



Factors associated with psychological distress among patients with breast cancer during the COVID-19 pandemic: a cross-sectional study in Wuhan, China

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Abstract

Purpose This study aimed to examine the prevalence of psychological distress and the corresponding risk factors among patients with breast cancer affected by the outbreak of coronavirus disease 2019 (COVID-19).

Methods This cross-sectional, survey-based, region-stratified study was conducted from March 14 to March 21, 2020. An online survey was used to collect the basic characteristics of patients with breast cancer. The degree of depression, anxiety, and insomnia symptoms were assessed using the Patient Health Questionnaire (PHQ-9), the Generalized Anxiety Disorder (GAD-7), and the Insomnia Severity Index (ISI) questionnaires, respectively. Multivariate logistic analysis was performed to identify factors associated with psychological distress outcomes.

Results Among the 834 patients with breast cancer included in the study, the prevalence of depression, anxiety, and insomnia was 21.6%, 15.5%, and 14.7%, respectively. No statistically significant difference in the prevalence of these symptoms was observed between patients in Wuhan and those outside Wuhan. Multivariate logistic regression analyses revealed that comorbidity, living alone, deterioration of breast cancer, and affected treatment plan were risk factors for psychological distress including depression, anxiety, and insomnia. When stratified by location, living alone was associated with depression and insomnia only among patients in Wuhan, but not those outside Wuhan.

Conclusions This study shows an elevated prevalence of depression, anxiety, and insomnia among patients with breast cancer during part of the COVID-19 pandemic. Patients with comorbidity, living alone, deterioration of breast cancer, and whose treatment plan was affected should be paid more attention to prevent mental disorders.

Keywords COVID-19 · Breast cancer · Risk factors · Depression · Anxiety · Insomnia

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Introduction

Coronavirus disease 2019 (COVID-19) first emerged in Wuhan, Hubei Province, China, in December 2019 [1]. It rapidly spread to 212 countries or territories outside of China and was later declared an international public health emergency by the World Health Organization on March 11, 2020. Many individuals have been affected and developed symptoms of psychological distress due to COVID-19. Studies among various populations such as the general public [2, 3], healthcare workers [4], pregnant women [5], or children [6] have revealed higher scores of anxiety and depression compared to that before COVID-19.

Patients with cancer might be immunocompromised by the effects of antineoplastic therapy and more likely to experience mental disorders, which can reduce their quality of life [7]. Among all solid malignancies, the highest prevalence of mental disorders was reported to be observed in patients with breast cancer [8]. As in many other countries, breast cancer now is the most common type of cancer among Chinese women, and cases in China account for 12.2% of all newly diagnosed breast cancers worldwide [9]. Depression, anxiety, and insomnia are the three common symptoms of psychological distress during the treatment period among women with breast cancer [10–12], which have also been identified to be associated with substantial functional impairment and higher mortality among breast cancer patients [13, 14].

During the COVID-19 pandemic, most breast cancer patients may not have access to the healthcare system for anti-cancer therapy, monitoring, and preventive or supportive care due to fear for safety or traffic control [15, 16]. To our knowledge, only one previous study conducted at the beginning of Wuhan lockdown demonstrated the prevalence of psychological distress and found poor general condition, treatment discontinuation, aggressive molecular subtypes, and metastatic breast cancer as risk factors associated with psychological distress among patients with breast cancer [17]. However, the study was based only in Wuhan and did not identify the differences of risk factors for psychological distress between Wuhan, the origin and epicenter of the pandemic in China, and the areas less affected outside Wuhan. Additionally, previous studies found living alone was associated with psychological distress [18], but whether it is still the main risk factor during pandemic remains unknown. Given the limitations, more evidence is needed for policymakers to address the specific risk factors related to mental disorders of patients with breast cancer during the COVID-19 pandemic and implement effective healthcare interventions for them.

The current study aimed to evaluate mental health status among patients with breast cancer by quantifying the magnitude of symptoms of depression, anxiety, and insomnia and identify factors associated with these symptoms. Also,

participants from Wuhan City and other areas outside Wuhan were enrolled in this study to compare interregional differences.

Methods

Study population

We conducted an observational cross-sectional study to address our research objectives. All participants were recruited mainly from hospitals in the Hubei Province of China from March 14 to March 21, 2020. All the patients with breast cancer enrolled in the study were being under the treatment of surgery, chemotherapy, endocrine therapy, targeted therapy, radiotherapy, or reexamination. Samples were stratified by their geographic location (Wuhan, outside Wuhan). The required ethical approval was obtained from the institutional review board of hospitals. Informed consent was obtained from the participants. The questionnaire was filled out anonymously and the confidentiality of the information and privacy of the participants were protected throughout the study. The study was approved by the Ethics Review Committee of Hubei Cancer Hospital (No. LLHBCH2020LW-002).

Data collection

The data were collected using a self-administered questionnaire. The questionnaire was filled out online through the Wenjuanxing platform, a website used to collect questionnaires (<https://www.wjx.cn/app/survey.aspx>). A total of 834 individuals provided informed consent and submitted the questionnaires.

The demographic factors included age (years), educational level (elementary school, high school, and college or higher), location (Wuhan, outside Wuhan), menstrual status (menstruating, perimenopause, and postmenopause), marital status (single, married, divorced, and widowed), comorbidity (no, yes), and living alone (no, yes). Breast cancer-related factors included stage of breast cancer (early or middle, late stage), deterioration of breast cancer (no, not sure, yes), and affected treatment plan (no, yes). Among patients whose treatment plan was affected, information on duration of treatment interruption (2–4, 4–6, 6–8, ≥ 8 weeks), reason for treatment interruption, and type of discontinued anticancer therapy were also collected.

Psychological status

Depression, anxiety, and insomnia were assessed using the Chinese translation of the Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder Scale (GAD-7), and the Insomnia Severity Index (ISI), respectively [19]. The

validity and reliability of these 3 Chinese version questionnaires have been previously proven [20–22]. The PHQ-9 is a 9-item screening instrument. Each of the 9 items received a score of 0–3. Depression severity was classified into none (0–4), mild (5–9), moderate (10–14), and severe (> 15). Depression was defined as a sum score of ≥ 10 . The GAD-7 scale consists of 7 items, and each item was scored from 0 to 3. Scores of 5, 10, and 15 were established as the cutoff points for mild, moderate, and severe anxiety, respectively. Anxiety was defined as a sum score of ≥ 10 . ISI has 7 questions. Each of the 7 items received a score of 0–4. The total score is interpreted as follows: none (0–7), mild (8–14), moderate insomnia (15–21), and severe insomnia (22–28). Insomnia was defined as a sum score of ≥ 15 .

Cronbach's α value was determined as an indicator to assess the internal consistency of the questionnaire. In this study, the Cronbach's α value was 0.91, 0.91, and 0.94 for the Chinese version of PHQ-9, GAD-7, and ISI scale, respectively, which is generally regarded as acceptable.

Statistical analyses

The data were presented using frequencies and percentages for categorical variables. A Chi-square test was used to compare basic characteristics between participants living in Wuhan and outside Wuhan. The nonparametric Mann-Whitney U test and Kruskal-Wallis test were used to compare the severity of each symptom between 2 or more groups. To determine potential risk factors for symptoms of depression, anxiety, and insomnia in participants, multivariate logistic regression models were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) adjusting for age, educational level, marital status, menstrual status, location, comorbidity, breast cancer stage, living alone, deterioration of breast cancer, and affected treatment plan. We also examined the associations stratified by location (Wuhan, outside Wuhan). Statistical analyses were performed using SAS Version 9.4 (SAS Institute Inc). All tests were 2-sided with a significance threshold of 5%.

Results

Among the 834 patients with breast cancer who responded to the questionnaire, 44.8% ($n = 374$) lived in Wuhan. Most participants were aged ≥ 46 years (65.1%, $n = 543$), had an education level of high school (51.0%, $n = 425$), were married (86%, $n = 717$), and were postmenopausal (47.6%, $n = 397$). Additionally, 48.3% ($n = 403$) of the patients experienced other diseases except for breast cancer. During the COVID-19 pandemic, 5.9% ($n = 49$) participants reported living alone. Of the patients, 90.8% ($n = 757$) were at early/middle stage of breast cancer, 9.1% ($n = 76$) reported deterioration of breast cancer, and 61.2% ($n = 510$) were affected on treatment plan.

Among these 510 patients whose treatment plan was affected, most participants were affected for more than 8 weeks (28.4%, $n = 145$), the most common reason was traffic control (57.3%, $n = 292$), and reexamination was the most common discontinued anticancer therapy (40.8%, $n = 208$). The proportion of participants who had depression, anxiety, and insomnia was 21.6%, 15.5%, and 14.7%, respectively (Table 1).

Compared to patients who lived in Wuhan, those living outside Wuhan were more likely to be lower educated, menstruating, and experiencing deterioration of breast cancer. No significant statistical differences were found in age, marital status, comorbidity, breast cancer stage, living alone, affected treatment plan, and symptoms of psychological distress between groups (Table 1).

For depression, there were 47.0%, 31.4%, 14.3%, and 7.3% of the patients categorized into none, mild, moderate, and severe categories, respectively. For anxiety, there were 32.3%, 52.3%, 11.3%, and 4.2% of the patients who reported none, mild, moderate, and severe status, respectively. For insomnia, 50.5%, 34.9%, 11.6%, and 3.4% of the patients experienced none, mild, moderate, and severe insomnia, respectively. The prevalence of depression, anxiety, and insomnia was 20.6%, 15.5%, and 14.7%, respectively. Compared with those who lived outside Wuhan, patients living in Wuhan were more likely to report severe symptoms of anxiety and insomnia, but not depression. Compared with patients without comorbidity, those who had comorbidity reported experiencing more severe symptoms of depression and insomnia, but not anxiety. Patients who were at late stage of breast cancer were more likely to experience severe symptoms of anxiety compared to those at early/middle stage. Patients who lived alone, had deterioration of breast cancer, and whose treatment plan was affected reported experiencing more severe symptom levels of depression, anxiety, and insomnia (Table 2).

In the multivariate analysis, comorbidity, living alone, and deterioration of breast cancer were independently associated with a higher risk of all the three symptoms of depression, anxiety, and insomnia in total participants after adjustment for potential confounders (comorbidity: depression, OR, 1.48, 95% CI, 1.03, 2.11; anxiety, OR, 1.58, 95% CI, 1.05, 2.37; insomnia, OR, 1.80, 95% CI, 1.19, 2.72; living alone: depression, OR, 2.66, 95% CI, 1.36, 5.22; anxiety, OR, 3.86, 95% CI, 1.90, 7.86; insomnia, OR, 2.78, 95% CI, 1.32, 5.83; deterioration of breast cancer: depression, OR, 7.41, 95% CI, 4.03, 13.61; anxiety, OR, 5.98, 95% CI, 3.07, 11.67; insomnia, OR, 4.35, 95% CI, 2.18, 8.70). Affected treatment plan was independently associated with depression and anxiety (depression, OR, 1.20, 95% CI, 1.81, 1.79; anxiety, OR, 1.68, 95% CI, 1.04, 2.70), but not insomnia (Table 3).

When stratified by location (Wuhan, outside Wuhan), significant associations of living alone with depression and insomnia were observed only among patients in Wuhan, but not in those outside Wuhan. The association between living alone

Table 1 Basic characteristics and psychological distress of the patients with breast cancer in Wuhan versus those outside Wuhan

Characteristics	Location			P
	Total (n = 834)	Wuhan (n = 374)	Outside Wuhan (n = 460)	
Basic characteristics				
Age (years)				0.422
< 46	291 (34.9)	125 (33.4)	166 (36.1)	
≥ 46	543 (65.1)	249 (66.6)	294 (63.9)	
Educational level				0.001
Junior school or lower	96 (11.5)	33 (8.8)	63 (13.7)	
High school	425 (51.0)	176 (47.1)	249 (54.1)	
College or higher	313 (37.5)	165 (44.1)	148 (32.2)	
Marital status				0.131
Married	717 (86.0)	314 (84.0)	403 (87.6)	
Single/divorced/windowed	117 (14.0)	60 (16.0)	57 (12.4)	
Menstrual status				< 0.001
Menstruating	281 (33.7)	113 (30.2)	168 (36.5)	
Perimenopausal	156 (18.7)	55 (14.7)	101 (22.0)	
Postmenopause	397 (47.6)	206 (55.1)	191 (41.5)	
Comorbidity				0.196
No	431 (51.7)	184 (49.2)	247 (53.7)	
Yes	403 (48.3)	190 (50.8)	213 (46.3)	
Living alone				0.549
No	785 (94.6)	350 (93.6)	435 (94.6)	
Yes	49 (5.9)	24 (6.4)	25 (5.4)	
Stage of breast cancer				0.724
Early or middle stage	757 (90.8)	338 (90.4)	419 (91.9)	
Late stage	77 (9.2)	36 (9.6)	41 (8.9)	
Deterioration of breast cancer				0.013
No	359 (43.0)	145 (38.8)	214 (46.5)	
Not sure	399 (47.8)	200 (53.5)	199 (43.3)	
Yes	76 (9.1)	29 (7.8)	47 (10.2)	
Affected treatment plan				0.369
No	324 (38.8)	139 (37.2)	185 (40.2)	
Yes	510 (61.2)	235 (62.8)	275 (59.8)	
Duration of treatment interruption ^a				0.019
2–4 weeks	89 (17.5)	40 (17.0)	49 (17.8)	
4–6 weeks	98 (19.2)	59 (25.1)	39 (14.2)	
6–8 weeks	101 (19.8)	48 (20.4)	53 (19.3)	
≥ 8 weeks	145 (28.4)	58 (24.7)	87 (31.6)	
Not sure	77 (15.1)	30 (12.8)	47 (17.1)	
Reason for treatment interruption ^a				0.004
Traffic control	292 (57.3)	117 (49.8)	175 (63.6)	
No hospital beds or appointment hours	66 (12.9)	42 (17.9)	24 (8.7)	
Fear of infection	134 (26.3)	67 (28.5)	67 (24.4)	
Personal other reasons	18 (3.5)	9 (3.8)	9 (3.3)	
Discontinued anticancer therapy ^a				0.105
Delayed surgery	44 (8.6)	17 (7.2)	27 (9.8)	
Chemotherapy after surgery	101 (19.8)	43 (18.3)	58 (21.1)	
Endocrine therapy after surgery	77 (15.1)	46 (19.6)	31 (11.3)	
Targeted therapy after surgery	65 (12.7)	30 (12.8)	35 (12.7)	
Radiotherapy after surgery	15 (2.9)	9 (3.8)	6 (2.2)	

Table 1 (continued)

		Location		
Reexamination	208 (40.8)	90 (38.3)	118 (42.9)	
<i>Psychological distress</i>				
<i>Depression</i>				0.371
No	654 (78.4)	288 (77.0)	366 (79.6)	
Yes	180 (21.6)	86 (23.0)	94 (20.6)	
<i>Anxiety</i>				0.117
No	705 (84.5)	308 (82.4)	397 (86.3)	
Yes	129 (15.5)	66 (17.6)	63 (13.7)	
<i>Insomnia</i>				0.124
No	711 (85.3)	311 (83.2)	400 (87.0)	
Yes	123 (14.7)	63 (16.8)	60 (13.0)	

Data are presented as number (%)

Percentages are weighted to account for the sample size, $n = 834$

^a Percentages are weighted to the size of the group of patients whose treatment plan was affected, $n = 510$

and anxiety was observed among both patients in Wuhan and those outside Wuhan. The associations between deterioration of breast cancer and the three symptoms of psychological distress were statistically significant among both patients in Wuhan and those outside Wuhan (Table 3).

Discussion

The present cross-sectional epidemiological study revealed that the prevalence of depression, anxiety, and insomnia symptoms in patients with breast cancer in China during part of the COVID-19 epidemic period was 21.6%, 15.5%, and 14.7%, respectively. After adjustment for potential confounders, comorbidity, late stage, living alone, deterioration of breast cancer, and affected treatment plan were independent risk factors for depression, anxiety, and insomnia. Additionally, living alone was associated with depression and insomnia only among patients in Wuhan, but not those outside Wuhan.

According to a meta-analysis of 72 studies performed in 30 countries, the global prevalence of depression among breast cancer patients was 32.2%, and the prevalence of depression was different across countries [23]. In a Chinese pre-COVID-19 cohort study, depression was estimated to affect 12.6% of patients with breast cancer, which is lower than that in our study [24]. However, two previous studies conducted in China before the pandemic showed similar prevalence of depression of 23.7% and 20.6% among patients with breast cancer to that of our study [18, 25]. Elevated symptom of anxiety was observed in our study compared to that of a previous Chinese study where 8.8% of patients with breast cancer reported experiencing anxiety [18]. One British study conducted

before the COVID-19 pandemic revealed that the prevalence of insomnia was 8% before diagnosis, and 18% after the breast cancer diagnosis, which is consistent with that of our study [26]. However, few studies reported the prevalence of psychological distress among patients with breast cancer during the COVID-19 pandemic. To our knowledge, there is only one survey of Chinese residents early in the COVID-19 outbreak (February 16–19, 2020), 22.1% of respondents reported moderate or severe depression, 21.4% reporting moderate or severe anxiety, and 16.8% reporting moderate to severe insomnia [17]. The prevalence of depressive, anxiety, and insomnia symptoms in our study is slightly lower, suggesting that the psychological impact of pandemic control may be of benefit for patients with breast cancer. Due to the limited evidence, more studies are warranted in the future to evaluate the prevalence of psychological distress during the COVID-19 pandemic among patients with breast cancer.

Consistent with previous studies, we confirmed several risk factors for psychological distress such as comorbidity and living alone [17, 18, 24]. Breast cancer patients with comorbidity are more likely to have worse outcomes such as higher death rates compared to those without comorbidity [27, 28]. Therefore, they faced more stress which may lead to elevated symptoms of psychological distress. Living alone increases the risk of social isolation. Individuals who are socially isolated receive significantly less emotional and family support, which in turn increases the risk of depression [29]. During the pandemic, it is a hard time for patients to maintain a social relationship with friends and doctors due to lockdown. More attention should be paid on those patients with comorbidity and living alone to prevent the symptoms of mental disorders.

In addition to the well-documented risk factors, due to the COVID-19 pandemic, deterioration of breast cancer and

Table 2 Severity categories of depression, anxiety, and insomnia measurements in total patients and subgroups

Severity category	Location		Comorbidity		Stage of breast cancer		Living alone		Deterioration of breast cancer		Affected treatment plan			
	Total	Wuhan	No	Yes	Early/middle	Late	No	Yes	No	Not sure	Yes	No		
		Outside Wuhan	P	P	P	P	P	P	P	P	P	P		
<i>PHQ-9, depression</i>			0.156	0.013	0.066	0.031								
None	392 (47.0)	167 (44.7)	225 (48.9)	216 (50.1)	176 (43.7)	302 (47.8)	30 (39.0)	374 (47.6)	18 (36.7)	221 (61.6)	152 (38.1)	19 (25.0)	190 (58.6)	202 (39.6)
Mild	262 (31.4)	121 (32.4)	141 (30.7)	138 (32.0)	124 (30.8)	237 (31.3)	25 (32.5)	249 (31.7)	13 (26.5)	101 (28.1)	140 (35.1)	21 (27.6)	83 (25.6)	179 (35.1)
Moderate	119 (14.3)	51 (13.6)	68 (14.8)	52 (12.1)	67 (16.6)	107 (14.1)	12 (15.6)	107 (13.6)	12 (24.5)	26 (7.2)	72 (18.0)	21 (27.6)	33 (10.2)	86 (16.9)
Severe	61 (7.3)	35 (9.4)	26 (5.7)	25 (5.8)	36 (8.9)	51 (6.7)	10 (13.0)	55 (7.0)	6 (12.2)	11 (3.1)	35 (8.8)	15 (19.7)	18 (5.6)	43 (8.4)
<i>GAD-7, anxiety</i>			0.018	0.051	0.001	0.013								
None	269 (32.3)	106 (28.3)	163 (35.4)	146 (33.9)	123 (30.5)	254 (33.6)	15 (19.5)	257 (32.7)	12 (24.5)	163 (45.4)	96 (24.1)	10 (13.2)	138 (42.6)	131 (25.7)
Mild	436 (52.3)	202 (54.0)	234 (50.9)	232 (53.8)	204 (50.6)	394 (52.0)	42 (54.5)	415 (52.9)	21 (42.9)	170 (47.4)	228 (57.1)	38 (50.0)	156 (48.1)	280 (54.9)
Moderate	94 (11.3)	49 (13.1)	45 (9.8)	36 (8.4)	58 (14.4)	82 (10.8)	12 (15.6)	82 (10.4)	12 (24.5)	22 (6.1)	55 (13.8)	17 (22.4)	20 (6.2)	74 (14.5)
Severe	35 (4.2)	17 (4.5)	18 (3.9)	17 (3.9)	18 (4.5)	27 (3.6)	8 (10.4)	31 (3.9)	4 (8.2)	4 (1.1)	20 (5.0)	11 (14.5)	10 (3.1)	25 (4.9)
<i>ISI, insomnia</i>			0.042	< 0.001	0.075	0.004								
None	418 (50.1)	175 (46.8)	246 (53.5)	246 (57.1)	175 (43.4)	388 (51.3)	33 (42.9)	405 (51.6)	16 (32.7)	224 (62.4)	174 (43.6)	23 (30.3)	193 (59.6)	228 (44.7)
Mild	291 (34.9)	136 (36.4)	154 (33.5)	138 (32.0)	152 (37.7)	263 (34.7)	27 (35.1)	270 (34.4)	20 (40.8)	109 (30.4)	150 (37.6)	31 (40.8)	98 (30.2)	192 (37.6)
Moderate	97 (11.6)	51 (13.6)	45 (9.8)	36 (8.4)	60 (14.9)	83 (11.0)	13 (16.9)	86 (11.0)	10 (20.4)	21 (5.8)	60 (15.0)	15 (19.7)	27 (8.3)	69 (13.5)
Severe	28 (3.4)	12 (3.2)	15 (3.3)	11 (2.6)	16 (4.0)	23 (3.0)	4 (5.2)	24 (3.1)	3 (6.1)	5 (1.4)	15 (3.8)	7 (9.2)	6 (1.9)	21 (4.1)

Data are presented as number (%)

No statistically significant difference in the severity of each symptom (depression, anxiety, and insomnia) was observed between/among age, education level, menstrual status, and marital status groups ($P > 0.05$), and the results are not shown in the table

Table 3 Risk factors for depression, anxiety, and insomnia identified by multivariable logistic regression analysis

	Total		Location Wuhan		Outside Wuhan	
	Cases/total (%)	OR (95% CI) ^a	Cases/total (%)	OR (95% CI) ^b	Cases/total (%)	OR (95% CI) ^b
<i>Depression</i>						
<i>Comorbidity</i>						
No	77/431 (17.9)	Ref	32/184 (17.4)	Ref	45/247 (18.2)	Ref
Yes	103/403 (25.9)	1.48 (1.03, 2.11)	54/190 (28.4)	1.65 (0.95, 2.87)	49/213 (23.0)	1.36 (0.84, 2.2)
<i>Living alone</i>						
No	162/785 (20.6)	Ref	74/350 (21.1)	Ref	88/435 (20.2)	Ref
Yes	18/49 (36.7)	2.66 (1.36, 5.22)	12/24 (50.0)	5.50 (2.11, 14.36)	6/25 (24.0)	1.34 (0.47, 3.78)
<i>Deterioration of breast cancer</i>						
No	37/359 (10.3)	Ref	14/145 (9.7)	Ref	23/214 (10.7)	Ref
Not sure	107/399 (26.8)	3.06 (2.00, 4.70)	54/200 (27.0)	3.24 (1.65, 6.35)	53/199 (26.6)	3.14 (1.77, 5.56)
Yes	36/76 (47.4)	7.41 (4.03, 13.61)	18/29 (62.1)	14.6 (5.3, 40.17)	18/47 (38.8)	5.07 (2.29, 11.21)
<i>Affected treatment plan</i>						
No	51/324 (15.7)	Ref	22/139 (15.8)	Ref	29/185 (15.7)	Ref
Yes	129/510 (25.3)	1.20 (1.81, 1.79)	64/235 (27.2)	1.50 (0.81, 2.77)	65/275 (23.6)	1.05 (0.61, 1.82)
<i>Anxiety</i>						
<i>Comorbidity</i>						
No	53/431 (12.3)	Ref	24/184 (13.0)	Ref	29/247 (11.7)	Ref
Yes	76/403 (18.9)	1.58 (1.05, 2.37)	42/190 (22.1)	1.8 (0.99, 3.27)	34/213 (16.0)	1.39 (0.78, 2.49)
<i>Living alone</i>						
No	113/785 (14.4)	Ref	57/350 (16.3)	Ref	56/435 (12.9)	Ref
Yes	16/49 (32.7)	3.86 (1.90, 7.86)	9/24 (37.5)	4.44 (1.63, 12.06)	7/25 (28.0)	3.80 (1.31, 11.03)
<i>Deterioration of breast cancer</i>						
No	26/359 (7.2)	Ref	13/145 (9.0)	Ref	13/214 (6.1)	Ref
Not sure	75/399 (18.8)	2.52 (1.53, 4.14)	41/200 (20.5)	2.26 (1.12, 4.57)	34/199 (17.1)	3.10 (1.50, 6.40)
Yes	28/76 (36.8)	5.98 (3.07, 11.66)	12/29 (41.4)	5.28 (1.9, 14.7)	16/47 (34.0)	6.54 (2.62, 16.29)
<i>Affected treatment plan</i>						
No	30/324 (9.3)	Ref	15/139 (10.8)	Ref	15/185 (8.1)	ref
Yes	99/510 (19.4)	1.68 (1.04, 2.70)	51/235 (21.7)	1.83 (0.93, 3.64)	48/275 (17.5)	1.44 (0.72, 2.89)
<i>Insomnia</i>						
<i>Comorbidity</i>						
No	47/431 (10.9)	Ref	16/184 (8.7)	Ref	31/247 (12.6)	Ref
Yes	76/403 (18.9)	1.80 (1.19, 2.72)	47/190 (24.7)	3.34 (1.73, 6.43)	29/213 (13.6)	1.1 (0.62, 1.96)
<i>Living alone</i>						
No	110/785 (14.0)	Ref	54/350 (15.4)	Ref	56/435 (12.9)	Ref
Yes	13/49 (26.5)	2.78 (1.32, 5.83)	9/24 (37.5)	4.99 (1.79, 13.92)	4/25 (16.0)	1.69 (0.5, 5.66)
<i>Deterioration of breast cancer</i>						
No	26/359 (7.2)	Ref	10/145 (6.9)	Ref	16/214 (7.5)	Ref
Not sure	75/399 (18.8)	2.67 (1.62, 4.38)	42/200 (21.0)	3.28 (1.51, 7.13)	33/199 (16.6)	2.35 (1.19, 4.65)
Yes	22/76 (28.9)	4.35 (2.18, 8.70)	11/29 (37.9)	6.90 (2.31, 20.63)	11/47 (23.4)	2.9 (1.15, 7.33)
<i>Affected treatment plan</i>						
No	33/324 (10.2)	Ref	17/139 (12.2)	Ref	16/185 (8.6)	Ref
Yes	90/510 (17.6)	1.36 (0.85, 2.17)	46/235 (19.6)	1.28 (0.64, 2.57)	44/275 (16.0)	1.46 (0.74, 2.88)

^a Multivariate analyses were adjusted for age, educational level, marital status, menstrual status, location, comorbidity, stage of breast cancer, living alone, deterioration of breast cancer, and affected treatment plan. Factors including location, age, educational level, menstrual status, marital status, and stage of breast cancer are not significantly associated with psychological distress symptoms and not shown in the table

^b Multivariate analyses were adjusted for all the covariates included in the total population except location

affected treatment plan were reported by most patients. To our knowledge, these two issues were firstly reported to be risk factors for psychological distress. During the COVID-19 pandemic, China implemented measures to limit the spread of the virus, such as traffic control [30], which was the most common reason for discontinued therapy in our study. Besides, many patients chose to stay at home instead of visiting doctors because of fear for their safety. Therefore, when the pandemic is under control, psychologists and social groups need to provide support to patients whose breast cancer was deteriorated and treatment plan was affected during the COVID-19 outbreak to reduce mental health problems.

Subgroups analyses found that the mental health status of patients in Wuhan was more likely to be affected by living alone compared to those outside Wuhan. When faced with the same situation of COVID-19, patients in Wuhan might worry about more problems such as shortage of food supply. Living alone may exacerbate this negative emotion without support from family members as well as friends. The imposed lockdown resulted in travel restrictions to and from Wuhan to ensure rigorous adherence to home quarantine. Social distancing was practiced by canceling events and gatherings and closing public places as well as schools and universities [16]. Our results suggested that the interventions for the mental health of patients who lived alone should be a priority during any public wide epidemic, especially in epicenters during a pandemic such as Wuhan in China.

This study has several limitations. Firstly, this is a cross-sectional study. Previous studies demonstrated that depression, anxiety, and insomnia changed during intermittent periods between chemotherapy sessions [31, 32]. Longitudinal studies should be conducted in the future. Besides, due to the lack of data from general people, we cannot distinguish specific risk factors for mental health outcomes among patients with breast cancer. What's more, we did not explore the factors associated with a lower risk of psychological distress. Further studies addressing the protective factors for mental health status among patients with breast cancer were warranted.

Conclusions

Our study presents the prevalence of depression, anxiety, and insomnia in patients with breast cancer during the part of the COVID-19 pandemic. Meanwhile, the associated factors were identified, indicating that awareness of the increased risk of psychological distress in patients with comorbidity, living alone, reporting deterioration of breast cancer, and whose treatment plan was affected. Our results emphasize the importance of implementing effective interventions for screening high-risk patients with breast cancer for mental disorders during routine treatment and follow-ups after the COVID-19

pandemic. Furthermore, psychological support should be offered to mitigate the negative emotional sequelae of breast cancer.

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Authors' contributions JS and XZ conceived the study conception. All authors conducted the survey and collected data. XC, LW, and LL contributed equally to the study design. XC performed the statistical analysis and wrote the manuscript. LW and LL participated in the discussions concerning the interpretation of results and revision of the manuscript. MJ contributed to get the resources. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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

Compliance with ethical standards

Conflict of interest All authors declare no competing interest.

Ethics approval The study was approved by the Ethics Review Committee of Hubei Cancer Hospital (No. LLHBCH2020LW-002).

Consent to participate Informed consent was obtained from the participants.

Consent for publication Informed consent for publication was obtained from the authors.

Code availability The code used in the current study is available from the corresponding author on reasonable request.

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