



BMJ Open Prevalence of non-communicable chronic conditions, multimorbidity and its correlates among older adults in rural Nepal: a cross-sectional study

Uday Narayan Yadav ^{1,2,3}, Saruna Ghimire,⁴ Sabuj Kanti Mistry,¹ Selvanaayagam Shanmuganathan,^{3,5} Lal B Rawal,⁶ Mark Harris ¹

To cite: Yadav UN, Ghimire S, Mistry SK, *et al.* Prevalence of non-communicable chronic conditions, multimorbidity and its correlates among older adults in rural Nepal: a cross-sectional study. *BMJ Open* 2021;**11**:e041728. doi:10.1136/bmjopen-2020-041728

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2020-041728>).

Received 16 June 2020
Revised 08 February 2021
Accepted 09 February 2021



© Author(s) (or their employer(s)) 2021. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to
Dr Uday Narayan Yadav;
unyadav1@gmail.com

ABSTRACT

Objectives This study's objectives were to estimate the prevalence of major non-communicable conditions and multimorbidity among older adults in rural Nepal and examine the associated socioeconomic and behavioural risk factors.

Design This was a community-based cross-sectional study conducted between January and April 2018.

Setting Rural municipalities of Sunsari and Morang districts in eastern Nepal.

Participants 794 older Nepalese adults, 60 years and older, were recruited using a multistage cluster sampling approach.

Primary outcome measure(s) Prevalence of four major non-communicable chronic conditions (osteoarthritis, cardiovascular disease, diabetes and chronic obstructive pulmonary disease (COPD) and multimorbidity.

Results Almost half (48.9%: men 45.3%; women 52.4%) of the participants had at least one of four non-communicable chronic conditions, and 14.6% (men 12.5%; women 16.8%) had two or more conditions. The prevalence of individual conditions included: osteoarthritis—41.7% (men 37.5%; women 45.9%), cardiovascular disease—2.4% (men 2.8%; women 2.0%), diabetes—5.3% (men 6.0%; women 4.6%) and COPD—15.4% (men 13.3%; women 17.5%). In the adjusted model, older adults aged 70–79 years (adjusted OR (AOR): 1.62; 95% CI: 1.04 to 2.54), those from Madhesi and other ethnic groups (AOR: 1.08; 95% CI: 1.02 to 1.72), without a history of alcohol drinking (AOR: 1.53; 95% CI: 1.18 to 2.01) and those physically inactive (AOR: 5.02; 95% CI: 1.47 to 17.17) had significantly higher odds of multimorbidity.

Conclusions This study found one in seven study participants had multimorbidity. The prevalence of multimorbidity and associated socioeconomic and behavioural correlates need to be addressed by integrating social programmes with health prevention and management at multiple levels. Moreover, a longitudinal study is suggested to understand the temporal relationship between lifestyle predictors and multimorbidity among older Nepalese adults.

INTRODUCTION

The population of older adults is increasing globally¹ and is projected to increase to over 1.5 billion by 2050.² A similar demographic

Strengths and limitations of this study

- This is the first community-based study that estimated the prevalence of multimorbidity among older adults using a multistage cluster sampling approach in rural Nepal.
- This study presented the data from 794 older adults collected through face-to-face interviews (a response rate of 93.7%) using trained enumerators fluent in local languages (Maithili/Tharu/Nepali) of rural Nepal.
- We have included only four non-communicable conditions in the definition of multimorbidity, and thus the estimated prevalence may be underestimated.
- The study findings may not be generalisable to younger age groups and geography other than Morang and Sunsari districts of Nepal.
- A cause–effect relationship between multimorbidity and the identified correlates cannot be inferred due to the cross-sectional design of the study.

transition is occurring in Nepal. The Senior Citizen Act in Nepal 2006 defines 'an individual aged 60 and over as a senior citizen'.³ In the most recent census in Nepal in 2011, there were 2.5 million older adults (8.1%).⁴ This population is growing at a rate of 3.5% annually, which exceeds the nation's overall population growth rate at 1.35%.⁴ While we celebrate longevity,^{5,6} health and quality of life are two crucial agendas for the older population.^{7,8} Older adults have a higher prevalence of non-communicable chronic conditions, and with longevity, the likelihood of experiencing more than one non-communicable chronic condition also increases.⁹

Multimorbidity is the simultaneous coexistence of two or more non-communicable conditions in the same individual.¹⁰ Multimorbidity can have a significant impact on an individual's quality of life and the demand for healthcare.^{11,12} The impact of multimorbidity is greater than the cumulative effect of the



single condition.¹³ Individuals with multimorbidity are at a substantially greater risk of death compared with those with single conditions.¹⁴ Multimorbidity also adds to the existing challenges of providing quality geriatric healthcare, especially in developing countries with limited resources. Although multimorbidity requires a multitude of specialists' referrals, biomedical investigations and poly-pharmacy, current healthcare is based on a single condition approach to treatment, which may not be appropriate for patients with multimorbidity.^{15 16} Multimorbidity is challenging for both patients and health professionals, especially in setting priority goals for self-management. As we understand more about multimorbidity and the inequalities in its burden, subpopulations at risk may be identified for preventive and self-management strategies.

The prevalence of non-communicable conditions related to multimorbidity has increased substantially across the globe, especially among those aged 65 years and older with a reported prevalence of 33.1%.¹⁷ Longevity, coupled with an increase in incident non-communicable conditions and sedentary and unhealthy lifestyles, suggests that the burden of multimorbidity, especially among the older population, will continue to rise globally.¹⁰ Efforts to recognise and address multimorbidity in clinical settings have increased in many high-income countries.¹⁶ However, in developing countries, this emerging public health issue is often overlooked.¹⁸

In 2013, the Nepal STEPwise approach to surveillance survey reported that 99.6% of the Nepalese adults had at least one of the eight known risk factors for non-communicable conditions (smoking, alcohol consumption, less than five servings of fruits and vegetables per day, low physical activity, raised blood pressure, raised blood glucose, overweight and obesity, and raised total cholesterol).¹⁷ Similarly, a study conducted by Yadav *et al* found 74.8% of the people with chronic obstructive pulmonary disease (COPD) had two or more non-communicable conditions.¹⁹ Previously, using data from the 2003 World Health Survey (WHS), a 15.2% prevalence of multimorbidity among the Nepalese population was estimated, which doubled for the older age groups (30.2%).²⁰

Previous research on multimorbidity has mostly focused on quantifying the prevalence^{20 21} and has not analysed its association with risk behaviours or underlying social and economic factors. Rural areas in Nepal are characterised by higher poverty rates and lower health literacy, lack of human resources for health and regular supply of medications at the peripheral health system and means (transportation and financial) to access healthcare which include both interpersonal and intrapersonal characteristics.^{22–24} Malnutrition, an important determinant of health and well-being, is also more prevalent among older adults in rural than in urban Nepal.²⁵ Socioeconomic characteristics play an important role in determining the prevalence and management of both single chronic conditions and multimorbidity. Despite older adults being at increased risk, to date, there has been no specific study that focused on multimorbidity and its

risk factors in rural older Nepalese adults. Therefore, this study aimed to assess the prevalence of more major non-communicable conditions and multimorbidity among rural older Nepalese adults and examine the associated socioeconomic and behavioural risk factors.

METHODS

Study design and participants

This study was a community-based cross-sectional study conducted among older Nepalese adults 60 years or older living in the rural settings of Sunsari and Morang districts of Nepal. We recruited study samples from the community settings using a multistage cluster sampling approach. In the first stage, four rural municipalities (RMs) were randomly selected from each district. Second, five wards were randomly selected in each of the selected RMs, and then finally, study participants were randomly selected from the list of eligible subjects in each RM. Data were collected between January and April 2018 from 794 study participants through face-to-face interviews (a response rate of 93.7%). The 53 individuals who declined to participate were of similar characteristics to that of included sample in this study. Details of the methodology of this study are documented elsewhere.²⁶ Data were collected using a validated Nepali-version survey questionnaire administered through trained research assistants in the field. The inclusion criteria included older Nepalese adults aged ≥ 60 years and residents of the community for the past year. The exclusion criteria included residing in nursing care, being mentally disabled (clinically proved schizophrenia, bipolar mood disorder), being seriously ill (terminal illness like cancer, chronic kidney condition), having a hearing disability or being unable to communicate.

Patient and public involvement

Patients and the public were not involved in the conception of this study, development of the research question, interpretation of the results or manuscript writing.

Measurements

Multimorbidity

The data on four non-communicable chronic conditions (osteoarthritis, cardiovascular disease (CVD), diabetes and COPD) were collected using self-reported information from the participants. Information on self-reported non-communicable chronic conditions was verified either by checking the medical records of the study participants or by asking about prescribed medicines that they were taking for the relevant condition.²⁷ Table 1 presents the definition of the individual non-communicable condition. Each of the individual conditions was coded as a binary response (0=absent, 1=present). The cumulative of the four conditions (range 0=absence of all four conditions to 4=all four conditions present) was further dichotomised into presence or absence of multimorbidity,

Table 1 Definition of non-communicable chronic conditions included in the study

Conditions	Definition
Diabetes	Taking diabetic medications (insulin, hypoglycaemic); self-report of diabetes or diabetes recorded as a diagnosis in the medical record. <i>In line with operational definition, the diabetes condition was coded as '1' and its absence as '0'.</i>
Chronic obstructive pulmonary disease (COPD)	Clinical assessment as evident in the medical records or use of bronchodilators, or self-reported production of sputum for last 3 months with any smoking history. <i>In line with operational definition, COPD was coded as '1' and its absence as '0'.</i>
Cardiovascular disease (CVD)	Presence of any of the following conditions: <ul style="list-style-type: none"> ▶ Hypertension—self-report of diagnosed hypertension; verified by blood pressure level in the provided medical records. ▶ Self-report of heart attack, angina or 'heart trouble'. ▶ Stroke—self-reported presence of valve condition or taking medications for those. <i>In line with operational definition, CVD condition was coded as '1' and its absence as '0'.</i>
Osteoarthritis	Self-report of joint pain problems. <i>In line with operational definition, joint problem was coded as '1' and its absence as '0'.</i>
Multimorbidity	Presence of more than one of the four aforementioned conditions in the same individual. Multimorbidity was then dichotomised as present (ie, 2–4 conditions) or absent (ie, single or no condition) for assessing relationships with the independent variables.

where multimorbidity was defined as the presence of two or more conditions (cumulative score of ≥ 2).

Covariates

Included independent variables were age (continuous age recoded into 60–69, 70–79, and ≥ 80 years to see the comparison and to explore statistical relationships between the age categories), gender (male and female), study district (Morang and Sunsari), religion (Hinduism, Buddhism, Islam and Christianity), ethnicity, marital status, educational status, past occupation, family monthly income, history of smoking, tobacco use and alcohol drinking (yes/no), and physical activity. Based on the Nepal government's classification, ethnicity was categorised into Brahmin/Chettri/Thakuri, Aadiwasi/Janjatis, Dalit, Madheshi and other ethnic groups. Historically, the Brahmin/Chettri/Thakuri is considered as the upper caste group. Other ethnic groups are relatively disadvantaged and minority groups. Marital status was dichotomised into married and others; the latter included widowed, divorced, separated and never married. Educational status was defined in terms of the number of formal schooling years and was categorised into with (any numbers of years of formal schooling) or without (no formal schooling) formal schooling. Participants were asked about their participation in different types of moderate-to-vigorous intensity activities (such as regular walk, jogging, yoga, cycling, exercise, swimming, weightlift, activities related to the farmhouse and so on) over the previous 7 days. Participants were categorised as physically inactive if they reported not being involved in any activities; otherwise, they were classified as physically active. Further details on these covariates are also available in the previous work published by Yadav *et al.*^{26 27}

Statistical analysis

Stata (V.13.0)²⁸ was used to analyse the data. Descriptive analyses (mean with SD and frequency with percentage) are reported on each studied variable. Univariate analysis was performed using the X^2 test, and the variables with p value of < 0.2 were included in a mixed-effected logistic regression model. The generalised estimating equation approach with 95% CIs was employed to examine the association between multimorbidity and its associated factors.

RESULTS

Study participants' characteristics

The participants' mean age was 69.9 years (male: 70.2 ± 8.5 ; female: 69.7 ± 8.9), and there was almost equal participation by gender; 50.4% men and 49.6% women. The majority of participants were Hindu (78.7%), without formal education (80.1%), married (53.5%), from indigenous (Aadiwasi/Janjatis) or Madhesi ethnic groups (71.5%) and unemployed (54.2%). Just under half (48.0%) reported a family monthly income of US\$44 or less at the time of the survey. The majority of the participants reported lack of physical activity (77.1%) and had a history of smoking (62.2%). However, only 36.5% gave history of alcohol consumption. The descriptive findings have been reported in our previous paper.²⁷

Prevalence of individual chronic conditions/conditions and multimorbidity

The prevalence of osteoarthritis, CVD, diabetes, and COPD was 41.7%, 2.4%, 5.3% and 15.4%, respectively. While 48.9% of the participants were living from at least one chronic condition, 14.6% had multimorbidity (table 2). The prevalence of osteoarthritis, COPD, any

Table 2 Prevalence of chronic conditions and multiple morbidities (n=794)

Conditions	Osteoarthritis n (%)	CVD n (%)	Diabetes n (%)	COPD n (%)
Osteoarthritis (OA)	331 (41.7)			
Cardiovascular disease (CVD)	13 (1.7)	19 (2.4)		
Diabetes	16 (2.0)	3 (0.4)	42 (5.3)	
Chronic obstructive pulmonary disease (COPD)	90 (11.3)	8 (1.0)	6 (0.8)	122 (15.4)
OA and CVD			1 (0.1)	5 (0.6)
Diabetes and COPD	4 (0.5)	0.0		
Any comorbidities* n (%)	388 (48.9)			
Multiple morbidities† n (%)	116 (14.6)			

*At least two chronic conditions (osteoarthritis, CVD, diabetes and COPD) were prevalent.

†Two or more non-communicable chronic conditions were prevalent.

comorbidities and multimorbidity was higher among women compared with male participants, whereas that for CVD and diabetes were more prevalent in men than women (table 3). The only significant differences in prevalence between men and women were for osteoarthritis and any comorbidities (table 3).

Socioeconomic and lifestyle characteristics by multimorbidity

The mean age of the participants with multimorbidity was 70.3 years (table 4). The prevalence of multimorbidity was similar in men compared with women (16.8%; 12.5%, $p=0.090$). The prevalence of multimorbidity was significantly higher among unemployed (18.4%; 10.2%,

$p<0.001$), those without a history of drinking alcohol (16.9%; 10.7%, $p=0.018$), and those who were physically inactive (18.3%; 2.2%, $p<0.001$) compared the other respondents (table 2).

Risk factors associated with multimorbidity

In the final adjusted model (table 5), age, ethnicity, history of alcohol drinking and physical inactivity were significantly associated with multimorbidity. Individuals in their 70s (70–79 years) had 1.6 times higher odds of multimorbidity (adjusted OR (AOR): 1.62; 95% CI: 1.04 to 2.54) compared with the individuals aged 60–69 years. Individuals from the Madhesi and other ethnic groups

Table 3 Gender-wise distribution of non-communicable chronic conditions and multimorbidity

Prevalent conditions	Male	Female	P value
Osteoarthritis (OA)	150 (37.5)	181 (45.9)	0.016
CVD	11 (2.8)	8 (2.0)	0.507
Diabetes	24 (6.0)	18 (4.6)	0.368
COPD	53 (13.3)	69 (17.5)	0.096
OA and CVD	8 (2.0)	5 (1.3)	0.417
OA and diabetes	8 (2.0)	8 (2.0)	0.976
OA and COPD	37 (9.3)	53 (13.5)	0.062
CVD and diabetes	2 (0.5)	1 (0.3)	0.572
CVD and COPD	6 (1.5)	2 (0.5)	0.162
Diabetes and COPD	3 (0.8)	3 (0.8)	0.985
OA, CVD and diabetes	1 (0.3)	0 (0.0)	0.321
OA, CVD and COPD	4 (1.0)	1 (0.3)	0.184
OA, diabetes and COPD	2 (0.5)	2 (0.5)	0.988
Diabetes, CVD and COPD	–	–	–
OA, Diabetes, CVD and COPD	–	–	–
Any comorbidities*	181 (45.3)	207 (52.5)	0.040
Multimorbidity†	50 (12.5)	66 (16.8)	0.090

Significant p values are bolded.

*At least two chronic conditions (osteoarthritis, CVD, diabetes and COPD) were prevalent.

†Two or more chronic conditions were prevalent.

COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease.

Table 4 Sociodemographic and lifestyle characteristics by participant's multimorbidity status

	Multimorbidity*		P value
	No N=678 (85.4%)	Yes N=116 (14.6%)	
Age (mean, SD)	69.87 (8.8)	70.29 (7.7)	0.627
Age (years, %)			
60–69	381 (86.5)	59 (13.4)	0.235
70–79	193 (82.1)	42 (17.8)	
≥80	104 (87.3)	15 (12.6)	
Gender			
Male	350 (87.5)	50 (12.5)	0.090
Female	328 (83.2)	66 (16.7)	
Study district			
Morang	351 (86.8)	53 (13.1)	0.220
Sunsari	327 (83.8)	63 (16.1)	
Religion			
Hinduism	529 (84.6)	96 (15.3)	0.046
Buddhism	19 (100.0)	0 (0.0)	
Islam	105 (84.0)	20 (16.0)	
Christianity	25 (100.0)	0 (0.0)	
Ethnicity			
Brahmin/Chettri/Thakuri	62 (89.8)	7 (10.1)	0.706
Aadiwasi/Janjatis	255 (85.5)	43 (14.4)	
Dalit	132 (84.0)	25 (15.9)	
Madhesi and other ethnic groups	229 (84.8)	41 (15.1)	
Marital status			
Married	365 (85.8)	60 (14.1)	0.674
Others†	313 (84.8)	56 (15.1)	
Education status			
Without formal education	538 (84.5)	98 (15.4)	0.201
With formal education/schooling	140 (88.6)	18 (11.3)	
Past occupation			
Employed	327 (89.8)	37 (10.1)	<0.001
Unemployed	351 (81.6)	79 (18.3)	
Family monthly income			
<US\$49	331 (86.8)	50 (13.1)	0.453
US\$49–88	120 (82.7)	25 (17.2)	
>US\$88	227 (84.7)	41 (15.3)	
History of smoking			
No	257 (85.6)	43 (14.3)	0.864
Yes	421 (85.2)	73 (14.7)	
History of tobacco use			
No	354 (86.1)	57 (13.8)	0.540
Yes	324 (84.6)	59 (15.4)	
History of alcohol drinking			
No	419 (83.1)	85 (16.8)	0.018
Yes	259 (89.3)	31 (10.6)	

Continued



Table 4 Continued

	Multimorbidity*		P value
	No N=678 (85.4%)	Yes N=116 (14.6%)	
Physical activity			
Inactive	500 (81.7)	112 (18.3)	<0.001
Active	178 (97.8)	4 (2.2)	

Significant p values are bolded.

*At least two chronic conditions (osteoarthritis, cardiovascular disease, diabetes and chronic obstructive pulmonary disease) were prevalent.

†Others denotes widowed/divorced/separated/unmarried.

had 8% higher odds of multimorbidity than those of the upper caste (Brahmin/Chettri/Thakuri) (AOR: 1.08; 95% CI: 1.02 to 1.72). Study participants without a history of alcohol drinking (AOR: 1.53; 95% CI: 1.18 to 2.01) had 1.5 times higher odds of multimorbidity than those with a history. However, physically inactive individuals had five times higher odds of multimorbidity compared with those who were physically active (AOR: 5.02; 95% CI: 1.47 to 17.17).

DISCUSSION

This is the first study to assess the prevalence and correlates of multimorbidity among older adults in rural Nepal. We found that almost half (48.9%) of the older adults had at least one non-communicable disease conditions. Approximately one in seven had multimorbidity—most frequently involving osteoarthritis and COPD. This proportion was low compared with prevalence reported from India (>35%), China (>35%) and Bangladesh (14.9%).^{29–31} Studies on multimorbidity among the Nepalese population are limited, and the only available estimates come from the WHS²⁰ conducted in 2003 that defined multimorbidity as the presence of two or more of the six conditions: arthritis, angina or angina pectoris, asthma, depression, schizophrenia or psychosis, and diabetes. This survey found a prevalence of 15.2% among the Nepalese population, which doubled for the age group 65 years and older (30.2%).²⁰ Since Nepal has an ageing population and is in the process of the epidemiological transition, we would expect to see a higher prevalence of multimorbidity compared with the estimates from 2003. However, our prevalence estimate was half that of the 2003 WHS for the older age group. In our study, the possible reasons behind this discrepancy could be the measurement of a limited number of common non-communicable conditions (only four conditions included), methodological differences or geographical variation. In multimorbidity studies, the number and type of conditions included in the count contributed to greater variability in estimates between the studies.³² Given that the high prevalence of depression among older Nepalese adults (>50%),²⁷ the inclusion of depression in WHS but

not in the currently reported result, is likely to explain most of the difference in prevalence of multimorbidity. Moreover, in our current study, those who were mentally disabled (clinically proved schizophrenia, bipolar mood disorder) or seriously ill (terminal illness like cancer, chronic kidney condition) were excluded from the study, and this could have contributed to an underestimation of multimorbidity prevalence. In this regard, this suggests the need to develop a uniform standardised definition of multimorbidity, indicating which specific conditions should be included.

The impact of multimorbidity is greater than the cumulative effects of a single condition.¹³ In the Nepalese context, patients with multimorbidity rely on specialist services at secondary or tertiary hospitals as the primary healthcare system does not have the capacity to adequately assess and manage non-communicable chronic conditions, including multimorbidity. There is a need for a multisectoral integrated primary care approach³³ to address the needs of pre-existing non-communicable chronic conditions, including multimorbidity.

Significant differences in multimorbidity by ethnicity were noted: underprivileged minority groups, particularly the Madhesi ethnic group, were slightly more likely to suffer from multimorbidity than the upper caste groups. Our finding is consistent with previous literature from Nepal, which documented a higher burden of non-communicable chronic conditions among the Madhesi ethnic group.^{19 26} Historically, the Madhesi ethnic group were discriminated against by the upper caste groups and had limited access to education and employment.³⁴ As one of the marginalised groups, they have a comparatively lower socioeconomic status increasing their risk of poor health and well-being.

The increased risk of multimorbidity among physically inactive individuals is consistent with other research.^{35–37} However, surprisingly, study participants without a history of alcohol drinking had 50% higher odds of multimorbidity than those with such history. The literature on the association between alcohol consumption and multimorbidity has been inconsistent since previous studies have reported lower odds of having multimorbidity among

Table 5 Factors associated with multimorbidity in adjusted and unadjusted binary logistic regression models

	Crude			Adjusted		
	OR	P value	95% CI	OR	P value	95% CI
Age (years)						
60–69	1.00			1.00		
70–79	1.61	0.027	1.06 to 2.45	1.62	0.033	1.04 to 2.54
≥80	1.24	0.155	0.92 to 1.67	0.97	0.834	0.75 to 1.26
Gender						
Male	1.00			Not taken in the model		
Female	1.34	0.132	0.92 to 1.96			
Study district						
Morang	1.00			Not taken in the model		
Sunsari	1.27	0.713	0.36 to 4.49			
Religion						
Hinduism	1.00			Not taken in the model		
Buddhism	1.00	–	–			
Islam	0.69	0.396	0.79 to 1.62			
Christianity	1.00	–	–			
Ethnicity						
Brahmin/Chettri/Thakuri	1.00			1.00		
Aadiwasi/Janjatis	1.46	0.042	1.01 to 1.60	0.80	0.489	0.44 to 1.29
Dalit	1.08	<0.001	1.04 to 1.76	0.98	0.392	0.91 to 1.20
Madheshi and other ethnic groups	1.45	<0.001	1.28 to 1.75	1.08	0.002	1.02 to 1.72
Marital status						
Married	1.00			Not taken in the model		
Others*	1.01	0.951	0.67 to 1.54			
Education status						
With formal education/schooling	1.00			Not taken in the model		
Without formal education	1.40	0.465	0.57 to 3.43			
Past occupation						
Employed	1.00			1.00		
Unemployed	1.72	0.012	1.12 to 2.62	1.49	0.060	0.98 to 2.26
Family monthly income						
<US\$49	1.00			Not taken in the model		
US\$49–88	0.98	0.972	0.42 to 2.31			
>US\$88	1.11	0.656	0.69 to 1.82			
History of smoking						
No	1.00			Not taken in the model		
Yes	1.05	0.713	0.81 to 1.35			
History of tobacco use						
No	1.00			Not taken in the model		
Yes	0.99	0.942	0.72 to 1.36			
History of alcohol drinking						
Yes	1.00			1.00		
No	1.41	0.006	1.10 to 1.81	1.53	<0.001	1.18 to 2.01
Physical activity						
Active	1.00			1.00		

Continued



Table 5 Continued

	Crude			Adjusted		
	OR	P value	95% CI	OR	P value	95% CI
Inactive	5.51	0.007	1.60 to 19.05	5.02	0.010	1.47 to 17.17

Significant p values are bolded.

*Others denotes widowed/divorced/separated/unmarried.

those who consumed alcohol daily,^{35 38} whereas other studies found no association between alcohol consumption and multimorbidity.^{36 39} Likewise, few studies have reported that use of alcohol may have protective effects against some non-communicable diseases like type II diabetes⁴⁰ and CVD,^{41 42} however a large meta-analysis results evidenced that alcohol use is a risk for non-communicable disease. A number of explanations may justify our findings. First, in a society where alcohol consumption is unaccepted, self-reported measures of alcohol consumption may not be reliable, and participants' responses may be subjected to social desirability bias. Second, people with multimorbidity might have stopped drinking alcohol and could have been reluctant in reporting their history of alcohol use at the time of field survey. Third, in a low-income setting such as ours, the ability to consume alcohol also indicates an individual's purchasing power and relative wealth. Hence, older adults who could afford to consume alcohol may have had a relatively better socioeconomic status, good access to health services and had associated better health in later life. In this light, our finding warrants the need of longitudinal research to access the temporal relationship between alcohol use and multimorbidity.

Policy implications

In light of our findings, we suggest the need to shift from the approach of treating and management of single conditions to a more integrated approach where people's needs can be more comprehensively met.⁴³ Our study demonstrated the strong association between multimorbidity and lack of physical activity, which suggests both the opportunity for early prevention and the need for tailoring the physical activity to the level of disability (especially for osteoarthritis). In this regard, our findings have implications at the primary healthcare level as well as at the secondary/tertiary levels, where healthcare providers can assess physical activity level among individuals who access health services and can tailor interventions accordingly to avert the further health consequences, especially among socioeconomically deprived communities. Moreover, promotion of physical activity needs to be mainstreamed in existing community health programmes and at all levels of care. There is a need for national population-based database on non-communicable conditions, to assess their burden on Nepalese society and to guide policies and strategies to tackle non-communicable diseases.

Strengths and limitations

Some of the strengths of this study include a very high response rate (93.7%), data collection by trained enumerators fluent in local languages (Maithili/Tharu/Nepali). It is the first community-based study to report multimorbidity prevalence from Nepal. Limitations included: (a) cross-sectional design that precludes examination of the cause–effect relationship; (b) limited generalisability to younger age groups and geography other than Morang and Sunsari districts of Nepal; and (c) partial reliance on self-reported data on non-communicable chronic conditions. A major limitation was the inclusion of only four chronic conditions in the survey and in the definition of multimorbidity. The study analysed survey data conducted for the main objective of assessing frailty among older adults. These factors may have contributed to an underestimation of the prevalence of multimorbidity. The assessment of lifestyle behaviour may be subject to social desirability bias. All this suggests the need for a community-based longitudinal study that can include a larger number of conditions and assess the impact of lifestyle behaviours over time. There is also a need for qualitative research to understand the problems at the individual, community/family, and organisation level which influence the development and management of multimorbidity and inform more comprehensive interventions to address it.

CONCLUSIONS

This study found a modest prevalence of multimorbidity among older adults in rural Nepal. There is a need to conduct a more comprehensive, nationally representative study to obtain a more reliable estimate of prevalence and correlates of multimorbidity. The prevalence of multimorbidity and its socioeconomic and behavioural correlates needs to be addressed by integrating social programmes with health prevention and management at multiple levels. As such, the findings will help policymakers and stakeholders identify needs and develop comprehensive multisectoral strategies to address the needs of a growing older population with multimorbidity.

Author affiliations

¹Centre for Primary Health Care and Equity, University of New South Wales, Sydney, New South Wales, Australia

²Center for Research Policy and Implementation, Biratnagar, Nepal

³Torrens University, Sydney, New South Wales, Australia

⁴Department of Sociology and Gerontology and Scripps Gerontology Center, Miami University, Oxford, Ohio, USA

⁵Menzies Centre for Health Policy, The University of Sydney Faculty of Medicine and Health, Sydney, New South Wales, Australia

⁶School of Health Medical and Allied Sciences, Central Queensland University—Sydney Campus, Sydney, New South Wales, Australia

Twitter Uday Narayan Yadav @UNYadav_

Acknowledgements We would like to thank all the participants of this study and local government bodies. This paper's preprint version is available on <https://www.researchsquare.com/article/rs-19792/v1>, and the authors hold the right to publish it with any journal. Authors would also like to acknowledge research assistants who helped in data collection.

Contributors UNY conceived and designed the experiments. UNY performed fieldwork. UNY, SG, SKM, SS, LBR and MH analysed the data. UNY, SG, SKM, SS, LBR and MFH wrote the paper. All authors read and approved the final manuscript.

Funding UNY received funding from the Nepal Health Research Council, Ministry of Health, Government of Nepal (provincial grant).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval The study was approved by the Institutional Review Board of Nepal Health Research Council, Government of Nepal, Ministry of Health, Kathmandu (reg no: 545/2017). After detailed information, all study participants gave their written informed consent (included both written consent and thumb impressions). Prior to the interview, thumb impressions were obtained from those who were unable to read and write (n=636) and written informed consent was obtained from all literate participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. Data are available upon reasonable request. The de-identified data are available on request from the corresponding author.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Uday Narayan Yadav <http://orcid.org/0000-0002-6626-1604>

Mark Harris <http://orcid.org/0000-0002-0705-8913>

REFERENCES

- United Nations. *World population ageing 2015*. United Nations, Department of Economic and Social Affairs, Population Division, 2015.
- McNicol G. *World population ageing 1950-2050*. Academic OneFile, 2002: 814–6.
- Nepal Law Commission. *Senior citizen act*. Nepal Law Commission website, 2006.
- Central Bureau of Statistics. *National population and housing census 2011*. Kathmandu, Nepal, 2012.
- Knickman JR, Snell EK. The 2030 problem: caring for aging baby boomers. *Health Serv Res* 2002;37:849–84.
- National Research Council Committee on Population. *Preparing for an aging world: the case for cross-national research*. National Academies Press, 2001.
- Yadav UN, Thapa TB, Mistry SK, *et al*. Biosocial and disease conditions are associated with good quality of life among older adults in rural eastern Nepal: findings from a cross-sectional study. *PLoS One* 2020;15:e0242942.
- Gurung LB, Paudel G, Yadav UN. Health service utilization by elderly population in urban Nepal: a cross-sectional study. *Journal of Manmohan Memorial Institute of Health Sciences* 2016;2:27–36.
- Chang AY, Skirbekk VF, Tyrovolas S, *et al*. Measuring population ageing: an analysis of the global burden of disease study 2017. *Lancet Public Health* 2019;4:e159–67.
- World Health Organization. *Multimorbidity: technical series on safer primary care*. Licence: CC BY-NC-SA 3.0 IGO. Geneva: World Health Organization, 2016.
- Glynn LG. Multimorbidity: another key issue for cardiovascular medicine. *Lancet* 2009;374:1421–2.
- Tinetti ME, Fried TR, Boyd CM. Designing health care for the most common chronic condition--multimorbidity. *JAMA* 2012;307:2493–4.
- Marengoni A, Angleman S, Melis R, *et al*. Aging with multimorbidity: a systematic review of the literature. *Ageing Res Rev* 2011;10:430–9.
- Di Angelantonio E, Kaptoge S, *et al*. Emerging Risk Factors Collaboration. Association of cardiometabolic multimorbidity with mortality. *JAMA* 2015;314:52–60.
- National Guideline C. National Institute for Health and Care Excellence. *Clinical guidelines. multimorbidity: assessment, prioritisation and management of care for people with commonly occurring multimorbidity*. London: National Institute for Health and Care Excellence (UK) Copyright © National Institute for Health and Care Excellence, 2016.
- Pearson-Stuttard J, Ezzati M, Gregg EW. Multimorbidity—a defining challenge for health systems. *Lancet Public Health* 2019;4:e599–600.
- Aryal KK, Mehata S, Neupane S, *et al*. The burden and determinants of non communicable diseases risk factors in Nepal: findings from a nationwide steps survey. *PLoS One* 2015;10:e0134834.
- Beran D. *Difficulties facing the provision of care for multimorbidity in low-income countries. comorbidity of mental and physical disorders*. . Karger Publishers, 2015: 179. 33–41.
- Yadav UN, Lloyd J, Hosseinzadeh H, *et al*. Self-Management practice, associated factors and its relationship with health literacy and patient activation among multi-morbid COPD patients from rural Nepal. *BMC Public Health* 2020;20:300.
- Afshar S, Roderick PJ, Kowal P, *et al*. Multimorbidity and the inequalities of global ageing: a cross-sectional study of 28 countries using the world health surveys. *BMC Public Health* 2015;15:776.
- Acharya S, Ghimire S, Jeffers EM, *et al*. Health care utilization and health care expenditure of Nepali older adults. *Front Public Health* 2019;7:24.
- Yadav UN, Lloyd J, Hosseinzadeh H, *et al*. Levels and determinants of health literacy and patient activation among multi-morbid COPD people in rural Nepal: findings from a cross-sectional study. *PLoS One* 2020;15:e0233488.
- Rawal LB, Kharel C, Yadav UN, *et al*. Community health workers for non-communicable disease prevention and control in Nepal: a qualitative study. *BMJ Open* 2020;10:e040350.
- Yadav UN, Lloyd J, Hosseinzadeh H, *et al*. Facilitators and barriers to the self-management of COPD: a qualitative study from rural Nepal. *BMJ Open* 2020;10:e035700.
- Ghimire S, Baral BK, Callahan K. Nutritional assessment of community-dwelling older adults in rural Nepal. *PLoS One* 2017;12:e0172052.
- Yadav UN, Tamang MK, Thapa TB, *et al*. Prevalence and determinants of frailty in the absence of disability among older population: a cross sectional study from rural communities in Nepal. *BMC Geriatr* 2019;19:283.
- Yadav UN, Thapa TB, Mistry SK, *et al*. Socio-demographic characteristics, lifestyle factors, multi-morbid conditions and depressive symptoms among Nepalese older adults. *BMC Psychiatry* 2020;20:261.
- StataCorp. *inventorStata statistical software: release 13*. College Station, TX: StataCorp LP, 2013.
- Pati S, Swain S, Hussain MA, *et al*. Prevalence, correlates, and outcomes of multimorbidity among patients attending primary care in Odisha, India. *Ann Fam Med* 2015;13:446–50.
- Wang HHX, Wang JJ, Wong SYS, *et al*. Epidemiology of multimorbidity in China and implications for the healthcare system: cross-sectional survey among 162,464 community household residents in southern China. *BMC Med* 2014;12:188.
- Khan N, Rahman M, Mitra D, *et al*. Prevalence of multimorbidity among Bangladeshi adult population: a nationwide cross-sectional study. *BMJ Open* 2019;9:e030886.
- Subramanian SV, Subramanyam MA, Selvaraj S, *et al*. Are self-reports of health and morbidities in developing countries misleading? Evidence from India. *Soc Sci Med* 2009;68:260–5.
- Haque M, Islam T, Rahman NAA, *et al*. Strengthening primary Health-Care services to help prevent and control long-term (chronic) non-communicable diseases in low- and middle-income countries. *Risk Manag Healthc Policy* 2020;13:409–26.
- Jha K. *The Madhesi upsurge and the contested idea of Nepal*. Springer, 2017.
- Sakib MN, Shooshtari S, St John P, *et al*. The prevalence of multimorbidity and associations with lifestyle factors among middle-



- aged Canadians: an analysis of Canadian longitudinal study on aging data. *BMC Public Health* 2019;19:243.
- 36 Taylor AW, Price K, Gill TK, *et al.* Multimorbidity - not just an older person's issue. Results from an Australian biomedical study. *BMC Public Health* 2010;10:718.
- 37 Autenrieth CS, Kirchberger I, Heier M, *et al.* Physical activity is inversely associated with multimorbidity in elderly men: results from the KORA-Age Augsburg study. *Prev Med* 2013;57:17–19.
- 38 Dhalwani NN, Zaccardi F, O'Donovan G, *et al.* Association between lifestyle factors and the incidence of multimorbidity in an older English population. *J Gerontol A Biol Sci Med Sci* 2017;72:528–34.
- 39 Fortin M, Haggerty J, Almirall J, *et al.* Lifestyle factors and multimorbidity: a cross sectional study. *BMC Public Health* 2014;14:686.
- 40 Koppes LLJ, Dekker JM, Hendriks HFJ, *et al.* Moderate alcohol consumption lowers the risk of type 2 diabetes: a meta-analysis of prospective observational studies. *Diabetes Care* 2005;28:719–25.
- 41 Chiva-Blanch G, Badimon L. Benefits and risks of moderate alcohol consumption on cardiovascular disease: current findings and controversies. *Nutrients* 2019;12:108.
- 42 Sacco RL, Elkind M, Boden-Albala B, *et al.* The protective effect of moderate alcohol consumption on ischemic stroke. *JAMA* 1999;281:53–60.
- 43 Barnett K, Mercer SW, Norbury M, *et al.* Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet* 2012;380:37–43.