BILINGUAL PUBLISHING GROUP

**Journal of Geriatric Medicine**

https://journals.bilpubgroup.com/index.php/jgm

**ARTICLE**

# Musculoskeletal Disorders and Associated Predictors among Elderly Nigerians with Post-Stroke Disabilities: A Cross-Sectional Study Applying Global Shrinkage Estimation

*Uchenna Cosmas Ugwu* * , *Osmond Chukwuemeka Ene, Blessing Amuchechi Omeh, Cordelia Chinonyerem Ugwu, Agatha Nneka Obayi, Chuka Mackson Jones*

*Department of Human Kinetics and Health Education, Faculty of Education, University of Nigeria, Nsukka 410001, Nigeria*

## ABSTRACT

Population ageing has led to a growing burden of chronic disability among older adults, particularly those living with post-stroke conditions and musculoskeletal disorders (MSDs). These conditions often coexist, compounding functional limitations and care needs, yet nationally representative data from Nigeria remain scarce. This study examined the prevalence, patterns, and correlates of MSDs among older adults with post-stroke disabilities across Nigeria's six geopolitical zones. A hospital-based cross-sectional survey was conducted between February 2024 and July 2025 in six purposively selected tertiary hospitals. Older adults aged ≥60 years with confirmed MSDs and post-stroke disabilities were consecutively recruited, yielding 305 valid participants. Data were collected using a culturally adapted, multilingual structured questionnaire and analyzed using descriptive statistics, chi-square tests, and odds ratios at a significance level of $p < 0.05$. Participants were predominantly aged ≥70 years (66.2%) and female (64.9%). A high burden of MSDs was observed in 66.6% of respondents. Common conditions included tendinopathies and bursitis, low back pain, sarcopenia, gout, and osteoarthritis. Frequently reported post-stroke disabilities were speech difficulties, dependence in daily activities, and social isolation. Higher MSD prevalence was significantly associated with older age, female sex, marital status, living with family, medication dependence, and longer stroke duration. Multivariate analysis indicated increased odds of MSDs

*CORRESPONDING AUTHOR:

Uchenna Cosmas Ugwu, Department of Human Kinetics and Health Education, Faculty of Education, University of Nigeria, Nsukka 410001, Nigeria; Email: uchennacos.ugwu@unn.edu.ng

ARTICLE INFO

Received: 8 November 2024 | Revised: 10 December 2024 | Accepted: 1 January 2025 | Published Online: 7 January 2025
DOI: https://doi.org/10.30564/jgm.v7i1.13007

CITATION

Ugwu, U.C., Ene, O.C., Omeh, B.A., et al., 2025. Musculoskeletal Disorders and Associated Predictors among Elderly Nigerians with Post-Stroke Disabilities: A Cross-Sectional Study Applying Global Shrinkage Estimation. Journal of Geriatric Medicine. 7(1): 1–11.
DOI: https://doi.org/10.30564/jgm.v7i1.13007

among adults aged ≥70 years, females, those living with family, and individuals with prolonged post-stroke duration. These findings highlight the substantial musculoskeletal burden among older Nigerians with post-stroke disabilities and underscore the need for integrated geriatric, neurological, and musculoskeletal care models to improve functional outcomes and quality of life in this growing population.

***Keywords:*** Musculoskeletal Disorders; Nigeria; Older Adults; Post-Stroke Disability; Shrinkage Estimation

# 1. Introduction

Musculoskeletal disorders (MSDs) are increasingly recognized as a major contributor to long-term disability among older adults, yet their role in shaping outcomes for people living with post-stroke impairments remains insufficiently examined, particularly in low- and middle-income countries (LMICs). Stroke survivors commonly experience persistent neurological deficits that predispose them to secondary complications such as chronic pain, sarcopenia, and degenerative musculoskeletal conditions. These conditions can further restrict mobility, reduce independence, and worsen overall quality of life. In Nigeria, where stroke constitutes a leading cause of adult neurological disability, the burden of MSDs among post-stroke populations is still poorly described within both clinical practice and public health research. Available evidence suggests that the burden of MSDs in Nigeria may considerably exceed global estimates, especially for sarcopenia, whose pooled prevalence among stroke survivors is approximately 42% worldwide [1].

These observed disparities reflect the combined influence of population ageing, prolonged immobilization, and structural barriers to rehabilitation commonly encountered in LMICs [2]. Despite growing global recognition of musculoskeletal decline as a consequence of aging and reduced mobility, few studies have systematically quantified its magnitude or determinants in African post-stroke cohorts, particularly within the context of sociocultural, demographic, and health system factors. For instance, while studies have highlighted the high prevalence of MSDs in stroke survivors worldwide [3], only a few have explored these conditions in sub-Saharan Africa, where stroke burden and healthcare challenges differ markedly [4,5]. Furthermore, there is limited research on how sociodemographic factors like age, gender, and socio-economic status, as well as healthcare access, influence MSD outcomes in this population [6].

Against this backdrop, the present study aimed to investigate the prevalence and predictors of MSDs among older Nigerian adults living with post-stroke disabilities, using global shrinkage estimation to improve the stability of predictor effect sizes. By identifying both modifiable and contextual risk factors, the study contributes to ongoing efforts advocating integrated rehabilitation approaches that extend beyond neurological recovery to encompass musculoskeletal health, pain management, and caregiver support [7,8]. In light of the rising burden of non-communicable diseases in LMICs and projected increases in age-related conditions such as gout and sarcopenia [9], the study's findings provide evidence to inform geriatric and post-stroke care pathways. The study successfully achieved its aim, demonstrating that MSDs are highly prevalent in this population and shaped by identifiable demographic and clinical factors, underscoring the need for more holistic post-stroke care models.

# 2. Materials and Methods

## 2.1. Study Design and Setting

This study employed a hospital-based, cross-sectional survey design. Data collection occurred between February 2024 and July 2025 across six tertiary hospitals, each purposely selected to represent one of Nigeria's six geopolitical zones. The selection criteria were based on each hospital's capacity to deliver specialized geriatric care, including management of musculoskeletal and post-stroke conditions. The participating facilities included: Jos University Teaching Hospital (North Central); University of Maiduguri Teaching Hospital (North East); Usmanu Danfodiyo University Teaching Hospital, Sokoto (North West); Lagos University Teaching Hospital (South West); University of Calabar Teaching Hospital (South South); and Nnamdi Azikiwe University Teaching Hospital, Nnewi (South East). Each center enrolled 51 participants, culminating in a total sample of 306 older adults.

## 2.2. Participants and Eligibility Criteria

Eligible participants were older adults aged 60 years and above with clinically confirmed diagnoses of at least one musculoskeletal disorder and a history of post-stroke disabilities. Diagnosis verification was performed through medical record reviews and corroborated by the attending physicians. Musculoskeletal disorders were confirmed using ICD-10 diagnostic categories, including: Osteoarthritis (M15–M19), Rheumatoid arthritis (M05–M06), Osteoporosis with fractures (M80), Osteoporosis without fractures (M81), Low back pain (M54.5), Gout (M10), Polymyalgia Rheumatica (M35.3), Sarcopenia (M62.84), Degenerative disc disease/spondylosis (M47), Spinal stenosis (M48.0), and Tendinopathies and bursitis (M70–M77). Post-stroke disabilities were similarly coded using appropriate ICD-10 classifications, such as: Cognitive impairment post-stroke (F02.80, F06.7, I69.398), Mobility loss or hemiplegia (I69.35, R26.9), Speech and language difficulties (R47.1, R47.89, R47.01, I69.320), Functional dependence (Z74.1), and Social isolation (Z60.4).

Participants were recruited from geriatric outpatient clinics or inpatient wards within the selected hospitals. Inclusion criteria required participants to: (i) be aged ≥ 60 years; (ii) have a confirmed diagnosis of both MSD and post-stroke disability; (iii) be under active care at the participating institutions; (iv) possess adequate cognitive and physical capacity to engage with the questionnaire (independently or with caregiver support); and (v) demonstrate the ability to communicate in English or any of the three major Nigerian languages (Hausa, Igbo, Yoruba). Exclusion criteria included: individuals younger than 60 years; absence of clinically confirmed diagnoses; severe cognitive impairment or acute illness preventing participation; uncorrected sensory deficits impeding communication; enrollment in concurrent research protocols that could affect study validity; or inability to provide informed consent.

## 2.3. Sampling Procedure

A multistage sampling approach was employed. In the first stage, Nigeria's six geopolitical zones served as the primary strata. One tertiary hospital was purposely selected per zone in the second stage. Finally, consecutive sampling of eligible participants was conducted at each hospital until the target number (n = 51) was achieved.

## 2.4. Sample Size and Power Calculation

Sample size estimation was based on Cohen's formula[10] for proportions: $n = 0.4MS/P^2$, where M is the estimated prevalence (6%), S is its complement (94%), and P is the desired precision level (0.15). This yielded a minimum sample of 278 participants. To account for possible non-response, an additional 10% was included, increasing the final target to 306 participants. Ultimately, 305 valid responses were obtained, reflecting a response rate of 99.7%. The study was powered at 80% with a significance threshold of $p < 0.05$, ensuring the ability to detect medium effect sizes in chi-square analysis.

## 2.5. Instrumentation and Materials

Data were collected using a structured instrument titled the Musculoskeletal Disorders in Older Adults with Post-Stroke Disabilities Questionnaire (MDOAPSDQ). The MDOAPSDQ is an investigator-developed instrument designed specifically for this study and has not been previously published. The MDOAPSDQ is an investigator-developed instrument designed specifically for this study and has not been previously published. It was developed through the adaptation and integration of items from several validated international and national sources to ensure conceptual rigor and content validity. Section A: Sociodemographic and clinical variables were adapted from the WHO World Health Survey[11], the Nigeria Demographic and Health Survey[12], and the Charlson Comorbidity Index[13]. Section B: Musculoskeletal disorders were categorized based on diagnostic labels aligned with ICD-10 codes, informed by the Global Burden of Disease Study[14], the Bone and Joint Decade framework[15], and the SARC-F Questionnaire[16]. Section C: Post-stroke disabilities were assessed using a combination of the Modified Rankin Scale[17], WHO Disability Assessment Schedule (WHODAS) 2.0[18], and the Post-Stroke Checklist[19], with classification supplemented by relevant ICD-10 codes for both neurological and psychosocial sequelae. Section D: Participant information and consent were modeled after ethical templates from the Declaration of Helsinki[20] and Nigeria's National Health Research Ethics Code (NHREC)[21]. The tool was culturally and linguistically adapted into English, Hausa, Yoruba, and Igbo. Pretesting was conducted among 20 older adults to assess clarity and contextual relevance. Content validity was established by a panel of 13 doctoral-level public health experts. Because the MDOAPSDQ is a newly developed composite instrument, psychometric evaluation was conducted within the present study sample, and the final questionnaire demonstrated strong internal consistency (Cronbach's $\alpha = 0.86$).

### 2.6. Data Collection Procedures

Twelve trained research assistants (two per hospital), all of whom were registered nurses, facilitated data collection. Each received standardized training covering ethical considerations, consent protocols, and standardized questionnaire administration. Interviews were conducted in private consultation rooms to ensure confidentiality. Where necessary, caregiver or personnel assistance was provided for participants with sensory or cognitive limitations. All participants (or their legal representatives) provided written informed consent, either via signature or thumbprint.

### 2.7. Ethical Approval

Ethical approval was granted by the Federal Ethics Committee of Nigeria (Ref: REC/FE/2024/00073), and administrative permissions were secured from the Chief Medical Directors of all participating institutions. Participation was entirely voluntary, and no incentives were offered. Data were anonymized to maintain confidentiality in accordance with the Declaration of Helsinki [20] and American Psychological Association (APA) guidelines [22].

### 2.8. Statistical Analysis

All data were coded and analyzed using IBM SPSS Statistics Version 28 [23]. Descriptive statistics, including frequencies and percentages, were computed to summarize demographic and clinical characteristics. The Chi-Square Test of Independence was used to assess associations between MSD prevalence and participant variables (e.g., age, sex, education, marital status, comorbidities, and living situation). A $p$-value of $< 0.05$ was considered statistically significant. Statistically significant results were further examined using odds ratios (ORs) with 95% confidence intervals (CIs). Missing data (<5%) were addressed using listwise deletion. Statistical power was set at 80%, adequate for detecting medium-sized effects. Reporting followed Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [24].

### Explanation of Categorization

Musculoskeletal disorder (MSD) burden was determined based on the number of clinically confirmed MSD diagnoses per participant, as documented in medical records and aligned with ICD-10 classifications. Each of the listed MSD conditions (e.g., osteoarthritis, rheumatoid arthritis, low back pain, sarcopenia, gout, polymyalgia rheumatica, spinal stenosis, degenerative disc disease/spondylosis, tendinopathies/bursitis, and osteoporosis categories) was coded dichotomously (1 = present, 0 = absent). A composite MSD burden score was computed by summing the total number of MSD conditions present for each participant.

The categorization into 'low' and 'high' MSD burden was performed as follows: Low MSD burden: Presence of 1–4 MSD conditions. High MSD burden: Presence of ≥5 MSD conditions. The cutoff point (≥5 conditions) was determined using the sample median split method, which provided a balanced distribution of participants across categories and ensured sufficient cell counts for chi-square analysis. This approach is consistent with epidemiological practices when analyzing multimorbidity burden in cross-sectional studies. This modification clarifies the categorization of MSDs and the method used for dividing participants into the low and high MSD burden groups, ensuring the method's transparency and reproducibility.

## 3. Results

### 3.1. Sociodemographic and Clinical Characteristics

A total of 305 older adults with post-stroke disabilities were enrolled in the study. The majority of participants were aged 70 years and above (66.2%), female (64.9%), and affiliated with the Christian religion (69.2%). A substantial proportion had attained non-tertiary education (61.6%) and were married (59.7%). Most participants lived with family members (70.8%), were consistently dependent on medications (92.1%), and had been living with the condition for five years or less (62.0%). Comorbid conditions such as hypertension, cardiovascular diseases, and diabetes were present in 89.8% of the respondents. Regarding mobility, 70.8% reported independent ambulation, while 29.2% were dependent (Refer to **Table 1** for full details).

**Table 1.** Sociodemographic and Clinical Characteristics of Older Adults with Post-Stroke Disabilities (N = 305).

| Variables | Category | Frequency (f) | Percentage (%) |
|---|---|---|---|
| Age | ≥70 years | 202 | 66.2% |
| | 60–69 years | 103 | 33.8% |
| Gender | Male | 107 | 35.1% |
| | Female | 198 | 64.9% |
| Religious Affiliation | Christianity | 211 | 69.2% |
| | Others (Pagan, African Traditional Religion, Islam) | 94 | 30.8% |
| Education Level | Tertiary | 117 | 38.4% |
| | Others (non-formal, primary, secondary) | 188 | 61.6% |
| Marital Status | Married | 182 | 59.7% |
| | Others (single, divorced/separated, widowed) | 123 | 40.3% |
| Living Situation | With family | 216 | 70.8% |
| | Others (alone, institutionalized) | 89 | 29.2% |
| Medication Dependence | Always | 281 | 92.1% |
| | Rarely | 24 | 7.9% |
| Duration of Condition | ≥5 years | 116 | 38.0% |
| | ≤5 years | 189 | 62.0% |
| Comorbidity (e.g., diabetes, CVD, HBP) | Present | 274 | 89.8% |
| | Absent | 31 | 10.2% |
| Musculoskeletal Disorders | High | 203 | 66.6% |
| | Low | 102 | 33.4% |

Note: N = sample size, () = bracket sign, ≥ = greater than sign, ≤ = less than sign, f = frequency, % = percentage, CVD = cardiovascular disease, high blood pressure = HBP.

## 3.2. Prevalence of Musculoskeletal Disorders

Musculoskeletal disorders (MSDs) were highly prevalent among the participants, with 66.6% (n = 203) experiencing a high burden. The most commonly reported MSDs included tendinopathies and bursitis (79.0%), low back pain (78.4%), sarcopenia (77.4%), gout (74.4%), and polymyalgia rheumatica (71.1%). Additionally, osteoarthritis (69.8%), spinal stenosis (68.2%), degenerative disc disease/spondylosis (65.2%), and rheumatoid arthritis (70.8%) were frequently observed. Osteoporosis, with or without fractures, was less common but still present in 36.7% and 27.5% of respondents, respectively (Refer to **Table 2** for full details).

## 3.3. Post-Stroke Disabilities

Among the various post-stroke disabilities assessed, difficulty in speech was the most prevalent (81.6%), followed by dependency on others for daily activities (65.9%) and social isolation (62.0%). Cognitive impairment was reported by 58.0% of participants, while language difficulties and loss of mobility were noted in 37.7% and 29.2%, respectively (Refer to **Table 3** for full details).

## 3.4. Association between Participant Characteristics and Musculoskeletal Disorders

Chi-square analyses revealed statistically significant associations between high MSD prevalence and several sociodemographic and clinical variables. These included age ≥ 70 years ($\chi^2 = 6.25$, $p = 0.01$), female gender ($\chi^2 = 4.50$, $p = 0.03$), Christian religious affiliation ($\chi^2 = 37.93$, $p < 0.001$), being married ($\chi^2 = 5.41$, $p = 0.02$), and living with family ($\chi^2 = 44.57$, $p < 0.001$). Similarly, medication dependence ($\chi^2 = 4.09$, $p = 0.04$) and having lived with the stroke condition for ≥5 years ($\chi^2 = 7.17$, $p = 0.01$) were significantly associated with high MSD prevalence. No significant association was found for education level ($\chi^2 = 3.14$, $p = 0.08$) or the presence of comorbidities ($\chi^2 = 0.02$, $p = 0.88$) (Refer to **Table 4** for full details).

**Table 2.** Prevalence of Specific Musculoskeletal Disorders among Older Adults with Post-Stroke Disabilities (N = 305).

| S/N | Musculoskeletal Disorders | Yes f (%) | No f (%) |
|---|---|---|---|
| 1 | Osteoarthritis | 213 (69.8%) | 92 (30.2%) |
| 2 | Rheumatoid arthritis | 261 (85.6%) | 44 (14.4%) |
| 3 | Osteoporosis with fractures | 84 (27.5%) | 221 (72.5%) |
| 4 | Osteoporosis | 112 (36.7%) | 193 (63.3%) |
| 5 | Low Back Pain | 239 (78.4%) | 66 (21.6%) |
| 6 | Gout | 227 (74.4%) | 78 (25.6%) |
| 7 | Polymyalgia Rheumatica (PMR) | 217 (71.1%) | 88 (28.9%) |
| 8 | Sarcopenia | 236 (77.4%) | 69 (22.6%) |
| 9 | Degenerative Disc Disease/Spondylosis | 199 (65.2%) | 106 (34.8%) |
| 10 | Spinal Stenosis | 208 (68.2%) | 97 (31.8%) |
| 11 | Tendinopathies and Bursitis | 241 (79.0%) | 64 (21.0%) |
| Average Mean Percentage | | 203 (66.6%) | 102 (33.4%) |

Note: N = sample size, f = frequency, % = percentage.

**Table 3.** Prevalence of Post-Stroke Disabilities among Older Adult Participants (N = 305).

| S/N | Post-Stroke Disabilities | Yes f (%) | No f (%) |
|---|---|---|---|
| 1 | Cognitive impairment | 177 (58.0%) | 128 (42.0%) |
| 2 | Loss of mobility | 89 (29.2%) | 216 (70.8%) |
| 3 | Difficulty in speech | 249 (81.6%) | 56 (18.4%) |
| 4 | Language difficulty | 115 (37.7%) | 190 (62.3%) |
| 5 | Dependency on others | 201 (65.9%) | 104 (34.1%) |
| 6 | Social isolation | 189 (62.0%) | 116 (38.0%) |

Note: N = sample size, f = frequency, % = percentage.

**Table 4.** Chi-Square Analysis of Musculoskeletal Disorder Prevalence by Sociodemographic and Clinical Variables (N = 304).

| Variables | Categories | N | High [203 (66.6%)] f (%) | Low [102 (33.4%)] f (%) | Chi-Square | *p*-Value |
|---|---|---|---|---|---|---|
| Age | ≥70 years<br>60–69 years | 202<br>103 | 144 (71.3%)<br>59 (57.3%) | 58 (28.7%)<br>44 (42.7%) | 6.25 | 0.01 |
| Gender | Male<br>Female | 107<br>198 | 62 (57.9%)<br>141 (71.2%) | 45 (42.1%)<br>57 (28.8%) | 4.50 | 0.03 |
| Religious Affiliation | Christianity<br>Others | 211<br>94 | 162 (76.8%)<br>41 (43.6%) | 49 (23.2%)<br>53 (56.4%) | 37.93 | 0.00 |
| Education Level | Tertiary<br>Others | 117<br>188 | 85 (72.6%)<br>118 (62.8%) | 32 (27.4%)<br>70 (37.2%) | 3.14 | 0.08 |
| Marital Status | Married<br>Others | 182<br>123 | 131 (72.0%)<br>72 (58.5%) | 51 (28.0%)<br>51 (41.5%) | 5.41 | 0.02 |
| Living Situation | With family<br>Others | 216<br>89 | 166 (76.9%)<br>37 (41.6%) | 50 (23.1%)<br>52 (58.4%) | 44.57 | 0.00 |
| Medication Dependence | Always<br>Rarely | 281<br>24 | 192 (68.3%)<br>11 (45.8%) | 89 (31.7%)<br>13 (54.2%) | 4.09 | 0.04 |
| Duration of Condition | ≥5 years<br>≤5 years | 116<br>189 | 88 (75.9%)<br>115 (60.8%) | 28 (24.1%)<br>74 (39.2%) | 7.17 | 0.01 |
| Comorbidity (e.g., diabetes, CVD, HBP) | Present<br>Absent | 274<br>31 | 182 (66.4%)<br>21 (67.7%) | 92 (33.6%)<br>10 (32.3%) | 0.02 | 0.88 |

Note: N = sample size, () = bracket sign, ≥ = greater than sign, ≤ = less than sign, f = frequency, % = percentage. CVD = cardiovascular disease, living situation: others (alone, institutionalized), marital status: others (single, divorced/separated, widowed), religious affiliation: others (Pagan, African Traditional Religion, Islam), education level: others (non-formal, primary, secondary), HBP = high blood pressure.

## 3.5. Predictors of Musculoskeletal Disorders

Multivariate odds ratio analysis further supported the findings from the chi-square tests. Older adults aged ≥ 70 years had significantly higher odds of experiencing MSDs (Original odds ratio (OR) = 1.85; 95% confidence interval (CI): 1.07–3.21; upper limit to lower limit (UL/LL) ratio = 3.00; λ = 0.5; shrunk OR = 0.93), as did those who were married (Original OR = 1.82; 95% CI: 1.13–2.92; UL/LL = 2.58; λ = 0.5; shrunk OR = 0.91), and those living with family (Original OR = 4.68; 95% CI: 2.77–7.91; UL/LL = 2.86; λ = 0.5; shrunk OR = 2.34). Christians appeared to have the highest risk (Original OR = 4.30; 95% CI: 2.57–7.20; UL/LL = 2.80; λ = 0.5; shrunk OR = 2.15), but the wide confidence interval suggests substantial imprecision, limiting the reliability of this estimate for clinical prediction or public health prioritization. Participants who were consistently dependent on medication had increased odds of MSDs (Original OR = 2.54; 95% CI: 1.01–6.35; UL/LL = 6.29; λ = 0.25; shrunk OR = 0.64), while those with stroke duration of ≥5 years were twice as likely to report MSDs (Original OR = 2.01; 95% CI: 1.23–3.29; UL/LL = 2.67; λ = 0.5; shrunk OR = 1.01). Interestingly, male sex was associated with significantly lower odds of MSDs (Original OR = 0.56; 95% CI: 0.34–0.93; UL/LL = 2.74; λ = 0.5; shrunk OR = 0.28), indicating increased risk among females. However, no significant associations were found between MSD prevalence and comorbidity status (Original OR = 0.94; 95% CI: 0.43–2.03; UL/LL = 4.72; λ = 0.25; shrunk OR = 0.24) or education level (Original OR = 1.57; 95% CI: 0.97–2.54; UL/LL = 2.62; λ = 0.5; shrunk OR = 0.79). These shrunk estimates offer a more conservative and stable reflection of the relative importance of each factor in predicting MSD risk among older adults with post-stroke disabilities (Refer to **Table 5** for full details of both original and shrunk ORs).

**Table 5.** Odds Ratio Analysis of Musculoskeletal Disorder Prevalence by Sociodemographic and Clinical Variables (N = 304).

| Variables | Categories | N | High [203 (66.6%)] f (%) | Low [102 (33.4%)] f (%) | Odds | Original OR | 95% CI | UL/LL | λ | Shrunk OR |
|---|---|---|---|---|---|---|---|---|---|---|
| Age Bracket | ≥70 years<br>60–69 years | 202<br>103 | 144 (71.3%)<br>59 (57.3%) | 58 (28.7%)<br>44 (42.7%) | 2.48<br>1.34 | 1.85 | 1.07, 3.21 | 3.00 | 0.5 | 0.93 |
| Gender | Male<br>Female | 107<br>198 | 62 (57.9%)<br>141 (71.2%) | 45 (42.1%)<br>57 (28.8%) | 1.38<br>2.47 | 0.56 | 0.34, 0.93 | 2.74 | 0.5 | 0.28 |
| Religious Affiliation | Christianity<br>Others | 211<br>94 | 162 (76.8%)<br>41 (43.6%) | 49 (23.2%)<br>53 (56.4%) | 3.31<br>0.77 | 4.30 | 2.57, 7.20 | 2.80 | 0.5 | 2.15 |
| Education Level | Tertiary<br>Others | 117<br>188 | 85 (72.6%)<br>118 (62.8%) | 32 (27.4%)<br>70 (37.2%) | 2.66<br>1.69 | 1.57 | 0.97, 2.54 | 2.62 | 0.5 | 0.79 |
| Marital Status | Married<br>Others | 182<br>123 | 131 (72.0%)<br>72 (58.5%) | 51 (28.0%)<br>51 (41.5%) | 2.57<br>1.41 | 1.82 | 1.13, 2.92 | 2.58 | 0.5 | 0.91 |
| Living Situation | With family<br>Others | 216<br>89 | 166 (76.9%)<br>37 (41.6%) | 50 (23.1%)<br>52 (58.4%) | 3.32<br>0.71 | 4.68 | 2.77, 7.91 | 2.86 | 0.5 | 2.34 |
| Medication Dependence | Always<br>Rarely | 281<br>24 | 192 (68.3%)<br>11 (45.8%) | 89 (31.7%)<br>13 (54.2%) | 2.16<br>0.85 | 2.54 | 1.01, 6.35 | 6.29 | 0.25 | 0.64 |
| Duration of Condition | ≥5 years<br>≤5 years | 116<br>189 | 88 (75.9%)<br>115 (60.8%) | 28 (24.1%)<br>74 (39.2%) | 3.14<br>1.56 | 2.01 | 1.23, 3.29 | 2.67 | 0.5 | 1.01 |
| Comorbidity (e.g., diabetes, CVD, HBP) | Present<br>Absent | 274<br>31 | 182 (66.4%)<br>21 (67.7%) | 92 (33.6%)<br>10 (32.3%) | 1.98<br>2.10 | 0.94 | 0.43, 2.03 | 4.72 | 0.25 | 0.24 |

Note: N = sample size, () = bracket sign, ≥ = greater than sign, ≤ = less than sign, f = frequency, % = percentage. CVD = cardiovascular disease, living situation: others (alone, institutionalized), marital status: others (single, divorced/separated, widowed), religious affiliation: others (Pagan, African Traditional Religion, Islam), education level: others (non-formal, primary, secondary).

# 4. Discussion

This study revealed a high burden of musculoskeletal disorders (MSDs) among older Nigerian adults living with post-stroke disabilities, with 66.6% of participants reporting at least one MSD. The most common conditions were tendinopathies and bursitis, low back pain, sarcopenia, gout, and polymyalgia rheumatica, underscoring a complex musculoskeletal vulnerability in this population. The sarcopenia prevalence of 77.4% notably exceeds pooled global estimates. For example, a recent meta-analysis reported a prevalence of approximately 42% among stroke survivors, with elevated risk during the acute post-stroke period [1]. A Korean cohort similarly found a 32.5% incidence at discharge, associated with older age, stroke severity, and dysphagia [25]. These discrepancies may partly reflect methodological variation, but they also likely signal a possible heavier burden in low- and middle-income countries (LMICs) such as Nigeria, where delayed diagnosis, fragmented rehabilitation, and nutritional deficiencies are common [2]. Importantly, while bivariate and original odds ratio (OR) analyses initially suggested several strong associations, the application of shrinkage estimation, used to stabilize effect size estimates by reducing the impact of sampling error, resulted in notable shifts in predictor ranking and magnitude [26,27]. This is critical, as the original, unadjusted ORs for several variables were likely overstated due to wide confidence intervals and high variance.

After shrinkage adjustment, several predictors maintained their relative importance. Living with family remained a robust and strong predictor of MSDs, suggesting that co-residence may increase physical responsibilities or caregiving strain in this population. Although often presumed to be supportive, multigenerational households in LMICs can place functional demands on older adults due to cultural expectations and lack of formal care systems [2,28]. Female sex also remained significantly associated with higher MSD risk. Males demonstrated lower odds, consistent with international evidence that women experience higher musculoskeletal burden, possibly due to hormonal factors, lower muscle mass, and caregiving roles [29]. This finding is particularly relevant in Nigeria, where women are more likely to assume informal caregiving duties, even in old age [30]. Christian religious affiliation, though subject to a wide confidence interval in the original estimate, retained a relatively high shrunk OR (2.15). While causality cannot be inferred, this may reflect participation in community or church activities that involve physical exertion or caregiving duties. Alternatively, cultural roles within religious structures may shape exposure to physical strain, although this requires further qualitative inquiry.

Other predictors that initially appeared important in unadjusted analyses were attenuated following shrinkage, suggesting more modest or uncertain effects. Age $\geq$ 70 years, while statistically significant in the original model, saw its shrunk OR reduced to 0.93, indicating a marginal effect. Although age is a known risk factor for sarcopenia and MSDs [28], its influence here may be confounded by post-stroke disability itself, which levels functional capacity across older age groups. Being married also lost strength after shrinkage, implying that marital status may not independently predict MSDs once other factors, such as living arrangement or caregiving context, are controlled. Consistent medication dependence had an original OR of 2.54 but a shrunk OR of 0.64, reflecting high uncertainty. While long-term medication use is often associated with musculoskeletal side effects, such as those from corticosteroids and statins, the true strength of this association in this population is likely more modest and may reflect confounding from disease severity. Stroke duration of five years or more, which initially appeared significant, shrank to a near-null effect, suggesting that stroke chronicity alone may not predict MSDs. Instead, functional status or rehabilitation history may be more relevant.

Comorbidity status remained a non-significant predictor even in the unadjusted model, and further shrank to 0.24. This finding contrasts with the literature in which diabetes, hypertension, and cardiovascular diseases are frequently associated with increased MSD risk [31,32], but it supports the hypothesis that neurological sequelae of stroke may dominate musculoskeletal outcomes in this cohort. Education level also lost predictive value, which runs counter to broader geriatric health research where higher education often confers protective effects [25]. Stroke-related disability may neutralize educational disparities by limiting access to health resources across all socioeconomic levels. These adjusted findings reinforce the need for context-sensitive rehabilitation strategies. While many initial predictors appeared important, only a subset remained strong after statistical correction, most notably co-residence with family and female sex. This suggests that social role expectations and gendered caregiving dynamics may be more critical drivers of musculoskeletal burden than age or comorbidities in post-stroke populations. Interventions should be integrated to include routine MSD screening during post-stroke follow-up, with particular focus on women and individuals living in extended households. Multidimensional rehabilitation approaches are warranted, addressing both neurological recovery and musculoskeletal preservation. These may include resistance training, ergonomic education, pain management, and nutritional support [7,8]. Additionally, technology-enabled rehabilitation models, such as virtual reality-based telerehabilitation and wearable monitors, could help bridge gaps in service delivery in Nigeria and similar LMICs, where rehabilitation specialists are limited [25,33].

At a policy and systems level, Nigeria's healthcare infrastructure remains predominantly focused on acute care, with insufficient attention to long-term functional outcomes, including MSDs. These findings support growing calls to integrate MSD management into stroke rehabilitation protocols in alignment with the WHO Rehabilitation 2030 agenda[34]. Community-based rehabilitation should also be expanded, particularly through task-shifting to trained community health workers, caregiver education programs, and the provision of assistive devices. Recognizing MSDs in post-stroke survivors as a public health priority is imperative, especially in light of global epidemiological trends. For instance, gout alone is projected to affect 96 million individuals globally by 2050[9]. Ultimately, global health agencies and national policymakers must acknowledge musculoskeletal complications as a key component of post-stroke disability. Investment in workforce training, culturally adapted interventions, and scalable rehabilitation technologies will be essential to reducing disability-adjusted life years (DALYs) and promoting functional independence in aging populations.

This study demonstrates strong methodological rigor, enhancing its credibility and relevance. Multi-center, geopolitically stratified sampling across six tertiary hospitals ensures broad national representation. Rigorous eligibility criteria and the validated, multilingual MDOAPSDQ (Cronbach's $\alpha = 0.86$) support diagnostic validity and measurement reliability. Pretesting, standardized data collection, a high response rate (99.7%), and STROBE adherence reinforce robustness. However, its cross-sectional design limits causal inference, and purposive hospital-based sampling may reduce generalizability to rural or non-hospitalized populations. Self-report bias, residual confounding, and exclusion of severely impaired individuals may underestimate the MSD burden. Future longitudinal, community-based research should address cultural, biomedical, and environmental determinants of musculoskeletal outcomes.

## 5. Conclusions

This multicenter study provides nationally representative evidence on the burden of musculoskeletal disorders among older Nigerian stroke survivors. By spanning all six geopolitical zones, it informs equitable, region-specific rehabilitation strategies. Its focus on socio-demographic and contextual predictors, caregiving, religion, and medication use, broadens understanding beyond biomedical factors, revealing cultural and structural influences. The findings advocate integrated, community-based models emphasizing early screening, pain control, and caregiver support. Highlighting gaps in post-stroke care, the study underscores the potential of low-cost interventions and calls for longitudinal research on causal pathways, gender, and caregiving dynamics to strengthen rehabilitation and reduce disability burdens.

## Author Contributions

All the authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by U.C.U., O.C.E., B.A.O., C.C.U., A.N.O., and C.M.J. The first draft of the manuscript was written by U.C.U., and all the authors commented on previous versions of the manuscript. All authors have read and agreed to the published version of the manuscript.

## Funding

No funding was received for conducting this study.

## Institutional Review Board Statement

The approval for the study was obtained from the Federal Ethics Committee of Nigeria (Ref: REC/FE/2024/00073). This was in accordance with the tenets of the Declaration of Helsinki.

## Informed Consent Statement

Informed consent was obtained from all individual participants included in the study.

## Data Availability Statement

The datasets used and/or analysed during the current study are available from the corresponding author (U.C.U.: uchennacos.ugwu@unn.edu.ng) on reasonable request.

## Acknowledgments

The authors gratefully acknowledge the Chief Medical Directors and staff of the six tertiary hospitals for facilitating access and recruitment. We appreciate the twelve research assistants whose professionalism and linguistic fluency ensured high-quality data collection. Special thanks go to the physicians, nurses, and allied health professionals who supported clinical verification and logistics. We are deeply thankful to the older adult participants and caregivers for their trust and cooperation. We also thank the 13 expert reviewers for validating the instrument and the Federal Ethics Committee for ethical approval.

## Conflicts of Interest

The authors declare that they have no competing interests.

## References


[1] Su, Y., Yuki, M., Otsuki, M., 2020. Prevalence of Stroke-Related Sarcopenia: A Systematic Review and Meta-Analysis. Journal of Stroke and Cerebrovascular Diseases. 29(9), 105092. DOI: https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105092

[2] Kayola, G., Mataa, M.M., Asukile, M., et al., 2023. Stroke Rehabilitation in Low- and Middle-Income Countries: Challenges and Opportunities. American Journal of Physical Medicine & Rehabilitation. 102(2S), S24–S32.

[3] Mensah, G.A., Norrving, B., Feigin, V.L., 2015. The Global Burden of Stroke. Neuroepidemiology. 45(3), 143–145. DOI: https://doi.org/10.1159/000441082

[4] Owolabi, M.O., Akarolo-Anthony, S., Akinyemi, R., et al., 2015. The Burden of Stroke in Africa: A Glance at the Present and a Glimpse into the Future. Cardiovascular Journal of Africa. 26(2), S27–S38. DOI: https://doi.org/10.5830/CVJA-2015-038

[5] Akinyemi, R.O., Ovbiagele, B., Adeniji, O.A., et al., 2021. Stroke in Africa: Profile, Progress, Prospects and Priorities. Nature Reviews Neurology. 17(10), 634–656. DOI: https://doi.org/10.1038/s41582-021-00542-4

[6] Olaoluwa, O., Ajayi, M.S., 2025. Influence of Sociodemographic and Clinical Factors on Illness Progression and Quality of Life among Older Adults in Ibadan, Nigeria. BMC Geriatrics. 25(1), 791. DOI: https://doi.org/10.1186/s12877-025-06458-8

[7] Matsushita, T., Nishioka, S., Taguchi, S., et al., 2021. Effect of Improvement in Sarcopenia on Functional and Discharge Outcomes in Stroke Rehabilitation Patients. Nutrients. 13(7), 2192. DOI: https://doi.org/10.3390/nu13072192

[8] Cruz-Jentoft, A.J., Bahat, G., Bauer, J., et al., 2019. Sarcopenia: Revised European Consensus on Definition and Diagnosis. Age and Ageing. 48(4), 16–31.

[9] Global Burden of Disease (GBD) 2021 Gout Collaborators, 2024. Global, regional, and national burden of gout, 1990–2020, and projections to 2050: A systematic analysis of the Global Burden of Disease Study 2021. The Lancet Rheumatology. 6(8), e507–e517. DOI: https://doi.org/10.1016/S2665-9913(24)00117-6

[10] Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. Lawrence Erlbaum Associates: Hillsdale, NJ, USA.

[11] World Health Organization, 2002. World Health Survey: Individual Questionnaire. World Health Organization: Geneva, Switzerland.

[12] National Population Commission (NPC), ICF, 2019. Nigeria Demographic and Health Survey 2018. Available from: https://dhsprogram.com/pubs/pdf/FR359/FR359.pdf (cited 7 November 2024).

[13] Charlson, M.E., Pompei, P., Ales, K.L., et al., 1987. A New Method of Classifying Prognostic Comorbidity in Longitudinal Studies: Development and Validation. Journal of Chronic Diseases. 40(5), 373–383.

[14] Institute for Health Metrics and Evaluation, 2020. Global Burden of Disease Study 2019 (GBD 2019) Data Resources. Available from: http://ghdx.healthdata.org/gbd-2019 (cited 7 November 2024).

[15] Woolf, A.D., Pfleger, B., 2003. Burden of Major Musculoskeletal Conditions. Bulletin of the World Health Organization. 81(9), 646–656.

[16] Malmstrom, T.K., Morley, J.E., 2013. SARC-F: A Simple Questionnaire to Rapidly Diagnose Sarcopenia. Journal of the American Medical Directors Association. 14(8), 531–532.

[17] van Swieten, J.C., Koudstaal, P.J., Visser, M.C., et al., 1988. Interobserver Agreement for the Assessment of Handicap in Stroke Patients. Stroke. 19(5), 604–607.

[18] World Health Organization, 2010. WHO Disability Assessment Schedule 2.0 (WHODAS 2.0). Available from: https://www.who.int/classifications/icf/whodasii/en/ (cited 7 November 2024).

[19] Ward, A.B., Chen, C., Norrving, B., et al., 2014. Evaluation of the Post Stroke Checklist: A pilot study in the United Kingdom and Singapore. International Journal of Stroke. 9(SA100), 76–84. DOI: https://doi.org/10.1111/ijs.12291

[20] World Medical Association, 2013. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. Journal of the American Medical Association. 310(20), 2191–2194.

[21] National Health Research Ethics Committee, 2007. National Code of Health Research Ethics. National Health Research Ethics Committee: Abuja, Nigeria. Available from: https://healthresearchwebafrica.org.za/files/NCHRECurrentVersion.pdf (cited 7 November 2024).

[22] American Psychological Association, 2017. Ethical Principles of Psychologists and Code of Conduct. American Psychological Association: Washington, DC, USA.

[23] IBM Corp., 2021. IBM SPSS Statistics for Windows, Version 28.0. IBM Corp.: Armonk, NY, USA.

[24] von Elm, E., Altman, D.G., Egger, M., et al., 2008. The Strengthening the Reporting of Observational Studies

in Epidemiology (STROBE) Statement: Guidelines for Reporting Observational Studies. Epidemiology. 18(6), 800–804.

[25] Aydin, T., Kesiktaş, F.N., Oren, M.M., et al., 2021. Sarcopenia in Patients Following Stroke: An Overlooked Problem. International Journal of Rehabilitation Research. 44(3), 269–275.

[26] Zengin, A., Jarjou, L.M., Prentice, A., et al., 2018. The prevalence of sarcopenia and relationships between muscle and bone in ageing West-African Gambian men and women. Journal of Cachexia, Sarcopenia and Muscle. 9(5), 920–928. DOI: https://doi.org/10.1002/jcsm.12341

[27] Wang, L., Chao, J., Zhang, N., et al., 2025. Prevalence and Factors Associated with Sarcopenia in Community-Dwelling Older Adults: A Systematic Review and Meta-Analysis. Gerontology. 72(2), 110–125. DOI: https://doi.org/10.1159/000549808

[28] Cruz-Jentoft, A.J., Sayer, A.A., 2019. Sarcopenia. The Lancet. 393(10191), 2636–2646.

[29] Yoshimura, Y., Wakabayashi, H., Nagano, F., et al., 2025. Sex Differences in Sarcopenia Prevalence and Muscle-Related Outcomes among Post-Stroke Inpatients. European Geriatric Medicine. 16(3), 1071–1079.

[30] Vincent-Onabajo, G., Daniel, H., Kuyinu, Y.E., 2018. Musculoskeletal Symptoms among Family Caregivers of Stroke Survivors in Nigeria. Journal of Caring Sciences. 7(2), 59–66.

[31] Nweke, M., Mshunqane, N., 2025. Characterization and Stratification of Risk Factors of Stroke in People Living with HIV: A Theory-Informed Systematic Review. BMC Cardiovascular Disorders. 25(1), 405. DOI: https://doi.org/10.1186/s12872-025-04833-2

[32] Khan, A., Podlasek, A., Somaa, F., 2023. Virtual Reality in Post-Stroke Neurorehabilitation: A Systematic Review and Meta-Analysis. Topics in Stroke Rehabilitation. 30(1), 53–72.

[33] World Health Organization, 2020. Rehabilitation 2030: A call for action: 6–7 February 2017, Executive Boardroom, WHO Headquarters, meeting report. World Health Organization: Geneva, Switzerland. Available from: https://iris.who.int/handle/10665/339910

[34] Wilson, E., Lee, L., Klas, R., et al., 2020. Technology and Rehabilitation Training for Community Health Workers: Strengthening Health Systems in Malawi. Health & Social Care in the Community. 28(3), 833–841.