

1 **Abstract**

2 **Introduction**

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

8 **Methods**

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

17 **Results**

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

25 **Conclusion**

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

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

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36 **Introduction**

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

47 Ageing represents the greatest risk factor for disease and brings with it the chronic uncontrol of
48 multiple organ systems (Fabbri et al., 2015). In other words, the uncompromising form of reality is
49 that chronic diseases rarely occur in isolation, and as life expectancy increases, people acquire a
50 growing number of illnesses (Barnett et al., 2012a). The number of people affected by multiple
51 chronic diseases a condition termed multimorbidity is increasing dramatically around the world
52 and caring for them has placed substantial stress on many health systems (Navickas et al., 2016).
53 Although this rising burden of chronic diseases has attracted the attention of public health
54 researchers and policymakers worldwide, studies have shown that evidence on the epidemiology
55 of multimorbidity in Low- and Middle-Income Countries (LMICs) is limited even though the
56 region bears 80% of the global burden of non-communicable diseases (NCDs) (Hunter & Reddy,
57 2013). Healthcare utilization and cost have surged in LMICs as a result of the prevalence of
58 multimorbidity which places strain on the health system (Frølich et al., 2019; Sum et al., 2019).
59 Multimorbidity management requires a lot of resources that are hard work for both the patients
60 and practitioners, especially when deepened with socioeconomic deprivation (O'Brien et al., 2011).
61 Likewise, multimorbid patients are prone to frequent hospitalization, polypharmacy, treatment
62 burden, and mortality (Duerden et al., 2013; Palmer et al., 2018).

63 Recent studies reported that only 5% of multimorbidity research studies originated in LMICs, out
64 of which were confined to only six middle-income countries (Brazil, China, South Africa, India,
65 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**

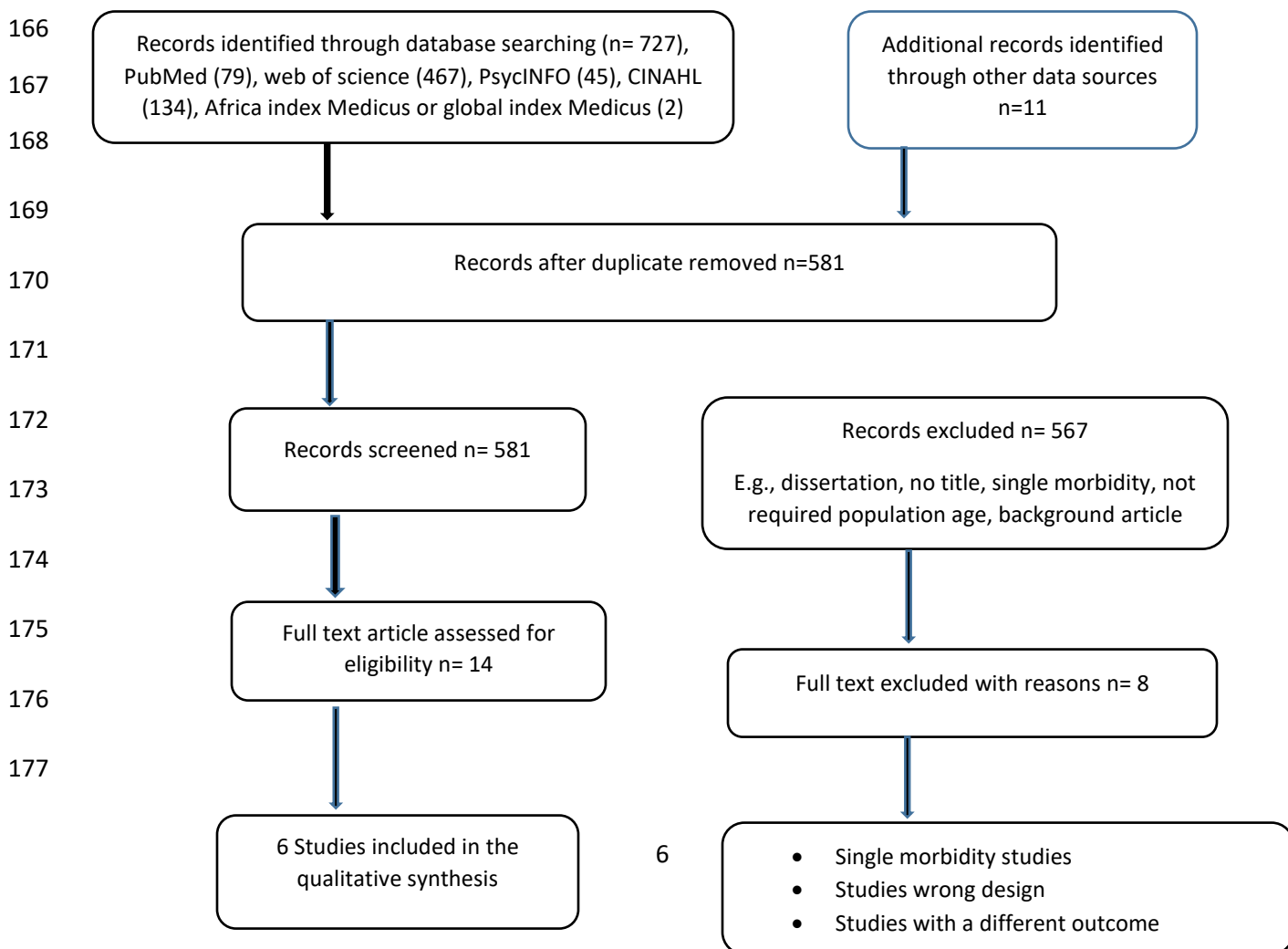
154 This review received ethics approval as part of a larger project from the College of Nursing,
155 Midwifery, and Healthcare, Research Ethics Panel (ethical approval number 1055). This research
156 provided information on the prevalence of multimorbidity and other studied outcomes in Nigeria.
157 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**



178 **Study characteristics**

179 Although the studies are relatively few, available ones are spread to cover the northern and
180 southern parts of the country. Two studies each were conducted in north-central of Nigeria
181 (Abdulraheem et al., 2017; Adams & Abubakar, 2019). Two studies were also conducted in Kano
182 state northwestern Nigeria (Abdulazeez et al., 2021; Olawumi et al., 2021). One study each was
183 conducted in the western and eastern parts of Nigeria respectively (Faronbi et al., 2020; Nwani &
184 Isah, 2016a). The total number of participants across the six studies was 3332 (men: 47.5%,
185 women: 52.5%) (Abdulazeez et al., 2021; Abdulraheem et al., 2017; Adams & Abubakar, 2019; Faronbi
186 et al., 2020; Nwani & Isah, 2016a; Olawumi et al., 2021). The sample sizes of the included studies
187 range from 333 to 1650 participants see Table 1. All included studies were published after 2013
188 and the majority were in the last 6 years. Four studies conducted primary cross-sectional
189 descriptive using either or a combination of clinical evaluation and administration of a
190 questionnaire, interviews, and review of medical records (Abdulazeez et al., 2021; Abdulraheem et
191 al., 2017; Faronbi et al., 2020; Olawumi et al., 2021). One study conducted a cross-sectional
192 retrospective study over 12 months from January to December 2018 (Adams & Abubakar, 2019),
193 and the other study longitudinal prospective study both using medical health records (Nwani &
194 Isah, 2016b). Two studies were carried out at the family medicine/ outpatient department of
195 Aminu Kano teaching hospital Kano, Nigeria respectively (Abdulazeez et al., 2021; Olawumi et al.,
196 2021). One study each was conducted at Nnamdi Azikiwe University Teaching Hospital
197 (NAUTH), Nnewi Anambra state Nigeria (Nwani & Isah, 2016a), and General Out-Patient Clinic
198 of the UATH Gwagwalada, Abuja, Nigeria (Adams & Abubakar, 2019), Osogbo, and Osun State,
199 Nigeria respectively (Faronbi et al., 2020). Four studies were hospital-based (Abdulazeez et al.,
200 2021; Adams & Abubakar, 2019; Nwani & Isah, 2016b; Olawumi et al., 2021) while two were
201 conducted in the community (Abdulraheem et al., 2017; Faronbi et al., 2020).

202 **Study quality assessment**

203 The result of the study quality assessment is provided in S2 **Table**. Of the included studies, 66%
204 were high quality, and the remaining studies were medium quality. There was no study with low
205 quality. The threshold for the conversion of the JBI is as follows. Any item with a yes gets a
206 score of 1, for no and unclear the score is zero, and for not applicable items are not included in
207 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).

227

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 health care 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 = 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 <i>et al.</i> , 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 <i>et al.</i> , 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 <i>et al.</i> , 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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245 **Secondary outcomes**

246 **Pattern of multimorbidity**

247 The results of the studies were difficult to compare due to how data were reported. Only two
 248 studies reported the most frequent common pairs (Abdulazeez et al., 2021; Abdulraheem et al.,
 249 2017), See table 2. The study by Abdulraheem et al., (2018) reported the most prevalent dyads of
 250 morbidities were hypertension and diabetes (31.4%), and hypertension and heart disease
 251 (25.6%). For triads of morbidities, the highest prevalence was found in HBP, diabetes, and heart
 252 problem (10.3), and HBP, heart problems, and Osteoarthritis (9.8%) (Abdulraheem et al., 2017).
 253 While Abdulazeez et al., (2021) reported the commonest multimorbidity pattern based on system
 254 clusters was cardio-metabolic-mechanical conditions at 15.1% (Abdulazeez et al., 2021). The top
 255 three frequent patterns of multimorbidity involving two clusters (dyad) of chronic disease were
 256 hypertension-diabetes (17%) followed by hypertension-overweight (12.1%) and hypertension-
 257 osteoarthritis (9.7). The commonest triad of chronic disease was hypertension-diabetes-
 258 osteoarthritis (22.1%). The commonest quartet of chronic diseases was hypertension-diabetes-
 259 osteoarthritis- depression (5.9%) (Abdulazeez et al., 2021). The commonest quintet of chronic
 260 disease was hypertension-diabetes-osteoarthritis-visual impairment/overweight (7.3%). The
 261 remaining four studies were not structured to display the pairs but the pattern reported that
 262 hypertension was the commonest in all the studies (Abdulazeez et al., 2021).

263

264 **Determinant of multimorbidity**

265 Age was the frequently studied determinant of multimorbidity (Barnett et al., 2012b; Marengoni et
 266 al., 2008; Minas et al., 2010; Prados-Torres et al., 2012; Van den Akker et al., 1998). Although the
 267 determinant of multimorbidity was not assessed in all the included studies, 3 studies reported the
 268 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

336 **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.

344 **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.

351 **Declaration of conflicting interests**

352 The author(s) declared no potential conflicts of interest with respect to the research, authorship,
353 and/or publication of this article.

354 **Funding**

355 No funding support was received for this research.

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