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Gender differences in depression and anxiety among migrant workers in Shenzhen: A cross-sectional study

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Abstract

Objectives

To investigate the gender differences and associated factors of depression and anxiety among migrant workers in Shenzhen.

Design

Cross-sectional study.

Setting

Labor intensive factories in Shenzhen, Guangdong, China.

Participants

We recruited 3200 migrant workers who aged over 18 years old and above and did not register in Shenzhen's Hukou system. In total, there were 3095 participants eligible for this study.

Methods

Participants completed sociodemographic questionnaire, the Patient Health Questionnaire-9, the Generalized Anxiety Disorder-7, the UCLA Loneliness Scale, the Barratt Impulsiveness Scale, the Social Support Rating Scale, the Simplified Coping Style Questionnaire and Meaning in Life Questionnaire. We applied Chi-square test, analysis of variance, Wilcoxon rank test, Fisher's exact test, and univariate and multivariate linear regression analysis.

Results

The overall prevalence of depression and anxiety was 27.85% and 19.26% among migrant workers. We reported gender disparities of mental health among migrant workers in Shenzhen that the prevalence of depression and anxiety was higher in females (30.57% vs. 26.43% and 22.67% vs. 17.47%), and the symptoms were more severe among females. Female migrant workers were more likely to be singled, have lower prevalence of smoking and drinking, receive less education and monthly income, have higher level of impulsiveness and social support and lower level of meaning in life. Further, we found the severity of anxiety symptoms

among female migrant workers would be 0.43 unit higher than male migrant workers. Additionally, we found age, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of mental health among migrant workers.

Conclusion

Gender inequity may be the institutional factor leading to disparities in the mental health among migrant workers. Prevention and intervention strategies that improve the migrant workers' mental health should focus on factors associated with gender inequities.

Keywords : Depression, Anxiety, Gender disparity, Migrant workers, China

Strength and limitations

1. This is a large cross-sectional study with a sample of 3095 Chinese migrant workers exploring the gender disparities of depression and anxiety in Shenzhen.
2. The overall prevalence of depression and anxiety was 27.85% and 19.26% among migrant workers in Shenzhen; the prevalence of depression and anxiety was 30.57% and 22.67% among females, and it was 26.43% and 17.47 among males.
3. This study recruited participants from labor intensive factories and the generalizability was limited.
4. The parent study did not collect more detailed information related to gender disparities, and we could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems.

Introduction

Internal migrant workers contribute to China's accomplishments in economics, industrialization and urbanization in recent decades. In 2018, the internal migrant population is up to 244 million, accounting for 17.4% of China's total population[1]. Based on China's household registration system, the "*Hukou*" policy, migrant workers or the "floating population" are defined as people who leave registered residence areas (cities, towns and villages) for engaging in various jobs in non-residence areas. The coastal urban cities including Shenzhen in the Pearl River Delta area are the major destination of the internal migration.

Migrant workers are vulnerable to both physical and psychological problems because of the "*Hukou*" policy that migrants don't share the same social benefits as the local residents, including education, employment, health care and social services in urban cities [2 3]. After a series of Foxconn migrant worker suicides in Shenzhen, 2010, the mental health of migrant workers in China, especially depression, anxiety and suicide, has gained tremendous attention; and a growing number of studies have examined the relationship between migration and mental health through different perspectives, such as help-seeking, income-related inequality and social integration[4-9]. The prevalence of mental health problems of migrant workers varies among inland and coastal urban cities. For example, the prevalence of depressive symptoms varied from 16.5% in Beijing, 23.7% in Chengdu, 34.2% in Wuxi to 37.3% in Shenzhen[10-13].

It has been well established that women are in greater risk for mental health problems than men[14 15]. The increased risk cannot be attributed to biological differences, it results from the interactions between biological factors and social determinants including gender stereotypes and roles, social stigma and inequity, and social autonomy[16 17]. Internal migration and related changes naturally serves as their primary source of stressors for accumulative stress that leads to mental health problems[18]. In He and Wong' s study, involving 959 female migrant workers from 12 factories in Shanghai, Kunshan, Dongguan and Shenzhen, about 24% of participants

were in poor mental health, measured by Brief Symptom Inventory, and the rate was the highest in Shenzhen of 35%[19]. Other studies, applying the Symptom Check List 90 (SCL-90), reported female migrant workers gained higher scores in most of the sub-scales of SCL-90 than the Chinese norms, and the prevalence of any mental health symptoms was also higher than males[20 21]. Few studies reported the prevalence of a specific mental health problem among female migrant workers. For example, in Beijing, a study reported the prevalence of depression 22.6% among female migrant workers, which was close to another study in Shenzhen reporting the prevalence was 22.4%[22 23]; and another study in Chengdu reported the prevalence of anxiety was 22.72% in female migrants workers, and there was no gender differences[24].

Shenzhen is one of the pilot cities in China to develop the Psychosocial Service System (PSS). As a meta-city with about 8.48 million migrants accounting for 65.1% of total population in 2018, a large portion of the migrants work in labor-intensive industries and have gained great attention during the PSS development[25]. This study is part of a larger observational epidemiological study aiming to investigate the mental health problems of migrant workers in Shenzhen, including depression, anxiety, suicide ideation, suicide plan and suicide attempt. This study aims to 1) investigate the gender differences of mental health problems, especially depression and anxiety, among migrant workers in Shenzhen; 2) to explore the relationships between mental health problems and factors that help understand the gender differences.

Methods

As mentioned, this study is a part of a larger observational epidemiological study conducted among migrant workers in Shenzhen.

Sample and sampling

During 2018 to 2019, with a multistage sampling strategy, the parent study first randomly selected 4 out of 10 districts in Shenzhen, then randomly selected 8 labor intensive factories to

recruit participants. For each factory, the parent study randomly selected 400 participants. The study recruited migrant workers who: 1) aged 18 years old and above, 2) were born elsewhere or did not register in Shenzhen's Hukou (local registry record) system, 3) provided written consent. We excluded migrant workers, who had a history of severe mental disorders that might impede them finishing the survey, from this study.

Procedure

Before the field survey, the study team contacted with liaisons in selected factories and provided sampling frame; then the liaisons delivered written consents to selected migrant workers. Once all participants provided consents, the team and the liaisons would select a date, on which liaisons would gather participants to finish the field survey. Considering mental health problems were sensitive information, we required all participants to complete the survey while keeping personal space with others.

During the field survey, experienced and well-trained investigators would help participants complete questionnaires. After participants finished the survey, investigators would check if all required fields had been completed and remind participants to complete missing items before they left.

Measurements

The study team developed the sociodemographic questionnaire to collect participants' characteristics including age, gender, education, marriage, monthly personal income, length of staying in Shenzhen, adaption, self-perceived discrimination, drinking, smoking and number of mental health source.

As mentioned earlier, we mainly focused on migrant workers' depression and anxiety, and we also collected information on other psychological factors that might associate with depression and anxiety including hopelessness, loneliness, impulsiveness, social support, coping strategies and perceived meaning of life.

We applied the Chinese version of Patient Health Questionnaire-9 (PHQ-9), which has shown great reliability and validity, to measure the severity of depressive symptoms among participants[26 27]. The items capture 9 symptom criteria for clinical depression diagnosis from Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 27 with a higher score indicating more severity of depressive symptoms; and a total score of 5, 10, 15 and 20 indicates mild, moderate, moderately severe and severe depression[26]. We set the cut-off point at 5 to screen for distress/depression. The Cronbach's alpha was 0.880 in this study.

We applied the Chinese version of the Generalized Anxiety Disorder-7 (GAD-7), which has shown great reliability and validity, measure the severity of anxiety among participants[28 29]. The times reflect all symptom criteria for GAD from DSM-IV. Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 21 with a higher score indicating a more severity of GAD symptoms; and a total score of 5, 10, and 15 indicates mild, moderate and severe anxiety[28]. We set the cut-off point at 5 to screen for anxiety. The Cronbach's alpha was 0.906 in this study.

We applied the Chinese version of 6-item UCLA Loneliness Scale (ULS-6), which was developed and validated by Li in China based on the short-form of the UCLA Loneliness Scale (ULS-8), to measure loneliness among participants[30 31]. The ULS-6 removed item "I am an outgoing person" and "I can find companionship when I want it" from the ULS-8. Each item can be scored from 1 to 4, and the total score ranges from 6 to 24 with a higher score indicating a more severity of of loneliness. The Cronbach's alpha was 0.859 in this study.

We applied the Chinese version of the Barratt Impulsiveness Scale (BIS-11), which has been translated and validated in Chinese population by Li and Phillips et al., to measure impulsiveness among participants [32]. Different from the English version, the 30-item Chinese

version is a 5-point scale by separating "Never" and "Rarely", and has 3 sub scales to evaluate attentional, motor and non-planning impulsiveness. Each item can be scored from 1 ("Never") to 5 ("Always"), and, after transforming, the total score ranges from 0 to 100 with a higher score indicating a higher level of impulsiveness. The Cronbach's alpha was 0.794 in this study.

We applied the Social Support Rating Scale (SSRS), developed by Xiao in China, to measure social support among participants. The SSRS is a 10-item scale and measures social support from objective social support, subjective social support and utilization, and it has been widely used in China with great reliability and validity[33-36]. Each item inquires participant either the types and numbers of source, the supportive circumstances and relationships, how to utilize help. Each item has been assigned a score, and the total ranges from 12 to 66 with a higher score indicating a higher level of social support. The Cronbach's alpha was 0.804 in this study.

We applied the Simplified Coping Style Questionnaire (SCSQ), developed by Xie in China, to explore how participants cope with daily stress or events. The SCSQ is a 20-item scale and measures both positive and negative coping[37]. There are 12 items for positive coping and 8 items for negative coping. Each item can be scored from 1 ("Never") to 4 ("Very often"). For each type of coping, the score is the mean of the domain with a higher score indicating being more inclined to adopt the coping strategy. The Cronbach's alpha was 0.863 in this study.

We applied the Chinese version of Meaning in Life Questionnaire (C-MLQ), which has been translated and validated in China, to measure how participants assessed the presence of and searched for meaning in life[38 39]. The C-MLQ scale is a 10-item scale. Each item can be scored from 1 ("Strongly disagree") to 7 ("Strongly agree"), and the total score ranges from 10 to 70 with a higher score indicating more satisfied in life. The Cronbach's alpha was 0.844 in this study.

Statistical analysis

In this study, we analyzed data with R (version 3.5.1) and set the statistical significance at 0.05[40].

Data preparation

Before analysis, we recoded participants' marital status into two categories: singled and married/coupled. We divided education into four groups: primary school and below, junior high school, high school, and college and above. We divided personal monthly income into four groups: ≤￥2999, ¥3000 ~ 4999, ¥5000 ~ 9999, and ≥¥10000.

Analytic plan

We compared the characteristics between male and female participants by one-way analysis of variance (ANOVA) or Wilcoxon rank test (if the data were of skewed distribution) for continuous variables, Chi-square test for categorical variables, and Fisher's exact test if necessary. Descriptive analysis were conducted by R package "psych"[41].

We created dummy variables for categorical variables first, then conducted univariate linear regression analysis between depression/anxiety and potential associated variables, and then to conduct multivariate linear regression analysis with variables of significance in the univariate analysis. In multivariate analysis, we adopted a stepwise backward strategy. We chose the Akaike information criterion (AIC), adjusted R-squared and F-value to assess the fitness of models, and lower values indicated better model fitness. Analysis were conducted by R package "car" and "lme4" and "MASS"[42-44].

Patient and Public Involvement

Participants who we recruited did not involve in the design, or conduct, or reporting, or dissemination plans of our study.

Results

From July 1st 2018 to June 30th 2019, we have recruited 3200 migrant workers in Shenzhen, and 3095 of them were eligible for this study. Of 3095 participants, there were 2032 males and 1063 females.

Overall, the age of participants ranged from 18 to 62 years old with a mean of 34.38 ± 9.03. There were 1959 (63.30%) participants married or coupled. Among all participants, and 227 of them (7.33%) have finished college and above, 1461of them (47.21%) finished junior high school, 1346 of them finished high school (43.49%), and 61 of them (1.97%) finished primary school. A majority of participants (1995, 64.46%) received monthly personal income between ¥3000 ~ 4999, followed by 17.42% (539/3095) and 17.16% (531/3095) of them received monthly personal income of ≤￥2999 and ¥5000 ~ 9999, and only 0.97% (30/3095) of them received monthly personal income of 10000 and above. The length of stay in Shenzhen ranged from one month to 34 years with a mean of 7.53 ± 6.17 years. There were 89.63% of participants (2774/3095) adapted to living in Shenzhen, and there were 75.12% of participants (2325/3095) reported not being discriminated. The prevalence of smoking and drinking was 31.21% (966/3095) and 42.58% (1318/3095) respectively. The total number of mental health resource ranged from 0 to 9 with a mean of 1.35 ± 0.95. The score of ULS-6 ranged from 6 to 24 with a mean of 9.89 ± 3.86. The score of BIS-11 ranged from 25 to 88 with a mean of 51.43 ± 8.78. The score of SSRS ranged from 14 to 63 with a mean of 38.85 ± 8.63. The score of positive coping ranged from 0 to 36 with a mean of 21.39 ± 7.47. The score of negative coping ranged from 0 to 24 with a mean of 8.14 ± 4.72. The score of CMLQ ranged from 10 to 70 with a mean of 49.94 ± 10.95. The score of PHQ-9 ranged from 0 to 27 with a mean of 3.31 ± 4.34; and the prevalence of depression was 27.85% (862/3095). The score of GAD-7 ranged from 0 to 21 with a mean of 2.30 ± 3.53 and the prevalence of anxiety was 19.26% (596/3095).

We observed gender disparities in several aspects. Among sociodemographic

characteristics, we found the proportion of being singled was higher in males (43.90% vs. 22.95%), the proportion of receiving high school education and above was higher in males (55.56% vs. 42.17%), the proportion of monthly personal income over ¥5000 was higher in males (21.8% vs. 11.1%), the prevalence of smoking (46.31% vs. 2.35%) and drinking (53.48% vs. 21.07%) was also higher in males than in females. Among psychological scales, the scores of BIS-11 (53.18 vs. 50.51) and SSRS (39.70 vs. 38.40) were higher in females than males; and the score of CMLQ (58.50 vs. 48.85) was higher in males than in females. These results indicated that female migrant workers had a higher level of impulsiveness, social support, while male migrant workers were more satisfied in life. The mean scores of PHQ-9 (3.66 vs. 3.14) and GAD-7 (2.69 vs. 2.09) were higher in females than in male, and the prevalence of depression and anxiety were also higher among females (30.57% vs. 26.43% and 22.67% vs. 17.47%). More details were shown in Table 1.

Table 1 Demographic information of participants

	Overall N=3095 (mean/%)	Gender		*p*
		Male n=2032 (mean/%)	Female n=1063(mean/%)	
Age	34.38 (9.03)	34.75 (9.59)	33.69 (7.78)	<0.01
Marriage				<0.01
Singled	1136 (36.70%)	892 (43.90%)	244 (22.95%)	
Married/coupled	1959 (63.30%)	1140 (56.10%)	819 (77.05%)	
Education				<0.01
Primary school	61 (1.97%)	32 (1.57%)	29 (2.73%)	
Junior high school	1461 (47.21%)	871 (42.86%)	590 (55.50%)	
High school	1346 (43.49%)	1003 (49.36%)	343 (32.67%)	
College and above	227 (7.33%)	126 (6.20 %)	101 (9.5%)	
Monthly personal income				<0.01
≤￥2999	539 (17.42%)	372 (18.31%)	167 (15.71%)	
￥3000 ~ 4999	1995 (64.46%)	1217 (59.89%)	778 (73.19%)	
￥5000 ~ 9999	531 (17.16%)	419 (20.62%)	112 (10.54%)	
≥￥10000	30 (0.97%)	24 (1.18%)	6 (0.56%)	
Years in Shenzhen	7.53 (6.17)	7.28 (6.18)	8.03 (6.11)	<0.01
Adaption				0.88
Yes	2774 (89.63%)	1823 (89.71%)	951 (89.46%)	
No	321 (10.37%)	209 (10.29%)	112 (10.54%)	
Discrimination				0.02
Yes	770 (24.88%)	532 (26.18%)	238 (22.39%)	
No	2325 (75.12%)	1500 (73.82%)	825 (77.61%)	
Smoking				<0.01
Yes	966 (31.21%)	941 (46.31%)	25 (2.35%)	
No	2129 (68.79%)	1091 (53.69%)	1038 (97.65%)	
Drinking				<0.01
Yes	1318 (42.58%)	1094 (53.84%)	224 (21.07%)	

No	1777 (57.42%)	938 (46.16%)	839 (78.93%)	
Number of mental health source	1.35 (0.95)	1.34 (0.96)	1.35 (0.92)	0.85
Loneliness (ULS-6)	9.89 (3.86)	2.09 (3.36)	2.69 (3.79)	0.42
Impulsiveness (BIS-11)	51.43 (8.78)	50.51 (8.97)	53.18 (8.11)	<0.01
Social support (SSRS)	38.85(8.63)	38.40 (8.75)	39.70 (8.32)	<0.01
Coping				
Positive coping	21.39 (7.47)	21.45 (7.53)	21.26 (7.37)	0.51
Negative coping	8.14 (4.72)	8.16 (4.74)	8.10 (4.68)	0.71
Meaning of life (C-MLQ)	49.94 (10.95)	50.50 (11.13)	48.85 (10.53)	<0.01
Depression (PHQ-9)	3.32 (4.43)	3.14 (4.26)	3.66 (4.47)	<0.01
Anxiety (GAD-7)	2.30 (3.53)	2.09 (3.36)	2.69 (3.79)	<0.01

Linear regression analysis of depressive symptoms

As showed in Table 2, after univariate linear regression analysis, age, gender, marriage status, monthly personal income, years in Shenzhen, adaption, discrimination, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with depressive symptoms. Then, we included these variables into multivariate linear regression analysis (Model 1).

Table 2 Univariate linear regression analysis

	PHQ 9 score			GAD-7 score		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.048	-0.65	-0.031	-0.022	-0.35	-0.0079
Gender						
Male	--	--	--	--	--	--
Female	0.52	0.20	0.84	0.60	0.34	0.86
Marriage						
Singled	--	--	--	--	--	--
Married/coupled	-0.32	-0.77	0.13	-0.010	-0.27	0.24
Education						
Primary school	--	--	--	--	--	--
Junior high school	0.73	-0.094	1.56	0.59	-0.082	1.26
High school	0.069	-0.57	0.70	0.46	-0.058	0.97
College and above	0.13	-0.22	0.48	0.15	-0.13	0.43
Monthly personal income						
≤￥2999	--	--	--	--	--	--
￥3000 ~ 4999	2.41	1.35	3.48	1.74	0.87	2.61
￥5000 ~ 9999	2.08	1.26	2.89	1.62	0.96	2.29
≥￥10000	1.59	1.14	2.04	1.17	0.80	1.53
Years in Shenzhen	-0.030	-0.055	-0.0055	-0.0043	-0.024	0.016
Adaption						
Yes	--	--	--	--	--	--
No	2.66	2.17	3.16	1.61	1.21	2.01
Discrimination						
Yes	--	--	--	--	--	--
No	-1.08	-1.43	-0.73	-0.85	-1.13	-0.56
Smoking						

Yes	--	--	--	--	--	--
No	-0.16	-0.49	0.17	0.10	-0.16	0.37
Drinking						
Yes	--	--	--	--	--	--
No	-1.03	-1.34	-0.72	-0.65	-0.90	-0.40
Number of mental health source	-0.31	-0.47	-0.15	-0.24	-0.37	-0.11
Loneliness (ULS-6)	0.62	0.59	0.66	0.52	0.49	0.55
Impulsiveness (BIS-11)	0.20	0.19	0.22	0.15	0.14	0.17
Social support (SSRS)	-0.14	-0.15	-0.12	-0.092	-0.11	-0.078
Coping						
Positive coping	-0.065	-0.085	-0.044	-0.048	-0.064	-0.031
Negative coping	0.25	0.21	0.28	0.19	0.16	0.21
Meaning of life (CMLQ)	-0.059	-0.072	-0.045	-0.042	-0.053	-0.031

We found Model 1 was a significant regression equation with an adjusted R-squared of 0.3887, an F-value of 116.7 ($p<0.05$) and an AIC of 7582.69. We applied a backward step-wisely removed number of mental health source, years in Shenzhen and positive coping strategy from the analysis, and finally we got the final model (Model 2). Comparing with Model 1, Model 2 improved in model fitness with an adjusted R-squared of 0.3889, an F-value of 141.7 ($p<0.05$) and an AIC of 7579.018.

In this study, the severity of depressive symptoms would increase 0.46, 0.088 and 0.11 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively. Comparing with singled migrant workers, the severity of depressive symptoms among married/coupled migrant workers would be 0.31 unit higher; comparing with migrant workers with monthly personal income of 2999 and below, the severity of depressive symptoms among those with income between ￥3000 ~ 4999, ￥5000 ~ 9999, and over 10000 would 3000 would be 1.39, 0.96 and 0.69 units higher; and the severity of depressive symptoms would be 0.90 unit higher among migrant workers did not adapt to living in Shenzhen. The severity of depressive symptoms would decrease 0.038, 0.022 and 0.013 unit for each unit of age, social support and meaning of life increased. Comparing with migrant workers who reported discrimination and who reported drinking, the severity of depressive symptoms among migrant workers who did not report discrimination, and did not drink would be 0.31 and 0.29 unit lower.

More details were showed in Table 3.

Table 3 Stepwise Linear Model analysis of depression

	Model 1			Model 2		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.037	-0.055	-0.018	-0.038	-0.054	-0.021
Gender						
Male	--	--	--	--	--	--
Female	0.25	-0.032	0.54	0.24	-0.050	0.52
Marriage						
Singled	--			--		
Married/coupled	0.30	0.073	0.54	0.31	0.075	0.53
Monthly personal income						
≤￥2999	--	--	--	--	--	--
￥3000 ~ 4999	1.43	0.58	228	1.39	0.55	2.24
￥5000 ~ 9999	0.95	0.30	1.61	0.96	0.30	1.61
≥￥10000	0.69	0.33	1.05	0.69	0.34	1.05
Years in Shenzhen	-0.0059	-0.029	0.018	--	--	--
Adaption						
Yes	--	--	--	--	--	--
No	0.89	0.61	1.18	0.90	0.62	1.19
Discrimination						
Yes	--	--	--	--	--	--
No	-0.31	-0.54	-0.11	-0.31	-0.51	-0.11
Drinking						
Yes	--	--	--	--	--	--
No	-0.30	-0.48	-0.11	-0.29	-0.48	-0.11
Number of mental health source	-0.020	-0.15	0.11	--	--	--
Loneliness (ULS-6)	0.46	0.43	0.50	0.46	0.43	0.50
Impulsiveness (BIS-11)	0.086	0.069	0.10	0.088	0.072	0.10
Social support (SSRS)	-0.030	-0.037	-0.0029	-0.022	-0.039	-0.0057
Coping						
Positive coping	-0.010	-0.031	0.010	--	--	--
Negative coping	0.12	0.089	0.15	0.11	0.085	0.14
Meaning of life (CMLQ)	-0.012	-0.024	0.00016	-0.013	-0.025	-0.0016
AIC		7582.690			7578.018	
Adjusted R-squared		0.3887			0.3889	
F value		116.7			141.7	
p		<0.05			<0.05	

Linear regression analysis of anxiety symptoms

As showed in Table 2, after univariate linear regression analysis, we found age, gender monthly personal income, adaption, discrimination, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with anxiety symptoms. Then, we included these variables into multivariate linear regression analysis (Model 3).

We found Model 3 was a significant regression equation with an adjusted R-squared of 0.3746, an F-value of 124.50 ($p<0.05$) and an AIC of 6364.065. We applied a backward step-wisely removed age, social support and positive coping from the analysis, and finally we got the final model (Model 4). Comparing with Model 3, Model 4 improved in model fitness with an adjusted R-squared of 0.0.3747, an F-value of 169.60 ($p<0.05$) and an AIC of 6359.401.

In this study, the severity of anxiety symptoms would increase 0.42,0.064 and 0.081 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively. Comparing with male migrant workers, the severity of anxiety symptoms among female migrant workers would be 0.43 unit higher; comparing with migrant workers with monthly personal income of 2999 and below, the severity of anxiety symptoms among those with income between ￥3000 ~ 4999, ￥5000 ~ 9999, and over 10000 would 3000 would be 1.03, 0.67 and 0.42 units higher; and the severity of anxiety symptoms would be 0.40 unit higher among migrant workers did not adapt to living in Shenzhen. The severity of anxiety symptoms would decrease 0.0091 unit for each unit of meaning of life increased. Comparing with migrant workers who reported discrimination and who reported drinking, the severity of anxiety symptoms among migrant workers who did not report discrimination, and did not drink would be 0.20 and 0.14 unit lower. More details were showed in Table 4.

Table 4 Stepwise Linear Model analysis of anxiety

	Model 3			Model 4		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.0088	-0.021	0.0030	--	--	--
Gender						
Male	--	--	--	--	--	--
Female	0.42	0.19	0.64	0.43	0.21	0.66
Monthly personal income						
≤￥2999	--	--	--	--	--	--
￥3000 ~ 4999	1.03	0.33	1.73	1.03	0.34	1.73
￥5000 ~ 9999	0.70	0.16	1.23	0.67	0.14	1.21
≥￥10000	0.43	0.15	0.72	0.42	0.13	0.72
Adaption						
Yes	--	--	--	--	--	--
No	0.38	0.15	0.61	0.40	0.16	0.63
Discrimination						
Yes	--	--	--	--	--	--

No	-0.21	-0.38	-0.049	-0.20	-0.37	-0.038
Drinking						
Yes	--	--	--	--	--	--
No	-0.13	-0.28	0.020	-0.14	-0.29	0.012
Number of mental health source	-0.019	-0.13	-0.0890	--	--	--
Loneliness (ULS-6)	0.42	0.39	0.45	0.42	0.39	0.45
Impulsiveness (BIS-11)	0.062	0.048	0.076	0.064	0.051	0.077
Social support (SSRS)	0.0057	-0.0077	0.019	--	--	--
Coping						
Positive coping	-0.0097	-0.026	0.0070	--	--	--
Negative coping	0.088	0.063	0.11	0.081	0.048	0.10
Meaning of life (CMLQ)	-0.018	0.018	0.0086	-0.0091	-0.018	0.00038
AIC		6364.065			6359.401	
Adjusted R-squared		0.3746			0.3747	
F value		124.5			169.6	
p		<0.05			<0.05	

Discussion

We identified several key findings based on a sample of 3095 migrant workers: a) the overall prevalence of depression and anxiety was 27.85% and 19.26% among migrant workers in Shenzhen, which was lower than the previous study in Shenzhen[13]; b) gender disparities were observed among migrant workers in Shenzhen that the prevalence of depression and anxiety was higher in females, and the symptoms were also more severe among females; c) age, gender, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of mental health; d) we observed gender differences among these sociodemographic characteristics and psychological factors that male migrant workers were older, more likely to be married, to receive more education and income, to feel being discriminated, to drink, to be more satisfied with life, and to have a lower level of impulsiveness and social support.

Migrant workers in Shenzhen are faced with increased mental health problems than local community residents. A large epidemiology study among community residents from seven Chinese provinces reported the mean score of PHQ-9 and GAD-7 was 3.95 and 2.71, respectively, and it also reported the score of GAD-7 was higher in females than in males (2.75 vs. 2.66) [45]. Further, this study comprised a sample of 2002 residents in Guangdong province

and the mean score of PHQ-9 and GAD-7 in the sub-sample was 2.46 and 1.91, respectively, and gender differences were not reported in the subsample[45]. In comparison, we reported the mean score of PHQ-9 and GAD-7 among migrant workers in Shenzhen was 3.31 and 2.30, respectively. Not only the severity of depression and anxiety symptoms, we believe the prevalence of depression and anxiety among migrant workers in Shenzhen is higher than local residents, which is consistent with previous studies[10-13 45 46]. An epidemiology study in 2009, applying the Composite International Diagnostic Interview (CIDI), reported the prevalence of depression and anxiety in Shenzhen was 9.15% and 12.58% among registered residents, and it was 9.74% and 14.92% among non-registered residents[47]. However, we could not estimate the change of mental health problems among migrant workers after a decade because of the non-diagnostic tool we applied.

The prevalence of mental health problems varies among studies cross China, and we contribute the variation to explanations. First, the cross-sectional studies applied different tools to screen depression and anxiety, such as the Center of Epidemiologic Studies Depression (CES-D), the Symptom Checklist 90 (SCL-90), the Self-rating Depression Scale (SDS), the Patient Health Questionnaire Depression Module (PHQ-9), the Beck's Depression Inventory (BDI), the Generalized Anxiety Disorder Scale (GAD-7), the Self-rating Anxiety Scale (SAS) and the Beck's Anxiety Inventory (BAI)[10-13 45 48-50]. And even applying the same scale, studies may choose different cut-off points to report the prevalence, for example, we chose the cut-off point at 5 for PHQ-9 and GAD-7 while Wang set the cut-off point at 7 for both scales[45]. Second, studies recruited different sub-groups of migrant workers. In this study, participants came from labor intensive factories living in factory campuses which were micro-societal systems; other studies recruited migrant workers from different industries like catering, retail and service etc. Third, the prevalence also varies cross different samples of migrant workers because of sampling methods and sample size. Fourth, more developed cities, like first-tier cities (i.e.

Beijing, Shanghai, Guangzhou and Shenzhen), are selective based on migrants' skills, where working and living are much more stressful than in the rest[51].

We identified factors associated with depression and anxiety from the social ecological framework, and our results were consistent with previous studies that lower sociodemographic status is associated with migrant workers' mental health problems[10 52 53]. Though gender as a biological factor is at the individual level, it also crosses all levels of the framework and results in institutional effects that lead to the gender disparities in mental health among migrant workers. Empirical studies among Chinese internal migrant workers reported that, comparing with males, females were younger, less educated and paid 20% to 30% less[7 54 55]. Rural households have lower educational expectations for girls, especially among poorer households, that leads to a higher dropout rate for girls[56]. Consequently, shortened education indicates females are younger and less skilled when they enter the labor market in urban cities resulting in the inequity of wages[57]. We found female migrant workers have stayed longer in Shenzhen that may enable them a longer time to build social networks which would increase their social support and reduce perceived discrimination in return. We reported female migrant workers perceived lower meaning in life which may result from the labor intensity and the inequity in wages. Despite social support, which would buffer daily stress and improve mental wellbeing[58], was higher among female migrant workers, they were in increased risk of mental health problems. We believe the institutional gender disparities or even inequities might play a more important role, and we encourage future research to collect detailed information, hypothesize the mechanism between mental health problems and gender disparities in sociodemographic factors, and test these hypotheses.

We recognize a few study limitations worth noting. First, the parent study aimed to investigate the prevalence of common mental health problems among migrant workers from labor intensive factories in Shenzhen, and the sample did not recruit migrant workers from

other industries, hence it was difficult to estimate the representativeness of our findings comparing with the whole migrant worker population in Shenzhen. Second, because the parent study did not focus on gender disparities among migrant workers, we did not collect further information such as disparities in labor intensity, living environment, economic pressure, hence we could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems. Third, as a cross-sectional study, we could not draw causal inferences from the findings. We encourage future studies to use longitudinal design to investigate the causal effects of gender disparities on migrant workers' mental health problems, to develop prevention and intervention strategies and to improve migrant workers' mental health.

Conclusion

The findings suggest the reported prevalence of depression and anxiety is 27.85% and 19.26% among migrant workers in Shenzhen, which was lower than previous results, and gender inequity may be the institutional factor leading to disparities in mental health among migrant workers. Future studies should explore factors associated with gender inequities and migrant workers' mental health problems to develop prevention and intervention strategies.

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Conflict of interest

The authors declare that they have not conflict of interest.

Ethical Statement

The Ethics Committee of Shenzhen Kangning Hospital reviewed and approved the protocol, including the on-line informed consent process, and approved analysis of de-identified data (KN-2020-04).

Contribution

FH developed the plan for analysis, analyzed the data, drafted and revised the paper. HL designed the survey instruments, monitored data collection, developed the plan for analysis and revised the paper. XP, LY, ZZ and HX designed the survey instruments, sent out recruitment advertisement, assisted in data collection and revised the paper. TL initiated the project, designed the study, and revised the paper. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Data sharing statement

The data on which this manuscript is based are not available to public. The data from this study are under certain restrictions according to the Shenzhen Science and Technology Innovation Commission and always under the supervision of the principal investigator of the study. Thus, there are access restrictions to the data. However, at any time, researchers can contact the principal investigator (Tiebang Liu, liutbsz@126.com) for data sharing.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6,7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	No applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8,9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8,9
Bias	9	Describe any efforts to address potential sources of bias	17
Study size	10	Explain how the study size was arrived at	7,8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10
		(*b*) Describe any methods used to examine subgroups and interactions	No applicable
		(*c*) Explain how missing data were addressed	7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	10
		(*e*) Describe any sensitivity analyses	No applicable

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	6,7
		(c) Consider use of a flow diagram	No applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11 , 12
		(b) Indicate number of participants with missing data for each variable of interest	11
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	No applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	No applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	No applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	11,12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-14
		(*b*) Report category boundaries when continuous variables were categorized	11-12
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	No applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	14-17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17,18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Gender disparities in depressive and anxiety symptoms among internal migrant workers in Shenzhen: A cross-sectional study

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Gender disparities in depressive and anxiety symptoms among internal migrant workers in Shenzhen: A cross-sectional study

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Word account: 3797

Abstract

Objectives

To investigate the gender disparities in the prevalence and severity of depressive and anxiety symptoms and associated factors among internal migrant workers in Shenzhen.

Design

Cross-sectional study.

Setting

Labor intensive factories in Shenzhen, Guangdong, China.

Participants

We recruited 3200 internal migrant workers who aged over 18 years old and above and did not register in Shenzhen's household registration system. There were 3095 participants eligible for this study.

Methods

Participants completed sociodemographic questionnaire, the Patient Health Questionnaire-9, the Generalized Anxiety Disorder-7, the UCLA Loneliness Scale, the Barratt Impulsiveness Scale, the Social Support Rating Scale, the Simplified Coping Style Questionnaire and Meaning in Life Questionnaire. We applied Chi-square test, analysis of variance, Wilcoxon rank test, Fisher's exact test, and univariate and multivariate multilevel linear regression analysis.

Results

The overall prevalence of depressive and anxiety symptoms was 27.85% and 19.26% among internal migrant workers. We reported gender disparities of depressive and anxiety symptoms among participants that the prevalence of depressive and anxiety symptoms was higher in females (30.57% vs. 26.43% and 22.67% vs. 17.47%), and the symptoms were more severe among females. Female migrant workers were more likely to be singled, have lower

prevalence of smoking and drinking, receive less education and monthly income, have higher level of impulsiveness and social support and lower level of meaning in life. We found age, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of depressive and anxiety symptoms among internal migrant workers in Shenzhen.

Conclusion

Gender inequality may be the institutional factor leading to disparities in depressive and anxiety symptoms among internal migrant workers. Interventions should be embedded with strategies improving gender equality.

Keywords : Depression, Anxiety, Gender disparity, Migrant workers, China

Strengths and limitations of this study

1. This is a cross-sectional study with a large sample of Chinese internal migrant workers in Shenzhen exploring the gender disparities in the prevalence and severity of depressive and anxiety symptoms.
2. We report factors associated with the severity of depressive and anxiety symptoms among Chinese internal migrant workers.
3. This study recruited participants from labor intensive factories that limited the generalizability to internal migrant workers in other industries.
4. We were limited to detailed information on gender disparities and could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems.

Introduction

Internal migrant workers contribute to China's accomplishments in economics, industrialization and urbanization in recent decades. In 2018, the internal migrant population is up to 244 million, accounting for 17.4% of China's total population[1]. Based on China's household registration system, the "*Hukou*" policy, migrant workers or the "floating population" are defined as people who leave registered residence areas (cities, towns and villages) for engaging in various jobs in non-residence areas. The coastal urban cities including Shenzhen in the Pearl River Delta area are the major destinations of the internal migration.

Migrant workers are vulnerable to both physical and psychological problems because of the "*Hukou*" policy that migrants don't share the same social benefits as the registered household residents, including education, employment, health care and social services in urban cities [2 3]. After a series of Foxconn migrant worker suicides in Shenzhen, 2010, the mental health of migrant workers in China, especially depression, anxiety and suicide, has gained tremendous attention; and a growing number of studies have examined the relationship between internal migration and mental health through different perspectives, such as help-seeking, income-related inequality and social integration[4-9]. The prevalence of mental health problems of migrant workers varies among inland and coastal urban cities. For example, the prevalence of depressive symptoms varied from 16.5% in Beijing, 23.7% in Chengdu, 34.2% in Wuxi to 37.3% in Shenzhen[10-13].

Women are in greater risk for mental health problems than men[14 15]. The increased risk cannot be attributed to biological differences, it results from the interactions between biological factors and social determinants including gender stereotypes and roles, social stigma and inequality, and social autonomy[16 17]. Internal migration and related changes naturally serve as their primary source of stressors for accumulative stress leading to mental health problems[18]. In He and Wong' s study of 959 female migrant workers from 12 factories in Shanghai,

Kunshan, Dongguan and Shenzhen, about 24% of participants were in poor mental health, measured by Brief Symptom Inventory, and the rate was the highest in Shenzhen of 35%[19]. Other studies, applying the Symptom Check List 90 (SCL-90), reported female migrant workers gained higher scores in most of the sub-scales than the Chinese norms, and the prevalence of any mental health symptoms was also higher than males[20 21]. Few studies reported the prevalence of a specific mental health problem among female migrant workers. For example, in Beijing, a study reported the prevalence of depression 22.6% among female migrant workers, which was close to another study in Shenzhen reporting the prevalence was 22.4%[22 23]; and another study in Chengdu reported the prevalence of anxiety was 22.72% in female migrants workers, and there was no gender differences[24].

Shenzhen is one of the pilot cities in China to develop the Psychosocial Service System (PSS). There were about 8.48 million internal migrants in Shenzhen accounting for 65.1% of its total population in 2018, and a large portion of the migrants work in labor-intensive industries who have gained great attention during the PSS development[25]. This study is a part of the Social Epidemiological and Biological Study of Suicide Behaviors Among Factory Migrant Workers in Shenzhen, which aims to investigate the social, biological and mental health factors associated with suicide, suicide ideation, suicide plan and suicide attempts among internal migrant workers in Shenzhen. The current study aims to 1) investigate the gender disparities in the prevalence and severity of depressive and anxiety symptoms among internal migrant workers in Shenzhen; 2) to explore factors associated with the severity of depressive and anxiety symptoms.

Methods

Sample and sampling

This study adopted the sample of the parent study, and the sample size was calculated to

estimate the prevalence of suicide ideation among internal migrant workers in Shenzhen based on the following equation:

$$n = Z^2_{1-a/2}p(1-p)/d^2$$

Based on a prior study that reported the prevalence of suicide ideation was 19.9% among internal migrant workers in Shenzhen[26], the parent study set the significant level α at 0.01, the quantity d for permissible error as 0.02, and the sample size was 2644; meanwhile, considering the possible clustering effect and sample loss, the parent study used a positive design effect of 1.20 to set the adjusted sample size as 3200.

During 2018 to 2019, with a multistage sampling strategy, the parent study first randomly selected 4 out of 10 districts in Shenzhen, then randomly selected 8 labor intensive factories to recruit participants. For each factory, the parent study randomly selected 400 participants. The parent study recruited migrant workers who: 1) aged 18 years old and above, 2) were born elsewhere or did not register in Shenzhen's Hukou (household registration) system, 3) provided written consent. Internal migrant workers who had a history of severe mental disorders that might impede completing the survey were excluded.

Procedure

Before the field survey, the study team contacted with liaisons in selected factories, and the liaisons delivered written consents to selected migrant workers based on the sampling frame. The study team and the liaisons determined a date and gathered participants to finish the field survey after participants provided consents. Considering mental health problems were sensitive information, we required all participants to complete the survey while keeping social distance.

During the field survey, experienced and well-trained investigators would help participants complete questionnaires and remind participants to complete missing items.

Measurements

The study team developed the sociodemographic questionnaire to collect participants'

characteristics including age, gender, education, marriage, monthly personal income, length of staying in Shenzhen, adaption, self-perceived discrimination, drinking, smoking and number of mental health source.

We applied the Chinese version of Patient Health Questionnaire-9 (PHQ-9) to measure the severity of depressive symptoms, which has shown great reliability and validity[27 28]. The items capture 9 symptom criteria for clinical depression diagnosis from Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 27 with a higher score indicating a more severity of depressive symptoms; and a total score of 5, 10, 15 and 20 indicates mild, moderate, moderately severe and severe depression[27]. We set the cut-off point at 5 to screen for depressive symptoms. The Cronbach's alpha was 0.880 in this study.

We applied the Chinese version of the Generalized Anxiety Disorder-7 (GAD-7) measure the severity of anxiety symptoms, which has shown great reliability and validity[29 30]. The times reflect all symptom criteria for GAD from DSM-IV. Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 21 with a higher score indicating a more severity of anxiety symptoms; and a total score of 5, 10, and 15 indicates mild, moderate and severe anxiety[29]. We set the cut-off point at 5 to screen for anxiety symptoms. The Cronbach's alpha was 0.906 in this study.

We applied the Chinese version of 6-item UCLA Loneliness Scale (ULS-6) to measure loneliness, which has been translated and validated in China[31 32]. The total score ranges from 6 to 24 with a higher score indicating a more severity of loneliness. The Cronbach's alpha was 0.859 in this study.

We applied the Chinese version of the Barratt Impulsiveness Scale (BIS-11) to measure impulsiveness, which has been translated and validated in Chinese population[33]. The total score ranges from 0 to 100 with a higher score indicating a higher level of impulsiveness. The

Cronbach's alpha was 0.794 in this study.

We applied the Social Support Rating Scale (SSRS) to measure social support, which was a 10-item scale developed and had been widely used in China with great reliability and validity[34-37]. The total ranges from 12 to 66 with a higher score indicating a higher level of social support. The Cronbach's alpha was 0.804 in this study.

We applied the Simplified Coping Style Questionnaire (SCSQ) to explore how participants cope with daily stress or events, which was 20-item scale developed in China[38]. There are two subscales, positive coping and negative coping, and a higher mean score of each subscale indicates being more inclined to adopt the coping strategy. The Cronbach's alpha was 0.863 in this study.

We applied the Chinese version of Meaning in Life Questionnaire (C-MLQ) to measure how participants assessed the presence of and searched for meaning in life, which was a 10-item scale and had been translated and validated in China [39 40]. The total score ranges from 10 to 70 with a higher score indicating more satisfied in life. The Cronbach's alpha was 0.844 in this study.

Statistical analysis

In this study, we analyzed data with R (version 3.5.1) and set the statistical significance at 0.05[41].

Data preparation

Before analysis, we recoded participants' marital status into two categories: singled and married/coupled. We categorized participants' education level into four groups: primary school and below (≤ 6 years of education), junior high school (7 ~ 9 years of education), high school (10 ~ 12 years of education), and college and above (≥ 13 years of education). We categorized participants' personal monthly income into four groups: ≤$439.49 (¥2999), $439.64 ~ 732.58 (¥3000 ~ 4999), $732.73 ~ 1465.31 (¥5000 ~ 9999), and ≥$1465.46 (¥10000).

Analytic plan

To compare the characteristics between male and female participants, we applied one-way analysis of variance (ANOVA) or Wilcoxon rank test (if the data were of skewed distribution) for continuous variables, and Chi-square test for categorical variables. Descriptive analysis was conducted by R package "psych"[42].

We created dummy variables for categorical variables, and the first category of each variable the reference group was the reference group in regression analysis. Considering the clustering effect of the sample, we conducted univariate multilevel linear regression analysis between the severity of depressive symptoms/anxiety symptoms and potential associated variables including sociodemographic factors, loneliness, impulsiveness, social support, coping strategy and meaning of life, and then to conduct multivariate multilevel linear regression analysis. In multivariate analysis, we adopted a stepwise backward strategy, and the baseline model was the first model with explanatory variables that showed significance in the univariate analysis ($p<0.05$). We chose the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and adjusted R-squared and to assess the fitness of models, and lower values of the parameters indicated better model fitness. Analysis were conducted by R package "car" and "lme4" and "MASS"[43-45].

Patient and Public Involvement

This study was conducted without patient and public involvement.

Results

The parent study recruited 3200 participants, and there were 105 participants did not provide complete information on PHQ-9 or GAD-7, who were excluded from analysis in this study. Of 3095 eligible participants, there were 2032 males and 1063 females. The differences of sociodemographic information between eligible and non-eligible participants were not

significant.

Overall, the age of participants ranged from 18 to 62 years old with a mean of 34.38 ± 9.03. There were 1959 (63.30%, 1959/3095) participants being married or coupled. There were 47.21% (1461/3095) and 43.49% (1346/3095) of participants have finished junior high school and high school. A majority of participants (64.46%, 1995/3095) received monthly personal income between $439.64 ~ 732.58. The length of stay in Shenzhen ranged from one month to 34 years with a mean of 7.53 ± 6.17 years. There were 89.63% of participants (2774/3095) adapted to living in Shenzhen, and there were 75.12% of participants (2325/3095) reported not being discriminated. The prevalence of smoking and drinking was 31.21% (966/3095) and 42.58% (1318/3095) respectively. The total number of mental health resource ranged from 0 to 9 with a mean of 1.35 ± 0.95. The score of ULS-6 ranged from 6 to 24 with a mean of 9.89 ± 3.86. The score of BIS-11 ranged from 25 to 88 with a mean of 51.43 ± 8.78. The score of SSRS ranged from 14 to 63 with a mean of 38.85 ± 8.63. The score of positive coping ranged from 0 to 36 with a mean of 21.39 ± 7.47. The score of negative coping ranged from 0 to 24 with a mean of 8.14 ± 4.72. The score of CMLQ ranged from 10 to 70 with a mean of 49.94 ± 10.95. The score of PHQ-9 ranged from 0 to 27 with a mean of 3.31 ± 4.34; and the prevalence of depressive symptoms was 27.85% (862/3095). The score of GAD-7 ranged from 0 to 21 with a mean of 2.30 ± 3.53; and the prevalence of anxiety symptoms was 19.26% (596/3095).

We observed gender disparities in several aspects. First, comparing with female participants, we found male participants were more likely to be singled (43.90% vs. 22.95%), to receive high school education and above (55.56% vs. 42.17%), to receive personal income over $732.73 (¥5000) (21.8% vs. 11.1%), to smoke (46.31% vs. 2.35%) and to drink (53.48% vs. 21.07%). We also found male participants were less impulsive, reported lower social support were more satisfied in life. Further, we reported the mean scores of PHQ-9 (3.66 vs. 3.14) and GAD-7 (2.69 vs. 2.09) were higher in females than in males, and the prevalence of

depressive and anxiety symptoms were also higher among females (30.57% vs. 26.43% and 22.67% vs. 17.47%). More details were shown in Table 1.

Table 1 Demographic information of participants

	Overall N=3095	Gender		*p*
		Male n=2032	Female n=1063	
Age (mean, SD)	34.38 (9.03)	34.75 (9.59)	33.69 (7.78)	<0.01
Marriage (n, %)				<0.01
Singled	1136 (36.70%)	892 (43.90%)	244 (22.95%)	
Married/coupled	1959 (63.30%)	1140 (56.10%)	819 (77.05%)	
Education (n, %)				<0.01
Primary school	61 (1.97%)	32 (1.57%)	29 (2.73%)	
Junior high school	1461 (47.21%)	871 (42.86%)	590 (55.50%)	
High school	1346 (43.49%)	1003 (49.36%)	343 (32.67%)	
College and above	227 (7.33%)	126 (6.20 %)	101 (9.5%)	
Monthly personal income (n, %)				<0.01
≤$439.49	539 (17.42%)	372 (18.31%)	167 (15.71%)	
$439.64~732.58	1995 (64.46%)	1217 (59.89%)	778 (73.19%)	
$732.73~1465.31	531 (17.16%)	419 (20.62%)	112 (10.54%)	
≥$1465.46	30 (0.97%)	24 (1.18%)	6 (0.56%)	
Years in Shenzhen (mean, SD)	7.53 (6.17)	7.28 (6.18)	8.03 (6.11)	<0.01
Adaption (n, %)				0.88
Yes	2774 (89.63%)	1823 (89.71%)	951 (89.46%)	
No	321 (10.37%)	209 (10.29%)	112 (10.54%)	
Discrimination (n, %)				0.02
Yes	770 (24.88%)	532 (26.18%)	238 (22.39%)	
No	2325 (75.12%)	1500 (73.82%)	825 (77.61%)	
Smoking (n, %)				<0.01
Yes	966 (31.21%)	941 (46.31%)	25 (2.35%)	
No	2129 (68.79%)	1091 (53.69%)	1038 (97.65%)	
Drinking (n, %)				<0.01
Yes	1318 (42.58%)	1094 (53.84%)	224 (21.07%)	
No	1777 (57.42%)	938 (46.16%)	839 (78.93%)	
Number of mental health source (mean, SD)	1.35 (0.95)	1.34 (0.96)	1.35 (0.92)	0.85
Loneliness (ULS-6) (mean, SD)	9.89 (3.86)	2.09 (3.36)	2.69 (3.79)	0.42
Impulsiveness (BIS-11) (mean, SD)	51.43 (8.78)	50.51 (8.97)	53.18 (8.11)	<0.01
Social support (SSRS) (mean, SD)	38.85(8.63)	38.40 (8.75)	39.70 (8.32)	<0.01
Coping (mean, SD)				
Positive coping	21.39 (7.47)	21.45 (7.53)	21.26 (7.37)	0.51
Negative coping	8.14 (4.72)	8.16 (4.74)	8.10 (4.68)	0.71
Meaning of life (C-MLQ) (mean, SD)	49.94 (10.95)	50.50 (11.13)	48.85 (10.53)	<0.01
Mean score of the PHQ-9 (mean, SD)	3.32 (4.43)	3.14 (4.26)	3.66 (4.47)	<0.01
Depressive symptoms (n, %)				
No	2233	1495	738	<0.01
Yes	862	537	325	
Mean score of the GAD-7` (mean, SD)	2.30 (3.53)	2.09 (3.36)	2.69 (3.79)	<0.01
Anxiety symptoms (n, %)				
No	2499	1677	822	<0.01
Yes	596	355	241	

Linear regression analysis of depressive symptoms

Table 2 showed the results of univariate linear regression analysis for depressive symptoms. We found age, marriage status, monthly personal income, years in Shenzhen, adaption, discrimination, smoking, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with depressive symptoms. Therefore, we included these variables into multivariate multilevel linear regression analysis (Model 1).

Table 2 Results of univariate multilevel linear regression analysis for depressive and anxiety symptoms

	PHQ 9 score			GAD-7 score		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.066	-0.085	-0.046	-0.037	-0.053	-0.021
Gender						
Male	--	--	--	--	--	--
Female	-0.093	-0.45	0.28	0.15	-0.15	0.45
Marriage						
Singled	--	--	--	--	--	--
Married/coupled	-0.75	-1.07	-0.42	-0.29	-0.56	-0.023
Education						
Primary school	--	--	--	--	--	--
Junior high school	0.28	-0.74	1.49	-0.091	-0.96	0.84
High school	0.68	-0.59	1.64	0.21	-0.90	0.90
College and above	0.93	-0.19	2.27	0.75	-0.14	1.85
Monthly personal income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.18	-0.24	0.59	-0.028	-0.3	0.31
$732.73~1465.31	-0.72	-1.27	-0.16	-0.59	-1.04	-0.14
≥$1465.46	3.80	2.22	5.38	2.74	1.46	4.02
Years in Shenzhen	-0.050	-0.075	-0.025	-0.022	-0.042	-0.0013
Adaption						
Yes	--	--	--	--	--	--
No	1.83	1.48	2.17	1.11	0.83	1.40
Discrimination						
Yes	--	--	--	--	--	--
No	-0.80	-1.05	-0.55	-0.61	-0.81	-0.41
Smoking						
Yes	--	--	--	--	--	--
No	-0.59	-0.93	-0.24	-0.21	-0.49	0.072
Drinking						
Yes	--	--	--	--	--	--
No	-0.84	-1.05	-0.62	-0.53	-0.71	-0.35
Number of mental health source	-0.28	-0.45	-0.12	-0.19	-0.333	-0.056
Loneliness (ULS-6)	0.62	0.58	0.65	0.51	0.48	0.54
Impulsiveness (BIS-11)	0.20	0.18	0.21	0.15	0.13	0.16
Social support (SSRS)	-0.14	-0.16	-0.12	-0.095	-0.11	-0.081
Coping						
Positive coping	-0.058	-0.078	-0.038	-0.040	-0.057	-0.023

Negative coping	0.24	0.21	0.27	0.18	0.16	0.21
Meaning of life (CMLQ)	-0.055	-0.069	-0.042	-0.040	-0.051	-0.028

In Model 1, the AIC was 16337.21, the BIC was 16457.10, and the adjusted R-squared was 0.4020. We step-wisely removed years in Shenzhen, smoking, number of mental health source and positive coping strategy from the analysis. Finally, we got the final model (Model 2). Comparing with Model 1, Model 2 improved in model fitness with an AIC of 16331.71, a BIC of 16428.31, and an adjusted R-squared of 0.4003.

Table 3 showed that the severity of depressive symptoms would increase 0.46, 0.086 and 0.11 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively. Comparing with singled participants, the severity of depressive symptoms among married/coupled participants would be 0.26 unit higher; comparing with participants with monthly personal income of $439.49 and below, the severity of depressive symptoms among those with income over $1465.46 would be 2.30 units higher; and the severity of depressive symptoms would be 0.87 unit higher among participants did not adapt to living in Shenzhen. The severity of depressive symptoms would decrease 0.045, 0.022 and 0.015 unit for each unit of age, social support and meaning of life increased. Comparing with participants who reported discrimination and who reported drinking, the severity of depressive symptoms among those who did not report discrimination and did not drink would be 0.33 and 0.26 unit lower.

Table 3 Results of the stepwise multilevel linear regression analysis of depressive symptoms

	Model 1			Model 2		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.043	-0.062	-0.023	-0.045	-0.063	-0.027
Marriage						
Singled	--			--		
Married/coupled	0.27	0.044	0.50	0.26	0.032	0.48
Monthly personal income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.25	-0.084	0.58	0.24	-0.095	0.57
$732.73~1465.31	0.039	-0.42	0.49	0.020	-0.42	0.46
≥$1465.46	2.34	1.08	3.59	2.30	1.05	3.55
Years in Shenzhen	-0.0076	-0.031	0.016	--	--	--
Adaption						

Yes	--	--	--	--	--	--
No	0.86	0.57	1.14	0.87	0.59	1.15
Discrimination						
Yes	--	--	--	--	--	--
No	-0.34	-0.54	-0.13	-0.33	-0.53	-0.13
Smoking						
Yes	--	--	--	--	--	--
No	-0.17	-0.45	0.12	--	--	--
Drinking						
Yes	--	--	--	--	--	--
No	-0.24	-0.43	-0.061	-0.26	-0.44	-0.089
Number of mental health source	-0.015	-0.15	0.12	--	--	--
Loneliness (ULS-6)	0.46	0.43	0.50	0.46	0.43	0.50
Impulsiveness (BIS-11)	0.084	0.068	0.10	0.086	0.070	0.10
Social support (SSRS)	-0.019	-0.037	-0.0023	-0.022	-0.038	-0.0049
Coping						
Positive coping	-0.0073	-0.027	0.013	--	--	--
Negative coping	0.12	0.086	0.15	0.11	0.085	0.14
Meaning of life (CMLQ)	-0.014	-0.025	-0.0017	-0.015	-0.026	-0.0029
AIC		16337.21			16331.71	
BIC		16457.10			16428.31	
Adjusted R-squared		0.4020			0.4003	

Note: * Model 1 is the initial model of the multilevel linear regression analysis. Model 2 is the final model of the analysis after four iterations. ** Estimate stands for the coefficient of each variable. ***AIC stands for the Akaike information criterion; BIC stands for the Bayesian information criterion.

Linear regression analysis of anxiety symptoms

Table 2 showed the results of univariate linear regression analysis for anxiety symptoms. We found age, marriage, monthly personal income, years in Shenzhen, adaption, discrimination, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with anxiety symptoms, and we included these variables into multivariate multilevel linear regression analysis (Model 3).

In Model 3, the AIC was 15121.74, the BIC was 15236.45, and the adjusted R-squared was 0.3845. We step-wisely removed years in Shenzhen, drinking, number of mental health source, social support, positive coping strategy and meaning of life from the analysis. Finally, we got the final model (Model 4). Comparing with Model 3, Model 4 improved in model fitness with an AIC of 15116.08 and a BIC of 15194.57.

Table 4 showed that the severity of anxiety symptoms would increase 0.42, 0.065 and 0.080 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively.

Comparing with participants with monthly personal income of $439.49 and below, the severity of anxiety symptoms among those with income over $1465.46 would be 1.57 units higher; and the severity of anxiety symptoms would be 0.38 unit higher among migrant workers did not adapt to living in Shenzhen. Comparing with participants who reported discrimination, the severity of anxiety symptoms among those who did not report discrimination would be 0.23 unit lower.

Table 4 Results of the stepwise multilevel linear regression analysis of anxiety symptoms

	Model 3			Model 4		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.030	-0.046	-0.014	-0.029	-0.044	-0.014
Marriage						
Singled	--	--	--	--	--	--
Married/coupled	0.30	0.11	0.49	0.27	0.10	0.45
Monthly personal income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.054	-0.22	0.33	0.056	-0.22	0.33
$732.73~1465.31	-0.014	-0.39	0.35	0.0043	-0.36	0.37
≥$1465.46	1.58	0.55	2.61	1.57	0.54	2.60
Years in Shenzhen	0.0027	-0.016	0.022	--	--	--
Adaption						
Yes	--	--	--	--	--	--
No	0.38	0.14	0.61	0.38	0.15	0.61
Discrimination						
Yes	--	--	--	--	--	--
No	-0.22	-0.38	-0.051	-0.23	-0.39	-0.063
Drinking						
Yes	--	--	--	--	--	--
No	-0.077	-0.22	0.068	--	--	--
Number of mental health source	-0.0040	-0.11	0.11	--	--	--
Loneliness (ULS-6)	0.42	0.39	0.45	0.42	0.39	0.45
Impulsiveness (BIS-11)	0.060	0.046	0.074	0.065	0.053	0.078
Social support (SSRS)	-0.0025	-0.017	0.012	--	--	--
Coping						
Positive coping	-0.0044	-0.021	0.012	--	--	--
Negative coping	0.086	0.062	0.11	0.080	0.059	0.10
Meaning of life (CMLQ)	-0.0095	-0.019	0.00034	--	--	--
AIC		15121.74			15116.08	
BIC		15236.45			15194.57	
Adjusted R-squared		0.3845			0.3845	

Note: * Model 3 is the initial model of the multilevel linear regression analysis. Model 4 is the final model of the analysis after six iterations. ** Estimate stands for the coefficient of each variable. ***AIC stands for the Akaike information criterion; BIC stands for the Bayesian information criterion.

Discussion

We identified several key findings based on a sample of 3095 internal migrant workers in Shenzhen, China: a) the overall prevalence of depressive and anxiety symptoms was 27.85% and 19.26%, which was lower than the previous study in Shenzhen[13]; b) gender disparities were observed that the prevalence of depressive and anxiety was higher in females, and the symptoms were also more severe in them; c) age, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of depressive or anxiety symptoms; d) we observed gender disparities among sociodemographic characteristics and psychological factors that male migrant workers were older, more likely to be married, to receive more education and income, to feel being discriminated, to drink, to be more satisfied with life, and to have a lower level of impulsiveness and social support.

To understand the mental health problems among internal migrant workers in China, it is necessary to be familiar with the "Hukou" system. The "Hukou" system, known as the household registration system, is implemented to classify the place of registration (urban or rural residence areas) and the type of registration (agriculture or non-agriculture)[46]. Due to the registration, internal migrant workers, who are usually rural to urban migrants, have limited access to social welfare provided by the local governments of their destinations. Empirical studies have reported the associations between mental health and social inequities resulted from the registration system, including labor rights, wages, employment benefits, reimbursement for health care, limited access to public schools for migrant children[2-13].

Internal migrant workers in Shenzhen are faced with increased mental health problems than local community residents. A large epidemiology study among community residents from seven Chinese provinces reported the mean score of PHQ-9 and GAD-7 was 3.95 and 2.71, respectively, and it also reported the score of GAD-7 was higher in females than in males (2.75

vs. 2.66)[47]. Further, this study comprised a sample of 2002 residents in Guangdong province and the mean score of PHQ-9 and GAD-7 in the sub-sample was 2.46 and 1.91, respectively, and gender differences were not reported in the subsample[47]. In comparison, we reported the mean score of PHQ-9 and GAD-7 among migrant workers in Shenzhen was 3.31 and 2.30, respectively, which were both higher than that in the mentioned study. An epidemiology study in 2009, applying the Composite International Diagnostic Interview (CIDI), reported the prevalence of depression and anxiety in Shenzhen was 9.15% and 12.58% among registered residents, and it was 9.74% and 14.92% among non-registered residents[48]. However, because of the non-diagnostic tools this study applied, we were limited to compare results.

The prevalence of depression and anxiety, including depressive and anxiety symptoms, varies among studies cross China, and we contribute the variation to explanations. First, cross-sectional studies applied different tools to screen for depression and anxiety, such as the Center of Epidemiologic Studies Depression (CES-D), the Symptom Checklist 90 (SCL-90), the Self-rating Depression Scale (SDS), the Patient Health Questionnaire Depression Module (PHQ-9), the Beck's Depression Inventory (BDI), the Generalized Anxiety Disorder Scale (GAD-7), the Self-rating Anxiety Scale (SAS) and the Beck's Anxiety Inventory (BAI)[10-13 47 49-51]. And even applying the same scale, studies may choose different cut-off points to report the prevalence, for example, we chose the cut-off point at 5 for PHQ-9 and GAD-7 while Wang set the cut-off point at 7 for both scales[47]. Second, studies recruited different sub-groups of Chinese internal migrant workers. In this study, participants came from labor intensive factories living in factory campuses which were micro-societal systems; other studies recruited participants from different industries like catering, retail and service etc. Third, the prevalence also varies cross different samples of internal migrant workers because of sampling methods and sample size. Fourth, more developed cities, like first-tier cities (i.e. Beijing, Shanghai, Guangzhou and Shenzhen), are selective based on migrants' skills, where working and living are much more

stressful than the rest[52].

We identified factors associated with depressive and anxiety symptoms from the social ecological framework, and our results were consistent with previous studies that lower sociodemographic status was associated with internal migrant workers' mental health problems[10 53 54]. Gender as a factor at the individual level, it crosses all levels of the framework and results in institutional effects leading to the gender disparities in mental health among internal migrant workers. Empirical studies among Chinese internal migrant workers reported that female migrant workers were younger, less educated and paid 20% to 30% less than their male counterparts[7 55 56]. Generally, rural households have lower educational expectations for girls, especially among poorer households, that lead to a higher dropout rate for girls[57]; and shortened education indicates females are younger and less skilled when they enter the labor market in urban cities resulting in the inequality of wages[58]. We found female migrant workers have stayed longer in Shenzhen the males, which may enable them a longer time to build social networks to increase their social support and reduce perceived discrimination in return. We reported female migrant workers perceived lower meaning in life, and it may result from the labor intensity and the inequality in wages. We believe the institutional gender disparities or even inequities might play an important role, and we encourage future research to collect detailed information, hypothesize the mechanism between mental health problems and gender disparities in sociodemographic factors, and test these hypotheses.

We recognize a few limitations of this study. First, the parent study did not aim to investigate the prevalence of depression and anxiety (including depressive and anxiety symptoms) among internal migrant workers from labor intensive factories in Shenzhen, and the sample did not recruit migrant workers from other industries, hence it was difficult to estimate the representativeness of our findings comparing with the whole migrant worker population in Shenzhen. Second, because the parent study did not focus on gender disparities among migrant

workers, we did not collect further information such as disparities in labor intensity, living environment, economic pressure, work related stress, and, especially, the interaction between gender disparities and the "Hukou" system, hence we could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems. Third, as a cross-sectional study, we could not draw causal inferences from the findings. We encourage future studies to use longitudinal design to investigate the causal effects of gender disparities on migrant workers' mental health to develop strategies to improve migrant workers' mental health.

Conclusion

Among internal migrant workers in Shenzhen, females reported higher prevalence and severity of depressive and anxiety symptoms than the males, and the differences are associated with disparities resulting from institutional gender inequality. Interventions to improve the mental health of internal migration population in China should be embedded with strategies improving gender equality from individual to societal perspectives.

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Conflict of interest

The authors declare that they have not conflict of interest.

Ethical Statement

The Ethics Committee of Shenzhen Kangning Hospital reviewed and approved the protocol,

including the on-line informed consent process, and approved analysis of de-identified data (KN-2020-04).

Contribution

FH developed the plan for analysis, analyzed the data, drafted and revised the paper. HL designed the survey instruments, monitored data collection, developed the plan for analysis and revised the paper. XP, LY, ZZ and HX designed the survey instruments, sent out recruitment advertisement, assisted in data collection and revised the paper. TL initiated the project, designed the study, and revised the paper. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Data sharing statement

The data on which this manuscript is based are not available to public. The data from this study are under certain restrictions according to the Shenzhen Science and Technology Innovation Commission and always under the supervision of the principal investigator of the study. Thus, there are access restrictions to the data. However, at any time, researchers can contact the principal investigator (Tiebang Liu, liutbsz@126.com) for data sharing.

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1

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6,7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	No applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8,9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8,9
Bias	9	Describe any efforts to address potential sources of bias	17
Study size	10	Explain how the study size was arrived at	6,7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10
		(*b*) Describe any methods used to examine subgroups and interactions	No applicable
		(*c*) Explain how missing data were addressed	7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	10
		(*e*) Describe any sensitivity analyses	No applicable

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	No applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10,11,12
		(b) Indicate number of participants with missing data for each variable of interest	10, 11
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	No applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	No applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	No applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	10,11,12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-16
		(*b*) Report category boundaries when continuous variables were categorized	10,11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	No applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19,20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Gender disparities in depressive and anxiety symptoms among internal migrant workers in Shenzhen: A cross-sectional study

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Word account: 3798

Abstract

Objectives

To investigate the gender disparities in the prevalence and severity of depressive and anxiety symptoms and associated factors among internal migrant workers in Shenzhen.

Design

Cross-sectional study.

Setting

Labor intensive factories in Shenzhen, Guangdong, China.

Participants

We recruited 3200 internal migrant workers who aged over 18 years old and above and did not register in Shenzhen's household registration system. There were 3095 participants eligible for this study.

Methods

Participants completed sociodemographic questionnaire, the Patient Health Questionnaire-9, the Generalized Anxiety Disorder-7, the UCLA Loneliness Scale, the Barratt Impulsiveness Scale, the Social Support Rating Scale, the Simplified Coping Style Questionnaire and Meaning in Life Questionnaire. We applied Chi-square test, analysis of variance, Wilcoxon rank test, Fisher's exact test, and univariate and multivariate multilevel linear regression analysis.

Results

The overall prevalence of depressive and anxiety symptoms was 27.85% and 19.26% among internal migrant workers. We reported gender disparities of depressive and anxiety symptoms among participants that the prevalence of depressive and anxiety symptoms was higher in females (30.57% vs. 26.43% and 22.67% vs. 17.47%), and the symptoms were more severe among females. Female migrant workers were more likely to be singled, have lower

prevalence of smoking and drinking, receive less education and monthly income, have higher level of impulsiveness and social support and lower level of meaning in life. We found age, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of depressive and anxiety symptoms among internal migrant workers in Shenzhen.

Conclusion

Gender inequality may be the institutional factor leading to disparities in depressive and anxiety symptoms among internal migrant workers. Interventions should be embedded with strategies improving gender equality.

Keywords : Depression, Anxiety, Gender disparity, Migrant workers, China

Strengths and limitations of this study

1. This is a cross-sectional study with a large sample of Chinese internal migrant workers in Shenzhen exploring the gender disparities in the prevalence and severity of depressive and anxiety symptoms.
2. We report factors associated with the severity of depressive and anxiety symptoms among Chinese internal migrant workers.
3. This study recruited participants from labor intensive factories that limited the generalizability to internal migrant workers in other industries.
4. We were limited to detailed information on gender disparities and could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems.

Introduction

Internal migrant workers have made important contributions to China's accomplishments in economics, industrialization and urbanization in recent decades. In 2018, the internal migrant population has been up to 244 million, accounting for 17.4% of China's total population[1]. Based on China's household registration system, the "*Hukou*" policy, migrant workers or the "floating population" are defined as people who leave their registered residence areas (e.g., cities, towns and villages) for engaging in various jobs in non-residence areas. The coastal urban cities, like Shenzhen in the Pearl River Delta area, are the major destinations of the internal migration.

Migrant workers are vulnerable to both physical and psychological problems because of the "*Hukou*" policy that migrants don't share the equal social benefits as the registered household residents, including education, employment, health care and social services in urban cities [2 3]. After a series of Foxconn migrant worker suicides in Shenzhen, 2010, the mental health of migrant workers in China, especially depression, anxiety and suicide, has gained tremendous attention; and a growing number of studies have examined the relationship between internal migration and mental health through different perspectives, such as help-seeking, income-related inequality and social integration[4-9]. The prevalence of mental health problems of migrant workers varies among inland and coastal urban cities. For example, the prevalence of depressive symptoms varied from 16.5% in Beijing, 23.7% in Chengdu, 34.2% in Wuxi to 37.3% in Shenzhen[10-13].

Women are in greater risk for mental health problems than men[14 15]. The increased risk cannot be simply attributed to biological differences, it results from the interactions between biological factors and social determinants including gender stereotypes and roles, social stigma and inequality, and social autonomy[16 17]. Internal migration and related changes naturally serve as their primary source of stressors for accumulative stress leading to mental health problems[18].

In He and Wong' s study of 959 female migrant workers from 12 factories in Shanghai, Kunshan, Dongguan and Shenzhen, about 24% of participants were in poor mental health, measured by the Brief Symptom Inventory, and the rate was the highest in Shenzhen (35%)[19]. Other studies, applying the Symptom Check List 90 (SCL-90), reported female migrant workers gained higher scores in most of the sub-scales than the Chinese norms, and the prevalence of any mental health symptoms was also higher than the males[20 21]. Few studies reported the prevalence of a specific mental health problem among female migrant workers. For example, in Beijing, a study reported the prevalence of depression was 22.6% among female migrant workers, which was close to another study in Shenzhen reporting the prevalence was 22.4%[22 23]; and another study in Chengdu reported the prevalence of anxiety was 22.72% among female migrant workers, and there was no gender differences[24].

Shenzhen is one of the pilot cities in China to develop the Psychosocial Service System (PSS). There were about 8.48 million internal migrants in Shenzhen accounting for 65.1% of its total population in 2018, and a large portion of the migrants working in labor-intensive industries have gained great attention in the PSS development[25]. This study is a part of the Social Epidemiological and Biological Study of Suicide Behaviors Among Factory Migrant Workers in Shenzhen, which aims to investigate the social, biological and mental health factors associated with suicide, suicide ideation, suicide plan and suicide attempts among internal migrant workers in Shenzhen. The current study aims 1) to investigate the gender disparities in the prevalence and severity of depressive and anxiety symptoms among internal migrant workers in Shenzhen; 2) to explore factors associated with the severity of depressive and anxiety symptoms.

Methods

Sample and sampling

This study adopted the sample of the parent study, and the sample size was calculated to estimate the prevalence of suicide ideation among internal migrant workers in Shenzhen based on the following equation:

$$n = \mathcal{Z}^2_{1-\alpha/2} p(1-p)/d^2$$

Based on a prior study that reported the prevalence of suicide ideation was 19.9% among internal migrant workers in Shenzhen[26], the parent study set the significant level α at 0.01, the quantity d for permissible error as 0.02, and the sample size was 2644; meanwhile, considering the possible clustering effect and sample loss, the parent study used a positive design effect of 1.20 to set the adjusted sample size as 3200.

During 2018 to 2019, with a multistage sampling strategy, the parent study first randomly selected 4 out of 10 districts in Shenzhen, then randomly selected 8 labor intensive factories to recruit participants. For each factory, the parent study randomly selected 400 participants. The parent study recruited migrant workers who: 1) aged 18 years old and above, 2) were born elsewhere or did not register in Shenzhen's Hukou (household registration) system, 3) provided written consent. Internal migrant workers who had a history of severe mental disorders that might impede completing the survey were excluded.

Procedure

Before the field survey, the study team contacted with liaisons in selected factories, and the liaisons delivered written consents to selected migrant workers based on the sampling frame. The study team and the liaisons determined a date and gathered participants to finish the field survey after participants provided consents. Considering mental health problems were sensitive information, we required all participants to complete the survey while keeping social distance.

During the field survey, experienced and well-trained investigators helped participants

complete questionnaires and reminded participants to complete missing items.

Measurements

The study team developed the sociodemographic questionnaire to collect participants' characteristics including age, gender, education, marriage, monthly personal income, length of staying in Shenzhen, adaption, self-perceived discrimination, drinking, smoking and number of mental health source.

We applied the Chinese version of Patient Health Questionnaire-9 (PHQ-9) to measure the severity of depressive symptoms, which has shown great reliability and validity[27 28]. The items capture 9 symptom criteria for clinical depression diagnosis from Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV). Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 27 with a higher score indicating a more severity of depressive symptoms; and a total score of 5, 10, 15 and 20 indicates mild, moderate, moderately severe and severe depression[27]. We set the cut-off point at 5 to screen for depressive symptoms. The Cronbach's alpha was 0.880 in this study.

We applied the Chinese version of the Generalized Anxiety Disorder-7 (GAD-7) measure the severity of anxiety symptoms, which has shown great reliability and validity[29 30]. The times reflect all symptom criteria for GAD from DSM-IV. Each item can be scored from 0 ("Not at all") to 3 ("Nearly every day"), and the total score ranges from 0 to 21 with a higher score indicating a more severity of anxiety symptoms; and a total score of 5, 10, and 15 indicates mild, moderate and severe anxiety[29]. We set the cut-off point at 5 to screen for anxiety symptoms. The Cronbach's alpha was 0.906 in this study.

We applied the Chinese version of 6-item UCLA Loneliness Scale (ULS-6) to measure loneliness, which has been translated and validated in China[31 32]. The total score ranges from 6 to 24 with a higher score indicating a more severity of loneliness. The Cronbach's alpha was 0.859 in this study.

We applied the Chinese version of the Barratt Impulsiveness Scale (BIS-11) to measure impulsiveness, which has been translated and validated in Chinese population[33]. The total score ranges from 0 to 100 with a higher score indicating a higher level of impulsiveness. The Cronbach's alpha was 0.794 in this study.

We applied the Social Support Rating Scale (SSRS) to measure social support, which was a 10-item scale developed and has been widely used in China with great reliability and validity[34-37]. The total ranges from 12 to 66 with a higher score indicating a higher level of social support. The Cronbach's alpha was 0.804 in this study.

We applied the Simplified Coping Style Questionnaire (SCSQ) to explore how participants cope with daily stress or events, which was 20-item scale developed in China[38]. There are two subscales, positive coping and negative coping, and a higher mean score of each subscale indicates being more inclined to adopt the coping strategy. The Cronbach's alpha was 0.863 in this study.

We applied the Chinese version of Meaning in Life Questionnaire (C-MLQ) to measure how participants assessed the presence of and searched for meaning in life, which was a 10-item scale and had been translated and validated in China [39 40]. The total score ranges from 10 to 70 with a higher score indicating more satisfied in life. The Cronbach's alpha was 0.844 in this study.

Statistical analysis

In this study, we analyzed data with R (version 3.5.1) and set the statistical significance at 0.05[41].

Data preparation

Before analysis, we recoded participants' marital status into two categories: singled and married/coupled. We categorized participants' education level into four groups: primary school and below (≤ 6 years of education), junior high school (7 ~ 9 years of education), high school

(10 ~ 12 years of education), and college and above (≥ 13 years of education). We categorized participants' personal monthly income into four groups: ≤$439.49 (¥2999), $439.64 ~ 732.58 (¥3000 ~ 4999), $732.73 ~ 1465.31 (¥5000 ~ 9999), and ≥$1465.46 (¥10000).

Analytic plan

To compare the characteristics between male and female participants, we applied one-way analysis of variance (ANOVA) or Wilcoxon rank test (if the data were of skewed distribution) for continuous variables, and Chi-square test for categorical variables. Descriptive analysis was conducted by R package "psych"[42].

We created dummy variables for categorical variables, and the first category of each variable the reference group was the reference group in regression analysis. Considering the clustering effect of the sample, we conducted univariate multilevel linear regression analysis between the severity of depressive symptoms/anxiety symptoms and potential associated variables including sociodemographic factors, loneliness, impulsiveness, social support, coping strategy and meaning of life, and then to conduct multivariate multilevel linear regression analysis. In multivariate analysis, we adopted a stepwise backward strategy, and the baseline model was the first model with explanatory variables that showed significance in the univariate analysis ($p<0.05$). We chose the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and adjusted R-squared and to assess the fitness of models, and lower values of the parameters indicated better model fitness. Analysis were conducted by R package "car" and "lme4" and "MASS"[43-45].

Patient and Public Involvement

This study was conducted without patient and public involvement.

Results

The parent study recruited 3200 participants, and there were 105 participants did not provide

complete information on PHQ-9 or GAD-7, who were excluded from analysis in this study. Of 3095 eligible participants, there were 2032 males and 1063 females. The differences of sociodemographic information between eligible and non-eligible participants were not significant.

Overall, the age of participants ranged from 18 to 62 years old with a mean of 34.38 ± 9.03. There were 1959 (63.30%, 1959/3095) participants being married or coupled. There were 47.21% (1461/3095) and 43.49% (1346/3095) of participants have finished junior high school and high school. A majority of participants (64.46%, 1995/3095) received monthly personal income between $439.64 ~ 732.58. The length of stay in Shenzhen ranged from one month to 34 years with a mean of 7.53 ± 6.17 years. There were 89.63% of participants (2774/3095) adapted to living in Shenzhen, and there were 75.12% of participants (2325/3095) reported not being discriminated. The prevalence of smoking and drinking was 31.21% (966/3095) and 42.58% (1318/3095) respectively. The total number of mental health resource ranged from 0 to 9 with a mean of 1.35 ± 0.95. The score of ULS-6 ranged from 6 to 24 with a mean of 9.89 ± 3.86. The score of BIS-11 ranged from 25 to 88 with a mean of 51.43 ± 8.78. The score of SSRS ranged from 14 to 63 with a mean of 38.85 ± 8.63. The score of positive coping ranged from 0 to 36 with a mean of 21.39 ± 7.47. The score of negative coping ranged from 0 to 24 with a mean of 8.14 ± 4.72. The score of CMLQ ranged from 10 to 70 with a mean of 49.94 ± 10.95. The score of PHQ-9 ranged from 0 to 27 with a mean of 3.31 ± 4.34; and the prevalence of depressive symptoms was 27.85% (862/3095). The score of GAD-7 ranged from 0 to 21 with a mean of 2.30 ± 3.53; and the prevalence of anxiety symptoms was 19.26% (596/3095).

We observed gender disparities in several aspects. First, comparing with female participants, we found male participants were more likely to be singled (43.90% vs. 22.95%), to receive high school education and above (55.56% vs. 42.17%), to receive personal income over $732.73 (¥5000) (21.8% vs. 11.1%), to smoke (46.31% vs. 2.35%) and to drink (53.48%

vs. 21.07%). We also found male participants were less impulsive, reported lower social support, and were more satisfied in life. Further, we reported the mean score of PHQ-9 (3.66 vs. 3.14) and GAD-7 (2.69 vs. 2.09) were higher in females than in males, and the prevalence of depressive and anxiety symptoms were also higher among females (30.57% vs. 26.43% and 22.67% vs. 17.47%). More details were shown in Table 1.

Table 1 Demographic information of participants

	Overall N=3095	Gender		*p*
		Male n=2032	Female n=1063	
Age (mean, SD)	34.38 (9.03)	34.75 (9.59)	33.69 (7.78)	<0.01
Marriage (n, %)				<0.01
Singled	1136 (36.70%)	892 (43.90%)	244 (22.95%)	
Married/coupled	1959 (63.30%)	1140 (56.10%)	819 (77.05%)	
Education (n, %)				<0.01
Primary school	61 (1.97%)	32 (1.57%)	29 (2.73%)	
Junior high school	1461 (47.21%)	871 (42.86%)	590 (55.50%)	
High school	1346 (43.49%)	1003 (49.36%)	343 (32.67%)	
College and above	227 (7.33%)	126 (6.20 %)	101 (9.5%)	
Monthly personal income (n, %)				<0.01
≤$439.49	539 (17.42%)	372 (18.31%)	167 (15.71%)	
$439.64~732.58	1995 (64.46%)	1217 (59.89%)	778 (73.19%)	
$732.73~1465.31	531 (17.16%)	419 (20.62%)	112 (10.54%)	
≥$1465.46	30 (0.97%)	24 (1.18%)	6 (0.56%)	
Years in Shenzhen (mean, SD)	7.53 (6.17)	7.28 (6.18)	8.03 (6.11)	<0.01
Adaption (n, %)				0.88
Yes	2774 (89.63%)	1823 (89.71%)	951 (89.46%)	
No	321 (10.37%)	209 (10.29%)	112 (10.54%)	
Discrimination (n, %)				0.02
Yes	770 (24.88%)	532 (26.18%)	238 (22.39%)	
No	2325 (75.12%)	1500 (73.82%)	825 (77.61%)	
Smoking (n, %)				<0.01
Yes	966 (31.21%)	941 (46.31%)	25 (2.35%)	
No	2129 (68.79%)	1091 (53.69%)	1038 (97.65%)	
Drinking (n, %)				<0.01
Yes	1318 (42.58%)	1094 (53.84%)	224 (21.07%)	
No	1777 (57.42%)	938 (46.16%)	839 (78.93%)	
Number of mental health source (mean, SD)	1.35 (0.95)	1.34 (0.96)	1.35 (0.92)	0.85
Loneliness (ULS-6) (mean, SD)	9.89 (3.86)	2.09 (3.36)	2.69 (3.79)	0.42
Impulsiveness (BIS-11) (mean, SD)	51.43 (8.78)	50.51 (8.97)	53.18 (8.11)	<0.01
Social support (SSRS) (mean, SD)	38.85(8.63)	38.40 (8.75)	39.70 (8.32)	<0.01
Coping (mean, SD)				
Positive coping	21.39 (7.47)	21.45 (7.53)	21.26 (7.37)	0.51
Negative coping	8.14 (4.72)	8.16 (4.74)	8.10 (4.68)	0.71
Meaning of life (C-MLQ) (mean, SD)	49.94 (10.95)	50.50 (11.13)	48.85 (10.53)	<0.01
Mean score of the PHQ-9 (mean, SD)	3.32 (4.43)	3.14 (4.26)	3.66 (4.47)	<0.01
Depressive symptoms (n, %)				

No	2233	1495	738	<0.01
Yes	862	537	325	
Mean score of the GAD-7` (mean, SD)	2.30 (3.53)	2.09 (3.36)	2.69 (3.79)	<0.01
Anxiety symptoms (n, %)				
No	2499	1677	822	<0.01
Yes	596	355	241	

Linear regression analysis of depressive symptoms

Table 2 showed the results of univariate multilevel linear regression analysis for depressive symptoms. We found age, marriage status, monthly personal income, years in Shenzhen, adaption, discrimination, smoking, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with depressive symptoms. Therefore, we included these variables into multivariate multilevel linear regression analysis (Model 1).

Table 2 Results of univariate multilevel linear regression analysis for depressive and anxiety symptoms

	PHQ 9 score			GAD-7 score		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.066	-0.085	-0.046	-0.037	-0.053	-0.021
Gender						
Male	--	--	--	--	--	--
Female	-0.093	-0.45	0.28	0.15	-0.15	0.45
Marriage						
Singled	--	--	--	--	--	--
Married/coupled	-0.75	-1.07	-0.42	-0.29	-0.56	-0.023
Education						
Primary school	--	--	--	--	--	--
Junior high school	0.28	-0.74	1.49	-0.091	-0.96	0.84
High school	0.68	-0.59	1.64	0.21	-0.90	0.90
College and above	0.93	-0.19	2.27	0.75	-0.14	1.85
Monthly personal income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.18	-0.24	0.59	-0.028	-0.3	0.31
$732.73~1465.31	-0.72	-1.27	-0.16	-0.59	-1.04	-0.14
≥$1465.46	3.80	2.22	5.38	2.74	1.46	4.02
Years in Shenzhen	-0.050	-0.075	-0.025	-0.022	-0.042	-0.0013
Adaption						
Yes	--	--	--	--	--	--
No	1.83	1.48	2.17	1.11	0.83	1.40
Discrimination						
Yes	--	--	--	--	--	--
No	-0.80	-1.05	-0.55	-0.61	-0.81	-0.41
Smoking						
Yes	--	--	--	--	--	--
No	-0.59	-0.93	-0.24	-0.21	-0.49	0.072
Drinking						
Yes	--	--	--	--	--	--
No	-0.84	-1.05	-0.62	-0.53	-0.71	-0.35

Number of mental health source	-0.28	-0.45	-0.12	-0.19	-0.333	-0.056
Loneliness (ULS-6)	0.62	0.58	0.65	0.51	0.48	0.54
Impulsiveness (BIS-11)	0.20	0.18	0.21	0.15	0.13	0.16
Social support (SSRS)	-0.14	-0.16	-0.12	-0.095	-0.11	-0.081
Coping						
Positive coping	-0.058	-0.078	-0.038	-0.040	-0.057	-0.023
Negative coping	0.24	0.21	0.27	0.18	0.16	0.21
Meaning of life (CMLQ)	-0.055	-0.069	-0.042	-0.040	-0.051	-0.028

In Model 1, the AIC was 16337.21, the BIC was 16457.10, and the adjusted R-squared was 0.4020. We step-wisely removed years in Shenzhen, smoking, number of mental health source and positive coping strategy from the analysis. Finally, we got the final model (Model 2). Comparing with Model 1, Model 2 improved in model fitness with an AIC of 16331.71, a BIC of 16428.31, and an adjusted R-squared of 0.4003.

Table 3 showed that the severity of depressive symptoms would increase 0.46, 0.086 and 0.11 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively. Comparing with singled participants, the severity of depressive symptoms among married/coupled participants would be 0.26 unit higher; comparing with participants with monthly personal income of $439.49 and below, the severity of depressive symptoms among those with income over $1465.46 would be 2.30 units higher; and the severity of depressive symptoms would be 0.87 unit higher among participants did not adapt to living in Shenzhen. The severity of depressive symptoms would decrease 0.045, 0.022 and 0.015 unit for each unit of age, social support and meaning of life increased. Comparing with participants who reported discrimination and who reported drinking, the severity of depressive symptoms among those who did not report discrimination and did not drink would be 0.33 and 0.26 unit lower.

Table 3 Results of the stepwise multilevel linear regression analysis of depressive symptoms

	Model 1			Model 2		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.043	-0.062	-0.023	-0.045	-0.063	-0.027
Marriage						
Singled	--			--		
Married/coupled	0.27	0.044	0.50	0.26	0.032	0.48
Monthly personal						

income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.25	-0.084	0.58	0.24	-0.095	0.57
$732.73~1465.31	0.039	-0.42	0.49	0.020	-0.42	0.46
≥$1465.46	2.34	1.08	3.59	2.30	1.05	3.55
Years in Shenzhen	-0.0076	-0.031	0.016	--	--	--
Adaption						
Yes	--	--	--	--	--	--
No	0.86	0.57	1.14	0.87	0.59	1.15
Discrimination						
Yes	--	--	--	--	--	--
No	-0.34	-0.54	-0.13	-0.33	-0.53	-0.13
Smoking						
Yes	--	--	--	--	--	--
No	-0.17	-0.45	0.12	--	--	--
Drinking						
Yes	--	--	--	--	--	--
No	-0.24	-0.43	-0.061	-0.26	-0.44	-0.089
Number of mental health source	-0.015	-0.15	0.12	--	--	--
Loneliness (ULS-6)	0.46	0.43	0.50	0.46	0.43	0.50
Impulsiveness (BIS-11)	0.084	0.068	0.10	0.086	0.070	0.10
Social support (SSRS)	-0.019	-0.037	-0.0023	-0.022	-0.038	-0.0049
Coping						
Positive coping	-0.0073	-0.027	0.013	--	--	--
Negative coping	0.12	0.086	0.15	0.11	0.085	0.14
Meaning of life (CMLQ)	-0.014	-0.025	-0.0017	-0.015	-0.026	-0.0029
AIC		16337.21			16331.71	
BIC		16457.10			16428.31	
Adjusted R-squared		0.4020			0.4003	

Note: * Model 1 is the initial model of the multilevel linear regression analysis. Model 2 is the final model of the analysis after four iterations. ** Estimate stands for the coefficient of each variable. ***AIC stands for the Akaike information criterion; BIC stands for the Bayesian information criterion.

Linear regression analysis of anxiety symptoms

Table 2 showed the results of univariate multilevel linear regression analysis for anxiety symptoms. We found age, marriage, monthly personal income, years in Shenzhen, adaption, discrimination, drinking, number of mental health source, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with anxiety symptoms, and we included these variables into multivariate multilevel linear regression analysis (Model 3).

In Model 3, the AIC was 15121.74, the BIC was 15236.45, and the adjusted R-squared was 0.3845. We step-wisely removed years in Shenzhen, drinking, number of mental health source, social support, positive coping strategy and meaning of life from the analysis. Finally, we got the final model (Model 4). Comparing with Model 3, Model 4 improved in model fitness with

an AIC of 15116.08 and a BIC of 15194.57.

Table 4 showed that the severity of anxiety symptoms would increase 0.42, 0.065 and 0.080 unit for each unit of loneliness, impulsiveness and negative coping increased, respectively. Comparing with participants with monthly personal income of $439.49 and below, the severity of anxiety symptoms among those with income over $1465.46 would be 1.57 units higher; and the severity of anxiety symptoms would be 0.38 unit higher among migrant workers did not adapt to living in Shenzhen. Comparing with participants who reported discrimination, the severity of anxiety symptoms among those who did not report discrimination would be 0.23 unit lower.

Table 4 Results of the stepwise multilevel linear regression analysis of anxiety symptoms

	Model 3			Model 4		
	Estimate	95%CI		Estimate	95%CI	
		Lower	Upper		Lower	Upper
Age	-0.030	-0.046	-0.014	-0.029	-0.044	-0.014
Marriage						
Singled	--	--	--	--	--	--
Married/coupled	0.30	0.11	0.49	0.27	0.10	0.45
Monthly personal income						
≤$439.49	--	--	--	--	--	--
$439.64~732.58	0.054	-0.22	0.33	0.056	-0.22	0.33
$732.73~1465.31	-0.014	-0.39	0.35	0.0043	-0.36	0.37
≥$1465.46	1.58	0.55	2.61	1.57	0.54	2.60
Years in Shenzhen	0.0027	-0.016	0.022	--	--	--
Adaption						
Yes	--	--	--	--	--	--
No	0.38	0.14	0.61	0.38	0.15	0.61
Discrimination						
Yes	--	--	--	--	--	--
No	-0.22	-0.38	-0.051	-0.23	-0.39	-0.063
Drinking						
Yes	--	--	--	--	--	--
No	-0.077	-0.22	0.068	--	--	--
Number of mental health source	-0.0040	-0.11	0.11	--	--	--
Loneliness (ULS-6)	0.42	0.39	0.45	0.42	0.39	0.45
Impulsiveness (BIS-11)	0.060	0.046	0.074	0.065	0.053	0.078
Social support (SSRS)	-0.0025	-0.017	0.012	--	--	--
Coping						
Positive coping	-0.0044	-0.021	0.012	--	--	--
Negative coping	0.086	0.062	0.11	0.080	0.059	0.10
Meaning of life (CMLQ)	-0.0095	-0.019	0.00034	--	--	--
AIC		15121.74			15116.08	
BIC		15236.45			15194.57	
Adjusted R-squared		0.3845			0.3845	

Note: * Model 3 is the initial model of the multilevel linear regression analysis. Model 4 is the final model of the analysis after six iterations. ** Estimate stands for the coefficient of each variable. ***AIC stands for the Akaike information

criterion; BIC stands for the Bayesian information criterion.

Discussion

We identified several key findings based on a sample of 3095 internal migrant workers in Shenzhen, China: a) the overall prevalence of depressive and anxiety symptoms was 27.85% and 19.26%, which was lower than the previous study in Shenzhen[13]; b) gender disparities were observed that the prevalence of depressive and anxiety was higher in females, and the symptoms were also more severe in them; c) age, marriage, income, adaption to living in Shenzhen, being discriminated, drinking, loneliness, impulsiveness, social support, coping strategies and meaning of life were associated with the severity of depressive or anxiety symptoms; d) we observed gender disparities among sociodemographic characteristics and psychological factors that male migrant workers were older, more likely to be married, to receive more education and income, to feel being discriminated, to drink, to be more satisfied with life, and to have a lower level of impulsiveness and social support.

To understand the mental health problems among internal migrant workers in China, it is necessary to be familiar with the "Hukou" system. The "Hukou" system, known as the household registration system, is implemented to classify the place of registration (urban or rural residence areas) and the type of registration (agriculture or non-agriculture)[46]. Due to the registration, internal migrant workers, who are usually rural to urban migrants, have limited access to social welfare provided by the local governments of their destinations. Empirical studies have reported the associations between mental health and social inequities resulted from the registration system, including labor rights, wages, employment benefits, reimbursement for health care, limited access to public schools for migrant children[2-13].

Noticeably, internal migrant workers in Shenzhen are faced with increased mental health problems than local community residents. A large epidemiology study among community residents from seven Chinese provinces reported the mean score of PHQ-9 and GAD-7 was

3.95 and 2.71, respectively, and it also reported the score of GAD-7 was higher in females than in males (2.75 vs. 2.66)[47]. Further, this study comprised a sample of 2002 residents in Guangdong province and the mean score of PHQ-9 and GAD-7 in the sub-sample was 2.46 and 1.91, respectively, and gender differences were not reported in the subsample[47]. In comparison, we reported the mean score of PHQ-9 and GAD-7 among migrant workers in Shenzhen was 3.31 and 2.30, respectively, which were both higher than that in the mentioned study. An epidemiology study in 2009, applying the Composite International Diagnostic Interview (CIDI), reported the prevalence of depression and anxiety in Shenzhen was 9.15% and 12.58% among registered residents, and it was 9.74% and 14.92% among non-registered residents[48]. However, because of the non-diagnostic tools this study applied, we were limited to compare results.

The prevalence of depression and anxiety, including depressive and anxiety symptoms, varies among studies cross China, and we contribute the variation to following explanations. First, cross-sectional studies applied different tools to screen for depression and anxiety, such as the Center of Epidemiologic Studies Depression (CES-D), the Symptom Checklist 90 (SCL-90), the Self-rating Depression Scale (SDS), the Patient Health Questionnaire Depression Module (PHQ-9), the Beck's Depression Inventory (BDI), the Generalized Anxiety Disorder Scale (GAD-7), the Self-rating Anxiety Scale (SAS) and the Beck's Anxiety Inventory (BAI)[10-13 47 49-51]. And even applying the same scale, studies may choose different cut-off points to report the prevalence, for example, we chose the cut-off point at 5 for PHQ-9 and GAD-7 while Wang set the cut-off point at 7 for both scales[47]. Second, studies recruited different sub-groups of Chinese internal migrant workers. In this study, participants came from labor intensive factories living in factory campuses which were micro-societal systems; other studies recruited participants from different industries like catering, retail and service etc. Third, the prevalence also varies cross different samples of internal migrant workers because of sampling methods

and sample size. Fourth, more developed cities, like first-tier cities (i.e. Beijing, Shanghai, Guangzhou and Shenzhen), are selective based on migrants' skills, where working and living are much more stressful than the rest[52].

We identified factors associated with depressive and anxiety symptoms from the social ecological framework, and our results were consistent with previous studies that lower sociodemographic status was associated with internal migrant workers' mental health problems[10 53 54]. Gender as a factor at the individual level, it crosses all levels of the framework and results in institutional effects leading to the gender disparities in mental health among internal migrant workers. Empirical studies among Chinese internal migrant workers reported that female migrant workers were younger, less educated and paid 20% to 30% less than their male counterparts[7 55 56]. Generally, rural households have lower educational expectations for girls, especially among poorer households, that lead to a higher dropout rate for girls[57]; and shortened education indicates females are younger and less skilled when they enter the labor market in urban cities resulting in the inequality of wages[58]. We found female migrant workers have stayed longer in Shenzhen than the males, which may enable them a longer time to build social networks to increase their social support and reduce perceived discrimination in return. We reported female migrant workers perceived lower meaning in life, and it may result from the labor intensity and the inequality in wages. We believe the institutional gender disparities or even inequities might play an important role, and we encourage future research to collect detailed information, hypothesize the mechanism between mental health problems and gender disparities in sociodemographic factors, and test these hypotheses.

We recognize a few limitations of this study. First, the parent study did not aim to investigate the prevalence of depression and anxiety (including depressive and anxiety symptoms) among internal migrant workers from labor intensive factories in Shenzhen, and the sample did not recruit migrant workers from other industries, hence it was difficult to estimate the

representativeness of our findings comparing with the whole migrant worker population in Shenzhen. Second, because the parent study did not focus on gender disparities among migrant workers, we did not collect further information such as disparities in labor intensity, living environment, economic pressure, work related stress, and, especially, the interaction between gender disparities and the "Hukou" system, hence we could not conceptualize frameworks to explain the mechanism from gender disparities to mental health problems. Third, as a cross-sectional study, we could not draw causal inferences from the findings. We encourage future studies to use longitudinal design to investigate the causal effects of gender disparities on migrant workers' mental health to develop strategies to improve migrant workers' mental health.

Conclusion

Among internal migrant workers in Shenzhen, females reported higher prevalence and severity of depressive and anxiety symptoms than the males, and the differences are associated with disparities resulting from institutional gender inequality. Interventions to improve the mental health of internal migration population in China should be embedded with strategies improving gender equality from individual to societal perspectives.

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Conflict of interest

The authors declare that they have not conflict of interest.

Ethical Statement

The Ethics Committee of Shenzhen Kangning Hospital reviewed and approved the protocol, including the on-line informed consent process, and approved analysis of de-identified data (KN-2020-04).

Contribution

FH developed the plan for analysis, analyzed the data, drafted and revised the paper. HL designed the survey instruments, monitored data collection, developed the plan for analysis and revised the paper. XP, LY, ZZ and HX designed the survey instruments, sent out recruitment advertisement, assisted in data collection and revised the paper. TL initiated the project, designed the study, and revised the paper. All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors read and approved the final manuscript.

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Data sharing statement

The data on which this manuscript is based are not available to public. The data from this study are under certain restrictions according to the Shenzhen Science and Technology Innovation Commission and always under the supervision of the principal investigator of the study. Thus, there are access restrictions to the data. However, at any time, researchers can contact the principal investigator (Tiebang Liu, liutbsz@126.com) for data sharing.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6,7
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	No applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8,9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8,9
Bias	9	Describe any efforts to address potential sources of bias	17
Study size	10	Explain how the study size was arrived at	6,7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10
		(*b*) Describe any methods used to examine subgroups and interactions	No applicable
		(*c*) Explain how missing data were addressed	7
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	10
		(*e*) Describe any sensitivity analyses	No applicable

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	10
		(b) Give reasons for non-participation at each stage	7
		(c) Consider use of a flow diagram	No applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	10,11,12
		(b) Indicate number of participants with missing data for each variable of interest	10, 11
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	No applicable
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	No applicable
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	No applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	10,11,12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	11-16
		(*b*) Report category boundaries when continuous variables were categorized	10,11
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	No applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	No applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19,20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.