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Systematic literature review of the prevalence, pattern, and determinant of multimorbidity among older adults in Nigeria

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**Abstract**

**Introduction**

Multimorbidity is a rising health issue globally and it is likely to become challenging in developing countries like Nigeria as they experience economic, demographic, and epidemiology transition. Yet, evidence of prevalence and patterns of multimorbidity, and their determinants, are scarce. This study aims to systematically review studies of the prevalence, patterns, and determinants of multimorbidity in Nigeria.

**Methods**

Studies were identified by searching five electronic databases (PubMed, Web of Science, CINAHL, PsycINFO, Africa Index Medicus/Global Index Medicus). Multimorbidity as well as other versions of it was used to search. The prevalence and determinants were also searched. According to pre-established inclusion criteria, and using different search strategies, 6 articles were included. The quality and risk of bias were assessed using Joanna Briggs Institute (JBI) appraisal tool for prevalence studies. Two researchers assessed the eligibility of studies for inclusion. The Protocol was registered on PROSPERO Ref no. CRD42021273222. The overall prevalence, pattern, and determinants were analyzed.

**Results**

We identified 6 eligible publications describing studies that included a total of 3332 (men 47.5%, women 52.5%) patients from 4 states plus the federal capital territory Abuja. The multimorbidity prevalence ranges from 27% to 74 % among elderly Nigerians. Cardiovascular together with metabolic and/or musculoskeletal conditions were the frequent patterns of multimorbidity. A positive association was observed between age and multimorbidity in most studies. Other factors associated with multimorbidity were female gender, low education status, poor monthly income/ unemployment, hospitalization, medical visits, and emergency services.

**Conclusion**

There has been a growing need for more applied health services research to understand better and manage multimorbidity in developed countries. The scarcity of studies in our review reveals that multimorbidity is not a priority area of research in Nigeria and this will continue to hinder policy development in that area.

Keywords: Multimorbidity, Prevalence, Pattern, Determinant, Older Adults, Nigeria

## Introduction

The increase in average life span and transformation in global age structure towards a rapidly ageing society is a major success for medical and public health systems. Though lengthening lifespans is a global trend, the impact is not spread equally across the world (Khan, 2019). A huge difference still exists in life expectancy across the globe, it is said to be less than 60 years in sub-Saharan Africa and it is higher in first-world countries and even higher than 80 years in Japan (Roser et al., 2013). They also reported that global life expectancy increased from an average of 29 to 73 years in 2019. This success epitomizes new challenges for public health policy to ensure that healthy life expectancy is increased rather than just life expectancy (Brayne, 2007). This is because an ageing population presents many challenges and ignoring them could undermine the potential benefits and opportunities that living for longer can bring (Khan, 2019).

Ageing represents the greatest risk factor for disease and brings with it the chronic uncontrol of multiple organ systems (Fabbri et al., 2015). In other words, the uncompromising form of reality is that chronic diseases rarely occur in isolation, and as life expectancy increases, people acquire a growing number of illnesses (Barnett et al., 2012a). The number of people affected by multiple chronic diseases a condition termed multimorbidity is increasing dramatically around the world and caring for them has placed substantial stress on many health systems (Navickas et al., 2016). Although this rising burden of chronic diseases has attracted the attention of public health researchers and policymakers worldwide, studies have shown that evidence on the epidemiology of multimorbidity in Low- and Middle-Income Countries (LMICs) is limited even though the region bears 80% of the global burden of non-communicable diseases (NCDs) (Hunter & Reddy, 2013). Healthcare utilization and cost have surged in LMICs as a result of the prevalence of multimorbidity which places strain on the health system (Frølich et al., 2019; Sum et al., 2019). Multimorbidity management requires a lot of resources that are hard work for both the patients and practitioners, especially when deepened with socioeconomic deprivation (O'Brien et al., 2011). Likewise, multimorbid patients are prone to frequent hospitalization, polypharmacy, treatment burden, and mortality (Duerden et al., 2013; Palmer et al., 2018).

Recent studies reported that only 5% of multimorbidity research studies originated in LMICs, out of which were confined to only six middle-income countries (Brazil, China, South Africa, India, Mexico, and Iran) (Xu et al., 2017). Similarly, most of the recognized studies on multimorbidity

66 extrapolated from the global population through the largest systematic review of the prevalence of

67 multimorbidity conducted up to date for over 25 years (1992-2017), by Nguyen et al. (2019) were

68 largely skewed to the other region of the world excluding Africa. This skewed distribution of

69 multimorbidity studies demonstrates that there is a lack of attention on studying the phenomenon

70 in other LMICs where it is likely to be more prevalent.

71 It has been estimated that the number of people experiencing multimorbidity is projected to rise

72 along with population ageing by >1% per annum until 2030 (Yoon et al., 2014). Therefore, there is

73 a need for greater insight and an up-to-date understanding of the prevalence and patterns of

74 multimorbidity, especially among the older population to inform preventive strategies in LMICs

75 like Nigeria. There is a dearth of knowledge on the prevalence, pattern, and determinants of

76 multimorbidity in Nigeria to our knowledge. And hence, this systematic review of literature was

77 conducted to determine (I) the prevalence of multimorbidity in older adults aged 60 years and

78 above in Nigeria. (II) The common multimorbidity disease clusters in Nigeria and (III) the

79 determinant of multimorbidity disease in Nigeria.

80 **Methods**

81 We conducted a systematic review that was preceded by a designed priori protocol (S1 File),

82 following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

83 checklist (S2 File) (Moher, 2009) and the PRISMA Protocols statement (S3 File) (Shamseer et al.,

84 2015) respectively. The Protocol was registered on PROSPERO Ref no. CRD42021273222 and

85 available at https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=273222.

86 **Inclusion and exclusion criteria**

87 Included articles were peer-reviewed original articles with abstracts in English. However,

88 conference presentations, opinion articles, books, and dissertations are excluded. The articles are

89 observational cross-sectional articles on multimorbidity with a well-defined population 60 years

90 and above conducted in Nigeria. The setting of the study was either community-based or health

91 facility-based involving either or both inpatient and outpatient. Any other studies besides cross-

92 sectional studies like cohort studies, and experimental studies were excluded. In addition, papers

93 with single-review morbidity studies and without a clear description of the population were also

94 excluded. Articles about the prevalence, pattern, and determinants of multimorbidity in Nigeria

95 were included. Where multimorbidity has not been clearly defined, articles documenting two or

96 more chronic medical conditions were considered in this (SR) even if they did not mention

97 multimorbidity. Papers with single-review morbidity and studies with suboptimal methodology

98 were excluded. No limitations were placed on the years of publication.

99 **Outcomes**

100 Recent studies centered on defined multimorbidity as the simultaneous presence of more than

101 one chronic medical condition in the same individual  (Cucinotta & Vanelli, 2020; Javanmardi et al.,

102 2020; Johnston et al., 2019; Sinclair & Abdelhafiz, 2020; van den Akker et al., 1996) and multimorbidity

103 patterns as the most frequent combination of specific disease pairs and the groups of health

104 conditions with the highest degree of association using the corresponding statistical analyses of

105 either cluster and factor analysis (Violan et al., 2014).

106 **Search strategy and study selection**

107 We conducted an online literature search on PubMed, Web of Science, CINAHL, PsycINFO,

108 Africa Index Medicus/Global Index Medicus electronic databases, from inception up to 16 of

109 August 2021. Additionally, a corresponding internet search was done in Google Scholar, Google,

110 and an online search from Africa Journal Online (AJOL) applying the same algorithm used in the

111 bibliographic database search. However, where necessary the search was altered in line with the

112 search engines and databases used. Screening of the reference list of included articles for the

113 likelihood of relevant articles was conducted. The search terms included multimorbidity and other

114 versions like 'multimorbidities', 'multi-morbidities', 'multi morbidity', and multiple morbidities.

115 We excluded 'comorbidity' and other synonyms in our search strategy. And prevalence or

116 epidemiology AND (pattern) AND determinants were used. This was done by using the 'AND'

117 and 'OR' Boolean operators where appropriate (online supplement). These terms will be further

118 restricted by location 'Nigeria (Abia OR Adamawa OR Akwa Ibom OR Anambra or Bauchi or

119 Bayelsa OR Benue OR Borno OR Cross River OR Delta OR Ebonyi OR Edo State OR Ekiti OR

120 Enugu OR Gombe OR Imo OR Jigawa OR Kaduna OR Kano OR Katsina OR Kebbi OR Kogi OR

121 Kwara OR Lagos OR Nasarawa OR Niger OR Ogun OR Ondo OR Osun OR Oyo OR Plateau OR

122 Rivers OR Sokoto OR Taraba OR Yobe OR Zamfara OR ABUJA OR FCT). The details of the

123 search in specific databases are given in the study protocol (S1 File).

124 We downloaded and exported all identified citations to RefWorks referencing software manager.
125 Duplicates were excluded using the Mendeley reference manager deduplication function.
126 Afterward, the citations were exported from the reference manager into Rayyan systematic review
127 software (Ouzzani et al., 2016) for the screening process. Title/abstract and full-text screening were
128 carried out on the Rayyan software. The first reviewer (AA) screened the title and abstract of all
129 initial articles. To ensure that appropriate studies were not unexploited a random 10% of all
130 references were tested by the second reviewer (ML). (AA) and (ML) screened the full text
131 independently and any area of variance was fixed between the two reviewers and also with input
132 from the third reviewer (HK). The most suitable data was included from multiple studies from the
133 equivalent dataset. A PRISMA flow diagram is attached to show the detail of the study selection
134 decisions made.

135 **Data extraction**

136 The extraction of data was conducted simultaneously with full-text searching. The relevant
137 information was extracted from each article included and recorded immediately in the data
138 extraction file (MS Excel). (AA) and (ML) independently extract the data.  The extracted data are
139 citation details: authors, title, journal, and year, details of the study: study setting (community or
140 health facility) study design, period of data collection, location of the study, size of the sample,
141 case definition, characteristics of the participants, description of main results: percentage
142 prevalence of multimorbidity and the most common disease clusters in the study sample.

143 **Study quality assessment**

144 Assessing the study characteristics and the risk of bias was done by two reviewers. The Joanna
145 Briggs Institute (JBI) critical appraisal tool for prevalence studies was used  (Joanna Briggs Institute,
146 2017). The JBI uses 9 items. There are four possible answers to the nine items (yes, no, not clear,
147 and not applicable). The threshold for the conversion of the JBI is as follows. Any item with a yes
148 gets a score of 1, for no and unclear the score is zero, and for not applicable items are not included
149 in the % calculation. A score of 60% and above was regarded as good quality. Based on the JBI
150 data quality assessment system, all 6 studies were rated good quality. 4 studies had a score of
151 100%, one study have 88% and one study had 62.5%. The results from the two researchers were
152 compared and differences were discussed between them.
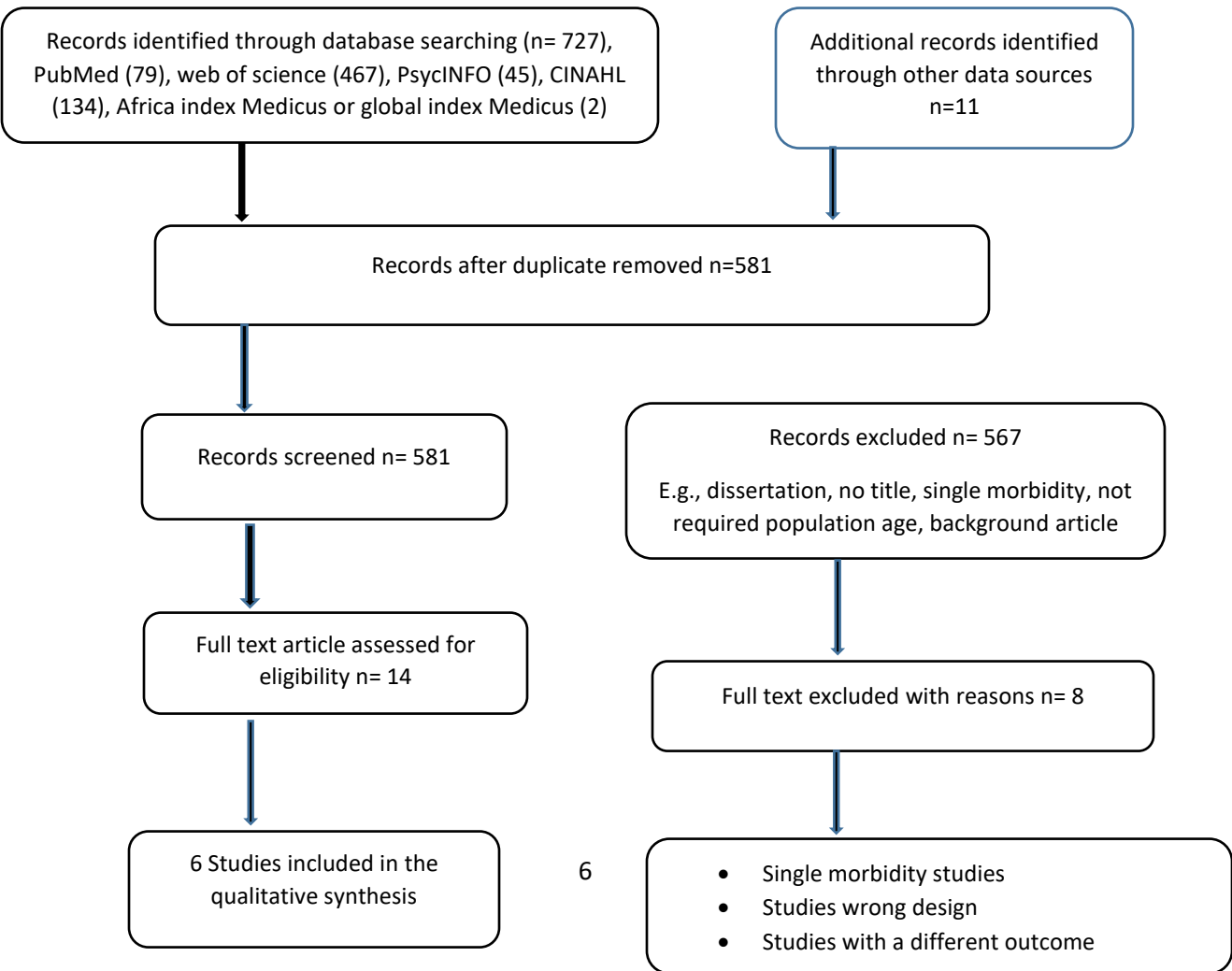
153 **Ethics and dissemination**

154 This review received ethics approval as part of a larger project from the College of Nursing,

155 Midwifery, and Healthcare, Research Ethics Panel (ethical approval number 1055). This research

156 provided information on the prevalence of multimorbidity and other studied outcomes in Nigeria.

157 The findings of this SR will be disseminated in a peer-reviewed journal article.

158 **Results**

159 **Study overview**

160 The processes of screening articles are shown on the PRISMA flowchart in Figure 1. The

161 preliminary search yielded 738 titles; this was reduced to 581 after deduplication in the

162 RefWorks citation manager software. In the title and abstract screening process 567 were

163 excluded leaving only 14 articles for assessment and only 6 were included in the narrative

164 synthesis (S1Table).

165 **Figure 1 shows the Prisma flow chart**

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Records identified through database searching (n= 727), PubMed (79), web of science (467), PsycINFO (45), CINAHL (134), Africa index Medicus or global index Medicus (2)

Additional records identified through other data sources n=11

Records after duplicate removed n=581

Records screened n= 581

Records excluded n= 567

E.g., dissertation, no title, single morbidity, not required population age, background article

Full text article assessed for eligibility n= 14

Full text excluded with reasons n= 8

6 Studies included in the qualitative synthesis

6

- Single morbidity studies
- Studies wrong design
- Studies with a different outcome

**Study characteristics**

Although the studies are relatively few, available ones are spread to cover the northern and southern parts of the country. Two studies each were conducted in north-central of Nigeria (Abdulraheem et al., 2017; Adams & Abubakar, 2019). Two studies were also conducted in Kano state northwestern Nigeria (Abdulazeez et al., 2021; Olawumi et al., 2021). One study each was conducted in the western and eastern parts of Nigeria respectively (Faronbi et al., 2020; Nwani & Isah, 2016a). The total number of participants across the six studies was 3332 (men: 47.5%, women: 52.5%) (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Adams & Abubakar, 2019; Faronbi et al., 2020; Nwani & Isah, 2016a; Olawumi et al., 2021). The sample sizes of the included studies range from 333 to 1650 participants see Table 1. All included studies were published after 2013 and the majority were in the last 6 years. Four studies conducted primary cross-sectional descriptive using either or a combination of clinical evaluation and administration of a questionnaire, interviews, and review of medical records (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Faronbi et al., 2020; Olawumi et al., 2021). One study conducted a cross-sectional retrospective study over 12 months from January to December 2018 (Adams & Abubakar, 2019), and the other study longitudinal prospective study both using medical health records (Nwani & Isah, 2016b). Two studies were carried out at the family medicine/ outpatient department of Aminu Kano teaching hospital Kano, Nigeria respectively (Abdulazeez et al., 2021; Olawumi et al., 2021). One study each was conducted at Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi Anambra state Nigeria (Nwani & Isah, 2016a), and General Out-Patient Clinic of the UATH Gwagwalada, Abuja, Nigeria (Adams & Abubakar, 2019), Osogbo, and Osun State, Nigeria respectively (Faronbi et al., 2020). Four studies were hospital-based (Abdulazeez et al., 2021; Adams & Abubakar, 2019; Nwani & Isah, 2016b; Olawumi et al., 2021) while two were conducted in the community (Abdulraheem et al., 2017; Faronbi et al., 2020).

**Study quality assessment**

The result of the study quality assessment is provided in S2 **Table**. Of the included studies, 66% were high quality, and the remaining studies were medium quality. There was no study with low quality. The threshold for the conversion of the JBI is as follows. Any item with a yes gets a score of 1, for no and unclear the score is zero, and for not applicable items are not included in the % calculation. A score of 60% and above was regarded as good quality (high and medium).

208 Based on the JBI data quality assessment system, all 6 studies were rated good quality. 4 studies

209 had a score of 100%, one study have 88% and one study had 62.5%. The results from the two

210 researchers were compared and differences were discussed between them.

211

212 **Outcomes**

213 **Primary outcome**

214 The definition of multimorbidity used, the number of disease conditions included in the study,

215 and how the disease conditions were measured are all known facts that influence the prevalence

216 of multimorbidity. However, all included studies used a 'count' of the number of diseases to

217 define multimorbidity, and multimorbidity was defined by having two or more diseases in an

218 individual. All the included studies specified they were only focused on chronic conditions. One

219 study qualified chronic diseases as compiled and counted by the world health organization

220 (WHO) (Nwani & Isah, 2016b). They stated that WHO defines chronic diseases as health problems

221 that require ongoing management over a period of years or decades. Four studies draw and

222 classify the chronic health problems of interest from the 147 International Classification of

223 Primary Care, second edition (ICPC-2) rubrics list gathered by the Family Medicine Research

224 Centre, University of Sydney (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Nwani & Isah,

225 2016a; Olawumi et al., 2021). Two studies do not clearly measure (Adams & Abubakar, 2019; Faronbi

226 et al., 2020).

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**Table 1 shows study characteristics**

| Study (state of study) | Study setting | Study design | Data collection period | Data source | Sample size | Age of participants |
|---|---|---|---|---|---|---|
| Nwani and Isah, 2016 (Anambra state) | Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi Anambra State Nigeria | prospective study | January 1, 2009, to December 31, 2009 | Not reported | 345 patients | patients aged 65 years |
| Adams and Abubakar, 2018 (Abuja) | General Out-Patient Clinic of the UATH Gwagwalada, Abuja. | Cross-sectional retrospective study | 12 months, January 2018-December 2018 | Medical health record | 333 patients | 60 and above years |

| Olawumi et al., 2021 (Kano) | conducted in the family medicine clinic (FMC) of Aminu kano teaching hospital kano | descriptive cross-sectional study | 5th October 2020 to 28th December 2020. | Clinical evaluation and administration of a questionnaire | 348 patients | 60 and above years |
|---|---|---|---|---|---|---|
| Abdulraheem et al., 2017 (Niger) | The study was carried out in Niger State, Nigeria | A descriptive cross-sectional study | August 2014 to February 2015 | Data were collected by questionnaire, interviews, review of medical records and clinical examination | conducted among 1650 rural elderly populations attending primary healthcare centers | age 60 years and above |
| Faronbi, Ajadi and Gobbens, 2020 (Osun state) | Osogbo, Osun State, Nigeria. | A cross-sectional study | Data collection took six weeks (between October and November 2015) | Data were collected by questionnaire | 400 | 60 years of age and above |
| Abdulazeez et al., 2021 (Kano) | General Outpatient Clinic of Aminu Kano Teaching Hospital (AKTH) Kano | A descriptive cross-sectional study | May to June 2018. | interviewer-administered questionnaire | 384 | 60 years and above |

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230 **Prevalence of multimorbidity**

231 All the included studies measured the prevalence of multimorbidity out of which 5 was among

232 60 years and above (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Adams & Abubakar, 2019;

233 Faronbi et al., 2020; Olawumi et al., 2021) and one study uses 65 years and above (Nwani & Isah,

234 2016a). One study conducted in Oshogbo in Osun state reported the lowest prevalence of 27%

235 (Faronbi et al., 2020) while another conducted in Kano, kano state-reported prevalence of 74%

236 (Olawumi et al., 2021). The overall estimate ranges from 27% to 74.4% among elderly Nigerians.

237 The most common study design observed is cross-sectional (Abdulazeez et al., 2021; Abdulraheem

238 et al., 2017; Adams & Abubakar, 2019; Faronbi et al., 2020; Olawumi et al., 2021). In addition to the

239 common cut-off point of 2 chronic diseases used in 5 studies, one study also investigated the

240     prevalence estimate when multimorbidity was defined as 'the co-occurrence of three or more

241     chronic diseases' (Abdulazeez et al., 2021). The higher the number of diseases in the operational

242     definition, the lower the prevalence. See table 2

243

**Table 2 shows the prevalence and pattern of multimorbidity among elderly Nigerians**

| Study (state of study) | Prevalence (%) | Patterns of multimorbidity |
|---|---|---|
| Nwani and Isah, 2016 (Anambra state) | The overall prevalence of multimorbidity among the elderly population studied was 49%. Two chronic diseases were present in 39.4% (n ¼ 136), whereas three or more chronic diseases were present in 9.6%. | No pattern was reported. However, a percentage of single morbidity was reported |
| Adams and Abubakar, 2018 (Abuja) | The majority 236 (71%) of the study participants had multiple morbidities. | No morbidity pattern was reported. The cardiovascular system was the most affected system with 227 of the study population followed by the musculoskeletal system 90 and 84 had metabolic derangement. The least affected system was the Ears Nose and Throat with 13 persons. |
| Olawumi *et al.,* 2021 (Kano) | The prevalence of multimorbidity in this study is 74.4%. | No multimorbidity pattern was reported. CV diseases were the most prevalent morbidity (88.5%) among the respondents, followed by the diseases of the musculoskeletal system (42%). Hypertension was the most prevalent (50%) among all the CV diseases. |
| Abdulraheem et al., 2017 (Niger) | The percentage of participants with multimorbidity was 68.4% for 2 or more and 57.3 for 3 or more morbidities. | The most prevalent dyads of morbidities were hypertension and diabetes (31.4%), and hypertension and heart disease (25.6%). For triads of morbidities, the highest prevalence was found in HBP, diabetes and heart problem (10.3), and HBP, heart problem and Osteoarthritis (9.8%). |
| Faronbi, Ajadi and Gobbens, 2020 (Osun state) | This study also showed that multimorbidity is prevalent (27.0%) among the older adults in Nigeria. | No pattern was reported. However, percentage of single morbidity was reported |
| Abdulazeez *et al.,* 2021 (Kano) | More than half 190 (68.2%) of the participants had a 201(72.0%) had two or more chronic diseases (multimorbidity). | The commonest multimorbidity pattern based on system cluster were cardio-metabolic-mechanical conditions 42(15.1%). The top three frequent patterns of multimorbidity involving two clusters (dyad) of chronic diseases were hypertension-diabetes 7(17%), followed by hypertension overweight 5(12.1%) and hypertension osteoarthritis 4(9.7%). The commonest triads of chronic |

| | | diseases were hypertension-diabetes-osteoarthritis 15(22.1%). The commonest quartet of chronic disease was hypertension diabetes-osteoarthritis-depression 3(5.9%). The commonest quintet of chronic diseases was hypertension diabetes-osteoarthritis-visual impairment-obesity/overweight 3(7.3%). |
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**Secondary outcomes**

**Pattern of multimorbidity**

The results of the studies were difficult to compare due to how data were reported. Only two studies reported the most frequent common pairs (Abdulazeez et al., 2021; Abdulraheem et al., 2017), See table 2. The study by Abdulraheem et al., (2018) reported the most prevalent dyads of morbidities were hypertension and diabetes (31.4%), and hypertension and heart disease (25.6%). For triads of morbidities, the highest prevalence was found in HBP, diabetes, and heart problem (10.3), and HBP, heart problems, and Osteoarthritis (9.8%) (Abdulraheem et al., 2017). While Abdulazeez et al., (2021) reported the commonest multimorbidity pattern based on system clusters was cardio-metabolic-mechanical conditions at 15.1% (Abdulazeez et al., 2021). The top three frequent patterns of multimorbidity involving two clusters (dyad) of chronic disease were hypertension-diabetes (17%) followed by hypertension-overweight (12.1%) and hypertension-osteoarthritis (9.7). The commonest triad of chronic disease was hypertension-diabetes-osteoarthritis (22.1%). The commonest quartet of chronic diseases was hypertension-diabetes-osteoarthritis- depression (5.9%) (Abdulazeez et al., 2021). The commonest quintet of chronic disease was hypertension-diabetes-osteoarthritis-visual impairment/overweight (7.3%). The remaining four studies were not structured to display the pairs but the pattern reported that hypertension was the commonest in all the studies (Abdulazeez et al., 2021).

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**Determinant of multimorbidity**

Age was the frequently studied determinant of multimorbidity (Barnett et al., 2012b; Marengoni et al., 2008; Minas et al., 2010; Prados-Torres et al., 2012; Van den Akker et al., 1998). Although the determinant of multimorbidity was not assessed in all the included studies, 3 studies reported the determinants of multimorbidity (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Adams &

269    Abubakar, 2019). One study reported that multi-morbidity occurred more in males (73.4% of

270    males; OR = 1.062; CI = 0.926-1.219), aged 70 – 79 years (72.2%), unskilled workers (73.8%),

271    and urban dwellers (73% of patients living in urban areas) (Adams & Abubakar, 2019). Although

272    the p values show that these associations were not statistically significant however the relatively

273    small sample size could account for this. However, a larger study by  (Abdulraheem et al., 2017)

274    showed that age and sex are independent risks factors for multi-morbidity (Abdulraheem et al.,

275    2017). They further stated that apart from age, factors most strongly and independently associated

276    with multi-morbidity were female gender, low education status, poor monthly income/

277    unemployment, hospitalization, medical visits, and emergency services. One study reported that

278    apart from age, factors most strongly and independently associated with multi-morbidity were

279    female gender, low education status, poor monthly income/ unemployment, hospitalization,

280    medical visits and emergency services (Abdulraheem et al., 2017).

281    Another study reported that Participants with formal education were more than 30% less likely to

282    have multimorbidity than those without formal education (Abdulazeez et al., 2021). Similarly,

283    participants that were employed were almost 40% less likely to have multimorbidity than those

284    that were unemployed (Abdulazeez et al., 2021). The same study reported that participants that

285    were overweight/obese had higher chances of developing multimorbidity when compared with

286    individuals with normal BMI. And that participants that were functionally dependent were 20

287    times more likely to have multimorbidity than functionally independent elderly participants

288    (Abdulazeez *et al.,* 2021).

289    **Discussion**

290    This systematic review provides a well-informed and comprehensive analysis of multimorbidity

291    prevalence, pattern, and determinants in Nigeria. We identified 6 articles across 5 states in

292    Nigeria. Earlier authors of systematic literature reviews of multimorbidity also noted the limited

293    representation of developing countries in multimorbidity research (Khanam et al., 2011). In

294    essence, multimorbidity is not a priority area of research in Nigeria and this will continue to

295    hinder policy development in that area. Our review shows that prevalence estimates varied

296    markedly according to age, gender, marital status, marital setting, tribe, educational levels,

297    adequate income, living conditions, family support, and operational definitions of multimorbidity

298     (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Adams & Abubakar, 2019; Nwani & Isah, 2016b).

299     However, the findings from our studies were consistent with other previous studies and

300     systematic reviews (Marengoni et al., 2011; Nguyen et al., 2019; Violan et al., 2014). While the

301     prevalence estimates varied between and within age groups, most studies in our sample indicated

302     multimorbidity as a common phenomenon in individuals 60 years and above. Where prevalence

303     estimates by gender were reported, it showed variation, two studies reported higher prevalence

304     among men (Adams & Abubakar, 2019; Nwani & Isah, 2016a). However, in one study females

305     appeared to have a higher multimorbidity prevalence than males in studies (Abdulraheem et al.,

306     2017). This is suggestive of an association between sex and multimorbidity, evidence of which

307     was provided in multiple studies (Alimohammadian et al., 2017; Munn et al., 2014; Nguyen et al.,

308     2019). The higher the number of diseases in the operational definition, the lower the prevalence.

309     This was observed in our review, the percentage of participants with multimorbidity was 68.4%

310     for 2 or more and 57.3 for 3 or more morbidities (Abdulraheem et al., 2017). This finding

311     supported an observation where it was found that from 44% when multimorbidity was defined as

312     2 diseases, the prevalence reduced to 27% for 3 diseases, 15% for 4 diseases, 7% for 5 diseases,

313     and only 3% for 6 diseases (Harrison et al., 2014).  The highest prevalence estimates in our sample

314     were reported in studies that used 2 diseases to define multimorbidity 71% (Adams & Abubakar,

315     2019) and 74%  (Olawumi et al., 2021). The combination of diseases may make multimorbidity

316     prevalence differ significantly (Fortin et al., 2012; Harrison et al., 2014). In the existing literature, a

317     range of different combinations has been proposed from a list of 16 chronic diseases  (Ferrer et

318     al., 2017) to a list of 291 diseases (Quiñones et al., 2016) and anything in between (Van den Bussche

319     et al., 2011). Ferrer et al. (Ferrer et al., 2017) argued that an open list of diagnoses should be used

320     since it gave the highest prevalence estimate. For our studies, most of the chronic health

321     problems of interest were drawn from the 147 International Classification of Primary Care,

322     second edition (ICPC-2) rubrics list gathered by the Family Medicine Research Centre, the

323     University of Sydney (WHO, 2022). The known fact is that there were no specific criteria for

324     disease inclusion in these studies because of the lack of a standardized list and they were often

325     determined by the author's expertise and experience. However, the most common conditions

326     included were those that have the highest prevalence of clinical relevance.

327 While hypertension and diabetes mellitus appear to be common findings in this study, this is not
328 completely different from other parts of the world. For example, in Korean adult men, diabetes
329 mellitus and hypertension yielded the highest probability of multimorbidity, and for women
330 polyarthritis and hypertension (Lee et al., 2020). In the United state, the most prevalent dyads of
331 multimorbidity in men after 65 years of age is arthritis and hypertension followed by diabetes
332 mellitus and hypertension in both sexes (Goodman et al., 2016). The most prevalent cluster in all
333 four strata of multimorbidity included hypertension diseases and metabolic disorders (Foguet-
334 Boreu et al., 2015).

335

**Strengths and limitations**

337 Our study selection, screening processes, search strategy, inclusion criteria, and quality
338 assessment were wide-ranging and exhaustive. Our review included studies in both the hospital
339 and communities and the first of its kind to conduct SLR of prevalence, pattern, and determinant
340 of multimorbidity in Nigeria. This review, however, was not without limitations. Evaluations of
341 prevalence, determinants, and patterns in our study are limited by the methods used in the
342 primary studies. Similarly, all the measures of multimorbidity used in these studies were mostly
343 disease count and disease count are only one of the 20 measures to date.

**Conclusion**

345 The overall prevalence estimates range from 27% to 74.4% among elderly Nigerians. Although,
346 the disease pair varies among studies, hypertension, and diabetes appear to be the commonest
347 dyads. Determinants of multimorbidity in our study include age, gender, and lower
348 socioeconomic status. The scarcity of studies in our review reveals that multimorbidity is not a
349 priority area of research in Nigeria and this will continue to hinder policy development in that
350 area.

**Declaration of conflicting interests**

352 The author(s) declared no potential conflicts of interest with respect to the research, authorship,
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