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Original Research

The Psychological Impacts of COVID-19 Pandemics on Pregnant Women in Hong Kong—Results of a Web-Based Cross-Sectional Survey

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Abstract

Background: We sought to assess the anxiety and depression scores of pregnant women in Hong Kong during the COVID-19 pandemic and to evaluate the impact of demographic, economic and social factors on these scores. **Methods**: This was part of an ongoing worldwide cross-sectional study conducted from 22 May 2020 to 28 February 2021. Data were collected through an anonymous web-based survey. The severity of depression and anxiety was assessed using the Patient Health Questionnaire-9 (PHQ-9) score and the General Anxiety Disorder-7 (GAD-7) score, respectively. **Results**: A total of 361 participants completed both the GAD-7 and PHQ-9 questionnaires. Participants with psychiatric illness reported a significant higher median GAD-7 score (6.00, interquartile range [IQR] 3.00–7.75 *vs.* 2.00, IQR 0.00–6.00, $p = 0.001$), while the median PHQ-9 score was also higher but was not statistically significant (6.50, IQR 3.00–11.00 *vs.* 5.00, IQR 3.00–8.00, $p = 0.066$). A higher proportion of participants with psychiatric illness reported moderate-severe depression and anxiety (35.7% *vs.* 16.5%, $p = 0.002$, 17.8% *vs.* 3.6%, $p < 0.001$ respectively). Multivariate regression analysis demonstrated that financial difficulty, in education and pregnancy by *in-vitro* fertilization were associated with a higher PHQ-9 score in pregnant women during the COVID-19 pandemic, while underlying psychiatric illness was associated with a higher GAD-7 score. Support from a partner was demonstrated to be associated with a reduced level of depression and anxiety in pregnancy. **Conclusions**: Pregnant women with underlying psychiatric illness were more vulnerable during the COVID-19 pandemics than the non-psychiatric counterparts. Partner support is important for alleviating depression and anxiety in pregnancy during the COVID-19 pandemic. **Clinical Trial Registration**: The study was registered at http://www.clinicaltrials.gov, registration number NCT04377412.

Keywords: anxiety; COVID-19; depression; mental health; patient health questionnaire

1. Introduction

The outbreak of the coronavirus disease 2019 (COVID-19) imposed a huge burden on the healthcare system worldwide, together with increased social, psychological and economic stress. The Government of Hong Kong, in response to the COVID-19 outbreak, implemented a series of public health policies, including social distancing and mandatory mask-wearing, while the Hospital Authority also implemented restrictive measures, including suspension of visiting hours at all public hospitals [1]. In obstetrics, companionship during childbirth and visitation to mothers and newborn babies were suspended and all antenatal and postnatal classes were cancelled during the period of the Emergency Response Level. These had led to a drop in delivery rates in the public hospitals and a change in intrapartum plans during this period [2].

The unpredictability of the COVID-19 pandemic has substantial negative psychological effects on the general population as well as pregnant women [3–5]. Research has shown that pregnant women are especially prone to anxiety and depression [6], and unaddressed mental health disorders may result in adverse maternal, fetal and neonatal outcomes [7–10].

The aims of our study were to (i) assess the anxiety and depression scores of pregnant women during the COVID-19 pandemic in Hong Kong, and to compare the anxiety and depression scores between pregnant women with or without underlying psychiatric illness (ii) evaluate the impact demographic, economic and social factors on the maternal anxiety and depression scores, and (iii) assess the perception by the pregnant women of the different restrictive policies related to the pandemic (*e.g.*, social distancing, restrictions related to delivery).

2. Materials and Methods

This study is part of an ongoing worldwide cross-sectional study. Data was collected through an anonymous web-based survey (www.pregmind.org) made up of closed questions with multiple choice answers. The survey consisted of three parts. The first part included questions related to general demography, pregnancy health history, mental health history (*e.g.*, presence of adjustment disor-

ders, depression, anxiety and bipolar disorders) and socioeconomic factors. The second part assessed perception of fear, burden and restrictions related to the COVID-19 pandemic via a subjective score ranging from 0 to 100. The last part consisted of the Patient Health Questionnaire-9 (PHQ-9) for depression assessment and the General Anxiety Disorder-7 (GAD-7) questionnaire for anxiety assessment. Details of the study protocol have been previously published [11].

2.1 General Anxiety Disorder-7 (GAD-7) for Assessment of Anxiety

GAD-7 is a 7-question scoring system that assesses the frequency of anxiety symptoms over a two-week period. There are four choices regarding the severity of symptoms: "not at all", "several days", "more than half the days" and "nearly every day", which correspond to 0, 1, 2, and 3 points score, respectively (minimum total score 0, maximum 21) [12]. The summarized score is used to assess anxiety severity (0–5: none, 6–10: mild, 11–15: moderate, 16–21: severe). This scoring system is commonly used to diagnose generalized anxiety disorders in the general population. The National Institute for Health and Care Excellence (NICE) in the United Kingdom recommends using this tool as a measurement of prenatal anxiety [13].

2.2 Patient Health Questionnaire-9 (PHQ-9) for Assessment of Depression

The National Institute for Health and Care Excellence also recommends using the PHQ-9 score with the GAD-7 score to assess the severity of depression in pregnant women [13]. The PHQ-9 has a similar grading system to the GAD-7 and consists of nine questions exploring depression symptoms over a two-week period with four possible answers: "not at all", "several days", "more than half the days" and "nearly every day", which correspond to 0, 1, 2, and 3 points score, respectively (minimum total score 0, maximum 27) [14]. The summarized score is used to assess depression severity (0–4: none, 5–9: mild, 10–14: moderate, 15–19: moderately severe, 20–27: severe). According to the American College of Obstetricians and Gynecologists (ACOG), both the Edinburg Postnatal Depression Scale (EPDS) and PHQ-9 are appropriate tools to measure antepartum depression [15,16].

Recruitment took place from 22 May 2020 to 28 February 2021. Women were recruited through a dedicated webpage (www.pregmind.org) and social media (Facebook, Instagram). The webpage link with the description of the survey was posted in open and closed groups and dedicated to pregnant and postpartum women. In addition, medical staff at the Prince of Wales Hospital, Hong Kong SAR, provided pregnant women with flyers with a quick response code to the survey during their hospital visits. Inclusion criteria included the following: declaration of being pregnant, being able to complete the survey in the available languages (English, French, Spanish, Chinese, Polish, German, Russian, Italian, Ukrainian, Czech, Swedish, Albanian, Hebrew, Arabic, and Norwegian), completion of screening questions and provision of informed consent for participation. Exclusion criteria included the following: not providing online informed consent for participation or if the participant did not click on the submit button at the end of the survey, and women who did not answer all the GAD-7 and PHQ-9 questions.

Ethics approval was obtained from the Centre of Postgraduate Medical Education Research Ethics Committee in Warsaw, Poland (Ref No. 56/PB/2020), and the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee in Hong Kong (CREC Ref. No. 2020.245). The study was registered at Clinicaltrials.gov, registration number NCT04377412.

Data was kept anonymous and non-identifiable. Normality of data was assessed using the Kolmogorov-Smirnov test. Descriptive data were presented in median and interquartile range (IQR) for continuous variables and in counts and percentages for categorical variables. Comparison was made between pregnant women with or without underlying psychiatric illness using either the Independent sample-T test or the Mann-Whitney U test for continuous variables and χ^2 test for categorical variables. The sum of PHQ-9 and GAD-7 scores were log10 transformed to obtain a symmetrical distribution of residuals with approximately constant standard deviation. Univariate logistic regression analysis was used to investigate the association between demographic characteristics, medical, obstetric and mental health history and socioeconomic factors and log10 values of PHQ-9 and GAD-7 scores. Significant factors were identified if $p < 0.1$ and were included in the multivariate regression analysis for the association of these factors with increasing PHQ-9 and GAD-7 scores. Significant factors were identified if $p < 0.05$. Statistical software package SPSS 26.0 (SPSS Inc., Chicago, IL, USA) was used for data analyses.

3. Results

A total of 474 pregnant women responded to the survey website and 361 participants completed both the GAD-7 and PHQ-9 questionnaires (completion rate of 76.2%). One participant had COVID-19 before pregnancy while one participant had COVID-19 during pregnancy.

Demographic characteristics of the study population are presented in Tables 1,2. Among the 361 participants, 28 had ever suffered or currently suffering from psychiatric illness. Comparing participants with and without a past or current history of psychiatric illness, there were significantly higher proportions of participants with psychiatric illness reporting 'finding it difficult on present income' or 'finding it very difficult on present income' (21.4% *vs.* 7.8%; 7.1% *vs.* 1.8%; $p = 0.02$). There was otherwise no statistical difference between the two groups in other demographic factors including education level, pre-pregnant and current job status, support from a partner, family and

Table 1. Demographic characteristics.

	Total (N = 361 (%)/Mean ± SD)	Ever have Psy illness (N = 28 (%)/Mean ± SD)	No Psy illness (N = 333 (%)/Mean ± SD)	*p* value
Education				
Elementary Education	2 (0.6%)	0 (0%)	2 (0.6%)	
Secondary Education	133 (36.8%)	11 (39.3%)	122 (36.6%)	0.889
Higher Education	226 (62.6%)	17 (60.7%)	209 (62.8%)	
Relationship status				
Married	337 (93.4%)	26 (92.9%)	311 (93.4%)	
In a relationship	18 (5%)	2 (7.1%)	16 (4.8%)	0.674
Single	6 (1.7%)	0 (0%)	6 (1.8%)	
How you feel about your household's income nowadays?				
Living comfortably on present income	154 (42.7%)	10 (35.7%)	144 (43.2%)	0.020
Coping on present income	167 (46.3%)	10 (35.7%)	157 (47.1%)	
Finding it difficult on present income	32 (8.9%)	6 (21.4%)	26 (7.8%)	
Finding it very difficult on present income	8 (2.2%)	2 (7.1%)	6 (1.8%)	
The number of people living in household	3.26 ± 1.32	2.89 ± 1.03	3.29 ± 1.34	0.123
The number of people living in your household that have a source of income	1.96 ± 0.79	1.71 ± 0.60	1.98 ± 0.80	0.082
Which of these descriptions applies to what you have been doing just before finding out you got pregnant?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	283 (78.4%)	22 (78.6%)	261 (78.4%)	
In education (not paid for by employer) even if on vacation	1 (0.3%)	0 (0%)	1 (0.3%)	0.901
Unemployed and actively looking for a job	4 (1.1%)	0 (0%)	4 (1.2%)	
Unemployed, wanting a job but not actively looking for a job	6 (1.7%)	0 (0%)	6 (1.8%)	
Doing housework, looking after children or other persons	67 (18.6%)	6 (21.4%)	61 (18.3%)	
Which of these descriptions applies to your current employment situation?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	270 (74.8%)	19 (67.9%)	251 (75.4%)	
In education (not paid for by employer) even if on vacation	2 (0.6%)	0 (0%)	2 (0.6%)	0.463
Unemployed and actively looking for a job	4 (1.1%)	1 (3.6%	3 (0.9%)	
Unemployed, wanting a job but not actively looking for a job	9 (2.5%)	0 (0%)	9 (2.7%)	
Doing housework, looking after children or other persons	76 (21.1%)	8 (28.6%)	68 (20.4%)	
Do you feel supported by your partner during this pregnancy?				
Yes	350 (97%)	27 (96.4%)	324 (97.3%)	0.788
No	11 (3%)	1 (3.6%)	9 (2.7%)	
Do you feel supported by other family members or friends during this pregnancy?				
Yes	351 (97.2%)	27 (96.4%)	324 (97.3%)	0.788
No	10 (2.8%)	1 (3.6%)	9 (2.7%)	

SD, Standard deviation; Psy, Psychiatric.

friends, parity, pre-pregnant chronic medical condition and pregnancy-related illness.

Analysis of attitudes towards the pandemic and the related restrictions showed that women with or without psychiatric illness expressed similar sources of fear and burden regarding the pandemic (Table 3). The median declared value of fear regarding restrictions related to childbirth and feeling burdened by restrictions imposed on labour and delivery because of the COVID-19 pandemic (presence of accompanying persons at hospital etc.) for the total population were 74.00 (IQR 61.00–91.00) and 73.00 (IQR 58.00–90.50) respectively and there was not statistical difference between women with or without psychiatric illness. The median declared value of feeling burdened by the COVID-19 pandemic in regard to the provision of childcare was 56.00 (IQR 23.50–73.00) for the total population, but was significantly higher in women with psychiatric illness compared to those without 129 (72.50, IQR 53.50–86.00 *vs.* 54.00, IQR 23.00–71.00, $p = 0.016$). A significantly higher proportion of women with psychiatric illness felt being burdened by the COVID-19 pandemic on work-related restrictions ('I have to work from home' and 'I cannot work at all': 25% *vs.* 6%, $p = 0.007$).

The median score reported for PHQ-9 was 5.00 (IQR 3.00–8.00). Participants with psychiatric illness reported a higher median PHQ-9 score although it was not statistically

Table 2. Obstetric history and mental health.

	Total (N = 361 (%))	Ever have Psy illness (N = 28 (%))	No Psy illness (N = 333 (%))	*p* value
Primiparous	198 (57.8%)	15 (53.6%)	182 (54.8%)	0.899
Singleton pregnancy	354 (98.1%)	27 (96.4%)	327 (98.2%)	0.514
Conception by *in-vitro* fertilization (IVF)	28 (7.8%)	4 (14.3%)	24 (7.2%)	0.179
High risk pregnancy	64 (17.7%)	6 (21.4%)	58 (17.4%)	0.593
Presence of pre-pregnancy chronic illness	48 (13.3%)	4 (14.3%)	44 (13.3%)	0.877
Presence of pregnancy-related conditions	59 (16.3%)	5 (17.9%)	54 (16.3%)	0.827
Who do you receive antenatal care from?				
By doctors	234 (64.8%)	16 (46.4%)	221 (66.4%)	0.028
By midwives	19 (5.3%)	0 (0%)	19 (5.7%)	
By doctors and midwives	83 (23%)	11 (39.3%)	72 (21.6%)	
No antenatal care	25 (6.9%)	4 (14.3%)	21 (6.3%)	
Before pregnancy have you ever sought any mental health support?				
Yes	22 (6.1%)	22 (78.6%)	0 (0%)	<0.001
Before pregnancy have you had any psychiatric treatment?				
Yes, pharmacologic	5 (1.4%)	3 (10.7%)	2 (0.6%)	<0.001
Yes, psychotherapy	10 (2.8%)	6 (21.4%)	4 (1.2%)	
Yes, psychotherapy and pharmacologic	8 (2.2%)	6 (21.4%)	2 (0.6%)	
No	338 (93.6%)	13 (46.5 %)	325 (97.6%)	
During this pregnancy have you sought any mental health support?				
Yes	10 (2.8%)	10 (35.7%)	0 (0%)	<0.001
During this pregnancy have you received/are you receiving any psychiatric treatment?				
Yes, pharmacologic	1 (0.3%)	0 (0%)	3 (0.9%)	<0.001
Yes, psychotherapy	5 (1.3%)	4 (14.3%)	6 (1.8%)	
Yes, psychotherapy and pharmacologic	2 (0.6%)	2 (7.2%)	6 (1.8%)	
No	353 (97.8%)	22 (78.5%)	318 (95.5%)	

Psy, Psychiatric.

significant (6.50, IQR 3.00–11.00 *vs.* 5.00, IQR 3.00–8.00, $p = 0.066$). A higher proportion of participants with psychiatric illness reported moderate to severe depression (35.7% *vs.* 16.5%, $p = 0.002$). The median score reported for the GAD-7 score was 3.00 (IQR 0.00–9.00). Compared to participants without psychiatric illness, those with psychiatric illness reported significantly higher median GAD-7 scores (6.00, IQR 3.00–7.75 *vs.* 2.00, IQR 0.00–6.00, $p = 0.001$) and a higher proportion of women reporting moderate to severe anxiety (17.8% *vs.* 3.6%, $p \leq 0.001$) (Table 4).

In the total study population, multivariate regression analysis demonstrated that financial difficulty, in education and pregnancy by *in-vitro* ertilisation was associated with a higher PHQ- 9 score in pregnant women during the COVID-19 pandemic. Doing household chores, looking after children or other persons, a higher number of people living in the household and having support from a partner were associated with a lower depression score (Table 5). Multivariate regression analysis demonstrated that underlying psychiatric illness was associated with a higher GAD-7 score in pregnant women during the COVID-19 pandemic, while having support from a partner, no financial stress, and being unemployed but not actively looking for a job were associated with a lower anxiety score (Table 6).

4. Discussion

The present study reports on the mental health of pregnant women during the COVID-19 pandemic and their views on the pandemic in Hong Kong. Our study has demonstrated that pregnant women with past or current psychiatric illness are more prone to moderate–severe depression and anxiety. Financial difficulty, in education and pregnancy by *in-vitro* fertilization was associated with a higher PHQ-9 score in pregnant women during the COVID-19 pandemic. Doing household chores, looking after children or other persons, a higher number of people living in the household and having support from a partner were associated with a lower depression score. Whereas for anxiety, underlying psychiatric illness was associated with a higher GAD-7 score in pregnant women during the COVID-19 pandemic, while having support from a partner, no financial stress and being unemployed but not actively looking for a job were associated with a lower anxiety score.

The first specific aim of the study was to evaluate the degree of depression and anxiety in pregnant women during the COVID-19 pandemic. Studies have shown that pregnant women are at higher risk for developing mental health problems, such as anxiety and depressive symptomatology, during the pandemic due to emotional stress and partial social support [17,18]. Specific populations are particularly

Table 3. Views of COVID-19 pandemic and self- assessed levels of fear and burden regarding restrictions during COVID-19 pandemics.

	Total (N = 361 (%))	Ever have Psy illness (N = 28 (%))	No Psy illness (N = 333 (%))	*p* value
How do you view your country's policies related to the COVID-19 pandemic? Which statement best describes your view/feeling/fear?				
They are sufficient and I feel they are aimed at protecting me and my unborn child	66 (18.3%)	2 (7.1%)	64 (19.2%)	0.682
The restrictions are not sufficient enough fear for myself and my unborn child	146 (40.4%)	12 (42.9%)	134 (40.2%)	
I feel the restrictions such as labour without an accompanying person are harmful to me and my child	63 (17.5%)	7 (25.0%)	56 (16.8%)	
I fear that I will have to have a Caesarean section if I have suspected/confirmed COVID-19 infection	12 (3.3%)	1 (3.6%)	11 (3.3%)	
I fear that if I have suspected/confirmed COVID-19 infection I will be separated from my child	61 (16.9%)	5 (17.9%)	56 (16.8%)	
I fear that if I have suspected/confirmed COVID-19 infection I will not be allowed to breastfeed	13 (3.6%)	1 (3.6%)	12 (3.6%)	
How would you rate your fear and burden regarding restrictions during COVID-19 pandemics? *				
Level of fear that you or the people close to you will become infected with COVID-19	65.00 (49.00–78.00)	68.50 (50.25–87.00)	65.00 (47.00–77.00)	0.161
Feel restricted due to social distancing recommended or implemented during the COVID-19 pandemic	62.00 (49.00–73.00)	63.50 (50.00–81.75)	61.00 (49.00–73.00)	0.388
How burdened do you feel by the current COVID-19 in regard to you or your family members' possibility to work and earn money?	57.00 (30.00–74.50)	59.00 (40.75–77.50)	57.00 (29.00–74.00)	0.304
How burdened do you feel by the current COVID-19 in regard to your favourite leisure activities	60.00 (47.50–70.00)	64.50 (54–83.75.00)	58.00 (44.50– 70.00)	0.050
How burdened do you feel by the current COVID-19 in regard to the provision of childcare – closed schools, kindergartens, nurseries etc.	56.00 (23.50–73.00)	72.50 (53.50–86.00)	54.00 (23.00–71.00)	0.016
How burdened do you feel by the current COVID-19 in regard to how it has affected your household's financial situation?	50.00 (21.50–67.50)	56.50 (32.75–82.00)	50.00 (21.00–67.00)	0.092
How much are you concerned about your unborn child's safety due to COVID-19 pandemic?	69.00 (57.00–83.00)	72.50 (57.75–95.25)	69.00 (57.00–82.00)	0.207
How much are you concerned about your family members getting sick and have the adverse effects of the COVID-19?	71.00 (57.00–85.00)	72.50 (52.75–98.25)	71.00 (57.00–84.00)	0.358
How much are you concerned about you getting sick and having the adverse effects of COVID-19?	71.00 (54.00–86.00)	75.00 (51.25–96.50)	71.00 (54.00–85.00)	0.467
How much do you fear that the COVID-19 pandemic will result in restrictions related to your childbirth (presence of accompanying persons at hospital etc.)	74.00 (61.00–91.00)	90.50 (60.75–99.50)	73.00 (61.00–90.00)	0.095
How much do you feel burdened by restrictions imposes on labour and delivery as a result of COVID-19 pandemic (presence of accompanying persons at hospital etc.)?	73.00 (58.00–90.50)	87.50 (65.00–97.00)	73.00 (56.50–89.00)	0.075
How much do you fear that your baby will become ill during/ after delivery and will have adverse outcomes due to COVID-19?	77.00 (61.00–95.00)	83.50 (64.00– 95.75)	77.00 (61.00–95.00)	0.428
How much do you fear that your partner will not be able to be present during the delivery?	77.00 (57.50–97.00)	87.00 (56.50–100.00)	76.00 (57.50–97.00)	0.367

* Scores are presented as median + interquartile range.

Psy, Psychiatric.

Table 4. PHQ-9 and GAD-7 scores.

	Total (N = 361 (%)/Median ± IQR)	Ever have Psy illness (N = 28 (%)/median ± IQR)	No Psy illness (N = 333 (%)/median ± IQR)	*p* value
PHQ-9 score				
Median score	5.00 (3.00–8.00)	6.50 (3.00–11.00)	5.00 (3.00–8.00)	0.066
None – minimal	153 (42.4%)	10 (35.7%)	143 (42.9%)	
Mild	143 (39.6%)	8 (28.6%)	135 (40.5%)	
Moderate	51 (14.1%)	7 (25.0%)	44 (13.2%)	0.002
Moderately severe	13 (3.6%)	2 (7.1%)	11 (3.3%)	
Severe	1 (0.3%)	1 (3.6%)	0 (0%)	
GAD-7 score				
Mean score	3.00 (0.00–9.00)	6.00 (3.00–7.75)	2.00 (0.00–6.00)	0.001
None – minimal	262 (72.6%)	13 (46.4%)	249 (74.8%)	
Mild	82 (22.7%)	10 (35.7%)	72 (21.6%)	<0.001
Moderate	15 (4.2%)	3 (10.7%)	12 (3.6%)	
Severe	2 (0.6%)	2 (7.1%)	(0%)	

Psy, Psychiatric; PHQ-9, Patient Health Questionnaire-9; GAD-7, General Anxiety Disorder-7; IQR, Interquartile range.

Table 5. Univariate regression and multivariate regression results for PHQ-9 score.

Independent variable	PHQ-9 score			
	Univariate		Multivariate	
	Regression coefficient (95% CI)	*p*	Regression coefficient (95% CI)	*p*
Education				
Elementary Education	0.754 (–0.648 to 2.155)	0.291		
Secondary Education	1			
Higher Education	0.054 (–0.161 to 0.269)	0.624		
Relationship status:				
Married	1			
In a relationship	0.292 (–0.184 to 0.767)	0.228		
Single	0.278 (–0.531 to 1.088)	0.500		

Table 5. Continued.

Independent variable	PHQ-9 score			
	Univariate		Multivariate	
	Regression coefficient (95% CI)	*p*	Regression coefficient (95% CI)	*p*
How you feel about your household's income nowadays?				
Living comfortably on present income	0.043 (–0.175 to 0.261)	0.696		
Coping on present income	1		1	
Finding it difficult on present income	0.549 (0.173 to 0.926)	0.004	0.687 (0.339 to 1.034)	<0.001
Finding it very difficult on present income	–0.072 (–0.778 to 0.633)	0.841		
The number of people living in household	–0.078 (–0.156 to 0.000)	0.051	–0.116 (–0.193 to –0.040)	0.003
The number of people living in your household that have a source of income	–0.057 (–0.189 to 0.074)	0.389		
Which of these descriptions applies to what you have been doing just before finding out you got pregnant?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	1		1	
In education (not paid for by employer) even if on vacation	0.905 (–1.055 to 2.866)	0.364		
Unemployed and actively looking for a job	0.074 (– 0.912 to 1.059)	0.883		
Unemployed, wanting a job but not actively looking for a job	–0.546 (–1.354 to 0.261)	0.184		
Doing housework, looking after children or other persons	– 0.284 (–0.550 to –0.018)	0.036	0.024 (–0.532 to 0.580)	0.932
Which of these descriptions applies to your current employment situation?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	1		1	
In education (not paid for by employer) even if on vacation	1.427 (0.050 to 2.804)	0.042	1.534 (0.224–2.843)	0.022
Unemployed and actively looking for a job	–0.480 (–1.457 to 0.497)	0.334		
Unemployed, wanting a job but not actively looking for a job	–0.540 (–1.197 to 0.118)	0.107		
Doing housework, looking after children or other persons	–0.315 (–0.567 to –0.063)	0.014	–0.302 (–0.547 to –0.058)	0.015
Support from partner	–1.224 (–1.813 to –0.635)	<0.001	–1.261 (–1.832 to –0.690)	<0.001
Support from family or friends	– 0.490 (–1.532 to 0.126)	0.126		
Primiparity	–0.178 (–0.386 to 0.029)	0.092	–0.027 (–0.265 to 0.212)	0.825
Singleton vs. multiple pregnancy	–0.382 (–1.132 to 0.368)	0.317		
Pre-pregnancy health conditions	0.090 (–0.213 to 0.394)	0.558		
Pregnancy-related conditions	0.129 (–0.151 to 0.409)	0.366		
Psychiatric illness ever	0.434 (0.049 to 0.818)	0.027	0.198 (–0.254 to 0.650)	0.390
Pre-pregnant mental health condition	0.267 (–0.165 to 0.699)	0.225		
Current mental health condition	0.625 (–0.003 to 1.252)	0.051	0.531 (–0.064 to 1.127)	0.080
Infertility	–0.188 (–0.542 to 0.166)	0.297		
IVF pregnancy	0.385 (–0.001 to 0.770)	0.050	0.543 (0.171 to 0.915)	0.004
High risk pregnancy	–0.061 (–0.332 to 0.210)	0.659		
Antenatal care provision				
By doctors	1			
By midwives	0.117 (–0.352 to 0.587)	0.624		
By doctors and midwives	0.037 (–0.215 to 0.288)	0.775		
No antenatal care	–0.233 (–0.647 to 0.181)	0.270		

IVF, *In-vitro* fertilization; PHQ-9, Patient Health Questionnaire-9; CI, Confidence interval.

Table 6. Univariate regression and multivariate regression results for GAD-7 score.

Independent variable	GAD-7 score			
	Univariate		Multivariate	
	Regression coefficient (95% CI)	*p*	Regression coefficient (95% CI)	*p*
Education				
Elementary Education	–0.014 (–0.479 to 0.452)	0.954		
Secondary Education	1			
Higher Education	–0.015 (–0.098 to 0.069)	0.725		
Relationship status:				
Married	1			
In a relationship	0.159 (–0.019 to 0.337)	0.079	0.124 (–0.049 to 0.298)	0.160
Single	0.134 (–0.158 to 0.426)	0.367		
How you feel about your household's income nowadays?				
Living comfortably on present income	–0.092 (–0.178 to –0.006)	0.036	–0.097 (–0.176 to –0.017)	0.017
Coping on present income	1			
Finding it difficult on present income	0.073 (–0.062 to 0.208)	0.289		
Finding it very difficult on present income	0.034 (–0.236 to 0.303)	0.806		
The number of people living in household	–0.011 (–0.042 to 0.020)	0.489		
The number of people living in your household that have a source of income	–0.006 (–0.062 to 0.051)	0.841		
Which of these descriptions applies to what you have been doing just before finding out you got pregnant?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	1			
In education (not paid for by employer) even if on vacation	0.314 (–0.337 to 0.965)	0.343		
Unemployed and actively looking for a job	0.357 (–0.105 to 0.819)	0.129		
Unemployed, wanting a job but not actively looking for a job	–0.112 (–0.574 to 0.350)	0.634		
Doing housework, looking after children or other persons	0.003 (–0.105 to 0.111)	0.052	–0.035 (–0.141 to 0.072)	0.521
Which of these descriptions applies to your current employment situation?				
In paid work (or away temporarily) (employee, self-employed, working for your family business)	1			
In education (not paid for by employer) even if on vacation	0.351 (–0.107 to 0.809)	0.132		
Unemployed and actively looking for a job	–0.060 (–0.518 to 0.397)	0.795		
Unemployed, wanting a job but not actively looking for a job	–0.340 (0.632 to –0.048)	0.023	–0.335 (–0.618 to –0.052)	0.020
Doing housework, looking after children or other persons	–0.016 (–0.116 to 0.085)	0.761		
Support from partner	–0.292 (–0.489 to –0.095)	0.004	– 0.248 (–0.442 to –0.055)	0.012
Support from family or friends	–0.074 (–0.295 to 0.146)	0.508		
Primiparity	–0.027 (–0.109 to 0.056)	0.525		
Singleton vs. multiple pregnancy	–0.103 (–0.371 to 0.166)	0.452		
Pre-pregnancy health conditions	0.046 (–0.071 to 0.163)	0.440		
Pregnancy-related conditions	0.087 (–0.017 to 0.792)	0.101		
Psychiatric illness ever	0.178 (0.043 to 0.313)	0.010	0.150 (0.018 to 0.282)	0.026
Pre-pregnant mental health condition	0.304 (–0.232 to –0.242)	0.192		
Current mental health condition	0.175 (–0.103 to –0.201)	0.385		
Infertility	0.005 (–0.134 to 0.145)	0.939		
IVF pregnancy	0.064 (–0.087 to 0.215)	0.403		
High risk pregnancy	0.037 (–0.066 to 0.141)	0.479		
Antenatal care provision				
By doctors	1			
By midwives	0.049 (–0.138 to 0.237)	0.603		
By doctors and midwives	0.073 (–0.024 to 0.170)	0.142		
No antenatal care	0.066 (–0.095 to 0.227)	0.420		

IVF, *In-vitro* fertilization; GAD-7, General Anxiety Disorder-7; CI, confidence interval.

vulnerable, including women with pre-existing psychiatric conditions [19]. Our study has confirmed that participants with a past or current history of psychiatric illness reported a significantly higher median GAD-7 scores and are more prone to moderate–severe depression and anxiety during the COVID-19 pandemics. This highlights the need to identify vulnerable populations at increased risk of psychological distress and provide regular assessment of mental wellbeing during pregnancy and the peripartum period and to ensure that adequate support is provided [20]. Early detection, intervention and treatment of mental health problems in pregnancy is essential in preventing adverse maternal and fetal outcomes [20]. According to a systemic review, factors most associated with prenatal depression and anxiety include lack of partner or social support, adverse life events and a high level of perceived stress [21]. Our study has also confirmed that partner support is important in lowering depression and anxiety in pregnancy during the COVID-19 pandemic. Various measures have been adopted to encourage and facilitate a partner's involvement throughout pregnancy during this difficult time. With the adjustment and revision of hospital policies, a partner's participation during antenatal follow-ups and antenatal talks have been resumed. Although a partner's visit during the inpatient stay is still prohibited, the condition of women are regularly updated to the partners via phone and joint decision making is encouraged in obstetric management.

Our study has also demonstrated that financial difficulty plays a crucial role in mental health conditions in pregnant women. For pregnant women, the greatest potential burden of the imposed restrictions is not being able to leave the house for work or unable to work at all. Financial challenges, fear of loss of employment and reduced salary are important risk factors affecting family stability and a sense of security [22]. In view of the negative economic consequences brought by the COVID-19 pandemic, the Government of the Hong Kong Special Administrative Region (HKSARS) has implemented various Economic Stimulus Measures and an Employment Support Scheme to help individuals through this difficult time [23].

COVID-19 also has a serious negative impact on pregnant women's expectations and experiences of childbirth. Continuous support from a partner and companionship in labour are important in helping pregnant women cope with this challenging period in life and have been shown to reduce interventions during labour [24]. Participants in our study have reported increasing fear and anxiety because of the restrictive policies related to childbirth (presence of accompanying person/s at hospital etc.) and have been burdened by restrictions imposed on labour and delivery. With the revision and adjustment of service policies, which include resumption of companionship in labour for partners who have been vaccinated with negative SARS-CoV-2 testing, we hope to optimize the support for our pregnant women and improve the overall obstetric outcomes and childbirth experience during this difficult period.

The main strength of this study is that it is a web-based survey in 16 different languages, thus reducing selection bias in terms of language barrier. Answers to the survey are automatically saved when the survey is submitted, thus providing privacy and confidentiality of participants when answering sensitive questions. For this study, we have employed the GAD-7 and PHQ-9, which are two short and validated questionnaires that are easy to be completed by participants online without the guidance of medical personnel. Limitations of the current study include the online nature in collecting data, which could lead to selection bias. Moreover, certain questions in the questionnaire may be sensitive and participants are allowed to skip questions that they do not feel comfortable to answer although they are reassured that the data is kept anonymous and non-identifiable. This has led to a reduced final sample size as only the data of individuals who have completed the PHQ-9 and GAD-7 scores have been included in the final analysis. Although there has been a time lag between the data collection and the completion of this manuscript due to the collaborative nature of the study, underlying mental health disorder is a well-established risk factor for worsening mental health conditions during pregnancy, while the COVID-19 pandemics have further complicated these issues due to the various restriction policies. Therefore, the results of our study are still applicable for the ongoing pandemic and can serve as a reference for new policy implementation when facing future pandemics.

5. Conclusions

Our study has shown that pregnant women with underlying psychiatric illness are more vulnerable during the COVID-19 pandemics. Adequate support from a partner during pregnancy and childbirth is important in alleviating anxiety and depression. Partner involvement should be encouraged throughout the pregnancy and policies allowing partners to be present during labor should be facilitated. Although the COVID-19 pandemic is rapidly evolving, maternal mental health remains an important area that warrants continuous medical attention when facing future pandemics.

Availability of Data and Materials

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

Author Contributions

STKW, DS, AK, LCYP designed the research study. STKW, SLL, CPHC, PNPI, LW, LCYP performed the research. STKW, LCYP analyzed the data. STKW, LCYP wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Ethics approval was obtained from the Centre of Postgraduate Medical Education Research Ethics Committee in Warsaw, Poland (Ref No. 56/PB/2020), and the Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee in Hong Kong (CREC Ref. No. 2020.245). The study was registered at Clinicaltrials.gov, registration number NCT04377412.

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Conflict of Interest

The authors declare no conflict of interest.

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