Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Psychiatry Research 317 (2022) 114920

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

Correlation between psychiatric impact of COVID-19 during pregnancy and fetal outcomes in Egyptian women

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ARTICLE INFO

Keywords:
Prenatal
COVID-19
Egypt
Psychiatry
Fetal

ABSTRACT

The prevalence of depression, anxiety, and post-traumatic stress disorder (PTSD) was examined in 238 pregnant women with ($n = 146$) and without ($n = 92$) coronavirus disease 2019 (COVID-19) using the State-Trait Anxiety Inventory (STAI), Edinburgh Postnatal Depression Scale (EPDS), and PTSD Checklist for DSM-5 (PCL-5). Fetal outcomes in the same groups were evaluated using the Apgar score. Anxiety and depression scores were significantly higher in women with COVID-19 but PTSD scores were similar in both groups. Infection with COVID-19 was associated with a higher number of fetal deaths or an Apgar score <7. During the COVID-19 pandemic, approximately 46.6% of pregnant women had depression, 5.5% had PTSD, 64.3% had state anxiety, and 60.9% had trait anxiety. Except for PTSD, psychiatric problems and poor fetal outcomes were higher in women with COVID-19 than in those without COVID-19. Lastly, women with COVID-19 were more prone to have a fetus who died or had an Apgar score of <7.

1. Introduction

The World Health Organization declared coronavirus disease 2019 (COVID-19) as a pandemic on March 11, 2020 (Cucinotta and Vanelli, 2020). As the pandemic unfolded, public concern regarding risks to life and health, inadequate healthcare services, and economic consequences grew (Farrell et al., 2020) and governments across the world introduced measures to reduce social contacts to prevent transmission of the disease. However, social isolation has negative effects on mental health and the ability to cope with stress (Bavel et al., 2020).

Even in normal conditions, some pregnant women who are isolated at home may lack social support from family, friends, and partners; they may experience financial struggles; or they may have to work away from home or stay in homes that are overcrowded. These problems were exacerbated in the COVID-19 pandemic, due to difficulties in caring for school-aged children at home, an increased risk of domestic violence because they have to live with a potential aggressor during a lockdown period, fewer prenatal and postnatal checkups, and limited participation of their partner in childbirth (Holmes et al., 2020; Royal College of Obstetrics and Gynaecologists, 2020). Previous studies have noted that anxiety in postpartum women was significantly higher while anhedonia and depression were significantly lower during COVID-19 (Takubo et al., 2021). There is also an increased occurrence of thoughts of self-harm in postpartum mothers during the chronic phase of the COVID-19 pandemic (Takubo et al., 2022).

Robust evidence has shown that prenatal psychological distress is harmful to the mother and fetus even after they grow up. Indeed, maternal stress during pregnancy has been associated with serious negative outcomes, including poor maternal psychosocial functioning, parenting difficulties, lower infant birthweight, earlier infant gestational age, offspring psychopathology, brain development abnormalities, and poorer socioemotional and cognitive development (Dean et al., 2018; Wu et al., 2020). Since depression and anxiety before and after birth have been linked to negative outcomes in mothers, babies, and newborns, the psychological effects of COVID-19 and the corresponding quarantine imposed on pregnant women and new mothers are causes for concern (Ceulemans et al., 2020a; Grigoriadis et al., 2018).

The aim of this study was to evaluate the prevalence of psychiatric

Abbreviations: COVID-19, coronavirus disease 2019; NICU, neonatal intensive care unit; PTSD, post-traumatic stress disorder; STAI, State-Trait Anxiety Inventory; EPDS, Edinburgh Postnatal Depression Scale; PCL-5, PTSD Checklist for DSM-5; ACE2, angiotensin-converting enzyme 2; TMPRSS2, transmembrane protease serine 2; DPP4, dipeptidyl peptidase 4.

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https://doi.org/10.1016/j.psychres.2022.114920
Received 23 July 2022; Received in revised form 17 October 2022; Accepted 19 October 2022
Available online 26 October 2022

problems, specifically depression, anxiety, and post-traumatic stress disorder (PTSD), in pregnant women during the COVID-19 pandemic and to explore the fetal outcomes for the affected participants.

2. Methods

This prospective study enrolled pregnant women who attended the antenatal clinic at the Woman's Health Hospital, Assiut University, from January 2021 to December 2021. Participants were evaluated for prenatal psychological distress and followed up after delivery to assess fetal outcomes. Participants were excluded if they had a history of previous psychiatric disorders (50 out of 288 participants). The participants were categorized into two groups: women with and without COVID-19.

2.1. Ethical considerations

This study was approved by the institutional review board of Assiut University's Faculty of Medicine (Approval Number: 17101249) and registered as a clinical trial (Approval Number: NCT04558749). All participants signed a written informed consent form before participating in the study. They were assured that their information would be kept private and that their data would be anonymized. This research was conducted in accordance with the most recent version of the Helsinki Declaration.

2.2. Measures

2.2.1. Sociodemographic data

Data on maternal age, place of residence, educational level, employment status, history of chronic illness, previous diagnosis of psychiatric disorder, and history of COVID-19 as confirmed using polymerase chain reaction were collected.

2.2.2. Obstetric data

Data on gravidity (number of previous miscarriages, number of living children, number of deceased children), parity (number and type of previous delivery), gestational age (gestational age during survey), complications during antenatal care in the current pregnancy, obstetric drug medications during pregnancy, and complications in the current pregnancy were collected.

2.2.3. Clinical variables of COVID-19 (for women who diagnosed with it)

Date of diagnosis, types of drugs taken, symptoms, and complications (intensive care unit admission and oxygen use) were recorded.

2.2.4. Exposure to COVID-19 during pregnancy

Data on participants' relatives who were diagnosed with or died from COVID-19, instances of contact with a patient with COVID-19, and employment in the medical field were collected.

2.3. Psychometric scales

2.3.1. Socioeconomic scale (Abdel-Tawab, 2010)

Abdel-Tawab (2010) developed a socioeconomic scale for identifying social burdens and socioeconomic strata. This scale reflects four important factors: the parents' and mothers' level of education, their occupations, their combined family income, and their lifestyles.

2.3.2. State-Trait Anxiety Inventory (STAI)

The first portion of the scale assesses trait anxiety, whereas the second portion assesses state anxiety. Each portion consists of 20 statements and uses a four-point scale with a minimum score of 20 and a maximum score of 80. The cutoff score was set at 45 for each portion (Tendais et al., 2014). We used Arabic version of the original STAI established by Abdel-Khalek (Abdel-Khalek, 1989)

2.3.3. Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987)

The EPDS is a self-reporting instrument for assessing cognitive symptoms of depression. It excludes somatic components that could lead to false positives during or after pregnancy. With a scale score of 0–30, the EPDS consists of 10 elements that are rated from 0 to 3. The cutoff point for determining depression was set at 13 (Usuda et al., 2017). We used the Arabic version (Ghubash et al., 1997) and using 13 as cut-off point in our study, alpha Cronbach was 81% in our study.

2.3.4. PTSD Checklist for DSM-5 (PCL-5)

The PCL-5 is a validated 20-item scale for assessing PTSD in mothers. Participants rated their concerns about stressful life events in the past month from 1 (not at all) to 5 (extremely). The item scores were added together to create a dichotomous variable with a cutoff score of 33 (Weathers et al., 2013). We used the Arabic version (Ibrahim, 2018)

2.4. Follow-up of fetal outcomes

2.4.1. Apgar score

It is a grading system used by doctors and nurses to evaluate fetal at 1 and 5 min after birth. Each category is given a score of 0–2. A child's overall score will be no higher than 10. After 5 min, a score of 7–10 is considered normal. The Apgar scores for the fetal of women who had not yet given birth or who had given birth outside of our facility were marked as unknown in this study (Calmes, 2015).

2.4.2. Fetal outcomes

The number of fetuses in the current pregnancy, fetal outcome at delivery (full-term, preterm, intrauterine fetal death, stillbirth, or unknown), fetal need for respiratory aid or neonatal intensive care unit (NICU) admission, and fetal living problems, such as congenital anomaly or desaturation, were evaluated.

2.5. Statistical analysis

Statistical analysis was performed using SPSS version 26 (IBM, Armonk, NY, USA). Continuous data are expressed as mean ± standard deviation, whereas nominal data are expressed as frequency (percentage). The chi-square test was used to analyze nominal data. To identify the potential risk variables for psychiatric diseases, a univariate logistic regression analysis was performed. Statistical significance was defined as a P-value ≤ 0.05.

3. Results

3.1. Sociodemographic data and obstetric history

Table 1 shows the sociodemographic data of the 238 pregnant women who were recruited. There were no significant differences in the sociodemographic data between the two groups. Most of the participants were aged 20–35 years, unemployed, and middle class.

In the COVID-19 group, most of the participants were of a higher socioeconomic class (22.8% vs. 7.6%), whereas those without COVID-19 were evenly distributed (15.1% vs. 14.4%). A higher percentage of women with COVID-19 were employed in government and private sector jobs than those without COVID-19 (12% vs. 8.9% and 6.5% vs. 2.7%, respectively). A significantly higher percentage of women without COVID-19 were unemployed (88.4% vs. 81.5%).

A significantly higher proportion of women with COVID-19 had one child (29.3%), whereas a higher proportion of women without COVID-19 had two children (24.8%). A significantly higher percentage of women with COVID-19 had two or three previous miscarriages than those without COVID-19 (14.1% vs. 10.3%, 6.5% vs. 4.1%, respectively). A higher percentage of women with COVID-19 had two (2.2% vs. 1.4%) or more than three (2.2% vs. 0.0%) deceased children than those without COVID-19. A higher percentage of women with COVID-19 had

Table 1
The Sociodemographic data and Obstetric history among the studied groups.

Variables	Women without COVID-19 infection ($N = 146$)	Women with COVID-19 infection ($N = 92$)	Total of women ($N = 238$)	Chi^{2}*	*p* value
Age				0.900	0.638
Less than 20 years	12(8.2%)	9(9.8%)	21 (8.8%)		
20-35 years	117 (80.1%)	69(75%)	186 (78.2%)		
More than 35 years	17(11.6%)	14(15.2%)	31(13%)		
Education level				3.0	0.39
Illiterate	20(13.6%)	10(10.9%)	30 (12.6%)		
Primary	22(15%)	9(9.8%)	31(13%)		
Secondary	83(56.5%)	53(57.6%)	136 (56.9%)		
University	22(15%)	20(21.7%)	42 (17.6%)		
Occupation state				2.750	0.253
Governmental job	13(8.9%)	11(12%)	24 (10.1%)		
Private job	4(2.7%)	6(6.5%)	10 (4.2%)		
unemployed	129 (88.4%)	75(81.5%)	204 (85.7%)		
History of chronic illness	20(13.7%)	10(10.9%)	30 (12.6%)	0.410	0.522
Socioeconomic level				4.865	0.088
Low class	22(15.1%)	7(7.6%)	29 (12.2%)		
Middle class	103 (70.5%)	64(69.6%)	167 (70.2%)		
High class	21(14.4%)	21(22.8%)	42 (17.6%)		
Smoking cigarettes	1(0.7%)	1(1.1%)	2(0.8%)	0.109	0.741
Number of previous deliveries					
None	27(18.5%)	16 (17.4%)	43(18.1%)	5.638	0.228
One	26(17.8%)	26 (28.3%)	52(21.8%)		
Two	28(19.2%)	14 (15.2%)	42(17.6%)		
three	31(21.2%)	12(13%)	43(18.1%)		
More than three	34(23.3%)	24 (26.1%)	58(24.4%)		
Type of previous deliveries					
None	27(18.5%)	16 (17.4%)	43(18.1%)	1.055	0.788
All normal	19(13%)	16 (17.4%)	35(14.7%)		
All C. S	70(47.9%)	40 (43.5%)	110(46.2%)		
Some normal and some C. S	30(20.5%)	20 (21.7%)	50(21%)		
Last time of delivery					
None	27(18.5%)	16 (17.4%)	43(18.1%)	0.603	0.740
Normal	20(13.7%)	16 (17.4%)	36(15.1%)		
C.S	99(67.8%)	60 (65.2%)	159(66.8%)		
Number of previous miscarriages					
None	88(60.3%)	54 (58.7%)	142(59.7%)	2.912	0.573
One	29(19.9%)	17 (18.5%)	46(19.3%)		
Two	15(10.3%)	13 (14.1%)	28(11.8%)		
three	6(4.1%)	6(6.5%)	12(5%)		
More than three	8(5.5%)	2(2.2%)	10(4.2%)		
Number of living children					
None	32(22.1%)	19 (20.7%)	51(21.5%)	11.855	0.018*
One	21(14.5%)	27 (29.3%)	48(20.3%)		
Two	36(24.8%)	11(12%)	47(19.8%)		
three	25(17.2%)	12(13%)	37(15.6%)		
More than three	31(21.4%)	23(25%)	54(22.8%)		
Number of dead children					
None	122 (84.1%)	77 (83.7%)	199(84%)	4.144	0.387
One	20(13.8%)	12 (13.04%)	32(13.44%)		
Two	2(1.4%)	2(2.2%)	4(1.7%)		
three	1(0.7%)	0(0%)	1(0.4%)		
More than three	0(0%)	2(2.2%)	2(0.8%)		
Children with congenital anomalies or disability	1(0.7%)	5(5.4%)	6(2.5%)	5.181	0.023*
Gestational age during survey					
First trimester	5(3.4%)	2(2.2%)	7(2.9%)	1.051	0.591
Second trimester	14(9.6%)	6(6.5%)	20(8.4%)		
Third trimester	127(87%)	84 (91.3%)	211(88.7%)		
Problems during antenatal care (current pregnancy)	114 (78.1%)	61 (66.3%)	175(73.5%)	4.022	0.045*
Obstetric Drug intake during current pregnancy	35(24%)	21 (22.8%)	56(23.5%)	0.041	0.839

COVID-19: the coronavirus disease 2019, * is significant *p* value.

children with congenital anomalies or disabilities (5.4%) than those without COVID-19 (0.7%).

3.2. Clinical data of women with COVID-19

The most frequent symptom of COVID-19 was severe cough (91.3%), followed by a temperature of >38°C (80.4%) and sore throat (65.2%). In contrast, the least frequent symptom of COVID-19 was gastrointestinal symptoms (vomiting or diarrhea; 23.9%). Most participants were in their third trimester (88.7%), whereas most participants had COVID-19 infection in their second trimester (59.8%; Table 2).

Table 2
Clinical data of COVID-19 infection.

Variables	Women with COVID-19 infection $N = 92$ N (%)
Drugs intake for COVID-19 infection	
yes	75(81.5%)
No	17(18.5%)
Symptoms of COVID-19	
Temperature more than 38c	74(80.4%)
Sever cough	84(91.3%)
Sore throat	60(65.2%)
Vomiting or diarrhoea	22(23.9%)
Time of infection	
First trimester	1(1.1%)
Second trimester	55(59.8%)
Third trimester	36(39.1%)
Intensive care units (ICU) admission	3(3.2%)
Oxygen supply	6(6.5) %)

COVID-19: the coronavirus disease 2019.

3.3. Exposure to COVID-19 and fetal outcomes

Table 3 presents data on the participants' exposure to COVID-19. Women with COVID-19 had a higher frequency of infected relatives (72.8% vs. 37%), contact with patients with COVID-19 (66.3% vs. 4.1%), and working in the medical field (6.5% vs. 2.1%) than those without COVID-19.

Table 4 presents data on fetal outcomes at delivery. Women with COVID-19 had a higher tendency to have a fetus who died (6.5%), required nasal continuous positive airway pressure (5.4%), or had an Apgar score of <7 (7.6%) than those without COVID-19. Stillbirth was observed only in women with COVID-19 (3.3%). However, the incidence of fetal complications was almost equal in both the groups.

3.4. Comparison of the prevalence of anxiety, depression, and PTSD between the two studied groups (STAI, EPDS, and PCL-5 results: Table 5)

There was a significant difference in the STAI, EPDS, and PCL-5 results between the two groups. The prevalence of an abnormal response for S-Anxiety (76.1% vs. 56.8%) and T-Anxiety (69.6% vs. 55.5%) as well as an EPDS score above the cut-off point (48.9% vs. 45.2%) was significantly higher in the COVID-19 group. In contrast, the prevalence of an abnormal response for PCL-5 was almost equal in both groups.

3.5. Relational results

3.5.1. Logistic regression for EPDS and other parameters

Multiple risk factors that affected depression were analyzed using a univariate regression analysis (Table 6, supplemental file). Women aged <20 years ($p = 0.03$) were less vulnerable to depression ($p = 0.03$), whereas women who were screened during their second trimester ($p = 0.04$), those who delivered a fetus with an Apgar score of >7 ($p = 0.02$), and those who worked in the medical field ($p = 0.033$) were more vulnerable to depression.

3.5.2. Logistic regression for S-Anxiety and other parameters

A univariate logistic regression revealed that women who belonged to the middle class ($p = 0.01$) were less vulnerable to state anxiety than those who belonged to other classes. Conversely, a temperature > 38°C ($p = 0.004$), severe cough ($p = 0.004$), contact with a patient with COVID-19 ($p = 0.017$), contracting COVID-19 ($p = 0.003$), and contracting COVID-19 in the second ($p = 0.41$) or third trimester ($p = 0.011$) were risk factors for state anxiety (Table 7, supplemental file).

3.5.3. Logistic regression for T-Anxiety and other parameters

As shown in (Table 8, supplemental file), the univariate logistic regression module also revealed the risk factors for trait anxiety in the study population. Women who presented with severe cough, had a relative diagnosed with COVID-19 ($p = 0.011$), contacted a patient with COVID-19 ($p = 0.015$), contracted COVID-19 ($p = 0.031$), or contracted COVID-19 in the third trimester ($p = 0.008$) were at higher risk for state anxiety. Women who belonged to the middle class ($p = 0.006$) and had no history of previous delivery ($p = 0.002$) were less vulnerable to trait anxiety.

Table 3
Exposure to COVID-19 infection among studied groups.

Variables	Women without COVID-19 infection (N = 146)	Women with COVID-19 infection (N = 92)	Total of women (N = 238)	Chi²*	p value
Did you have any relative diagnosed with COVID19	54(37%)	67(72.8%)	121 (50.8%)	29.005	0.0001*
Did you have any relative died because COVID19	20(13.8%)	7(7.6%)	27 (11.4%)	2.133	0.144
Did you have contact with COVID-19 patient	6(4.1%)	61(66.3%)	67 (28.3%)	107.273	0.0001*
Are you work in the medical field	3(2.1%)	6(6.5%)	9(3.8%)	3.095	0.079

COVID-19: the coronavirus disease 2019, * is significant p value.

Table 4
Fetal outcomes among studied groups.

Variables	Women without COVID-19 infection (N = 146)	Women with COVID-19 infection (N = 92)	Total of women (N = 238)	Chi²*	p value
Number of foetus in current pregnancy					
One	129(88.4%)	87(94.6%)	216 (90.8%)	2.604	0.272
Two	14(9.6%)	4(4.3%)	18(7.6%)		
More than two	3(2.1%)	1(1.1%)	4(1.7%)		
Fetal outcome at delivery					
Full term	66(45.2%)	46(50%)	112 (47.1%)	14.37	0.006*
Preterm	43(29.5%)	23(25%)	66 (27.7%)		
stillbirth	0(0%)	3(3.3%)	3(1.3%)		
Dead (intrauterine fetal death)	1(0.7%)	6(6.5%)	7(2.9%)		
Not knowing	36(24.7%)	14(15.2%)	50(21%)		
Respiratory aid					
Nasal continuous positive airway pressure	7(4.8%)	5(5.4%)	12(5%)	14.99	0.01*
Mechanical ventilation	5(3.4%)	1(1.1%)	6(2.5%)		
No need for respiratory aid (health fetal)	97(66.4%)	63(68.5%)	160 (67.2%)		
Neonatal intensive care	6(5.6%)	1(1.5%)	7(4%)	1.74	0.25
Fetal living problems					
No problem	95(65.1%)	62(67.4%)	157 (66%)	10.8	0.05
Born with problems	14(9.5%)	9(9.7%)	23(9.6%)		
Congenital anomaly	2(1.4%)	2(2.2%)	4(1.7%)		
Desaturation	12(8.2%)	7(7.6%)	19(8%)		
Not knowing	36(24.7%)	14(15.2%)	50(21%)		
APGAR score				1.580	0.664
7 or More	103(70.5%	64(69.6%)	167 (70.1%)		
Less than 7	6(4.1%)	7(7.6%)	13(5.5%)		
Dead (intrauterine fetal death) and still birth	1(0.7%)	7(7.6%)	8(3.4%)		
Not known	36(24.7%)	14(15.2%)	50(21%)		

COVID-19: the coronavirus disease 2019, * is significant p value.

Table 5
Compare of the prevalence of anxiety, depression, and post-traumatic stress disorder among the studied groups.

Variables	Women without COVID-19 infection (N = 146)	Women with COVID-19 infection (N = 92)	Total of women (N = 238)	Chi^{2}*	p value
S-Anxiety					
Normal	63(43.2%)	22(23.9%)	85(35.7%)	9.097	0.003*
Abnormal	83(56.8%)	70(76.1%)	153 (64.3%)		
T-Anxiety					
Normal	65(44.5%)	28(30.4%)	93(39.1%)	4.704	0.030*
Abnormal	81(55.5%)	64(69.6%)	145 (60.9%)		
Edinburgh Postnatal Depression Scale (EPDS)					
Normal	80(54.8%)	47(51.1%)	127 (53.4%)	0.312	0.577
Abnormal	66(45.2%)	45(48.9%)	111 (46.6%)		
PCL5					
Normal	138(94.5%)	87(94.6%)	225 (94.5%)	0.000	0.988
Abnormal	8(5.5%)	5(5.4%)	13(5.5%)		

COVID-19: the coronavirus disease 2019, * is significant p value, STAI, State-Trait Anxiety Inventory; EPDS, Edinburgh Postnatal Depression Scale; PCL-5, PTSD Checklist for DSM-5.

3.5.4. Logistic regression for PCL-5 and other parameters

Table 9 (supplemental file), shows that women who had one fetus in their current pregnancy ($p = 0.0001$), had one ($p = 0.000$) or no previous miscarriage ($p = 0.000$), and worked in the medical field ($p = 0.002$) were more vulnerable to PTSD. Women who belonged to the middle class ($p = 0.025$) and had a government job ($p = 0.023$) were less likely to develop PTSD.

4. Discussion

To the best of our knowledge, this is the first study of the mental health of a population of Egyptian women who were pregnant during the COVID-19 pandemic. We also followed up the participants in order to determine fetal outcomes. Most of the participants were 20–35 years old, unemployed, and belonged to the middle class. The women who contracted COVID-19 belonged to a higher socioeconomic class and worked in government and private sector jobs. These findings were similar to those of a study conducted by Janik et al. (2021) (Janik et al., 2021).

The angiotensin-converting enzyme 2 (ACE2) gene, which encodes the ACE2 protein, is a genetic risk factor for SARS-CoV-2 infection and is required by the virus to enter cells. Together with *ACE2*, the transmembrane protease serine 2 (TMPRSS2) and dipeptidyl peptidase 4 genes also play important roles in the disease severity (Choudhary et al., 2021).

During pregnancy, the ACE2 mRNA levels in the kidney, placenta, and uterus increase by approximately two times compared with those before pregnancy (Levy et al., 2008). Physiological changes during pregnancy increase the vulnerability of women to severe SARS-CoV-2 infection (Zhao et al., 2020). The abovementioned genes are coexpressed in the blastocyst trophoblast as well as in the syncytiotrophoblast and hypoblast during the implantation stage, which develop into tissues that interact with the maternal blood supply for nutrient exchange. The presence of *ACE2 and TMPRSS2* in these tissues suggests the possibility of vertical transmission of COVID-19 (Weatherbee et al., 2020). However, another study concluded that vertical transmission has not been verified in the past reports on pregnant women with Middle East respiratory syndrome and severe acute respiratory syndrome (Chen et al., 2020). The association between ACE2 overexpression and SARS-CoV-2 infection during pregnancy needs further investigations.

In this study, complications during antenatal care of the current pregnancy, obstetric complications, and medication during pregnancy were higher in women without COVID-19 than in those with COVID-19. In addition, a higher proportion of women without COVID-19 had a history of chronic illness (maternal comorbidities). Similarly, a systematic review involving 386 pregnant women with COVID-19 found that almost all mothers were healthy and did not have serious diseases, such as diabetes mellitus, heart disease, or autoimmune disease (Mirbeyk et al., 2021).

In our study, the most frequent symptoms of COVID-19 were cough, fever, and sore throat, whereas the least frequent symptoms were the gastrointestinal symptoms. Similarly, the most common symptoms of hospitalized patients reported in other studies included fever (up to 90% of patients), dry cough (60%–86%), shortness of breath (53%–80%), fatigue (38%), nausea/vomiting or diarrhea (15%–39%), and myalgia (15%–44%). Patients may also present with nonclassical symptoms, such as isolated gastrointestinal symptoms (Docherty et al., 2020; Eastin and Eastin, 2020; Grasselli et al., 2020; Huang et al., 2020; Mao et al., 2020).

Most of the participants in the study were in their second trimester during the COVID-19 pandemic. Conversely, in a systematic review of 364 pregnant women, a large proportion of patients were in their third trimester of pregnancy, with only 45 cases in the first or second trimester (12.4%) (Mirbeyk et al., 2021). Fetal outcomes such as stillbirth, asphyxia at birth, and high Apgar scores were worse in women with COVID-19. However, the incidence of fetal complications was almost equal in women with and without COVID-19. These findings may be attributable to genetic susceptibilities in women with COVID-19, which were possibly indicated by a higher rate of previous miscarriages and having children with congenital anomalies or disabilities than in women without COVID-19. Furthermore, SARS-CoV-2 may exploit a potential host's genetic risk factors (Choudhary et al., 2021) or vulnerability in the central nervous system (Boldrini et al., 2021).

4.1. Prevalence of depression, anxiety, and PTSD

In this study, 46.6% of pregnant women during the COVID-19 pandemic suffered from depression, 5.5% developed PTSD, 64.3% had state anxiety, and 60.9% had trait anxiety. Approximately 48.9% pregnant women with COVID-19 suffered from depression, 5.4% had PTSD, 69.6% had trait anxiety, and 6.1% had state anxiety. Furthermore, the rates of state anxiety, trait anxiety, and depression were higher in women with COVID-19 than in those without COVID-19. About two thirds of women with COVID-19 developed state anxiety and trait anxiety while a half-developed depression. However, the incidence of PTSD was almost equal in both groups.

The rate of depression among pregnant women during the COVID-19 pandemic in the United States was 36.4% from May 21 to August 5, 2020 (Liu, Erdei et al. 2021), whereas in Canada, it was 33.2% from mid-April to late April 2020 (Cameron et al., 2020). In a preliminary study conducted on 260 pregnant women in Turkey, the percentage of pregnant women with an EPDS score of >13 was 35.4% (Durankuş and Aksu, 2022). Another study in the southwest of Iran (Maharlouei et al., 2021) reported that pregnant women had higher depression and anxiety levels during the initial stage of the COVID-19 pandemic. Furthermore, a study conducted on pregnant and puerperal women in Qatar during the COVID-19 pandemic revealed that 39.2% participants suffered from depression (Farrell et al., 2020). The latter study reported that the prevalence of anxiety in the same population of women was 34.4% (Farrell et al., 2020). Other studies on the prevalence of anxiety reported 22.7% generalized anxiety in a similar population in the USA (Liu et al., 2021), 36.2% in Canadian women with children aged <18 months old (Cameron et al., 2020), and 45.4% among young adults in the USA (Liu et al., 2020). In contrast, 14% of pregnant and postpartum women in Belgium had generalized anxiety (Ceulemans et al., 2020b).

A Polish cross-sectional study found that the percentage of pregnant women with moderate anxiety on the STAI scale anxiety (Janik et al., 2021), as indicated by a score of <40, was 57.23%. Another study found that anxiety symptoms were present in 62.6% of those who took the STAI (STAI > 40) (Saccone et al., 2020). The anxiety levels associated with the COVID-19 pandemic in the present study were almost similar to those reported in a study conducted on pregnant women in Italy (68%) (Da Costa et al., 1999). STAI scores exceeding the cut-off for clinically severe anxiety symptoms have also been recorded in a Turkish study (Hocaoglu et al., 2020).

During the COVID-19 pandemic, the prevalence of perinatal depression and anxiety was higher than the global figures reported (12% for perinatal depression and 22% for anxiety) in a systematic review published before the pandemic (Woody et al., 2017).

PTSD symptoms evaluated using the PCL-5 were addressed in fewer studies during the pandemic. However, Liu et al. (Liu et al., 2021) reported clinically significant levels of PTSD (10.3%) among women in the USA, whereas in another study conducted from April to May 2020, the prevalence of PTSD was reported to be 31.8% (Liu et al., 2020). An international cross-sectional survey of pregnant and postpartum women from 64 countries during the COVID-19 pandemic recorded an increased prevalence of mental health symptoms, with a 43% prevalence of PTSD symptoms associated with COVID-19 (Basu et al., 2021).

Furthermore, two studies reported that pregnant women experienced substantial anxiety about transmitting the virus vertically to their infant, and many women surveyed from various nations expressed concerns about delivery and their baby's health (Akgor et al., 2021; Saccone et al., 2020). Over half of the mothers surveyed in another study in Italy were concerned that COVID-19 could induce fetal anatomical abnormalities, prenatal growth limitations, or preterm delivery (Mappa et al., 2020).

4.2. Risks of depression, anxiety, and PTSD

Evaluation of the risk factors for mental health problems in our participants showed that women aged <20 years were less likely to develop depression, whereas the opposite was true in women who were screened in the second trimester and who worked in the medical field. This may be because healthcare staff, as well as patients admitted to a health institution for other reasons, are particularly susceptible to infection from "super-spreader events." One huge case cluster of infection in Wuhan, China, involved healthcare personnel and patients (Wang et al., 2020).

Women who belonged to the middle class were less vulnerable to state anxiety. However, fever, cough, contact with a patient with COVID-19, and infected with COVID-19 during the second or third trimesters increase the risk of state anxiety. Meanwhile, primigravida and those of the middle class were less vulnerable to develop trait anxiety.

During COVID-19 pandemic, multigravida women were more prone to anxiety and depression than primigravida women (Yan et al., 2020). Previous studies conducted prior to the COVID-19 pandemic reported similar results (Dipietro et al., 2008; Figueiredo and Conde, 2011). Multigravida women face several challenges, including taking care of an additional child, restructuring of the existing parental system, and increased parenting and financial duties. These obstacles may have a negative impact on the mental health of multigravida women. However, in a Polish study, Janik et al. (Janik et al., 2021) found that primiparous women had statistically significantly higher anxiety levels than multiparous women. STAI data reported by Italian researchers also verified this finding (Mappa et al., 2020).

Despite contradictory findings, Janik et al. (Janik et al., 2021) observed no statistically significant differences in the effect of gestational age on anxiety levels associated with COVID-19. Other researchers found that STAI scores were higher in the first and third trimesters (Da Costa et al., 1999); however, Schubert et al. (Schubert et al., 2017) found that STAI levels remained stable throughout the pregnancies of the women surveyed in their study.

Regarding PTSD, women who had one fetus in their current pregnancy, had one or no previous miscarriage, and worked in the medical field were more vulnerable to PTSD. Conversely, women of the middle class and had a governmental were less likely to develop PTSD. Healthcare women are particularly vulnerable to infection and transmission to their families. In addition to our awareness that life stress is a significant predictor of prenatal mental health issues, the COVID-19 pandemic has become a novel life stressor that exacerbates psychological distress.

This study had some limitations. First, only fetal outcomes were assessed in the follow-up. Ideally, the follow-up should continue to evaluate postnatal psychiatric problems in the new mothers. Second, the study sample consisted of mothers who visited our hospital; therefore, the findings of this study may not be generalizable to the general population of Egyptian women. Third, recall bias may have affected the results since our data were based on the patients' self-reported symptoms and previous mental health history, which may contain inaccuracies.

Thus, further research on mothers who visit primary health units, clinics, and hospitals, as well as participants from the community, should be conducted to increase the generalizability of the results to the general population of Egyptian women. Also, further studies on the effect of personality traits on psychiatric problems in COVID-19 pandemic is still needed. Collaboration with pediatricians should also be initiated to assess infants and their developmental outcomes. Lastly, in the current and future health crises, public health education activities should be implemented to emphasize the critical role of healthcare professionals in reducing anxiety and tension in such situations. Professionals should be supported and employed by their organization to address the crisis and promote the region's cultural values.

5. Conclusions

In this study, we found that during the COVID-19 pandemic, 46.6% of pregnant women developed depression, 5.5% developed PTSD, 64.3% had state anxiety, and 60.9% had trait anxiety. The prevalence of state anxiety, trait anxiety, and depression were higher in women with COVID-19 than in those without COVID-19. However, the prevalence of PTSD was almost equal in women with and without COVID-19

Women screened in their second trimester and healthcare professionals were more vulnerable to depression. Fever, severe cough, contact with patients with COVID-19, and contacting COVID-19, especially in the second or third trimester, were risk factors for anxiety. In contrast, having one fetus in the current pregnancy, having one or no previous miscarriage, and working in the medical field were risk factors for PTSD. Women with COVID-19 were more prone to have a dead fetus or had a worse Apgar score. However, the incidence of fetal complications was almost equal between women with and without COVID-19.

Funding

None.

CRediT authorship contribution statement

Gellan k. Ahmed: Investigation, Formal analysis, Writing – original draft, Visualization. **Safwat A. Salman:** Conceptualization, Supervision, Project administration. **Khaled Elbeh:** Conceptualization, Supervision, Project administration. **Zaynap S. Amer:** Data curation, Visualization, Investigation. **Ahmed M. Abbas:** Investigation, Formal analysis, Writing – original draft, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We are grateful to Dr. John Rothwell (Emeritus Professor of Human Neurophysiology, University College London, UK) for revision of the English style and comments on the manuscript. He is not included as a contributing author.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2022.114920.

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