No	2,308	33.8
Living arrangement	With family	4,102	60.1
	Others	2,718	39.9
Geographical location	Urban city	2,288	33.5
	Rural area	4,532	66.5
Prevalence	Osteoporosis	4,924	72.2
	Osteopenia	1,896	27.8

n: Sample size

Overall, osteoporosis (72.2%) and osteopenia (27.8%) were prevalent among older adults in Nigeria. The female older adults had a high prevalence of osteoporosis (73.8%), while osteopenia (30.0%) was high on male counterparts. The prevalence of osteoporosis was less (75.6%) among married older adults, while osteopenia (24.4%) was high. Tobacco users had a low prevalence of osteoporosis (75.2%) while osteopenia (24.8) was high. Older adults aged 70 years and above had a high prevalence of osteoporosis (73.4%), while osteopenia was high among those aged 60–69 years (31.1%). The dependent older adults had a high prevalence of osteoporosis (71.6%), while osteopenia (28.4%) was low. The Muslims had a high prevalence of osteoporosis (84.8%), while osteopenia (22.0%) was high among Christians. Older adults with university degrees had a low prevalence (73.2%) of osteoporosis while osteopenia (26.8%) was high. The prevalence of osteopenia was high (40.1%) among alcohol consumers while osteoporosis (59.9%) was low. Those living with families had a low prevalence of osteoporosis (72.9%) while osteopenia (27.1%) was high. The rural dwellers had a high prevalence of osteoporosis (72.5%) while osteopenia (43.1%) was high among the urban counterparts. Furthermore, there was significant association between osteoporosis and osteopenia and gender ($P = 0.002 < 0.05$), tobacco use ($P = 0.010 < 0.05$), personal age ($P = 0.038 < 0.05$), denomination ($P = 0.041 < 0.05$), university degree ($P = 0.007 < 0.05$), living arrangement ($P = 0.016 < 0.05$), and location

($P = 0.031 < 0.05$). Furthermore, no significant association existed between osteoporosis and osteopenia with marital status ($P = 0.991 > 0.05$), daily living ($P = 0.810 > 0.05$), and alcohol intake ($P = 0.102 > 0.05$), respectively [Table 2].

Positive correlation existed between osteoporosis and osteopenia with age (odds ratio [OR] = 1.241 ≥ 1), daily living (OR = 1.416 ≥ 1), denomination (OR = 1.569 ≥ 1), and alcohol consumption (OR = 1.907 ≥ 1), respectively. Furthermore, negative correlation existed between osteoporosis and osteopenia with gender (OR = 0.817 ≤ 1), marital status (OR = 0.886 ≤ 1), tobacco use (OR = 0.995 ≤ 1), university degree (OR = 0.628 ≤ 1), living arrangement (OR = 0.782 ≤ 1), and location (OR = 0.500 ≤ 1), respectively [Table 3].

DISCUSSION

It is a cross-sectional representative large-scale sample survey showing the prevalence of osteoporosis (72.2%) and osteopenia (27.8%) among older adults in Nigeria. This finding is not surprising rather expected as it reflects the real situation of bone diseases as characterized by high cases of bone fragility fractures in elderly population. Similarly, a large scale sample of 13,347 involving 30 studies revealed 34% prevalence of osteoporosis and 47% prevalence of osteopenia among persons aged 60 years and above in Iran.[17] A meta-analysis study of 34,814 participants reported 0.17 prevalence of osteoporosis and 0.35% prevalence of osteopenia in the Iranian population.[18] Furthermore, a sample of 2425 elderly men and women over 60 years revealed 41.5% prevalence of osteoporosis.[14] Another meta-analysis study involving 562 female participants revealed 25.26% and 45.23% prevalence of osteoporosis and osteopenia, respectively.[19] A similar gender-specific systematic review and meta-analysis study involving 6735 female participants reported 33.70% prevalence of osteoporosis and 47.60% prevalence of osteopenia, respectively.[20] Furthermore, a cross-sectional survey involving 1779 persons over 60 years reported a 7.99% prevalence of osteoporosis in the province of Hamadan.[13] A survey of 199 elderly patients in England reported 72% prevalence of osteoporosis and 43% prevalence of osteopenia.[21] Similarly, 25.55% osteoporosis prevalent rate was reported among 759 older adults with an average mean age of 62.55 years.[22] These findings suggest the need for education-based interventions, sensitization, and awareness campaigns on bone health particularly in Nigeria. Furthermore, these findings may be linked to inadequate knowledge of bone health, onset of menopause, lifestyle, and limited access to medical care services.

Our study revealed that osteoporosis was high in occurrence among female elderly, unmarried older adults, non-tobacco users, those over 70 years old, those

Table 2: Independent Chi-square analysis of association of osteoporosis and osteopenia with demographic characteristics of the study participants ($n = 6,820$).

Demographics	Variables	Sample size (*n*)	Osteoporosis (PR = 72.2%) f (%)	Osteopenia (PR = 27.8%) f (%)	χ^2	*P*-value	Remark
Gender	Male	2,665	1,859 (70.0)	806 (30.0)	1.910	0.002	S
	Female	4,155	3,068 (73.8)	1,087 (26.2)			
Marital status	Married	5,533	4,184 (75.6)	1,349 (24.4)	5.014	0.991	NS
	Others	1,287	1001 (77.8)	286 (22.2)			
Tobacco use	Yes	2,654	1995 (75.2)	659 (24.8)	3.101	0.010	S
	No	4,166	3,135 (75.3)	1,031 (24.7)			
Personal age	70 years plus	4,886	3,584 (73.4)	1,302 (26.6)	6.017	0.038	S
	60–69 years	1,934	1,333 (68.9)	601 (31.1)			
Daily living	Dependent	4,229	3,028 (71.6)	1,201 (28.4)	1.991	0.810	NS
	Independent	2,591	1,659 (64.0)	932 (36.0)			
Denomination	Muslim	2,009	1,703 (84.8)	306 (15.2)	4.330	0.041	S
	Christianity	4,811	3,753 (78.0)	1,058 (22.0)			
Univ. degree	Yes	3,812	2,791 (73.2)	1,021 (26.8)	3.099	0.007	S
	Others	3,008	2,446 (81.3)	562 (18.7)			
Alcohol intake	Yes	4,512	2,701 (59.9)	1,811 (40.1)	5.091	0.102	NS
	No	2,308	1,417 (61.4)	891 (38.6)			
Living Argmt.	With family	4,102	2,992 (72.9)	1,110 (27.1)	1.098	0.016	S
	Others	2,718	2,107 (77.5)	611 (22.5)			
Geogr. location	Urban city	2288	1,301 (56.9)	987 (43.1)	3.054	0.031	S
	Rural area	4,532	3,285 (72.5)	1,247 (27.5)			

NS: Not significant, S: Significant, Geogr.: Geographical, Univ.: University, Argmt.: Arrangement, χ^2: Chi-square, n: Sample size, PR: Prevalent rate

Table 3: Presenting odds ratio estimates of correlation of osteoporosis and osteopenia with demographic characteristics of the study participants (*n*=6,820).

Demographics	Variables	Sample Size (*n*)	Osteoporosis (PR=72.2%)	Osteopenia (PR=27.8%)	Odds	Odds Ratio	Remark
Gender	Male	2,665	1,859 (70.0)	806 (30.0)	2.306	0.817	NC
	Female	4,155	3,068 (73.8)	1,087 (26.2)	2.822		
Marital status	Married	5,533	4,184 (75.6)	1,349 (24.4)	3.102	0.886	NC
	Others	1,287	1001 (77.8)	286 (22.2)	3.500		
Tobacco use	Yes	2,654	1995 (75.2)	659 (24.8)	3.027	0.995	NC
	No	4,166	3,135 (75.3)	1,031 (24.7)	3.041		
Personal age	70 years plus	4,886	3,584 (73.4)	1,302 (26.6)	2.753	1.241	PC
	60–69 years	1,934	1,333 (68.9)	601 (31.1)	2.218		
Daily living	Dependent	4,229	3,028 (71.6)	1,201 (28.4)	2.521	1.416	PC
	Independent	2,591	1,659 (64.0)	932 (36.0)	1.780		
Denomination	Muslim	2,009	1,703 (84.8)	306 (15.2)	5.565	1.569	PC
	Christianity	4,811	3,753 (78.0)	1,058 (22.0)	3.547		
Univ. degree	Yes	3,812	2,791 (73.2)	1,021 (26.8)	2.734	0.628	NC
	Others	3,008	2,446 (81.3)	562 (18.7)	4.352		
Alcohol Intake	Yes	4,512	2,701 (59.9)	1,811 (40.1)	1.491	1.907	PC
	No	2,308	1,417 (61.4)	891 (38.6)	0.782		
Living Argnt.	With family	4,102	2,992 (72.9)	1,110 (27.1)	2.695	0.782	NC
	Others	2,718	2,107 (77.5)	611 (22.5)	3.448		
Geogr. location	Urban city	2288	1,301 (56.9)	987 (43.1)	1.318	0.500	NC
	Rural area	4,532	3,285 (72.5)	1,247 (27.5)	2.634		

Geogr.: Geographical, Univ.: University, Argmt.: Arrangement, NC: Negative correlation, PC: Positive correlation, n: Sample size, PR: Prevalent rate

depending on others for survival, Muslims, low education group, alcohol consumers, those living alone, and rural dwellers. Furthermore, osteopenia was high among older men, married older adults, tobacco users, those below 70 years, independent adults, Christians, educated elders, non-alcohol consumers, those living with families, and urban dwellers. These findings are expected due to certain factors such as menopause, physiological decline due to age, lifestyle modifications, access to media, and gained experiences. Similarities relating to differences in osteoporosis and osteopenia prevalent rates in different population cohorts based on demographic factors were explored and properly documented.[13,18,19,21,22]

We found that osteoporosis and osteopenia were significantly associated with gender, tobacco use, personal age, religious affiliation, university degree, living arrangement, and geographical location ($P < 0.05$) while no association was found between osteoporosis and osteopenia with marital status, daily living, and alcohol intake ($P > 0.05$), respectively. Furthermore, a positive correlation existed between osteoporosis and osteopenia with age, daily living, religious affiliation, and alcohol intake (OR ≥ 1), while a negative correlation was observed with gender, marital status, tobacco use, university degree, living arrangement, and location (OR ≤ 1), respectively. Similar studies reporting the status of association and correlation of osteoporosis and osteopenia with demographic variables are documented.[13,14,17,19,21-24]

Limitation of the study

Only the registered members of NUP aged 60 years and above were studied excluding non-members and persons below the sampled age and thus obvious weakness and research lapse. By implication, our findings cannot be extrapolated to the entire population of older adults in Nigeria. Second, a semi-structured questionnaire was the only instrument used for data collection. All responses were limited to the contents of the questionnaire. No platform was provided for sharing of experiences and views regarding the study phenomenon. The design allowed for investigating osteoporosis and osteopenia prevalent rates but did not explore casualties.

Implications for future

As age-related complications, osteoporosis, and osteopenia strive with the growing population of older adults with severe consequences, including bone fractures. Such challenging scenarios present huge medical care costs, dependency, vulnerability to multiple complications, and negative health burdens. Healthy education-based interventions on bone health are paramount for the elderly population, among others (organized welfare, free medical services, and recreational centers).

CONCLUSION

Both osteoporosis and osteopenia are prevalent among older adults in Nigeria. Bone diseases are associated and

correlated with demographic characteristics. Considering the severe health consequences such as bone fragility fracture, intervention approaches are paramount.

Ethical approval

The research/study is approved by the Institutional Ethics Committee at University of Nigeria Nsukka, number RF/HKHE/023/R-0048, dated 21st March 2023.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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