REVIEW

GLOBAL PREVALENCE OF NON-COMMUNICABLE DISEASES MORBIDITY AND COMORBIDITY AMONG ELDERLY INDIVIDUALS: A SYSTEMATIC REVIEW OF OBSERVATIONAL STUDIES

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Abstract. A systematic review was carried out to assess prevalence of noncommunicable disease morbidity and comorbidity in relationship to socioeconomic, behavioural health and environmental risk factors for among elderly people globally. Observational studies were culled from public databases, such as PubMed, SCOPUS, Science Direct, and Google Scholar from January 2015 to December 2020, and a Newcastle-Ottawa Quality Assessment Scale tool and PRISMA 2009 checklist were used to assess risk of bias in selected material. Analysis was performed using a weighted mean of morbidity prevalence and disease subgroup together with an R program for data analysis. Among 16 eligible studies and 14 cross-sectional studies weighted mean of morbidity and comorbidity prevalence was 75.1 and 60.6% respectively. NCDs constituted mainly coronary heart disease, diabetes mellitus, hypercholesterolemia, hypertension, and stroke, with hypertension having the highest prevalence among all subjects (62.2%), both females (65.9%) and males (65.4%). In the elderly population individual and behavioural risk factors were the main categories related to morbidity, with behavioral risk factors contributing to comorbidities. In conclusion, morbidity and comorbidity prevalence are high among the elderly population worldwide. Diabetes mellitus and hypertension are the most common illnesses. Age, socioeconomic status, environmental settings and behavioral risk factors influenced comorbidity occurrence.

Keywords: morbidity, comorbidity, factors, elderly, systematic review

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INTRODUCTION

The age distribution of the world population has changed dramatically over the last century, with increasing numbers and proportions of people >60 years of age (WHO, 2017). In 2019, the number of people >60 years of age is 1 billion and will increase to 1.4 billion by 2030 and to 2.1 billion by 2050 (Sadana *et al*, 2019; WHO, n.d.). This phenomenon is unprecedented and occurs particularly in developing countries (WHO, 2018). More than 142 million elderly people (14% of those >60 years of age) globally are unable to meet all their basic daily needs (WHO, n.d.). In addition, elderlies in low- and middle-income countries carry a greater disease burden compared to those in high-income countries (WHO, 2018).

Increasing age leads to decreasing physiological function resulting in serious deterioration in health and increases factors that underlie risk of chronic diseases (CDs), such as cancer, chronic respiratory disorders, coronary heart disease (CHD), dementia, diabetes mellitus (DM), hypertension (HT), and stroke (Blokzijl *et al*, 2016). In the United States, >90% of older adults have at least one CD, and 73% have ≥2 CDs (PAHO/WHO, n.d.), while an earlier study in South Korea reported 31.2% of elderly diagnosed with one morbidity and 23.1% with ≥3 comorbidities (Woo *et al*, 2007). In Iran DM and HT prevalence among elderlies is 22.0 and 55.6% respectively (Taheri Tanjani *et al*, 2015), and a cross-sectional survey study in India revealed 42.5% of elderly patients were with 4-6 comorbidities, the most common being cataracts, chronic obstructive airway disease (COAD), HT, and osteoarthritis (Joshi *et al*, 2003). A systematic study on the prevalence of co-morbidities among older persons reported a range of 55 to 98% (Marengoni *et al*, 2011).

Chronic diseases for long periods in elderly individuals can affect both their physical and mental health. Metabolic diseases, particularly hypertension, have a high risk of subsequent chronic kidney disease, DM, myocardial infarction (MI), and stroke, all of which significantly increase the risk by approximately twofold of acute cerebrovascular/cardiovascular events and proteinuria and correlate significantly with decline in glomerular filtration rate (Mendis *et al*, 2011; Saiki *et al*, 2020). In addition, these existing problems may eventually lead to disability and low health-related quality of life (HRQoL), and in particular concurrence of diabetes and hypertension confers a two- to three-fold greater risk of future CVDs compared to that associated with hypertension alone

(Almdal *et al*, 2004).

Although many studies on elderly morbidity and comorbidity have been conducted around the world (Kaur *et al*, 2019; Zhang *et al*, 2020; Zhao *et al*, 2018; Islas-Granillo *et al*, 2018; Jacob *et al*, 2016; Marengoni *et al*, 2016; Sukchan *et al*, 2020; Wandera *et al*, 2015), evidences are still limited, and comparisons cannot always be carried out. According to the global strategy and action plan of the United Nations Decade of Healthy Ageing 2021-2030, evidence-based approaches should be used to promote healthy ageing and minimize disabilities in the older population (WHO, n.d.). Here, a systematic review was carried out among elderly people to determine prevalence of morbidity and comorbidity of NCDs and to investigate the impact of socioeconomic, health behavioral and environmental factors on the risk of NCD morbidity and comorbidity. Such evidences should assist in aligning global, national and local policies, including global public health practice, particularly in the context of non-communicable diseases (NCDs), disability and HRQoL of the elderly.

MATERIALS AND METHODS

Study design

A systematic review (SR)was carried out between January 2015 and December 2020 of globally available evidences from observational studies, both cross-sectional and survey, on morbidity and co-morbidity and their risk factors in the elderly population.

The research protocols were approved by the Ethics Committee of the Faculty of Medicine, Princess of Naradhiwas University (Code: 001-2564-Sb) and registered with PROSPERO (CRD42021265910). No prior written consents were required as secondary data were collected.

Data sources and search strategy

Data were curated from the existing literature stored in electronic databases (Google Scholar, PubMed, Science Direct, and SCOPUS). Multidisciplinary studies, including those published in medical, nursing, and health sciences journals, which reported principal outcomes of morbidity, co-morbidity, and related risk factors in the elderly population, were included. Morbidity and co-morbidity are defined as current, emerging or underlying medical conditions present in patients NCDs or CDs for >6 months. NCDs- or CDs-associated risk factors are defined as personal characteristics and socioeconomic, environmental and health behavioral factors. Keyword search was performed using the following combinations: morbidity, co-morbidity, risk factors, and elderly. Search strategies in PubMed were ("Prevalence" [Mesh] OR "Epidemiology" [Mesh]) AND ("Chronic Disease" [Mesh] OR "Non-communicable Diseases" [Mesh]) AND ("Aged" [Mesh] OR "Elderly" [Mesh]).

Searches of Science Direct and Google Scholar databases employed keywords ("chronic diseases" or "morbidity" or "prevalence" or "illness") AND ("risk factors" or "related factors") AND ("older" or "elderly"). Data were recorded according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Fig 1).

Study selection

Inclusion criteria were (i) any observational study design, such as cross-sectional, case-control and systematic reviews, which report risk factors related to NCDs morbidity, co-morbidity or multi-morbidity; (ii) studies that included PICOS four items, namely, participants, interventions, comparators, outcomes, and study design (Table 1); and (iii) studies conducted in any country or setting between January 2015 and December 2020, reported in English, and involved people ≥60 years of age. Exclusion criterion was any report devoid of experimental or intervention studies.

Evidence quality assessment

Quality of retrieved articles was assessed using the following assessment tools (Wells *et al*, 2020; Moher *et al*, 2009)

i) The Newcastle - Ottawa Quality Assessment Scale (adapted for cross-sectional studies) for cross-sectional studies. This consists consisted of three sections: The first section is "selection" (maximum score of five stars) composed of four elements, namely, representativeness of the sample consisting of four components with a maximum score of two stars, sample size with two components and a maximum score of one star, non-response consisting of three components with a maximum score of one star, and ascertainment of exposure (risk factor) consisting of three components with a maximum score of three stars. The second section is "comparability" (maximum score of two stars), which examines the extent to which subjects in different outcome groups are comparable based on study design or analysis and the extent to which confounding factors are controlled. The third section contains two components, "assessment of outcome" and "statistical test" (maximum score of three stars). The quality of the eligible studies is divided into three categories: high (8-10 stars), medium (5-7 stars), and low (>5 stars). Only studies of high quality were included in the data extraction process.

ii) The Newcastle - Ottawa Quality Assessment Scale for case-control studies. This consisted of three parts, namely, "selection", "comparability" and "exposure". The selection component consists of case definition, case representativeness, selection of controls, and definition of controls (maximum score of four stars). The comparability component

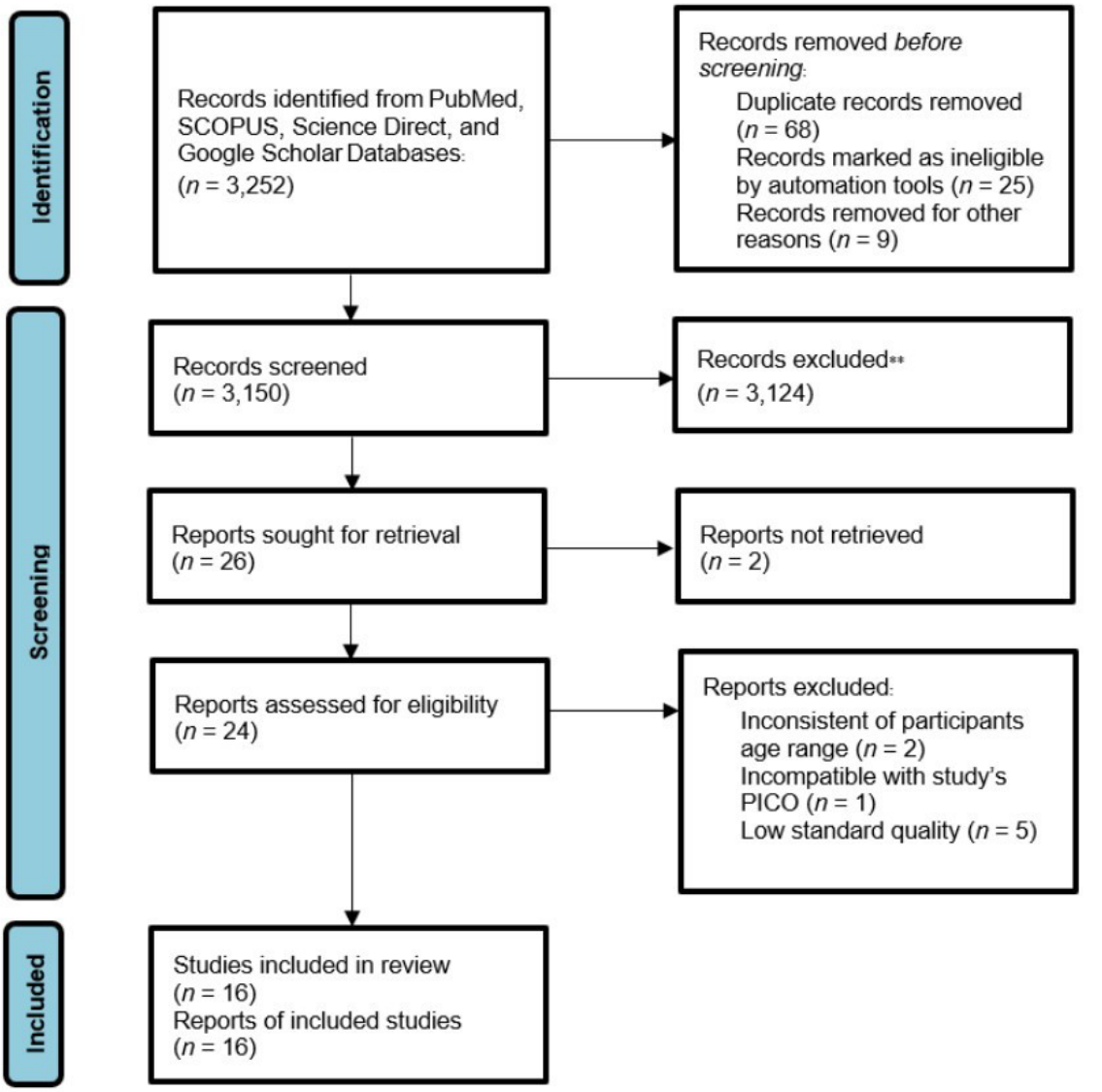

Fig 1 - Flow diagram depicting procedure of literature search and selection with numbers of articles at each stage of the process according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

PICO: Participants, Interventions, Comparators, Outcomes

Table 1

Criteria for eligibility of studies based on participants, interventions, comparators, outcomes, and study design (PICOS)

PICOS criterion	Parameter
Population	Elderly (≥60 years of age)
Interventions	None
Comparator	Risk factors related to non-communicable diseases or chronic diseases; personal characteristics and socio-economic, environment and health behavioural factors
Outcomes	Morbidity and/or comorbidity
Study design	Observational study: cross-sectional, case-control and systematic review

consists of comparability of cases and controls based on study design or analysis (maximum score of two stars). The exposure component consists of three categories, namely, ascertainment of exposure, ascertainment of exposure in cases and controls, and non-response (maximum score of three stars). Studies receiving 8-9 stars were included in the data extraction process.

iii) PRISMA 2009 checklist for systematic reviews. The PRISMA 2009 checklist consists of a 14-point questionnaire addressing study quality and reporting. The key points are: i) Title (one point), ii) Abstract: structured summary (one point), iii) Introduction: rationale and objectives (two points), and iv) Methods: protocol and registration, eligibility criteria, information sources, search, study selection, data collection process, data items, risk of bias in individual studies, summary measures, and synthesis of results (10 points). High-quality systematic reviews with 13-14 stars were included in the data extraction process.

Data extraction and data analysis

For data extraction process, we developed a template form to record data from eligible articles. In order to ensure reliability of the template developed, five studies were chosen for pilot testing, and the template was subsequently revised to remove unnecessary section based on expert advice. The data form alphabetically sorts the list of selected articles according to last name of the first author

and year of publication, extracts data according to the template and conducts an audit on a subset of the articles to quality-check the extraction. The following information were extracted from each chosen study: i)study characteristics (type and duration), ii) study population characteristics (study setting, age group(s) and gender), iii) study independent variables (type(s) of variable(s) measured, unit and results), iv) study dependent variables (type(s) of outcome(s) measured, unit and results), v) study data collection tool, vi) study quality control method of data collection tool, vii) study analytical methods, and viii) study results and contextual factors of interest. The final data extraction was verified by unanimous consensus of the researcher team, but when this was not reached, decision was based a two-thirds majority with inclusion of an outside expert's opinion.

Data synthesis and statistical analysis

In order to assess heterogeneity and data synthesis, analyses of data were carried out, taking into consideration variability in the general population characteristics, methodological features and outcomes among the selected studies, using a R program version 4.0.3 (2020-10-10, "Bunny-Wunnies Freak Out") (The R Foundation for Statistical Computing 2008, Vienna, Austria) and R studio version 1.0.153 (2009 to 2017) (R Studio Inc, Boston, MA) with descriptive statistics. Outcomes, morbidity and comorbidity of NCDs were analyzed using a weighted mean of morbidity prevalence and weighted mean of disease subgroup. Results are reported as frequency and percent type of risk factors.

RESULTS

Characteristics of articles selected in the systematic review

Of 3,252 articles identified, following review and quality assessment, 24/26 articles, reporting NCD prevalence and risk factors, fulfilled the inclusion criteria (Fig 1). However, eight articles were excluded on the basis of low quality, incompatibility with PICO criteria and inconsistency in participants' age group. Of the 16 eligible articles, half were published during 2015 to 2017, 56% from Asia, 62% conducted on community-based participants, 81% on participants ≥60 years of age, and 50% being on participants with single morbidity (Table 2).

Weighted mean of morbidity and comorbidity presence

Weighted mean morbidity in the study population was highest in studies from India, China (hospital), and Germany (98, 91.4, and 83.4%, respectively, with a weighted mean of morbidity from all studies of 75.1%, and a similar pattern was observed with studies on weighted mean comorbidity, namely, highest in studies from India (87%), China (hospital) (69.3%) and Germany (63.4%), with a weighted mean of comorbidity from all studies of 60.6% (Table 3).

Table 2

General characteristics of the selected articles

Characteristic	Number (%) (N = 16)
Level of evidence/study design	
Cross-sectional or survey	14 (88)
Retrospective observation	2 (12)
Publication period	
2015 - 2017	8 (50)
2018 - 2019	4 (25)
2020 - 2021	4 (25)
Geographical region	
Asia	9 (57)
Europe	2 (12)
America	4 (25)
Africa	1 (6)
Research focus	
Morbidity	8 (50)
Comorbidity	2 (12)
Both	6 (38)
Participant age, years	
≥60	13 (81)
≥65	3 (19)
Study setting	
Community	10 (63)
Hospital	5 (31)
Nursing home	1 (6)

Table 3

Weighted mean prevalence of morbidity and comorbidity in the study population

Reference	Study site	Study setting	Number with morbidity (weighted mean prevalence, %)	Number with comorbidity* (weighted mean prevalence, %)	Total number of participants
Kaur *et al* (2019)	India	Hospital	221 (98.2)	197 (87.5)	225
Li *et al* (2020)	China	Community	2,876 (59.5)	776 (16.1)	4,833
Zhang *et al* (2020)	China	Hospital	3,973 (91.4)	3,031 (69.3)	4,348
Zhao *et al* (2018)	Japan	Community	2,961 (31.7)	N/A	9,344
Aye *et al* (2019)	Myanmar	Community	2,815 (57.9)	1,613 (33.2)	4,859
Islas-Granillo *et al* (2018)	Mexico	Nursing home	101 (73.0)	38 (27.3)	139
Jacob *et al* (2016)	Germany	Hospital	400,586 (83.4)	304,522 (63.4)	480,319
Marengoni *et al* (2016)	Sweden	Community	2,496 (79.1)	1,653 (52.4)	3,155
Samsudin *et al* (2016)	Malaysia	Community	956 (67.6)	N/A	1,414
Sukchan *et al* (2020)	Thailand	Community	355 (68.7)	87 (16.8)	460
Wandera *et al* (2015)	Uganda	Community	555 (23.3)	97 (4.1)	2,382
Mino-León *et al* (2017)	Mexico	Hospital	63,687 (82.1)	38,787 (50.0)	77,573
Weighted mean prevalence			75.1	60.6	589,139

*≥2 comorbidities; N/A: not available

Weighted mean prevalence of NCD morbidity according to gender

NCDs in the selected articles represented only five diseases, namely, cardiovascular disease, diabetes mellitus (DM), hypercholesterolemia, hypertension (HT), and stroke, the majority being DM and HT. NCD with the highest weighted mean prevalence was HT, 65.4 and 65.9% in male and female population respectively and hypercholesterolemia the lowest, 18.5 and 12.3% respectively (Table 4). Weighted mean prevalence of NCD morbidity is significantly higher among males compared to females for four NCDs (p-value <0.05), the exception being HT.

Risk factors for NCD morbidity and comorbidity

Among the 16 selected articles, 17 risk factors (reported in a total of 27 instances) related to NCD morbidity in the elderly were identified, with highest frequency (11%) being gender and alcohol, followed by age, education level, religion, exercise/activity, smoking, and history of illness or injury (7% each) (Table 5). Risk factors related to NCD comorbidities were lower in number (n = 12), reported in a total of 23 instances, with alcohol consumption and smoking being the most common risk factors (frequency of 17%), followed by age, gender and obesity (frequency of 8% each) (Table 5). Among the top seven risk factors for NCD morbidity, all except education level were risks for chronic obstructive pulmonary disease (COPD), five (gender and education excluded) for stroke and three (gender, education level, alcohol consumption, and smoking) for DM and HT (Table 6). Among the 16 selected articles, two identified all types of risk factors for morbidity and comorbidity, three noted two types (individual and behavior/management), two identified one (individual), and eight (half of the selected articles) failed to categorize the risk factor types (Table 7).

DISCUSSION

A systematic review of 16 observational studies on NCD morbidity and comorbidity among elderly individuals published between January 2015 and December 2020 were carried out. A high weighted mean prevalence of NCD morbidity (75%) among elderly individuals was revealed, highest in India (98.2%) (Kaur *et al*, 2019) and in Uganda (23.3%) (Wandera *et al*, 2015). Surprisingly, in general developed countries have a higher morbidity prevalence than developing countries. This phenomenon could be attributed to the difference in health service accessibility among the studied countries. Health service accessibility is higher in developed countries (WHO, 2018). Of note, other than impoverishment, factors, which obstruct access to advanced health services include lack of promotion in prevention, treatment and rehabilitation

measures for the elderly population in developing countries (WHO, n.d.). However, high prevalence was reported by Mino-León *et al* (2017) in Mexico and by Kaur *et al* (2019) in India. Such divergent findings could be attributed to differences in cohort size, age group and sampling location.

Table 4

Weighted mean non-communicable diseases (NCDs) morbidity prevalence according to gender

NCD	Weighted mean of morbidity prevalence (%)	Number of articles	Number of participants
Hypertension			
Male	65.4	8	363,378
Female	65.9	8	485,645
Overall	62.2	15	589,755
Diabetes mellitus			
Male	32.8	7	363,139
Female	27.3	7	485,368
Overall	29.3	10	869,219
Cardiovascular disease			
Male	30.5	5	362,987
Female	21.2	5	485,347
Overall	25.2	8	854,443
Hypercholesterolemia			
Male	18.5	1	1,052
Female	12.3	1	570
Overall	13.7	1	1,622
Stroke			
Male	6.6	3	362,539
Female	5.1	3	484,235
Overall	5.9	5	860,554

Table 5

Frequency and average adjusted odds ratio (aOR) of risk factors related to morbidity and comorbidity of non-communicable diseases reported in the 26 selected articles

Risk factor	Morbidity No. occurrences (%) (N = 27)	Average aOR (95% CI)	Comorbidity* *n* (%)	Average aOR (95% CI)
Alcohol consumption†	3 (11)	1.36 (0.67-2.58)	4 (17)	1.12 (0.49-2.67)
Smoking†	3 (11)	1.86 (0.63-9.66)	4 (17)	0.97 (0.48-2.21)
Gender (maleref: female)	3 (11)	1.70 (1.16-2.69)	2 (9)	0.90 (0.58-1.30)
Age, years				
60-65ref: >65	2 (7)	1.62 (1.09-3.39)	2 (9)	1.46 (1.16–2.07)
60-74ref: >74	0 (0)	N/A	1 (4)	3.75 (2.40-6.30)
Religion (Buddhist/Catholicref: Islam)	2 (7)	1.74 (1.15-2.67)	0 (0)	N/A
Exercise/activity†	2 (7)	1.28 (1.00-1.69)	1 (4)	0.91 (0.85-0.97)
Education level				
Diploma/graduateref: lower level	1 (4)	0.37 (0.22-2.46)	1 (4)	0.50 (0.22-1.27)
Illiterateref: literate	1 (4)	1.73 (1.13-2.92)	1 (4)	0.90 (0.70-1.10)
Socioeconomic status				
Poorref: middle class/rich	1 (4)	6.59 (2.40-18.05)	0 (0)	N/A
Richref: poor	1 (4)	0.76 (0.59-0.99)	0 (0)	N/A
History of illness or injury†	1 (4)	1.56 (1.25-1.96)	0 (0)	N/A

Table 5 (cont)

Risk factor	Morbidity No. occurrences (%) (N = 27)	Average aOR (95% CI)	Comorbidity* *n* (%)	Average aOR (95% CI)
Type of family (extendedref: nuclear)	1 (4)	4.30 (1.87-9.83)	0 (0)	N/A
Residence (urbanref: rural)	1 (4)	1.36 (0.42-5.20)	1 (4)	0.78 (0.62-0.98)
Social activity[†]	1 (4)	1.14 (0.89-1.46)	1 (4)	1.24 (0.98-1.57)
Obesity[‡]	0 (0)	N/A	2 (9)	1.44 (1.08-2.23)
General health status (goodref: fair/poor)	1 (4)	1.63 (0.95-2.81)	0 (0)	N/A
Family history of chronic diseases[†]	0 (0)	N/A	1 (4)	2.04 (1.71-2.43)
Dietary habit (vegetarianref: non-vegetarian)	1 (4)	0.86 (0.81-0.91)	0 (0)	N/A
Health check-up[†]	1 (4)	1.41 (1.11-1.79)	0 (0)	N/A
Disabled[†]	1 (4)	1.62 (1.31-2.00)	0 (0)	N/A
Household asset (poorref: rich)	0 (0)	N/A	1 (4)	0.56 (0.47-0.66)
Access to medical service[†]	0 (0)	N/A	1 (4)	0.67 (0.55-0.81)

*≥2 comorbidities; [†]Reference: none/never

CI: confidence interval; N/A: not applicable; ref: reference

Table 6

Risk factors of non-communicable disease morbidity among study participants

Risk factor	Hypertension	Diabetes mellitus	COPD	Stroke
Gender	No	No	Yes	No
Age	Yes	Yes	Yes	Yes
Residence type	Yes	Yes	Yes	Yes
Education level	No	No	Yes	No
Alcohol consumption	No	No	No	Yes
Smoking	No	No	Yes	Yes
Obesity*	Yes	Yes	Yes	Yes

*Body mass index ≥25 kg/m^2
COPD: chronic obstructive pulmonary disease

Table 7

Prevalence of risk factors according to type reported in the selected articles

Type of risk factor	Reference	Morbidity and comorbidity No. of studies (%) (N = 16)
Individual	Wandera *et al* (2015); Marengoni *et al* (2016)	2 (12.5)
Environmental	None	0 (0.0)
Behavior/management	None	0 (0.0)
Both individual and environmental	Zhao *et al* (2018)	1 (6.3)
Both individual and behavior/management	Kaur *et al* (2019); Li *et al* (2020); Sukchan *et al* (2020)	3 (18.8)
All risk factors	Aye *et al* (2019); Zhang *et al* (2020)	2 (12.5)
Not identified	Taheri Tanjani *et al* (2015); Jacob *et al* (2016); Oh *et al* (2016); Samsudin *et al* (2016); Mino-León *et al* (2017); Ortiz-Rodríguez *et al* (2017); Islas-Granillo *et al* (2018); Bonilla-Sierra *et al* (2020)	8 (50.0)

Similarly, weighted mean NCD comorbidity prevalence is high (60.6%), with India (Kaur *et al*, 2019) and China (Zhang *et al*, 2020) having the highest prevalence, in keeping with the developing status of the two countries. However, some developing countries have low prevalence. In order to understand these findings, it is necessary to examine details regarding the study group, socioeconomic status and geographical setting. For instance, in the Ugandan study (Wandera *et al*, 2015), 25% of the study subjects are rich elderly individuals and 30% are traders.

The overall weighted mean NCD morbidity prevalence is highest for HT, with no difference between males and females. The body blood circulatory system is well known to deteriorate with age (Mendis *et al*, 2011). Not surprisingly, DM is also prevalent in the study elderly population, being slightly higher in males. This could be attributed to differences in risk behavior, as evidenced by the higher prevalence of CVD, hypercholesterolemia and stroke in this gender group.

Risk factors related to morbidity in the elderly population include alcohol consumption, higher age, education level, religion, exercise/activity, and smoking, while alcohol consumption and smoking are related to comorbidity. Regarding morbidity in the elderly, risk factors could be classified into two main categories, namely, individual and behavioral. Decreasing physiological functions with aging, such as hormone changes and sarcopenia, can lead to serious deterioration in health (Awang *et al*, 2018), and such individual risk factors are beyond control. However, elderly individuals of sufficiently high socioeconomic status tend will be healthier and experience less illness (Huisman *et al*, 2003). Nevertheless, exercise/activity and abstention from smoking promote good health. Elderly individuals with good health behaviour have a lower risk of NCDs (Mendis *et al*, 2011; WHO, n.d.). Our study shows alcohol consumption and smoking are risk factors for comorbidity, as observed by others in Kenya (Haregu *et al*, 2015) and South Korea (Jeong *et al*, 2021).

Even so, our study had several limitations. Firstly, the study groups in the 16 selected articles were not consistent, some included those ≥60 years of age while others included only those ≥65 years of age. Secondly, participants were drawn from different settings: urban, rural, hospital/nursing homes, and unspecified. Thirdly, the actual number (other than being >2) and combinations of NCDs are not specified in the articles. Articles may have been overlooked due to limited time available and non-meticulousness for the literature review. And fourthly, information was based on observational data, accuracy of which requires additional heterogeneity and meta-regression analyses.

In summary, the survey of the literature during January 2015 and

December 2020 confirmed that morbidity and comorbidity prevalence are high among the elderly population worldwide. High prevalence is found in both developing and developed countries, being very dependent on the age and socioeconomic status of the study population and their environmental settings. Among the non-communicable diseases examined diabetes mellitus and hypertension are the most common illnesses, and behavioral risk factors influenced comorbidity occurrence. In future studies, case-control and cohort study design should be employed to investigate specific groups of individuals and geographical areas. Questions left unanswered include relationship between personal health behavior and clinical severity, and types of intervention measures needed to prevent occurrence and decrease severity of comorbidity in the elderly population.

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CONFLICTS OF INTEREST DISCLOSURE

The authors declare no conflicts of interest.

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