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Common mental disorders and perinatal outcomes in Victoria, Australia: A population-based retrospective cohort study

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ABSTRACT

Purpose: Common mental disorders (non-psychotic mental health conditions which impact on day-to-day functioning) are increasingly common in childbearing women and may impact significantly on both maternal and neonatal outcomes. Our study examines the associations between common mental disorders and perinatal outcomes.

Methods: We used routinely collected perinatal data (2009–2016) for this population-based retrospective cohort study (n = 597,522 singleton births). We undertook multiple logistic regression adjusting for key maternal medical conditions and sociodemographic factors to determine associations between maternal common mental disorders and adverse perinatal outcomes with confidence intervals set at 95%.

Results: Women with common mental disorders were more likely to have an induction of labour and caesarean birth, have a postpartum haemorrhage (PPH), and be admitted to the Intensive Care Unit (ICU) than women without common mental disorders. Neonates of women with common mental disorders were more likely to have an Apgar score at five minutes of less than seven (a measure of neonatal wellbeing at birth), be born preterm and low birthweight, be admitted to the Special Care Nursery or Neonatal Intensive Care Unit (SCN/NICU) and have a congenital anomaly than neonates of women without common mental disorders.

Conclusion: Common mental disorders during the perinatal period were associated with poorer perinatal outcomes for mothers and their neonates. Strategies that enable early recognition and response to maternal common mental disorders should be developed to mitigate the consequential impact on maternal and infant wellbeing.

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Statement of significance

Problem or issue.

Common mental disorders (CMD) are experienced by one in five women in Australia during the perinatal period. Understanding the impact of common mental disorders on perinatal outcomes will enable an informed approach to screening, diagnosis and perinatal care.

What is already known.

Maternal CMD during the perinatal period is associated with adverse perinatal outcomes in low/middle income countries. Women experiencing CMD report experiencing multi-level barriers to accessing therapeutic care in the perinatal period. CMD continues to be underdiagnosed and undertreated in the perinatal period.

What this paper adds.

This paper is the first to examine population-based data to evaluate the impact of common mental disorders on perinatal outcomes of Australian women finding that women experiencing CMD were more likely to experience adverse perinatal outcomes than women not experiencing CMD in the perinatal period.

Introduction

The perinatal period is a period of significant change for women during which they are vulnerable to the onset of, or exacerbation of existing, mental illness [1]. Maternal mental illness during the perinatal period has been independently associated with adverse maternal and neonatal outcomes [2], in addition to longer term sequelae for their offspring such as anxiety, depression, attention deficit hyperactivity disorder and severe mental illness including schizophrenia [3,4]. Women who experience depression or anxiety during pregnancy are also more likely to experience postnatal depression [5] further impacting on the wellbeing of themselves and their infants having a negative impact on feeding [6], sleep [7], maternal-infant bonding [8] and motor, cognitive and behavioural development [7]. Furthermore, suicidal ideation has been demonstrated to be much more prevalent in women experiencing postpartum depression when compared to those not experiencing depression (51.8% and 3.3% respectively) [9] and maternal suicide in the perinatal period is a leading cause of all indirect maternal deaths (that is, deaths resulting from conditions that were not due to a direct obstetric cause but aggravated by the physiological effects of pregnancy) nationally [10] and globally [11]. Women who are vulnerable, such as those also experiencing poverty, poor nutrition, pregnancy during adolescence or who have little, or no support are at greater risk of perinatal mental illness [12].

In Australia, one in five women will experience perinatal depression and anxiety [13]. In 2019, annual costs to the health system related to perinatal depression and anxiety equated to $227 million in increased use of hospital and community services, and a further $643 million in economic costs including workforce exits, absenteeism, presenteeism and carer requirements [13]. This suggests that maternal mental illness during the perinatal period should be positioned as a public health priority and understanding the impact is central to determining strategy and implementation of mitigation policies and programs.

Determining the prevalence of perinatal mental health disorders and generalisability to populations is challenging due to the diversity of conditions and diagnostic groups, in addition to significant methodological heterogeneity of the evidence [14]. Whilst much has been studied and written regarding perinatal anxiety and depression disorders (both separately and together as comorbid conditions) a standardised definition has not yet been endorsed from a public health epidemiological perspective with respect to 'common mental disorders'. Historically, the diagnostic cohort of 'common mental disorders' describes non-psychotic mental health conditions which impact on day-to-day functioning and are identifiable in primary health care contexts [15]. Common mental disorders (CMD) can include mood disorders such as depression, anxiety disorders including phobias and obsessive-compulsive disorder, post-traumatic stress disorder (PTSD) and other conditions such as personality disorders and eating disorders [16]. This diagnostic cohort reliably excludes severe mental illnesses such as bipolar and psychotic disorders including schizophrenia that induce significant functional impairment [2]. CMDs during the perinatal period continue to be underdiagnosed and subsequently undertreated [11], but are highly treatable when identified and responded to early [17].

The impact of CMD on perinatal outcomes has been widely examined in low to middle income countries with associations between CMD and adverse perinatal outcomes reported focusing primarily on neonatal or child health outcomes [18]. Other studies have examined the impact of maternal depression and anxiety [19] (both comorbid or as separate diagnoses), maternal childhood maltreatment [20] and adverse childhood events (ACEs) [21] on perinatal outcomes in higher income countries, in addition to severe mental illness (SMI) [22]. The authors are not aware of any other population-based studies that examine perinatal outcomes for women with CMD in high income countries and, unlike any other study of this kind, this study controls for sociodemographic factors *and* maternal medical conditions – both of which have been shown to be independently associated with adverse perinatal outcomes [23–27].

This study aims to determine the impact of non-psychotic mental health conditions on perinatal outcomes using the diagnostic cohort of CMD. Understanding the impact of common mental disorders for Australian women during the perinatal period is critical to informing screening, diagnostic and treatment strategies at every stage – preconception, during pregnancy and in the postnatal period. We based this work on the directional hypothesis - *women who have common mental disorders have higher odds of adverse perinatal outcomes than women who do not have common mental disorders*.

Methods

Study setting, design, and data source

This study was conducted in the state of Victoria, Australia. Victoria is Australia's second most populated state, although the second smallest by land size. Healthcare in Australia is state and nationally funded through Medicare (general practice, psychiatry and primary healthcare facilities) and state-run public health (and mental health) services.

For this population-based study we undertook secondary analysis of routinely collected data from the Victorian Perinatal Data Collection (VPDC). The VPDC is a population-based surveillance system used to collect data routinely from all birthing services across the state of Victoria. Data collection items are standardised across all health services in Victoria and data were de-identified prior to access by the research team.

We included all registered singleton births in Victoria between 2009 and 2016 (n = 597,522). Births were included in this data if gestation was greater than 20 weeks or, if gestation unknown, birthweight was greater than 400 gram [28].

Reporting is compliant with STROBE reporting guidelines for observational research. We obtained approval for use of data from the Consultative Council on Obstetric and Paediatric Mortality and Morbidity, Victoria, and ethical approval from the relevant Human Ethics committee prior to commencement of this study.

Exclusion criteria

The original sample consisted of 616,528 births. Multiple births

(3.1%; n = 19,006) were excluded from the study due to the higher rates of adverse perinatal outcomes in this group, especially for the second twin [29].

Variables

Exposure variable

Common mental disorders were identified using International Classification of Diseases (ICD-10) codes related to depressive, mood or anxiety disorders during the pregnancy and the immediate postpartum period (up until discharge from hospital care) (Table 1). The authorship team included content experts who assisted in determining appropriate ICD-10 codes to include in analysis based on prior research and clinical application a priori. Mood disorders related to alcohol and drug use were included due to high rates of comorbidity of these disorders and subsequent potential for differential diagnosis at data entry. Common mental disorders were then coded as a dichotomous variable (CMD present[exposed]/CMD absent[unexposed]). Diagnoses were entered into the perinatal database at any stage throughout the pregnancy, labour and postnatal inpatient event with data collection ceasing at discharge from the birth hospital.

Outcome variables

Maternal outcomes

Maternal outcomes included maternal admission to Intensive Care Unit (ICU), caesarean birth of any type (emergency caesarean or elective caesarean), postpartum haemorrhage (PPH) (defined as blood loss more than 500 ml), labour type (induced or augmented) and perineal status for vaginal births.

Table 1
ICD-10 diagnoses codes used to denote Common Mental Disorders in data analysis.

Diagnostic Group	ICD-10 Codes
O99 Other maternal diseases classifiable elsewhere but complicating pregnancy, childbirth and the puerperium	O99.3
F10 Alcohol related disorders	F10.14
F12 Cannabis related disorders	F12.180, F12.188, F12.19
F13 Sedative, hypnotic, or anxiolytic related disorders	F13.14, F13.18, F13.180
F14 Cocaine related disorders	F14.14, F14.19, F14.280, F14.980
F15 Other stimulant related disorders	F15.15, F15.180, F15.280
F16 Hallucinogen related disorders	F16.14, F16.180, F16.280, F16.980
F19 Other psychoactive substance related disorders	F19.14, F19.180, F19.24
F32 Depressive episode	F32.00, F32.09, F32.10, F32.20, F32.80, F32.90, F32.91
F33 Recurrent depressive disorder	F33.1, F33.2, F33.4, F33.8, F33.9, F33.90
F34 Persistent mood [affective] disorders	F34.0, F34.1, F34.8, F34.9
F38 Other mood [affective] disorder	F38.0, F38.1, F38.8
F39 Unspecified mood [affective] disorder	F39.9
F40 Phobic anxiety disorders	F40.00, F40.1, F40.2, F40.8, F40.9
F41 Other anxiety disorders	F41.0, F41.1, F41.2, F41.3, F41.8, F41.9
F42 Obsessive compulsive disorder	F42.0, F42.2, F42.8, F42.9
F43 Reaction to severe stress and adjustment disorders	F43.0, F43.1, F43.2, F43.8, F43.9
F45 Somatoform disorders	F45.0, F45.1, F45.2, F45.3, F45.4, F45.8, F45.9
F48 Other neurotic disorders	F48.0, F48.1, F48.8, F48.9
F53 Mental and behavioural disorders associated with the puerperium, not elsewhere classified	F53.0, F53.1, F53.8, F53.9
F99 Mental disorder, not otherwise specified	F99.0, F99.9
Z86 Personal history of certain other diseases	Z86.5

Neonatal outcomes

Neonatal outcomes included preterm birth (babies born before 37 completed weeks gestation); perinatal mortality (here defined as death occurring prior to or during labour and/or birth (stillbirth), up to 28 days after birth (neonatal death) where gestational age is 20 or more completed weeks of gestation or with a birthweight of at least 400 g) [30]; low birthweight (LBW) (birthweight less than 2500 g); admission to Special Care Nursery/Neonatal Intensive Care Unit (SCN/NICU); an Apgar score (which is an indicator of neonatal wellbeing at birth) [31] of less than seven at five minutes; and congenital anomaly. The VPDC data manual [32] defines congenital anomaly as: "any congenital abnormality detected before birth, at birth or days later. This includes structural, functional, genetic, chromosomal and biochemical anomalies in either a live born or stillborn baby." [32]. As data collection for the VPDC ceases at discharge from the birth hospital/service this was the latest determination of congenital anomalies for reporting. This was documented in the dataset as reportable congenital anomaly present or no reportable congenital anomaly present.

Confounders

Maternal characteristics were examined as possible confounders based on their potential to impact on perinatal outcomes as described in the literature [33–35]. These included maternal age in years; partner status; smoking after 20 weeks of gestational age; parity (total number of previous pregnancies that have resulted in a live birth or a stillbirth of at least 20 weeks gestation); country of birth; rurality (using the Australian Statistical Geography Standard Remoteness Structure (ASGS-RA) [36] with respect to relative accessibility of services categorised as major cities, inner regional and outer regional/rural/remote); relative disadvantage (based on the Index of Relative Socioeconomic Disadvantage (IRSD) [37] deciles collapsed to 5 quintiles) and Body Mass Index (BMI) (collected as a self-reported measure at registration for pregnancy care). Other confounders were applied based on their known impact on maternal or neonatal outcomes and included maternal medical conditions (pre-existing diabetes mellitus [24], gestational diabetes mellitus [25], hypertension [26], pre-eclampsia, eclampsia [27]); severe mental illness (SMI) including bipolar, schizophrenia and psychosis [22]; birth type for maternal outcomes; and gestational age in weeks for neonataloutcomes.

Data cleaning

The raw data were provided by VPDC in Microsoft Excel format. Initial data cleaning was done in Microsoft Excel. Variables were reviewed for collection period and accuracy in data entry. Variables were considered by the research team with respect to ranges that were feasible based on accepted parameters within the literature and data items outside of these ranges were set to missing and subsequently excluded from the analyses. The data were then imported into STATA© (version 16) (Statacorp, College Park, TX, USA) for analysis.

Missing data

In this study, missing data were < 0.1% for postcode; < 0.3% for maternal date of birth, date of birth (neonate), maternal country of birth, parity, birth status, and birth type; < 0.4% for gestational age and maternal admission to ICU; < 0.5% for birthweight; 1.5% for gestation at first antenatal visit; 1.6% for blood loss; 1.8% for partner status; 3% for neonatal admission to SCN/NICU; 17.3% for smoking after 20 weeks; and 9.6% for BMI measures (maternal height and weight). Smoking after 20 weeks and BMI (maternal weight and height) data items were only

Table 2
Demographic and clinical characteristics of women with and without Common Mental Disorders (CMD) giving birth in Victoria 2009–2016 (n = 597, 522).

N (%)	Women with CMD 54,973 (9.2)		Women without CMD 542,549 (90.8)		OR (CI 95%) (CMD)
	n	%	n	%	
Age, mean (SD) *(Median 30.85)*	30.1 (6.0)		30.9 (5.3)		#t = 30.46 (*p-value < 0.001)*
< 20 years	2401	4.4	10,217	1.9	2.72 (2.60, 2.85) *
20-24 years	8434	15.3	55,325	10.2	1.77 (1.72, 1.82) *
25-29 years	13,730	25.0	143,834	26.5	1.11 (1.08, 1.13) *
30-34 years	16,820	30.6	194,894	35.9	**Ref**
35-39 years	10,670	19.4	111,062	20.5	1.11 (1.09, 1.14) *
40 + years	2918	5.3	27,217	5.0	1.24 (1.19, 1.29) *
Marital status					
Partnered	40,103	74.5	475,711	89.2	**Ref**
Unpartnered	13,762	25.5	57,368	10.8	2.85 (2.79, 2.91) *
Country of birth					
Australia (and Territories)	46,307	84.2	347,559	64.1	**Ref**
English as dominant language countries	2961	5.4	29,532	5.4	0.75 (0.72, 0.78) *
Other	5705	10.4	165,458	30.5	0.26 (0.25, 0.27) *
IRSD (Index of Relative Socioeconomic Disadvantage)					
Quintile 1 (most disadvantaged)	9216	16.8	79,973	14.8	1.13 (1.10, 1.17) *
Quintile 2	10,401	18.9	85,945	15.9	1.19 (1.16, 1.22) *
Quintile 3	11,911	21.8	117,027	21.6	**Ref**
Quintile 4	12,299	22.4	124,137	22.9	0.97 (0.95, 1.00)
Quintile 5 (least disadvantaged)	11,055	20.1	134,982	24.9	0.80 (0.78, 0.83) *
Parity					
Nullipara	24,111	43.9	239,259	44.2	**Ref**
One	17,035	31.0	191,223	35.4	0.88 (0.87, 0.90) *
Two	8099	14.7	73,141	13.5	1.10 (1.07, 1.13) *
Three+	5706	10.4	37,252	6.9	1.52 (1.47, 1.57) *
1st antenatal visit, gestational age in weeks, mean (SD) *(Median 13.95)*	14.8 (7.7)		13.9 (7.2)		#t = −25.85 *(p-value < 0.001)*
1st Trimester	26,920	49.7	306,077	57.3	**Ref**
2nd Trimester	23,272	42.9	196,995	36.9	1.34 (1.32, 1.37) *
3rd Trimester	3876	7.2	30,530	5.7	1.44 (1.39, 1.50) *
No antenatal care	117	0.22	833	0.16	1.60 (1.32, 1.94) *
Smoking					
No smoking after 20 weeks of gestation	36,725	81.6	427,182	95.1	**Ref**
Smoking during pregnancy after 20 weeks of gestation	8262	18.4	21,976	4.9	4.37 (4.25, 4.49) *
BMI[1] *(Median 25.75)*	26.7 (6.1)		25.7 (5.4)		#t = −37.02 (p-value <0.001)
BMI < 18.5 Underweight	1365	2.9	14,681	3.0	1.06 (1.00, 1.12)
BMI 18.5-29.9 Non-obese	33,942	71.7	386,483	78.4	**Ref**
BMI 30-34.9 Obese Class I	6854	14.5	57,668	11.7	1.35 (1.32, 1.39) *
BMI 35-39.9 Obese Class II	3332	7.0	23,096	4.7	1.64 (1.58, 1.71) *
BMI > 40 Obese Class III	1857	3.9	11,066	2.2	1.91 (1.82, 2.01) *
Congenital anomalies	2838	5.20	22,290	4.16	1.26 (1.21, 1.31) *
Rurality					
Major Cities	32,242	58.7	368,739	68.0	**Ref**
Inner regional	17,885	32.6	134,996	24.9	1.52 (1.49, 1.54) *
Outer regional, rural, remote	4757	8.7	38,405	7.1	1.42 (1.37, 1.46) *

[1]WHO classification
[#]Independent sample t-test assuming unequal variances *p-value< 0.001

added to the VPDC data collection in 2009 and may have taken some time to be reliably and accurately collected. Women with missing variable values in the regression model were excluded from the data analysis in STATA.

Data analysis

Descriptive statistics were calculated for exposure and all outcome variables, with number and percentage used for categorical variables and mean and standard deviation (SD) used for continuous variables. An independent sample t-test was performed to compare the means of age (in years), body mass index (BMI) and gestational age at the first antenatal visit (in weeks) in the CMD and non-CMD groups with unequal variances. Bivariate analysis followed for each characteristic and the presence (or absence) of CMD to examine differences in the maternal characteristics of each group, however, further multiple regression was not conducted for these characteristics as this did not align with the aim of the study. Bivariate logistic regression was conducted to estimate crude odds ratios (cOR) for CMD, and a 95% confidence interval (CI) was applied. Adjusted odds ratios (aOR) for the outcome variables were calculated using multiple regression for each outcome variable adjusting for confounders with a confidence interval (CI) of 95%. Adjusted models included maternal age, parity, partner status, IRSD, rurality, smoking, country of birth, maternal medical conditions, birth type (for maternal outcomes), BMI, severe mental illness and gestation (for neonatal outcomes). Rare adverse event prevalence (perinatal mortality and maternal admission to ICU) has been reported using two decimal points whilst other variables have been reported using one.

Results

Demographic and clinical characteristics of participants

During the study period (2009–2016) there were 597,522 singleton infants born with 54,973 (9.2%) being born to mothers with a common mental disorder (CMD). The demographic characteristics of the study sample are presented in Table 2. Mothers in the CMD group were slightly younger (M = 30.1, SD = 6.0) than women without CMD (M = 30.9 SD = 5.3), they engaged with pregnancy care later than women without CMD (mean gestational age of 14.8 weeks vs 13.9 weeks) and mothers with CMD had a higher BMI at booking in (for pregnancy care) (CMD: M = 26.7, SD = 6.1; no CMD: M = 25.7 SD = 5.43).

Women with CMD were nearly three times more likely to be unpartnered (OR 2.85: CI 2.79, 2.91), and more than four times more likely to smoke after 20 weeks gestation (OR 4.37: CI 4.25, 4.49). They were also more likely to be aged < 20 years (OR 2.18: CI 2.08, 2.29). In addition, women with CMD were more likely to engage in pregnancy

Table 3
Association between Common Mental Disorders (CMD) and maternal outcomes in Victoria 2009–2016 (n = 597,522).

Outcome	Prevalence (%)	Odds Ratio (OR) for adverse maternal outcomes for women with CMD								
		Crude OR 2009-2016					Adjusted OR 2009-2016[a]			
	CMD (%)	No CMD (%)	Included in analysis (n)	cOR	95% CI	P-value	Included in analysis (n)	aOR	95% CI	P-value
Maternal admission to ICU	1.8	1.3	595,117	1.38	1.29, 1.48	< **0.001**	440,996	1.27	1.17, 1.38	< **0.001**
PPH (blood loss >500mls)	16.4	14.5	588,045	1.16	1.13, 1.18	< **0.001**	436,118	1.18	1.14, 1.21	< **0.001**
Induced labour[b]	36.6	32.9	483,203	1.18	1.15, 1.21	< **0.001**	358,752	1.12	1.09, 1.15	< **0.001**
Augmented labour	21.1	22.3	483,203	1.00	0.98, 1.03	0.707	358,752	0.98	0.95, 1.01	0.254
Perineal laceration (any degree)[c]	28.4	32.9	404,317	0.77	0.76, 0.79	< **0.001**	300,801	0.90	0.87, 0.92	< **0.001**
Caesarean birth (elective)	16.7	16.7	595,764	0.99	0.97, 1.02	0.534	441,299	1.08	1.05, 1.12	< **0.001**
Caesarean birth (emergency)[b]	16.1	15.3	595,764	1.05	1.02, 1.07	< **0.001**	441,299	1.07	1.03, 1.10	< **0.001**

[a] Adjustment factors: Maternal age (continuous), parity, partner status, IRSD (Index of relative Socioeconomic Disadvantage), rurality, smoking, country of birth, maternal medical conditions (pre-existing diabetes mellitus, gestational diabetes mellitus, hypertension, pre-eclampsia, eclampsia), birth type (for maternal admission to ICU and PPH), BMI (categorised based on WHO classifications), maternal SMI.
[b] Elective caesareans not included in labour type analysis.
[c] Logistic regression for perineal status applied to vaginal births only, categorised as perineal laceration present (any degree) vs intact perineum.

care later (2nd or 3rd trimester) or not receive pregnancy care at all (OR 1.39: CI 1.14, 1.68). Women with CMD were more likely to live in the lowest two IRSD quintiles (indicating disadvantaged living circumstances) and in rural or remote areas than women not experiencing CMD during the perinatal period. Our results indicated a stepwise increase in the likelihood of overweight or obesity (by BMI category) for women with CMD, when compared to women without CMD. Women with CMD were also more likely to have more than three children (OR 1.52: CI 1.47, 1.57) than women without CMD. Women who were born in Australia were more likely to experience CMD than women born in countries where English is not the dominant language.

Association between CMD and maternal and neonatal outcomes

Maternal outcomes

Experiencing CMD during the perinatal period increased the odds of maternal admission to ICU (aOR 1.27: CI 1.17, 1.38), PPH (aOR 1.18: CI 1.14, 1.21), induction of labour (versus spontaneous labour) (aOR 1.12: CI 1.09, 1.15) and emergency (aOR 1.07: 1.03, 1.10) or elective (aOR 1.08: CI 1.05, 1.12) caesarean birth (Table 3) when compared to women not experiencing CMD. Conversely, women with CMD were less likely to sustain a perineal laceration during a vaginal birth (aOR 0.90: CI 0.87, 0.92). There was no significant difference between groups for augmentation of labour (aOR 0.95: CI 0.95, 1.01).

Neonatal outcomes

Following adjustment for confounders, neonates of women with CMD were more likely to have an Apgar score of less than seven at five minutes (aOR 1.67: CI 1.57, 1.78), to be born preterm (aOR 1.44: CI 1.39, 1.50), be born low birthweight (aOR 1.22: CI 1.15, 1.29), and more likely to be admitted to the SCN or the NICU (aOR 1.45: CI 1.41, 1.50) when compared to neonates of women without CMD. In addition, infants of women with CMD were more likely to have a congenital anomaly (aOR 1.18: CI 1.12, 1.24). In the unadjusted model an association existed between CMD and perinatal mortality (cOR 1.29: CI 1.17, 1.42) but this association disappeared after adjustment for confounders.

Discussion

Main findings

In this study, we found that 9.2% of women who gave birth to a singleton baby in Victoria between 2009 and 2016 experienced CMD during their pregnancy or the immediate postpartum period (prior to discharge from hospital care). CMD was associated with increased odds of adverse outcomes for both mothers and their newborns. In addition, women experiencing CMD were more likely to be experiencing social vulnerability such as being young, unpartnered, living in low socio-economic areas or in rural areas and were more likely to smoke, be obese (BMI $\geq$ 30) or underweight (BMI <18.5) and engage with pregnancy care later (second or third trimester) or not at all.

Interpretation

The estimated prevalence of CMD within the population studied was 9.2%. There is a paucity of evidence that is homogenous in cohort definition and methodology to compare prevalence meaningfully. Similarly, differences in data collection methods, varying settings (lower resource versus higher resource environments), inconsistent screening tools and diagnostic criteria mean comparative analysis is challenging [18]. There is a need to clearly define this common group of disorders, which are identifiable in primary health contexts, enabling accurate data collection, analysis and public health responses to address the risks and outcomes associated with perinatal CMD.

Despite a high degree of heterogeneity in studies examining perinatal outcomes for women experiencing CMD, the international evidence broadly supports our findings of an association between CMD and adverse outcomes for both mothers and their newborns. Prior research has demonstrated an association between perinatal mood and anxiety disorders and severe maternal morbidity and mortality, higher rates of caesarean birth [2] and postpartum haemorrhage (PPH) [38]. Our study examined neonatal outcomes for women with CMD when adjusting for social *and* medical conditions that have been shown to impact on outcomes. Previous research has also demonstrated an association between depression during pregnancy and preterm birth (PTB), low birthweight (LBW) and intrauterine growth restriction (IUGR) [39] and the impact of mental illness generally on neonatal Apgar scores – a measure of neonatal wellbeing at birth [31]. Our study examined a broader

Table 4
Association between Common Mental Disorders (CMD) and neonatal outcomes in Victoria 2009–2016 (n = 597,522).

Outcome	Prevalence (%)		Odds Ratio (OR) for adverse neonatal outcomes for women with CMD							
			Crude OR 2009-2016				Adjusted OR 2009-2016[a]			
	CMD (%)	No CMD (%)	Included in analysis (n)	cOR	95% CI	P-value	Included in analysis (n)	aOR	95% CI	P-value
Perinatal mortality[b]	0.81	0.63	595,965	1.29	1.17, 1.42	< **0.001**	441,076	0.84	0.73, 0.97	0.019
Apgar < 7 at 5 min	3.8	2.0	597,522	1.93	1.84, 2.03	< **0.001**	441,076	1.67	1.57, 1.78	< **0.001**
Preterm birth (<37 weeks gestation)	9.8	6.1	595,291	1.69	1.64, 1.74	< **0.001**	441,076	1.44	1.39, 1.50	< **0.001**
Low birthweight (<2500 gms)	8.3	4.8	594,405	1.80	1.74, 1.86	< **0.001**	440,133	1.22	1.15, 1.29	< **0.001**
Admission to Special Care Nursery (SCN) or Neonatal Intensive Care Unit (NICU)	22.1	14.1	579,563	1.72	1.69, 1.76	< **0.001**	438,615	1.45	1.41, 1.50	< **0.001**
Congenital anomaly	5.2	4.2	589,924	1.26	1.21, 1.31	< **0.001**	436,011	1.18	1.12, 1.24	< **0.001**

[a] Adjustment factors: Maternal age (continuous), parity, partner status, IRSD (Index of relative Socioeconomic Disadvantage), rurality, smoking, country of birth, maternal medical conditions (pre-existing diabetes mellitus, gestational diabetes mellitus, hypertension, pre-eclampsia, eclampsia), BMI (categorised based on WHO classifications), gestation (continuous), maternal SMI.

[b] Perinatal mortality defined as death occurring prior to or during labour and/or birth (stillbirth) or up to 28 days after birth (neonatal death) where gestational age is 20 or more completed weeks of gestation or with a birthweight of at least 400 gs (Australian Institute of Health & Welfare, 2021).

diagnostic group and demonstrated comparable associations for CMD.

The mechanism by which these adverse outcomes occur appears to be multifactorial and complex. Women who experience CMD during the perinatal period report experiencing multilevel, compound barriers to accessing effective, therapeutic care [40]. Such barriers include stigma and fear [41], limited perinatal mental health literacy [42], poor understanding and awareness of perinatal mental illness by maternity care providers, distance to services, fragmented referral pathways and sociocultural factors such as language barriers and cultural values [40]. The interplay between vulnerability and CMD is one that requires further examination to address the inequities that exist for women who are experiencing CMD complicated by social vulnerability. Callander, et al. (2021) evaluated the socioeconomic inequalities in costs and access to care for women with postpartum depression in Australia. They found that significant differences existed in the range of services accessed and the associated costs in relation to socioeconomic status. Women of higher socioeconomic status experienced greater access to inpatient, specialist services and psychiatric care in addition to antidepressants [43] indicating that disadvantage may further impact on the capacity to access care. Further to this, our study found that women from countries in which English is not the dominant language were much less likely to experience CMD than women who were born in Australia. Whilst this may initially have been interpreted as a positive finding, there is evidence that screening, diagnosis and management of CMD is inequitable for vulnerable groups such as ethnic minority women which may contribute to lower rates of diagnosis and subsequent treatment [44].

How maternity care is organised and delivered is a key factor in providing safe and responsive care to women with CMD acknowledging the complex social environments in which they exist. In a recent systematic review and meta-analysis of the uptake rates of referrals for women with positive perinatal depression screening results the authors found that close to 60% of women *do not* accept referral offers [45]. As stigma and fear of judgment is a barrier to seeking treatment for perinatal mental illness [41], models in which women feel supported, 'seen' and safe may facilitate and encourage disclosure and help-seeking behaviours. Relational care models such as midwifery continuity of care may improve detection and response to CMD in pregnant women [46]. Pregnancy is often the first sustained contact women have with the health system and midwives are well placed to perform screening, referral and intervention roles for women with CMD provided they are equipped with clear referral pathways and therapeutic approaches to manage disclosure [47,48]. Further to this, a recent systematic review and meta-analysis examining the effectiveness of nonspecialist-delivered interventions for perinatal mental health in high-income countries found that nonspecialist providers (that is, individuals with no formal training in mental health such as midwives) are effective in recognising and treating perinatal depressive and anxiety symptoms [49]. In addition, digital solutions for screening and treatment of CMD reduce the burden and cost of seeking treatment for disadvantaged or rural women and improve access to suitably qualified clinicians [50]. Collaborative care models with extended multidisciplinary teams and effective communication strategies can also improve access for vulnerable women [51].

Finally, perinatal care providers who approach care through a trauma-informed lens may diminish the impact of CMD on the mother and her newborn [52]. Pregnant women with a history of childhood abuse or family violence are at an increased risk of CMD *and* adverse pregnancy outcomes [53–55]. Clinicians caring for pregnant women should be trained in the therapeutic use of trauma-informed practices when working with potentially vulnerable women.

Strengths & limitations

This study included 597,522 singleton births and adequate statistical power or sensitivity to detect clinically relevant associations for adverse perinatal events. Data were collected over a period of eight years and selection bias was minimised as the data are a near complete record for a large population of childbearing women. The VPDC has been validated by researchers and found to demonstrate high levels of accuracy (90.2–100%) and may be reliably used for population health reporting and research [56].

For women experiencing CMD, pharmacotherapy is a common treatment modality, and some studies indicate this may be a mechanism through which perinatal outcomes may be affected [57]. Medication data for women during pregnancy was not available in the dataset used for this study.

Routinely collected population-based data is limited in terms of elucidating the social circumstances in which women live and this study was unable to consider factors such as family or intimate partner violence [58], maternal history of complex trauma [59], and social disadvantage [60] which can also contribute to CMD and independently impact on maternal and neonatal outcomes. Further to this, Indigenous status was not available in the dataset used for this study and poorer

perinatal outcomes have been demonstrated for Aboriginal women experiencing CMD [61].

Conclusion

Maternal CMD throughout pregnancy and the early postpartum period was associated with poorer perinatal outcomes for both the mother and her newborn compared to women not experiencing these disorders. The mechanisms underlying the association between maternal mental disorders and adverse outcomes most likely involves complex interactions between biological, psychosocial, and environmental factors which warrant further investigation to enable the development of public health strategies and education that support, destigmatise and value help seeking behaviours from preconception through to the postnatal period.

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