Anxiety, stress, and depression in Australian pregnant women during the COVID-19 pandemic: A cross sectional study

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ABSTRACT

Background: The COVID-19 pandemic necessitated rapid responses by health services to suppress transmission of the virus.

Aim: This study aimed to investigate predictors of anxiety, stress and depression in Australian pregnant women during the COVID-19 pandemic including continuity of carer and the role of social support.

Methods: Women aged 18 years and over in their third trimester of pregnancy were invited to complete an online survey between July 2020 and January 2021. The survey included validated tools for anxiety, stress, and depression. Regression modelling was used to identify associations between a range of factors including continuity of carer, and mental health measures.

Findings: 1668 women completed the survey. One quarter screened positive for depression, 19% for moderate or higher range anxiety, and 15.5% for stress. The most significant contribution to higher anxiety, stress, and depression scores was a pre-existing mental health condition, followed by financial strain and a current complex pregnancy. Protective factors included age, social support, and parity.

Discussion: Maternity care strategies to reduce COVID-19 transmission restricted women's access to their customary pregnancy supports and increased their psychological morbidity.

Conclusion: Factors associated with anxiety, stress and depression scores during the COVID-19 pandemic were identified. Maternity care during the pandemic compromised pregnant women's support systems.

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Statement of significance

Problem: The COVID-19 pandemic has significantly impacted maternity services.

What is Already Known: Pregnancy is a time of increased psychological vulnerability.

What this Paper Adds: Isolation and altered maternity care during the pandemic compromised pregnant women's support systems, which are protective of mental health and wellbeing.

Introduction

Originating in December 2019, COVID-19 quickly spread across the globe with millions of confirmed cases and deaths (John Hopkins University, and Medicine Corona Resource Center 2020). Australia experienced two waves in 2020, the first (May-June affecting all States and Territories and the second (June- October) mainly affecting the State of Victoria. In an attempt to supress spread of the virus, States and Territories reponded by initiating contact tracing procedures and limiting movement within communities and across Australia, and introducing stay-at-home orders known as lockdowns. Due to the legislative power of each of Australia's States and Territories, lockdown rules varied across Australia, based on case numbers and local policy. Victoria was one of the worst affected States enduring a period of 111 consecutive days of lockdown during the second wave of the pandemic in 2020. By the

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end of 2020, these measures appeared to be successful as Australia had 28,500 cases of COVID-19, which represents a small proportion of the population of 25.6 million. To the end of 2020 there were approximately 900 deaths with most of these occurring in the State of Victoria and most in people over 85 years of age. There is no publicly available data on case numbers in pregnant women over this period. A study examining the impact of lockdowns on the mental health of Australians found a significant negative effect with greater decline in the mental health of Victorians compared to residents of other States and Territories (Butterworth et al., 2022).

Lockdowns and restriction of movement impact many aspects of daily life. To reduce the spread of COVID-19, maternity services amended their models of maternity care, cancelling antenatal parenting classes, replacing several face-to-face services with online or telephone appointments and limiting the number of support people available to women during ultrasounds, birth and the postnal period. Australian women reported high levels of distress during this period particularly in relation to reduced antenatal care, the frequently changing health service requirements and not having their chosen support people with them during care episodes (Wilson et al., 2022). One survey of pregnant Australian women in 2020 identified depressive symptoms in 26% of the sample (Lequertier et al., 2022). This finding parallels those of a rapid review of the international evidence examining the impact of the pandemic on pregnant women's mental health which found a significant increase in rates of depression and symptoms of anxiety. In this study, social support and regular physical activity had a protective effect on mental health (Ahmad and Vismara, 2021).

Perinatal mental health is important because it can have far reaching implications for mother and baby. Maternal stress and anxiety during pregnancy has been associated with pre-term birth (Staneva et al., 2015; Pearson et al., 2013), low birth weight infants (Pearson et al., 2013; Wallwiener et al., 2019) and increased risk of postnatal mood disorders such as depression (Robertson et al., 2004). Poor mental health is associated with lower rates of breastfeeding initiation (Hoff et al., 2019) and disrupted maternal-infant bonding (Brassel et al., 2020; Haram et al., 2020) which has been associated with infant developmental delay and behavioural and mood disorders later in life (Pearson et al., 2013).

Pregnancy is a time of psychological vulnerability with the antenatal period associated with increased worry, anxiety, concern, stress and/or depression in some women (Staneva et al., 2015). Women most at risk for poor mental health in pregnancy include those with low levels of education, low socioeconomic status, women who are unpartnered, those lacking social support, experiencing unplanned, unwanted or medically complex pregnancy, those with a previous history of mental health conditions or experiencing stressful life events (Hopkins et al., 2018; Verbeek et al., 2019; van de Loo et al., 2018; Monti et al., 2008). Vulnerability of pregnant women is compounded by devastating events such as natural disasters, occurring more frequently with global warming and the global COVID-19 pandemic. Due to the adverse impact of poor mental health on women and babies, it is important to identify models of maternity care that can best support women during adversity and promote their mental health and wellbeing.

Continuity of carer models have demonstrated a mitigating effect on levels of anxiety and depression during situations of high environmental stress. One Australian study explored the effect of continuity of midwifery care for women experiencing pregnancy during the 2011 Queensland flood disaster (Kildea et al., 2018). Results from self-reported assessments of participants' depression and anxiety (during pregnancy, at 6 weeks and 6 months postnatally) showed a significant interaction between model of care and stress with increasing stress related to increasing depression scores in women experiencing standard care but not in those experienc-

ing continuity of midwifery care. The researchers concluded that participation in midwifery continuity of care models could mitigate some effects of high levels of stress perceived by women who had experienced the natural disaster (Kildea et al., 2018). Further exploration of the value of models of maternity care, which provide continuity of carer in times of unprecedented stress and change is warranted.

This study aimed to investigate predictors of anxiety, stress, and depression in Australian pregnant women during the COVID-19 pandemic, including the role of social support and continuity of carer as potential protective mechanisms.

Methods

This national cross-sectional online survey was delivered via Qualtrics software (Qualtrics) drawing on a convenience sample of self-selected participants.

Participants and recruitment

Pregnant women at least 28 weeks gestation, and 18 years of age and above who were residing in Australia were eligible to participate. We chose 3rd trimester to ensure women had some exposure to their model of care. We did not include women in the postpartum period as we wanted to capture the woman's level of anxiety, stress and depression during pregnancy. An advertising flyer was created with a QR code that linked directly to the online survey and this was distributed by social media. Research team members with social media connections posted to their Facebook pages. The survey was open for seven months from July 2020 until January 2021 when the target sample size was reached. Sample size was set at 1584 which would allow us to demonstrate a difference in perinatal anxiety and/or depression in women experiencing continuity of carer compared to those who were not, with a 95% confidence level and 80% power.

Ethics

Ethics approval was provided by an accredited Ethics Committee (ETH204977). A pre-amble to the survey in the online platform provided participant information with contact details of the researchers if the potential participant wanted to discuss any aspect of the study. The first questions of the survey established eligibility, followed by consent. Only those eligible and consenting were able to progress with the remaining survey questions. The pre-amble also provided contact details of relevant and freely accessible mental health services.

Measures

The survey tool was purpose-designed for this study and included validated measures of perinatal mental health.

Sociodemographic and physical health

Collection of data related to socioecomic status and physical health included questions on participant age, marital status, education level, ethnicity, and place of residence. Socioeconomic situation was indicated by the Index of Relative Social Advantage and Disadvantage (IRSAD) established by postcode and a question relating to the participant's financial situation pre and post COVID-19, "Did you or your family ever go without things you really needed because you were short of money?" This question was designed to capture participant perception of financial hardship irrespective of income level.

Using a multiple response format, data related to current medical and mental health conditions was gathered using the following

questions: "Do you have any of the following medical conditions (choose all that apply)?" and "Do you have any of the following mental health conditions (choose all that apply)?" The listed medical conditions included those often used and well-researched for capturing physical health such as diabetes, asthma, and obesity. Mental health conditions included anxiety, depression, obsessive compulsive disorder, schizophrenia and post-traumatic stress disorder. Supplementary file 1 shows details of the options available for medical and mental health conditions. In analysis responses were dichotomised (yes, any condition identified and no, none of the above).

Pregnancy related data included questions related to parity, and mode of conception. Women were also asked if they perceived their current pregnancy as straight forward or complex (health concerns [actual or potential] for mother or baby such as diabetes, high blood pressure or concerns about the baby).

Exposure to COVID

One multiple response question gathered data on participant exposure to COVID-19. Participants indicated whether or not they had experienced one or more of the following: a confirmed positive test to COVID-19; a confirmed negative test to COVID-19; having had a close family member/friend test positive to COVID-19.

Models of maternity care

To understand the model of maternity care being used by the participant, and for it to be relevant to the Australian context of the study, the major model categories from the Maternity Care Classification System (MACCS) (Donnolley et al., 2019) were utilised to identify model of care (see Box 1).

Box 1. The Major Model Categories from the Maternity Care Classification System.

Private obstetrician (specialist) care
Private midwifery care
General Practitioner obstetrician care
Shared care
Combined care
Public hospital maternity care
Public hospital high-risk maternity care
Team midwifery care
Midwifery Group Practice caseload care
Remote area maternity care
Private obstetrician and privately practising midwife joint care

To promote participant comprehension of the MACCS, descriptions/definitions of the model categories were provided. Based on these descriptions/definitions, women were asked: "Which maternity care arrangement *best* applies to you?"

Continuity of carer

Continuity of carer was established by the following question: "Are you experiencing or planning for continuity of carer in your maternity care arrangement?" For the purposes of this study continuity of carer was defined as care that is provided by the same, named health professional (midwife or doctor) over the full length of the episode of care, even when other caregivers may be involved (Donnolley et al., 2019). The fixed response choices included full continuity of carer (antenatal, labour and birth, and postnatal periods), partial (continuity of carer in at least one of antenatal, labour and birth, or postnatal periods), no continuity of carer, or other

(with free text box for participants to specify). It is important to note that as participants were in their 3rd trimester of pregnancy, this question captured anticipated rather than actual level of continuity of carer for birth and afterwards.

Instruments for capturing mental health data

Antenatal anxiety, stress and depression

Anxiety and stress were assessed using the Anxiety and Stress subscales from the Depression, Anxiety and Stress Scales–short form (Lovibond, 1995). The DASS- 21 is a self-reporting scale with 7 items in each category of Depression, Anxiety and Stress symptoms. The seven anxiety and seven stress items were used in the present study. Responses are scored on a 4-point Likert scale ranging from 0 to 3, with higher scores indicating higher levels of anxiety and stress.

The DASS-21 is a widely used, standardised instrument found to reliably distinguish between the symptoms of depression, anxiety and stress in clinical as well as non-clinical samples. It has demonstrated strong reliability and validity with Cronbach's alpha 0.87 and 0.91 for anxiety and stress respectively (Crawford and Henry, 2003). In the current study the alpha coefficients were 0.84 for the Anxiety subscale, and 0.75 for the Stress subscale. Stress and anxiety subscale scoring utilised the Black Dog Institute recommendations (Black Dog Institute 2021) which categorise the continuous scale as: normal (0–7; 0–3), mild (8–9; 4–5), moderate (10–12; 6–7), severe (13–16; 8–9), and extremely severe (17+; 10+) for stress and anxiety, respectively. Total scores were used in logistic regression analyses.

The Edinburgh Postnatal Depression Scale (EPDS) was used to assess levels of depressive symptoms. The EPDS is a 10-item self report scale which assesses depressive symptoms experienced in the previous 7 days. Responses are scored on a 4-point Likert scale ranging from 0 to 3, with higher scores indicating the presence of more depressive symptoms. The EPDS was initially developed for use with postnatal women but has subsequently been validated for use in the antenatal period. The EPDS was chosen for use in the study because it is widely used as a screening tool for depressive symptoms in maternity care in Australia, with a score of 13 or above as the recommended cut-off point (Austin, 2017). The probability of depression is relatively high for women scoring at or above this cut-off point. The EPDS has reported sensitivity levels of 0.86, specificity levels of 0.76 and strong reliability with Cronbach's alpha 0.87 (Cox et al., 1987). In the present study Cronbach's alpha for internal consistency was 0.90. Data on EPDS were categorised; screening positive or negative for depression (score ≥13 or yes on suicide question; score < 13 and no on suicide question respectively).

Social support

Social support was measured by the Support Behavior Inventory (SBI short version), developed for use with pregnant women (Brown, 1986). The short version of the SBI consists of 11 items asking participants to indicate their degree of satisfaction with a variety of supportive behaviours provided by partner/spouse and others (friends and other family members). Separate scales are used for each group (partner and others) and responses are scored on a 6-point semantic differential scale with 1, representing very dissatisfied, and 6, representing very satisfied, with the particular support behaviour. For each of the two scales, possible scores range from 11 to 66 with higher scores indicating higher perceptions of support. Data from the SBI were treated as a continuous variable.

Face and content validity of the questionnaire was assessed prior to data collection. Subject matter experts were consulted and asked to comment on the content of the survey tool to determine

whether the items reflected the objectives of the study. Pilot testing of the self-completed online survey was then undertaken with a small group of women prior to national distribution. Pilot test respondents were asked to evaluate and provide comments on the overall design of the questionnaire, its content and response options, readability and fluency, the clarity of the phrasing as well as time taken to complete the survey. Some minor changes were made based on the pilot feedback. Pilot data were not included in the results.

Data analysis

The Statistical Package for Social Sciences (SPSS) (Corp., 2017) was used to analyse the data. Frequencies and percentages were calculated for categorical data and means and standard deviations for continuous. Data were examined to ensure assumptions were not violated for parametric testing and were found to be robust. Univariate analysis using one-way between groups analysis of variance (with post hoc comparisons using the Tukey test) was used to examine associations between Sate/Territory of residence and level of continuity of carer and perinatal anxiety and stress. Logistic regression and standard multiple regression methods were used to identify predictors of depression, stress, and anxiety, respectively. Odds ratios and coefficients are presented with their 95% confidence intervals and as suited for the sample size, significance for all tests was set at 0.05.

Results

Two thousand and sixty-seven women began the survey with 1668 progressing beyond the initial demographics section. Analyses comparing the 399 women who did not progress beyond the demographics section with those who did, revealed no significant differences on key characteristics including age, level of education, highest qualification, IRSAD decile and parity.

Table 1 shows the characteristics of participants. The majority were of white/European ethnicity with more than half holding a university degree. Half (50%) of respondents resided in postcodes with an Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) in the top three deciles. Most participants were in a relationship and over half were primiparous. Just over 40% reported that they had an existing mental health condition, 21% an existing medical health condition and most described their pregnancy as straightforward.

Table 2 shows the proportion of participants exposed to COVID-19 with 37.3% of participants being tested for COVID-19 with a small proportion having a positive result.

Table 3 presents the results of scores on the anxiety, stress and depression scales. Just over 19% of participants scored in the moderate or higher range for anxiety, 15.5% for stress and over 25% screened positive for depression.

Model of care and continuity of carer are shown in Table 4. Most participants were experiencing standard public hospital maternity care (34.4%) followed by GP shared care (17.6%) and private obstetric care (15.8%). A large proportion of participants receiving care from private practicing midwife (94.3%), employed caseload midwifery (87.4%) and a private obstetrician (84.2%) considered that they were experiencing *full* continuity of carer. In total 42.8% of participants described experiencing *full*, 21.7% *partial* and 31.8% *nil* continuity of carer (3.7% missing data) (data not shown in table).

Table 1
Participant characteristics.

Characteristic	$n = 1668$ Mean (SD) / n (%)
Age	30.77 (4.52)
Ethnicity	
Aboriginal and Torres Strait Islander	38 (2.3)
White/European	1462 (87.6)
Middle Eastern	13 (0.8)
Asian (East, South Eastern and Eastern)	67 (4.0)
Maori and Pacifika	19 (1.1)
Other	69 (4.2)
Education	
Nil	8 (0.5)
School Cert	60 (3.6)
Higher School Cert	163 (9.8)
Trade /Certificate/Diploma	490 (29.4)
Bachelors or higher degree	919 (55.1)
Other	28 (1.7)
State	
Western Australia	63 (3.8)
South Australia	89 (5.3)
Victoria	593 (35.6)
Australian Capital Territory	93 (5.6)
New South Wales	562 (33.7)
Queensland	218 (13.1)
Tasmania	34 (2)
Northern Territory	10 (0.6)
Missing	9 (0.4)
IRSAD decile	
1	104 (6.3)
2	106 (6.4)
3	105 (6.3)
4	176 (10.6)
5	147 (8.9)
6	190 (11.5)
7	165 (10.0)
8	192 (11.6)
9	252 (15.2)
10	219 (13.2)
Missing	12 (0.7)
Relationship status	
Single	59 (3.5)
In a relationship	1590 (95.3)
Other	19 (1.1)
Parity	
Primiparous	911 (54.6)
Multiparous	756 (45.3)
Missing	1 (0.1)
Conceived using reproductive technology	
Yes	148 (8.9)
No	1495 (89.6)
Unsure	16 (1.0)
Missing	9 (0.5)
Existing mental health condition	
Yes	671 (40.2)
No	993 (59.5)
Missing	4 (0.2)
Existing medical condition	
Yes	361 (21.6)
No	1302 (78.1)
Missing	5 (0.3)
Complexity of pregnancy	
Straightforward	1108 (66.4)
Complex	473 (28.4)
Unsure	87 (5.2)
Gestation	33.45 (3.72)

Table 2
Participants exposure to COVID-19 cases.

COVID-19 testing ($n = 1699$)*	n /%
Positive test confirming COVID-19, not yet fully recovered	1 (0.1)
Positive test confirming COVID-19, fully recovered	1 (0.1)
Negative test for COVID-19	619 (37.1)
Close family member or friend test positive for COVID-19	60 (3.6)
None of the above	1018 (61)

* $n > 1668$ as categories not mutually exclusive.

Table 3
Anxiety, Stress and Depression.

Anxiety ($n = 1554$)	
Mean and SD	3.20 (3.0)
Categories	*n* (%)
Normal	981(63.1)
Mild	275 (17.7)
Moderate	148 (9.5)
Severe	92 (5.9)
Extreme	58 (3.7)
Stress ($n = 1554$)	
Mean and SD	6.00 (3.87)
Categories	*n* (%)
Normal	1120 (72.1)
Mild	193 (12.4)
Moderate	132 (8.5)
Severe	81(5.2)
Extreme	28 (1.8)
Depression ($n = 1607$)	
Mean and SD	8.57 (5.78)
Negative	1178 (73.3)
Positive	429 (26.7)

Univariate analyses

State/territory

One-way between groups analysis of variance was conducted to explore the impact of State/Territory of residence on anxiety and stress scores as measured by the subscales in the DASS 21. There was a statistically significant difference in mean anxiety scores between groups ($p = 0.002$). Post hoc comparison using the Tukey test indicated that the mean score of anxiety for women residing in New South Wales (2.8, SD 2.85) differed significantly from those in Victoria (3.6, SD 3.2). A similar pattern was demonstrated for stress with a significant difference in stress scores between groups ($p = 0.004$). The mean score for stress varied significantly for women residing in New South Wales (5.7, SD 3.6) compared to Victoria (6.5, SD 4.2). In addition, logistic regression was used to assess the impact of State/Territory on depression screening. Results demonstrate that women residing in Victoria were significantly more likely ($p<0.001$) to screen positively for depression than women residing in New South Wales (OR 1.80, 95%CI 1.38–2.34).

Level of continuity of carer

One-way between groups analysis of variance was conducted to explore the impact of level of continuity of carer (full, partial, nil) on anxiety and stress scores as measured by the subscales of the DASS 21. There was a statistically significant difference in mean anxiety scores between groups ($p = 0.005$). Post hoc com-

parison using the Tukey test indicated that the mean score of anxiety for women experiencing nil continuity (3.5, SD 3.1) differed significantly from those women experiencing full continuity (2.9, SD 2.8). There were no significant differences for stress scores between groups ($p = 0.155$). In addition, logistic regression was used to assess the impact of level of continuity of carer on depression screening. Results demonstrate that women experiencing full continuity of carer were significantly less likely ($p = 0.001$) to screen positive for depression than someone experiencing nil continuity (OR 0.65, 95%CI 0.50–0.85).

Multivariate analyses

Stress

Multivariate analysis using standard multiple regression was used to determine the ability of several factors to predict levels of stress. The model as a whole presented in Table 5 explains 29.5% of the variance in stress scores. Table 5 shows the association with State /Territory and higher stress scores persists, while level of continuity of carer no longer makes a significant contribution when other factors are entered into the model. Existing mental health condition made the strongest unique contribution to higher stress scores, while increasing social support from another source and social support from a partner were associated with lower stress scores. Other variables which made a small but significant contribution include age, experiencing financial strain pre COVID-19 and experiencing a pregnancy described as complex. Increasing age was associated with lower stress scores while financial strain and a pregnancy described as complex were associated with higher scores.

Anxiety

Multivariate analysis using standard multiple regression was used to determine the ability of several factors to predict levels of anxiety. The model as a whole presented in Table 6 explains 28.8% of the variance in anxiety scores. Table 6 shows that the association with State /Territory and higher anxiety scores persists, while level of continuity of carer no longer makes a significant contribution when other factors are entered into the model. Existing mental health condition makes the strongest unique contribution to anxiety, followed by social support other, parity and social support partner. Other variables making a small but significant contribution include age, experiencing financial strain pre COVID-19, existing medical condition and experiencing a pregnancy described as complex. Increasing age, increasing parity and higher levels of social support were associated with decreasing levels of anxiety while financial strain, an existing medical and mental health condition, and a pregnancy described as complex were associated with increasing levels of anxiety.

Table 4
Model of care and continuity of carer.

Model of maternity care	*n* (%)	Continuity of carer		
		Nil	Partial	Full
Standard public hospital	573 (34.4)	60.3%	22.5%	17.2%
GP shared care	293 (17.6)	40.4%	38.9%	20.7%
Private obstetrician	263 (15.8)	2.7%	13.1%	84.2%
Private obstetrician and midwife joint	58 (3.5)	3.6%	21.8%	74.5%
Private practicing midwife	71 (4.3)	0.0%	5.7%	94.3%
GP obstetrician	25 (1.5)	8.3%	29.2%	62.5%
Employed midwifery team	106 (6.4)	32.7%	19.2%	48.1%
Employed caseload midwife	151 (9.1)	0.7%	11.9%	87.4%
Specialist high risk	57 (3.4)	42.3%	36.5%	21.2%
Combined care	22 (1.3)	27.3%	45.5%	27.3%
Remote	7 (0.4)	57.1%	14.3%	28.6%
Other	42 (2.5)	26.5%	14.7%	58.8%

Table 5
Predictors of Stress.

Factor	Standardized Coefficients Beta	Sig.	95.0% Confidence Interval for B	
			Lower Bound	Upper Bound
Age	**-0.079**	**.002**	**-0.122**	**-0.024**
Education	.026	.305	-0.070	.222
State/Territory	**.079**	**.001**	**0.51**	**.199**
IRSAD	.021	.402	-0.039	.096
Financial strain pre COVID-19	**-0.085**	**.008**	**−1.111**	**-0.168**
Financial strain since COVID-19	-0.017	.579	-0.296	.529
Existing medical condition	-0.016	.519	-0.601	.304
Existing mental health condition	**-0.322**	**.001**	**−2.903**	**-2.149**
Parity	-0.016	.528	-0.494	.254
Complexity of pregnancy	.027	.270	-0.548	.153
Social Support Partner	**-0.186**	**.001**	**-0.079**	**-0.045**
Social Support Other	**-0.200**	**.001**	**-0.079**	**-0.045**
Continuity of carer	-0.017	.468	-0.188	.086

Table 6
Predictors of Anxiety.

Factor	Standardized Coefficients Beta	95.0% C I for B		Sig.
		Lower	Upper	
Age	**-0.094**	**-0.097**	**-0.029**	**.000**
Education	-0.031	-0.183	.044	.230
State/Territory	**-0.061**	**-0.017**	**.132**	**.011**
IRSAD	-0.028	-0.083	.022	.249
Financial strain pre COVID-19	**.076**	**.078**	**.811**	**.018**
Financial strain since COVID-19	.061	-0.007	.634	.055
Existing medical condition	**.053**	**.029**	**.747**	**.034**
Existing mental health condition	**.316**	**1.626**	**2.213**	**.000**
Parity	**-0.107**	**-0.931**	**-0.349**	**.000**
Complexity of pregnancy	**.092**	**.142**	**.479**	**.000**
Social Support Partner	**-0.085**	**-0.035**	**-0.008**	**.001**
Social Support Other	**-0.158**	**-0.047**	**-0.023**	**.000**
Continuity of carer	-0.036	-0.280	.038	.135

Depression

Logistic regression was performed to assess the impact of various factors on the likelihood of screening positive for depression as measured by the EPDS. The model as a whole explains between 23.5 and 34.7% of the variance in depression results. As shown in Table 7, the strongest predictor of screening positive for depression was existing mental health condition. Women with an existing mental health condition were 4.7 times more likely than those without, to screen positive for depression. Women in Victoria were almost twice as likely as women in New South Wales to screen positive for depression and those who perceived their pregnancy to be complex were 1.6 times more likely to screen positive compared to those who pereceived their pregnancy to be straightforward. Protective factors included multiparity and higher levels of social support from partner and others.

Discussion

This study provides important new knowledge about pregnant women's anxiety, stress, and depression during the COVID-19 pandemic in Australia. In our study, 19.1% of women had anxiety and 15.5% stress scores that placed them in the moderate to extreme range. Viswasam et al. (Viswasam et al., 2020) examined stress and anxiety (using the DASS 21) in a cohort of Australian women pre-pandemic. They reported mean scores (and standard deviations) for anxiety and stress in the 3rd trimester of pregnancy to be 2.69 (3.26) and 4.88 (3.89) respectively. Our study conducted during the pandemic reports higher mean scores of 3.20 (3.0) for anxiety and 6.00 (3.87) for stress. More than a quarter of women in our study reported depressive symptoms (26.7%). This finding is similar to another study which used the EPDS to survey pregnant Australian women during a similar time period, identify-ing depressive symptoms in 26% of participants (Lequertier et al., 2022). These findings can be compared to those from a large cohort study measuring EPDS in over 40,000 Australian pregnant women in pre-COVID-19 times (2002–2005) which identified depressive symptoms in only 8.9% of the sample (Milgrom et al., 2008). A more recent but smaller cohort study ($n = 17,564$) drawing data from one health service in Australia in 2015 found depressive symptoms in 7% of their sample of pregnant women (Eastwood et al., 2017). In both of these studies antenatal depressive symptoms were associated with a higher risk of postnatal depressive symptoms. In line with research on the general Australian population (Butterworth et al., 2022) it is reasonable to suggest that the COVID-19 pandemic has had a deleterious effect on the mental health of pregnant women. Given the relationship between poor antenatal mental health and poor postnatal mental health and the consequences for both mother and baby, it is important that clinicians and health services pre-emptively respond when anxiety, stress and/or depression is identified in the antenatal period.

Women with a history of mental health conditions are particularly at risk of perinatal mental health conditions. In our sample, 40% reported an existing mental health condition, and this was the strongest contributor to having higher stress and anxiety scores and screening positive for depression. A large Australian cohort study conducted pre COVID-19 found that a prior history of depression, antental depression and low levels of partner support were the strongest predictors of postnatal depression (Milgrom et al., 2008). Another group particularly at risk are those with complex pregnancies. In our study almost a third (28.4%) considered their pregnancy to be complex. Other studies have noted an association with pregnancy complications and an increased prevalence of antenatal mood disorders including anxiety and de-

Table 7
Predictors of Depression.

Factor	Exp(B)	95% C.I. for EXP(B)		Sig.
		Lower	Upper	
Age	.976	.941	1.014	.210
Education No formal	Reference			
Year 10	3.993	.122	130.291	.436
HSC	.559	.128	2.436	.439
Trade	.888	.241	3.280	.859
Certificate/diploma	.599	.131	2.744	.509
Bachelor	.661	.192	2.279	.512
Higher degree	.746	.220	2.533	.638
Other	.756	.219	2.617	.659
State/Territory NSW	Reference			
VIC	**1.829**	**1.278**	**2.617**	**.001**
ACT	1.104	.541	2.251	.786
SA	.975	.467	2.036	.947
WA	.517	.201	1.329	.171
NT	3.951	.842	18.544	.082
QLD	.687	.406	1.162	.162
TAS	1.822	.715	4.645	.209
IRSAD	.959	.903	1.019	.180
Financial strain pre COVID-19 No	Reference			
Sometimes	**1.545**	**1.000**	**2.386**	**.050**
Often	2.089	.884	4.935	.093
Financial strain since COVID-19 No	Reference			
Sometimes	1.327	.885	1.990	.171
Often	1.850	.912	3.750	.088
Existing medical condition	.995	.692	1.430	.979
Existing mental health condition	**4.699**	**3.449**	**6.401**	**.000**
Parity	**.579**	**.420**	**.797**	**.001**
Complexity of pregnancy Straightforward	Reference			
Unsure	1.495	.799	2.796	.209
Complex	**1.592**	**1.134**	**2.235**	**.007**
Social Support Partner	**.966**	**.953**	**.978**	**.000**
Social Support Other	**.971**	**.960**	**.982**	**.000**
Continuity of carer Nil	Reference			
Partial	.925	.622	1.376	.700
Full	.863	.611	1.219	.404

pression (Biaggi et al., 2016; Brandon et al., 2008; Carter et al., 2018). Our study also found that women residing in Victoria were almost twice as likely to screen positive for depression. This finding, similar to Frankham, (Frankham et al., 2021) reflects the increased burden of COVID-19 cases and longer periods of lockdown experienced by this State in 2020, compared to other Australian States and Territories (Costantino and MacIntyre, 2021).

Multiparity and social support from a partner or other source were protective for anxiety, stress and depression, a finding consistent with other research (Redshaw and Henderson, 2013). However, access to other sources of social support (besides partner) were reduced as a result of the pandemic and social distancing practices (Meaney et al., 2021). Evidence suggests reduced face-to-face engagement with maternity care providers and absence of support from partners and other sources further augments the risk of postpartum mood disorders (Viaux et al., 2020; Oskovi-Kaplan et al., 2020). An international study assessed pregnant women's satisfaction with antenatal care and social support and also examined stress-reduction strategies used by women during the pandemic (Meaney et al., 2021). The authors considered that an increased vulnerability to postpartum depression is a potential consequence of women having to attend antenatal visits, ultrasound scans and labour and birth alone due to restrictions on accompanying family or support (Meaney et al., 2021). Considering this, maternity care services must consider approaches to buffer the adverse psychological impact of this or future pandemics on women and consider the compounding effect of emotional, socioeconomic, and demographic factors on perinatal mental health and wellbeing.

Continuity of carer was not associated with anxiety, stress, and depression scores in this study when other variables were consid-

ered. Continuity of carer has previously demonstrated protective effects on maternal stress, anxiety and depression scores during the Queenslad Flood Study (Kildea et al., 2018). Our null findings in this respect, might reflect the timing of data collection which was the 3rd trimester of pregnancy. Data on model of care was self reported in the antenatal period and reflected anticipated model of care, not model of care as experienced, because participants had not yet experienced labour, birth and the postnatal period. Future studies examining the impact of models of care on maternal mental health should consider obtaining data after the model of care has been fully experienced.

Strengths and limitations

This cross sectional study benefits from a large sample size.. Participants were recruited by social media (Facebook and Instagram), and all States and Territories of Australia were represented. This recruitment strategy may have resulted in response bias leading to over or under estimation of levels of depression, anxiety and stress. This study was conducted during the second wave of the pandemic in Australia, in a country pursuing a suppression strategy with low case numbers and mortality. Care should be taken when comparing our results to those emerging from countries with higher case numbers and mortality.

Conclusion

The findings of this study suggest that the mental health of Australian pregnant women was impacted by the COVID-19 pandemic and that long periods of lockdown contribute to poorer

mental health outcomes. Factors predictive of poorer mental health in our sample included previous mental health condition, complex pregnancy, and age. Protective factors included good social support from partner and others. Having knowledge of these predictive and protective factors is useful to health services so they can target support for at risk women in the antenatal time.

Pregnant women are a priority population and strategies are required within the maternity care system to protect them from the psychological impact of the restrictions implemented in this pandemic. Ensuring pregnant women with known mental health risk factors have access to supportive models of maternity care should be a high priority during public health emergencies.

Ethical Approval

Ethical approval for this study was provided by the University of Canberra Human Research Ethics Committee (ETH20–4977).

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Declaration of Competing Interest

None declared.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.midw.2023.103619.

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