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Raquel Costa, Tiago Miguel Pinto, Ana Conde, Ana Mesquita, Emma Motrico, Bárbara Figueiredo

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Women's perinatal depression: Anhedonia-related symptoms have increased in the COVID-19 pandemic

Authors: Raquel Costa[1,2,3] *, Tiago Miguel Pinto[3,4], Ana Conde[5], Ana Mesquita[4], Emma Motrico[6], & Bárbara Figueiredo[4]

Affiliations

[1]EPIUnit, Instituto de Saúde Pública, Universidade do Porto, Rua das Taipas, 135, 4050-600 Porto, Portugal; raquel.costa@ispup.up.pt (R.C.)

[2]Laboratório para a Investigação Integrativa e Translacional em Saúde Populacional (ITR), Porto, Portugal; raquel.costa@ispup.up.pt (R.C.)

[3]Lusófona University, HEI-Lab: Digital Human-Environment Interaction Labs, Portugal raquel.costa@ulusofona.pt (R.C.); tiago.pinto@ulusofona.pt (T.P.)

[4]School of Psychology, University of Minho, Campus Gualtar, 4710-057, Braga, Portugal; ana.mesquita@psi.uminho.pt (A.M.); bbfi@psi.uminho.pt

[5]INPP – Portucalense Institute for Human Development, Portucalense University, Porto, Portugal; anac@upt.pt (A.C.)

[6]Psychology Department, Universidad Loyola Andalucía Avenida de las Universidades s/n, Dos Hermanas (Sevilla), Spain; emotrico@uloyola.es (E.M.)

*Corresponding author:
EPIUnit, Instituto de Saúde Pública, Universidade do Porto, Rua das Taipas, 135, 4050-600 Porto, Portugal
E-mail: raquel.costa@ispup.up.pt

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Abstract

Background

The prevalence of perinatal depression increased during the COVID-19 pandemic, which may be due to changes in the profile of specific depressive symptoms.

Aims

To analyze the impact of the COVID-19 pandemic on the (1) prevalence and severity of specific depressive symptoms; and on the (2) prevalence of clinically significant symptoms of depression during pregnancy and postpartum.

Methods

Pregnant and postpartum women recruited before (n = 2395) and during the COVID-19 pandemic (n = 1396) completed a sociodemographic and obstetric questionnaire and the Edinburgh Postnatal Depression Scale (EPDS). For each item, scores ≥ 1 and ≥ 2 were used to calculate the prevalence and severity of depressive symptoms, respectively.

Results

The prevalence and severity of symptoms of depression were significantly higher during the COVID-19 pandemic. The prevalence of specific symptoms increased by more than 30%, namely "being able to laugh and see the funny side of things" (pregnancy 32.6%, postpartum 40.6%), "looking forward with enjoyment to things" (pregnancy 37.2%, postpartum 47.2%); and "feelings of sadness/miserable" or "unhappiness leading to crying" during postpartum (34.2% and 30.2%, respectively). A substantial increase was observed in the severity of specific symptoms related to feelings that "things have been getting on top of me" during pregnancy and the postpartum period (19.4% and 31.6%, respectively); "feeling sad or miserable" during pregnancy (10.8%); and "feeling scared/panicky" during postpartum (21.4%).

Conclusion

Special attention should be paid to anhedonia-related symptoms of perinatal depression to ensure that they are adequately managed in present and future situations of crisis.

Word count: 249

Introduction

Mental health problems emerged as a major public health concern during the COVID-19 pandemic [1] and were considered an integral component of COVID-19 response plans by the World Health Organization (WHO) [2]. Nonetheless, out of 130 WHO member states, less than 1 in 5 countries allocated additional funding for mental health and psychosocial support, and more than 60% of antenatal or postnatal mental health services were disrupted [2]. At the same time, perinatal mental health problems increased, including clinically significant symptoms of depression [3].

COVID-19 Pandemic and Perinatal Symptoms of Depression

Systematic reviews published two to three years before the COVID-19 outbreak consistently estimated the prevalence of depressive symptoms to be 9.2% for the prenatal and 9.5% for the postpartum period in high-income countries [4], regardless of the tools used (symptom severity scales or diagnostic tools). In Portuguese cohorts, about 20.0% of pregnant women [5,6] and 15.0% 22.4% of postpartum women had clinically significant symptoms of depression [7,8].

The prevalence of perinatal symptoms of depression increased during the COVID-19 pandemic [3,9, 10]. About 30% of women living in European and South American countries scored ≥ 13 on the Edinburgh Postnatal Depression Scale (EPDS), which indicates the presence of clinically significant symptoms of depression [10]. Specifically in Europe, a study conducted in five countries with pregnant and postpartum women reported lower prevalence of EPDS ≥ 13 in Switzerland (10.5%/10.4%); the Netherlands (11.5%/9.1%); and Norway (12.0%/14.6%), as compared to the UK (42.1%/42.3%) or Ireland (26.3%/24.3) [11]. The authors hypothesized that differences in prevalence rates could be explained at least

partly by differences in social isolation; at the time of the study, social distancing restrictions were still in place in the UK and had recently been reduced in Ireland.

COVID-19 Pandemic and Specific Symptoms of Perinatal Depression

The prevalence of clinically significant symptoms of depression during the COVID-19 pandemic is alarming. It is essential to gain knowledge on the increase in the prevalence and severity of specific symptoms of depression as a result of the COVID-19 pandemic. This would enhance the understanding of the presentation of symptoms which will ensure that adequate interventions are developed to meet the women's specific needs. Exploring the presentation of perinatal depression symptoms during the COVID-19 pandemic is especially relevant, as differences have been reported in the literature in relation to depressive symptoms in the perinatal period, as compared to other life periods [12,13,14]. The Edinburgh Postnatal Depression Scale [15] is a validated instrument for screening clinically significant symptoms of depression, both in pregnant and postpartum women [16]. The EPDS provides information on symptoms of depression, categorized as symptoms of anhedonia (items 1 and 2: able to laugh/looking forward); anxiety (items 3 to 5: self-blame, anxious/worried, scared panicky); and depression (items 6 to 10: overwhelmed, difficulty sleeping, sad or miserable, unhappy/crying, self-harm) [17,18]. This scale provides detailed information on the symptoms of perinatal depression, which prevalence and severity may have increased during the COVID-19 pandemic. The results obtained may help improve the readiness of health systems to meet the mental health needs of these women, according to their individual circumstances.

The aim of this study was to analyze the impact of the COVID-19 pandemic on the (1) prevalence and severity of specific symptoms of depression and on the (2) prevalence of clinically significant symptoms of depression during pregnancy and the postpartum period.

This study will contribute to the literature by providing comparative data on the prevalence and severity of specific symptoms of depression before and during the COVID-19 pandemic in a large sample of women in the perinatal period.

Method

Procedure

Data for the pre-pandemic period was collected from longitudinal cohorts of pregnant women recruited at public health centers in Northern Portugal (between 2004 and 2019). The aims and procedures of the study were explained to the participants. Written consent was obtained from pregnant women willing to participate. Data on expectant/postpartum women during the COVID-19 pandemic was collected through an online survey conducted between June 2020 and October 2020. All pregnant women (regardless of the stage of pregnancy) and mothers to infants younger than six months living in Portugal were eligible for inclusion. The aims and procedures of the study were explained to participants. Written consent was obtained prior to access being granted to the questionnaire (detailed procedures are described elsewhere; [19] reference omitted for blinded peer review). All the studies were conducted according to the Declaration of Helsinki. The study was approved by the local Ethics Committees of the participating sites. The final sample included 3,791 women from the cohorts described (prior to the COVID-19 pandemic, n = 2395; during the COVID-19 pandemic, n = 1396). Participants filled in a socio-demographic and obstetric questionnaire and completed the EPDS [15] either during pregnancy or postpartum.

Measures

Socio-demographic and obstetric characteristics

Information regarding age; country of birth (foreign *vs.* native); education (≤ 9 years of education *vs.* 10-12 years of education *vs.* higher education [bachelor, master's degree or postgraduate diploma]); marital status (married/cohabiting *vs.* single/separated/divorced/widow); employment status (employed *vs.* unemployed/student/housewife); history of mental health problems (yes *vs.* no); parity (nulliparous/primiparous *vs.* multiparous); and risk pregnancy (Yes *vs*. No; with *yes* including maternal age over 40 or gestational diabetes or hypertension or short cervix or other clinical condition) was collected via a self-reported questionnaire.

Symptoms of Depression

Symptoms of depression were assessed using the EPDS [15]. EPDS is a 10-item self-report scale rated on a four-point Likert-type scale (0 to 3) aimed at assessing the severity of symptoms of depression within the previous seven days. Total scores range from 0 to 30, with higher scores indicating a higher severity of symptoms of depression. The items and scoring system are as follows: *"Item 1. I have been able to laugh and see the funny side of things;* 0. As much as I always could, 1. Not quite so much now, 2. Definitely not so much now, 3. Not at all"; *"Item 2. I have looked forward with enjoyment to things;* 0. As much as I ever did, 1. Rather less than I used to, 2. Definitely less than I used to, 3. Hardly at all"; *"Item 3. I have blamed myself unnecessarily when things went wrong;* 0. No, never, 1. Not very often, 2. Yes, some of the time, 3. Yes, most of the time"; *"Item 4. I have been anxious or worried for no good reason;* 0. No, not at all, 1. Hardly ever, 2. Yes, sometimes, 3. Yes, very

often"; *"Item 5. I have felt scared or panicky for no very good reason;* 0. No, not at all, 1. No, not much, 2. Yes, sometimes, 3. Yes, quite a lot"; *"Item 6. Things have been getting on top of me;* 0. No, I have been coping as well as ever, 1. No, most of the time I have coped quite well, 2. Yes, sometimes I haven't been coping as well as usual, 3. Yes, most of the time I haven't been able to cope"; *"Item 7. I have been so unhappy that I have had difficulty sleeping;* 0. No, not at all, 1. Not very often, 2. Yes, sometimes, 3. Yes, most of the time"; *"Item 8. I have felt sad or miserable*; 0 No, not at all, 1. Not very often, 2. Yes, quite often, 3. Yes, most of the time*"; "Item 9. I have been so unhappy that I have been crying;* 0. No, never, 1. Only occasionally, 2. Yes, quite often, 3. Yes, most of the time"; *"Item 10. The thought of harming myself has occurred to me;* 0. Never, 1. Hardly ever, 2. Sometimes, 3. Yes, quite often". Two categorization processes were conducted to calculate the prevalence (absent *vs.* present; score = 0 *vs.* scores ≥1) and severity (non-severe *vs.* severe; scores ≤1 *vs.* scores ≥2) of each item. The Portuguese version of EPDS has good internal consistency [20,21]. In the cohorts assessed prior to the COVID-19 pandemic, Cronbach's α coefficient was 0.83 during pregnancy and 0.85 during the postpartum period. In the cohort assessed during the COVID-19 pandemic, Cronbach's α coefficient was 0.90 during pregnancy and 0.91 during the postpartum period. As recommended, a cut-off of 13 was used to identify women with clinically significant symptoms of depression [16].

Statistical Analyses

Descriptive statistics were calculated to analyze the socio-demographic and clinical characteristics of participants. The estimated prevalence (scores ≥ 1) and severity (scores ≥ 2) of each depressive symptom were compared in the cohorts before and during the COVID-19 pandemic. Chi-square tests were performed to compare the prevalence of EPDS ≥ 13 in

the cohorts before and during the COVID-19 pandemic. Two Multivariate Analyses of Covariance (MANCOVAs) and two Univariate Analyses of Covariance (UNIANCOVAs) were conducted to analyze the impact of the COVID-19 pandemic (before *vs.* during) on specific symptoms of depression during pregnancy and the postpartum period. As independent variables, the models included the period (before *vs.* during the COVID-19 pandemic) and the stage of pregnancy (early pregnancy –first and second trimester – *vs.* late pregnancy – third trimester) or stage of postpartum (early postpartum –until 12 weeks after childbirth– *vs.* late postpartum –more than 12 weeks after childbirth). The MANCOVA models included the 10 EPDS items as dependent variables, whereas the UNIANCOVA models included EPDS total score as the dependent variable. The models included potential sociodemographic, obstetric and health confounders (age, country of birth, education, marital status, employment status, history of mental health problems, parity, and risk pregnancy) as covariates.

Two-step logistic regressions were performed to analyze the impact of the COVID-19 pandemic on the prevalence of clinically significant symptoms of depression (EPDS ≥ 13) during pregnancy and the postpartum period. The first step (enter method) was performed to control potential sociodemographic, obstetric and health confounders. As independent variables, the second step included the variables of the first step, along with the period (before *vs.* during the COVID-19 pandemic), and stage of pregnancy (early pregnancy –first and second trimester – *vs.* late pregnancy –third trimester) or stage of postpartum (early postpartum –until 12 weeks after childbirth– *vs.* late postpartum –more than 12 weeks after childbirth) and clinically significant symptoms of depression (EPDS ≥ 13) as dependent variable.

Statistical significance was considered at *p* values < 0.05. Data were analysed with IBM SPSS 26.0 version (SPSS Inc, Chicago).

Results

Characteristics of participants

Table 1 shows the characteristics of participants by perinatal period: pregnancy vs. postpartum. Most pregnant women were 25 to 35 years old (63.0%); primiparous (78.3%); lived with their partner (85.3%); and about half had higher education (53.6%). Near one in four had experienced a mental health problem ever in life, 20.4% had a risk pregnancy; 28.5% were unemployed; and 8.7% were foreign-born. Most postpartum women were 25 to 35 years old (63.9%), primiparous (66.6%), and lived with their partner (88.0%), and about half had a higher education (57.6%). Near one in four had had a mental health problem ever in life, 21.2% had a risk pregnancy, 18.7% were unemployed, and 8.8% were foreign-born.

Both, pregnant and postpartum women assessed during the COVID-19 pandemic were more likely (*p*s < .001) to have clinically significant symptoms of depression (EPDS≥13; 24.3% and 28.2%, respectively, as compared to women assessed prior to the COVID-19 pandemic (9.0% and 6.5%, respectively).

Pregnant women assessed during the COVID-19 pandemic were more likely to be older, live with their partner, have a high education, be primiparous, have a history of mental health problem, and have a risk pregnancy, as compared to pregnant women assessed prior to the COVID-19 pandemic. Postpartum women assessed during the COVID-19 pandemic were more likely to be older, live with their partner, have a higher education, be multiparous, and have a risk pregnancy. In addition, they were less likely to be unemployed, as compared to postpartum women assessed prior to the COVID-19 pandemic.

Impact of the COVID-19 Pandemic on Specific Symptoms of Depression (EPDS items and total) during Pregnancy and the Postpartum Period

Supplementary Figure 1 displays the proportion of answer options selected per EPDS item by pregnant women assessed before *vs.* during the COVID-19 pandemic. The estimated prevalence of symptoms of depression in pregnant women (scores ≥1; see Figure 1a) was higher during the COVID-19 pandemic for all items, except for items 3, 5, and 10, as compared to the pre-pandemic period. The items which prevalence increased the most (>30%) were item 1 (32.6%) and item 2 (37.2%) during the COVID-19 pandemic (49.9% and 53.3%, respectively), as compared to the pre-pandemic period (17.3% and 16.1%, respectively). The severity of symptoms of depression (scores ≥ 2; see Figure 1b) was higher in all items except for item 10. The highest increases in severity were observed in items 6 (19.4%) and 8 (10.8%) during the COVID-19 pandemic (42.9% and 19.5%, respectively), as compared to the pre-pandemic period (23.5% and 8.7%, respectively).

Supplementary Figure 2 displays the proportion of answer options selected per EPDS item by postpartum women before *vs.* during the COVID-19 pandemic. The estimated prevalence of symptoms of depression in postpartum women (scores ≥ 1; see Figure 2a) was higher during the COVID-19 pandemic for all EPDS items, as compared to the pre-pandemic period. A > 40 % increase was observed in the estimated prevalence of items 1 (40.6%) and 2 (47.2%), followed by a > 30% increase in items 8 (34.2%) and 9 (30.2%) during the pandemic (56.8%, 60.0%, 68.5%, and 56.6%, respectively), as compared to the pre-pandemic period (16.2%; 12.8%, 34.3%, and 26.4% respectively). The severity of symptoms of depression (scores ≥ 2; see Figure 2b) was higher in all items during the COVID-19 pandemic. The highest increases in severity were observed in items 5 (21.4%) and 6 (31.6%) during the

COVID-19 pandemic (41.5% and 56.0%, respectively), as compared to the pre-pandemic (20.1% and 24.4%, respectively).

Significant multivariate effects of the COVID-19 pandemic were found on symptoms of depression (EPDS items) during pregnancy, *Wilk's Lambda* = 0.86, *F*(10, 1789) = 28.89, *p* < .001, ηp^2 = 0.14. Significant univariate effects of the COVID-19 pandemic were found on EPDS total score and all items, except for items 3 and 10. Pregnant women assessed during the COVID-19 pandemic reported more symptoms of depression, as compared to pregnant women assessed prior to the COVID-19 pandemic (see Table 2). Significant multivariate effects of the COVID-19 pandemic were found on symptoms of depression (EPDS items) during postpartum, *Wilk's Lambda* = 0.77, *F*(10, 1435) = 44.66, *p* < .001, ηp^2 = 0.24. Results revealed significant univariate effects of the COVID-19 pandemic on all EPDS items and the total score. Postpartum women assessed during the COVID-19 pandemic reported more symptoms of depression compared to postpartum women assessed prior to the COVID-19 pandemic (see Table 2).

Impact of the COVID-19 Pandemic on the Prevalence of Clinically Significant Symptoms of Depression (EPDS ≥ 13) during Pregnancy and the Postpartum Period

The first step of the regression model for the prevalence of clinically significant symptoms of depression (EPDS ≥ 13) during pregnancy included potential sociodemographic, obstetric and health confounders. The model was statistically significant (χ^2(9) = 61.79, *p* < .001), explained 3% to 6% of the variance in the prevalence of clinically significant symptoms of depression during pregnancy (Cox & Snell R^2 = 0.03, Nagelkerke R^2 = 0.06), and correctly classified 86.2% of cases. The period (before *vs.* during the COVID-19 pandemic) and stage of pregnancy (early *vs.* late) were added in the second step of the model. The second step of

the regression model was statistically significant (χ^2(11) = 154.33, p < .001), explained 8% to 15% of the variance in the prevalence of clinically significant symptoms of depression during pregnancy (Cox & Snell R^2 = 0.08, Nagelkerke R^2 = 0.15), and correctly classified 86.6% of cases. Pregnant women assessed during the COVID-19 pandemic had higher odds of reporting clinically significant symptoms of depression, as compared to pregnant women assessed prior to the COVID-19 pandemic. Being foreign or having a low education level or a history of mental health problems increased the odds of reporting clinically significant symptoms of depression during pregnancy (see Table 3).

The first step of the regression model for the prevalence of clinically significant symptoms of depression (EPDS ≥ 13) during the postpartum period included potential sociodemographic, obstetric and health confounders. The model was statistically significant (χ^2(9) = 54.02, p < .001), explained 4% to 7% of the variance in the prevalence of clinically significant symptoms of depression during the postpartum period (Cox & Snell R^2 = 0.04, Nagelkerke R^2 = 0.07) and correctly classified 86.2% of cases. The period (before $vs.$ during the COVID-19 pandemic) and stage of postpartum (early $vs.$ late) were added in the second step. The second step was statistically significant (χ^2(11) = 165.58, p < .001), explained 11% to 19% of the variance in the prevalence of clinically significant symptoms of depression during the postpartum period (Cox & Snell R^2 = 0.11, Nagelkerke R^2 = 0.19), and correctly classified 86.1% of cases. Postpartum women assessed during the COVID-19 pandemic had higher odds of reporting clinically significant symptoms of depression, as compared to postpartum women assessed prior to the COVID-19 pandemic. A foreign nationality, a history of mental health problems, and a young age increased the odds of reporting clinically significant symptoms of depression during the postpartum period (see Table 3).

Discussion

Main findings

This study provides evidence that pregnant/postpartum women during the COVID-19 pandemic had higher odds of reporting clinically significant symptoms of depression, as compared to pregnant/postpartum women assessed prior to the COVID-19 pandemic. The increased prevalence of clinically significant symptoms of depression during the COVID-19 pandemic can be due to a significantly higher prevalence and severity of specific core depressive and anhedonia-related symptoms, as assessed on the EPDS.

Additionally, being foreign or having a history of mental health problems increased the odds of having clinically significant symptoms of depression during pregnancy/postpartum. A low education only increased the odds of having clinically significant depressive symptoms during pregnancy, whereas a young age only increased the odds during the postpartum period.

During the COVID-19 pandemic, the number and severity of symptoms of depression during pregnancy and the postpartum period was considerably higher, as compared to the pre-pandemic period.

Prevalence of Clinically Significant Symptoms of Depression

Our data show that about one in four pregnant women obtained a score ≥ 13 on the EPDS and this prevalence was even higher in the postpartum period. Lower prevalence rates have been reported in Switzerland and the Netherlands, whereas higher prevalence rates have been reported in the UK, and similar in Ireland [11]. Importantly, the increase observed

in the prevalence and severity of depressive symptoms during the pandemic was more remarkable during postpartum, as compared to the pregnancy period (21.3% vs. 15.3%, respectively). This finding suggests a higher burden of the COVID-19 pandemic on the mental health of women during the postpartum period.

Prevalence of Symptoms of Depression

Important increases were observed in the prevalence of difficulties in being able to laugh and see the funny side of things (item 1, pregnancy 32.5%, postpartum 40.6%); looking forward with enjoyment to things (item 2, pregnancy 37.2%, postpartum 47.2%); feeling sad/miserable in the postpartum period (item 8, 34.2%) and unhappiness leading to crying in the postpartum period (item 9, 30.2%). The last two symptoms are core symptoms of depression, whereas the first two symptoms have been previously classified as anhedonia-related symptoms [17,18,22] and refer to the inability to feel pleasure in normally pleasurable activities. The increases in the prevalence of core symptoms of depression and anhedonia-related symptoms may be related to non-pharmaceutical interventions (including containment and closure policies) implemented by governments to contain the COVID-19 outbreak [23,24]. These measures had a huge impact on daily routines and prevented engagement in pleasurable activities, particularly those that involved social contact, which resulted in social isolation. In Portugal, within the study period, the Portuguese "lockdown style" was quite strict, with a high median stringency index (index varies from 0 to 100; 100 = strictest [23]) (71.30; P_{25}-P_{75}: 71.30-72.69; Min-Max: 63.43-74.54). This high stringency index indicates that social contact was substantially restricted in the population. Preventive measures included containment and closure policies such as school and workplace closure, cancellation of public events, restrictions on gatherings, closure of public transport, stay-at-

home measures, restrictions on internal movements, or border restriction [23], which led to increased social isolation.

The prevalence of anxiety-related symptoms (items 3 to 5: self-blame, anxious/worried, scared panicky) remained steadily. Those symptoms were the most prevalent in the pre-pandemic. During the COVID-19 pandemic, these symptoms remained the most prevalent along with the core depression symptom of overwhelmed (item 6), both during pregnancy and the postpartum period. This finding suggests that the symptoms that were already the most prevalent in women assessed prior to the COVID-19 pandemic may be less prone to variability resulting from contextual changes.

Severity of Symptoms of Depression

The severity of symptoms of depression also increased significantly during the COVID-19 pandemic, especially concerning core-symptoms of depression of feeling overwhelmed – "things have been getting on top of me" – during pregnancy and the postpartum period (item 6, pregnancy 19.4%, postpartum 31.6%), and sadness during pregnancy –"I have felt sad or miserable" (item 8, 10.8%)–, as well as the anxiety-related symptom of feeling scared/panicky in the postpartum period (item 5, 21.4%). During pregnancy, severity increased most significantly in two core symptoms of depression (items 6 and 8), whereas in the postpartum period, the highest increases were observed in a core-depressive symptom and an anxiety-related symptom (items 5 and 6).

The feeling of overwhelm during pregnancy and the postpartum might be associated with the significant proportion of Portuguese women reporting difficulties in accessing routine antenatal care (49.2%) and the reduced overall quality of maternal and neonatal care during the COVID-19 pandemic (47.3%) [25]. These concerns added to worries about

the lack of social support (e.g., restrictions on visits) [26] resulting from non-pharmaceutical interventions (movement restrictions and stay-at-home requirements). These restrictions may have resulted in isolation and deprivation from the social support that is usually provided to women by relatives and friends around the postpartum period. A previous study showed that support from healthcare providers is associated with lower symptoms of depression [27]. Feeling scared in the postpartum period might be driven by increased worries about the infant and medical care, including the possibility that the infant will be infected with SARS-CoV-2.

The proportion of pregnant women that had feelings of scariness or panic without a reason and of pregnant or postpartum women that had feelings of unnecessary blame or self-harm did not increase in the COVID-19 pandemic compared to before. The first two symptoms are anxiety-related components of depression [17,18,22]. These results suggest that the COVID-19 pandemic had a higher impact on symptoms of depression, as compared to anxiety-related symptoms in the perinatal period.

Finally, the severity of anxiety-related symptoms did not increase during the COVID-19 pandemic. Those symptoms (e.g., self-blame, anxious/worried, scared panicky) were the most severe both before and during the COVID-19 pandemic, along with the core depressive symptom of feeling overwhelmed, both in pregnant and postpartum women.

Factors Associated with the Prevalence of Clinically Significant Symptoms of Perinatal Depression during the COVID-19 Pandemic

Overall, pregnant/postpartum women assessed during the COVID-19 pandemic had higher odds of reporting clinically significant symptoms of depression, as compared to those

assessed prior to the COVID-19 pandemic, which is consistent with previous evidence [3,9]. This is a major and serious public health concern, in the light that 60% of antenatal or postnatal mental health services were disrupted during the COVID-19 pandemic [2]. Untreated perinatal mental health problems have adverse consequences for children [28]. The finding that a young age, being foreign, a low education level or a history of mental health problems increase the risk for reporting clinically significant symptoms of depression during pregnancy and/or the postpartum period during the COVID-19 pandemic is consistent with previous reports [29]. Awareness should be raised about the mental health needs of the most vulnerable groups of women during the perinatal period. This would greatly contribute to the implementation of priority policies and promote the readiness of mental health services during the perinatal period in a context of crisis.

Strengths and Limitations

The EPDS was used to assess symptoms of depression during pregnancy and the postpartum period. Since it is one of the most widely used self-reported measures to assess perinatal symptoms of depression [16], it allows comparison with other studies. Considering the normative sociodemographic characteristics of the sample, generalization of findings to other populations should be dealt with caution.

Significant differences were found between the cohort of women assessed during the COVID-19 pandemic and the cohort women assessed prior to the COVID-19 pandemic. However, these differences were controlled in the statistical analysis to examine the impact of the COVID-19 pandemic on perinatal symptoms of depression.

Implications for Clinical Practice and Research

A variety of reliable short versions of the EPDS have been developed [e.g. 30,31] in order to increase the cost-effectiveness of mental health screening plans. The significant increase in the prevalence and severity of specific depressive symptoms during the COVID-19 pandemic raises concerns on the adequacy of using shortened EPDS versions during future contexts of crisis. For instance, items 5 and 6 were removed in some validated shortened versions of the EPDS [e.g. 31,32]. However, these items represent symptoms which severity increases in situations of crisis, especially in the postpartum period. Clinicians should be aware that the use of shortened versions of the EPDS may lead to the underestimation of perinatal mental health problems. This may occur as short versions of the EPDS do not assess the symptoms which prevalence and severity increase the most during situations of crisis or when social isolation is required for any reason. Additionally, the administration of shortened versions prevents perinatal mental healthcare services from becoming aware of the occurrence of symptoms of depression in contexts of crisis or social isolation. This limitation results in health services failing to provide adequate screening, monitoring, and health care services, including strategies for reducing social isolation and improving social support, according to the specific needs of women during pregnancy or the postpartum period.   We identified vulnerable groups that need the clinicians' special attention in terms of perinatal mental health. Maternal and neonatal health care services should be aware that women who are young, foreign or have a history of mental health problems or a low education level, have higher odds of developing mental health problems. Therefore, screening for mental health problems is of foremost importance to overcome inequities in health care. Funding for mental health and psychosocial support is scarce and antenatal or postnatal mental health services were disrupted during the COVID-19 pandemic [2]. At the same time our

study showed that perinatal mental health worsened. If used wisely, the evidence provided in this study may contribute to improving the quality of mental healthcare by targeting and monitoring vulnerable groups using cost-effective tools.

Conclusion

The COVID-19 pandemic had an impact on the prevalence and severity of specific symptoms of depression, as well as on the prevalence of clinically significant symptoms of depression during the perinatal period. These deleterious effects were mainly due to the significantly higher prevalence and severity of core depressive and anhedonia-related symptoms. Our results suggest that clinical attention should be focused on the specific symptoms of depression that these women experience, in order to improve screening and treatment in this and future pandemics. The use of appropriate tools that assess a broad range of symptoms and address vulnerable groups is key to improving mental health care during current and future situations of crisis.

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Table 1
Participants' characteristics according to perinatal period, before and during the COVID-19 pandemic

		Pregnancy				Postpartum			
		COVID-19 pandemic				COVID-19 pandemic			
		Before	During	Total		Before	During	Total	
		n = 1402	n = 748	N = 2150		n = 993	n = 648	N = 1641	
		n (%)	n (%)	N (%)	p	n (%)	n (%)	N (%)	p
Age	≤24	254 (18.5)	36 (5.1)	290 (14.0)	< .001	156 (15.9)	24 (3.9)	180 (11.2)	< .001
	25-35	870 (63.5)	438 (62.2)	1308 (63.0)		642 (65.2)	382 (61.8)	1024 (63.9)	
	≥36	247 (18.0)	230 (32.7)	477 (23.0)		186 (18.9)	212 (34.3)	398 (24.8)	
	Missing	1371	704	2075		984	618	1602	
Country of birth	Native	1252 (91.1)	590 (91.6)	1842 (91.3)	.714	893 (90.8)	534 (92.1)	1427 (91.2)	.374
	Foreign	122 (8.9)	54 (8.4)	176 (8.7)		91 (9.2)	46 (7.9)	137 (8.8)	
	Missing	28	104	132		984	580	1564	
Education	≤ 9 years of education	356(26.0)	7 (1.0)	363(17.3)	< .001	235(23.9)	8(1.3)	243(15.0)	< .001
	10-12 years of education	443 (32.4)	167 (22.8)	610 (29.1)		300 (30.5)	145 (22.7)	445 (27.5)	
	Higher education[1]	569 (41.6)	557 (76.2)	1126 (53.6)		447 (45.5)	486 (76.1)	933 (57.6)	
	Missing	1308	731	2099		982	639	1621	
Employment status	Unemployed or other[2]	371 (27.1)	232 (31.1)	603 (28.5)	.051	231 (23.5)	74 (11.5)	305 (18.7)	< .001
	Employed	997 (72.9)	513 (68.9)	1510 (71.5)		752 (76.5)	572 (88.5)	1324 (81.3)	
	Missing	1368	745	2113		983	646	1629	
Marital status	Married/cohabiting	1100 (80.4)	690 (94.4)	1790 (85.3)	< .001	813 (82.9)	613 (95.9)	1426 (88.0)	< .001
	Other situation[3]	268 (19.6)	41 (5.6)	309 (14.7)		168 (17.1)	26 (4.1)	194 (12.0)	
	Missing	1368	731	2099		981	639	1620	
History of mental health problems	Yes[4]	326 (23.9)	207 (28.0)	533 (25.3)	.039	233 (23.7)	180 (27.9)	413 (25.4)	.059
	No	1039 (76.1)	533 (72.0)	1572 (74.7)		750 (78.3)	466 (72.1)	1216 (74.6)	
	Missing	1365	740	2105		983	646	1629	
Parity	Nulliparous/Primiparous	979 (70.3)	628 (88.1)	1607 (78.3)	< .001	723 (73.2)	360 (56.3)	1083 (66.6)	< .001
	Multiparous	413 (29.7)	85 (11.9)	498 (23.7)		265 (26.8)	279 (43.7)	544 (33.4)	

	Missing	*1392*	*713*	*2105*		*988*	*639*	*1627*	
Risk pregnancy[5]	Yes	202(16.5)	199(27.0)	401(20.4)	<	156(15.9)	178(29.9)	334(21.2)	<
	No	1025(83.5)	538(73.0)	1563(79.6)	.001	824(84.1)	417(70.1)	1241(78.8)	.001
	Missing	*175*	*11*	*186*		*13*	*53*	*66*	

Notes. [1]bachelor, master´s degree or postgraduate diploma [2]Other includes student/housewife; [3]Other situation includes single/separated/divorced/widow; [4]Any mental health problem ever in life; [5]Risk pregnancy includes age over 40 or gestational diabetes or hypertension or short cervix or other clinical condition; COVID-19 = coronavirus disease.

Table 2
The impact of COVID-19 pandemic on specific symptoms of depression (EPDS items and total) during pregnancy and the postpartum period, adjusting for sociodemographic and health confounders

| EPDS | Pregnancy COVID-19 pandemic | | | | | Postpartum COVID-19 pandemic | | | | |
| | Before n = 1402 | | During n = 748 | | | Before n = 962 | | During n = 513 | | |
	M	SD	M	SD	F	M	SD	M	SD	F
Item 1. I have been able to laugh and see the funny side of things	0.19	0.44	0.54	0.66	187.72***	0.17	0.42	0.71	0.71	211.28***
Item 2. I have looked forward with enjoyment to things	0.20	0.52	0.63	0.69	185.08***	0.15	0.44	0.74	0.70	337.06***
Item 3. I have blamed myself unnecessarily when things go wrong	1.15	0.82	1.16	0.78	1.47	1.10	0.80	1.40	0.92	32.55***
Item 4. I have been anxious or worried for no good reason	1.35	0.88	1.42	0.86	11.55**	1.14	0.83	1.48	0.88	40.01***
Item 5. I have felt scared or panicky for no very good reason	1.06	0.85	1.13	0.91	7.21**	0.83	0.78	1.26	0.91	63.40***
Item 6. Things have been getting on top of me	0.92	0.79	1.26	0.90	54.25***	0.99	0.76	1.51	0.87	77.98***
Item 7. I have been so unhappy that I have had difficulty sleeping	0.45	0.69	0.60	0.77	27.18***	0.32	0.58	0.59	0.74	50.95***
Item 8. I have felt sad or miserable	0.51	0.69	0.77	0.81	54.32***	0.39	0.58	0.94	0.80	175.05***
Item 9. I have been so unhappy that I have been crying	0.40	0.61	0.59	0.74	38.88***	0.29	0.52	0.71	0.73	128.17***
Item 10. The thought of harming myself has occurred to me	0.08	0.35	0.07	0.34	2.81	0.06	0.32	0.11	0.44	6.49*

Total	6.30	4.28	8.20	5.74	75.62***	5.72	4.18	9.44	5.61	159.38***

Notes. Response options, Item 1. 0. As much as I always could, 1. Not quite so much now, 2. Definitely not so much now, 3. Not at all; Item 2. 0. As much as I ever did, 1. Rather less than I used to, 2. Definitely less than I used to, 3. Hardly at all; Item 3. 0. No, never, 1. Not very often, 2. Yes, some of the time, 3. Yes, most of the time; Item 4. 0. No, not at all, 1. Hardly ever, 2. Yes, sometimes, 3. Yes, very often; Item 5. 0. No, not at all, 1. No, not much, 2. Yes, sometimes, 3. Yes, quite a lot; Item 6. 0. No, I have been coping as well as ever, 1. No, most of the time I have coped quite well, 2. Yes, sometimes I haven't been coping as well as usual, 3. Yes, most of the time I haven't been able to cope; Item 7. 0. No, not at all, 1. Not very often, 2. Yes, sometimes, 3. Yes, most of the time; Item 8. 0 No, not at all, 1. Not very often, 2. Yes, quite often, 3. Yes, most of the time; Item 9. 0. No, never, 1. Only occasionally, 2. Yes, quite often, 3. Yes, most of the time; Item 10. 0. Never, 1. Hardly ever, 2. Sometimes, 3. Yes, quite often.

Models adjusted for age, country of birth, education, marital status, employment status, history of mental health problems, parity, and risk pregnancy

Table 3

The impact of timing (before *vs* during COVID-19 pandemic) on the prevalence of clinically significant symptoms of depression (EPDS ≥ 13) during pregnancy and the postpartum period, adjusting for sociodemographic, obstetric, and health confounders

Pregnancy	β	Wald	p	OR	95% CI
Step 1					
Not married/cohabiting[1] (ref. married/cohabiting)	0.01	0.01	0.948	0.99	0.67 – 1.46
Risk pregnancy[2] (ref. normal pregnancy)	0.25	2.10	0.147	0.78	0.56 – 1.09
Foreign (ref. native)	0.66	9.70	0.002	1.93	1.28 – 2.92
Unemployed or other[3] (ref. employed)	0.48	10.12	0.001	1.62	1.20 – 2.18
≤ 9 years of education (ref. higher education[4])	0.21	0.94	0.332	0.81	0.53 – 1.24
10-12 years of education (ref. higher education[4])	0.22	1.69	0.195	1.24	0.90 – 1.72
Any mental health problem ever in life (ref. no)	0.81	30.38	< 0.001	0.45	0.34 – 0.60
≤ 24 years old (ref. >33 years old)	0.16	0.37	0.541	1.17	0.71 – 1.93
25-33 years old (ref. >33 years old)	-0.18	1.10	0.294	0.84	0.60 – 1.17
Step 2					
Not married/cohabiting[1] (ref. married/cohabiting)	0.29	1.76	0.185	1.33	0.87 – 2.03
Risk pregnancy[2] (ref. normal pregnancy)	0.04	0.06	0.814	0.96	0.68 – 1.36
Foreign (ref. native)	0.81	13.06	< 0.001	2.25	1.45 – 3.48
Unemployed or other[3] (ref. employed)	0.28	3.22	0.073	1.33	0.97 – 1.81
≤ 9 years of education (ref. higher education[4])	0.82	10.30	< 0.001	2.27	1.38 – 3.75
10-12 years of education (ref. higher education[4])	0.55	9.77	0.002	1.74	1.23 – 2.46
Any mental health problem ever in life (ref. no)	0.73	22.82	< 0.001	0.48	0.36 – 0.65
≤ 24 years old (ref. >33 years old)	0.32	1.45	0.228	1.38	0.82 – 2.34
25-33 years old (ref. >33 years old)	-0.06	0.12	0.725	0.94	0.67 – 1.33
During COVID-19 pandemic (ref. before)	1.60	81.35	< 0.001	0.20	0.14 – 0.29
Early pregnancy[5] (ref. late pregnancy[6])	0.36	4.91	0.027	0.70	0.51 – 0.96

Postpartum	β	Wald	p	OR	95% CI
Step 1					
Not married/cohabiting[1] (ref. married/cohabiting)	0.06	0.06	0.807	0.94	0.57 – 1.56
Risk pregnancy[2] (ref. normal pregnancy)	0.42	5.54	0.019	1.52	1.07 – 2.16
Foreign (ref. native)	0.54	4.84	0.028	1.71	1.06 – 2.77
Unemployed or other[3] (ref. employed)	0.26	1.38	0.240	0.77	0.50 – 1.19
≤ 9 years of education (ref. higher education[4])	0.95	12.13	< 0.001	0.39	0.23 – 0.66
10-12 years of education (ref. higher education[4])	0.43	4.99	0.026	0.65	0.44 – 0.95

Any mental health problem ever in life (ref. no)	0.95	33.28	< 0.001	0.39	0.28 – 0.53
≤ 24 years old (ref. >33 years old)	0.54	2.70	0.100	1.72	0.90 – 3.27
25-33 years old (ref. >33 years old)	0.19	1.00	0.317	1.21	0.84 – 1.74
Step 2					
Not married/cohabiting[1] (ref. married/cohabiting)	0.35	1.56	0.212	1.42	0.82 – 2.44
Risk pregnancy[2] (ref. normal pregnancy)	0.18	0.94	0.332	1.20	0.83 – 1.74
Foreign (ref. native)	0.70	7.03	0.008	2.01	1.20 – 3.36
Unemployed or other[3] (ref. employed)	0.14	0.36	0.547	0.87	0.55 – 1.38
≤ 9 years of education (ref. higher education[4])	0.11	0.12	0.734	1.12	0.60 – 2.09
10-12 years of education (ref. higher education[4])	0.13	0.43	0.511	0.87	0.59 – 1.31
Any mental health problem (ref. no)	0.85	24.04	< 0.001	0.43	0.30 – 0.60
≤ 24 years old (ref. >33 years old)	0.84	5.71	0.017	2.32	1.16 – 4.61
25-33 years old (ref. >33 years old)	0.41	4.34	0.037	1.50	1.03 – 2.21
During COVID-19 pandemic (ref. before)	1.97	89.76	<0.001	7.14	4.75 – 10.72
Early postpartum[7] (ref. late postpartum[8])	0.09	0.25	0.616	0.92	0.65 – 1.29

Notes. COVID-19, coronavirus disease; EPDS, Edinburgh Postnatal Depression Scale; OR, odds ratio; CI, Confidence interval; [1]Includes single/separated/divorced/widow; [2]Risk pregnancy includes age over 40 or gestational diabetes or hypertension or short cervix or other clinical condition; [3]Other includes student/housewife; [4]bachelor, master´s degree or posgraduate diploma; [5]first and second pregnancy trimester; [6]third pregnancy trimester; [7]until 12 weeks after childbirth; [8] more than 12 weeks after childbirth.

Models adjusted for age, country of birth, education, marital status, employment status, history of mental health problems, parity, and risk pregnancy

Figure 1. Estimates and 95% CI around the probability of having a depressive symptom (score ≥1) before (black) and after (grey) or a severe depressive symptom (score ≥2) before (black) and after
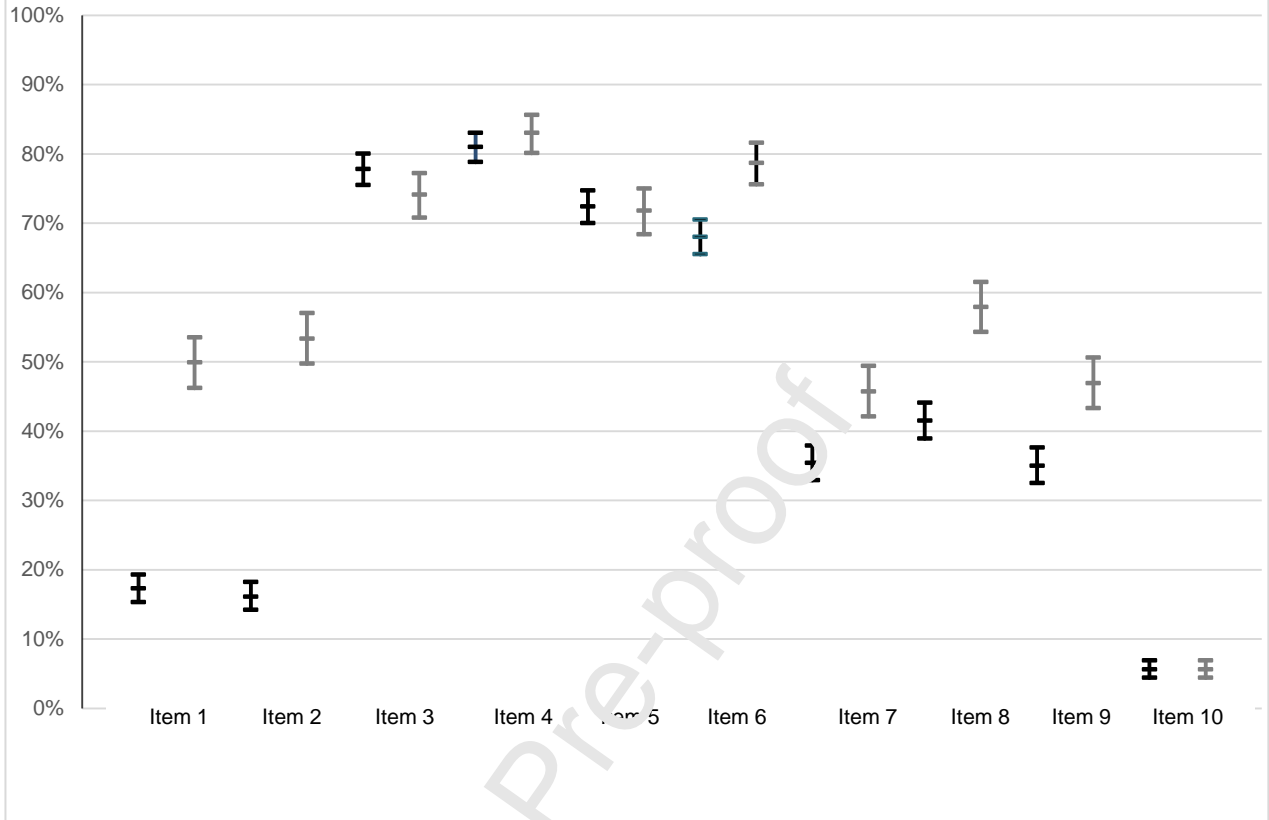
Figure 1. Estimates and 95% CI around the probability of having a depressive symptom (score ≥1) before (black) and after (grey) or a severe depressive symptom (score ≥2) before (black) and after
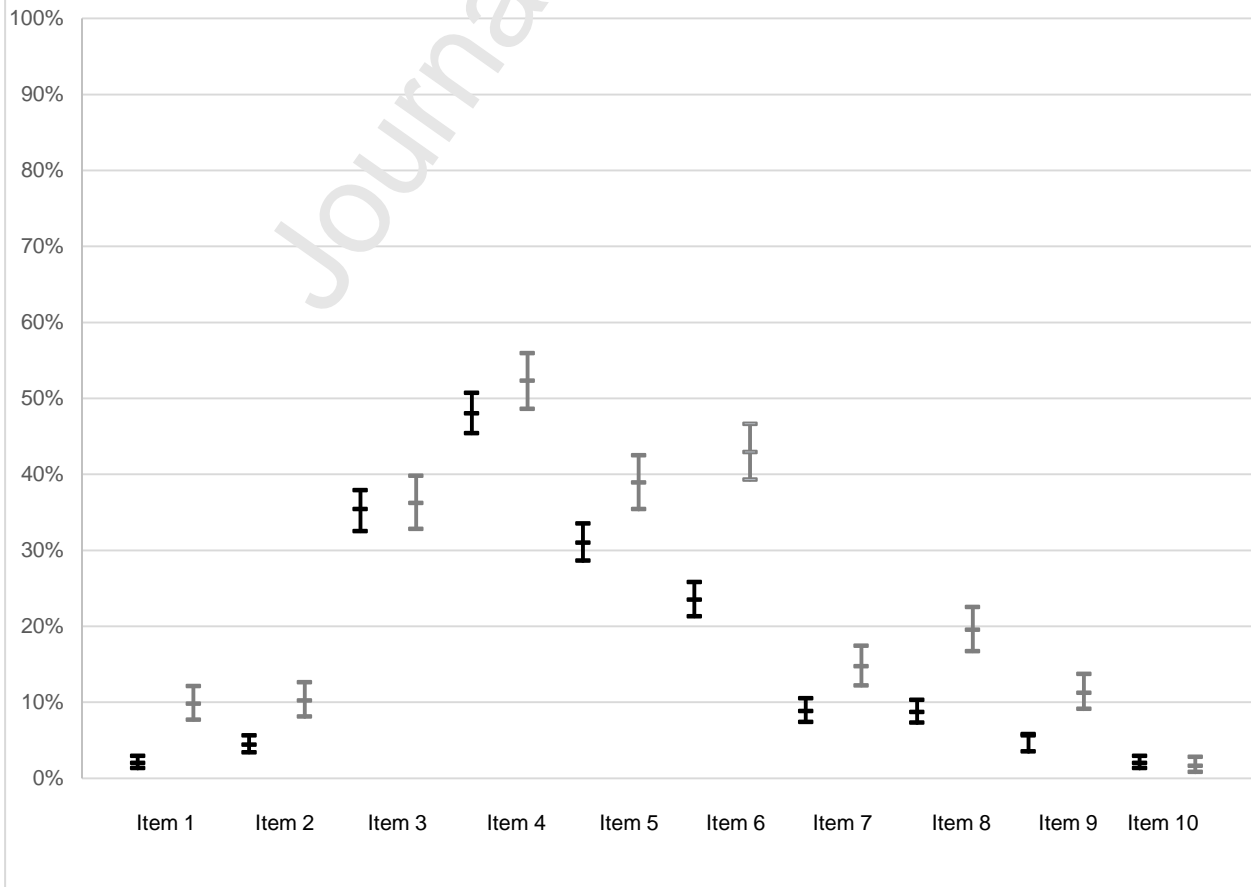
(grey) the COVID-19 pandemic - Pregnancy

Figure 1a. Estimates and 95% CI around the probability of having a depressive symptom (score ≥1) before (black) and after (grey) the COVID-19 pandemic - Pregnancy

Figure 1b. Estimates and 95% CI around the probability of having a severe depressive symptom (score ≥2) before (black) and after (grey) the COVID-19 pandemic - Pregnancy
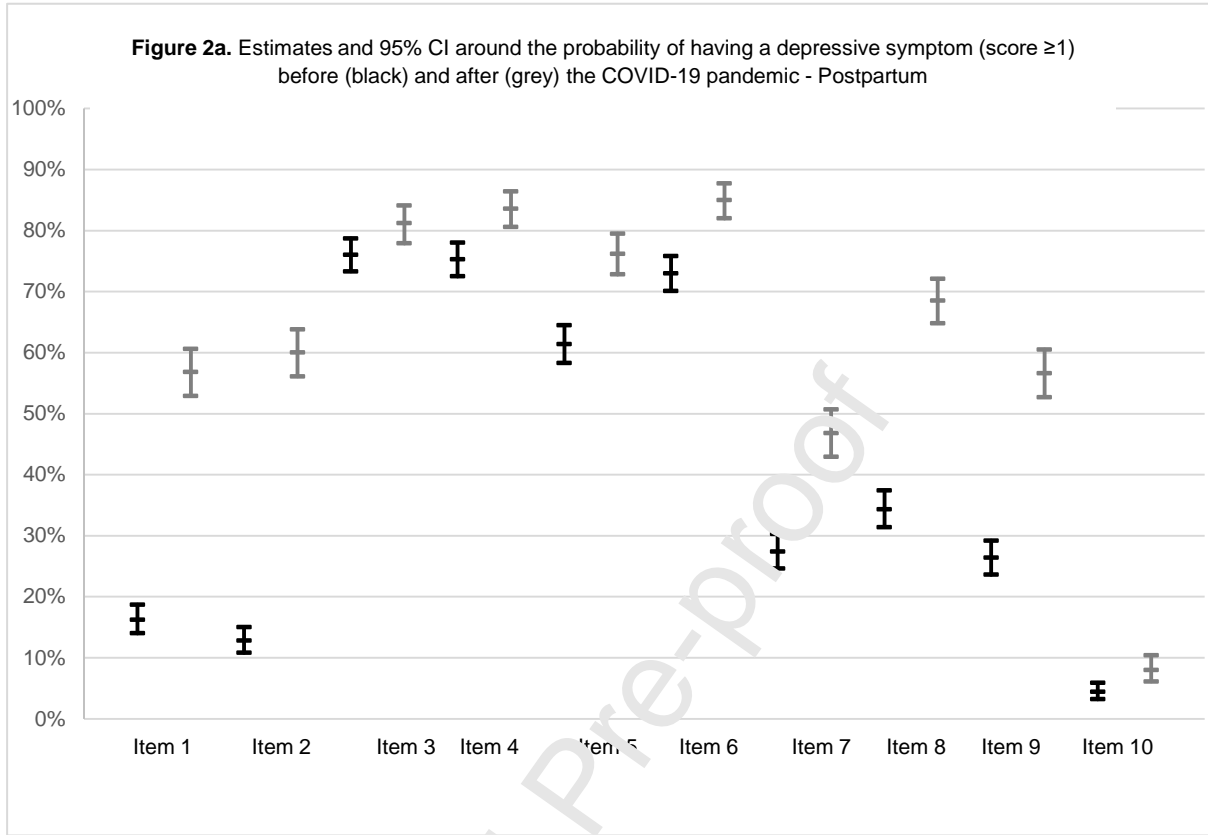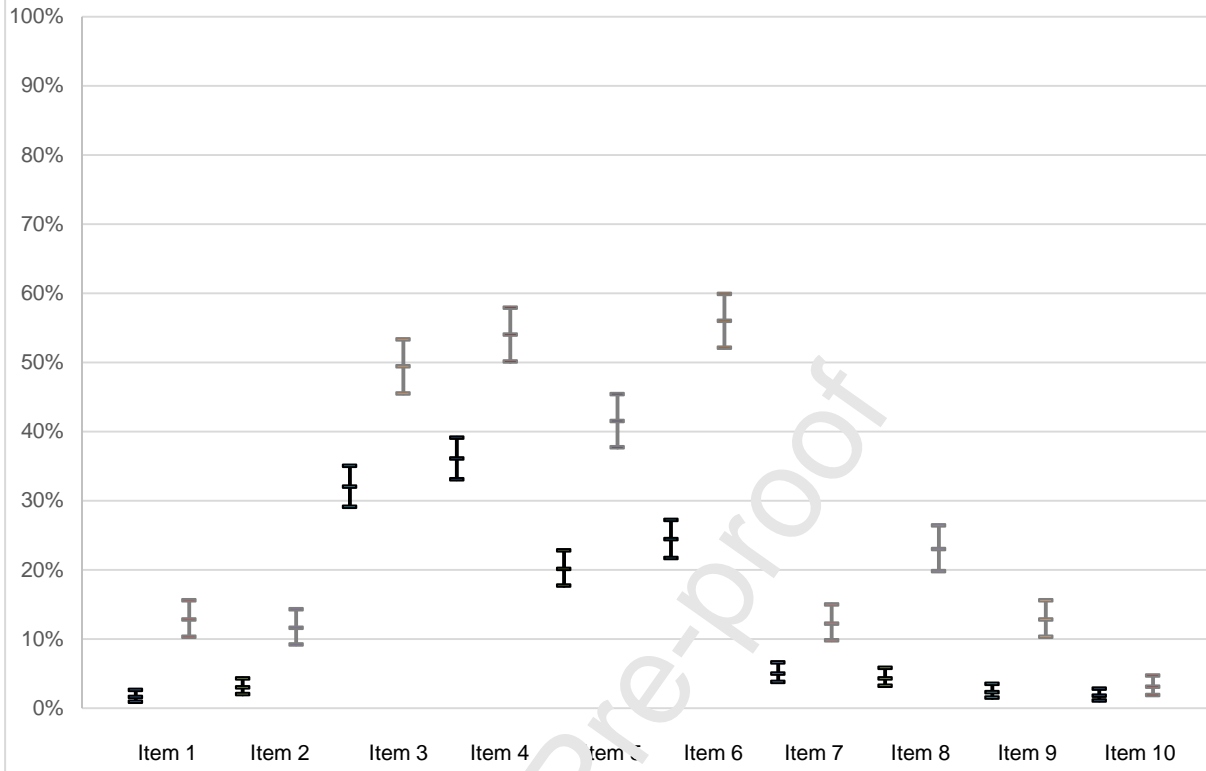
Item 1. I have been able to laugh and see the funny side of things
Item 2. I have looked forward with enjoyment to things
Item 3. I have blamed myself unnecessarily when things go wrong
Item 4. I have been anxious or worried for no good reason
Item 5. I have felt scared or panicky for no very good reason
Item 6. Things have been getting on top of me
Item 7. I have been so unhappy that I have had difficulty sleeping
Item 8. I have felt sad or miserable
Item 9. I have been so unhappy that I have been crying
Item 10. The thought of harming myself has occurred to me

Figure 2. Estimates and 95% CI around the probability of having a depressive symptom (score ≥1) before (black) and after (grey) or a severe depressive symptom (score ≥2) before (black) and after (grey) the COVID-19 pandemic - Postpartum

Figure 2a. Estimates and 95% CI around the probability of having a depressive symptom (score ≥1) before (black) and after (grey) the COVID-19 pandemic - Postpartum

Figure 2b. Estimates and 95% CI around the probability of having a severe depressive symptom (score ≥2) before (black) and after (grey) the COVID-19 pandemic - Postpartum

Item 1. I have been able to laugh and see the funny side of things
Item 2. I have looked forward with enjoyment to things
Item 3. I have blamed myself unnecessarily when things go wrong
Item 4. I have been anxious or worried for no good reason
Item 5. I have felt scared or panicky for no very good reason
Item 6. Things have been getting on top of me
Item 7. I have been so unhappy that I have had difficulty sleeping
Item 8. I have felt sad or miserable
Item 9. I have been so unhappy that I have been crying
Item 10. The thought of harming myself has occurred to me

Author Statement

I declare that I participated in the design, execution, and analysis of the paper by Costa and colleagues entitled "**Women's perinatal depression: Anhedonia-related symptoms have increased in the COVID-19 pandemic**", that I have seen and approved the final version and that it has neither been published nor submitted elsewhere. I also declare that I have no conflict of interest, other than any noted in the covering letter to the editor.

Role of the Funding Source

The funders had no role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the article for publication.

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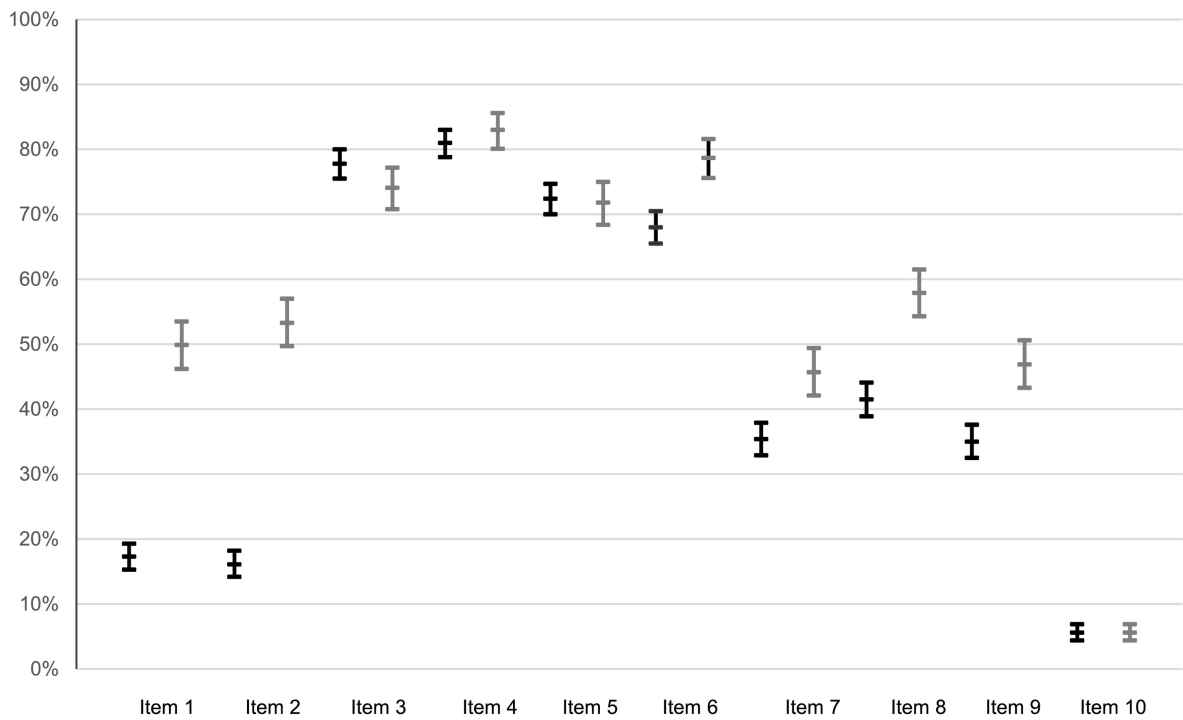
Author contributions

Costa and Pinto had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Concept and design: RC TP AC BF; Acquisition, analysis, or interpretation of data: RC TP AC BF AM EM; Drafting of the manuscript: RC TP AC; Critical revision of the manuscript for important intellectual content: RC TP AC BF AM EM; Statistical analysis: RC TP; Obtained funding: RC AC BF AM
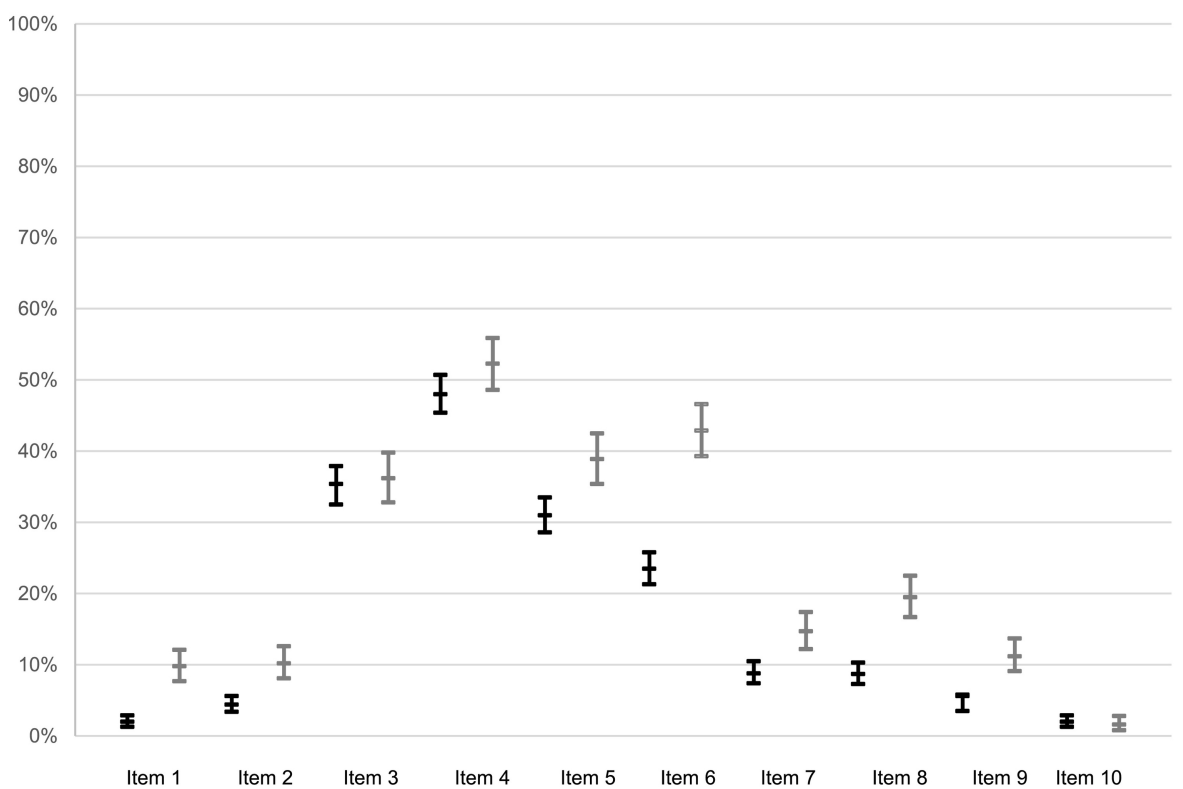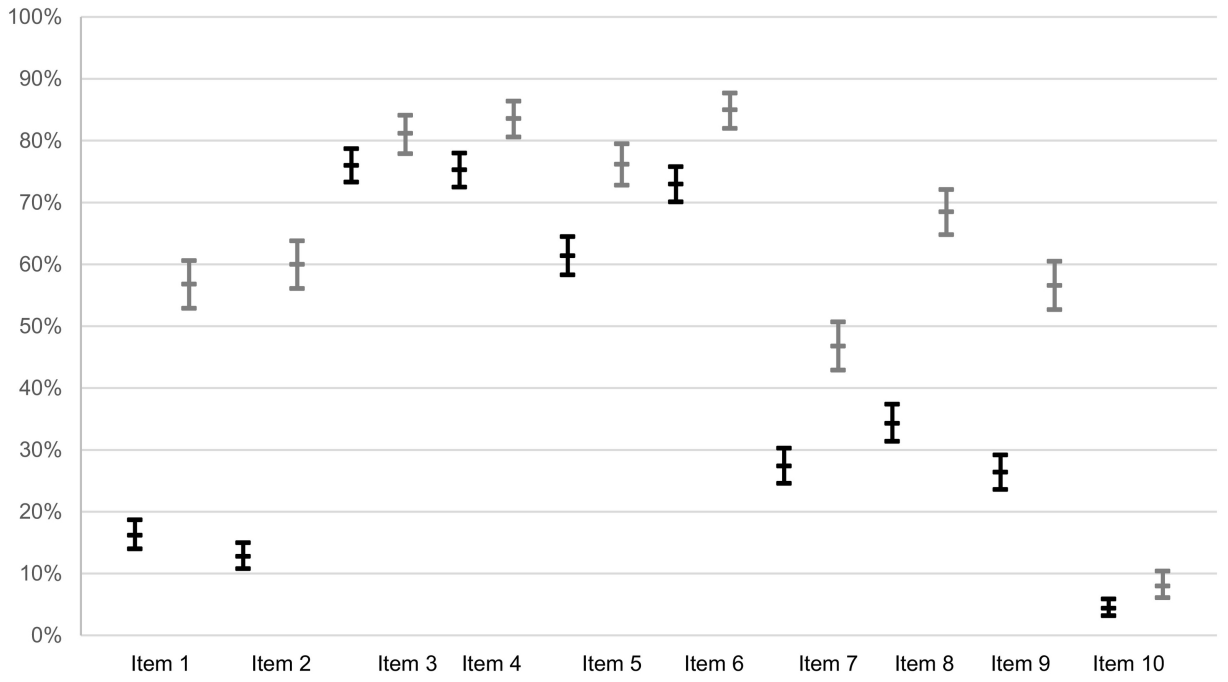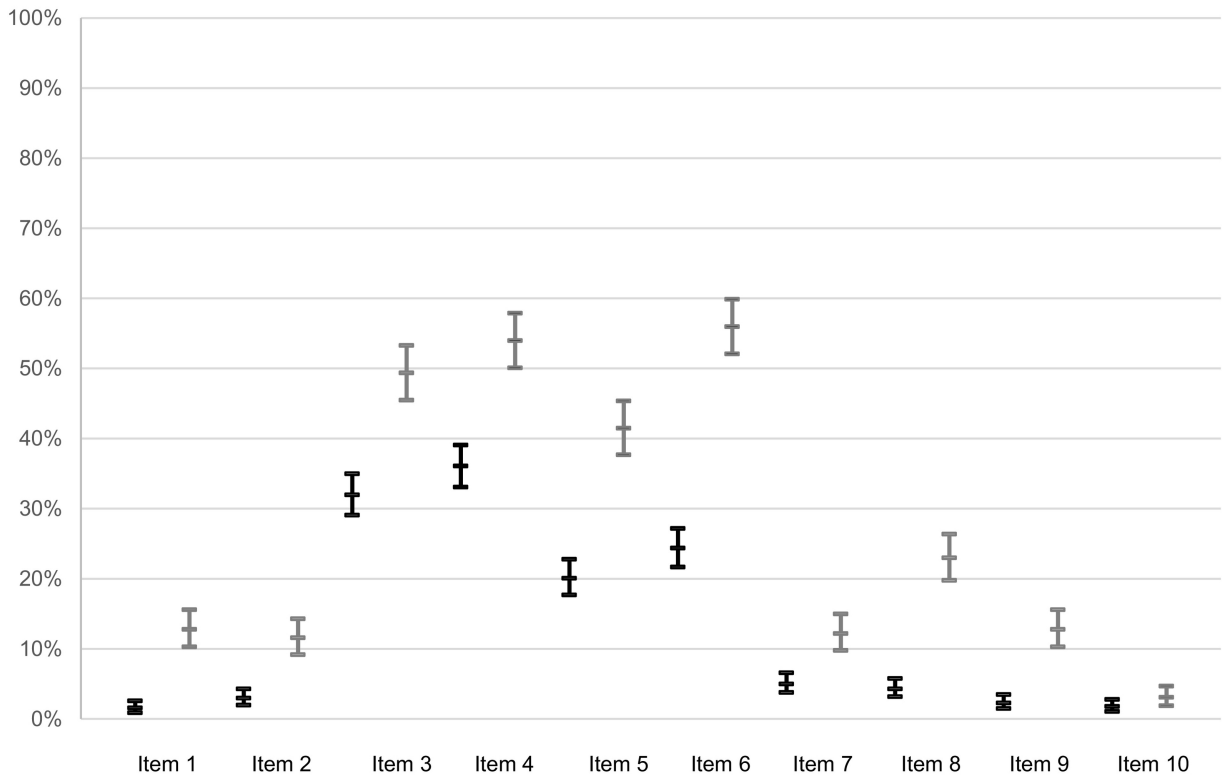
January 15th, 2023

Raquel Costa

(a)

(b)

Figure 1

Figure 2