Determining the Prevalence and Risk Factors for Depressive Symptoms Among Adults in Nepal: Findings from the Dhulikhel Heart Study

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Abstract

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Background: Nepal is currently experiencing a rapid growth in non-communicable diseases (NCDs). Depression has previously been associated with NCDs in South Asia; however, data regarding the prevalence and risk factors for depression is lacking in Nepal. We sought to describe the burden of depressive symptoms within an adult population living in Dhulikhel, Nepal, a suburban town outside of Kathmandu.

Methods: We conducted a cross-sectional analysis of baseline data collected from participants enrolled in the Dhulikhel Heart Study (DHS), a population-based, longitudinal cohort study investigating risk factors for cardiovascular disease in Dhulikhel. Baseline questionnaire data consisted of a random sample of 1,073 adults age 18 years and older, which included the Center for Epidemiologic Studies Depression Scale (CESD). A cutoff score of 16 or greater on the

CESD has been shown to indicate major depressive symptomatology. Pearson's chi-squared tests and multiple logistic regression were used to examine associations between the binary CESD depressive symptom score by gender, age, education level, marital status, body mass index, and hypertensive status.

Results: Among 1,073 participants, the mean age was 40.3 years (SD: 16.4), and 58.4% were female. The mean CESD score in the sample was 11.7 (SD: 5.3), with 21.3% scoring 16 or greater suggesting major depressive symptomatology. In the adjusted model, increasing age above 60 years old (OR: 1.05, 95% CI: 1.01-1.10, p=0.01) and having no formal education (OR 2.23, 95% CI: 1.21-4.11, p=0.01) were associated with increased risk of depressive symptoms. Persons with a BMI ≥30 (OR: 0.39, 95% CI: 0.18-0.82, p=0.01) and those who were physically active (OR: 0.37, 95% CI: 0.27-0.51, p<0.001) were associated with decreased risk of depressive symptoms. Marital status, gender, ethnicity, religion, tobacco and alcohol use, and hypertension status were not significantly associated with depressive symptoms in the adjusted model.

Discussion: Major depressive symptoms are common in Nepal, with an estimated prevalence of 21.3% in this sample. Significant risk factors for increased depressive symptoms included having no formal education, increasing age above 60 years old, and physical inactivity. Being obese was associated with decreased risk of depressive symptoms, which may be due to increased wealth and greater access to food. Gender was attenuated in the adjusted model, likely due to confounding by education, since 42% of women had no formal education.

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BACKGROUND

Nepal is currently experiencing an epidemiologic transition from infectious diseases to non-communicable diseases (NCDs), leading to rapid growth in chronic conditions such as cardiovascular disease (CVD), hypertension, and type 2 diabetes. Average life expectancy has increased from 54 years in 1990 to 70 years in 2014, contributing to a double burden of both communicable diseases and NCDs in Nepal (1). In Nepal, although no routine comprehensive surveillance or registry system for NCDs currently exists, hospital data suggest that the NCD disease burden is increasing as 31% of admissions at 31 hospitals in 2010 were for NCDs (2). The World Health Organization (WHO) also estimates that deaths attributed to NCDs in Nepal have risen from 51% in 2010 to 60% in 2014 (3,4). Moreover, the probability of dying between ages 30 and 70 from NCDs is 22% (4). CVD represents the third major cause of years of life lost in Nepal (5). Along with the rise in CVD, the country has also seen a significant rise in risk factors for CVD, as the WHO STEPS survey conducted in 2013 shows that among participants age 15-69 years old, the prevalence of overweight or obesity was 21%, the prevalence of hypertension was 26%, 23% had elevated total cholesterol, and 19% were current smokers (6).

NCDs and depression exhibit a bidirectional relationship in which chronic diseases such as cardiovascular disease and diabetes increase vulnerability to developing depression due to symptom burden, psychological stress, and functional limitations, while the presence of depression also increases the risk and severity of these NCDs (7). This bidirectional relationship results in a perpetuating cycle of poor mental and physical health (7). Major depression can also adversely impact the ability to self-manage chronic medical illness and can lead to maladaptive behaviors such as smoking, over-eating, and sedentary lifestyle (8). Increasing evidence from

large epidemiological studies have shown that depressive symptoms and major depression are associated with increased morbidity and mortality from illnesses such as diabetes and heart disease (8).

Major depressive disorder is the 2nd leading cause of years lived with disability (YLDs) globally, and within Nepal it is the 5th leading cause of YLDs (5). A significant treatment gap exists between people's mental health needs and appropriate, accessible care (9). Furthermore, among those with mental illness in Nepal, significant stigma and discrimination exist, which can lead to feelings of isolation and worsened health outcomes (10). Mental health stigma is also connected to a lack of awareness about mental illness, its effects, and its treatment (9).

Depression has been significantly associated with NCDs in Nepal, as cross-sectional data collected from a group of 321 hypertensive patients showed an estimated prevalence of undiagnosed depression of 15% (11). Studies conducted among type 2 diabetic patients attending tertiary care clinics in Kathmandu, Nepal showed an estimated prevalence of depression between 40.3 and 54.1% (12-14). While data regarding risk factors and comorbid depression has been collected among type 2 diabetics and hypertensive patients attending tertiary care clinics in urban Nepal, community-based assessments of the prevalence of and risk factors for depression among the general population are lacking. Prior community-based assessments of depression are limited to post-conflict areas in the mountainous regions of northwestern Nepal that were conducted in 2008 after the conclusion of the People's War in 2006 (15,16) or were limited to only those age 60 years and older (17).

Despite the rapid growth of CVD in Nepal, there is a lack of scientific evidence regarding risk factors (including information regarding depression), incidence, and management challenges (18). Recognizing the devastating impact of NCDs on its population, Dhulikhel Hospital, in

collaboration with the University of Washington, launched the Dhulikhel Heart Study (DHS), a population-based longitudinal cohort study of cardiovascular diseases and risk factors, one of the first of its kind in a developing country. The DHS was launched in 2013 with the aim of understanding the epidemiology of CVD and associated risk factors among adult residents in the multi-ethnic suburban town of Dhulikhel, located in central Nepal. Data from the DHS will be used to develop interventions for preventing CVD and associated comorbid conditions with plans for longitudinal follow-up for 20 years.

Specific Aims

AIM 1: To characterize the prevalence of depressive symptoms within a cohort of adults living in Dhulikhel, Nepal.

AIM 2: To describe the risk factors associated with depressive symptoms within a cohort of adults living in Dhulikhel, Nepal.

METHODS

Study Design and Setting

We conducted a descriptive, cross-sectional analysis of baseline data collected from participants enrolled in the DHS which is an ongoing population-based, longitudinal cohort study investigating risk factors for cardiovascular disease in Dhulikhel, Nepal (19). Baseline data for DHS participants was recently collected for a random sample of 1,073 adults age 18 years or older.

Study Participants

All adults age 18 years and older living in Dhulikhel, Nepal for at least 6 months were eligible for the DHS. A third of the households residing in each of the nine administrative divisions of Dhulikhel were selected for collection of baseline data. Exclusion criteria included: being pregnant at the time of data collection, temporary residents living in Dhulikhel less than 6 months or staying in hostels/motels, individuals who are mentally challenged and unable to respond, and individuals who refuse to participate. All participants provided written informed consent or a thumbprint for illiterate participants.

Ethical Approval

Study protocol for the DHS was reviewed and approved by Institutional Review Committee at Kathmandu University School of Medicine Sciences Institutional Review Committee and the University of Washington in Seattle, WA. Study protocol for this secondary data analysis was also reviewed and deemed to not be human subjects research by the University of Washington in Seattle, WA, as the authors did not participate in collecting individual data from enrolled DHS patients, data was anonymized upon collection, and authors did not have access to identifying information.

Data Collection and Study Parameters

The baseline visit included a standardized questionnaire administered through electronic tablet, physical exam, and laboratory testing. All data enumerators were trained in interviewing and measuring variables. Demographic data, including information regarding age, sex, ethnicity, marital status, education, economic status, diet, tobacco use, alcohol consumption, and physical activity were collected. Height, weight, and waist and hip circumference were measured using standardized instruments. Body Mass Index (BMI) was calculated as kg/m^2 and categorized as underweight ($<18.5\ kg/m^2$), normal ($18.5\text{-}24.9\ kg/m^2$), overweight ($25\text{-}29.9\ kg/m^2$), and obese

(>29.9 kg/m^2), according to WHO classifications [WHO 1995]. Using a standard digital blood pressure machine (Microlife, Switzerland), blood pressure was measured three times in a seated position on the right arm over loose clothing. The mean of the three measurements was calculated and used for analysis. Hypertension was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg or receiving medication for hypertension.

Assessment of Physical Activity

The Global Physical Activity Questionnaire (GPAQ) developed by the WHO was used to assess several components of physical activity, including intensity, duration and frequency in three domains of occupational physical activity, transport-related physical activity, and physical activity during leisure time (21). The WHO recommends that during one week, adults should do at least 600 MET-minutes of physical activity, including activity for work, during transport, and leisure time (21). Thus, the physical activity variable was dichotomized with a cutoff of 600 MET-minutes of physical activity per week for analysis.

Assessment of Depressive Symptoms

The Center for Epidemiologic Studies Depression Scale (CES-D) was used to assess depressive symptoms. The CES-D is a 20-item measure that asks participants to rate how often over the past week they have experienced symptoms associated with depression such as restless sleep, poor appetite, sadness, and hopelessness. There are four response options – rarely (<1 day), some (1-2 days), occasionally (3-4 days), and most (5-7 days). Items are scored 0-3 with an instrument range of 0-60. The CES-D represents an accurate and valid measurement of depression with high internal consistency and is frequently used in clinical and research settings to determine depression symptomatology in the general population (22,23). Prior studies in

Nepal have used the CES-D questionnaire to examine depressive symptoms among leprosy-affected patients (24) and female sex workers (25). Higher scores indicate greater frequency of depressive symptoms and correlate with an increased risk of clinical depression. Depression scores were dichotomized with a cutoff score of 16 or greater on the CES-D for analysis.

Statistical Analysis

STATA 13 was used for data analysis. Descriptive statistics were presented in frequency and percentages to identify the distribution of risk factors for depressive symptoms among socio-demographic characteristics. Baseline characteristics were compared between high and low depressive symptoms groups using Pearson's chi-squared tests for categorical variables and t-tests with unequal variance for continuous variables. All tests were two-tailed and $p \leq 0.05$ was considered statistically significant. Multiple logistic regression was used to examine associations between the binary CES-D depressive symptom score variable by gender, age, education level, marital status, body mass index, and hypertensive status. Potential confounders including gender, age, ethnicity, religion, education, and marital status were adjusted for in the regression analysis.

RESULTS

Socio-demographic Characteristics of Participants by Gender

Table 1 shows the socio-demographic characteristics of participants by gender. Among 1,073 participants, the mean age was 40.3 years (SD: 16.4), and 58.4% were female. 49% of the participants were of Newar ethnicity, and 85% self-reported their religion as Hindu. Women were much more likely to have no formal education (42%) and to be separated or widowed (9.4%) compared to men (17.3% and 1.1%, respectively). Women were also more likely to be

obese (9.4%) compared to men (5.4%). More males were current smokers (35.7%) compared to females (14.2%). Men were more likely to be heavier drinkers, with 29.6% reporting having >3 drinks/week compared to 7.8% for women. Men were also more likely to be hypertensive (39.5%) compared to women (23.1%).

Table 1. Socio-demographic, lifestyle, and clinical characteristics of participants by gender

Characteristic	Males N = 446		Females N = 627		Total N = 1073		P-value
	n	%	n	%	n	%	
Total Screened	446	41.6	627	58.4	1073		
Age (Mean, SD)	40.8 (16.5)		40.0 (16.3)		40.3 (16.4)		0.46**
Age (Years)							0.47*
18-24	91	20.4	140	22.3	231	21.5	
25-34	90	20.2	129	20.6	219	20.4	
35-44	81	18.2	129	20.6	210	19.6	
45-54	94	21.1	102	16.3	196	18.3	
55-64	49	11.0	71	11.3	120	11.2	
65+	41	9.2	56	8.9	97	9.0	
Ethnicity							0.53*
Brahmin	71	15.9	85	13.6	156	14.5	
Chettri/Thakuri/Sanyasi	64	14.4	78	12.4	142	13.2	
Newar	214	48.0	314	50.1	528	49.2	
Sherpa/Bhote	63	14.1	105	16.8	168	15.7	
Magar/Tamang, Kami/Damai/Sarki, Other	34	7.6	45	7.2	79	7.4	
Religion							0.90*
Hindu	379	85.0	531	84.7	910	84.8	
Non-Hindu	67	15.0	96	15.3	163	15.2	
Education Level							**<0.0001***
No formal education	129	17.3	126	42.0	255	23.8	
Less than high school	240	53.8	238	38.0	478	44.6	
High school or more	77	28.9	263	20.1	340	31.7	
Marital Status							**<0.0001***
Never married	102	22.9	123	19.6	225	21.0	
Currently married	339	76.0	445	71.0	784	73.1	
Separated/Widowed	5	1.1	59	9.4	64	6.0	
Tobacco Use							**<0.0001***
Current	159	35.7	89	14.2	248	23.1	
Former	56	12.6	43	6.9	99	9.2	
Never	231	51.8	495	79.0	726	67.7	
Alcohol Use (drinks/week)							**<0.0001***
<1	229	51.4	506	80.7	735	68.5	
1-3	46	10.3	52	8.3	98	9.1	
>3	132	29.6	49	7.8	181	16.9	
Physical Activity							0.13*
<600 MET min/wk	164	36.8	259	41.3	423	39.4	
>=600 MET min/wk	282	63.2	368	58.7	650	60.6	
BMI (kg/m^2)							0.09*
<18.5	28	6.3	36	5.7	64	6.0	

18.5-24.9	265	59.4	346	55.2	611	56.9	
25-29.9	129	28.9	186	29.7	315	29.4	
≥30	24	5.4	59	9.4	83	7.7	
Hypertension							**<0.0001***
No	270	60.5	482	76.9	752	70.1	
Yes	176	39.5	145	23.1	321	29.9	

**t-test with unequal variance, *Pearson's chi-squared tests

Depressive Symptoms

Table 2 shows the socio-demographic characteristics of participants by depression status. The mean CES-D score in the sample was 11.7 (SD: 5.3), and the estimated prevalence of depressive symptoms was 21.3%. Women were more likely to have depressive symptoms (24.1%) than men (17.3%). Increasing age, especially age above 60 years old, those with no formal education, and those who were separated or widowed also represented significant risk factors for depressive symptoms. Indeed, when examining the age distribution of participants with depressive symptoms, the prevalence of depressive symptoms remains stable at approximately 20% for adults until about age 60, when it begins to steadily increase to almost 50% at age 90. Thus, increasing age above 60 years old was associated with a higher prevalence of depressive symptoms. Having no formal education was also associated with higher risk of depressive symptoms, as 28.8% of those with no formal education had depressive symptoms, compared with only 17.2% among those who had less than high school and 18.8% who had high school level education or more. Being separated or widowed was also significantly associated with a higher risk of depressive symptoms, as 37.5% of those who were separated or widowed had depressive symptoms, compared to only 19.3% among those who were currently married.

Table 2. Socio-demographic and basic clinical characteristics of participants by depression status

Characteristic	No Depression (CES-D<16)		Depression (CES-D≥16)		Total	P-value
	n	%	n	%	N	
Total Screened	845	78.8	228	21.3	1073	
Gender						**0.007***
Male	369	82.7	77	17.3	446	
Female	476	75.9	151	24.1	627	
Age (Mean, SD)	40.0 (15.8)		41.71 (18.3)		40.3 (16.4)	0.19**
Age (Years)						**0.004***
18-24	176	76.2	55	23.8	231	
25-34	180	82.2	39	17.8	219	
35-44	170	81.0	40	19.1	210	
45-54	159	81.1	37	18.9	196	
55-64	98	81.7	22	18.3	120	
65+	62	63.9	35	36.1	97	
Ethnicity						0.86*
Brahmin	122	78.2	34	21.8	156	
Chettri/Thakuri/Sanyasi	115	81.0	27	19.0	142	
Newar	419	79.4	109	20.6	528	
Sherpa/Bhote	129	76.8	39	23.2	168	
Magar/Tamang, Kami/Damai/Sarki, Other	60	76.0	19	24.1	79	
Religion						0.58*
Hindu	714	78.5	196	21.5	910	
Non-Hindu	131	80.4	32	19.6	163	
Education Level						**<0.0001***
No formal education	242	71.2	98	28.8	340	
Less than high school	396	82.9	82	17.2	478	
High school or more	207	81.2	48	18.8	255	
Marital Status						**0.002***
Never married	172	76.4	53	23.6	225	
Currently married	633	80.7	151	19.3	784	
Separated/Widowed	40	62.5	24	37.5	64	
Tobacco Use						0.17*
Current	203	81.9	45	18.2	248	
Former	72	72.7	27	27.3	99	
Never	570	78.5	156	21.5	726	
Alcohol Use (drinks/week)						0.15*
<1	648	77.8	185	22.2	833	
1-3	52	88.1	7	11.9	59	
>3	145	80.1	36	19.9	181	
Physical Activity						0.13*
<600 MET min/wk	291	68.8	132	31.2	423	
≥600 MET min/wk	554	85.2	96	14.8	650	
BMI (kg/m^2)						0.09*
<18.5	48	75.0	16	25.0	64	
18.5-24.9	474	77.6	137	22.4	611	
25-29.9	249	79.1	66	21.0	315	
≥30	74	89.2	9	10.8	83	
Hypertension						0.72*
No	590	78.5	162	21.5	752	
Yes	255	79.4	66	20.6	321	

**t-test with unequal variance, *Pearson's chi-squared tests

Major risk factors of depressive symptoms

The results of the multiple logistic regression analysis to determine the association between socio-demographic and lifestyle factors and depression symptoms are shown in Table 3. In unadjusted models, a statistically significant increased risk of depressive symptoms was associated with female gender ($p=0.007$), increasing age above 60 years ($p=0.002$), having no formal education ($p<0.001$), being separated/widowed ($p=0.002$), and physical inactivity ($p<0.001$). BMI $\geq$30 was associated with a statistically significant decreased risk ($p=0.02$) of depressive symptoms when compared to people of normal BMI in the unadjusted model.

In the adjusted model, increasing age above 60 years ($p=0.01$), having no formal education ($p=0.01$), and physical inactivity ($p<0.001$) were associated with a statistically significant increased risk of depressive symptoms. In the adjusted model, for every one-year increase above age 60, odds of having depressive symptoms were higher by 5%. Having no formal education was associated with 2.2 times higher odds of depressive symptoms when compared to those with at least a high school education. Physical activity as a risk factor remained relatively unchanged in the adjusted model, as recommended levels of physical activity were associated with 63% lower odds of depressive symptoms. BMI $\geq$30 also remained as a statistically significant factor that was associated with 63% lower odds of having depressive symptoms compared to those with normal BMI in the adjusted model. Risk factors that were found to have no statistically significant association with depressive symptoms after adjustment for demographic variables included gender, ethnicity, religion, tobacco use, alcohol use, and hypertensive status.

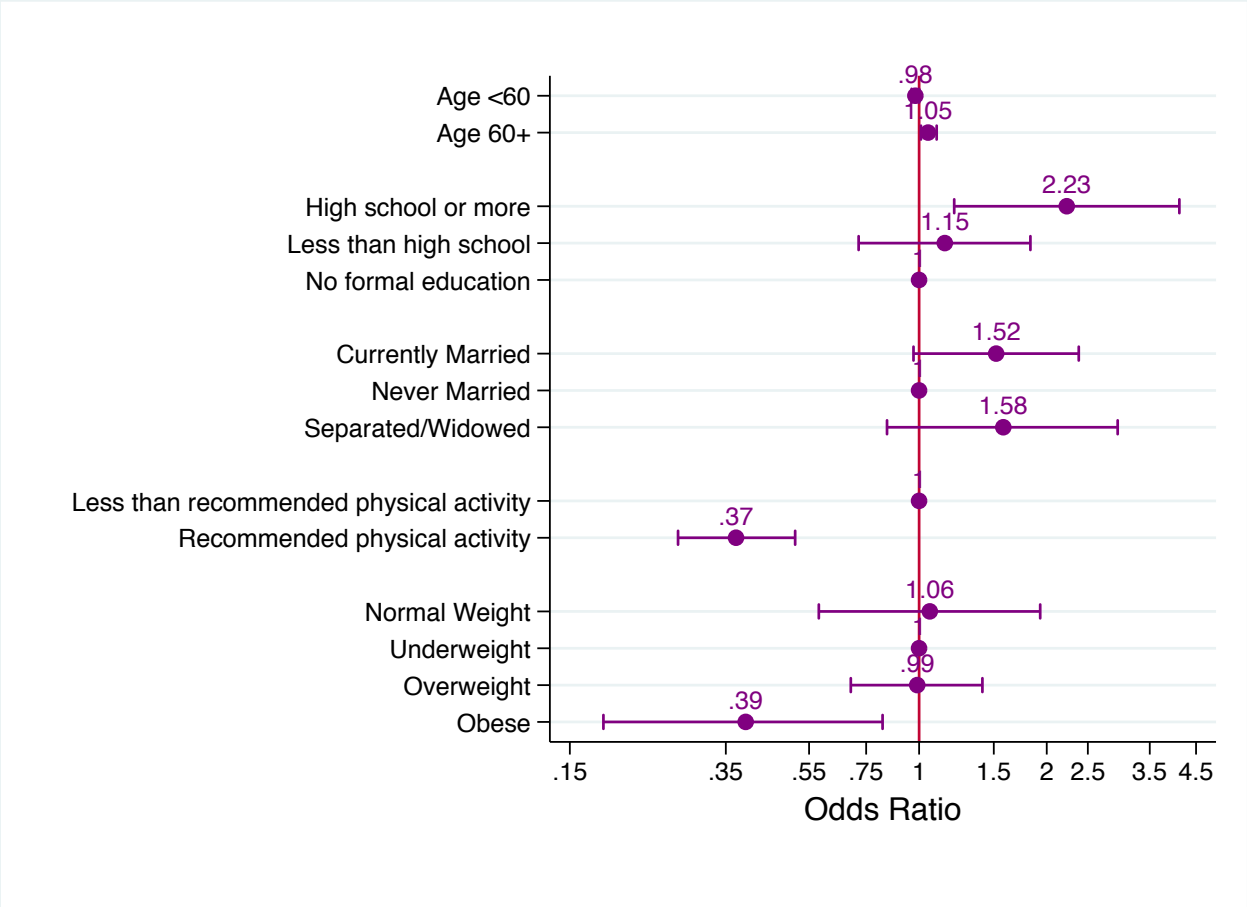
Table 3. Multiple logistic regression analysis for determining the association of socio-demographic characteristics and depression symptoms among DHS participants

Characteristic	n	Unadjusted OR	Unadjusted CI 95%	Unadjusted p	Adjusted* OR	Adjusted* CI 95%	Adjusted* p
Gender							
Male	446	Ref	-	-	Ref	-	-
Female	627	1.52	1.12-2.07	**0.007**	1.22	0.87-1.71	0.24
Age (Years)ǂ				**0.002**			**0.03**
<60		0.99	0.98-1.01	0.43	0.98	0.96-1.00	0.09
≥60		1.07	1.03-1.11	**0.001**	1.05	1.01-1.10	**0.01**
Ethnicity				0.86			0.55
Brahmin	156	Ref	-	-	Ref	-	-
Chettri/Thakuri/Sanyasi	142	0.84	0.48-1.48	0.55	0.87	0.48-1.57	0.64
Newar	528	0.93	0.60-1.44	0.76	0.97	0.62-1.53	0.91
Sherpa/Bhote	168	1.08	0.64-1.83	0.76	1.70	0.74-3.90	0.21
Magar/Tamang, Kami/Damai/Sarki, Other	79	1.14	0.60-2.16	0.70	1.22	0.64-2.33	0.54
Religion							
Hindu	910	Ref	-	-	Ref	-	-
Non-Hindu	163	0.89	0.59-1.35	0.58	0.48	0.22-1.05	0.06
Education Level				**<0.001**			**0.007**
No formal education	340	1.75	1.18-2.59	**0.005**	2.23	1.21-4.11	**0.01**
Less than high school	478	0.89	0.60-1.32	0.57	1.15	0.72-1.83	0.57
High school or more	255	Ref	-	-	Ref	-	-
Marital Status				**0.002**			0.07
Currently married	784	Ref	-	-	Ref	-	-
Never married	225	1.29	0.91-1.84	0.16	1.52	0.97-2.38	0.07
Separated/Widowed	64	2.52	1.47-4.30	**0.001**	1.58	0.84-2.94	0.15
Tobacco Use				0.17			0.46
Never	726	Ref	-	**-**	Ref	-	-
Current	248	0.81	0.56-1.17	0.20	0.81	0.53-1.23	0.32
Former	99	1.37	0.85-2.21	0.26	1.13	0.65-1.98	0.66
Alcohol Use (drinks/week)				0.16			0.23
<1	833	Ref	-	**-**	Ref	-	-
1-3	59	0.47	0.21-1.06	0.07	0.49	0.22-1.11	0.09
>3	181	0.87	0.58-1.30	0.49	0.94	0.58-1.52	0.80
Physical Activity							
<600 MET min/wk	423	Ref	-	**-**	Ref	-	-
≥600 MET min/wk	650	0.38	0.28-0.52	**<0.001**	0.37	0.27-0.51	**<0.001**
BMI (kg/m^2)				0.11			0.09
<18.5	64	1.15	0.63-2.10	0.64	1.06	0.58-1.93	0.85
18.5-24.9	611	Ref	-	-	Ref	-	-
25-29.9	315	0.92	0.66-1.28	0.61	0.99	0.69-1.41	0.94
≥30	83	0.42	0.21-0.86	**0.02**	0.39	0.18-0.82	**0.01**
Hypertension				0.72			
No	752	Ref	-	-	Ref	-	-
Yes	321	0.94	0.68-1.30	0.72	0.96	0.66-1.39	0.82

*Adjusted for demographic variables (gender, age, ethnicity, religion, education, marital status)

ǂSpline variable, per one year increase in age above age 60

Figure 1. Significant Risk Factors for Depressive Symptoms, Adjusted Model



DISCUSSION

Prevalence of Depressive Symptoms

This analysis of adults age 18 and older in Dhulikhel found an overall prevalence of depressive symptoms of 21.3%. This prevalence is relatively consistent with previously reported studies, which range from 11.7% prevalence of depression among 2,100 Nepalese adults age 18-65 (26), to 15% among 321 hypertensive patients in Kathmandu (11), to 27.5% among 720 adults in five districts in Nepal (16). This prevalence of depressive symptoms is also four times greater than the estimated global prevalence of major depressive disorder of 4.7% (27), indicating significant mental health burden in this population.

Risk Factors for Depressive Symptoms

Significant risk factors for depressive symptoms in the adjusted model included having no formal education, increasing age above 60 years old, and physical inactivity. Low levels of education and illiteracy have been described as risk factors for depression in prior studies among type 2 diabetics and hypertensive patients, respectively, attending tertiary care centers in Kathmandu, Nepal (11, 13). Older age has also been shown in prior studies to be a risk factor for depressive symptoms in Nepal. A study among 321 patients with hypertension attending a tertiary care center in Kathmandu, Nepal found increasing depression scores with each additional decade of age, with 29% of those age above 64 years having depressive symptoms, compared to only 11% of those who were age 45-64 years and 24-44 years (11). Moreover, Joshi et al found that among 379 patients with type 2 diabetes attending three treatment centers in Kathmandu, there was a positive association between depression and those age 61-70 years (13). Kohrt et al also found a similar trend in a post-conflict setting in northwestern Nepal, with increasing depression scores associated with increasing decades of age, with the highest risk group being those age 52-80 (15). A community-based assessment among 165 adults age 60 and above living in the Kathmandu Valley found a prevalence of depression of 29.7% (17).

Physical inactivity has also been shown to be a risk factor for depression and is known to mediate the relationship between depression and mortality among community-dwelling adults in a multicenter study in the US among adults age 65 and older (28). Prior studies show that gender may modify the relationship between physical activity and depression, as Gautam et al showed that among 489 community dwelling adults age 60 and above in Nepal, physical activity was associated with decreased depressive symptoms in men but not in women (29).

We also found that being obese (BMI ≥30) was associated with statistically significant

lower odds of depressive symptoms by 60% when compared with participants of normal weight. This represents a new finding that has not been reported in previous data from Nepal. Results from prior studies globally have been mixed, as those conducted in the U.S. and Europe have found a positive association between obesity and depression (30, 31). Nevertheless, data from Asian countries such as Japan, Taiwan, and China have shown a negative association between obesity and depression (32-34). Still others, such as a study in Korea, found a U-shaped distribution, where the highest level of depressive symptoms was found among the underweight (BMI <18.5), followed by the severely obese (BMI ≥30) and then the obese (BMI 25-30) (35). Our data showed that compared to participants with normal BMI, the highest risk of depressive symptoms was found among the underweight (BMI <18.5), followed by overweight (BMI 25-29.9) and then obese (BMI ≥30).

One potential explanation for this finding is that being obese may be a sign of higher socioeconomic status (SES) within the caste system. Data from India has shown that high caste is positively associated with obesity, mainly through increased wealth (36, 37). Moreover, a prior study examining the relationship between BMI and SES in 37 lower- and middle-income countries found that increased BMI was associated with increased wealth and higher SES (38). In this way, being obese may signify having higher income and greater access to food, thus less likelihood to have depressive symptoms.

Another explanation could be due to differing perceptions of body weight, as studies of body weight among women in South India have shown that women tend to have discrepancies in self-perceived body weight and actual body weight (39). In this way, women who are overweight or obese perceive themselves as normal weight (39). This finding is an important consideration, as obesity is a risk factor for many NCDs, including CVD, hypertension, and diabetes. Our data,

however, show that those who are underweight are most at risk for depressive symptoms and being obese was associated with a decreased risk of depressive symptoms.

While female gender has been associated with depressive symptoms in Nepal in previous studies (11,13), another study conducted in Nepal showed no association between gender and depressive symptoms among a cohort of 385 patients with type 2 diabetes attending tertiary care centers in Kathmandu, Nepal (12). This analysis found that although female gender was associated with depressive symptoms in unadjusted models, after adjustment for other demographic variables it was no longer statistically significant (OR:1.22, 95% CI: 0.87-1.71). This was likely due to education confounding the association between female gender and depressive symptoms given that 42% of females had no formal education and having no formal education was strongly associated with depressive symptoms.

Our study did not show a significant association of alcohol consumption and tobacco use with depressive symptoms. Although some studies among type 2 diabetics in Nepal have shown an association between tobacco use and depressive symptoms (11), other studies conducted among type 2 diabetics and hypertensive patients in Kathmandu, Nepal have not shown an association between either tobacco use or alcohol use and depressive symptoms (12, 13). In this analysis, the lack of a statistically significant association may be reflective of the fact that both tobacco use and alcohol use were self-reported measures and not many individuals with depressive symptoms reported heavy smoking or drinking, as almost 70% of those with depressive symptoms had never smoked, and 81% had less than 1 alcoholic drink per week.

Hypertension has also been associated with depressive symptoms in previous studies in Nepal (11). However, our analysis did not show an association between hypertensive status and depressive symptoms. This could be due to the fact that our definition of hypertension in the

study included individuals taking anti-hypertensive medications. Taking anti-hypertensive medications has been associated with lower risk of depression (11). Thus, the fact that some hypertensive individuals were receiving treatment for their hypertension could have confounded the relationship between hypertension and depressive symptoms.

Our study also did not show a significant association between ethnicity and depressive symptoms. While some prior studies that have shown an association between low-caste ethnicity groups and higher prevalence of depression (15,40), others have not found a significant association between ethnicity and depressive symptoms (11-13). Our finding is likely due to the fact that the majority of our sample belonged to the Brahmins and Newars, which are the higher income ethnic groups (40). Thus, with a higher socio-economic status, they may have been more likely to have access to healthcare facilities to start treatment for chronic conditions and less likely to develop associated depressive symptoms.

Strengths and Limitations

This study has several limitations. The cross-sectional design of this study prevents the ability to establish causal associations or directionality between risk factors and development of depressive symptoms. Since subjective self-reported behaviors were reported in the questionnaire data, participants may have not disclosed the full extent of their depressive symptoms due to stigma. Additionally, the questionnaire format may not have captured other unmeasured variables that could be contributing to the development of depressive symptoms, and the estimated prevalence from this analysis likely underestimates the true prevalence of depression in the community. This analysis is also specific to community members in Dhulikhel, a suburban town with a tertiary healthcare center, and thus these results may not be generalizable to other populations in Nepal due to high levels of ethnic and geographic variation within the country.

To our knowledge, this represents one of the first suburban, community-based assessments of depressive symptoms among a general population of adults age 18 and older in a non-conflict zone of Nepal. The random sampling technique, large sample size, and extensive collection of information on demographic and clinical risk factors represent strengths of this study in determining the prevalence and risk factors for depressive symptoms in this cohort.

CONCLUSION

This study describes the prevalence and risk factors for depressive symptoms in a suburban population of adults within Nepal. Major depressive symptoms are highly prevalent in Nepal and a significant treatment gap exists between the population's mental health needs and appropriate accessible care. Integrated programs specifically targeting the uneducated, the elderly, and the physically inactive should be explored to address this high burden of depressive symptoms.

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