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Neighborhood environment and quality of life of older adults in eastern Nepal: findings from a cross-sectional study

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Abstract

Introduction Quality of life (QoL) is a subjective measure reflecting individuals' evaluations based on their personal goals and values. While global research shows the role of neighborhood factors like ethnic diversity and socio-cultural dynamics on QoL, these are unexplored in the Nepali context. Therefore, this study examined the relationship between neighborhood environment and QoL among Nepali older adults in eastern Nepal.

Methods This cross-sectional study involved 847 non-institutionalized older adults (aged ≥ 60 years) from two districts in eastern Nepal. QoL was evaluated using the 13-item brief Older People's Quality of Life questionnaire, where a mean score of < 3 indicated low/poor QoL. The neighborhood environment, conceptualized across three domains (demographic, socio-cultural, and built environment), included ethnic diversity, connections with family, friends, and neighbors, cultural ties, residential stability, and rurality. Their association with QoL was examined using multivariable logistic regression.

Results Around 20% of older adults reported poor QoL. Higher ethnic diversity (adjusted Odds Ratio [aOR] = 0.12, 95% confidence interval [CI]: 0.04–0.36), moderate contact with family and relatives (aOR = 0.26, CI: 0.11–0.61), and high contact with neighbors (aOR = 0.09, CI: 0.03–0.21) were associated with lower odds of poor QoL. Conversely, high contact with friends (aOR = 2.29, CI: 1.30–4.04) and unstable residence (OR = 6.25, CI: 2.03–19.23) increased the odds of poor QoL. Additionally, among the covariates, chronic disease, tobacco use, unemployment, and lack of education were also significantly associated with poor QoL.

Conclusion Overall, the demographic environment, socio-cultural factors, and the built environment of the neighborhood influence QoL. Therefore, diversifying the neighborhood's ethnic composition, promoting social connections such as frequent contact with family, relatives, and neighbors, and ensuring residential stability can enhance the QoL of older adults.

Keywords Quality of life, OPQoL-brief, Neighborhood context, Ethnic diversity, Social connectedness, Older adults, Nepal

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Introduction

Quality of life (QoL) is a subjective assessment based on the goals and standards individuals set for their lives, covering aspects such as physical and psychosocial health, as well as social relations, and is driven by their cultural and value systems [1]. Globally, increased life expectancy brought many opportunities; however, when coupled with sensory loss, chronic conditions, disability-adjusted life years, and poor QoL, it can impede the progression to healthy and successful aging [2, 3]. The global prevalence of successful aging has been modest, ranging from 10 to 47%, highlighting the need to enhance older adults' QoL [4]. The significance of QoL among older adults in Nepal is also growing, propelled by the increasing aging population attributed to the rising life expectancy with improved healthcare access [5]. Notably, the proportion of adults aged 65 years and older has significantly risen, reaching 6.9% in 2021, up from 5.3% in 2011, and more than doubling since 1981, when it was 3.3% [5, 6].

In general, and especially among older adults, QoL is associated with various chronic morbidities [3, 7], mental health problems [8], and goes beyond traditional health measures to embrace a holistic view of well-being, incorporating physical, mental, social, cultural, and emotional aspects [9]. The enhancement of subjective well-being during the aging process is crucial for safeguarding the health and overall well-being of older adults [10].

Older adults' QoL is a multidimensional construct influenced by various factors at both macro and micro levels. Macro factors include social and environmental aspects, while micro factors involve individual characteristics [9]. Bronfenbrenner's Ecological Systems theory [11] highlights the impact of an individual's surroundings, emphasizing interconnected systems. This theory highlights how the socio-cultural environment influences the alignment between individuals and their surroundings through four layers of systems, i.e., microsystem, mesosystem, exosystem, and macrosystem [11, 12]. The microsystem encompasses neighborhood in which an individual lives and interacts directly with the environment, which includes factors like personal characteristics, behavioral attitudes, neighborhood demographics, relationships, and community support influencing an older adult's well-being. The mesosystem focuses on interactions within the neighborhood, such as interaction with social networks and friends, while the exosystem includes service accessibility, covering healthcare, infrastructures, and others. The macrosystem encompasses cultural and societal values shaping perceptions of aging in the community. These four components of Bronfenbrenner's Ecological Systems theory collectively shed light on the substantial influence of the neighborhood environment on the aging process [12], incorporating physical, sociocultural, economic, and environmental characteristics [13]. Examining the factors influencing the QoL of older adults in Nepal entails exploring the various dimensions of these neighborhood environments [9].

In the context of the neighborhood, the ethnic diversity of older adults plays a crucial role in determining their well-being [14, 15]. While ethnic enclaves may offer social support to older individuals, they can also contribute to racial/ethnic segregation, which negatively impacts the health and wellbeing of older adults [13]. Nepal, a multi-ethnic and diverse nation with 142 ethnic groups, each having its own cultural traditions, languages, and histories [6], experiences the formation of ethnic enclaves, particularly among historically marginalized groups like the Indigenous, Madheshi, *Janajatis*, and *Dalits* (the latter considered lower untouchable caste as termed in Nepal's national policy called *Muluki Ain* of Nepal, 1854 AD). The formation of distinct social communities is intricately linked to the nation's social structure, reflecting issues of identity, resource allocation, political representation, and stemming from historical discrimination and marginalization [16].

The socio-cultural environment in Nepal significantly influences the well-being of older adults, shaped by factors like connections with family, friends, and neighbors. Additionally, cultural bonds manifest through involvement in each other's social events and rituals, and the acceptance and celebration of each other's festivals play a significant role. Traditional values, including filial piety, emphasize the crucial roles of adult children, particularly sons and daughters-in-law, in caring for older parents within multigenerational households [17]. Previous studies in Nepal highlight the substantial impact of social support from spouses, family, and neighbors on the QoL of older adults [18–20]. Changing societal dynamics, including internal (rural-to-urban) migration and high rates of international migration, are reshaping traditional family structures from multigenerational to nuclear or smaller families. This transformation is slowly altering the nature of familial support, resulting in older adults living in skip-generational households, alone or in old-aged homes [21–23]. Considering the evolving dynamics of family structure in Nepali society, revisiting the association between social connections and QoL is timely and important.

The built environment of the neighborhood plays a crucial role in shaping the well-being of older adults. Access to essential services such as healthcare, grocery stores, and community centers is vital for their QoL [24–26]. Age-friendly infrastructure in the community contributes to active living, fostering a healthy aging process [24]. The neighborhood's design, including factors like population density, diversity, accessibility and proximity to essential resources, is a pivotal factor in enhancing the overall QoL for older adults [12, 27]. Additionally, given

that older adults frequently reside in the same area for extended periods and depend on community resources for social support [12], residential stability in the neighborhood has been associated with their improved psychosocial well-being [26].

Prior studies have quantified the QoL and identified socio-demographic covariates associated with QoL among Nepali older adults [8, 28–32]. However, despite the potential roles of neighborhood factors in determining QoL, there is a paucity of research specifically focused on investigating the role of neighborhood environment on QoL of older adults in Nepal. This study aimed to fill this gap by exploring the association between neighborhood environments and the QoL of Nepali older adults. To achieve this aim, a conceptual model was developed (Fig. 1) based on a comprehensive literature review [11, 14, 26, 33]. This model illustrates the intricate relationship between the neighborhood environment and the QoL of older adults.

Methods

Study design, setting, and participants

A cross-sectional study was conducted between July and September 2020 in two districts of eastern Nepal, namely Sunsari and Morang, located in Koshi Province. These districts rank among Nepal's top five most populous districts and have a notably high number of older population, with 9.5% and 10.8% aged 60 and above in Sunsari and Morang, respectively [6]. General demographics for these districts, as well as the province and the nation, are presented in Appendix 1.

The sample size was calculated based on a hypothesized proportion size of 0.5, a 5% error margin, and a design effect of 2. Additionally, a 10% non-response rate was considered. A total of 847 non-institutionalized community-dwelling older adults aged 60 years and above were surveyed with a response rate of more than 90%. The sampling process employed a multi-stage sampling technique. In the first stage, two rural municipalities were randomly selected from each district. Subsequently, four wards (the smallest administrative unit in Nepal) were chosen randomly from each municipality. In the final stage, participants were randomly selected from each

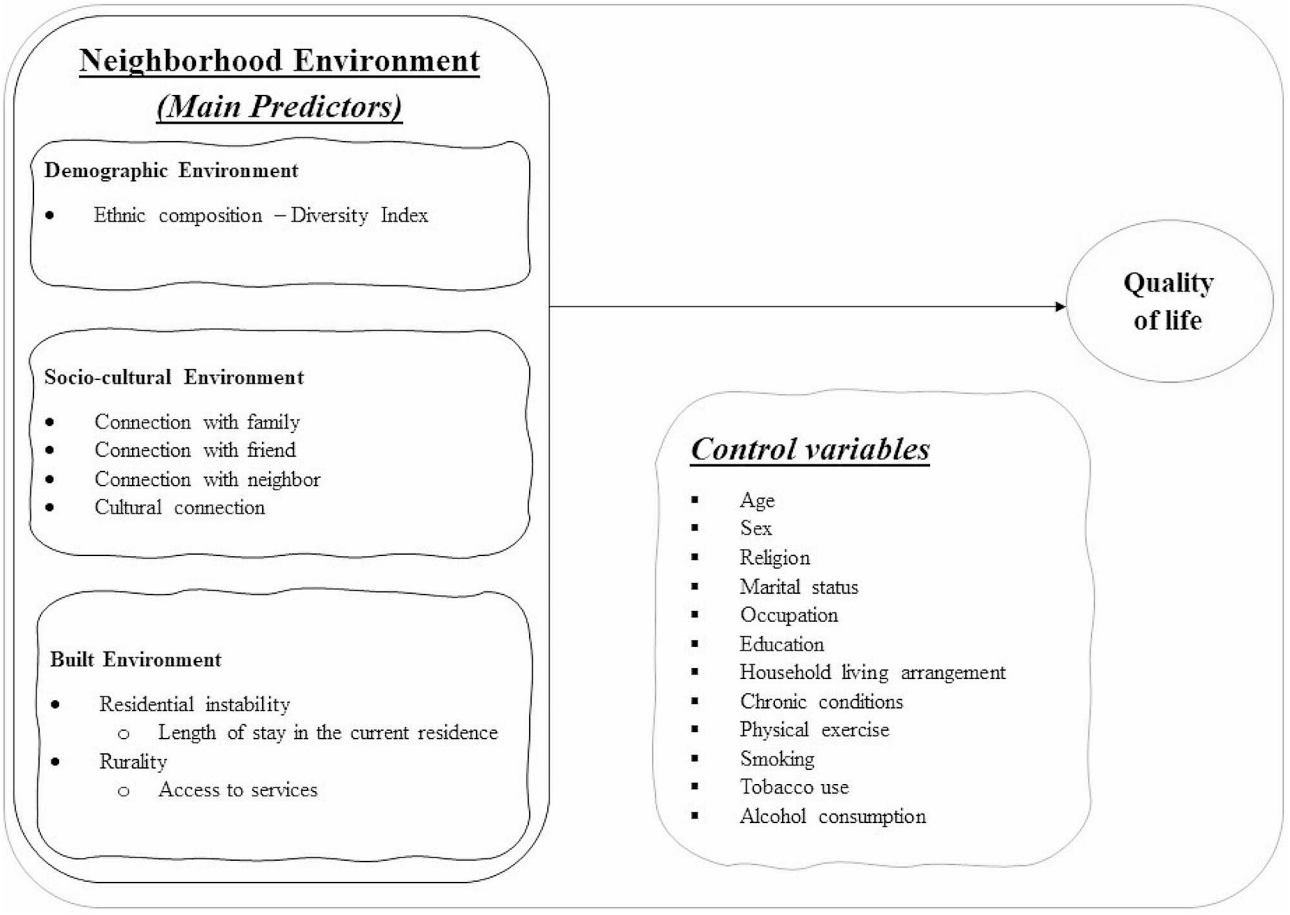

Fig. 1 Conceptual model for neighborhood environment and quality of life of older adults

ward. A sampling frame was obtained from each ward office, and samples were randomly chosen proportionate to population size of each ward. The study included Nepali nationals who had been residing in the community for at least six months, were willing to complete forms, capable of understanding the questionnaire, and able to provide informed consent. The study excluded older adults who had cognitive or hearing impairments, or who were unable to communicate effectively. The detailed methodology is published elsewhere [34].

Data collection

Data collection was carried out using the Kobo Toolbox survey design software, a recognized and reliable tablet data collection platform for researchers and professionals working in offline settings [35]. Initially, a semi-structured questionnaire was developed in English by study team members with expertise in public health and gerontology, incorporating both self-constructed and standard validated tools. Subsequently, the questionnaire underwent translation into the Nepali language, followed by a backward translation to ensure the accurate measurement of intended concepts in the translated tool. A pretest of the tool was carried out involving 10 older adults from a rural municipality, and minor language revisions were performed. Four enumerators conducted face-to-face interviews in Nepali language at the participants' homes. Enumerators received training in using the Kobo Toolbox on tablets and gained a comprehensive understanding of each question through role-play and in-depth discussions.

Measures

Outcome variable

The outcome variable was the QoL, measured by administering the 13-item brief Older People's Quality of Life questionnaire (OPQoL-brief) [36]. The OPQoL-brief assesses various constructs, including health, social relationships, independence, freedom, home and neighborhood characteristics, psychological and emotional well-being, and financial circumstances [36]. Each item was rated on a 5-point Likert scale, where "1" represented "strongly disagree," and "5" represented "strongly agree" [36]. In this study, a mean score was computed for each older adult based on the 13 items. This OPQoL-brief mean score was then dichotomized with scores <3.0 recoded as poor or low and scores ≥ 3.0 recoded as good or high QoL, consistent with earlier study [37]. The OPQoL-brief tool, previously validated in eastern Nepal [8], demonstrated strong internal consistency in the current study, with an omega coefficient value of 0.91, indicating high reliability in measuring the QoL among participants. Moreover, the construct validity was checked with exploratory factor analysis (EFA) of the 13 items of QoL, and only one factor was loaded in EFA with an Eigenvalue of 5.8, along with factor loading of >0.55 in each item. Both reliability and validity tests conducted here suggested that the Nepali version of OPQoL-brief was well capturing a single latent variable [38].

Predictor variables

Globally, a neighborhood is defined as a geographically defined area that is inhabited by a group of people who share common social, cultural, and economic characteristics [39]. A neighborhood in Nepal is considered a community where people living in the same area share a sense of belonging and mutual support. For the purposes of this study, a neighborhood's geography is considered equivalent to ward or local administrative units, with its environment conceptualized across three domains: demographic, socio-cultural, and built environment (Fig. 1). The demographic environment was assessed in terms of ethnic diversity. Ethnic diversity in each ward was quantified by indexing the number of ethnic compositions using Simpson's diversity index formula [40]. This formula considers the number of individuals belonging to a particular ethnic group within the community in relation to the total population of that community [40]. It considers both ethnicity richness (the number of different ethnicities present) and ethnicity evenness (how evenly the individuals are distributed among those ethnicities). The diversity index ranges from 0.00 to 1.00, where 0.00 signifies no diversity, and 1.00 indicates the maximum diversity. Therefore, a higher value implies greater ethnic diversity in a community. To calculate the diversity index, information on ethnicity was used, which was measured in four categories: *Brahmin/Chhetris*, *Dalits*, disadvantaged caste groups, such as Indigenous and *Madheshi*, and religious minorities.

The socio-cultural environment was measured in terms of connections with family, friends, neighbors, and culture. The frequency of contact with family members (those not living with the older adult), friends, and neighbors was assessed by asking about each category separately. Responses were recorded in three categories: low (contact at least once a year or never), moderate (contact at least once a month), and high (contact at least once a week or more). However, due to fewer observations in the low and moderate categories, the connection with neighbors was dichotomized as low/moderate or high. Similarly, cultural connection was evaluated by asking about the frequency of participation in cultural programs within the society or community. Responses for cultural connections were recorded in three categories: never, rarely, and frequently.

The built environment was assessed through two components: residential instability and rurality. Residential instability was assessed based on the duration of

residence at the current location, categorized as either one year or less (unstable residence) or more than one year. Rurality is often determined by factors such as population density and access to services like healthcare, entertainment, and employment. However, its operationalization can vary based on the research objective or policy importance [41]. In this study, rurality was assessed by measuring access to services in terms of travel time to the nearest city (Dharan, Itahari, or Biratnagar) providing tertiary-level healthcare services, employment, and education opportunities. The travel time was determined in two steps and the final travel time was obtained from cumulation of both. Initially, the distance from the local ward office to the trunk road or highway was calculated in kilometers (km), followed by the measurement of the distance from the highway point to the nearest city. The distance measurement utilized Google Maps, with the midpoint of the city serving as the reference point. Travel time calculations were based on walking speed (5 km per hour) for the distance up to the highway and motor speed (50 km per hour) for the distance up to the city [42]. This aligns with the average walking speed and the standard speed for the highway road recommended by the Nepal Government and Google Maps. Considering that healthcare should be accessible within 30 minutes (min) of travel time [43], a dichotomized accessibility variable was created. Travel time of 30 min or less was categorized as accessible, while the time required for more than 30 min was categorized as not accessible. These values served as a proxy for the dimension of rurality.

Covariates

Age, sex, religion, marital status, occupation, education, living arrangement, presence of chronic disease, and health-related behaviors such as physical exercise, smoking, tobacco, and alcohol use were measured as covariates. Age was recoded into three categories: 60–64, 65–74, and 75 years and above. Given that age 65 is commonly considered the cutoff to define older adults in many countries, and 75 years and above are typically classified as the older-old category, these cutoff ages were utilized to categorize the age of the respondents. Sex was categorized as male and female, and religion was dichotomized into "Hindu" and "Other than Hindu." Marital status was reclassified as "Married/with partner" and "Without partner," with older adults who were never married, separated, divorced, or widowed grouped as "Without partner." Occupation was regrouped as "Agriculture," "Business or job," and "Unemployed, retired, and others." Education had two responses: "No education" and "Formal education," with older adults who attended school and completed at least grade one considered to have "Formal education," and those who never attended school were categorized as "No education." Living arrangements were initially classified into five categories: "With son," "With daughter," "Couple only," "Alone," and "Relatives." However, due to fewer observations in the "With daughter" and " Relatives" categories, it was recoded into three categories: "With son/daughter/relatives," "Couple only," and "Alone."

The presence of chronic disease was assessed through two types of questions. Initially, respondents were asked a yes/no question regarding specific health conditions or diseases, namely hypertension, arthritis, diabetes, heart issues, and chronic lung disease. Additionally, an open-ended question prompted them to report any other types of health conditions they might have. The sum of chronic conditions for each participant was calculated and categorized into three groups: "None," "Single disease", and "More than one disease". Similarly, self-reported daily physical activity was binary, with categories of "Yes" or "No." Smoking, tobacco use, and alcohol consumption were dichotomized into "Never" and "Current/former."

Data analyses

Descriptive statistics, along with bivariate tests of association (Chi-square, Fisher's exact test, and t-test) were performed to explore the distribution of the variables. Multivariable logistic regression was performed to explore the association between neighborhood environmental factors and the QoL of older adults. Initially, the regression model-building process started with assessing multicollinearity through the variance inflation factor (VIF), and all variables in the model exhibited VIF values less than 2.5, indicating that multicollinearity was not a concern [44]. Additionally, advanced regression diagnostics, including Jackknife techniques, were employed, and no concerning or influential observations were identified. Then, a multivariable regression model was developed through stepwise regression, starting with all variables listed in Table 1 and utilizing the Akaike information criterion (AIC) for variable selection. The AIC-based model-building process excluded variables from the model, such as connection with family, sex, religion, physical exercise, and smoking. However, recognizing the theoretical significance of variables like connection with family and sex in our research question framework, they were retained in the final model. Consequently, the final model was executed with all the variables listed in Table 2. The final model, with a concordance statistic of 0.78, indicates its effectiveness in assessing the relationship between the QoL of older adults and independent variables [45]. Table 2 presents both unadjusted and adjusted odds ratios (ORs) for poor QoL, along with their 95% confidence intervals (CIs), obtained from logistic regressions. Statistical significance was set at 0.05. Data analyses were conducted using SAS software version 9.4 (SAS Institute Inc, 2013. Cary, NC).

Table 1 Neighborhood, socio-demographic, and health-related characteristics of the respondents, overall and by quality of life status (*N* = 847)

Characteristics	Total [*n* (%)]	Poor QoL [*n* = 172; 20.3%]		Good QoL [*n* = 675; 79.7%]		*p*-value
		n/mean	%/SD	*n*/mean	%/SD	
Neighborhood environment (Predictors)						
Ethnic diversity (Mean ± SD)	0.39 ± 0.21	0.33	0.21	0.41	0.20	**< 0.001**[a]
Connection with family/relatives						
High	432 (51.0)	98	22.7	334	77.3	
Moderate	361 (42.6)	54	15.0	307	85.0	**< 0.001**
Low	54 (6.4)	20	37.0	34	63.0	
Connection with friends						
High	647 (76.4)	143	22.1	504	77.9	**0.020**
Low	200 (23.6)	29	14.5	171	85.5	
Connection with neighbors						
High	817 (96.5)	153	18.7	664	81.3	**< 0.001**
Moderate/Low	30 (3.5)	19	63.3	11	36.7	
Participation in cultural activities						
Frequently	208 (24.6)	41	19.7	167	80.3	
Rarely	415 (49.0)	80	19.3	335	80.7	0.561
Never	224 (26.4)	51	22.8	173	77.2	
Length of residence						
One year or less	19 (2.2)	8	42.1	11	57.9	**0.037**[b]
More than a year	828 (97.8)	164	19.8	664	80.2	
Access to services						
Not accessible	568 (67.1)	126	22.2	442	77.8	0.053
Accessible	279 (32.9)	46	16.5	233	83.5	
Covariates						
Age						
60–64 years	290 (34.2)	57	19.7	233	80.3	0.845
65–74 years	421 (49.7)	85	20.2	336	79.8	
75 years and above	136 (16.1)	30	22.1	106	77.9	
Sex						
Female	378 (44.6)	73	19.3	305	80.7	0.518
Male	469 (55.4)	99	21.1	370	78.9	
Religion						
Hindu	808 (95.4)	170	21.0	638	79.0	**0.016**
Other than Hindu	39 (4.6)	2	5.1	37	94.9	
Ethnicity						**< 0.001**[b]
Dalit	141 (16.7)	42	29.8	99	70.2	
Disadvantaged	554 (65.4)	114	20.6	440	79.4	
Religious Minority	23 (2.7)	2	8.7	21	91.3	
Brahmin/Chhetris	129 (15.2)	14	10.9	115	89.1	
Marital status						
With partner	647 (76.4)	120	18.6	527	81.4	**0.022**
Without partner	200 (23.6)	52	26.0	148	74.0	
Occupation						
Agriculture	167 (19.7)	32	19.2	135	80.8	
Business or job	95 (11.2)	11	11.6	84	88.4	0.058
Unemployed, retired and others	585 (69.1)	129	22.1	456	77.9	
Education						
No education	756 (89.3)	160	21.2	596	78.8	0.074
Formal education	91 (10.7)	12	13.2	79	86.8	
Living arrangement						
With son/daughter/relatives	658 (77.7)	114	17.3	544	82.7	**< 0.001**
Couple only	162 (19.1)	42	25.9	120	74.1	

Table 1 (continued)

Characteristics	Total [*n* (%)]	Poor QoL [*n* = 172; 20.3%]		Good QoL [*n* = 675; 79.7%]		*p*-value
		n/mean	%/SD	*n*/mean	%/SD	
Alone	27 (3.2)	16	59.3	11	40.7	
Chronic disease status						
None	456 (53.8)	76	16.7	380	83.3	
Single disease	245 (29.0)	62	25.3	183	74.7	**0.016**
More than one disease	146 (17.2)	34	23.3	112	76.7	
Daily physical exercise (N = 840)						
Yes	25 (3.0)	6	24.0	19	76.0	0.646
No	815 (97.0)	165	20.2	650	79.8	
Smoking						
Never smoked	327 (38.6)	57	17.4	270	82.6	0.099
Current/former smoker	520 (61.4)	115	22.1	405	77.9	
Use of tobacco products						
Never used	303 (35.8)	40	13.2	263	86.8	**< 0.001**
Current/former user	544 (64.2)	132	24.3	412	75.7	
Alcohol use behavior						
Never used	317 (37.4)	44	13.9	273	86.1	**< 0.001**
Current/former user	530 (62.6)	128	24.2	402	75.8	

[a]*p*-value from t-test; [b]*p*-value from Fisher's exact test; all others are from Chi-square test. Significant *p*-values are bolded

Results

Socio-demographic descriptive

Table 1 depicts the characteristics of the respondents in terms of socio-demographic, economic, cultural, and health-related factors. One in five participants reported a poor QoL. The ethnic diversity score had a mean of 0.39, with a standard deviation (SD) of 0.21. The majority (65.4%) were from disadvantaged ethnic groups. Furthermore, 51.0%, 76.4%, and 96.5% of older adults had high (weekly or daily) contact with family/relatives, friends, and neighbors, respectively. About a quarter participated frequently in cultural activities. Regarding residential stability and rurality, 97.8% of older adults had been living in the same place for more than a year, and 67.1% did not have accessible services. In the bivariate test for main predictors, significant differences in QoL were observed based on ethnic diversity, connection with family/relatives, friends, and neighbors, as well as residential stability (Table 1).

In terms of covariates, participants had an average age of 68 years (SD = 7.1), with almost half falling into the 65–74 years category. Males constituted over 55% of the respondents, and the majority were married/partnered (76.4%), had no formal education (89.3%), and lived with children or relatives (77.7%). Additionally, nearly half (46.2%) of the participants had one or more chronic conditions, and more than 60% were current or former consumers of smoking, tobacco, and alcohol (Table 1).

Association between neighborhood environment and the quality of life

Table 2 presents the results from unadjusted and adjusted logistic regression analyses. Among the participants, a unit increase in ethnic diversity was significantly associated with 88% lower odds of experiencing poor QoL (adjusted Odds Ratio [aOR] = 0.12, CI = 0.04–0.36) after controlling for all other variables in the model. Compared to low family/relatives connections, the odds of reporting poor QoL were 74% lower for moderate family/relatives connections (aOR = 0.26, CI = 0.11–0.61). Moreover, in the unadjusted model, high connection (OR = 0.50, CI = 0.28–0.91) with family members and relatives was associated with a reduced odd of poor QoL, but the finding lost statistical significance when covariates were adjusted. High/frequent contact with neighbors (aOR = 0.09, CI = 0.03–0.21) was associated with lower odds of poor QoL; however, surprisingly, high/frequent contact with friends was associated with poor QoL (aOR = 2.29, CI = 1.30–4.04). Additionally, those residing in the study area for one year or less, indicating residential instability, had about six times the odds of poor QoL (aOR = 6.25, CI = 2.03–19.23) compared to those living in the same area for more than a year.

Several covariates demonstrated a significant association with QoL. Participants actively engaged in occupations such as agriculture (aOR = 0.49, CI = 0.27–0.87) or jobs/business (aOR = 0.32, CI = 0.14–0.73) showed lower odds of poor QoL compared to those who were unemployed, retired or in other occupations. Similarly, older individuals living with their children or relatives (aOR = 0.18, CI = 0.07–0.50) and with a spouse

Table 2 Association of neighborhood characteristics with poor quality of life of Nepali older adults

Characteristics	Unadjusted OR [95% CI]	Adjusted OR [95% CI]
Neighborhood environment		
Ethnic diversity	0.17 [0.08–0.39]***	0.12 [0.04–0.36]***
Connection with family/relatives (Ref = Low)		
Moderate	0.30 [0.16–0.56]***	0.26 [0.11–0.61]**
High	0.50 [0.28–0.91]*	0.84 [0.39–1.84]
Connection with friends (Ref = Low)		
High	1.67 [1.08–2.58]*	2.29 [1.30–4.04]**
Connection with neighbors (Ref = Low/Moderate)		
High	0.13 [0.06–0.29]***	0.09 [0.03–0.21]***
Participation in cultural activities (Ref = Frequently)		
Never	0.83 [0.52–1.32]	1.64 [0.87–3.10]
Rarely	0.81 [0.55–1.20]	1.15 [0.66–2.00]
Length of residence (Ref = More than a year)		
One year or less	2.94 [1.17–7.44]*	6.25 [2.03–19.23]**
Access to services (Ref = Accessible)		
Not accessible	1.44 [0.99–2.10]	1.13 [0.68–1.88]
Covariates		
Age (Ref = 60–64 years)		
65–74 years	1.03 [0.71–1.50]	0.76 [0.48–1.19]
75 years and above	1.16 [0.70–1.90]	0.71 [0.37–1.39]
Sex (Ref = Female)		
Male	1.12 [0.80–1.57]	1.21 [0.75–1.97]
Marital status (Ref = With partner)		
Without partner	1.54 [1.06–2.24]*	1.12 [0.68–1.85]
Occupation (Ref = Unemployed, retired and others)		
Agriculture	0.84 [0.54–1.29]	0.49 [0.27–0.87]*
Business or job	0.46 [0.24–0.89]*	0.32 [0.14–0.73]**
Education (Ref = Formal education)		
No education	1.77 [0.94–3.32]	2.37 [1.12–5.00]*
Living arrangement (Ref = Alone)		
With son/daughter/relatives	0.14 [0.07–0.32]***	0.18 [0.07–0.50]***
Couple only	0.24 [0.10–0.56]***	0.30 [0.10–0.92]*
Chronic disease status (Ref = None)		
Single disease	1.69 [1.16–2.48]**	2.20 [1.31–3.71]**
More than one disease	1.52 [0.96–2.39]	1.86 [1.01–3.42]*
Use of tobacco products (Ref = Never used)		
Current/former user	2.11 [1.43–3.10]***	1.72 [1.01–2.94]*
Alcohol use behavior (Ref = Never used)		
Current/former user	1.98 [1.36–2.88]***	1.18 [0.69–2.02]

OR = Odds Ratio; CI = Confidence Interval; *= p-value < 0.05, **= p-value < 0.01, ***= p-value < 0.001. Ref = Reference group

(aOR = 0.30, CI = 0.10–0.92) had lower odds of poor QoL compared to those living alone.

Older adults without formal education had more than doubled odds of poor QoL (aOR = 2.37, 1.12–5.00) compared to their counterparts with formal education. Similarly, compared to older adults without any diseases, those with a single disease (aOR = 2.20, CI = 1.31–3.71) or multiple diseases (aOR = 1.86, CI = 1.01–3.42) had increased odds of poor QoL. Likewise, older adults with a history of tobacco consumption had 72% higher odds of poor QoL (aOR = 1.72, CI = 1.01–2.94) than those who had never consumed tobacco.

Discussion

To the authors' knowledge, this study is the first of its kind from Nepal exploring the association between neighborhood environment and the QoL of older adults. Overall, one-fifth of the participants experienced poor QoL. Higher ethnic diversity, moderate family connections, and strong neighbor connections were significantly associated with increased QoL. Conversely, frequent/

high connections with friends and unstable residence increased the odds of poor QoL.

The reported prevalence of poor QoL, at 20.3% among older adults in this study, is lower compared to previous findings from eastern Nepal, where studies reported prevalences of 70.4% [8] and 51.8% [30], but higher than that in central Nepal, reported as 11.4% [32]. Variations in measurement tools and dichotomization processes for QoL may have contributed to these differences. Furthermore, the location of the current study and its level of remoteness could have impacted the QoL of older adults. Studies conducted outside Nepal, among older adults in Norway [37], Iran [46], India, and China [47], reported prevalences ranging from 6 to 16%. Specifically, India, which shares a similar socio-cultural context with Nepal, also reported a lower prevalence (12.5%) of poor QoL [47]. Similarly, the reported prevalence of 16% for poor QoL among older adults in Iran, based on the same QoL tool, aligns with our findings [46]. In addition to the common tools used for QoL measurements, socio-cultural similarities between the two countries may also explain this finding. For example, both Nepalese and Iranian societies tend to be hierarchical and collectivist, emphasizing respect for elders and strong family and kinship ties [48]. Despite inconsistencies in the literature, a decline in quality of life during later life is plausible. As individuals age, they may face challenges such as limited mobility, frailty, cognitive decline, chronic conditions, and increased dependency on others for daily activities, all of which can contribute to a decline in QoL [49–51]. Additionally, reduced social engagement, emotional instability, and feelings of loneliness during older age can further diminish QoL [49, 50]. Given that poor QoL is linked to various adverse health outcomes and contributes to morbidity and mortality, the finding that approximately 20% of older Nepalis are experiencing poor QoL is of significant concern [52, 53]. This emphasizes the importance of addressing factors contributing to poor QoL in this demographic group.

Ethnic diversity has been associated with higher QoL in our study, although previous research on this topic has produced mixed findings. While some studies have suggested that ethnic density (homogeneity) enhances the health and well-being of older individuals [54, 55], and diversity may lead to increased morbidity and adverse health outcomes [56], other studies, including ours, support a positive link between ethnic diversity and well-being [57]. Compared to Western countries, where societies are more individualistic, the collectivist strength of community and strong culture element in Nepal could have enhanced the QoL of older adults in an ethnically diverse community. Diverse and inclusive neighborhoods offer numerous benefits, including increased job opportunities, innovation, entrepreneurship, and overall prosperity across various domains such as employment, education, and health [58]. Additionally, ethnic diversity contributes to reduced racism and discrimination, promotes social cohesion, and strengthens social support networks [59, 60]. In the context of the study setting in Nepal, the majority of participants were from Indigenous and other ethnic groups with unique cultural practices such as local folk *Maithili*, *Thar*u, Santhal and other Indigenous songs and dances during the Tihar festival, *Chhath Pooja* (prayers to Sun and nature), *Udhauli*, *Joorshital/Siruwa Parba*, where people from different ethnicities are invited to observe and celebrate. Moreover, social events like community drama, films, weddings, and community fairs are important events that establish trust and provide a sense of belonging and the opportunity to learn from diverse cultures in the neighborhood. These unique cultural elements of ensuring ethnic diversity might have nurtured social cohesion, a sense of togetherness, and tolerance in the neighborhood environment. Despite its multiethnic composition with over 142 ethnic groups [6], Nepali society maintains social harmony, offering opportunities for cultural learning, participation in various cultural activities, and fostering friendships across different ethnic groups. These opportunities nurture supportive social networks, enrich collective experiences, promote cohesion and resilience, and contribute positively to overall well-being. Our findings suggest the need for further research to understand the role of cultural elements of different ethnic groups in creating and strengthening a sense of strong neighborhood in the Nepalese context.

Regular connection with non-cohabiting family members, especially on a monthly basis, was a significant factor contributing to higher QoL among participants. Regular communication with family members reduces loneliness and enhances self-esteem, ultimately leading to better QoL [61, 62]. This finding emphasizes the importance of maintaining strong family ties [63], and suggests that advancing meaningful and consistent connections with family members can positively impact the overall well-being of older individuals [34]. In Nepali society, which historically follows filial piety, families provide direct and indirect support to older adults, including economic assistance, informal caregiving, and facilitating access to healthcare, all of which contribute to better QoL [34].

Likewise, the findings from other studies indicating that strong connections with neighbors enhance QoL reflect the close-knit communities in Nepal, fostering social cohesion and a sense of belonging [21, 23]. Furthermore, in Nepal, neighborhoods play a crucial role in providing emotional and spiritual support, particularly when family support is lacking [18]. The significance of community relationships becomes apparent when considering the potential negative health impacts associated

with the absence of support from family, neighbors, and society [64, 65]. Studies suggest that the social environment within neighborhoods plays a crucial role in mitigating the risk of chronic diseases. This is achieved by reducing loneliness through strong peer support and encouraging social activities, promoting healthy behaviors by increasing health literacy, and facilitating access to healthcare services [66]. Neighborhoods significantly influence various aspects of older adults' lives, including family connections, community involvement, cultural activities, and spiritual opportunities, all of which impact their QoL. Older adults actively participate in community events such as festivals, marriage ceremonies, and funerals, contributing to stronger neighborhood bonds. They gather in shared spaces to socialize and play roles in community development activities. Social participation through these opportunities enhances their QoL, emphasizing the importance of supportive neighbors and a strong community presence for better overall well-being and QoL [67].

Interestingly, frequent contact with friends was associated with an increase in poor QoL among older adults, contrary to the existing literature [63, 68]. This unexpected result could be attributed to the impact of the COVID-19 pandemic, with people being cautious about maintaining physical proximity and adhering to social distancing measures for safety. Likewise, older adults, considered the most vulnerable group, were often kept homebound during the pandemic, leading to social isolation and a subsequent decline in QoL [34]. Furthermore, research indicates that extensive social networks can paradoxically reduce happiness, especially for older women [69]. While relationships offer support, they may also become burdensome, and supportive connections can unintentionally encourage unsupportive behaviors or dependency, impacting the well-being and physical health of older adults [69]. The contradictory findings reported in our research could also be explained by the fact that data for this study were collected during the COVID-19 pandemic, when people were avoiding contact with friends. Although our findings contradict the usual conclusions that report higher QoL with larger social networks, we do not know the length and quality of these friendships. Additionally, our study does not measure how social networks were utilized. Therefore, these factors raise intriguing questions and warrant further investigation to better understand the dynamics in this space.

Despite previous research suggesting that cultural and religious involvement contributes to the improved QoL of older adults [18, 70], surprisingly, cultural participation did not show statistical significance in relation to QoL in this study. This could be because this research use did not measure cultural elements comprehensively using any specific tool/instrument. Cultural participation has been shown to help reduce loneliness or social isolation by increasing social interaction, strengthening friendships, boosting confidence, and enhancing self-esteem [71]. However, the observed discrepancy in the lack of significance may be attributed to COVID-19 pandemic-related restrictions on cultural or religious gatherings, which could have affected overall engagement. The pandemic has led to decreased social life and fewer in-person interactions, factors associated with increased depression, sleep problems, and reduced QoL [72, 73].

Living in the same place for more than a year was associated with a higher QoL compared to those residing for less than a year. Previous research indicates that residing in a stable environment is linked to improved self-rated health [26]. A stable living environment provides residents with increased opportunities for strong socio-cultural bonds, local learning opportunities through participation in community events, the development of social capital, and a sense of security and familiarity, all contributing to the overall well-being and positive QoL for older adults [26, 54]. However, the accessibility based on travel time to the nearest city did not show a significant association with the QoL among study participants, indicating that rurality doesn't affect the QoL of older adults. This may be attributed to the study site being in the Terai area, which has better road access to major cities, facilitating commute and access to resources in nearby cities. The findings might differ if the study is replicated in hilly or mountainous regions, which are characterized by challenging terrain and limited development.

Among the covariates, chronic disease status, tobacco use, unemployment or retirement, and lack of education were statistically associated with poor QoL among participants. Chronic diseases, especially multimorbidity, have a negative impact on the QoL of older adults, a trend observed globally [3, 7, 8, 10]. Having chronic disease(s) increases the likelihood of older adults being unable to perform activities of daily living, thus leading to poorer QoL [50]. Likewise, tobacco consumption reduces the QoL of older adults by increasing the risk of chronic diseases such as cancer, cardiovascular disease, and diabetes [74]. Unemployment and retirement diminish the economic power of older adults, leading to financial insecurity and dependency, which contribute to poor QoL [32, 75]. Previous studies from Nepal also demonstrated that illiteracy was associated with poor QoL [8, 32]. No formal education contributes to lower health literacy, ultimately leading to poor QoL and low life satisfaction among the older population [76], whereas formal education improves health literacy, enabling older adults to make healthy choices and adopt healthy behaviors [8].

Limitations and strengths

This study has some limitations that should be acknowledged. First, the study fails to fully capture the built environment of the neighborhood, including access to natural areas, parks, recreational facilities, cleanliness, satisfaction with neighborhood aesthetics, walkability, and public spaces, as well as safety [39]. Access to natural parks is essential, as leisure-time physical activity in green spaces is associated with better QoL for older adults [77, 78]. Data collection in the Nepali language may have potentially excluded individuals not fluent in this language, introducing sampling bias. However, as Nepali is the official language of the country, with 91% of the population speaking or understanding it as their mother tongue or as a second language [6], any resulting bias is likely minimal. Additionally, this study did not measure the old-age monthly allowance from the government as a predictor, which could impact income and, consequently, the QoL of older adults. The government of Nepal provides a monthly allowance of 4,000 Nepali rupees (approximately 30 USD) [23]. This allowance may offer some financial support to older adults who receive it, potentially contributing to improved QoL compared to those who do not. Future studies could consider including social security allowances as significant predictors or control variables. However, we believe that omitting this variable in our study may have minimal impact, as the small monthly support does not provide substantial financial protection given Nepal's high inflation and cost of living [79]. Furthermore, being a cross-sectional study limits its capacity to establish causal associations with certain neighborhood characteristics, specifically those related to the socio-cultural environment, and thus does not describe the heterogeneous behavioral pathways of each individual [80]. Likewise, studies conducted during the COVID-19 pandemic might have shown different results; hence, studying QoL during normal times is warranted. Future longitudinal studies are recommended to include information on the built environment, the perception of neighborhood safety, belongingness, support systems, household income, and neighborhood demographic characteristics. Finally, limiting the study to selected rural areas restricts the generalizability of our findings for the whole country, particularly to urban regions.

Despite these limitations, this study has several strengths. It is one of the first to explore the effect of neighborhood environment on the QoL of older Nepali adults. Therefore, it serves as a cornerstone, setting an example for further research on neighborhood factors and the well-being of older adults in Nepal. Large sample size with a response rate of more than 90%, coupled with a robust methodology and the use of a validated tool to measure QoL are the strengths of this study. Further, involvement of locally trained enumerators who understand the local language and culture enhanced the validity and reliability of the collected data. Importantly, the majority of research team members are residents from the research setting, which ensures that findings are interpreted within a local socio-cultural lens applying strengthen-based approaches.

Conclusion

Ethnic diversity, family connections, and positive neighbor interactions are associated with higher QoL in older adults, while increased contact with friends and unstable residence during old age are linked to poorer QoL. This study provides valuable insights into the multifaceted factors shaping the QoL of older adults in Nepal. Overall, demographic environment, socio-cultural elements, and the built environment of the neighborhood play crucial roles in shaping QoL outcomes. These findings emphasize the importance of implementing neighborhood engagement strategies, such as hosting community meetings or forums, organizing events or activities, celebrating cultural festivals, and establishing communal spaces, resting areas, or community gardens. By strengthening community engagement, we can create a supportive environment where older adults feel connected, valued, and included. This approach not only fosters a sense of belonging but may also attract older adults from diverse backgrounds and enhance residential stability, both of which are important determinants of QoL in this study.

Abbreviations

AIC	Akaike information criterion
aOR	Adjusted odds ratio
CI	Confidence interval
COVID-19	Coronavirus disease 2019
EFA	Exploratory factor analysis
KM	Kilometers
Min	Minutes
OPQoL-brief	Brief Older People's Quality of Life questionnaire
OR	Odds ratio
QoL	Quality of life
Ref	Reference group
SD	Standard deviation
VIF	Variance inflation factor

Supplementary Information

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Supplementary Material 1

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Author contributions
KPS, AS, SG, UNY, RKM, SM, and OPY conceptualized the study. RKM, DRS, KKY, SCY, SM, and OPY collected the data. KPS, AS, and SG analyzed the data and interpreted the findings. KPS and AS wrote the first draft of the paper. UNY validated the interpretation of findings in line with strength-based approaches. All authors made critical revisions to the manuscript and approved the final version of the manuscript.

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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Ethical approval was obtained from the Ethical Review Board of the Nepal Health Research Council (Ref#114/2021P), and the current research plan received approval from Miami University's Research Ethics and Integrity Program (ref#04696e). Approval letters from the ward offices were obtained prior to data collection. During the consent process, older adults were briefed on the potential risks and benefits of participating in the survey. All respondents provided written informed consent via signatures or thumbprints. Additionally, respondents were informed about the voluntary nature of their participation, their right to skip questions if they were not interested, option to opt-out anytime in between the interview process, and confidentiality assured for their responses.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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