Prevalence of postpartum depression and antenatal anxiety symptoms during COVID-19 pandemic: An observational prospective cohort study in Greece

Georgia Micha1, Thomas Hyphantis2, Chryssoula Staikou3, Dimitrios Valsamidis4, Eleni Arnaoutoglou5, Petros Tzimas6, Nikolaos Vlahos7, Alexandros Daponte8, Ioannis Grypiotis1, Polyxeni Pappa1, Erofili Evangelaki1, Sofia Apostolidou2, Vasileios Paschos7, Giolanda Varvarousi4, Metaxia Bareka5, Gloria E. Izountouemio6, Orestis Tsonis9, Iouliani Koullourou10, Konstantina Kalopita1, Konstantinos Kotsis2

ABSTRACT

INTRODUCTION A significant proportion of pregnant women and women in the early postpartum period suffer from mental health problems. The COVID-19 pandemic represents a unique stressor during this period and many studies across the world have shown elevated rates of postpartum depression (PPD).

METHODS In this multicenter two-phase observational prospective cohort study, we aim to assess the prevalence of anxiety prior to labor (Generalized Anxiety Disorder-7), as well as PPD at 6–8 weeks postpartum using the Edinburgh Postnatal Depression Scale (EPDS).

RESULTS Of the 330 women analyzed, 13.2% reported symptoms of depression using EPDS cut-off score ≥13. High antenatal levels of anxiety (24.8% scored ≥10 in GAD-7) were documented. A significant proportion of postpartum women reported a decrease in willingness to attend antenatal education courses (36%) and fewer antenatal visits to their obstetrician (34%) due to pandemic. Higher antenatal anxiety increased the odds of being depressed at 6–8 weeks postpartum (EPDS ≥13).

CONCLUSIONS Compared to reported prevalence of PPD from previous studies before the COVID-19 era in Greece, we did not find elevated rates during the first wave of the pandemic. High anxiety levels were observed indicating that there is a need for close monitoring in pregnancy during the pandemic and anxiety screening to identify women who need support in the pandemic era. A well-planned maternity program should be employed by all the associated care providers to maintain the proper antenatal care adjusted to the pandemic strains as well as a follow-up after labor.

Eur J Midwifery 2022;6(April):23 https://doi.org/10.18332/ejm/146233

INTRODUCTION

COVID-19 viral pandemic has imposed a great worldwide psychological burden attributed to the fear of wellbeing and to an immediate threat to human life per se. The SARS-CoV-2 virus is associated with profound psychological implications ranging from stress and generalized anxiety disorder to depression and suicidal tendencies1,2. This is not unprecedented since there is previous experience of mental onus in recent outbreaks3 and all clinical manifestations are exaggerated during lockdown periods, by the fear of forthcoming socioeconomic crisis and loss of employment4.

Pregnancy is a period of conflicting emotions ranging from joyful expectations of the forthcoming baby to the fear of childbirth, trait anxiety and distress over the couple’s adjustment, while diagnosis of clinical depression intensifies the previous conditions5,7. In the context of the COVID-19 pandemic, emotions of fear seem to be more prevalent (49%) than before (7.5%) and joyful expectations are overclouded by the pandemic (63% before vs 17% after)9.

COVID-19-related concerns surfaced because this viral infection is considered to be a state of increased risk of severe illness, as was reported in previous outbreaks and in
a study from Italy during the COVID-19 pandemic. In a recent study of Centers for Disease Control and Prevention, women were strongly advised to self-isolate regardless of quarantine periods.

In this framework, pregnant women are reported to have higher levels of anxiety augmented by the protective measures taken relevant to perinatal care and labor. In most countries women are forced to separate from their supportive network due to a strict visitation policy system and present alone in the prenatal appointments and even in labor. Loss of social support and prolonged exposure of pregnant women to stressful events could be a leading pathway to postpartum depression (PPD).

PPD is defined as a major depression episode with perinatal onset; its prevalence ranges between 6.5% and 12.9%. Several studies regarding PPD in the pandemic have already been published and the first meta-analysis suggests that the pooled prevalence of PPD is 22%, representing a higher rate than before the pandemic. Studies assessing PPD at 6 weeks postpartum revealed a prevalence of PPD up to 34%.

According to a recent meta-analysis, the overall prevalence of perinatal anxiety has almost tripled during the COVID-19 pandemic from 15% to 40%. In Greece, the reported levels of anxiety, as recorded during the first lockdown period, were >50% with a decreasing tendency towards the end of the restrictive measures reaching 34–40%, probably due to the efficacious control of the pandemic.

Concerning PPD, however, to the best of our knowledge there are no studies assessing its prevalence during COVID-19 pandemic in Greece. Given this gap in the literature, we aim to assess the prevalence of PPD and anxiety symptoms in the Greek puerperal women and to evaluate the association of COVID-19 related concerns with antenatal anxiety and PPD symptoms.

**METHODS**

**Study design and participants**

This is a multicenter two-phase observational prospective cohort study conducted from June 2020 (one month after the first lockdown in Greece) to August 2020, involving 5 hospitals, throughout Greece. The study was approved by the ethics committees of all hospitals, and it was registered on clinicaltrials.gov. All procedures were in accordance with the World Medical Association Helsinki Declaration and signed informed consent was obtained from all participants.

In the first phase of the study, all parturients presenting for labor during June 2020, were asked to participate. Exclusion criteria were inability to read and write in Greek, history of an acute psychotic episode, intoxication or confusion. Each local investigator explained the aims of the study and a written informed consent was signed. The set of Phase 1 questionnaires (Generalized Anxiety Disorder-GAD-7 and a self-reported questionnaire about COVID-19 related concerns) was administered to all parturients. Demographic and medical variables were also recorded from the medical records. The second phase was conducted at 6–8 weeks postpartum by telephone and all women were asked to complete the Edinburgh Postnatal Depression Scale (EPDS). This is because PPD usually manifests at 6–8 weeks postpartum and in order to avoid the confounding impact of maternity blues (30–80% during the first 15 days postpartum). If a woman recorded suicidal ideation or a high score in the study tools, she was referred to a mental health service. Also, they were informed about the healthcare services and help lines operated during the pandemic.

**Measures and study instruments**

Sociodemographic and pregnancy variables were collected through a questionnaire and medical records. COVID-19 related concerns were collected using a 38-items structured questionnaire grouped in 5 domains (pregnancy, family, adequacy of information, obstetrics/gynecology, and anesthetic concerns). Fourteen items were dichotomous (Y/N) or with multiple responses (e.g. ‘where did you get information regarding viral transmission to the baby’ with possible answers such as physician, media, social media, other) and 24 items were scored on a 10-point Likert scale (0–9, in general 0 refers to ‘not at all’ and 9 to ‘extremely’, e.g. how much are you concerned about your pregnancy due to pandemic?). The questionnaire was developed specifically for this study after careful examination of the available regarding common concerns and anxieties among pregnant women. Subsequently all items were reviewed by all authors based on their expertise, specialty, and empirical knowledge at the first wave of pandemic in Greece, and consensus was established. Two parturients that were not included in the study sample were involved in this research by means of assisting in developing these research questions and in their prioritization in this structured questionnaire. Reliability analysis revealed a good strength of associations (Cronbach alpha=0.78).

PPD was assessed with the EPDS, which is a 10-item self-report tool. Mothers were asked to check the response that is closest to how they have been feeling in the last 7 days in a 4-point Likert scale (0–3; score range: 0–30). PPD was defined as an EPDS score of ≥13. The reliability of the scale was high (Cronbach’s alpha=0.87).

Anxiety symptoms were assessed by the Greek version...
of GAD-7 which rates the frequency of anxiety symptoms in the last 2 weeks on a Likert scale ranging from 0–3 (‘not at all’ to ‘nearly every day’) with a standard cut-off point of ≥10 indicating moderate to severe anxiety symptoms27.

Statistical analysis
All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 26 for Mac. Summary statistics for all variables were calculated using means and standard deviation for continuous variables and frequency and proportions for categorical variables. The primary outcome variable was the EPDS score at 6–8 weeks postpartum. To assess the association of COVID-19 related concerns with anxiety and depressive symptoms, Pearson’s correlations tests were carried out, followed by partial correlations adjusted for age, demographic and obstetric variables. To assess the independent associations of COVID-19 related concerns with anxiety and depression, two separate binary logistic regression analyses were performed with dependent variable the GAD-7 score (<10 and ≥10) and EPDS score (<13 and ≥13), respectively. Independent variables in each analysis were the most significant associations of COVID-19-related concerns derived from the correlation analysis.

RESULTS
Demographic characteristics of the study sample
In total, 339 parturients enrolled in the study. There was a 2.65% dropout rate between the first and second phase of the study (9 participants were not located at 6 weeks). Finally, the sample consisted of 330 women with a mean age of 32.3 years (SD: 5.6) [maternal age <35, (n=207; 62.7%) and maternal age ≥35 (n=123; 37.3%)], at a gestational age of 38 weeks (SD: 1.9). The majority were married (n=300; 90.6%), 63.1% were employed (n=209) and 85.5% (n=282) had completed secondary education (high school). Labor was conducted via caesarean (n=211; 64%) or vaginal (n=119; 36%) delivery. Preterm deliveries accounted for 10% of the study sample (n=33) and term deliveries for 90% (n=297).

Prevalence of postnatal depression and generalized anxiety disorder
In total, 43 mothers scored 13 or above in EPDS indicating that the prevalence of MDD (Major Depressive Disorder) was 13.2%. As far as anxiety symptoms are concerned, the mean score of GAD-7 before delivery was 6.3±5.0 indicating mild anxiety for parturients, while one-fourth (24.8%; n=82) could be identified as having probable, generalized anxiety disorder, when a cut-off point of ≥10 was used.

Concerns about COVID-19
Figure 1 shows the mean scores for the items related to COVID-19 concerns. Concerns about pregnancy and pandemic and transmission to fetus/newborn were moderate. They also seemed quite worried about the health of older children (5.4±3.2). Moreover, antenatal care seemed mildly affected due to the pandemic; however, a proportion of 36% (n=119) reported a decrease in willingness to attend antenatal education courses and a similar proportion of 34% (n=112) reported fewer antenatal visits to an obstetrician/gynecologist than planned. Also, mild concerns...
about COVID-19 transmission were reported because of their contact with the anesthesiologist as a first line doctor.

**Correlations between COVID-19 concerns and anxiety symptoms**

In univariate analysis (Table 1), a number of variables were associated with anxiety symptoms. A belief about transmission of the virus to the baby was positively correlated with anxiety score. Anxiety was significantly associated with the impact of COVID-19 outbreak on family relationships while the covariates did not affect this relationship. Parturients were anxious when their daily contact with their husband was affected by his work during the lockdown. As far as information related to transmission, our results revealed a negative relationship with anxiety, indicating that the better the information the less the anxiety.

**Table 1. Correlations among COVID-19 related concerns and anxiety symptoms (GAD-7)**

| Questions                                                                 | GAD-7 scale correlation to COVID-19 concern |
|---------------------------------------------------------------------------|---------------------------------------------|
|                                                                          | No covariates                              | Controlled for mother’s age/gestational age | Controlled for mother’s age/gestational age marital status, type of delivery, high risk group, educational level |
|                                                                          | Pearson p                                  | Pearson p                                   | Pearson p |
| Concern about pregnancy due to pandemic?                                  | 0.098 0.075                                | 0.154 0.031*                                | 0.157 0.030* |
| Concern about COVID-19 viral transmission to fetus/newborn?              | 0.097 0.079                                | 0.156 0.029*                                | 0.151 0.037* |
| Do you believe that COVID-19 virus can be transmitted by you to the baby?| 0.121 0.029*                               | 0.114 0.113                                | 0.116 0.111 |
| COVID-19 pandemic has an impact on family relationships?                  | 0.225 0.000***                             | 0.210 0.003**                              | 0.231 0.001** |
| If you already have children, are you worried about their health during COVID-19 pandemic? | 0.121 0.077                                | 0.155 0.030*                               | 0.147 0.042* |
| In case your daily contact with your partner/husband was affected due to his work during the lockdown period, to what extent this has affected you emotionally? | 0.156 0.006**                             | 0.132 0.065                              | 0.133 0.066 |
| How well informed were you in relation to fetal COVID-19 transmission?   | -0.164 0.003**                             | -0.136 0.058                              | -0.129 0.075 |
| How well informed were you in relation to newborn COVID-19 transmission? | -0.150 0.006**                             | -0.146 0.042*                            | -0.140 0.053 |
| How well informed were you in relation to preventive measures for COVID-19 transmission? | -0.103 0.061                                | -0.064 0.373                             | -0.046 0.526 |
| How well informed were you in relation to COVID-19 infection prognosis?  | -0.059 0.288                                | -0.071 0.327                            | -0.060 0.412 |
| How well informed were you in relation to COVID-19 infection therapy?    | -0.096 0.084                                | -0.149 0.037*                           | -0.141 0.052 |
| COVID-19 pandemic affected willingness for attending childbirth classes? | 0.146 0.008**                             | 0.289 0.000***                         | 0.309 0.000*** |
| COVID-19 affected prenatal visits to gynecologists?                      | 0.114 0.040*                              | 0.140 0.051                              | 0.152 0.035* |
| Are you anxious in relation to contact with the anesthesiologist as a possible source of COVID-19 transmission? | 0.025 0.660                                | 0.032 0.661                             | 0.062 0.392 |
| Do you believe that you or your baby can be infected by the contact with the anesthesiologist since he is a first line doctor in management of COVID-19 infected patients? | 0.034 0.534                                | 0.007 0.925                           | 0.036 0.628 |
| Do you believe that during anesthesiologist’s preoperative evaluation did he adequately use personal protective equipment for COVID-19 virus? | 0.070 0.214                                | 0.117 0.104                          | 0.097 0.183 |

GAD-7: generalized anxiety disorder-7, *p<0.05, **p<0.01, ***p<0.001.
anxiety. Finally, antenatal care as reflected in willingness to attend childbirth classes and prenatal visits was related to the GAD-7 total score. Partial correlation showed that certain associations were affected by the covariates like parturients’ age and gestational age (Table 1).

Separate univariate analysis (Table 2) showed that parturients aged ≥35 years were more anxious when they believed that the virus could be transmitted to the baby and less anxious when they were well informed about fetal transmission. The latter was also observed in parturients aged <35 years. Even so, younger women were more anxious if their daily contact with their husband was affected during the lockdown. In respect to gestational age, the anxiety symptoms were positively associated with their isolation from their partner due to his working during the lockdown only in preterm pregnancies. The same association was observed in term pregnancies along with the belief about viral transmission to the baby. Finally, in term pregnancies, a negative correlation was found between anxiety symptoms and the amount of information regarding the fetal transmission.

Subsequent regression analysis (Table 3) showed that the odds of being assessed with generalized anxiety disorder were higher in parturients who reported strong impact of pandemic on family relations (p=0.003, 95% CI: 1.060–1.316).

### Correlations between COVID-19 concerns and depressive symptoms at 6–8 weeks postpartum

Univariable analysis in Table 4 showed that different variables were correlated with depressive symptoms at 6–8 weeks postpartum, with a focus on the impact of COVID-19 related concerns on maternal mental health.

### Table 2. Correlations among COVID-19 related concerns and anxiety symptoms (GAD-7) in advanced maternal age and preterm and term pregnancies

| Questions                                                                 | Maternal age <35 (n=207) | Maternal age ≥35 (n=123) | Preterm (n=33) | Term (n=297) |
|--------------------------------------------------------------------------|--------------------------|--------------------------|----------------|--------------|
|                                                                           | Pearson                  | p                        | d              | Pearson      | p                        | d              | Pearson      | p                        | d              | Pearson      | p                        | d              |
| Do you believe that COVID-19 virus can be transmitted by you to the baby? | 0.092                    | 0.190                    | 0.391          | 0.119        | 0.036*       | 0.389          | 0.190        | 0.297          | 0.387          | 0.016        | 0.047**       | 0.233          |
| In case your daily contact with your partner/husband was affected due to his work during the lockdown period, to what extent this has affected you emotionally? | 0.147                    | 0.038*                   | 0.297          | 0.178        | 0.061        | 0.362          | 0.382        | 0.028*         | 0.826          | 0.123        | 0.041*        | 0.248          |
| How well informed were you in relation to fetal COVID-19 transmission?   | -0.145                   | 0.037*                   | -0.293         | -0.197       | 0.030*       | -0.402         | -0.039       | 0.831          | -0.078         | -0.180       | 0.002**       | -0.366         |
| How well informed were you in relation to newborn COVID-19 transmission? | -0.149                   | 0.032*                   | -0.301         | -0.152       | 0.094        | -0.307         | -0.160       | 0.373          | -0.324         | -0.147       | 0.011*        | -0.297         |
| COVID-19 pandemic affected willingness for attending childbirth classes? | 0.112                    | 0.109                    | 0.225          | 0.207        | 0.023*       | 0.423          | 0.456        | 0.008**        | 1.024          | 0.104        | 0.075         | 0.209          |
| COVID-19 affected prenatal visits to gynecologists?                      | 0.133                    | 0.057                    | 0.268          | 0.079        | 0.389        | 0.158          | 0.397        | 0.022*         | 0.865          | 0.086        | 0.139         | 0.172          |

GAD-7: generalized anxiety disorder-7, *p<0.05, **p<0.01, ***p<0.001.

### Table 3. COVID-19 related concerns independently associated with the maternal anxiety*

| Variables                                                                 | OR (95% CI) | p     |
|--------------------------------------------------------------------------|-------------|-------|
| Demographics                                                             |             |       |
| Age                                                                      | 0.973       | 0.901–1.050 | 0.480 |
| Advanced maternal age                                                    | 1.146       | 0.469–2.799 | 0.765 |
| Gestational age                                                           | 1.065       | 0.858–1.322 | 0.566 |
| Preterm/term                                                             | 0.581       | 0.154–2.201 | 0.425 |
| High risk group                                                           | 1.442       | 0.650–3.200 | 0.368 |
| Type of labor (NL/CS)                                                     | 0.737       | 0.403–1.349 | 0.323 |
| COVID-19 related concerns                                                |             |       |
| Belief about transmission to the baby                                     | 1.061       | 0.959–1.174 | 0.253 |
| Family relations affected                                                 | 1.181       | 1.060–1.316 | 0.003** |
| Emotional impact due to loss contact with husband                        | 0.988       | 0.892–1.095 | 0.820 |
| Information about transmission to the fetus                              | 0.882       | 0.716–1.088 | 0.242 |
| Information about transmission to the newborn                            | 0.982       | 0.807–1.196 | 0.858 |
| Affected willingness to childbirth classes                                | 1.078       | 0.983–1.183 | 0.109 |
| Affected prenatal visits to gynecologist                                  | 0.969       | 0.879–1.069 | 0.530 |

*Multivariable binary logistic regression analyses with dependent variable the ‘generalized anxiety disorder’ (GAD-7 ≥10) and independent variables the COVID-19 related concerns. The predictive values were calculated based on the probability of having ‘generalized anxiety disorder’ and the cut-off value between ‘case’ and ‘non-case’ was 0.500. Nagelkerke R²=0.129.
COVID-19 related variables correlated with EPDS depressive symptoms severity. When various variables were considered, only three remained significant. Depressive symptoms were positively associated with the degree of the emotional impact to the parturient due to the change in her daily contact with her husband because of his work.

Table 4. Correlations among COVID-19 related concerns and depressive symptoms at 6–8 weeks postpartum (EPDS)

| Questions                                                                 | EPDS scale correlation to COVID-19 concern |
|---------------------------------------------------------------------------|------------------------------------------|
|                                                                           | No covariates | Controlled for mother’s age/ gestational age | Controlled for mother’s age/ gestational age marital status, type of delivery, high risk group, educational level | Controlled for mother’s age/ gestational age marital status, type of delivery, high risk group, educational level and GAD-7 |
|                                                                           | Pearson      | p       | Pearson      | p       | Pearson      | p       | Pearson      | p       |
| Concern about pregnancy due to pandemic?                                  | 0.075        | 0.176   | 0.076        | 0.293   | 0.081        | 0.264   | 0.022        | 0.762   |
| Concern about COVID-19 viral transmission to fetus/newborn?              | 0.074        | 0.186   | 0.043        | 0.555   | 0.046        | 0.528   | -0.013       | 0.861   |
| Do you believe that COVID-19 virus can be transmitted by you to the baby? | 0.056        | 0.315   | 0.058        | 0.420   | 0.062        | 0.399   | 0.022        | 0.766   |
| COVID-19 pandemic has an impact on family relationships?                 | 0.209        | 0.000***| 0.174        | 0.015*  | 0.177        | 0.014*  | 0.106        | 0.147   |
| If you already have children, are you worried about their health during COVID-19 pandemic? | 0.023        | 0.744   | 0.032        | 0.654   | 0.037        | 0.608   | -0.020       | 0.787   |
| In case your daily contact with your partner/husband was affected due to his work during the lockdown period, to what extent this has affected you emotionally? | 0.219        | 0.000***| 0.215        | 0.003** | 0.206        | 0.004** | 0.172        | 0.018*  |
| How well informed were you in relation to fetal COVID-19 transmission?    | -0.085       | 0.088   | -0.068       | 0.346   | -0.059       | 0.417   | -0.016       | 0.829   |
| How well informed were you in relation to newborn COVID-19 transmission? | -0.071       | 0.199   | -0.046       | 0.521   | -0.047       | 0.517   | 0.002        | 0.973   |
| How well informed were you in relation to preventive measures for COVID-19 transmission? | -0.042       | 0.454   | -0.015       | 0.837   | -0.015       | 0.835   | 0.003        | 0.969   |
| How well informed were you in relation to COVID-19 infection prognosis?  | -0.069       | 0.212   | -0.088       | 0.224   | -0.086       | 0.236   | -0.071       | 0.330   |
| How well informed were you in relation to COVID-19 infection therapy?    | -0.064       | 0.251   | -0.053       | 0.466   | -0.041       | 0.572   | 0.008        | 0.916   |
| COVID-19 pandemic affected willingness for attending childbirth classes?  | 0.066        | 0.240   | 0.144        | 0.046*  | 0.149        | 0.040*  | 0.040        | 0.587   |
| COVID-19 affected prenatal visits to gynecologists?                      | 0.109        | 0.050*  | 0.053        | 0.464   | 0.054        | 0.462   | -0.004       | 0.952   |
| Are you anxious in relation to contact with the anesthesiologist as a possible source of COVID-19 transmission? | 0.160        | 0.004** | 0.147        | 0.041*  | 0.158        | 0.029*  | 0.147        | 0.043*  |
| Do you believe that you or your baby can be infected by the contact with the anesthesiologist since he is a first line doctor in management of COVID-19 infected patients? | 0.208        | 0.000***| 0.166        | 0.021*  | 0.165        | 0.023*  | 0.165        | 0.023*  |
| Do you believe that during anesthesiologist’s preoperative evaluation did he adequately use personal protective equipment for COVID-19 virus? | -0.033       | 0.563   | -0.028       | 0.702   | -0.042       | 0.563   | -0.083       | 0.253   |

EPDS: Edinburg Postnatal Depression Scale, GAD-7: Generalized Anxiety Disorder-7, *p<0.05, **p<0.01, ***p<0.001.
Similarly, Koutra et al.30, using the same cut-off with our month after delivery was 12.5% using the cut-off point of COVID-19 pandemic was not increased, most probably Therefore, the prevalence of PPD during the first phase of and 31.7% with mild depression according to BDI-II scores. PPD prior to the pandemic have revealed similar rates28-30. In our study, the prevalence of PPD at 6 weeks postpartum Main findings

**DISCUSSION**

**Main findings**

In our study, the prevalence of PPD at 6 weeks postpartum was 13.2%. Data from Greece regarding the prevalence of PPD prior to the pandemic have revealed similar rates28-30. Gonidakis et al.29 found that the prevalence of PPD one month after delivery was 12.5% using the cut-off point of 12. Similarly, Koutra et al.30, using the same cut-off with our study (≥13), found that the prevalence of PPD was 13.6% at 8 weeks postpartum. Moreover, Leonardou et al.28 used the cut-off point of 11/12 and found that the prevalence of PPD was 12.4%. Vivilaki et al.31 in 2007–2008, in a sample of postpartum women, reported that 6.7% of mothers diagnosed with major depression, 11.7% with moderate and 31.7% with mild depression according to BDI-II scores. Therefore, the prevalence of PPD during the first phase of COVID-19 pandemic was not increased, most probably because Greece was not hit hard by the first pandemic wave. Confirmed cases during the study period (June 2020–August 2020) ranged from 2.937 on 1 June to 10.757 on 1 September; the latter represents a rate near to 1% of the total population. Moreover, the number of deaths were low compared to other countries (n=271 on 1 September 2020). Moreover, our study was conducted over a period where no strict restrictive measures were implemented. Although a number of studies report an increase in PPD, a recent meta-analysis showed that even though the EPDS score was higher in the pandemic compared to the non-pandemic period, it did not reach the level of statistical significance12-14,32. In contrast, parturients reported high antenatal levels of anxiety, since 24.8% of them scored ≥10 in GAD-7. A recent meta-analysis, before the pandemic showed that self-reported anxiety symptoms prevalence was 24.6% in the third trimester and the overall prevalence of any anxiety disorder was 15.2%19. During the pandemic, two studies using GAD-7 reported lower rates compared to our study, of moderate anxiety (14% and 21.6%) in countries hit hard by COVID-1913,33. Similarly, in a multinational study of 3097 pregnant women, 11% scored ≥10 in GAD-713. Exception to these rates is the study of Preis et al.31 which revealed substantial levels of moderate to severe anxiety up to 43.3%. Evidence suggests that prenatal anxiety increases with the severity of the measures imposed. Interestingly, our recruitment was undertaken in a period where strict restrictive measures were not applied since Greece was not hit so hard in the first pandemic wave. One explanation is that family and social support during pregnancy in Greek families is very high and this was disrupted during lockdown, right before recruitment. Additionally, parturients were not allowed to have companions in the antenatal visits and in the hospital before delivery. By tradition, in Greece parturients have frequent visits to the hospital, and social support is associated with increased mental health and emotional well-being34. Still, we cannot ignore that anxiety measurement (even if GAD refers to the last 2 weeks) was undertaken right before delivery and this per se represents a stressful moment.

Our findings suggest that parturients were more anxious when they believed that SARS-CoV-2 virus could be transmitted by them to their baby. Anxiety could be due to lack of solid scientific evidence about transplacental transmission at the time the study was conducted35. However, even if the evidence was against transmission, parturients could be influenced by the so-called infodemic phenomenon. Moreover, antenatal care was correlated with GAD-7 scores probably because of the fear of transmission. Finally, anxiety symptoms were associated with the decreased contact with the partner, probably due to lack of emotional support.

In our study, anxiety of advanced maternal age mothers was correlated with the belief that the virus could be transmitted to the baby, something that was not observed in the younger group. Advanced maternal age and the fear of related complications in pregnancy could be the explanation. In contrast, younger mothers were anxious when they have

| Variables                                      | OR (95% CI) | p  |
|-----------------------------------------------|-------------|----|
| **Demographics**                              |             |    |
| Age                                           | 0.960 (0.867–1.062) | 0.427 |
| Advanced maternal age                         | 0.540 (0.167–1.751) | 0.305 |
| Gestational age                               | 0.811 (0.624–1.053) | 0.116 |
| Preterm/term                                  | 4.334 (0.577–32.534) | 0.154 |
| High risk group                               | 0.605 (0.197–1.859) | 0.380 |
| Type of labor (NL/CS)                         | 1.182 (0.550–2.540) | 0.669 |
| **COVID-19 related concerns**                 |             |    |
| Family relations affected                     | 1.044 (0.917–1.189) | 0.517 |
| Emotional impact due to loss contact with husband | 1.106 (0.984–1.242) | 0.091 |
| Anxiety to contact anesthesiologist           | 1.158 (0.931–1.441) | 0.188 |
| Baby infection by contact with anesthesiologist | 0.977 (0.806–1.84) | 0.814 |
| GAD-7 score                                   | 1.139 (1.063–1.221) | 0.000*** |

*Multivariable binary logistic regression analyses with dependent variable the ‘postpartum depression’ (EPDS ≥13) and independent variables the COVID-19 related concerns. The predictive values were calculated based on the probability of having ‘postpartum depression’ and the cut-off value between ‘case’ and ‘non-case’ was 0.500. Nagelkerke R²=0.178.

in lockdown (p=0.018). Moreover, there were positive correlations with the degree of the anxiety related to her contact with the anesthesiologist as a possible source of COVID-19 transmission (p=0.043) as well as the belief that the anesthesiologist, as a first line doctor, could transmit the infection to her and the baby (p=0.023). Subsequent regression analysis (Table 5) showed that the odds of having a postnatal major depressive episode were higher only in parturients that reported higher levels of anxiety (p=0.000; 95% CI: 1.063–1.221).
lost their daily contact with their husband. Anxiety of preterm pregnancy mothers (in contrast with term pregnancies) is not associated with beliefs about transmission to the baby probably because their primary source of anxiety is the survival or the complications to the newborn due to the preterm pregnancy itself\textsuperscript{36,37}. In general, little is known about predictive risk factors for anxiety disorders in pregnancy and postnatal period, being a neglected area of research\textsuperscript{38-42}. In our study during the pandemic, parturients being at higher risk for generalized anxiety disorder were those whose family relations were affected the most. This is indicative of the importance of marital and social support during pregnancy that a woman calls on during stressful events\textsuperscript{43}.

Depressive symptoms were correlated with various COVID-19 concerns. The PPD was positively associated with the reduced daily contact with the husband and with the fear that anesthesiologists could be a possible source of transmission. Previous studies related to SARS outbreak showed that the relationship with the partner was compromised due to interruption of intimacy and fear of transmission\textsuperscript{34,44}. Additionally, women who experience higher levels of support from their partners during the second trimester of pregnancy present lower levels of psychological implications postnatally\textsuperscript{44}. Therefore, it comes as no surprise that COVID-19 outbreak preventive measures related to partners’ distancing implemented in our study population could predispose to PPD. Moreover, anesthesiologists who come in close contact with severely ill patients are exposed to airborne viral transmission and are among the medical professionals of highest risk of infection\textsuperscript{45}. Furthermore, their contribution to the current pandemic management is vastly praised by the social media and the public\textsuperscript{46}. Considering that the public is overexposed to social media and TV news as a source of information during this pandemic\textsuperscript{47}, parturients were directly exposed to the infodemic phenomenon. However, concerning predictive factors, in our study only high levels of anxiety were associated with postnatal depression, a finding consistent with the literature\textsuperscript{48-50}.

**Limitations**

Our study has some limitations that need to be addressed. One lies in its cross-sectional nature. Yet it involves 5 centers throughout Greece (three located in Athens where half of the total population lives). Moreover, it assesses depressive symptoms at 6 weeks postpartum in order to avoid the ‘baby blues’ period. Although we used the most common PPD tool, we did not confirm the diagnosis using a structured interview. Another limitation is the fact that the 6 weeks’ postpartum assessment was performed by telephone contact where women underreport their symptoms. However, there are reports that EPDS administration over the telephone has high reliability\textsuperscript{51}. Finally, the study was conducted during the first pandemic wave where COVID-19 confirmed cases and deaths were not high in Greece. However, to the best of our knowledge, this is the first study in Greece assessing the prevalence of PPD during the COVID-19 pandemic.

**Future research**

Unfortunately, the pandemic is still on the rise and new mutations appear that may be a trigger for psychological distress for the population and of course for pregnant women. Future longitudinal research is needed to better identify high risk parturients and to provide the best maternal and child care both prenatal and postnatal. Future research should focus on psychosocial features such as the general support to pregnant women, e.g. marital and social support during pregnancy as well as medical staff support just after the labor, with well validated tools. Finally, since countries do not have the same infection rate throughout their region (and in different times this was the case in Greece), it is important to conduct further prevalence and longitudinal studies (throughout pregnancy) with larger samples in different regions to identify the effect of covid-infection rate in maternal psychological distress.

**CONCLUSIONS**

PPD rates according to our results did not increase during the first phase of the pandemic in Greece. It is known that many people do not develop psychopathology soon after a traumatic event and this may be the case in our sample. On the other hand, anxiety levels seem to be increased, indicating that there is a need for close monitoring and anxiety screening in order to identify women who need support in the pandemic era. Maternity care providers should employ an informative well-structured antenatal program in respect to the parturients’ concerns related to this pandemic. If restrictive measures are implemented, telephone contacts, video calls with the specialists or online antenatal courses could be applied. In such antenatal programs, enhancement of social support of pregnant women (e.g. involvement of husband and other close relatives) should be included. It is important to call attention to the need for close monitoring of antenatal care during the pandemic since a significant proportion of women were forced to skip the usual prepartum care appointments, like in previous outbreaks. Decreased antenatal care not only poses a medical danger to the mother and the fetus but also relates to PPD symptoms. Additionally, anesthesiologists should address parturients concerns. Safe emotional contact with their partners should be always advocated. Finally, a follow-up using teleconference in the first weeks of labor should be established by midwives in order to identify symptoms of PPD\textsuperscript{52}, especially in those with high antenatal anxiety which should be screened during pandemic in pregnancy as well as before labor.

**REFERENCES**

1. Serafni G, Parmigiani B, Amerio A, Aguglia A, Sher L, Amore M. The psychological impact of COVID-19 on the mental health in the general population. QJM. 2020;113(8):531–537. doi:10.1093/qjmed/hca201
2. John A, Pirkis J, Gunnell D, Appleby L, Morrissey J. Trends in suicide during the covid-19 pandemic. BMJ. 2020. doi:10.1136/bmj.m4352
3. Brooks SK, Weston D, Greenberg N. Psychological impact
of infectious disease outbreaks on pregnant women: rapid evidence review. Public Health. 2020;189:26-36. doi:10.1016/j.puhe.2020.09.006

4. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395(10227):912-920. doi:10.1016/S0140-6736(20)30460-8

5. Nilsson C, Hessman E, Sjoblom H, et al. Definitions, measurements and prevalence of fear of childbirth: a systematic review. BMC Pregnancy Childbirth. 2018;18(1):28. doi:10.1186/s12884-018-1659-7

6. Molgara S, Fenaroli V, Prino LE, et al. Fear of childbirth in primiparous Italian pregnant women: The role of anxiety, depression, and couple adjustment. Women Birth. 2018;31(2):117-123. doi:10.1016/j.wombi.2017.06.022

7. Vismara L, Sechi C, Neri M, Paoletti A, Lucarelli L. Maternal perinatal depression, anxiety, fear of birth, and perception of infants' negative affectivity at three months. J Reprod Infant Psychol. 2021;39(5):532-543. doi:10.1080/02646838.2020.1843612

8. Ravaldi C, Wilson A, Ricca V, Homer C, Vannacci A. Pregnant women voice their concerns and birth expectations during the COVID-19 pandemic in Italy. Women Birth. 2021;34(4):335-343. doi:10.1016/j.wombi.2020.07.002

9. Ahmad M, Vismara L. The Psychological Impact of COVID-19 Pandemic on Women’s Mental Health during Pregnancy: A Rapid Evidence Review. Int J Environ Res Public Health. 2021;18(13):7112. doi:10.3390/ijerph18137112

10. Zambrano LD, Ellington S, Strid P, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22–October 3, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(44):1641-1647. doi:10.15585/mmwr.mm6944e3

11. Reid KM, Taylor MG. Social support, stress, and maternal postpartum depression: A comparison of supportive relationships. Soc Sci Res. 2015;54:246-262. doi:10.1016/j.socscires.2015.08.009

12. Berthelot N, Lemieux R, Garon-Bissonnette J, Drouin-Maziade C, Martel É, Maziade M. Uptrend in distress and psychiatric symptomatology in pregnant women during the coronavirus disease 2019 pandemic. Acta Obstet Gynecol Scand. 2020;99(7):848-855. doi:10.1111/aogs.13925

13. Ceulemans M, Hompes T, Foulon V. Mental health status of pregnant and breastfeeding women during the COVID-19 pandemic: A call for action. Int J Gynaecol Obstet. 2020;151(1):146-147. doi:10.1002/ijo.23295

14. Gu XX, Chen K, Yu H, Liang GY, Chen H, Shen Y. How to prevent in-hospital COVID-19 infection and reassure women about the safety of pregnancy: Experience from an obstetric center in China. J Int Med Res. 2020;48(7):300060520939337. doi:10.1177/0300060520939337

15. Yan H, Ding Y, Guo W. Mental Health of Pregnant and Postpartum Women During the Coronavirus Disease 2019 Pandemic: A Systematic Review and Meta-Analysis. Front Psychol. 2020;11:617001. doi:10.3389/fpsyg.2020.617001

16. Shorey S, Chee CY, Ng ED, Chan YH, Tam WWS, Chong YS. Prevalence and incidence of postpartum depression among healthy mothers: A systematic review and meta-analysis. J Psychiatr Res. 2018;104:235-248. doi:10.1016/j.jpsychires.2018.08.001

17. Guvec G, Yesilcinar I, Ozkcecci F, et al. Anxiety, depression, and knowledge level in postpartum women during the COVID-19 pandemic. Perspect Psychiatr Care. 2021;57(3):1449-1458. doi:10.1111/ppc.12711

18. Liang P, Wang Y, Shi S, Liu Y, Xiong R. Prevalence and factors associated with postpartum depression during the COVID-19 pandemic among women in Guangzhou, China: a cross-sectional study. BMC Psychiatry. 2020;20(1):557. doi:10.1186/s12888-020-02969-3

19. Dennis CL, Falah-Hassani K, Shiri R. Prevalence of antenatal and postnatal anxiety: systematic review and meta-analysis. Br J Psychiatry. 2017;210(5):315-323. doi:10.1192/bjp.bp.116.187179

20. Shorey SY, Ng ED, Chee CY. Anxiety and depressive symptoms of women in the perinatal period during the COVID-19 pandemic: A systematic review and meta-analysis. Scand J Public Health. 2021;49(7):730-740. doi:10.1177/14034948211011793

21. Tsakiridis I, Dagklis T, Mamopoulos A, Athanasiadis A, Pearson R, Papazisis G. Antenatal depression and anxiety during the COVID-19 pandemic: a cross-sectional study in pregnant women from routine health care contact in Greece. J Perinat Med. 2021;49(6):656-663. doi:10.1515/jpm-2020-0473

22. Ostacoli L, Cosma S, Bevilacqua F, et al. Psychosocial factors associated with postpartum psychological distress during the Covid-19 pandemic: a cross-sectional study. BMC Pregnancy Childbirth. 2020;20(1):703. doi:10.1186/s12884-020-03399-5

23. Nanjundaswamy MH, Shiva L, Desai G, et al. COVID-19-related anxiety and concerns expressed by pregnant and postpartum women—a survey among obstetricians. Arch Womens Ment Health. 2020;23(6):787-790. doi:10.1007/s00737-020-01060-w

24. Lebel C, MacKinnon A, Bagshawe M, Tomfohr-Madsen L, Giesbrecht G. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. J Affect Disord. 2020;277:5-13. doi:10.1016/j.jad.2020.07.126

25. Coronavirus (COVID-19) Infection in Pregnancy: Information for healthcare professionals. Royal College of Obstetricians and Gynaecologists; 2020. March 9, 2020. Accessed December 6, 2021. http://allcatsrgrey.org.uk/wp/download/infection_control/coronavirus-covid-19-virus-infection-in-pregnancy-2020-03-09.pdf

26. Cox JL, Holden JM, Sagovsky R. Detection of...
postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry. 1987;150(6):782-786. doi:10.1192/bjp.150.6.782
27. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med. 2006;166(10):1092-1097. doi:10.1001/archinte.166.10.1092
28. Leonardou AA, Zervas YM, Papageorgiou CC, et al. Validation of the Edinburgh Postnatal Depression Scale and prevalence of postnatal depression at two months postpartum in a sample of Greek mothers. J Reprod Infant Psychol. 2009;27(1):28-39. doi:10.1080/02646830802004909
29. Goniaditis F, Rabavilas AD, Varsou E, Kreatsas G, Christodoulou GN. A 6-month study of postpartum depression and related factors in Athens Greece. Compr Psychiatry. 2008;49(3):275-282. doi:10.1016/j.comppsych.2007.05.018
30. Koutra K, Vassilaki M, Georgiou V, et al. Pregnancy, perinatal and postpartum complications as determinants of postpartum depression: the Rhea mother-child cohort in Crete, Greece. Epidemiol Psychiatr Sci. 2018;27(3):244-255. doi:10.1017/S2045796016001062
31. Vivilaki VG, Dafermos V, Kogevas M, Bitsios P, Lionis C. The Edinburgh Postnatal Depression Scale: translation and validation for a Greek sample. BMC Public Health. 2009;9(1):329. doi:10.1186/1471-2458-9-329
32. Hessami K, Romanelli C, Chiurazzi M, Cozzolino M. COVID-19 pandemic and maternal mental health: a systematic review and meta-analysis. J Matern Fetal Neonatal Med. 2020;33(6):100155. doi:10.1080/14767058.2020.1843155
33. Preiss H, Mahaffey B, Heiselman C, Lobel M. Pandemic-related pregnancy stress and anxiety among women pregnant during the coronavirus disease 2019 pandemic. Am J Obstet Gynecol MFM. 2020;2(3):100155. doi:10.1016/j.jafogmf.2020.100155
34. Dodgson JE, Tarrant M, Chee YO, Watkins A. New mothers’ experiences of social disruption and isolation during the severe acute respiratory syndrome outbreak in Hong Kong. Nurs Health Sci. 2010;12(2):198-204. doi:10.1111/j.1442-4410.2010.00520.x
35. Vivanti AJ, Vauloup-Fellous C, Prevot S, et al. Transplacental transmission of SARS-CoV-2 infection. Nat Commun. 2020;11(1):3572. doi:10.1038/s41467-020-17436-4
36. Trumello C, Candelori C, Cofini M, et al. Mothers’ Depression, Anxiety, and Mental Representations After Preterm Birth: A Study During the Infant’s Hospitalization in a Neonatal Intensive Care Unit. Front Public Health. 2018;6:359. doi:10.3389/fpubh.2018.00359
37. Çelen R, Tağ Arslan F. The Anxiety Levels of the Parents of Premature Infants and Related Factors. The Journal of Pediatric Research. 2017;4(2):68-74. doi:10.4274/jpr.65882
38. Antenatal and postnatal mental health: clinical management and service guidance. National Institute for Health and Clinical Excellence; 2007. Clinical guideline CG45. February 28, 2007. Accessed December 6, 2021. https://www.nice.org.uk/guidance/cg192/evidence/appendix-2-pdf-6962286999
39. Faisal-Cuy A, Rossi Menezes P. Prevalence of anxiety and depression during pregnancy in a private setting sample. Arch Womens Ment Health. 2007;10(1):25-32. doi:10.1007/s00737-006-0164-6
40. Qiao YX, Wang J, Li J, Ablat A. The prevalence and related risk factors of anxiety and depression symptoms among Chinese pregnant women in Shanghai. Aust N Z J Obstet Gynaecol. 2009;49(2):185-190. doi:10.1111/j.1479-828X.2009.00966.x
41. Nasreen HE, Kabir ZN, Forssell Y, Edhborg M. Prevalence and associated factors of depressive and anxiety symptoms during pregnancy: a population based study in rural Bangladesh. BMC Womens Health. 2011;11:22. doi:10.1186/1472-6874-11-22
42. Gourounti K, Anagnostopoulos F, Sandall J. Poor marital support associate with anxiety and worries during pregnancy in Greek pregnant women. Midwifery. 2013;30(6):628-635. doi:10.1016/j.midw.2013.10.008
43. Lancaster CA, Gold KJ, Flynn HA, Yoo H, Marcus SM, Davis MM. Risk factors for depressive symptoms during pregnancy: a systematic review. Am J Obstet Gynecol. 2010;202(1):5-14. doi:10.1016/j.ajog.2009.09.007
44. Mann JR, Mannan J, Quinones LA, Palmer AA, Torres M. Religion, spirituality, social support, and perceived stress in pregnant and postpartum Hispanic women. J Obstet Gynecol Neonatal Nurs. 2010;39(6):645-657. doi:10.1111/j.1552-6909.2010.01188.x
45. Stapleton LR, Schetter CD, Westling E, et al. Perceived partner support in pregnancy predicts lower maternal and infant distress. J Fam Psychol. 2012;26(3):453-463. doi:10.1037/a0028332
46. Cook TM. Risk to health from COVID-19 for anaesthetists and intensivists - a narrative review. Anaesthesia. 2020;75(11):1494-1508. doi:10.1111/anae.15220
47. van Klei WA, Hollmann MW, Sneyd JR. The value of anaesthesiologists in the COVID-19 pandemic: a model for our future practice? Br J Anaesth. 2020;125(5):652-655. doi:10.1016/j.bja.2020.08.014
48. Alipour Z, Lamyian M, Hajizadeh E. Anxiety and fear of childbirth as predictors of postnatal depression in nulliparous women. Women Birth. 2014;27(3):169-174. doi:10.1111/wombi.2011.09.002
49. Austin MP, Tully L, Parker G. Examining the relationship between antenatal anxiety and postnatal depression. J Affect Disord. 2007;101(1-3):169-174. doi:10.1016/j.jad.2006.11.015
50. Sutter-Dallay AL, Giaconne-Marcesche V, Glatigny-Dallay E, Verdoux H. Women with anxiety disorders during pregnancy are at increased risk of intense postnatal depressive symptoms: a prospective survey of the MATQUID cohort. Eur Psychiatry. 2004;19(8):459-463. doi:10.1016/j.eurpsy.2004.08.025
51. Figueiredo FR, Parada AP, Cardoso VC, et al. Postpartum...
depression screening by telephone: a good alternative for public health and research. Arch Womens Ment Health. 2015;18(3):547-553. doi:10.1007/s00737-014-0480-1

52. Almasidou ME. Postpartum depression during COVID-19. Eur J Midwifery. 2020;4(19):1-2. doi:10.18332/ejm/122386

PROTOCOL REGISTRATION
Clinicaltrials.gov: NCT04437342. Submitted on 15.06.2020
Official Title: Postpartum Depression in the Covid-19 Pandemic and the Impact of Anaesthesia

ACKNOWLEDGEMENTS
We would like to express our gratitude to all the women who participated in this study.

CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

FUNDING
There was no source of funding for this research.

ETHICAL APPROVAL AND INFORMED CONSENT
This research was approved by the Regional Ethical Review Board of all participating centers ("Helena Venizelou" General and Maternity Hospital in Athens on 30 June 2020 with an Identifier: 8/14HD/30-06-20). All procedures performed involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments. Signed informed consent was obtained from all participants.

DATA AVAILABILITY
The data supporting this research are available from the authors on reasonable request.

PROVENANCE AND PEER REVIEW
Not commissioned; externally peer reviewed.