

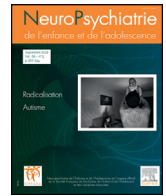


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Original article

## Postpartum maternal anxiety and depression during COVID-19 pandemic: Rates, risk factors and relations with maternal bonding

*Anxiété et dépression du postpartum lors de la pandémie de COVID-19 : prévalences, facteurs de risques et relations avec le lien mère-enfant*

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### ARTICLE INFO

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### ABSTRACT

**Objectives.** – This study aims to determine the rates of clinically-significant anxiety and depressive symptoms during the immediate postpartum in a sample of women referred to a university maternity department, as well as the associated risk factors and the relations with the level of maternal bonding.

**Patients and methods.** – During the third national lockdown for the COVID-19 pandemic (February–April 2021), on days 2–3 after delivery 127 mothers were administered the Edinburgh postnatal depression scale (EPDS), the state-trait anxiety inventory (STAI-YA), the mother-to-infant bonding scale (MIBS) and questions issued from the coronavirus health impact survey questionnaire (CRISIS).

**Results.** – The rate of perinatal clinically-significant symptoms were 17% for depression (EPDS cut-off  $\geq 12$ ) and 15% for anxiety (STAI-YA cut-off  $\geq 40$ ). In the multivariate analysis, being a single mother, risk of being infected by the SARS-CoV2, risk that a close relative might be infected by the SARS-CoV2 and the length of stay in maternity were associated with an increased EPDS total score, while breastfeeding was associated with a lower EPDS total score. Six variables remained positively associated with the STAI-YA total score in the multivariate model: the maternal level of academic achievement, a hospitalization during the pregnancy, peripartum medical complications, risk of being infected by the SARS-CoV2, risk of a close relative being infected by the SARS-CoV2 and physical fatigue. Low but statistically significant correlations were found between the MIBS total score and the EPDS total score ( $r_s = 0.26$ ) and with the STAI-YA total score ( $r_s = 0.26$ ).

**Discussion.** – The observed rates of anxiety and depressive symptoms were in the same range as those reported in observational studies conducted in high-resource countries during the COVID-19 pandemic. Risk of being infected by the SARS-CoV2 was both an independent risk factor for anxiety and depressive symptoms. The relations between the measure of maternal bonding and the severity of maternal emotional symptoms call for a better consideration of the long-term consequences of the pandemic on children's socio-emotional development.

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### R É S U M É

**Objectifs.** – Cette étude a pour objectif de déterminer la fréquence des symptômes dépressifs et anxieux maternels lors de la période du post-partum immédiat dans un groupe de femmes venant d'accoucher sur un service universitaire, ainsi que les facteurs de risques associés et les conséquences sur le lien mère-enfant.

**Mots clés :**  
Dépression  
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*Patients et méthodes.* – Au tout début de la pandémie de COVID-19 (entre les mois de février et avril 2021), 127 femmes venant d'accoucher ont complété dans les 2 à 3 jours qui suivent l'accouchement l'Edinburgh postnatal depression scale (EPDS), le State-trait anxiety inventory (STAI-YA), le Mother-to-infant bonding scale (MIBS) et le Coronavirus health impact survey questionnaire (CRISIS).

*Résultats.* – La fréquence des symptômes dépressifs cliniquement significatifs était de 17 % et de 15 % pour les symptômes anxieux. Le risque d'infection par le SARS-CoV2 était associé à la sévérité de ces symptômes dans les analyses multivariées. Des corrélations statistiquement significatives ont été mises en évidence entre le score MIBS et le score EPDS ( $r_s = 0.26$ ) et avec le score STAI-YA ( $r_s = 0.26$ ).

*Discussion.* – La fréquence des symptômes anxieux et dépressifs du péripartum étaient comparable avec d'autres études conduites dans les pays à haut niveau de ressource au cours de la pandémie de COVID-19. Le risque d'infection par le SARS-CoV2 est associé à des niveaux plus élevés de symptômes anxieux et dépressifs, à côté des autres facteurs connus de symptômes émotionnels du post-partum. Les liens retrouvés entre ces symptômes et le niveau de lien mère-enfant invitent à être attentif aux conséquences à long-terme de la pandémie sur le développement socio-émotionnel du nourrisson.

*Conclusion.* – Des études complémentaires sont nécessaires pour confirmer ces résultats et déterminer les conséquences potentiellement délétères sur le développement des interactions mère-enfant et du nourrisson.

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## Abbreviations

CPP	Committee for the Protection of Persons
CRISIS	Coronavirus Health Impact Survey Questionnaire
EPDS	Edinburgh Postnatal Depression Scale
MIBS	Mother-Infant Bonding Scale
STAI-YA	Subscore of the State-Trait Anxiety Inventory Y-form relative to anxiety-state

## 1. Introduction

Cumulative evidence supports an increased risk of maternal peripartum psychological difficulties since the beginning of the COVID-19 pandemic [1–6]. The meta-analysis conducted by Zhang and Yu [3] found an average prevalence of 43% for anxiety and of 32% for depression among pregnant women exposed to the context of the pandemic. These figures conceal although significant disparity across countries, with in particular a more substantial increase of postpartum depressive symptoms in low-resource compared to high-resource countries [7]. The capacity of the healthcare professionals providing adapted mental health interventions and care continuity during the pandemic appears a key moderator factor of maternal psychopathology risk [8,9]. In line with this, Chmielewska and Barratt [7] found that the estimated efficiency of the national health care system was a stronger predictor of the observed between-study heterogeneity for maternal health outcomes than factors-related to the stringency of mitigation measures for the COVID-19 epidemic (e.g. the duration of lockdown).

Alongside, several concerns have been raised that the application of social distancing measures in maternity wards led to lower social and professional support, ultimately contributing to increase the risk of maternal psychological difficulties [9–11]. The application of social distancing measures in maternity led to a strict restriction of partner and family visits while pregnant women faced additional sources of stress related to COVID-19 pandemic [11]. It has also been raised that a reduction of the length of stay in maternity and a constriction of paramedical team linked to the reorganization of workforce during the pandemic complicate the recognition of psychological needs of women during the perinatal period. An underestimation of maternal psychological difficulties could also be reinforced by a lower access to face-to-face supportive care (including social worker, psychologist and psychiatrist) and

subsequently decreased opportunity to receive professional help [12].

How additional stress related to COVID-19 pandemic and maternal psychopathology could impact the emergence of maternal bonding and secure attachment are key questions to better understand the possible long-term poor outcome of the pandemic in children. The onset or the persistence of psychiatric symptoms during the perinatal period may affect the emergence of parental attachment. Both perinatal anxiety and depressive symptoms are regarded as significant predictors of poorer parental sensitivity to infant's social signs [13,14], that could ultimately affect parent-to-infant interactions. In the context of the COVID-19 pandemic heightened sense of uncertainty about their own health and the newborn one and lower sense of social support may intensify the level of stress experienced in immediate post-partum [9] and could, in theory, affect maternal bonding.

To our knowledge, only two studies have so far examined the impact of perinatal mental health on maternal bonding or attachment during the COVID-19 pandemic. In a cross-sectional study conducted in 223 women recruited in the tertiary maternity care in Ankara, Turkey, Oskovi-Kaplan and Buyuk [15] found that women with higher depressive symptoms within 48 h after birth reported lower score at the self-reported maternal attachment inventory. In line with this, Liu and Hyun [16] found that postpartum women's depressive symptoms were related to lower quality maternal-infant bonding such as measured with the maternal postpartum attachment scale in an online survey conducted in 429 Chinese pregnant women.

The current single-center observational study was conducted to answer three questions. Firstly, we aimed to replicate previous reports on immediate perinatal mental health worsening during the COVID-19 pandemic. In line with Chmielewska and Barratt [7]'s cross-national analysis, we hypothesized that the pandemic-related surge in the rates of clinically significant anxiety and depressive symptoms will be limited in a modern hospital of a high-income country where newly developed telehealth interventions are largely available. As no historical control group was available, the findings will be compared with previous study conducted in France using comparable method [17–19].

Secondly, we aimed to determine which factors predicted the severity of postpartum mental health symptoms. In particular, we wondered whether factors related to social distancing measures in the maternity (i.e. rarefied visits and reduced length of stay) would predict high level of maternal psychopathology. If this is the case,

we planned to test whether such associations persist after controlling the effect of other predictors. Answering these questions could help to better estimate the benefit-risk value of social distancing measures in maternity with a better consideration of possible consequences on maternal mental health.

Thirdly, we aimed to measure the relation between maternal emotional symptoms and the level of maternal bonding. We hypothesized that both maternal anxiety and depressive symptoms measured in immediate postpartum (i.e. within 3 days after childbirth) would be associated to lower maternal bonding, in line with previous reports in other countries [15,16]. If confirmed, these findings will encourage clinicians and researchers to make a stronger case for the relation between maternal bonding and pandemic-related surge in maternal psychopathology to consider possible long-term impact on children mental health difficulties.

## 2. Methods

### 2.1. Population

The sample included women who gave birth in a university hospital in Amiens, France, between 1st of February 2021 and 30th of April 2021, i.e. questionnaires were distributed during their stay, on days 2–3 after delivery. The study period takes place during the third national lockdown in France. This period has been characterized by the closure of non-essential shops, the suspension of attendance at schools for three weeks, the ban of domestic travel and a nationwide curfew from 7pm–6am. Inclusion criteria were subjects aged more than 17-year-old, French-speaking patients, affiliated to a social security system, having a single pregnancy, giving birth of a living child who did not require an admission to neonatal intensive care unit. Of the 144 patients who received the questionnaires, 127 matched the inclusion criteria and signed consent form. This study received a favorable opinion from the Committee for the Protection of Persons (CPP Ile-de-France II, ID-RCB 2020-A01256-33). The study took place in a university hospital where telehealth (e.g. telephone and visioconferencing) and digital mental health resources were largely promoted in the context of the COVID-19 pandemic. During the study period the co-parent was authorized to stay during prenatal care (follow-up medical consultations, echography) and also during the childbirth, provided that a negative serological COVID status was presented. After the childbirth, the co-parent was authorized in maternity but no other visit was possible; the couples were asked to avoid as far as possible to stay outside the bedroom.

### 2.2. Measurement tools

The severity of depressive symptoms was assessed using the self-report 4-point Likert Edinburgh postnatal depression scale (EPDS) [20]. The EPDS total score ranges from 0 to 30. The psychometric properties of the French version were regarded as very good with a specificity of 95.7% and a sensitivity of 81.1% using a threshold of 12 to define clinically-significant depressive symptoms [5,21]. For the item 10 of the EPDS about suicidal ideation, an answer different from 0 was considered as clinically significant. Women were asked to rate the EPDS items based on the period following the childbirth.

Maternal anxiety was assessed with using the self-report state-trait anxiety inventory y-form (STAI-Y), only the subscore relative to *anxiety-state* was used here, i.e. STAI-YA. The psychometric properties of the French version were rated as good. Total STAI-YA scores  $\geq 40$  indicated clinically relevant symptoms of anxiety in line with Grant, McMahon [22].

The MIBS self-administered questionnaire was used to measure Mother-Infant bonding in the immediate postpartum period [13] with satisfactory psychometric properties of the French version [23]. Scores range from 0 to 24, higher score means poorer mother-to-infant interactions.

Two questions concerned the estimated risk of being infected by SARS-CoV2 were issued from the French translation of the coronavirus health impact survey questionnaire (CRISIS) developed by the National Institute of Mental Health was to measure worries and change during the COVID epidemic. The first question referred to the risk of being herself infected with four possible answers (“no symptoms”, “possible symptoms without diagnosis”, “suspected diagnosis without positive test”, “confirmed diagnosis with a positive test”). The second question referred to the likelihood of close relative (without further precision) being infected by the SARS-CoV2. The answer choices were similar as the first question. While, the completion of the full-version of the CRISIS survey was initially planned in the protocol, information was only available for very few participants ( $n=5$ ). Clinicians involved in the inclusion of participants estimated that the survey was excessively time-consuming and it was therefore decided to extract only two core questions about the risk of being infected by the SARS-CoV2.

An electronic CRF was used to document socio-demographic and medical information based on the medical and paramedical charts. The following information was collected: (a) general information: marital status and maternal level of academic achievement; (b) obstetrical history: number of previous pregnancies, number of previous deliveries, hospitalization during this pregnancy and medical complication during this pregnancy (i.e. premature delivery threat, gestational diabetes, intrauterine growth restriction, preeclampsia, gestational hypertension, premature rupture of the membranes, metrorrhagia, sepsis, renal colic, cholestase and other types); (c) peri- and postnatal care: preterm delivery, delivery by Caesarean, breastfeeding, medical complication during the postpartum (i.e. metrorrhagia, sepsis, thrombosis, breastfeeding-related problems, scar-related problems, subcutaneous hematoma and other types), length of stay in maternity prior and after childbirth (in days); (d) past/current psychiatric history: past outpatient psychiatric care, past inpatient psychiatric care, current outpatient psychiatric care, current psychotropic medication and (e) stay in the maternity ward: attendance of a close relative during the maternity care (Y/N), overall satisfaction of early discharge (Y/N), feeling of fatigue (Y/N) and feeling that breastfeeding was easier (only in those who previously breastfed a baby) (Y/N).

### 2.3. Statistical analysis

For descriptive statistics, the mean ( $M$ ) and the standard error of mean ( $\pm$ ) were presented for continuous variables, as well as the median ( $Mdn$ ), minimal ( $min$ ) and maximal ( $max$ ) scores for non-normally distributed variables. The proportions were presented for categorical variables. Estimation of the risk factors for depressive symptoms were carried out using a series of Poisson regression models, with the EPDS total score as the dependent variable. Statistically significant predictors in univariate analyses were then included in a multivariate regression model using the EPDS total score as the outcome. This two-step approach was then applied with the STAI-YA total score as the outcome. Non-parametric spearman tests were used to measure the correlation between the MIBS and the EPDS total score on one hand, and the STAI-YA total score on the other hand. Statistical analyzes were performed using STATA16 software [24].

**Table 1**  
Socio-demographic and medical features of the sample.

	Total Sample (n = 127)
Marital status	
Married	30 (24%)
Civil union	25 (20%)
Cohabitation	60 (47%)
Single	9 (7%)
No information	3 (2%)
Maternal level of academic achievement	
Grade school	18 (14%)
High school	17 (13%)
Secondary school diploma or GED	34 (27%)
Some college or 3-year degree	22 (17%)
5-year college graduate	18 (14%)
Graduate or professional degree	14 (11%)
No information	4 (3%)
Number of previous pregnancies	2.32 ± 0.15
Number of previous deliveries	1.74 ± 0.9
Hospitalization during this pregnancy	20 (16%)
Medical complication during this pregnancy	
Any	41 (32%)
Premature delivery threat	17 (13%)
Gestational diabetes	11 (9%)
Intrauterine growth restriction	5 (4%)
Preeclampsia	4 (3%)
Gestational hypertension	4 (3%)
Premature rupture of the membranes	3 (2%)
Metrorrhagia	2 (2%)
Renal sepsis	1 (1%)
Renal colic	0
Cholestase	1 (1%)
Others	10 (8%)
Preterm delivery	16 (13%)
Type of delivery	33 (26%)
Caesarean	17 (14%)
Vaginal instrumental	77 (63%)
Vaginal non-instrumental	
Breastfeeding	64 (50%)
Medical complication during the postpartum	
Any	17 (13%)
Metrorrhagia	5 (4%)
Endometritis	0
Thrombosis	1 (1%)
Breastfeeding-related problems	0
Scar-related problems	0
Subcutaneous hematoma	0
Other	11 (9%)
Length of stay in maternity (days)	3.69 ± 0.11

### 3. Results

#### 3.1. Description of the sample

Tables 1 and 2 described the main sociodemographic and clinical features of the participants. The mean EPDS score was  $7.05 \pm 0.52$ ,  $Med = 6$ ,  $min = 0$ ,  $max = 24$ . The rate of subjects with clinically significant depressive symptoms was 17%. The mean STAI-YA total score was  $30.78 \pm 1.05$ ,  $Med = 28$ ,  $min = 20$ ,  $max = 70$ . The rate of subjects with clinically significant anxiety symptoms was 15%.

#### 3.2. Predictors of depressive symptoms

The variables associated with the EPDS total score in univariate analyses are presented in Table 3. In multivariate analysis, being a single mother, risk of being infected by the SARS-CoV2, risk that a close relative be infected by the SARS-CoV2 and the length of stay in maternity were associated with increased EPDS total score, while breastfeeding was associated with lower EPDS total score.

**Table 2**  
Psychopathology and psychiatric history of the sample.

	Total Sample (n = 127)
Severity of maternal emotional symptoms	
Mean EPDS total score	$7.05 \pm 0.52$
Clinically-relevant depressive symptoms	18 (17%)
Suicidal ideation (positive answer to EPDS item 10)	4 (3%)
Mean STAIYA total score	$30.78 \pm 1.05$
Clinically-relevant anxiety symptoms	19 (15%)
Level of maternal bonding	
Mean MIBS total score	$0.9 \pm 0.14$
Psychiatric history	
Past outpatient psychiatric care	20 (18%)
Past inpatient psychiatric care	4 (4%)
Current outpatient psychiatric care	5 (5%)
Current psychotropes prescription	3 (2%)
Stay in the maternity ward	
Attendance of a close relative	90 (86%)
Overall satisfaction of early discharge	83 (84%)
Feeling of fatigue	19 (38%)
Feeling that breastfeeding was easier	18 (14%)

#### 3.3. Predictors of anxiety symptoms

The variables associated with the STAI-YA total score in the univariate analyses are presented in Table 4. Six variables remained positively associated with the STAI-YA total score in the multivariate model: the maternal level of academic achievement, a hospitalization during the pregnancy, peripartum medical complications, risk of being infected by the SARS-CoV2, risk of a close relative be infected by the SARS-CoV2, and physical fatigue.

#### 3.4. Relation with maternal bonding

The EPDS total score and the STAI-YA total score were moderately correlated ( $r_s = 0.59$ ,  $P < .001$ ). As presented Figs. 1 and 2, low but statistically significant correlations were found between the MIBS total score and the EPDS total score ( $r_s = 0.26$ ,  $P = .015$ ) and with the STAI-YA total score ( $r_s = 0.25$ ,  $P = .014$ ).

## 4. Discussion

#### 4.1. Rates of anxiety and depressive symptoms

The rates of immediate perinatal clinically-significant emotional symptoms were 17% for depression and 15% for anxiety, in line with the rates observed in three French studies prior the COVID-19 pandemic [17,18]. Teissèdre and Chabrol [17] reported a rate of clinically significant depressive symptoms at 19% in 859 women using the EPDS at the third day following childbirth. Cherif and Feki [18] found a rate of depression at 15% in 126 women using a similar method of assessment. Gaillard and Le Strat [19] study conducted in Paris area also found a 15% rate of postpartum depression.

This apparently contradicts systematic reviews showing a worldwide increase in the risk of perinatal depression during the COVID-19 pandemic [1–6], although much variation exists between countries. Our results confirm another study using comparable measure of maternal symptoms that did not find either an increase rate of postnatal depression during the first lockdown [25]. Chmielewska and Barratt [7] showed that the mean increase in the EPDS total score in studies comparing data before and after the pandemic was only significant for low- and middle-income countries, but not for high-income countries. The mechanisms underlying this heterogeneity are likely to be multi-factorial involving lower access to common health care [26]. A rapid restructuration of mental health care routine in countries with efficient health care system, e.g. promoting care continuity and alternative solutions to

**Table 3**  
Regression models predicting the severity of maternal depressive symptoms.

Effect	Univariate analysis			Multivariate analysis †		
	β	SE	P-value	β	SE	P-value
(Intercept)						
Marital status <sup>a</sup>	0.11	0.04	.006	0.23	0.05	.011
Postpartum medical complications	0.34	0.08	.034	0.17	0.19	.365
Prior hospitalization in psychiatric unit	0.47	0.16	.003	0.39	0.41	.334
Prior outpatient psychiatric care	0.31	0.09	<.001	0.21	0.23	.376
Current outpatient psychiatric care	0.42	0.14	.003	−0.24	0.46	.602
Risk of being infected by SARS-CoV2 <sup>a</sup>	0.11	0.05	.018	0.26	0.12	.023
Risk of close relative infected by SARS-CoV2 <sup>a</sup>	0.44	0.08	<.001	0.33	0.15	.035
Number of previous pregnancies	−0.06	0.03	.015	0.05	0.08	.480
Number of previous deliveries	−0.16	0.05	<.001	−0.17	0.11	.116
Breastfeeding <sup>a</sup>	−0.34	0.11	.003	−0.46	0.14	.001
Length of stay in maternity <sup>a</sup>	−0.08	0.03	.014	0.09	0.04	.035

† Adjusted R<sup>2</sup>=.13, Chi<sup>2</sup> (11) =41.78, P<.001.

<sup>a</sup> Variables statistically significant in multivariate analysis with P-value < .05

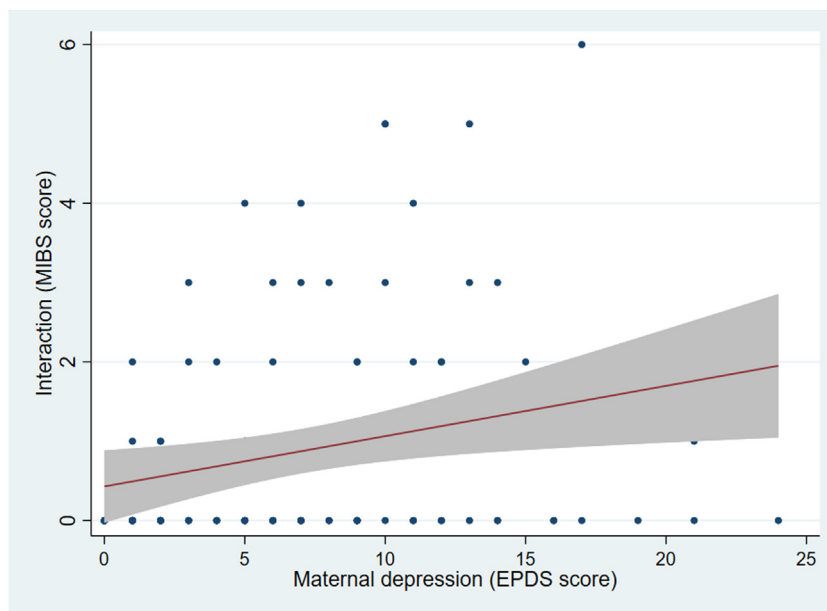
**Table 4**  
Regression models predicting the severity of maternal anxiety symptoms.

Effect	Univariate analysis			Multivariate analysis †		
	β	SE	P-value	β	SE	P-value
(Intercept)						
Maternal level of academic achievement <sup>b</sup>	0.04	0.01	.001	0.09	0.02	<.001
Number of previous deliveries	−0.06	0.02	.002	−0.01	0.04	.955
Hospitalization during the pregnancy <sup>a</sup>	−0.13	0.05	.007	0.23	0.11	.037
Medical complication during the pregnancy	−0.08	0.04	.027	−0.07	0.08	.362
Medical complication during postpartum <sup>a</sup>	0.16	0.05	<.001	0.19	0.09	.035
Risk of being infected by SARS-CoV2 <sup>a</sup>	0.10	0.02	<.001	0.09	0.04	.035
Risk of close relative infected by SARS-CoV2 <sup>b</sup>	0.18	0.04	<.001	0.36	0.07	<.001
Physical fatigue <sup>a</sup>	0.11	0.06	.046	0.19	0.07	.005

† Adjusted R<sup>2</sup>=.17, Chi<sup>2</sup> (8) =61.14, P<.001.

<sup>a</sup> Variables statistically significant in multivariate analysis with P-value < .05

<sup>b</sup> Variables statistically significant in multivariate analysis with P-value < .001



**Fig. 1.** Correlations between the mother-to-infant interaction and maternal depressive symptoms.

face-to-face contacts, was regarded as a key moderator factor for perinatal psychological risk during the COVID-19 pandemic [12].

**4.2. Risk factors for anxiety and depressive symptoms**

The risk factors associated with increased maternal depressive symptoms in our final predictive models were consistent with

literature. Single mother status is a well-recognized risk factor for perinatal mental health difficulties [13], with replicated findings in the context of the COVID-19 pandemic [27]. Breastfeeding was found to be associated with lower level of maternal depressive symptoms. The cross-sectional nature of our data precludes us to derive any firm conclusion about the nature of this association (for a review of different hypotheses see Pope and Mazmanian [28]). The



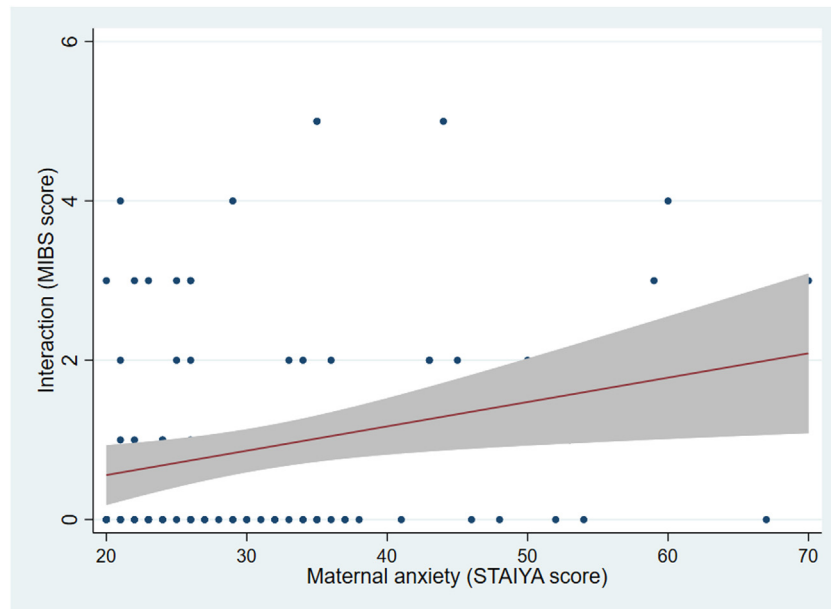


Fig. 2. Correlations between the mother-to-infant interaction and maternal anxiety symptoms.

exclusion of patients giving birth of a child requiring an admission to neonatal intensive care unit may explain that some well-known risk factors of perinatal depression, such as severe postpartum maternal or infant's medical problems [8,9], were not anymore associated with maternal depression in multivariate analysis.

Risk of being infected by SARS-CoV2, herself or a close relative, were both independently associated with increased perinatal depressive and anxiety symptoms. The contribution of these factors may be particularly significant among the participants as much uncertainty remained at the stage of the pandemic about possible mother-to-child transmission of the virus. An international online survey emphasized the importance of these worries among pregnant women, 59% of them feared that the baby contracts the virus, 55% feared to be alone during the delivery and 59% feared a lack of family visits after delivery [29].

Considering the protective role of social support in diminishing the risk of perinatal mental health problems [30], it is understandable that many women's pandemic-related fears concern the consequences of social distancing measures in maternity care [9]. Surprisingly, in our study a lack of family visit during the maternity care was not associated with increased maternal depressive or anxiety symptoms. We made the assumption that fewer visits in maternity ward would be associated with increased maternal feeling of isolation [30] and thus higher level of emotional symptoms. The choice of measuring emotional symptoms very early during the postpartum period should be considered when interpreting this finding. Birth-related pain and fatigue during the immediate postpartum could make the participants less available for social interactions. Said differently, the protective effect of social support and connectiveness on maternal psychopathology could be less relevant at this time. Indeed, some mothers have also reported that premature visits from family and friends in the maternity can be perceived as an additional burden if woman does not feel physically or emotionally available yet [31]. The strong association found between physical fatigue and the severity of anxiety symptom reported here supports this hypothesis. It is also possible that the psychological impact of social distancing in maternity ward was mitigated in this sample of women from high-income country by the use of digital technologies that help maintaining social links

[8]. Longer duration of stay was associated with increased depressive symptoms in multivariate analysis. This is not clear whether this relation was underpinned by confounding bias, in particular medical complications.

Current or previous psychiatric care were found to be associated with the severity of maternal depressive symptoms in univariate analysis, in line with recent reports [5,32,33]. However, a lack of statistical significance in multivariate analysis supports the assumption that COVID-19 related worries play a role in the emergence of depressive symptoms both in women with psychiatric history and in those without. In line with this, Ravaldi and Ricca [32] found that history of anxiety and depressive disorder were independently associated with higher COVID-19 related concerns among 737 Italian pregnant women who fulfilled an online survey at the beginning of the pandemic.

The implications of other risk factors for anxiety disorders were mostly consistent with the literature. Fewer years of education were found to be associated with increased maternal anxiety during the COVID-19 pandemic [1,9], as well as medical complications prior and after childbirth [8].

#### 4.3. Consequence on maternal bonding

Compared to the period that occurs prior the COVID-19 pandemic, pregnant mothers during the pandemic have faced additional sources of worries that may result in increased feeling of doubts and uncertainty at each step of the perinatal period [15,16]. Ravaldi and Ricca [32] showed that the emotional lexicon associated with childbirth in pregnant women included more negatively valenced words in the context of the COVID-19 pandemic compared to prior the pandemic, suggesting change in maternal representations and worries about the delivery. Mediation models using longitudinal data would help us to better understand the interplay between maternal worries (e.g. about the virus transmission and possible effects on fetal development), reactional emotional distress and maternal attachment. If replicated, these findings call for a better consideration of indirect long-term consequences of the COVID-19 pandemic on infant socio-emotional development.

#### 4.4. Strength and limitations

Firstly, this single-center study was conducted in a university hospital explaining that our sample may be particularly enriched in subjects with medical complications. Due to this selection bias, caution is required when considering the generability of our findings, especially the contribution of physical fatigue as a strong predictor of perinatal depressive symptoms reported here. In theory, this bias would lead us to overestimate the true rate of clinically-significant depressive symptoms and then did not contradict our main conclusion.

Secondly, all measures were cross-sectional and based on self-rated information. While this measurement method was in line with other studies for depressive symptoms [17,18], questions could be raised about its validity in the context of immediate post-partum. The normal dysphoric mood and emotional lability observed during this period (maternal “baby blues”) could be associated with increased overall levels of anxiety and depression, reducing the predictive validity of the measuring tools for pathological cases (i.e. characterized mood/anxiety disorders) [34]. In addition, possible overlap could exist between anxiety/depressive symptoms and medical complications occurring during the immediate postpartum (e.g. item 7 of the EPDS for sleep abnormalities). Repeated measure of maternal psychopathology would have helped to differentiate participants with temporary vs. persisting trajectories of anxiety/depressive symptoms. Of note, maternal bonding and maternal psychopathology are regarded as both particularly influenced by social desirability bias in observational survey [35]; these two constructs would be therefore worth measuring at different time. The use of proper scale for the measure of maternal worries and fear (e.g. Coronavirus Perinatal Experiences - Impact Survey [6] or the Fear of COVID-19 Scale [5]), instead of two isolated questions, would have resulted in more confident in the internal validity of this measure.

Thirdly, the cross-sectional nature of the study precludes use to distinguish the role of the COVID-19 pandemic from the effect of the lock-down related measures on the prevalence of maternal emotional symptoms. Finally, the small size of the sample could have resulted in underpowered comparison tests for some statistical variables.

#### 5. Conclusion

The rates of clinically-significant depressive and anxiety symptoms in the immediate postpartum among women referred to a university hospital center was roughly comparable to the range observed in previous observational studies prior the context of the COVID-19 pandemic. This report stresses the possible contribution of maternal worries about SARS-CoV2 infection in maternal anxiety and depressive symptoms, as long as other well-recognized risk factors. In a modern hospital where digital technologies and telehealth interventions were available the effect of social distancing measures in the maternity care was not clear. The relationships reported between the severity of maternal emotional symptoms and maternal bonding in the days following childbirth are worth considering to discuss the possible long-term impact of the pandemic on children socioemotional development.

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#### Disclosure of interest

The authors declare that they have no competing interest.

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