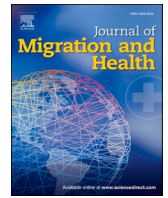


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Association of mental health with living and working conditions among Nepali migrant workers in destination countries

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ABSTRACT

Background: Depression, anxiety, and stress are widespread mental health conditions globally. Migrant workers, in particular, are vulnerable to experiencing these mental health challenges, including Nepali migrant workers. There have been limited studies on adverse living and working conditions prevalent in their circumstances and development of these mental illnesses among this population. The study aims to assess association between mental health and living and working conditions among Nepali migrant workers which, otherwise, has not been explored or examined.

Methods: We conducted a cross-sectional study with 334 Nepali migrant workers employed in Korea, Malaysia, Saudi Arabia, Kuwait, UAE, and Qatar using convenience sampling. We collected the data using two approaches; an online self-administered questionnaire for migrant workers living in their respective countries of employment and interview with migrant returnees at Tribhuvan International Airport in Nepal. We fitted three hierarchical multivariate logistic regression models and gsem models to explore potential association between depression symptoms, anxiety symptoms, stress symptoms and living and working conditions, respectively.

Result: Depression, anxiety and stress is highly prevalent among Nepali migrant workers working in Korea, Malaysia, Saudi Arabia, Kuwait, UAE, Qatar. About 20 %, 20 % and 15 % of the study participants had symptoms of depression, anxiety symptoms and stress symptoms, respectively. About 49 % and 36 % of study participants had poor working conditions and poor living conditions, respectively. The analyses showed that there are associations of depression symptoms, anxiety symptoms and stress symptoms with living and working conditions, respectively. The odds of having depression symptoms (aOR: 2.76, 95 % CI: 1.27-6.01, p value=0.010), anxiety symptoms (aOR: 3.93, 95 % CI: 1.71-8.98, p value=0.001), and stress symptoms (aOR: 4.81, 95 % CI: 1.80-12.82, p value=0.002) was higher among study participants with poor living conditions compared to good living conditions.

Meanwhile, the odds of having depression symptoms (aOR: 4.03, 95 % CI: 1.83-8.90, p value=0.001), anxiety symptoms (aOR: 2.33, (95 % CI: 1.10-4.92, p value=0.026), and stress symptoms (aOR: 3.18, 1.30-7.75, p value=0.011) was higher among study participants with poor working conditions compared to good working conditions.

Conclusion: The high prevalence of depression, anxiety, and stress among Nepali migrant workers due to poor conditions necessitates action. Pre-departure mental health programs are crucial, and both origin and destination governments must ensure safe and dignified conditions for these workers. Implementing these measures can alleviate mental health challenges and enhance their well-being.

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1. Background

Poor mental health is a growing concern among migrant workers with about 39 % of them experiencing depression and about 27 % of migrant workers facing anxiety (Hasan et al., 2021). The impact of poor mental health on the working population can be severe, leading to reduced productivity and increased healthcare costs (Devkota et al., 2021). Globally, 169 million are migrant workers, significantly contributing to their destination countries' economies (International Labour Organization, 2021). World Health Organization/International Labor Organization (WHO/ILO) estimates 7,500 individuals lose their lives daily due to unsafe and unhealthy working conditions every day, contributing to 5-7 % of global deaths (International Labour Organization, 2019). Migrant workers represent a vulnerable and hard-to-reach population, exposed to diverse circumstances in their destination countries compared to their country of origin. Work-related factors such as long working hours, inadequate rest periods, irregular work schedules, and insufficient remuneration can significantly impact both physical and mental health (International Labour Organization, 2022). Ensuring a safe work environment is not only crucial for the well-being of migrant workers but also has significant economic implications, as lost work days worldwide account for approximately 4 % of the world's GDP (International Labour Organization, 2019).

Nepal, being an underdeveloped country, faces an unemployment rate of 11 % (Central Bureau of Statistics, National Planning Commission, Government of Nepal, International Labour Organization, 2019). To address this issue, many Nepalis seek employment opportunities abroad. In 2019, approximately 236,208 Nepali individuals received labor approvals for foreign employment (Ministry of Labour, Employment and Social Security, Government of Nepal, 2020). Among the popular destination countries for Nepali migrants, Qatar holds the highest share at 31.8 %, followed by the UAE at 26.5 %, Saudi Arabia at 19.5 %, Kuwait at 6.8 %, and Malaysia at 4.2 %, respectively, accounting for 88 % of total Nepali migrants in 2018/2019 (Ministry of Labour, Employment and Social Security, Government of Nepal, 2020). In addition to these countries, Korea has also emerged as a destination country for employment since 2007, with around 8,511 Nepali workers leaving for Korea in 2018 under the Employment Permit System (EPS) (Ministry of Labour, Employment and Social Security, Government of Nepal, 2020).

Most migrant workers begin their migration as healthy individuals, but often face various challenges in the cycle of migration, leading to vulnerabilities in their physical and mental well-being (International Labour Organization, 2019). Among Nepali migrant workers, mental health issues are highly prevalent (Devkota et al., 2021, Joshi et al., 2011, Paudyal et al., 2020, Regmi et al., 2019, Khaled and Gray, 2019, Dhungana et al., 2019), with depression and anxiety affecting around 23 % and 56 % of them, respectively (Mahat et al., 2021). Besides, studies also show that mental health problems have a relationship with working (Burgard et al., 2013), and living conditions (Organista et al., 2017, Vahabi et al., 2018, Mangrio and Zdravkovic, 2018). In overcrowded living conditions, migrant workers are reported to be 46 % more likely to have mental health problems (Mangrio and Zdravkovic, 2018). Similarly, migrant workers working in environment not meeting labor standards are reported to be 66 % more likely to be depressive (Sohn et al., 2016). A study shows that Nepali migrant workers who rated their work environment as poor or very poor had two times higher odds of experiencing mental health problems (Adhikary et al., 2018). Additionally, a qualitative study revealed that factors such as adverse living and working conditions, long working hours without breaks, and unhealthy lifestyles contribute to migrant workers' poor mental health (Devkota et al., 2021). However, there is a paucity of research that explores living and working conditions as influencing factors for the mental health problems among Nepali migrant workers.

This study aims to fill this gap by examining the association between mental health and living and working conditions among Nepali migrant

workers in Korea, Malaysia, Qatar, Saudi Arabia, Kuwait, and the UAE. The findings from this study can offer valuable insights to address the mental health issues faced by this vulnerable population and can serve as a foundation for future policy and further research on mental health among other migrant worker populations. By understanding the unique challenges faced by Nepali migrant workers in these countries, policy-makers and stakeholders can develop targeted interventions to address their mental health needs and ensure safer and healthier living and working conditions. Ultimately, this study can contribute to promoting the overall well-being of migrant workers and improving their work experiences in foreign countries.

2. Methods and materials

2.1. Study design

This is a cross-sectional analytical study among Nepali migrant workers.

2.2. Study participants

Our study participants were migrant workers working in Korea, Malaysia, Saudi Arabia, Kuwait, UAE or Qatar at the time of data collection. We included the Nepali migrants who were 18 years old and older and were working in Korea, Malaysia and Middle East countries such as Saudi Arabia, Kuwait, UAE, or Qatar at the time of data collection. We excluded the Nepali migrants who did not have an experience in foreign employment for at least of one year before the time of data collection.

2.3. Sample size and sampling technique

The sample size of 334 was determined using a depression proportion of 0.68 from a previous study (Khaled and Gray, 2019), with a 95 % confidence level. Due to a lack of a sampling list of all Nepali migrants in the mentioned countries, we utilized a convenience sampling method. To recruit participants, we identified focal persons from two social media groups, 'Dari gang' and 'Mens Room Reloaded', and provided them with information about the research objectives; and identified eligible participants through them. Additionally, we recruited migrant returnees at Tribhuvan International Airport (TIA). Out of the total sample, 12 % were recruited at TIA. Informed consent was obtained from all participants before recruiting in the study. We took an ethical approval from the Institutional Review Board of Kathmandu University School of Medical Sciences (KU IRC), Dhulikhel, Kavre (KUSMS approval number 61/22).

2.4. Data collection technique

After obtaining informed consent, we circulated an online questionnaire link among study participants that were self-administered, meanwhile one of the researchers from the team stayed online as standby to address the questions when needed and once the questionnaire was completed, it was then submitted. A trained research assistant interviewed the migrant workers at the TIA using the same questionnaire, and the responses were directly filled into the KoboToolBox. We collected the data from July 18, 2022 to October 24, 2022.

2.5. Data collection tools

- 1. Depression, Anxiety and Stress:** We employed a validated Nepali version of the Depression, Anxiety, and Stress Scale 21 (DASS-21) questionnaire (Thapa et al., 2022), to evaluate depression, anxiety, and stress symptoms. The instrument in our study demonstrated a strong internal consistency with Cronbach's alpha values of 0.87, 0.88 and 0.88 for each domain of depression, anxiety and stress. The

DASS-21 is suitable for use in non-clinical settings as well (Lovibond and Lovibond, 1995). This questionnaire consists of 21 questions, which assess three domains: depression (items 3, 5, 10, 13, 16, 17, 21), anxiety (items 2, 4, 7, 9, 15, 19, 20), and stress (items 1, 6, 8, 11, 12, 14, 18). Based on the DASS-21 questionnaire, a person is said to have depression symptoms if s/he scores more than 9 in the survey, a person is said to have anxiety symptoms if s/he scores more than 7 in the survey, and a person is said to have stress symptoms if s/he scores more than 14 in the survey.

2. **Working and living conditions:** We designed a questionnaire to assess living conditions based on the 'Workers' housing standards' provided by the International Labor Organization (International Labour Organization, 1961), and working conditions considering the 'Guide to International Labor Standards' (International Labour Office, 2014). We translated the questionnaire into Nepali and conducted a pretest to ensure its appropriateness. The final version of the tool was developed by incorporating feedback obtained during the pretesting phase. The questionnaire demonstrated strong internal consistency with Cronbach's alpha values of 0.79 and 0.80 for working and living conditions, respectively.
3. **Lifestyle factors:** To assess lifestyle-related factors, we utilized various standardized survey questionnaires. For alcohol consumption, we employed the STEPS survey questionnaire (Ministry of Health and Population, Nepal Health Research Council, World Health Organization, 2019), while for smoking practices, we used the Global Adult Tobacco Survey (GATS) (Global Adult Tobacco Survey Collaborative Group, 2020). To assess diet quality, we used the Diet Quality Questionnaire (DQQ), with a Cronbach's alpha value of 0.87 in our study (Global Diet Quality Project - DQQ Tools and Data, 2022).
4. **Other variables:** For assessing the socio-demographic variables, we used variables such as age (in years), sex (male/female/others), ethnicity (brahmin/chettri /madhesi/dalit / newar /janajati /muslim/other/refused), religion (Hindu/Buddhist/Muslim/Christian/ Others/Refused), Marital status (Never married/currently married/separated/ divorced/widowed/cohabitating/refused), years of educational attainment, occupation, family type(nuclear/joint), years spent in foreign employment, type of residency, last visit made to family, daily working hours, daily rest hours, current weekly wage (in US dollars).

2.6. Data analysis

The statistical analysis was conducted in STATA-13. Sample characteristics were presented using means and standard deviations (SDs) for continuous variables, and percentages for categorical variables separately for men and women as shown in S1 and S2 Table.

We calculated a weighted score for the working conditions. We gave a score 1 for "Yes" and 0 for "No" and created missing data for the observations with "Not applicable". We then summed the total score received out of 17 questions. For the denominator to calculate a weighted score, we used the total of questions answered either yes or no. The working condition score was then multiplied by 100. Similarly, we calculated the score for living conditions. We scored 1 for "Yes" and 0 for "No". We then categorized the total score into two categories; poor and good, using the median value as cut off points. We used the median score as the cutoff value to categorize working conditions (poor/good) which we assessed through 17 items presented in S3 Table and living conditions (poor/good) which we assessed through 14 items as shown in S4 Table. We used a median value as the cut-off points for both conditions since they were not normally distributed.

As per the DASS-21 scoring system, the depression, anxiety, and stress symptom scores are categorized into normal, mild, moderate, severe, and extremely severe based on established cut-off values. In our dataset, the number of participants falling into the mild to extremely severe categories were relatively small, resulting in sparse data within

multiple outcome categories. To ensure adequate cell counts for statistical analysis and obtain stable parameter estimates, we dichotomized these variables into two groups: "no depression" (normal) and "yes depression" (mild to extremely severe). The same approach was applied for anxiety and stress variables.

To assess the association between mental health (depression symptoms, anxiety symptoms, and stress symptoms) and these conditions, we initially attempted to model the continuous DASS-21 scores using linear regression; however, diagnostic checks indicated that the key OLS assumptions of linearity, normality of residuals, and homoscedasticity were not satisfied. The Shapiro–Wilk test for three regression models for each domain of DASS-21 indicated that the residuals were not normally distributed ($p < 0.001$). The scatter plot of residuals versus predicted values revealed violation of OLS assumptions (homoscedasticity). Given these violations, we employed logistic regression, which uses the logit transformation of the probability of the occurrence of DASS-21 and does not require normally distributed residuals. Multivariable logistic regression thus provided a more appropriate and statistically robust modeling framework for our data. The logistic regression model allowed us to preserve the validity of statistical inference and to present interpretable measures of association in terms of odds ratios and 95 % confidence intervals. The outcome variables were dichotomized to allow for appropriate modeling in logistic regression. The odds ratios (ORs) with 95 % confidence intervals (CIs) were reported for three hierarchical models: (1) crude OR; (2) OR adjusted for demographic variables (age, sex, ethnicity, religion, occupation, years of educational attainment, marital status, family type, years spent in foreign employment, type of residency, last visit made to family, daily working hours, daily rest hours, current weekly wage); and (3) OR further adjusted for lifestyle variables (smoking status, alcohol consumption, global recommendations score for diet quality). These models were applied to each mental health issue independently to explore potential associations.

Besides, we conducted confirmatory factor analysis for the scales used in the study and reported Chi-square, root mean square of approximation (RMSEA), comparative fit index (CFI), good of fit index (GFI), adjusted good of fit index (AGFI), tucker-lewis index(TFI) using AMOS software (version 28). By presenting the model of initial generalized structural equations using Stata software (version 13), we have explored the relationship of living and working conditions with depression, anxiety and stress symptoms.

3. Results

3.1. Sociodemographic characteristics

Table 1 provides an overview of the sociodemographic characteristics of the study participants. Out of the total 334 study participants, 71 % were male. The mean age of male participants was 30.1 ± 6.2 years, whereas the mean age of female participants was 27.1 ± 4.3 years. The majority of the participants belonged to the Brahmin/Chettri ethnicity (81 %) and identified as Hindu (89 %). Most of the participants (32 %) were employed in the hotel industry, followed by 14 % in the construction sector, and 10 % as security guards.

3.2. Lifestyle related factors

Table 2 describes the information on the lifestyle-related factors of the study participants. Among the participants, 58 % were never smokers, 5 % were former smokers, and 37 % were current smokers. Of the participants, 45 % were lifetime abstainers, 11 % were former drinkers, and 44 % were current drinkers. The average global dietary recommendations score for the participants was 9 ± 2 .

3.3. Categories of living and working conditions

About 21 % had both poor working and living conditions, 29 % had

Table 1
Sociodemographic characteristics of participants.

Variables	Male (n=236) (%)	Female (n=96) (%)	Total(n=334) (%)
Age, mean (SD) years	30.1(6.2)	27.1(4.3)	29.2 (5.9)
Country			
Korea	24(10.3)	1(1.0)	25(7.7)
Malaysia	20(8.6)	70(74.4)	90(27.7)
Saudi Arabia	69(29.8)	0(0.0)	69(21.2)
Kuwait	11(4.7)	1(1.0)	12(3.6)
Qatar	41(17.7)	4(4.2)	45(13.8)
UAE	66(28.5)	18(19.1)	84(25.8)
Ethnicity			
Brahmin/Chettri	189(80.7)	78(81.2)	267(80.9)
Janajati	20(8.5)	7(7.2)	27(8.1)
Others	25(10.6)	11(11.4)	36(10.9)
Religion			
Hindu	214(91.0)	81(84.3)	295(89.1)
Non-hindu	21(8.9)	15(15.6)	36(10.8)
Years of education attainment			
Mean (SD)	11.7(2.9)	11.6(1.3)	11.6(2.5)
Separated from family in months due to job			
Mean(SD)	15.1(27.7)	13.0(16.1)	14.5(24.9)
Median (IQR)	8(14)	5(12)	7(14)
Occupation			
Construction/Manufacturing factories	73(31.06)	1(1.05)	74(22.4)
Agriculture	12(5.1)	16(16.8)	28(8.4)
Hotel industry	43(18.3)	64(67.3)	107(32.4)
Security guard/drivers/others	107(43.5)	14(14.7)	121(36.6)
Marital Status			
Unmarried	93(39.4)	63(65.6)	156(46.9)
Married	143(60.5)	33(34.3)	176(53.0)
Family type			
Nuclear	105(44.4)	87(90.6)	192(57.8)
Joint	131(55.5)	9(9.4)	140(42.1)
Type of residence			
Collective dormitory	151(63.9)	4(4.1)	155(46.6)
Renting with others	47(19.9)	84(87.5)	131(39.4)
Renting alone	28(11.8)	6(6.2)	34(10.2)
Others	10(4.2)	2(2.0)	12(3.6)
Current wage per week (in USD),			
Mean (SD)	280.0 (425.9)	171.1(62.7) 154.4(58.8)	248.1(364.0) 183.8(99.3)
Median (IQR)	187.5 (147.1)		
Daily working hours, mean (SD)	10.3(2.1) 10(4)	11.2(1.8) 11(3)	10.6(2.0) 10(3)
Median (IQR)			
Daily rest hours, mean (SD)	3.8(3.0)	1.53(1.6)	3.1(2.9)
Weekly rest hours, mean (SD)	22.1(20.2)	9.4(8.4)	18.6(18.5)
Median hours (IQR)	15(23)	7(0)	9(17)

good living conditions but poor working conditions, 15 % had poor living conditions but good working conditions, and 35 % had both good living and working conditions. Overall, 49 % of the participants had poor working conditions, while 51 % had good working conditions. In terms of living conditions, 36 % of the participants reported poor living conditions, and 64 % reported good living conditions.

3.4. Depression, anxiety and stress symptoms among categories of living and working conditions

Table 3 presents the distribution of DASS-21 subscale severity categories among study participants. Among the participants across all domains, it shows that a higher prevalence in the normal subscale. For depression, 79.9 % of participants were classified as normal, while only 1.5 % and 2.4 % fell into the severe and extremely severe categories, respectively. Similarly, for anxiety, 80.5 % were classified as normal, with 2.4 % severe and 6.6 % extremely severe. For stress, the proportion classified as normal was even higher (85.0 %), whereas only 2.4 % and 1.2 % were categorized as severe and extremely severe, respectively.

Table 2
Lifestyle related factors among participants.

Lifestyle factors	Male (n=236) (%)	Female(n=96) (%)	Total (%)
Smoking status			
Never smoker	107(51.6)	47(79.6)	154 (57.8)
Former smoker	12(5.8)	1(1.6)	13(4.9)
Current smoker	88(42.5)	11(18.6)	99 (37.2)
Alcohol consumption			
Lifetime abstainers	79(33.9)	70(72.9)	149 (45.2)
Former drinkers	28(12.0)	7(7.3)	35 (10.6)
Current drinkers	126(54.0)	19(19.8)	145 (44.0)
Diet quality			
Global dietary recommendations score, mean (SD)	9.7(2.3)	8.0(2.1)	9.2(2.4)

Table 3
Subscale of depression, anxiety and stress among participants.

SN	DASS-21 subscale	Frequency(n)	Percentage(%)
1.	Depression		
	a. Normal	267	79.9
	b. Mild	27	8.1
	c. Moderate	27	8.1
	d. Severe	5	1.5
	e. Extremely severe	8	2.4
2.	Anxiety		
	a. Normal	269	80.5
	b. Mild	12	3.6
	c. Moderate	23	6.9
	d. Severe	8	2.4
	e. Extremely severe	22	6.6
3.	Stress		
	a. Normal	284	85.0
	b. Mild	18	5.4
	c. Moderate	20	6.0
	d. Severe	8	2.4
	e. Extremely severe	4	1.2

Overall, higher-severity categories contained very small numbers of participants, resulting in sparse data at the upper ends of the score distributions.

Overall, 20 % of the study participants had depression, 19.5 % had anxiety, and 15 % had stress symptoms. Fig. 1 summarizes depression, anxiety and stress symptoms among the categories of living and working conditions. Among study participants with poor working and poor living conditions, 41 % had depression symptoms, 39 % had anxiety symptoms, and 36 % had stress symptoms. For participants with good living and poor working conditions, 17 % had depression symptoms, 13 % had anxiety symptoms, and 8 % had stress symptoms. Those with poor living and good working conditions had 22 % with depression symptoms, 28 % with anxiety symptoms, and 20 % with stress symptoms. Lastly, those with good living and good working conditions had 10 % with depression symptoms, 10 % with anxiety symptoms, and 6 % with stress symptoms.

Association of mental health problems with living and working conditions

Table 4 represents the association of mental health problems with living and working conditions across the three models used in the study. Corresponding to the Model 3, the odds of having depression symptoms among study participants with poor living conditions was 2.76 times more likely compared to those with good living conditions adjusting for socio-demographic variables and lifestyle variables (95 % CI: 1.27-6.01, p value=0.010). The odds of having anxiety symptoms among study participants with poor living conditions was 3.93 times more likely

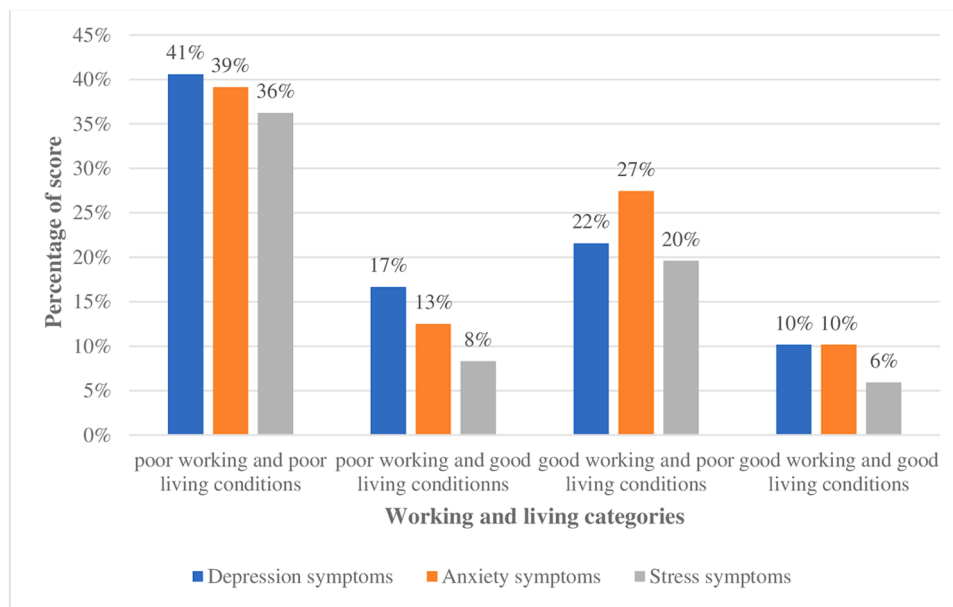


Fig. 1. Depression, anxiety and stress symptoms among categories of living and working conditions.

Table 4

Association between depression, anxiety and stress symptoms and living and working conditions(good/poor).

Depression symptoms	Model 1			Model 2			Model 3		
	Odds ratio	95 % CI	p-value	Odds ratio	95 % CI	p-value	Odds ratio	95 % CI	p-value
Living conditions									
Good (Ref)									
Poor	3.19	1.84-5.55	0.000	2.53	1.27-5.02	0.008	2.76	1.27-6.01	0.010
Working conditions									
Good (Ref)									
Poor	2.30	1.31-4.03	0.003	3.33	1.63-6.77	0.001	4.03	1.83-8.90	0.001
Anxiety symptoms									
Living conditions									
Good (Ref)									
Poor	4.10	2.32-7.25	0.000	4.13	1.99-8.57	0.000	3.93	1.71-8.98	0.001
Working conditions									
Good (Ref)									
Poor	1.70	0.98-2.95	0.058	2.22	1.13-4.39	0.021	2.33	1.10-4.92	0.026
Stress symptoms									
Living conditions									
Good (Ref)									
Poor	5.46	2.83-10.52	0.000	4.76	2.14-10.56	0.000	4.81	1.80-12.82	0.002
Working conditions									
Good (Ref)									
Poor	2.23	1.19-4.19	0.012	2.93	1.35-6.35	0.006	3.18	1.30-7.75	0.011

*Model 1 Univariate analysis between depression, anxiety and stress symptoms and living and working conditions, respectively.

*Model 2 Adjusted for sociodemographic variables such as age, sex, ethnicity, religion, occupation, years of education attainment, marital status, family type, number of family members, years spent in foreign employment, type of residency, last visit made to family, daily working hours, daily rest hours and current weekly wage.

*Model 3 Adjusted for sociodemographic variables used in model 2, and lifestyle factors such as smoking status, alcohol consumption status, global recommendations score for diet quality.

compared to those with good living conditions adjusting for socio-demographic variables and lifestyle variables (95 % CI: 1.71-8.98, p value=0.001). The odds of having stress symptoms among study participants with poor living conditions was 4.81 times more likely compared to those with good living conditions adjusting for socio-demographic variables and lifestyle variables (95 % CI: 1.80-12.82, p value=0.002).

Study participants with poor working conditions were 4.03 times more likely to have depression symptoms compared to those with good working conditions, after adjusting for socio-demographic variables, and lifestyle variables (95 % CI: 1.83-8.90, p value=0.001). Similarly, the odds of having anxiety symptoms were 2.33 times higher among those with poor working conditions compared to those with good

working conditions, after adjusting for socio-demographic variables, and lifestyle variables (95 % CI: 1.10-4.92, p value=0.026). Additionally, study participants with poor working conditions were 3.18 times more likely to experience stress symptoms than those with good working conditions (95 % CI: 1.30-7.75, p value=0.011) after adjusting for the sociodemographic variables and lifestyle variables.

Table 5 shows that study participants with both poor working and poor living conditions were 9.7 times more likely to have depression symptoms compared to those with good working and good living conditions, after adjusting for sociodemographic and lifestyle variables (95 % CI: 3.11-30.81, p-value<0.001). Table 4 also reports that the odds of having anxiety symptoms were 8.9 times higher among those with poor working and poor living conditions compared to those with good

Table 5
Association between depression, anxiety and stress symptoms and categories of living and working conditions.

Depression symptoms	Model 1			Model 2			Model 3		
	Odds ratio	95 % CI	p-value	Odds ratio	95 % CI	p-value	Odds ratio	95 % CI	p-value
Categories of working and living conditions									
Good working and good living conditions (Ref)									
Poor working and poor living	6.03	2.80-12.98	0.000	6.68	2.54-17.61	0.000	9.79	3.11-30.81	0.000
Good working and poor living	2.42	0.99-5.94	0.052	2.47	0.85-7.18	0.094	2.84	0.83-9.64	0.093
Poor working and good living	1.76	0.79-3.94	0.165	3.34	1.25-8.90	0.016	4.23	1.38-12.98	0.011
Anxiety symptoms									
Categories of working and living conditions									
Good working and good living conditions (Ref)									
Poor working and poor living	5.67	2.63-12.24	0.000	7.73	2.86-20.90	0.000	8.90	2.72-29.14	0.000
Good working and poor living	3.34	1.41-7.87	0.006	4.27	1.49-12.21	0.007	6.19	1.72-21.05	0.005
Poor working and good living	1.26	0.53-2.95	0.592	2.19	0.79-6.02	0.129	3.41	1.04-11.13	0.041
Stress symptoms									
Categories of working and living conditions									
Good working and good living conditions (Ref)									
Poor working and poor living	9.00	3.63-22.33	0.000	10.24	3.71-31.14	0.000	17.60	3.74-82.83	0.000
Good working and poor living	3.86	1.38-10.83	0.010	5.21	1.50-18.06	0.009	13.70	2.39-78.40	0.003
Poor working and good living	1.44	0.50-4.12	0.496	2.76	0.89-9.71	0.076	7.88	1.58-39.16	0.012

*Model 1 Univariate analysis between depression, anxiety and stress symptoms and living and working conditions, respectively.

*Model 2 Adjusted for sociodemographic variables such as age, sex, ethnicity, religion, occupation, years of education attainment, marital status, family type, number of family members, years spent in foreign employment, type of residency, last visit made to family, daily working hours, daily rest hours and current weekly wage.

*Model 3 Adjusted for sociodemographic variables and lifestyle factors such as smoking status, alcohol consumption, global recommendations score for diet quality.

working and good living conditions (95 % CI: 2.72-29.14, p-value<0.001). Table 4 also represents that the study participants with poor working and poor living conditions were 17.60 times more likely to experience stress symptoms than those with good working and good living conditions (95 % CI: 3.74-82.83, p-value<0.001) after adjusting for the socio-demographic and lifestyle variables.

3.5. In the generalized structural equation models

We have conducted CFA for individual validated scales used in the study presented in S4 table. We conducted an initial gSEM to assess the association of living and working conditions with depression, anxiety and stress symptoms (Fig. 2 and S6 Table).

The generalized structural equation modeling (gSEM) analysis demonstrated statistically significant associations between depression and both working and living conditions, anxiety and living conditions,

and stress and both working and living conditions.

For depression, each one-unit increase in the working condition score was associated with a 2 % [=exp(-0.02)] reduction in the odds of depressive symptoms (OR = 0.98; 95 % CI: 0.96–0.99; p = 0.002). Likewise, each one-unit increase in the living condition score was associated with a 16 % [=exp(-0.18)] decrease in the odds of depression (OR = 0.84; 95 % CI: 0.73–0.95; p = 0.005).

For anxiety, a significant association was observed with living conditions, whereby each one-unit increase in the living condition score was associated with a 20 % [=exp(-0.22)] lower odds of anxiety symptoms (OR = 0.80; 95 % CI: 0.70–0.91; p = 0.001). The association between working conditions and anxiety did not reach statistical significance.

For stress, each one-unit increase in the working condition score was associated with a 2 % [=exp(-0.02)] reduction in the odds of stress symptoms (OR = 0.98; 95 % CI: 0.96–0.99; p = 0.006). In addition, improved living conditions were significantly associated with stress,

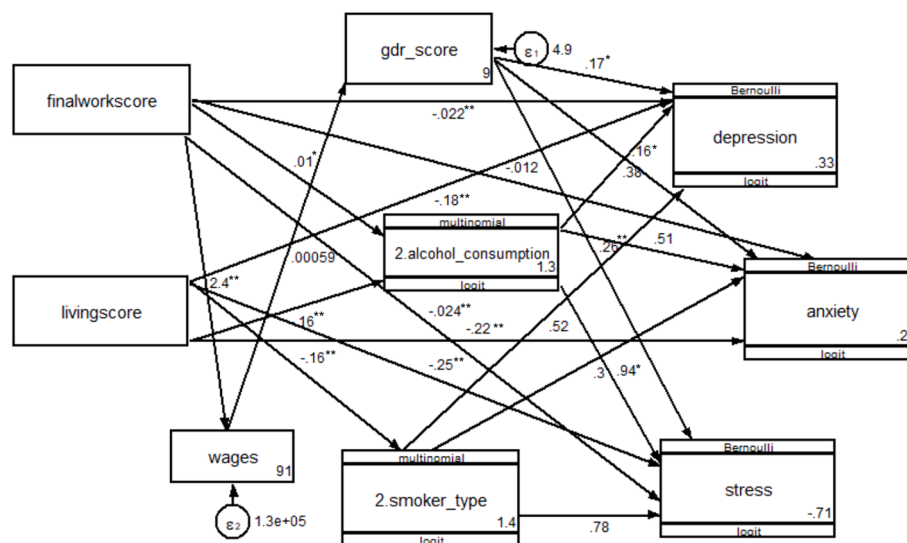


Fig. 2. Generalized structural equation model for living conditions, working conditions, depression, anxiety, stress, alcohol consumption, smoking, GDR, wages. Values on arrows represent **log-odds (logit) coefficients** from the generalized structural equation model. Asterisks denote statistical significance (*p < 0.05, **p < 0.01).

with each one-unit increase in the living condition score corresponding to a 22 % [=exp(-0.25)] decrease in the odds of stress symptoms (OR = 0.78; 95 % CI: 0.68–0.90; $p = 0.001$).

4. Discussion

Nepali migrant workers in Korea, Malaysia, Saudi Arabia, Kuwait, UAE, and Qatar had experienced high levels of depression, anxiety, and stress symptoms. In this study, around 20 % of participants reported depression symptoms, 20 % had anxiety symptoms, and 15 % experienced stress symptoms. Almost half of the participants faced poor working conditions, and about 36 % had poor living conditions. The study also found important connections between mental health and the conditions in which the workers lived and worked. Specifically, there were statistically significant links between depression, anxiety and stress symptoms and poor living and working conditions.

The findings of our study indicate an alarming prevalence of depression, anxiety, and stress symptoms among Nepali migrant workers. In the general population, while only 3 % of Nepali adults (18 years or older) in the country experience depression, 0.8 % have anxiety, and 3 % suffer from stress (National Health Research Council, 2020), our study reports much higher rates among migrant workers. This stark difference highlights the unique challenges and mental health risks faced by this vulnerable population. The strain of adjusting to a new environment, coupled with demanding work hours and inadequate living arrangements, may contribute to the higher rates of depression, anxiety, and stress experienced by these workers (Burgard et al., 2013, Organista et al., 2017, Vahabi et al., 2018, Mangrio and Zdravkovic, 2018). Additionally, migrant workers often bear the weight of financial responsibilities and family expectations, as they leave their homes to seek employment abroad. The pressure of being the primary breadwinner for their families could exacerbate the challenges they face during their employment, potentially leading to poorer mental health outcomes (Devkota et al., 2021).

Compared to previous research, we observe some variations in the prevalence of depression among migrant workers in different countries. A study in Saudi Arabia reported a prevalence of 20 % for depression (Nadim et al., 2016), which is consistent with our findings. However, a study in Qatar reported a much higher prevalence of 69 % for depression among migrant workers (Khaled and Gray, 2019). A study on migrant farm workers in Nebraska reported a prevalence of stress at 30 % (Ramos et al., 2015), which is 10 % higher than the prevalence we found in our study of Nepali migrant workers. These discrepancies could be attributed to the different screening tools. For example, the Qatar study used Wooley depression screening (Whooley, 2023), that does not assess the severity. Additionally, diverse ethnic backgrounds of the study participants might have influenced the interpretation and reporting of mental health symptoms, leading to these differences.

The findings of our study regarding the living and working conditions of Nepali migrant workers are concerning. A significant proportion of participants reported poor living conditions, with 36 % facing sub-optimal circumstances in their living environment. Similarly, nearly half of the participants, approximately 49.4 %, reported experiencing poor working conditions. These results highlight the challenging and often unfavorable situations that many Nepali migrant workers encounter during their employment abroad.

Our study revealed that those facing poor working and poor living conditions were more likely to have depression symptoms. Our results are consistent with a cross-sectional study on Latino migrant workers in San Francisco/Colma and Berkeley (Organista et al., 2017), which also demonstrated a significant negative relationship between living conditions and depression. Furthermore, our study demonstrated a significant association between depression and working conditions. This finding is consistent with a study on wage workers in South Korea (Sohn et al., 2016), which reported that migrants working in environments not meeting labor standards were 1.66 times more likely to experience

depression. Another study in Nepal also found that migrants who rated their work environment as poor or very poor were nearly twice as likely to experience mental health symptoms (Adhikary et al., 2018). Similarly, our study found a significant association between poor living and working conditions and increased depression, anxiety and stress symptoms among the participants. This aligns with a similar study on Latino migrant workers, which also reported a negative relationship between living conditions and anxiety (Organista et al., 2017). The participants with poor living and working conditions were also more likely to have stress symptoms.

The associations between working conditions and mental health issues like depression, anxiety, and stress can be attributed to various employment-related factors. Adverse living and working conditions, exploitation, lack of privacy, long working hours, and unhealthy lifestyles may contribute to poor mental health in migrant workers (Devkota et al., 2021). Additionally, language barriers (Devkota et al., 2021), employer prejudice, limited professional networks, insufficient health and labor system knowledge (Weishaar, 2008, Font et al., 2012, Hall et al., 2019), and inadequate social support (Magana and Hovey, 2023, Doki et al., 2018), may also influence their mental health. While our study didn't assess these factors, further research should explore these complexities and their impact on mental health outcomes in migrant workers.

The implications of this study are crucial for future research and policy development. The findings highlight the significance of addressing poor working conditions to prevent or manage mental health problems among migrant workers. Furthermore, the study findings are the foundation for raising awareness about the current living and working conditions among migrant workers and their impact on their mental well-being. This, in turn, can foster the development of policies aimed at creating safer working environments and better living conditions, ultimately protecting the health of migrant workers.

Our study possesses notable strengths. It benefits from a robust sample size of 334 Nepali migrant workers, enabling us to derive meaningful and reliable conclusions from the data. And, our data collection and analysis were conducted with rigorous precision. We employed standardized tools such as DASS-21 (Lovibond and Lovibond, 1995), and validated instruments on living and working conditions based on the 'Workers' housing standards' (International Labour Organization, 1961), and the 'Guide to International Labor Standards' (International Labour Office, 2014).

Despite these strengths, our study does have some limitations that should be considered when interpreting the results. First, we utilized the self-reporting tool DASS-21 to assess depression, anxiety, and stress symptoms. While this tool provides valuable insights into participants' mental well-being, it cannot be used as a clinical diagnostic tool to confirm mental health problems definitively. Second, our study may not have captured individuals with severe mental health problems, as they might be less likely to participate in the study due to the lack of concentration (World Health Organization, 2023), required to fill out the questionnaire. Consequently, the true prevalence of poor mental health among Nepali migrant workers might have been underestimated. Third, our study's cross-sectional design prevents us from establishing temporal relationships between living and working conditions and potential mental health problems. Fourth, we did not assess participants for their history of mental health problems, which could have provided valuable context for understanding their current mental well-being. And fifth, data collection was conducted using two methods: self-administered online questionnaires and in-person interviews with Nepali migrant workers returning to Nepal. The prevalence of depression, anxiety, and stress symptoms among the interview group was lower than that of the online questionnaire group. This discrepancy might be due to the returning workers being in a better mental state when compared to those still working abroad.

5. Conclusion

The study findings underscore the high prevalence of mental health problems, including depression, anxiety, and stress, among Nepali migrant workers. These mental health issues are closely associated with their poor living and working conditions, particularly in cases of poor working and living conditions. Our study's results can serve as a basis for labor unions, policymakers, and governments in both the countries of origin and destination to improve the safety and dignity of labor employment, as advocated by the International Labor Organization. While there were limited existing publications addressing the mental health of Nepali migrant workers and their living and working conditions, more research in this area is imperative to gain a deeper understanding of their physical and mental well-being. Based on our findings, to improve mental health among migrant workers, we propose providing pre-departure mental health orientation that includes education on mental health issues and coping mechanisms to enhance mental health literacy and encourage seeking support when needed. Introducing digital technologies for counseling services could be beneficial for those seeking help and support remotely.

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Poonam Subedi: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Madhusudan Kaphle:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Padam P Simkhada:** Writing – review & editing. **Biraj Man Karmacharya:** Writing – review & editing. **Minani Gurung:** Writing – review & editing. **Archana Shrestha:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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