



Impact of the COVID-19 pandemic on women's perinatal mental health and its association with personality traits: An observational study

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Abstract

Introduction: The burden of perinatal mental health problems was expected to increase during the COVID-19 pandemic. We prospectively investigated the impact of the COVID-19 pandemic on the mental health of pregnant and postpartum women in Norway and explored associations with their sociodemographic characteristics and personality traits.

Material and methods: Sociodemographic information and the self-reported impact of pandemic on wellbeing of pregnant women was collected using an online survey. To assess women's mental health, two validated questionnaires, the Edinburgh Postpartum Depression Scale (EPDS) and the Generalized Anxiety Disorder-7 item Scale (GAD-7), were used prenatally and postnatally. Personality traits were evaluated using HumanGuide, a web-based ipsative psychological evaluation instrument.

Results: 772 women were included prenatally, of which 526 also responded to the survey 4–6 weeks postnatally. The median age was 29 years, 53.6% of the women were nulliparous when enrolled, and 35.1% worked in the healthcare sector. The median EPDS (6.0; interquartile range [IQR] 3.0–10.0 vs 6.0; IQR: 3.0–10.0) and the median GAD-7 (5.0; IQR 2.0–9.0 vs 5.0; IQR 2.0–9.0) were similar pre- and postnatally. Prenatally, the proportion of women scoring ≥ 13 on EPDS and ≥ 10 on GAD-7 was 14.5% (112/772) and 21.5% (166/772), whereas the postnatal figures were 15.6% (82/526) and 21.5% (113/526), respectively. The differences were not significant ($P = 0.59$ and $P = 0.99$). Being < 25 years of age, being on pre-pregnancy psychotherapy or psychotropic medication, frequent voluntary isolation, perception of maternity care not proceeding normally, avoiding seeking medical assistance due to fear of infection and having negative economic consequences during the COVID-19 pandemic significantly increased the risk of both anxiety (GAD-7 ≥ 10) and depression

Abbreviations: CI, confidence interval; COVID-19, Coronavirus Disease 2019; EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7; HG personality test, HumanGuide personality test; IQR, interquartile range; OR, odds ratio.

Karine S. Birkelund and Solrun S. Rasmussen contributed equally.

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(EPDS ≥ 13). Nullipara had a higher risk of anxiety, whereas being a healthcare worker had a lower risk. The personality trait factors *Power* ($P = 0.008$), *Quality* ($P = 0.008$), *Stability* ($P < 0.001$) and *Contacts* ($P < 0.001$) were significant predictors of depression among pregnant women, whereas the *Quality* ($P = 0.005$) and *Contacts* ($P = 0.003$) were significant predictors of anxiety.

Conclusions: During the initial phase of the COVID-19 pandemic, the prevalence of depression (EPDS ≥ 13) and anxiety (GAD-7 ≥ 10) was 14.5% and 21.5%, respectively, among Norwegian pregnant women. Certain sociodemographic characteristics and personality traits were significant predictors of depression and anxiety.

KEYWORDS

anxiety, COVID-19, depression, mental health, perinatal mental health, postnatal depression, pregnancy

1 | INTRODUCTION

Perinatal depression is one of the most common disorders, affecting approximately 10%–15% of pregnant and postpartum women worldwide.¹ The prevalence of anxiety in pregnancy is around 15%, which is similar to the rest of the population, but symptoms may worsen during pregnancy.² Maternal anxiety and depression are associated with adverse pregnancy outcomes and can potentially increase the risk of ill-health and disease for the child later in life.³ The mental health issues can clinically manifest for the first time or preexisting psychological disorders may worsen during pregnancy and postpartum period. A major risk factor for perinatal anxiety and depression is the history of previous episodes of mental disorder.⁴ Other physical comorbidities, such as obesity, also increase the risk.⁵

One of the earliest studies on perinatal mental health during the outbreak of COVID-19 in China reported an increased rate of depressive symptoms among pregnant women.⁶ The investigators found that the severity of symptoms was associated with the number of daily reported cases of infection and death rate in China. Haruna et al. from Japan reported that the worries about women's own health and that of their fetuses or newborns were closely related to depressive symptoms during the pandemic.⁷

Early during the pandemic, we hypothesized that the burden of the COVID-19 pandemic due to the fear of infection, changes in routines of antenatal, intrapartum and postnatal care as well as the public health measures implemented to mitigate the spread of disease might lead to an increase in the prevalence and severity of maternal perinatal anxiety and depression.⁸ This could be further affected by women's sociodemographic factors and personality traits.

Thus, the aim of this study was to prospectively investigate the impact of the COVID-19 pandemic on the mental health of pregnant women in Norway and explore associations with their sociodemographic characteristics and personality traits. The secondary objectives were to investigate the change in anxiety and depression levels from the antenatal to postnatal period and explore whether

Key message

The COVID-19 pandemic had a negative impact on perinatal mental health in Norway, especially among younger pregnant women (<25 years) influenced by media, whereas working in healthcare was protective against anxiety. Women with certain personality traits were more vulnerable to anxiety/depression.

a significant life-event, such as childbirth during a pandemic, could change a woman's personality.

2 | MATERIAL AND METHODS

This prospective observational study was conducted during the early phase of the COVID-19 pandemic (June 7 to September 1, 2020). Pregnant women aged 18–50 years residing in Norway who consented to participate in the study were included. The exclusion criteria were: women who were not able to speak, read or understand Norwegian and those who had given birth during the pandemic but were not pregnant at the time of enrollment to the study.

Recruitment of study participants was done using an internet-based convenience sampling method. Data were collected through a self-reported questionnaire survey. The survey questionnaires were distributed through *Nettskjema*, a secure website maintained by the University of Oslo, Norway. A web-link to the survey was created and posted on the Facebook accounts of the researchers and forwarded to and shared through friends by snowballing. The link was also posted on their webpages and shared by several Facebook groups for pregnant women such as *Gravid i Coronatider*, by two Snapchat groups and in two forums. Several ultrasound clinics and midwives were contacted and asked to help with the recruitment. A number of them posted the survey link on their webpage or

Facebook and distributed the information brochure to women who attended in their clinics. The collected data were saved and stored directly in a secure server, Services for Sensitive Data (TSD), managed by the University of Oslo, and were accessible to the principal investigators via two-step authentication.

A general questionnaire was devised to collect data about women's socioeconomic and demographic details, information about their health and current pregnancy, their impressions about the COVID-19 pandemic, what measures have they been taking to avoid infection, and how have they used the media. Two other validated instruments, GAD-7 (Generalized Anxiety Disorder 7 item scale) and EPDS (Edinburgh Postnatal Depression Scale), were used to obtain information about anxiety and depression.

GAD-7 is a brief self-report questionnaire developed in 2006 by Spitzer et al. to facilitate clinicians in diagnosing generalized anxiety disorder.⁹ The respondents answered using a 4-point Likert scale: not at all, several days, more than half the days, and nearly every day, giving scores of 0–3. Depending on points received, the respondents can be categorized into groups; no anxiety (0–4 points), minimal (5–9 points), moderate (10–14 points) and severe anxiety (15–21 points). A cutoff of 10 or above was recommended by Spitzer et al. as a reasonable indication of generalized anxiety disorder.⁹ The questionnaire has been validated and shown to correlate strongly with disability, healthcare attention and anxiety symptoms.¹⁰ It has also been validated for use during pregnancy.¹¹

EPDS is a widely used screening tool for detecting postpartum and perinatal depression. Developed by Cox et al.,¹² it consists of 10 questions about symptoms of depression in the past 7 days. Each answer is scored on a scale of 0–3, giving a composite score between 0 and 30. According to the developers, a total score of 12 points or more is an indication for further assessment by healthcare professionals. However, a recent comprehensive individual participant data systematic review and meta-analysis showed that a cutoff of 11 or above maximizes the combined sensitivity and specificity, but a cutoff of 13 or above has the best specificity and could be used to identify women with higher level of depressive symptoms pre- and postnatally.¹³ The EPDS has been translated and validated for use in many countries. In Norway, it has been validated against the diagnostic criteria used by the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) for major depression and has been shown to correlate with other screening tools such as the Montgomery and Åsberg Depression Rating Scale (MADRS) and Hopkins Symptom Checklist (HSCL).¹⁴

Additionally, the women participating in this survey were given the opportunity to take a personality test separately. If they were interested and consented to the test, they were requested to provide an email address to which they received a link to the personality test website with instructions and password. A Norwegian version of the HumanGuide (HG) personality test (<https://humanguide.org/en/>), a web-based ipsative psychological evaluation instrument, evaluates a person's instinctive drives. The test is based on the psychodynamic theoretical perspective of Szondi.¹⁵ It assesses the need for eight factors in an individual, of which *Power*, *Exposure*, *Imagination* and *Contacts* are considered the driving factors and *Sensibility*, *Quality*,

Structure and *Stability* the reflecting factors. Detailed characteristics of each of these factors are provided in Figure 1.

The test is in a forced choice format and the individuals being tested must choose among the eight different socially desirable items presented in the questionnaire. In total, there are nine sets of questions related to communication, stress, attitude towards life, working style, view of resources, attitude towards others, management style, decision making and core behavior, each set consisting of eight items. The person must select the four characteristics that are most typical for her and the two characteristics that are not typical. The result can be positive, neutral or negative for each factor. Based on these answers, the dimension of each factor is determined. One can get a result with maximum nine answers as typical and nine answers not typical. If the values of typical characteristics minus the values of not typical characteristics gives a score of ≥ 4 , then this factor is seen as a primary strength and a score of 0 to 3 represents a secondary strength; if the score is < 0 , the factor is considered to be unneeded by the person.

Pregnant women who participated in the study by filling in the questionnaires received a follow-up questionnaire, EPDS, GAD-7 and the personality test 4–6 weeks after their expected date of delivery.

2.1 | Statistical analyses




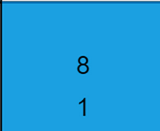
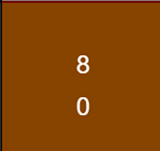

Assuming a population prevalence of perinatal anxiety/depression of 10%–20% (median 15%), we calculated that we would require at least 196 participants to detect a 50% increase in the prevalence of anxiety/depression with 80% power and an alpha of 0.05 using an online sample size calculator (<https://clincalc.com/Stats/SampleSize.aspx>). We could not predict how long the pandemic would last, but we estimated that approximately 3 months of data collection would be sufficient to reach the desired minimum sample size.

Data analysis was performed using IBM SPSS Statistics version 28 and MATLAB (R2021b, MathWorks). The normality of data distribution was checked using the Shapiro–Wilk test. None of the variables in the dataset was normally distributed and nonparametric methods were used as appropriate. For descriptive statistics, continuous variables are presented as median (range) and categorical variables as number (percent). The Chi-square test was used to investigate differences between the proportions of women who scored over and under a defined cutoff value, ie $GAD-7 \geq 10$ or < 10 and $EPDS \geq 13$ or < 13 .

Odds ratio (OR) with 95% confidence intervals (CI) were calculated to compare the relative odds of occurrence of the outcomes of interest between groups. OR was calculated for 16 items of a 30-item questionnaire that had different measurement scales, to assess the risk of having $EPDS \geq 13$ or $GAD-7 \geq 10$.

Multivariate regression was used to investigate the association between the dependent variables (EPDS and GAD-7 scores) and the independent predictor variables (survey questionnaires and HG personality test). To satisfy the assumption of normality, the dependent variables EPDS and GAD-7 were standardized using z-scores. Principal component analysis (PCA) was run on the remaining 19 items that had the same Likert scale of 1–5 to evaluate their

FIGURE 1 List of eight factors evaluated by the HumanGuide personality test (first column). The second column represents an example of the scores of different factors demonstrating primary strength (fully colored squares), secondary strength (half-colored squares) and a factor that is not needed by the individual (white squares). The typical characteristics (attributes) of each factor are described in the corresponding row of the third column. Figure modified from HumanGuide (HG) personality test (<https://humanguide.org/en/>), with permission from the publisher, Rolf Kenmo (H.E. Humankonsult AB).

Sensibility		Perceptive, considerate, careful, accommodating, complaisant, sensual, diplomatic, obliging, likes closeness
Power		Energetic, speedy, driving, eager, competitive, strong, active, resultorientated, straightforward, fearless
Quality		Reliable, quality-conscious, conscientious, supportive, persevering, comprehensive, thorough, unselfish, caring, dutiful
Exposure	2 5	Spontaneous, charming, witty, proud, likes attention, trendy, charismatic, colourful, dramatic, ready-witted
Structure		Orderly, methodical, likes planning, neutral, distinct, correct, realistic, objective, disciplined, forethoughtful
Imagination	4 1	Imaginative, inventive, improvises easily, clever, likes to experiment, ingenious, development-orientated, freedom-orientated, visionary, artistic
Stability		Stable, economical, wary, creature of habit, thrifty, down-to-earth, traditionbound, conservative, cautious
Contacts		Outgoing, sociable, open-hearted, easygoing, playful, humorous, food-loving, contact-orientated, optimistic, cheerful

association with EPDS and GAD-7 scores. The Kaiser–Meyer–Olkin (KMO) test was used to assess suitability of the data for factor analysis. The sampling adequacy value was 0.676, indicating that the sampling was adequate and the data were suitable for factor analysis. Further, the *P*-value associated with the Chi-square value in Bartlett's test of sphericity was <0.001, indicating that the data were suitable for PCA. With these results, PCA was conducted to reduce the number of variables in the survey questions to fewer interpretable variables guided by eigenvalue (ie the total amount of variance that can be explained by a given principal component) and the inflection point on the scree plot. Rotated components matrix (Varimax orthogonal rotation with Kaiser normalization) was used to identify factors to which several items were loaded. The PCA suggested that

the 19 survey questions could be reduced to following five components: (i) worried about being infected, sick or infecting the baby, (ii) confidence and trust in healthcare system, (iii) influence of media, (iv) confidence in recovering if sick and (v) adaptive change in behavior related to personal hygiene. Composite indices were calculated by grouping the questions to calculate the five variables generated from PCA. Cronbach's alpha was tested for the survey questions and had acceptable internal consistency (0.50–0.84).

The stepwise logistic regression was performed to check the association of survey questionnaires and the HG personality test with cutoff values of EPDS and GAD-7 scores separately. Only the components of independent variables identified as relevant after factor reduction were used in the regression models.

The pairwise Wilcoxon rank test was used to compare differences between continuous scores of prenatal and postnatal EPDS, GAD-7 and HG personality tests performed on the same women. The pairwise Spearman rank correlation coefficient was used to assess the strength of correlation between prenatal and postnatal scores. $P < 0.05$ was considered statistically significant.

2.2 | Ethics statement

Ethical approval was obtained from the Regional Committee for Medical and Health Research Ethics (REK) (reference number: 135968) on May 19, 2020. The data protection and privacy protocol was reviewed by the Norwegian Center for Research Data (NSD) and found to be satisfactory (reference number: 280934) on May 25, 2020. All women were provided with written information about the study and asked to provide a consent electronically if they agreed to participate in the study. As a part of patient–public involvement in research, we consulted Landsforeningen 1001 dager (<https://www.landsforeningen1001dager.no>), a national interest group organization that works to prevent mental health problems during pregnancy and after giving birth, for their input during the project development.

3 | RESULTS

In total, 795 women answered the survey questionnaire. A chart diagram demonstrating the flow of study participants is presented

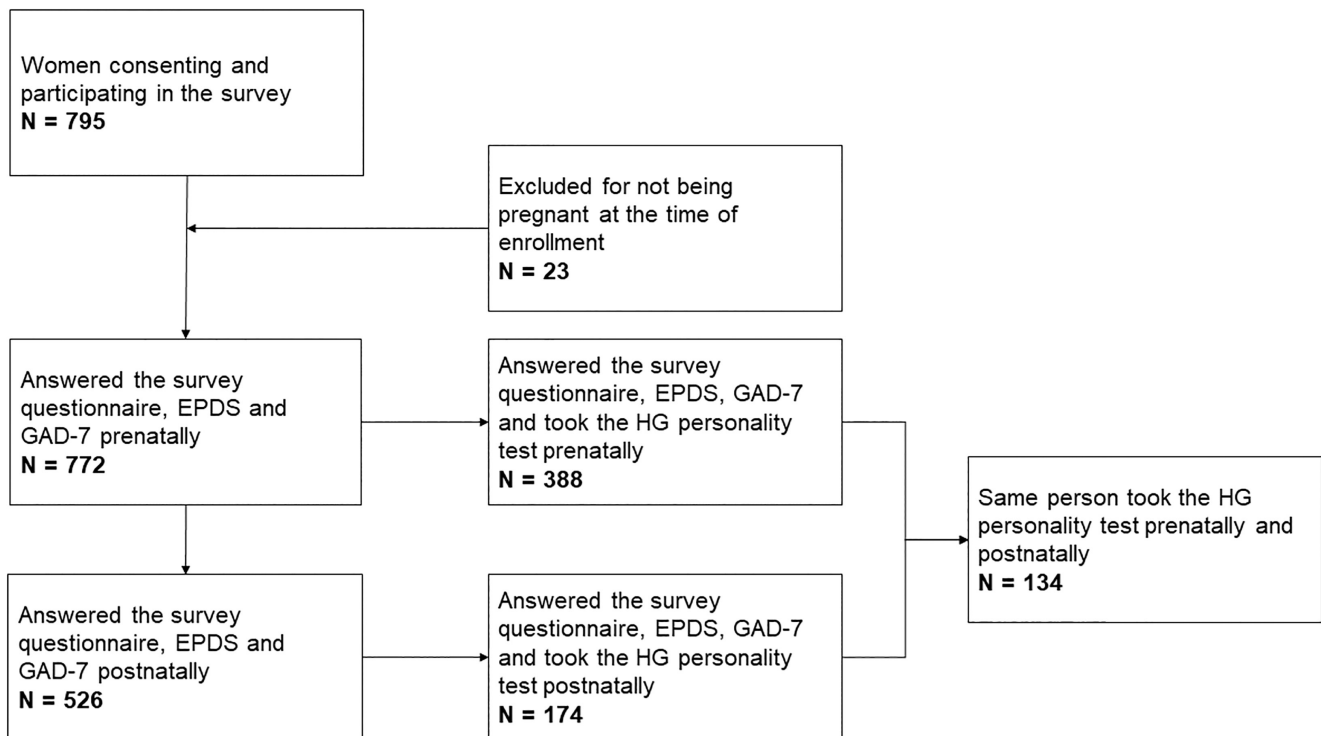


FIGURE 2 Chart diagram demonstrating the flow of study participants. EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7.

in **Figure 2**. Twenty-three women were excluded, as their date of the last menstrual period or the expected date of delivery indicated that they were not pregnant or had already given birth at the time of answering the questionnaire. The final sample consisted of 772 pregnant women. The median age was 29 years (range 19–44) and 53.6% ($n = 414$) were nulliparous. The median gestational age was 26 weeks, and most women were in the second ($n = 401$; 51.9%) and third ($n = 337$; 43.7%) trimester when enrolled in the study. Among the participants, 2.2% ($n = 18$) had only completed compulsory education (up to 10th grade) and 97.7% ($n = 754$) had a higher education. More than a third of the participants ($n = 271$; 35.1%) worked in the healthcare sector.

Participants from most counties in Norway responded to the survey. All four geographic healthcare trust regions (South-East Norway, West Norway, Mid-Norway, North Norway) were represented. A total of 185 (24.0%) women reported receiving psychotropic medicine or psychotherapy before pregnancy and 63 (8.2%) during pregnancy.

3.1 | EPDS and GAD-7 scores during pregnancy and other risk factors of depression and anxiety

In the pregnant study population, the median EPDS score was 6.0 (range 0–28). Thirty-three (4.3%) women reported having thoughts of self-harming during the past 2 weeks (EPDS question no. 10). The median GAD-7 score was 5 (range 0–21). Prenatally, the proportion of women scoring ≥ 13 on EPDS (indicative of depression) and ≥ 10 on

GAD-7 (indicative of anxiety) was 14.4% ($n = 111/772$) and 21.5% ($n = 166/772$).

Background characteristics of the study participants and their self-reported wellbeing, behavior, attitude and access to healthcare services during the initial phase of the COVID19 pandemic are presented in Table 1, grouped according to the cutoff scores of EPDS (<13 vs ≥ 13) and GAD-7 (<10 vs ≥ 10), indicative of low and high risk of depression and anxiety with corresponding ORs.

3.2 | Changes in EPDS and GAD-7 scores from prenatal to postnatal period

Of all the women who participated in the survey and answered the EPDS and GAD-7 questionnaires prenatally, 526 (68.1%) answered the same again postnatally, 4–6 weeks after the childbirth. The observed frequencies and distribution differences of prenatal and postnatal EPDS and GAD-7 scores are presented side by side for comparison in Figure 3A–D.

The median EPDS prenatally and postnatally (respectively, 6.0, IQR 3.0–10.0, 95% CI 5.00–6.00 vs 6.0, IQR 3.0–10.0, 95% CI 5.00–7.00; $P = 0.34$) and the median GAD-7 (5.0, IQR 2.0–9.0, 95% CI 4.28–5.00 vs 5.0, IQR 2.0–9.0, 95% CI 5.00–5.00; $P = 0.87$) were similar. Prenatally, the proportion of women scoring ≥ 13 on EPDS (indicative of depression) and ≥ 10 on GAD-7 (indicative of anxiety) was 14.5% ($n = 112/772$) and 21.5% ($n = 166/772$), respectively; the postnatal figures were 15.6% ($n = 82/526$) and 21.5% ($n = 113/526$). The differences were not significant ($\chi^2[1] = 0.29$, $P = 0.59$ and $\chi^2[1] = 0.00$; $P = 0.99$) and there were no statistically significant differences between prenatal and postnatal proportions of EPDS cutoff scores ≥ 13 (14.6%, $n = 77/526$ vs 15.6%, $n = 82/526$) or GAD-7 cut-off scores ≥ 10 (20.0%, $n = 105/256$ vs 21.5%, $n = 113/256$) among women who took the tests both prenatally and postnatally ($\chi^2[1] = 0.18$, $P = 0.67$ and $\chi^2[1] = 0.37$, $P = 0.54$). However, a moderately strong correlation was observed between paired prenatal and postnatal EPDS ($\rho = 0.40$; $P < 0.0001$) and GAD-7 scores ($\rho = 0.43$; $P < 0.0001$). Furthermore, among the women tested both pre- and postnatally, 37% (35/95) of those with EPDS ≥ 13 and 100% (61/61) of those with GAD-7 ≥ 10 prenatally retained their scores postnatally.

3.3 | Association of women's background characteristics and personality traits with prenatal EPDS and GAD-7 scores

Multivariate regression analyses showed the most significant positive associations of being worried about getting infected, sick or infecting the baby and not having the confidence and trust in healthcare system with the risk of depression ($P = 0.002$ and $P = 0.016$, respectively) and anxiety ($P = 0.016$ and $P = 0.02$, respectively). Being influenced by media also had a significant positive association with anxiety ($P = 0.03$).

The personality trait factors *Quality* ($P = 0.023$) and *Imagination* ($P = 0.004$) were significant predictors of GAD-7 continuous scores prenatally but none of the personality traits was a significant predictor of EPDS. A stepwise logistic regression analysis indicated that the personality trait factors *Power* ($P = 0.008$), *Quality* ($P = 0.008$), *Stability* ($P < 0.001$) and *Contacts* ($P < 0.001$) were significant predictors of depression among women, and a decrease in *Power*, *Stability* and *Contacts* or an increase in *Quality* was significantly associated with depression (EPDS ≥ 13). *Quality* ($P = 0.005$) and *Contacts* ($P = 0.003$) were significant predictors of anxiety, and a decrease in these factors was significantly associated with anxiety (GAD-7 ≥ 13). The models were significant and explained 36.8% of variation for EPDS and 38.5% for GAD-7.

3.4 | Changes in personality trait after childbirth and association with EPDS and GAD-7 scores

When analyzing the differences of continuous scores of individual personality trait factors between prenatal to postnatal periods among 134 women, a significant increase in the need for *Power* ($P = 0.0379$) was observed postnatally. The difference in the personality trait factors assessed pre- and postnatally using a cutoff of a 4-point increase or decrease in score to indicate a change (total possible score -9 to $+9$ points) showed no significant change ($P = 0.12$ to $P = 1.00$) in personality following childbirth.

Postnatally, personality trait factors *Exposure* ($\rho = 0.125$, $P = 0.036$) and *Stability* ($\rho = 0.153$, $P = 0.015$) were significantly correlated with depression (EPDS ≥ 13). However, none of these factors was correlated significantly with anxiety (GAD-7 ≥ 10).

4 | DISCUSSION

The COVID-19 pandemic has affected mental health globally, including that of pregnant and postpartum women. Our study showed that during the initial phase of pandemic, the prevalence of depression and anxiety among Norwegian pregnant women was 14.5% and 21.5%, respectively, and the EPDS and GAD-7 scores did not change significantly from the prenatal to the postnatal period. Although no regional differences were found in this nationwide study, the prevalence was affected by sociodemographic characteristics, with younger women (<25 years) at higher risk. Worrying about getting infected or infecting the baby and not having confidence and trust in the public healthcare system were associated with increased risk of anxiety as well as depression. Being influenced by media increased the risk of anxiety, whereas working within the healthcare system was a protective factor against anxiety.

We also assessed the personality traits of the women participating in this study. Stronger needs for *Quality* and *Imagination* were significantly associated with continuous GAD-7 scores prenatally but the association between personality traits and EPDS was not

TABLE 1 Background characteristics of study participants and their self-reported wellbeing, behavior, attitude and access to healthcare services during the initial phase of the COVID-19 pandemic grouped according to the cut-off scores of EPDS (<13 vs ≥13) and GAD-7 (<10 vs ≥10) indicative of low and high risk of depression and anxiety with corresponding odds ratios (OR).

Background characteristics of the study population	All N = 772		EPDS <13 N = 660		EPDS ≥13 N = 112		GAD-7 <10 N = 606		GAD-7 ≥10 N = 166			
	n (%)	n (%)	n (%)	n (%)	OR	95% CI	P-value	n (%)	n (%)	OR	95% CI	P-value
Age (years)												
<25	95 (12.3)	72 (10.9)	23 (20.5)	2.11	1.26–3.55	0.005	59 (9.7)	36 (21.7)	2.57	1.63–4.05	<0.001	
>=25	677 (87.7)	588 (89.1)	89 (79.5)				547 (90.3)	130 (79.3)				
Trimester												
First and second	432 (56.0)	366 (55.5)	66 (58.9)	1.17	0.77–1.76	0.45	344 (56.8)	88 (53.0)	1.16	0.82–1.64	0.41	
Third	337 (43.7)	292 (44.2)	45 (40.2)				260 (42.9)	77 (46.4)				
Minority ethnic group												
Yes	27 (3.5)	22 (3.3)	5 (4.5)	1.35	0.50–3.63	0.56	16 (2.6)	11 (6.6)	2.62	1.19–5.76	0.017	
No	741 (96.0)	634 (96.1)	107 (95.5)				587 (96.9)	154 (92.8)				
Marital status												
Married or cohabiting with a partner	750 (97.2)	642 (97.3)	108 (96.4)	1.32	0.439–3.98	0.62	592 (97.7)	158 (95.2)	2.14	0.88–5.19	0.09	
Single	22 (2.8)	18 (2.7)	4 (3.6)				14 (2.3)	8 (4.8)				
Parity												
Nullipara	414 (53.6)	354 (53.6)	60 (53.6)	1.00	0.67–1.49	0.99	311 (51.3)	103 (62.0)	1.55	1.09–2.20	0.015	
Paraous	358 (46.4)	306 (46.4)	52 (46.4)				295 (48.7)	63 (38.0)				
Education												
Compulsory (up to 10th grade)	18 (2.3)	13 (2)	5 (4.5)	2.33	0.82–6.66	0.12	11 (1.8)	7 (4.2)	2.38	0.91–6.24	0.078	
Higher education	754 (97.7)	647 (98.0)	107 (95.5)				595 (98.2)	159 (95.8)				
Healthcare worker												
Yes	271 (35.1)	239 (36.2)	32 (28.6)	1.41	0.91–2.20	0.12	228 (37.6)	43 (25.9)	1.72	1.18–2.53	0.005	
No	501 (64.9)	421 (63.8)	80 (71.4)				378 (62.4)	123 (74.1)				
Treatment before pregnancy												
Medicinal/psychotherapy	185 (24.0)	136 (20.6)	49 (43.8)	3.00	1.97–4.55	<0.001	120 (19.8)	65 (39.2)	2.61	1.80–3.77	<0.001	
None	587 (76.0)	524 (79.4)	63 (56.2)				486 (80.2)	101 (60.8)				
Treatment during pregnancy												
Medicinal/psychotherapy	63 (8.2)	35 (5.3)	28 (25.0)	5.95	3.45–10.28	<0.001	34 (5.6)	29 (17.5)	3.56	2.10–6.05	<0.001	

(continues)

TABLE 1 (Continued)

Background characteristics of the study population	All N = 772		EPDS <13 N = 660		EPDS ≥13 N = 112		OR		95% CI		P-value		GAD-7 <10 N = 606		GAD-7 ≥10 N = 166		OR		95% CI		P-value	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	OR	95% CI	P-value	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
None	709 (91.8)	625 (94.7)	84 (75.0)											572 (94.4)	137 (82.5)							
Have you or anyone you know been infected?																						
Yes	230 (29.8)	199 (30.2)	31 (27.7)	1.13	0.72-1.76	0.60				187 (30.9)	43 (25.9)	1.28	0.87-1.88	0.22								
No	542 (70.2)	461 (69.8)	81 (72.3)							419 (69.1)	123 (74.1)											
Imposed quarantine or isolation																						
Yes	138 (17.9)	111 (16.8)	27 (24.1)	1.57	0.97-2.53	0.064				95 (15.7)	43 (25.9)	1.88	1.25-2.84	0.003								
No	634 (82.1)	549 (83.2)	85 (75.9)							511 (84.3)	123 (74.1)											
Voluntary isolation																						
Yes, all the time or quite often	322	253	69	2.58	1.71-3.90	<0.001				225	97	2.38	1.68-3.38	<0.001								
No, never or sometimes	450	407	43							381	69											
Negative economic consequences due to COVID-19																						
Yes, for me or my partner	244 (31.6)	193 (29.2)	51 (45.5)	2.02	1.35-3.04	<0.001				169 (27.9)	75 (45.2)	2.13	1.50-3.04	<0.001								
None	528 (68.4)	467 (70.8)	61 (54.5)							437 (72.1)	91 (54.8)											
Has maternity care proceeded as normal?																						
Yes	466 (60.4)	416 (63.0)	50 (44.6)	2.11	1.41-3.17	<0.001				391 (64.5)	75 (45.2)	2.21	1.56-3.13	<0.001								
No	306 (39.6)	244 (37.0)	62 (55.4)							215 (35.5)	91 (54.8)											
Have you avoided seeking medical assistance (physical or psychological) due to fear of infection?																						
Yes	103 (13.3)	76 (11.5)	27 (24.1)	2.44	1.49-4.00	<0.001				64 (10.6)	39 (23.5)	2.60	1.67-4.05	<0.001								
No	669 (86.7)	584 (88.5)	85 (75.9)							542 (89.4)	127 (76.5)											
Have you sought health care but not received it?																						
Yes	122 (15.8)	82 (12.4)	40 (35.7)	3.92	2.50-6.14	<0.001				79 (13)	43 (25.9)	2.33	1.53-3.55	<0.001								
No	650 (84.2)	578 (87.6)	72 (64.3)							527 (87)	123 (74.1)											

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7.

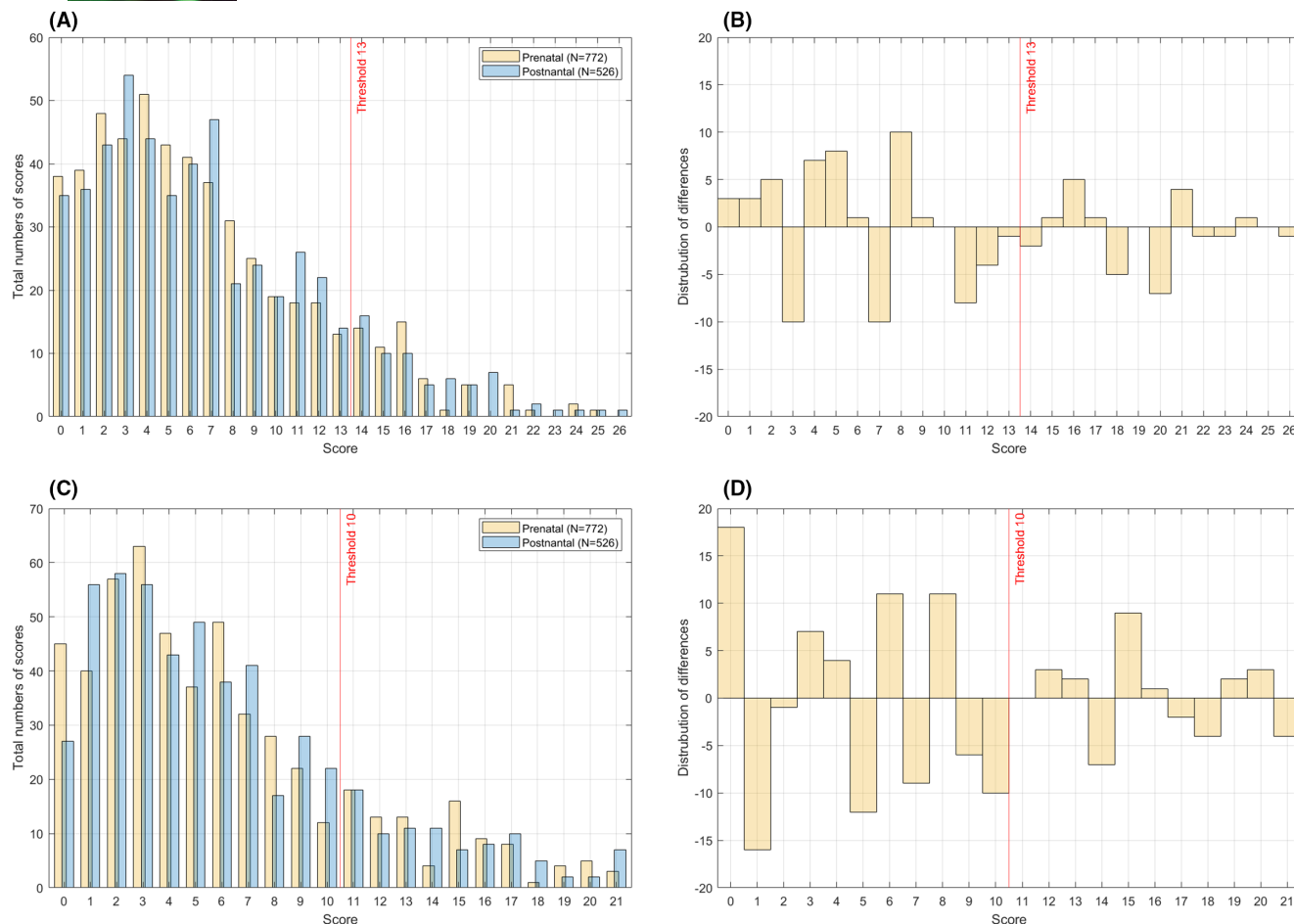


FIGURE 3 Observed frequencies and distribution of differences between prenatal and postnatal EPDS (A,B) and GAD-7 scores (C,D). EPDS, Edinburgh Postnatal Depression Scale; GAD-7, Generalized Anxiety Disorder 7.

significant. Certain personality trait factors, such as *Power*, *Quality*, *Stability* and *Contacts*, could predict depression ($EPDS \geq 13$) and *Quality* and *Contacts* could predict anxiety ($GAD-7 \geq 10$). Childbirth during the pandemic did not change a woman's personality significantly, but their need for *Power* increased. These findings indicate that women with certain personality traits could benefit from psychological support in their pregnancy and postpartum period during the pandemic.

The burden of perinatal mental health problems was expected to increase during the pandemic due to the enforced or voluntary social distancing and isolation, lockdowns, quarantines, modifications made in antenatal, intrapartum and postnatal care routines as well as limited access to services due to risk of infection. Therefore, it is not surprising to observe a higher prevalence of perinatal anxiety (21.5%) and depressive symptoms (14.5%) in our study compared with pre-pandemic reports from Norway and elsewhere.^{2,16,17} A multinational European study conducted during the pandemic between June 16 and July 14, 2020 reported a prevalence of depressive symptoms ($EPDS \geq 13$) of 12.0% among 161 pregnant and 14.6% among 217 breastfeeding Norwegian women, which is in concordance with our findings.¹⁸ However, the observed prevalence was not as high as reported by another study from Norway.¹⁹ This discrepancy could

be explained by the differences in study design, methodology and timing of the survey. The study by Eberhard-Gran et al.¹⁹ was based on an online survey conducted during the last week of April 2021, when the pandemic situation was more serious than during June to September 2020, when our study was conducted, a time with the fewest newly infected cases and most liberal restrictions. Further,

That study used a short matrix version of the EPDS consisting of four questions instead of the 10 we used,²⁰ and the threshold used to indicate probable depression could have been lower than in our study. On the other hand, several systematic reviews and meta-analyses have also shown a very high prevalence of perinatal anxiety (30%–40%) and depression (26%–42%) during the COVID-19 pandemic, although with significant heterogeneity.^{21–23} The prevalence of anxiety ($GAD-7$ scores ≥ 10) and depression ($EPDS \geq 13$) among pregnant women in Sweden during the pandemic was also found to be much higher (25.3% and 42.5%, respectively).²⁴ Interestingly, a study from Denmark showed no change in the prevalence of depressive symptoms and only a modest increase in anxiety during the pandemic compared with pre-pandemic period among pregnant women,²⁵ and although pregnant women reported a negative impact of the COVID-19 pandemic on their pregnancy experience, they had better mental health compared with women from the

general population.²⁶ Some of these differences observed within the Scandinavian countries might be related partly to different levels of social restrictions and public health measures implemented in different countries.

As expected, we found a moderately strong correlation between prenatal and postnatal EPDS and GAD-7 scores, and the strength of relation was similar to that reported for pre- and postnatal EPDS scores (correlation coefficients ranging from 4.0 to 6.9, with a $P < 0.001$) in pre-pandemic studies.^{27,28} Therefore, it appears that this association was not affected by the COVID-19 pandemic. Women may exhibit diverse trajectories in EPDS and GAD-7 scores during pregnancy and postpartum. Whether some risk factors, such as the COVID-19 pandemic, influence the direction of these trajectories is not known. However, in our study, 37% of pregnant women with high EPDS (≥ 13) and 100% of those with high GAD-7 scores (≥ 10) retained their prenatal scores postnatally.

Regarding personality traits, a study from India using a personality test based on the Five Factor (BigFive) model has reported that *neuroticism* had a significant positive association with pandemic anxiety (fear and somatic concern), whereas *agreeableness* had a negative association.²⁹ Our study using an eight-factor model showed that a stronger need for *Quality* and *Imagination* were significantly associated with GAD-7 scores. However, the associations of personality traits with EPDS were not significant, although certain personality traits could predict the EPDS and GAD-7 cutoff scores for risk of depression and anxiety in a regression model. A study from the UK general population using a reinforcement sensitivity theory (RST)-based personality questionnaire reported that personal safety concerns and self-isolation were related to flight-freeze system traits reflecting fear and anxiety.³⁰ This may create a psychological conflict between the need to stay safe and desire to maintain normality. However, in our study, the vast majority of women reported following public health authority recommendations and compliant behavior irrespective of their personality traits. Women with a stronger need for contacts reported to have been more affected by the information in the media.

Personality is affected by both genes as well as the environment. The heritability estimates of about 40% have been based on twin and family studies.³¹ In an adult person, personality is mostly stable, as it reflects relatively enduring patterns of behavior and tendency to respond to situations and circumstances in certain ways. However, it is believed that a very significant life-event may change one's personality. We wanted to investigate whether an important event, such as the childbirth, during a pandemic could alter women's personality traits. We found that personality was generally stable and did not change significantly following childbirth. However, analyzing the changes in standardized scores of individual personality attributes from the pre- to the postnatal period, a statistically significant increase in the need for *Power* was observed postnatally. This is plausible, as caring for a baby during a pandemic could require more control. Moreover, more *Power* is needed to be able to adapt to a new situation, and mothers may feel easily tired and need more support postnatally.

Regarding our choice of methods, two of the most commonly used validated screening tools for perinatal depression are the Patient Health Questionnaire (PHQ-9) and the EPDS. We chose EPDS, as it has been validated for use on pregnant women in Norway.¹⁴ Different studies use different cutoffs for EPDS depending on which test properties are emphasized. Using the threshold value of 10, Eberhard-Gran et al¹⁴ showed a sensitivity of 100% and a specificity of 87%. We decided to use a cutoff of ≥ 13 to avoid many false-positives. A recent individual participant data meta-analysis has reported a specificity of 0.95 (95% CI 0.92–0.96%) for this cutoff value.¹³ In addition to GAD-7, there exist many tools to screen for anxiety, such as State-Trait Anxiety Inventory (STAI), Hospital Anxiety and Depression Scale (HADS) and Spielberger State-Anxiety Inventory (SSAI). We chose GAD-7 because it has been validated in a pregnant population¹¹ and the Norwegian translation of GAD-7 was easily accessible through the Norwegian Association for Cognitive Behavioral Therapy. We used a cutoff score of ≥ 10 with an aim to identify moderate and severe anxiety avoiding false-positives. Similarly, there are many different personality tests available, such as Jung's personality test, a personality test based on the Five Factor model, DISC (dominance, influence, compliance, steadiness) assessment, etc. We chose the HG personality test as it is one of the few personality tests that was developed on a medical theoretical basis (Leopold Szondi's psychodynamic theory). The test is internet-based, user-friendly, easy to interpret and, most importantly, it was available in Norwegian, and data security was ensured in compliance with European General Data Protection Regulation (GDPR).

The major strength of our study is that it is the largest nationwide survey on the impact of the COVID-19 pandemic on perinatal mental health in Norway that evaluated the prevalence of anxiety and depression in the same population both prenatally and postnatally. The personality assessment might potentially be useful in additional comprehension of the maternal perinatal mental health status during a pandemic. This study is the first in Scandinavia to assess the association between personality traits and the risk of perinatal anxiety and depression during the COVID-19 pandemic.

Our study is not without limitations. An internet-based convenient sampling method was chosen due to uncertainty regarding the course of the pandemic and how long it would last. This may have introduced sampling/selection bias and the data may not be representative of whole pregnant population in Norway, as demonstrated by overrepresentation of women working in the healthcare sector. Our study showed a lower prevalence of anxiety among pregnant healthcare workers. In contrast, a recent meta-analysis has reported a high prevalence of depression (21.7%) and anxiety (22.1%) among 97 333 healthcare workers during the COVID-19 pandemic.³² However, although the vast majority (70%) of the workers were female, their pregnancy status was not provided. Women with mental health problems and those interested in personality tests might also have been eager to participate. This reduces the generalizability of our findings. The prevalence of preexisting psychological disorders among our study participants may appear high, considering that almost 24% of them reported

using psychiatric medicine (7.6%) or psychotherapy (16.3%) before pregnancy. However, the figures were 1.7% and 6.5%, respectively, during pregnancy. Regarding prevalence in the non-selected pregnant population, a large study based on linked individual-level data from the nationwide prescription and medical birth registers in Scandinavian countries has reported that 1.8% of pregnancies in Norway were exposed to the most commonly prescribed antidepressants,³³ which is in line with our findings, although the proportion of women in a unselected pregnant population in Norway receiving psychotherapy is not known.

However, using the internet could be considered the most appropriate sampling method during a pandemic situation, as direct contact with the participants is not desirable. Furthermore, it allowed recruitment of pregnant women nationally, and a relatively large sample size (almost four times larger than that initially estimated) could be achieved within a short time period in the initial phase of the pandemic. Recruiting through social media has been shown to be an efficient and cost-effective method.³⁴ Another important limitation of our study is that we did not have a control group of non-pregnant women; our findings can only be compared with other similar studies and the prevalence of perinatal anxiety and depression can only be compared with pre-pandemic prevalence. Another limitation is that the survey questionnaires were in Norwegian, which is likely to have led to reduced participation by non-Norwegian speaking women from ethnic minorities.

5 | CONCLUSION

During the initial phase of the COVID-19 pandemic, the prevalence of depression (EPDS ≥ 13) and anxiety (GAD-7 ≥ 10) among Norwegian pregnant women was 14.5% and 21.5%, respectively. Certain sociodemographic characteristics and personality traits were significant predictors of depression and anxiety. This highlights the importance of healthcare professionals being vigilant in recognizing pregnant women at risk for developing perinatal mental health disorders, in order to be able to provide appropriate qualified help and support.

AUTHOR CONTRIBUTIONS

Conception of the study: GA. Design of the study: GA, KSB, SSR and SES. Data acquisition: KSB and SSR. Data curation and analyses: GA, JJ, KSB and SSR. Interpretation of results: GA, GA, JJ, KSB and SSR. Writing: GA, JJ, KSB and SSR. Revising the paper critically and approval of the final version: GA, JJ, KSB, SSR and SES.

ACKNOWLEDGMENTS

We thank Rolf Kenmo for making the HumanGuide Personality test available to the study participants free of charge.

CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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How to cite this article: Birkelund KS, Rasmussen SS, Shwank SE, Johnson J, Acharya G. Impact of the COVID-19 pandemic on women's perinatal mental health and its association with personality traits: An observational study. *Acta Obstet Gynecol Scand.* 2023;102:270-281. doi:[10.1111/aogs.14525](https://doi.org/10.1111/aogs.14525)