



School of Psychology

Ysgol Seicoleg

“Pregnancy related physical health conditions and postnatal PTSD: the identification of risk factors associated with PTSD severity postpartum”

and

“Testing a cognitive model in regard to posttraumatic stress disorder following Hyperemesis Gravidarum”

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Table of Contents

Preface.....	5
Acknowledgements.....	8
Paper one: Systematic Review.....	10
Abstract.....	11
Introduction.....	13
Method.....	17
Search strategy.....	18
Inclusion and exclusion criteria.....	18
Table 1: <i>Study inclusion and exclusion criteria</i>	20
Search Results.....	21
Figure 1: <i>Flow diagram of the research selection process</i>	22
Procedure.....	23
Results.....	24
Table 2: <i>Design characteristics of included studies</i>	26
PHCP and postpartum PTSD	31
Table 3: <i>Study analyses, results and limitations</i>	32
PTSD prevalence	40
Risk factors for postpartum PTSD.....	41
Ehlers and Clark’s cognitive model of PTSD.....	43
Psychosocial impact of postpartum PTSD following PHCP.....	44
Figure 2: <i>Risk and protective factors of postpartum PTSD symptoms following PHCP</i>	46
Discussion.....	47
Strengths and Limitations.....	51
Recommendations for research.....	54
Implications for clinical practice, policy and research.....	55
Conclusions.....	56
References.....	57

Paper Two: Empirical Study	69
Abstract.....	70
Introduction.....	72
Hypotheses.....	76
Method.....	77
Design.....	77
Participants.....	78
Measures and Procedure.....	79
Statistical analyses.....	83
Results.....	87
Tests of hypotheses:	
(H1) Women exposed to HG in pregnancy will display elevated rates of PTSD during the postnatal period.....	87
Figure 1: <i>Percentage of women self-reporting symptoms indicative of PTSD and women who did not meet the threshold for PTSD, across the three assessment time points</i>	89
Demographic and HG related predictors of PTSD.....	89
Table 1: <i>Pregnancy and HG characteristics of the sample</i>	90
Predictors of PTSD severity at six-months post.....	91
Table 2: <i>Demographic, clinical and HG risk factors for PTSD symptom frequency at six-months post</i>	92
Table 3: <i>Regression coefficients and standard errors for HG variables and depression scores pertaining to PTSD severity at six-months post</i>	93
(H2) Peritraumatic cognitive processing and disorganized trauma memories assessed at time 1 will prospectively be associated with severity of PTSD symptoms following HG.....	93
Table 4: <i>Spearman's correlation coefficients for clinical and cognitive processing variables and postpartum PTSD symptoms</i>	95
Table 5: <i>Regression coefficients and standard errors for trauma memory quality, persistent dissociation, posttraumatic cognitions and</i>	

<i>behavioural responses to intrusions pertaining to PTSD severity at six-months post</i>	97
(H3 and H4) Persistent dissociation will be associated with the severity of PTSD symptoms over and above peritraumatic cognitive processing (H3) and posttraumatic cognitions and behavioural responses to intrusions will be associated with additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation (H4).....	97
Table 6: <i>Variables included in the final stepwise hierarchical regression model associated with variance in PTSD symptom severity at six-months post</i>	98
Table 7: <i>Hierarchical Regression Analysis of variables associated with PTSD severity at six-months post</i>	99
Discussion.....	99
Strengths and limitations.....	106
Clinical implications.....	108
Future Research.....	109
Conclusions.....	110
References.....	112
List of appendices	127
Appendix 1: Submission guidance for the British Medical Journal.....	128
Appendix 2: Example of search strategy.....	131
Appendix 3: Description of pregnancy related illnesses.....	134
Appendix 4: CASP and STROBE quality rating scores.....	135
Appendix 5: Submission guidance for the Journal of Consulting and Clinical Psychology	140

Appendix 6: Copy of informed consent sheet..... 143

Appendix 7: Copy of debriefing form..... 149

Appendix 8: Copy of ethical approval..... 153

Preface

Maternal physical health conditions of pregnancy (PHCP) can negatively impact on the wellbeing of women and the development of their baby. However, the association between PHCP and postpartum posttraumatic stress disorder (PTSD) requires development. This thesis has been written in the format of two papers: a systematic review and an empirical research paper. Paper one presents a systematic review of the association between PHCP and postpartum PTSD symptoms. Paper two is an empirical research paper investigating a specific PHCP, Hyperemesis gravidarum (HG), and the development and maintenance of postpartum PTSD symptoms over a six-month period. HG is a complication of pregnancy characterised by severe nausea and vomiting. Significant psychological morbidity is associated with the condition, although there is little investigation specifically regarding PTSD following HG in pregnancy.

The systematic review paper had the following aims; (1) To systematically review the evidence regarding physical health conditions of pregnancy (PHCP) and postpartum PTSD; and (2) to identify risk factors for PTSD severity postpartum. Thirteen papers sampling 8172 women were identified. Pregnancy related conditions including abnormally invasive placenta, ectopic pregnancy, HG, peripartum cardiomyopathy and premature rupture of the membranes were associated with elevated rates of PTSD postpartum. Evidence regarding the association between pregnancy related hypertensive disorders and PTSD however, was mixed.

In accordance with Ehlers and Clarke's cognitive model of PTSD, findings from the systematic review indicate that PHCP are associated with postpartum

PTSD. Findings suggest that postpartum PTSD may evolve as a result of multiple risk factors, and that individual cognitive processing of an event may increase vulnerability to postpartum PTSD. Further investigation with more stringent and homogenous research designs is required however, as with the exception of HG and hypertensive disorders of pregnancy, all other associations between pregnancy conditions and postpartum PTSD came from single studies. Enhanced monitoring of women who have been exposed to PHCP during the postnatal period is advisable to detect postpartum PTSD symptoms and ensure adequate support for women at risk of postpartum PTSD.

The empirical research study aimed to test the following four hypotheses: that (1) Women exposed to HG in pregnancy will display elevated rates of PTSD during the postnatal period; (2) Peritraumatic cognitive processing and disorganized trauma memories assessed at time 1 will be associated with the severity of PTSD symptoms following HG at 6-months post initial assessment; (3) Persistent dissociation will be associated with the severity of PTSD symptoms over and above peritraumatic cognitive processing; (4) Posttraumatic cognitions and behavioural responses to intrusions will be associated with additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation. Women participated in the study shortly after birth (on average they were 1.8 months postpartum) and completed a series of questionnaires assessing for PTSD symptoms as well as questionnaires assessing factors identified as important in the development and maintenance of PTSD. Women then completed further questionnaires assessing PTSD symptoms at three- and six-months post initial-assessment.

The PTSD screening questionnaire indicated that 50.6% of the women who participated in the study met the criteria for PTSD at some point during the study. Postpartum PTSD symptoms were related to all factors of the Ehlers and Clark's (2000) cognitive model across all assessment time points, with the exception of deficits in intentional trauma-memory recall. The final hierarchical regression model found negative self-cognitions, and responding to intrusions using thought suppression and numbing to be significant individual predictors of PTSD severity at six-months post assessment, and accounted for 51.2% of the variance. Results therefore indicate that symptoms indicative of postpartum PTSD are common amongst women who have experienced HG. The CBT model proposed by Ehlers and Clark (2000) appears suitable for understanding and formulating PTSD symptom development and maintenance for this population.

Collectively, findings from both the systematic review and empirical paper highlight the need to be aware of the potential for maternal postpartum PTSD symptoms following PHCP. Increased understanding of- and possibly screening for- postpartum PTSD by obstetric care workers may help to identify women who would benefit from a referral for further psychological assessment and treatment.

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I also want to thank our wider circle of family and friends, who have provided us with continuous emotional and practical support. Again, I'm aware of how achieving this doctorate would have been a near impossibility if we had not had you all to lean on.

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Thank you also to all the amazing women who participated in the study and to the Pregnancy Sickness Support charity, who support women experiencing Hyperemesis Gravidarum and work hard to raise awareness of the condition.

Additionally, I would like to thank my elective clinical placement supervisor's Dr Adrian Thomas and Dr Benna Waites for compassionately supporting the balance of

work with general life, and for their ability to create pockets of psychological safety where I felt able to relax and reflect.

Finally, I have had the pleasure of be a member of two cohorts whilst on the psychology clinical doctorate and I want to say a heartfelt thank you to both. It is a real privilege to be able to work among peers who are so thoughtful and compassionate. You have helped shape to make the journey what it was, and it has been fabulous.

Paper One: Systematic Review

Pregnancy related physical health conditions and postnatal Post Traumatic Stress Disorder (PTSD): the identification of risk factors associated with PTSD severity postpartum (PROSPERO 2019: CRD42019141932)

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Word Count = 5800 (excluding tables, figures and references)

Paper one has been prepared in accordance with the submission guidelines for the *British Medical Journal* (Appendix 1). APA 7th formatting has been used throughout in line with the DClinPsy submission and the 8000-word count limit has been used to ensure all relevant information has been included for the examiner. For ease of reading, Tables and Figures have also been embedded in the main body of the paper, however will be placed in supplementary information for journal submission.

Abstract

Objectives: (1) To systematically review the evidence regarding physical health conditions of pregnancy (PHCP) and postpartum PTSD; and (2) to identify risk factors for PTSD severity postpartum.

Methods: Quantitative research investigating the association between PHCP and postpartum PTSD was synthesised and critically evaluated in accordance with PRISMA guidance. CINAHL, EMBASE, Medline, and PsycINFO databases were searched between July 2019-October 2020 using specific inclusion/exclusion criteria. Included papers were critically reviewed by two independent reviewers using the relevant Critical Appraisal Skills Program (CASP) checklists or Strengthening the Reporting of Observational studies in Epidemiology (STROBE) assessment tool. Risk factors for PTSD severity postpartum identified in the included studies were categorised in-line with the Ehlers and Clark's cognitive model of PTSD.

Results: Thirteen papers sampling 8172 women were identified, with methodological quality rated between acceptable-to-high. Pregnancy related conditions including abnormally invasive placenta, ectopic pregnancy, hyperemesis gravidarum, peripartum cardiomyopathy and premature rupture of the membranes are associated with elevated rates of PTSD postpartum. Evidence regarding the association between pregnancy related hypertensive disorders and PTSD is mixed. In accordance with Ehlers and Clarke's cognitive model of PTSD, findings indicate that

postpartum PTSD following exposure to a PHCP may evolve as a result of multiple risk factors, and that individual cognitive processing of an event may increase vulnerability to postpartum PTSD.

Strengths and Limitations: This is the first systematic review to evaluate quantitative research regarding PHCP and postpartum PTSD. Strengths include the comprehensive search strategy that aligns with the PRISMA guidance and the inclusion of studies that sample women from a broad age range and a variety of countries. Lack of replication and heterogeneity between studies limits comparisons and conclusions.

Conclusions: Postpartum PTSD is associated with PHCP. Further investigation with more stringent and homogenous research designs is required, as with the exception of hyperemesis gravidarum and hypertensive disorders of pregnancy, all other associations between pregnancy conditions and postpartum PTSD came from single studies. Enhanced monitoring of women who have been exposed to PHCP during the postnatal period is advisable to detect and ensure adequate support for women at risk of postpartum PTSD.

What is already known on this topic:

Evidence has shown that postpartum PTSD can occur in women following pregnancy and birth-related complications, and that postpartum PTSD can have negative outcomes for mothers, fathers and infants, as well as significant cost-implications for healthcare services.

What this systematic review adds:

Whilst the effects of birth-trauma and postpartum PTSD are comparatively well-researched, less is known regarding the effects of PTSD risk factors occurring prior to birth, which may lead to an underestimation of reported prevalence of postpartum PTSD and associated risk-factors. This systematic review is the first to critically synthesise and evaluate research regarding maternal physical health conditions related to the pregnant state and postpartum PTSD prevalence. Our findings indicate that it would be beneficial for healthcare professionals to broaden their focus from trauma occurring in the intrapartum period and to be aware of the risk of postpartum PTSD following physical health conditions associated with pregnancy.

Introduction

Post-traumatic stress disorder (PTSD) is defined as persistent symptoms of physiological arousal and psychological sensitivity following exposure to an extremely stressful event/s that are either life-threatening or perceived as such (American Psychiatric Association, APA, 2013; World Health Organisation, WHO, 2019). Individuals with PTSD experience persistent, involuntary and intrusive memories of the event, and may re-live the trauma through nightmares or flashbacks. PTSD sequela significantly impacts on day-to-day functioning and can result in negative alterations to mood, arousal and activity, as well as difficulties with concentration and sleep, overly negative thoughts and the avoidance of reminders of the trauma.

During the prenatal period there is the potential for women to be exposed to a range of physical complications that can pose a threat to both the life of the mother and/or her baby. These include, but are not limited to, physical health-related conditions of pregnancy (PHCP), such as hyperemesis gravidarum (HG), ectopic pregnancy, and hypertensive disorders of pregnancy (HDP), including preeclampsia and eclampsia. A recent meta-analysis of postpartum PTSD reported a prevalence rate of 4% in community samples and 18.5% in women considered high risk (Yildiz, Ayers, & Phillips, 2017), although 'high risk' in this study was mostly in relation to traumatic birth experiences rather than experiences occurring during the antenatal period.

Evidence has shown postpartum PTSD to have negative outcomes for mothers, fathers and infants. Associated difficulties identified in the literature include negative impacts on maternal and paternal wellbeing (Ayers et al., 2016; Ruffell, Smith & Wittkowski, 2019; Simpson et al., 2018), difficulties with bonding and breastfeeding (Abdollahpour, Khosravi, & Bolbolhaghghi, 2016; Ionio & Di Blasio, 2014; McDonald, Slade, Spiby, & Iles, 2011; Parfitt, Pike, & Ayers, 2013), disruption to personal relationships (Garthus-Niegel et al., 2018; Parfitt et al., 2013; Parfitt, Pike, & Ayers, 2014), and a detrimental impact on the cognitive and behavioural development of children (Ayers, 2007; Cook, Ayers, & Horsch, 2018; Enlow et al.,

2011; Simpson et al., 2018). Given that the cost of perinatal mental health is estimated to be over £8.1 billion for each annual birth cohort (The Mental Health Taskforce, 2016), effective management of postpartum PTSD could not only improve outcomes for women and their families, but help reduce the economic cost for health and social care services.

Pregnancy and delivery have the potential to fulfil the traumatic stressor criteria as defined in the Diagnostic and Statistical Manual (DSM 5, APA, 2013). Much of the research regarding postpartum PTSD pertains to birth trauma (Furuta, Sandall, & Bick, 2012; Yildiz et al., 2017), however, emerging evidence suggests that PHCP can be traumatising for women (Khoramroudi, 2018; Yildiz et al., 2017). Failing to consider the impact of traumatic experiences that occur prior to childbirth may result in the underestimation of the total prevalence of PTSD in the postpartum period, affecting the availability of support and care provisions available for women.

Evidence indicates that PHCP, such as HG, are associated with adverse psychosocial outcomes, including difficulties with breastfeeding, low self-esteem, social isolation, marital problems and loss of employment (Dean et al., 2018; Mitchell-Jones et al., 2017; Poursharif et al., 2006). Additionally, following PHCP, women have reported becoming fearful future pregnancies. Decisions around future family planning are therefore affected, with some women electing to terminate subsequent unplanned pregnancies (Poursharif et al. 2008; Dean et al. 2018). Studies have also indicated how health care professionals, social workers, and the general public can often underestimate the adverse impact of PHCP, such as HG, on women's lives (Dean & Marsden, 2017; Sykes et al., 2013), with women who

perceived their healthcare provider to be uncaring or unaware of the severity of their symptoms being more likely to report adverse psychological sequelae (Poursharif et al. 2006). Given the culturally positive connotations that are typically assumed around pregnancy, PTSD following PHCP is qualitatively different to what is traditionally considered to be a traumatic experience. Subsequently, postpartum PTSD as a consequence PHCP might not conform to Ehlers and Clark's (2000) cognitive model of PTSD and further investigation regarding the relationship between PHCP and postpartum PTSD is warranted to ensure effective support and improve maternal and infant outcomes.

The primary aim of this review is to systematically assess the evidence regarding a potential relationship between PHCP occurring prior to childbirth and the onset of postpartum PTSD. PTSD can occur any time during pregnancy, however for the purpose of this review PTSD during the postpartum period is qualitatively distinct in that the trauma is specifically pertaining to health-related conditions occurring as a consequence of pregnancy, and that these physiological conditions will have resolved with the pregnancy coming to an end.

Ehlers and Clark (2000) cognitive model is commonly used in the psychological formulation and treatment of PTSD. The cognitive model proposes that PTSD develops as a result of peritraumatic cognitive processes, which cause trauma memories to be low in quality and poorly integrated into the memory system. This

results in individual experience increased symptoms of hyperarousal, intrusions and avoidance. The sequelae of PTSD is maintained through a process of unhelpful cognitive and behavioural strategies, which are intended to control an individual's sense of threat, but inadvertently maintain PTSD symptomology. All components of the cognitive model have received empirical support (Ehlers, Ehring, & Kleim, 2012). However, evidence supporting the utility of the cognitive model in understanding and treating PTSD for women who have experienced PHCP is lesser established. This review aims to address a gap in the literature in order to improve understanding of the development and maintenance of postpartum PTSD following PHCP, to support the identification of women who may be at greater risk of developing the disorder.

Method

To examine the relationship between pregnancy complications and postnatal PTSD, the following review questions were developed:

1. Are PHCP associated with the development of postpartum PTSD?
2. What factors might mediate the development and maintenance of postpartum PTSD?
3. What is the impact of postpartum PTSD following the diagnosis of a PHCP?

Search Strategy

In consultation with an experienced medical research librarian, relevant published research articles were identified by a systematic search of the following databases: CINAHL, EMBASE, Medline, and PsycINFO. To maximise the sensitivity of the search, the search strategy involved using the field codes title, abstract or key concepts. The following search terms were grouped under three main headings and combined: antenatal; pregnancy complication, and postpartum posttraumatic stress disorder. See Appendix 2 for the complete search strategy.

Inclusion and exclusion criteria

The inclusion and exclusion criteria for this review are outlined in Table 1. Studies were included providing that they were reports of primary research and investigated maternal postpartum PTSD in relation to PHCP. Studies were excluded if they did not meet the definition of a PHCP or if maternal postpartum PTSD outcome data was not reported separately from other mental health outcomes.

Keywords related to postpartum PTSD were searched in combination with terms related to exposure and included complications such as "eclampsia", "pre-eclampsia", "diabetes", "hyperemesis" and "trophoblastic disease". Searches were restricted to peer-reviewed articles published in English between 1970 and August 2019, as articles published after 1970 contributed to the understanding of the effects of trauma on psychotic symptoms, as well as towards the official introduction of PTSD into the DSM-III (APA, 1980; Friedman, Keane, & Resick, 2007). All studies identified in the electronic search were first assessed for relevance by reviewing the titles, abstracts and descriptor/MeSH terms and filtered using the listed

inclusion/exclusion criteria. The electronic search was supplemented by a manual search of the reference lists in all "potentially relevant" studies, as well as by recommendations from key authors who were contacted. Searches were completed on July 2019 and updated in May 2021.

PHCP were defined as maternal physical health conditions that are linked specifically to the pregnant state using guidelines for '*pregnancy complications*' by the Centre for Disease, Control and Prevention (CDC, 2018), the Office on Women's Health (OWH, 2019), the International Statistics Classification of Diseases and Related Health Problems (ICD-11, WHO, 2019) and the British Medical Journal (BMJ, 2018). Conditions that arose or occurred incidentally in pregnant women, e.g., cardiac arrest or stroke, or coma, as well as miscarriage and foetal complications, were therefore excluded. Pregnancy illnesses searched included: eclampsia, preeclampsia, ectopic pregnancy, gestational diabetes, hemolysis, elevated liver enzymes, and low platelet count syndrome (HELLP), hyperemesis gravidarum (HG), placenta accrete, placenta praevia, abruption placentae, peripartum cardiopathy (PPCM) and preterm premature rupture of membranes (PPROM) (see Appendix 3 for a description of pregnancy related illnesses and list of abbreviations). Due to significant focus of research on maternal wellbeing pertaining to birth trauma, this review was limited to conditions occurring in the antenatal period (before birth) and therefore excludes conditions that are associated with birth trauma, such as postpartum haemorrhage.

Table 1*Study inclusion and exclusion criteria*

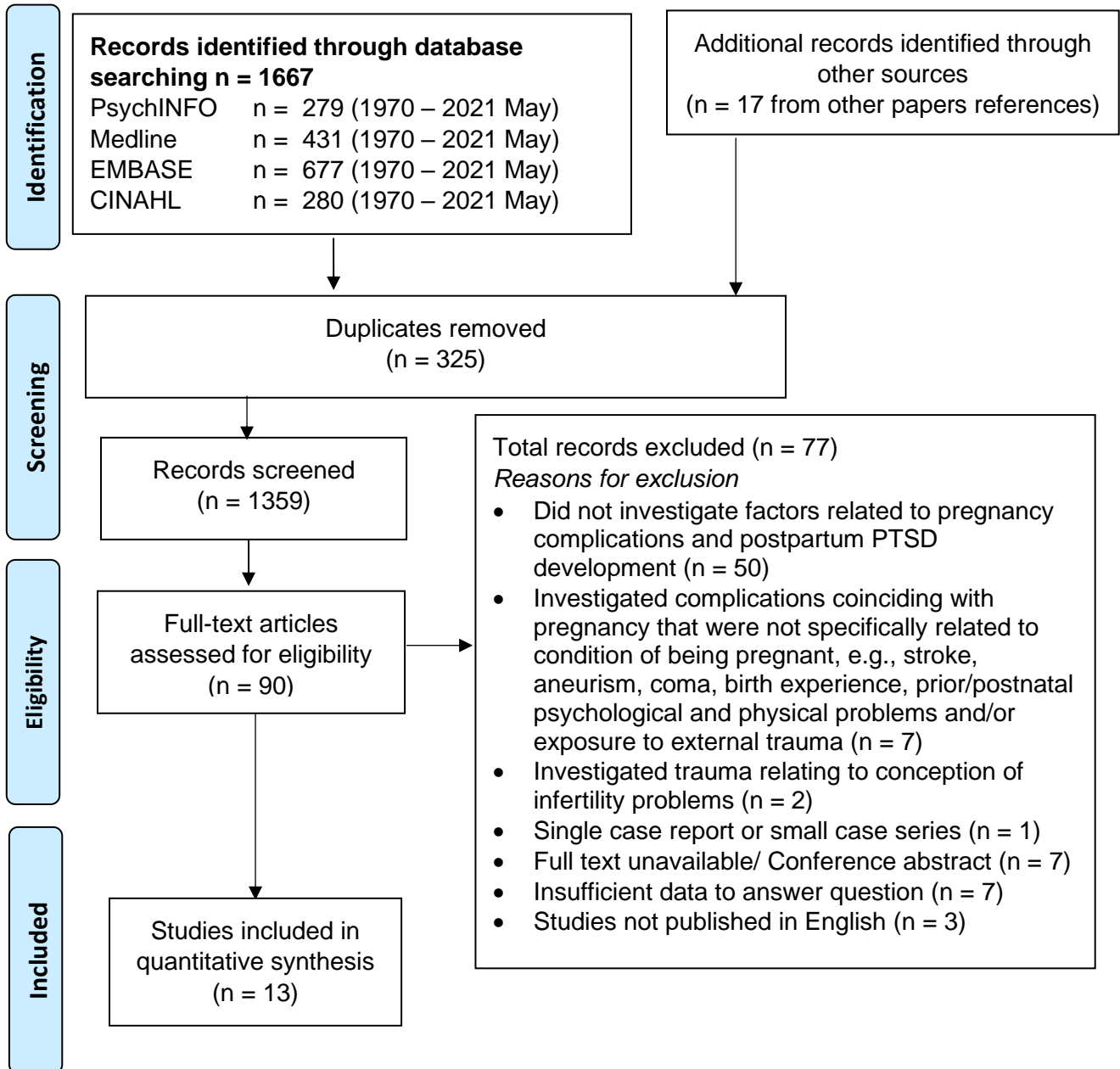
Inclusion	Exclusion
Research focus	
<ul style="list-style-type: none"> • Studies examining exposure to a physical health condition of pregnancy and post-partum PTSD • If co-morbid conditions are described (e.g., PTSD and depression), PTSD needs to be reported separately from other comorbid conditions 	<ul style="list-style-type: none"> • Studies investigating health complications coinciding with pregnancy, e.g., stroke, aneurism, coma and infections, which are not specifically related to condition of being pregnant itself • Studies looking at environmental, social or environmental risk factors in pregnancy and PTSD, such as conflict, natural disasters or accidents • Studies investigating PTSD unrelated to the index pregnancy, such as prior or postnatal psychological and physical problems • Studies looking at prevalence, experiences-of, coping strategies or treatment of PTSD only – needs to include correlates between PHCP in pregnancy and PTSD • Studies exploring PTSD related to childbirth or birth trauma • Studies investigating other postnatal psychological and physical problems
Population	
<ul style="list-style-type: none"> • Women who experienced a physical health condition or infection specifically related to the pregnant state, e.g., pre-eclampsia, HELLP syndrome, hyperemesis gravidarum 	<ul style="list-style-type: none"> • Women who have not experienced a health-related pregnancy complication
Setting/countries	
<ul style="list-style-type: none"> • No restriction 	<ul style="list-style-type: none"> • None
Study type/design	
<ul style="list-style-type: none"> • Cross sectional studies • Longitudinal studies • Experimental studies with relevant data 	<ul style="list-style-type: none"> • Single case reports or small case series • Qualitative studies • Systematic and narrative literature reviews • Letter, commentary, news or short communications • Repeated findings originated from same study • Studies with insufficient information to answer research question
Language	
<ul style="list-style-type: none"> • English 	<ul style="list-style-type: none"> • Non-English
Publication	
<ul style="list-style-type: none"> • Published in peer reviewed journals 	<ul style="list-style-type: none"> • Grey literature
Time Frame	
<ul style="list-style-type: none"> • Studies published after 1970 	<ul style="list-style-type: none"> • Studies published before 1970

Search results

The initial search identified 1683 articles. A total of 324 duplicates were removed and the remaining articles were screened for suitability in accordance with inclusion criteria. Review articles were excluded in order to reduce the risk of duplicating results or double reporting. Articles relating to physical childbirth trauma, or those that did not specifically investigate the relationship between a PHCP and PTSD, or sufficiently define or quantify PHCP were excluded. This resulted in 90 articles undergoing full-text review, with 13 studies meeting the inclusion criteria. The main reasons for exclusion were that factors related to pregnancy health complications and postpartum PTSD were not investigated (n = 50), that conditions that coincided with pregnancy, but were not specifically related to the condition of being pregnant were investigated (n = 7), that studies provided insufficient data to answer the research question (n = 7) or the full text was unavailable (n = 7). The search strategy was conducted using the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) guideline and checklist (Moher, Liberati, Tetzlaff, & Altman, 2009), as per Figure 1.

Figure 1

Flow diagram of the research selection process



Procedure

Initial screening was conducted by the primary reviewer. The inclusion of the studies was discussed with associate reviewers, with an independent reviewer screening 10% of all articles at the abstract and full-paper screening stages in order to reduce potential bias and increase screening accuracy (McDonagh et al., 2013). Two articles were queried for inclusion and conferred until a consensus was reached. The methodological quality of relevant studies was determined using standardised tools; the Critical Appraisal Skills Programme (CASP) tool was used for all cohort studies (CASP, 2014) and the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement checklist was used to evaluate cross-sectional and retrospective studies (Von Elm et al., 2007).

A summarised score of the STROBE and CASP checklists for each article was used to aid the comparison of quality across studies and reduce bias, as has been employed in previous systematic reviews (Rees, Channon, & Waters, 2019; Simpson et al., 2018). A score of two was given for 'yes', a score of one was given for 'can't tell' (suggesting there is partial support for the quality domain), and no score was awarded for an answer of 'no'. Scores across domains were then summed to provide a maximum quality score of 24 on the CASP and 60 on the STROBE. Studies that scored above 12 on the CASP and 30 on the STROBE were considered to be of a good standard in terms of quality of the research (See Appendix 4 for CASP/STROBE quality scores of studies). The independent reviewer also assessed the methodological quality of all included studies and disagreements were resolved by consensus. The total quality score for each study is included in Table 3.

Results

The 13 included studies sampled 8172 women of childbearing age, whose age ranged from 16 – 50 years, although this is an estimate as 10 studies did not report an upper age limit for participants. However, nine studies recruited women of childbearing age using either a cross-sectional or prospective design. The remaining two studies were retrospective in design. The first recruited women within two years of giving birth (Engelhard et al., 2002) and the second recruited women within an average of 7 years postpartum (Gaugler-Senden et al., 2012), suggesting age-ranges might not be dissimilar to those reported. Eight studies reported on HDP (Baecke et al., 2009; Engelhard et al., 2002; Gaugler-Senden et al., 2012; Hernández-Martínez et al. 2019a, 2019b; Hoedjes et al., 2011; Porcell et al., 2013; Stamrood et al., 2011a), two studies reported on HG (Christodoulou-Smith et al. 2011; Mullin et al., 2012), and single studies reported on the following conditions; AIP (Tol et al., 2019), ectopic pregnancy (Farren et al., 2020), PPRM (Stamrood et al., 2011a), and PPCM (Donnenwirth, Hess, & Ross, 2020). The majority of studies were conducted in Europe (n = 9), with one study being conducted in the USA (Mullin et al., 2012), and three studies recruiting women worldwide (Christodoulou-Smith et al. 2011; Donnenwirth et al., 2020; Porcel et al., 2013).

As outlined in Table 2, studies varied in their methodological approach as well as in regard to the assessment of postpartum PTSD. The most commonly used measure of PTSD was the IES (Weiss, 2007), which was used by four studies (Baecke et al., 2009; Donnenwirth et al., 2020; Gaugler-Senden et al., 2012; Tol et al., 2019), followed by the PSS (Foa et al., 1993) and the PPQ (DeMier et al., 1996),

which were each used twice by two studies (Engelhard et al., 2002; Hernández-Martínez et al. 2019a; 2019b; Stamrood et al., 2011a). Three studies used other validated measures (Farren et al., 2020; Porcel et al., 2013; Hoedjes et al., 2011), and two studies did not use a validated questionnaire (Christodoulou-Smith et al. 2011; Mullin et al., 2012). The methodological quality of the included studies ranged from acceptable to high, however inclusion of lower rated studies (e.g., Christodoulou-Smith et al. 2011; Hoedjes et al., 2011) did not affect conclusions regarding the association between PHCP and of postpartum PTSD. Study heterogeneity regarding the assessment of postpartum PTSD, the operationalisation of pregnancy related health-problems, and the controlling of potential confounds, limited comparisons between studies and negated a subsequent meta-analysis.

Table 2

Design characteristics of included studies

Authors	Pregnancy Condition	Design	Sample Size		Sampling method	Ethnicity of sample	Aim	Inclusion	Exclusion
			Total	Controls					
Baecke et al., 2009 Netherlands	HDP	Cross-sectional	169	72	Convenience sampling Women who were hospitalised between January 2003 and January 2005 for preterm pre-eclampsia (PPT), term pre-eclampsia (TPE), preterm birth (PT) or uneventful pregnancy (UP) received a set of questionnaires	Not reported	Evaluate cognitive complaints experienced after preeclampsia	Women hospitalised at the Radboud University Nijmegen Medical Centre between January 2003 and January 2005 for PPT, TPE, PT or UP. In the TPE group, women who delivered before 32 gestational Weeks and in the UP group, women delivered after 37 gestational weeks	Multiple pregnancies
Christodoulou-Smith et al. 2011 Worldwide	HG	Cross-sectional	610	233	Self-selecting sampling Women recruited via a website. Each case was asked to recruit a friend with at least two pregnancies that went beyond 27 weeks to participate as a control. All women completed online surveys	White (92%) and from USA (96%)	Explore posttraumatic stress symptoms (PTSS) and negative life outcomes following HG pregnancies	Women aged \geq 18 years with a diagnosis of HG and who had received treatment with IV fluids and/or total parenteral nutrition/nasogastric feeding tube. Recruitment was independent of hospitalization as some treatments were given to patients in an outpatient setting	Women aged < 18 or > 50 years. Women with multiple or abnormal gestations

Donnenwirth et al., 2020 Worldwide	PPCM	Cross-sectional	28	NA	Self-selecting Women recruited via Facebook PPCM support group. Participants completed online survey	White (92.86%)	Explore relationships between PPCM and maternal PTSD, depression, and quality of life	Women who have experienced PPCM. Aged ≥ 18 years	Women who have not experienced PPCM
Engelhard et al. 2002 Netherlands	HDP	Retrospective	225*	83	Convenience sampling Recruited Primiparous women who were hospitalised within two years of the study being conducted for PPT, PT, TPE, UP and their partners were invited (by telephone) to participate and sent questionnaires	Not reported	Explore whether PE is a risk factor for PTSD in women and their partners	Primiparous women aged ≥ 18 years	Women aged < 18 years at delivery. Women illiterate in Dutch, or those with pregnancy complicated by intrauterine foetal death.
Farren et al., 2020 England	Ectopic	Pros. cohort	246** <i>1-month post diagnosis</i> n = 75 <i>3-months</i> n = 68 <i>9-months</i> n = 53	171 <i>assessed at dating scan</i>	Convenience sampling Recruited pregnant women attending early pregnancy and antenatal clinics at 3 London hospitals, women were emailed questionnaires	Not reported	Investigate levels of PTS, depression, and anxiety in women in the 9 months after early pregnancy loss	Women who had received a diagnosis of a miscarriage (a small proportion of whom ultimately were diagnosed with a molar pregnancy) or an ectopic pregnancy or were classified as having a resolving or persistent pregnancy of unknown location. For the control group, women who had confirmation of viable pregnancy	Women aged < 18 years or whose gestation period was > 20 weeks. Women not proficient in English and unable to give informed consent. Women reporting a pregnancy loss due to voluntary termination or who were participating in other studies
Gaugler-Senden et al., 2012 Netherlands	HDP	Retrospective	182	78	Self-selecting - Pregnant women admitted to the Erasmus University Medical Center	White (93.5%)	Evaluate the impact of severe, early onset preeclampsia on long-term maternal	Women diagnosed with severe preeclampsia before 24 weeks' gestation	Women with major congenital anomalies

Rotterdam who delivered before 34 weeks' gestation were identified from the hospital database and matched with preterm controls. Participants were sent self-report questionnaires to complete

psychosocial outcome after preterm birth

Hernández-Martínez et al. 2019a Spain	HDP	Cross-sectional	2990	NA	Convenience sampling Women were approached who had received healthcare when giving birth in Spain in 2017 to complete an online questionnaire	Not reported	Determine the prevalence of PTSD at postpartum weeks 4 and 6, and its relation with perinatal variables and quality of life	Women aged ≥ 18 years who had received healthcare when giving birth in Spain in 2017	Women aged < 18 years or women who had births ending in foetal death
Hernández-Martínez et al. 2019b Spain	HDP	Cross-sectional	1531	NA	Convenience sampling Women were approached who had received healthcare when giving birth in Spain in 2017 to complete an online questionnaire.	Not reported	Determine the prevalence of PTSD symptoms after 1 year postpartum and their relationship with perinatal variables	Any women aged ≥ 18 years who had received healthcare when giving birth in Spain	Women aged < 18 years
Hoedjes et al. 2011 Netherlands	HDP	Pros. cohort	<i>6 weeks postpartum</i> n = 149 <i>12 weeks postpartum</i> n = 137	NA	Self-selecting Patients were selected by searching the birth records of four Dutch hospitals and invited to complete a questionnaire	Not reported, however sample was 95% Dutch	Describe the prevalence of postpartum PTSD based on the DSM-IV criteria, including its symptoms of intrusion, avoidance and hyperarousal after pregnancies complicated by preeclampsia, and examine which variables are associated with symptoms of PTSD	Women aged ≥ 18 years who had given birth between February 2007 and June 2009, and whose pregnancies had been complicated by preeclampsia. Women who understood and spoke the Dutch language	Women aged < 18 years

Mullin et al. 2012 USA	HG	Cross-sectional	395	194	Self-selecting Women recruited via websites, some participants invited others to participate, some participants heard about the study from articles, news stories. Participants completed online survey	White (92.9%)	Identify factors associated with prolonged HG	Women aged ≥ 18 years, with a diagnosis of HG and treatment with IV fluids and/or total parenteral nutrition /nasogastric feeding tube	Women aged < 18 or > 50 years at the time of first contact. Women with multiple or chromosomally abnormal gestations
Porcel et al. 2013 Worldwide	HDP	Cross-sectional	1446	372	Self-selecting Women were recruited via website or electronic newsletter inviting them to participate in the study and complete an online questionnaire	White (88.8%) Hispanic/Latino (3.5%) Black/African American (2.3%) Other (5.8%)	Determine the impact of self-reported history of HDP as a risk factor for screening positive for PTSD and to evaluate whether the risk of PTSD differed by severity of HDP	Women with a history of preeclampsia, who had their first pregnancy after 1990 and were not currently pregnant or had not been pregnant within 3 months of the study	Women who had their first pregnancy before 1990 and were currently pregnant or had given birth within 3 months of the study
Stramrood et al. 2011 Netherlands	HDP	Pros. cohort	<i>During pregnancy</i> n = 193 <i>6 weeks postpartum</i> n = 175 <i>15 months postpartum</i> n = 137	65	Convenience sampling Women hospitalised with PE or PPROM were recruited in the obstetric clinic of a University Medical Centre (2005-2008). Participants completed the Structured Clinical Interview for DSM-IV (SCID) at initial assessment, as well as self-report questionnaires	Not reported	Evaluate the prevalence of and risk factors for posttraumatic stress disorder (PTSD) in women with (PE) or preterm premature PPROM) compared to uncomplicated pregnancies	Women had singleton pregnancies and were native Dutch speakers	Women with multiple pregnancies, history of intrauterine foetal death, current alcohol or drugs dependence. Women with pre-existing medical conditions

Tol et al. 2019 UK	Abnormally Invasive Placenta (AIP)	Retrospective	69	NA	Convenience sampling Women who had been referred to specialist clinics were recruited, or controls who had delivered in the same obstetric unit as women who had. Women were identified using the theatre log books, placenta clinic records and/or hospital records. Women were sent questionnaires to complete	Not reported	Assess the risk of PTSD for women with AIP	Women aged ≥ 16 years, who were fluent in English and had given birth between September 2012 and September 2016	Women aged < 16 years who had not given birth in the allocated timeframe
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Definition of acronyms: **AIP** – Abnormally invasive placenta; **EPH** - Emergency peripartum hysterectomy; **HDP** – Hypertensive disorders of pregnancy (e.g., preeclampsia, eclampsia);

HG – Hyperemesis Gravidarum;

PE – Preeclampsia;

PPH – Postpartum haemorrhage;

PPROM – Preterm premature rupture of membranes;

PT – Preterm birth;

PPCM – Peripartum Cardiomyopathy;

PPT – Preeclampsia and preterm birth;

PTSD – Posttraumatic Stress Disorder;

UP – Uneventful pregnancy

* of this total sample size, 102 are male partners

** sample of cases relevant to this review (ectopic and control group), true sample size was much larger, n = 737

PHCP and postpartum PTSD

As outlined in Table 3, the majority of studies (n = 10) found PHCP to be a risk factor for postpartum PTSD (Christodoulou-Smith et al. 2011; Engelhard et al., 2002; Donnenwirth et al., 2020; Farren et al., 2020; Gaugler-Senden et al., 2012; Hoedjes et al., 2011; Mullin et al., 2012; Porcel et al., 2013; Stamrood et al., 2011a; Tol et al., 2019). Two studies reported HG as a risk factor (Christodoulou-Smith et al. 2011; Mullin et al., 2012), and single studies reported AIP (Tol et al., 2019), ectopic pregnancy (Farren et al., 2020), PPCM (Donnenwirth et al., 2020), and PPRM (Stamrood et al., 2011a) as risk factors. Evidence regarding HDP as a risk factor of postpartum PTSD was inconsistent. Five studies indicated that it was a risk factor (Engelhard et al., 2002; Gaugler-Senden et al., 2012; Hoedjes et al., 2011; Porcel et al., 2013; Stamrood et al., 2011a) and three indicated HDP was not (Baecke et al., 2009; Hernández-Martínez et al. 2019a; 2019b). Baecke et al. (2009) reported all women with PT delivery reported more symptoms of PTSD irrespective of whether they experienced PE or not, with women who experienced PE alone reporting the lowest scores on the IES, even when compared with uneventful pregnancies. The authors conclude that PT delivery is therefore more of a significant risk-factor. Both of Hernández-Martínez et al.'s studies were focused on numerous socio-demographic, as well as pregnancy and birth characteristics, of which hypertension in pregnancy and postpartum PTSD were included as a dichotomous answer of yes/no (Hernández-Martínez et al., 2019a; 2019b). Consequently, the design of these investigations may have affected reporting of PTSD symptoms.

Table 3

Study analyses, results and limitations

Authors	Exposure	Timing of assessment/s	Data Analyses	Findings	PTSD measure	PTSD Prevalence	Limitations: Sample bias, measurement bias and confounding factors	QR
Baecke et al., 2009	PPT vs TPE vs PT vs UP	Questionnaire sent 6 to 18 months post-partum	Descriptive statistics, ANOVA and ANCOVA	<p>HPD in pregnancy was not a significant risk factor for PTSD. All women with a PT delivery, irrespective of cause, reported more PTSD symptoms than women with term delivery. Women with PT delivery, irrespective of its cause also reported greater avoidance and intrusions symptoms.</p> <p>No significant differences between exposure groups regarding depression and trait anxiety scores. The percentage of women who had serious worries about a possible next pregnancy were sixfold for women with a PT delivery, irrespective of cause. In addition, the women with a PT delivery received four to five times more often help of a social worker after their problematic pregnancy</p>	<p>Dutch version of the Impact of Event Scale (IES)</p> <p>Totaled subscale scores indicative of PTSD severity</p>	<p>PPT 44% (n =21)</p> <p>PE 11% (n = 2)</p> <p>PT only 41% (n= 13)</p> <p>UP/Term birth 11% (n = 8)</p>	<p>Sample: Potential bias due to small sample size and no reporting of sample ethnicity</p> <p>Measurement: Self-report, rather than the gold standard of individualised assessment by a trained professional, may affect assessment of PTSD symptoms, therefore outcomes should be considered as estimates. The use of the IES means the PTSD symptom of hyperarousal cannot be assessed. Questionnaires completed over wide timespan (6-18 months) which could have biased assessment of PTSD symptoms</p> <p>Confounds: Prior history of mental health conditions was not assessed</p>	45
Christodoulou-Smith et al. 2011	HG vs no HG	Antenatally and then 1-month after due date	Chi-square analyses	<p>HG is a risk factor for PTSD at 1-month postpartum. Compared to controls, women with HG experienced significantly worse negative psychosocial outcomes after pregnancy, such as higher levels of missed time from work or school, higher rates of unemployment, greater problems with childcare, lower reported levels of self-care, higher incidence of marital problems and a greater number of psychiatric problems.</p> <p>Women experiencing postpartum PTSD following HG reported significantly greater levels of intrusions, avoidance and hyperarousal, than women with HG who did not</p>	Seven questions assessing the three PTSD symptom categories of re-experiencing, avoidance/numbing, and hyperarousal	18% (n = 68)	<p>Sample: Mostly White women (92%) from the USA (96%). Potential response bias, with women more severely affected physically and/or emotionally being more likely to participate</p> <p>Measurement: Use of an unvalidated measure to assess PTSD affects reliability and generalisability of findings, although authors report an expert on PTSD was consulted to support diagnostic criteria for this study. In addition, potential bias due to self-reporting of symptoms may contribute towards misclassification of PTSD symptoms and outcomes</p> <p>Confounds: Education level, marital status, and prior psychiatric history were not assessed</p>	36

Donnenwirth et al., 2020	PPCM	1 - 13 years post PPCM diagnosis (mean 3.6 years).	Pearson's correlations	<p>PPCM identified as a risk factor for postpartum PTSD symptoms. Twenty-three women (82.2%) reported a powerful or severe impact from PPCM, with seven women (25%) still reporting this impact four or more years after diagnosis.</p> <p>Women endorsed more intrusive than avoidance symptoms. PTSD symptoms were significantly associated with education level, with the 14 women (50%) who were not college graduates reporting a significantly higher PTS mean score.</p> <p>A significant, positive, strong correlation was found between PTSD symptoms and depression. A significant inverse correlation was found between PTSD symptoms and quality of life.</p>	IES PTSD >26	82.2% (n = 23)	<p>Sample: Small sample size limits power to detect clinically meaningful differences. Sample ethnicity consisted of women who were predominantly White</p> <p>Measurement: Self-report using IES may bias reporting of PTSD symptoms. Use of the IES means the PTSD symptom of hyperarousal cannot be assessed</p> <p>Confounds: Psychiatric history and demographic factors, such as marital status or income, were not assessed</p>	35
Engelhard et al. 2002	PPT vs PE vs PT vs UP	< 2 years postpartum, 15.3 months for term PE patients	Pearson 2 or Fisher's Exact Test, multiple regression, ANOVA	<p>PPT and PT are significant risk factors for postpartum PTSD. PTSD symptoms were more strongly associated with psychological factors than with objective indicators of condition-severity.</p> <p>Prevalence of PTSD in the PPT group was significantly higher than the UP, but not the PE group, suggesting that PE is psychologically stressful. Findings suggest that PE predisposes to PTSD, primarily, but not exclusively resulting from concomitant preterm birth. Therefore, symptom severity is not considered a risk factor for postpartum PTSD.</p> <p>When PE, PPT and PT groups were pooled, correlates of postpartum PTSD included peritraumatic dissociation, peritraumatic distress, negative interpretations of symptoms and thought suppression. The final regression model accounted for 61% of PTSD symptom variance. Peritraumatic dissociation, negative interpretations of symptoms and</p>	IES PTSD >25	PPT 28% PT 28% PE 17% UP 0	<p>Sample: Small sample size limits power to detect clinically meaningful differences. Sample ethnicity not reported</p> <p>Measurement: Self-reports used for preeclampsia occurring < 2 years ago and may be subject to recall and report bias, which might have resulted in an over or under-estimation of symptoms. The diagnoses of PTSD require a full interview and rates should therefore be viewed as estimates. The use of the IES means the PTSD symptom of hyperarousal cannot be assessed. PE and PT groups pooled together to analyses correlated of postpartum PTSD symptoms, therefore conclusions regarding the role of cognitive processes following PE are limited.</p> <p>Confounds: Psychiatric history was not assessed</p>	42

thought suppression were significant unique predictors.

Farren et al., 2020	Ectopic (and miscarriage vs. healthy pregnancy)	Months 1, 3, and 9 post diagnosis	Multivariate logistic regression	<p>High prevalence of PTSD following ectopic pregnancy at 1-9 months after pregnancy. This declined after time, but remained at clinically important levels. PTSD following ectopic pregnancy vs miscarriage is comparatively more persistent, as higher proportions of women met criteria for longer after ectopic pregnancy (30% of women with early pregnancy loss from miscarriage reported PTSD after 1 month and in 16% after 9 months).</p>	PTSD Symptom Scale (PSS)	<p>23% (n = 17) at 1-month (CI = 15-34),</p> <p>28% (n =19) at 2-months (CI = 19-40),</p> <p>21% (n = 11) at 9-months (CI = 12-34).</p>	<p>Sample: Small sample size and attrition rate means selection and participation bias must be considered. Sample ethnicity not reported</p> <p>Measurement: The timing of the assessment in the control group was not standardised, which could bias findings. Despite prevalence being high after ectopic pregnancies, confidence intervals are too wide for a robust comparison of how morbidity for ectopic, miscarriage and viable pregnancies changes over time. The utilisation of screening questionnaires means data should be viewed as estimates.</p> <p>Confounds: Demographic factors such as marital status or income were not assessed</p>	20
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High levels of moderate/severe anxiety and depression were also reported by women following ectopic pregnancy

Gaugler-Senden et al., 2012	Severe PPT vs. PT controls who had spontaneous preterm delivery	Retrospective timing, means ranged from 4 - 9 years, but was 7 years on average	T-tests, Chi-square, and Mann-Whitney test for bivariate analyses, where appropriate. ANCOVA was applied to compare adjusted values of IES for cases and controls.	Severe PPT increased severity of PTSD shortly after birth compared with PT only. There was no significant difference regarding PTSD prevalence between the two groups after birth.	Post-traumatic Stress Diagnostic Scale (PDS)	Severe PE with PT: 71.8% (n = 74*) at 1-month postpartum	Sample: Small sample size and response rate means selection and participation bias must be considered, as women with preeclampsia and preterm births had significantly higher response rate compared to controls	54
				Severity of PTSD significantly increased over time for both groups, however current prevalence of PTSD was significantly higher for women with severe PPT compared to PT only. This suggests PTSD following PT birth due to severe PE is more persistent.	PTSD ≥ 18	88.3% (n = 91) at 4-9 years	Measurement: Retrospective design means information regarding historic postpartum symptoms may be biased. It is generally known that exact recall of even very recent experiences can be extremely unreliable, especially when circumstances were very emotional or stressing. Furthermore, the use of self-report questionnaires means prevalence of PTSD symptomatology is estimated	
				Intrusion and avoidance symptoms were significantly associated with postpartum and current PTSD symptoms and depression symptoms, although there was no difference in depression scores between the two exposure groups, with depression improvements being similar over time.		PT only: 61.0% (n = 47) at 1-month postpartum		
				There were no significant differences between women with PPT and women with PT birth only regarding the effect on the quality of the relationship with husband/partner, relatives, and employer. Similar rates of divorce, conflict and future family planning were also reported, with both groups stating a negative change		77.9% (n = 60) at 4-9 years	Confounds: Psychosocial health status of participants before the index pregnancy was not reported so the relevance of pre-existing psychological or social problems on long-term outcome is unknown	
Hernández-Martínez et al. 2019a	Hypertension in pregnancy	4-6 weeks post-partum	Descriptive analysis, multivariate analysis, binary logistic regression	Pregnancy induced hypertension not identified as significant risk factors for postpartum PTSD	Perinatal Post-traumatic Stress Disorder Questionnaire (PPQ)	13.0% (n = 14)	Sample: Online questionnaire, which could affect participant selection and participation. Internet based research may represent women of higher education and income. Sample ethnicity not reported	39
					PTSD ≥ 19		Measurement: The PPQ has not been validated in a Spanish population. Did not define what is meant by pregnancy health complications so this variable could not be explored in relation to this review. The use of self-report, rather	

Hernández-Martínez et al. 2019b	Hypertension in pregnancy	1-5 years postpartum	Binary logistic regression	Pregnancy induced hypertension and pregnancy complications (although broader than the criteria specified for this review) were not identified as significant risk factors for postpartum PTSD	PPQ PTSD ≥ 19	5.0% (n = 3)	means outcomes should be considered as estimates	Confounds: Psychiatric history not assessed	Sample: Small sample. Women who were aware of birth trauma may have been more likely to participate due to study design. Sample ethnicity not reported	43
							Measurement: The PPQ has not been validated in a Spanish population. Did not define what is meant by pregnancy health complications so this variable could not be explored in relation to this review. The use of self-report, rather means outcomes should be considered as estimates	Confounds: Psychiatric history not assessed		

Hoedjes et al. 2011	Mild PE vs severe PE	Time 1: 6-weeks postpartum Time 2: 12-weeks postpartum	Descriptive analyses. Logistic regression analysis adjusted for confounders	<p>High prevalence of postpartum PTSD symptoms among women after PE, however PTSD prevalence was significantly higher among women with severe PE at both 6 and 12 weeks postpartum.</p> <p>PTSD symptoms improved over time for both the mild and severe PE groups, with no women with mild PE reporting PTSD symptoms at 12 weeks postpartum. For women with severe PE, the prevalence of PTSD symptoms of intrusion, avoidance and hyperarousal were higher than the mild preeclampsia group.</p> <p>Compared with women who had mild PE, women who experienced severe PE were younger, were more often admitted to the obstetric high care unit or intensive care unit, more likely to have had a caesarean section, had a lower gestational age at delivery, their children had a lower birth weight, and were more often admitted to the neonatal intensive care unit</p>	Dutch version of the self-rating scale. PTSD when stressor criterion met and one intrusion symptom, three avoidance symptoms and two hyperarousal symptoms scored ≥ 3	<p>Mild PE 3.0% (n = 1) at 6 weeks postpartum</p> <p>0 at 12 weeks postpartum</p> <p>Severe PE 10.5% (n = 12) at 6 weeks postpartum</p> <p>6.6% (n = 8) at 12 weeks postpartum</p>	<p>Sample: Possible selection bias as of the 255 eligible patients, 68% participated. No comparisons of differences between those that completed and those that dropped out. Relatively small sample size affects power. Sample ethnicity not reported</p> <p>Measurement: Self-report questionnaires, a full interview should preferably be used to measure symptoms of post-traumatic stress. Some data could not be calculated due to missing values, affecting some comparisons between mild and severe PE groups</p> <p>Confounds: Psychiatric history and demographic factors such as marital status or income, not assessed</p>	16
Mullin et al. 2012	HG long vs HG short vs no HG	Unclear, majority of participants joined during pregnancy and completed 1 month postpartum	Two-sided t-tests and F-test.	<p>Women with prolonged-HG (symptoms present until birth) were significantly more likely to experience PTSD, depression and anxiety, compared with controls and women with short-HG (symptoms of HG resolved before the end of the second trimester, 27 weeks).</p> <p>Women with prolonged HG were significantly younger (< 34 years) and weighed more than women with short-HG and controls.</p> <p>Poor maternal and infant outcomes were associated with prolonged HG, with women in this group reporting significantly greater irritability in children, higher rates of cholic and growth retardation</p>	No validated measure - patients self-reported if received a diagnosis and/or treated for PTSD	<p>10.2% (n = 13) in HG-Long</p> <p>1.2% (n = 1) in HG-Short</p> <p>0 of non-HG</p>	<p>Sample: Participants were primarily White, from the USA, older and with longer-lasting symptoms than the general affected population in the USA. This limitation may stem from the use of an internet-based survey</p> <p>Measurement: No validated measure of PTSD used. Study is based on self-reports, which can lead to misclassification of symptoms and outcomes. Small sample size and wide confidence intervals mean results should be interpreted cautiously</p> <p>Confounds: Age, prior psychiatric history, and prior pregnancy experiences were not explored</p>	40

Porcel et al. 2013	HDP vs. no history of HPD	Unclear, but would have been > 3 months postpartum	Logistic regression analysis	<p>Women with a history of HDP were more likely to screen positive for PTSD when compared to women with no HDP history. The risk of screening positive for PTSD increased as the severity of HDP increased from gestational hypertension to eclampsia.</p> <p>After adjusting for psychiatric treatment, parity, and age at affected pregnancy, women reporting a history of HDP were significantly more likely to respond affirmatively to all seven of the individual Breslau items for PTSD.</p> <p>Women with gestational hypertension and preeclampsia were more likely to screen positive for PTSD, after adjusting for covariates. By comparison, women with HELLP Syndrome were nearly six times as likely and women with eclampsia were ten times as likely to screen positive for PTSD when compared to women with a no history of HDP</p>	<p>Breslau Short Screening Scale for DSM-IV PTSD</p> <p>PTSD \geq 4</p>	<p>43% (n = 457) in HDP Group</p> <p>14% (n = 51) in non HDP Group</p>	<p>Sample: Possible selection bias due to use of website to recruit women. Sample consisted of predominantly White women, limiting generalisability of findings</p> <p>Measurement: Structured interviews were not performed in this study as the survey was conducted anonymously, and thus, confirmatory diagnosis of PTSD could not be made. Use of Breslau Short Screening Scale prevents assessment of intrusive PTSD symptoms. Cross-sectional design means a temporal relationship cannot be determined regarding HDP and PTSD. Potential recall bias as duration since pregnancy was not specified</p> <p>Confounds: Due to the nature of data collection the factor of psychiatric treatment may be overly conservative</p>	49
Stramrood et al. 2011	PE/ HELLP, vs PPRM vs UPR	<p>Time 1: During pregnancy</p> <p>Time 2: 6-weeks postpartum</p> <p>Time 3: 15-months postpartum</p>	Chi-square analyses, Spearman's rho, Kruskal-Wallis, and Mann-Whitney U tests.	<p>PTSD prevalence was significantly higher for women who experienced PE and PPRM, compared with controls. No significant differences were observed regarding the prevalence of PTSD between the PE and the PPRM group, suggesting conditions are similar in PTSD prognosis.</p> <p>PTSD prevalence increased between 6-12 weeks postpartum for women with PE, but decreased for women with PPRM and controls, indicating PTSD following PE is more persistent.</p> <p>Risk factors for postpartum PTSD were a self-reported history of depression, a high BDI score during hospitalisation, and infant death in the postpartum period.</p>	<p>PTSD Symptom Scale self-report questionnaire (PSS-SR)</p> <p>PTSD \geq 18 <i>Matched to Engelhard et al.'s scoring criteria</i></p>	<p>6-weeks postpartum 10.5% (n = 6) PE</p> <p>7% (n = 9) PPRM</p> <p>3.1% (n = 2) Controls</p> <p>15-months postpartum 11.4% (n = 5) PE</p> <p>3.2% (n = 1) PPRM</p> <p>0 controls</p>	<p>Sample: Potential bias due to small sample size. Systematic reporting of women not willing to participate would have strengthened assertion of having selected representative groups of women. Moreover, selective dropout occurred in the PPRM group, as women with PPRM not taking part in the 15-month follow-up reported more depression in history and during pregnancy, which may well have caused an underestimation of the prevalence rates of PTSD and depression at t3 in the PPRM group. Sample ethnicity not reported</p> <p>Measurement: The use of self-report questionnaires and the retrospective assessment may affect accuracy of results. The low response rate in the PPRM group at 15 months postpartum does not permit definite conclusions</p>	18

							regarding PPROM and postpartum PTSD prevalence	
							Confounds: Attrition at follow up in PPROM group was related to depression levels in pregnancy history so follow up results may have under-represented PTSD prevalence. Analyses did not include factors such as marital status and income	
Tol et al. 2019	AIP vs. uncomplicated CD vs. Clinic and CD vs. unexpected EPH and/or severe postpartum haemorrhage	< 3 years postpartum	Mann Whitney U and Fisher's exact test	Significantly higher PTSD scores observed for women with AIP compared to uncomplicated caesarean delivery. No significant difference was seen between AIP and EPH/PPH. The number of women with scores high enough to indicate probable PTSD was significantly greater with AIP than uncomplicated CD group. Suggests women antenatally diagnosed with AIP and anticipating a potentially traumatic delivery, are at significantly increased risk of developing PTSD.	Impacts of Events Scale-Revised (IES-R) PTSD ≥ 33	41.2% (n = 7) AIP 7.1% (n = 1) CD 31.8% (n = 7) unexpected EPH/PPH group 0 Clinic + CD	Sample: Small sample size prevented a power calculation as no effect size estimates were available in the literature. Sample ethnicity not reported Measurement: Majority of women who responded had given birth > 18 months ago (less than 3 years) meaning results could be subject to recall bias. The use of self-report questionnaires may create bias and the IES measure means the PTSD symptom of hyperarousal cannot be assessed. Confounds: Study did not record demographic variables or other variables that might have confounded results. Psychiatric history not assessed	42

Definition of acronyms:

AIP – Abnormally invasive placenta;
EPH - Emergency peripartum hysterectomy;
HDP – Hypertensive disorders of pregnancy (e.g., preeclampsia, eclampsia);
HG – Hyperemesis Gravidarum;
PE – Preeclampsia;
PPCM – Peripartum Cardiomyopathy
PPH – Postpartum haemorrhage;
PPROM – Preterm premature rupture of membranes;
PT – Preterm birth;
PPT – Preeclampsia and preterm birth;
UP – Uneventful pregnancy;
QR – Quality rating using CASP or STROBE (in italics)

PTSD Prevalence

The reported prevalence of postpartum PTSD following exposure to PHCP ranged from 1.2%- 88.3% (Table 3). Different PHCP have different symptom profiles, e.g., HG is characterised by severe levels of nausea and vomiting which can result in significant dehydration and malnutrition, whilst hypertensive disorders of pregnancy are characterised by high maternal blood pressure and can lead to complications such as kidney failure or placental abruption (where the placenta comes away from the wall of the uterus). This may affect generalisations across medical conditions and studies, although PHCP included in this review are alike in that they begin during pregnancy and if left untreated could prove fatal for the mother and/or her infant. Additionally, women's experiences of the severity of PHCP may vary, with only two studies exploring the impact of symptom severity of postpartum PTSD one study was in regard to mild vs. severe PE (Hoedjes et al., 2011) and the second was in regard to HG short vs. long symptom duration (Mullin et al., 2012). Both studies reported a greater prevalence of postpartum PTSM symptoms following more severe presentations, suggesting that the prevalence of postpartum PTSD following different PHCP is affected by symptom severity. Further exploration regarding the impact of PHCP severity on psychological morbidity is warranted to support understanding.

When multiple studies of the same PHCP were conducted (e.g., HG and HDP), prevalence estimates of PTSD varied both between and within studies (Table 3). For example, the prevalence of postpartum PTSD following HG identified by Mullin and colleagues (2012) ranged from 1.2%-10.2% depending on how long the symptoms of HG persisted for. Comparatively, sample prevalence of postpartum

PTSD following exposure to HG during pregnancy was reported at 18% by Christodoulou-Smith et al. (2011).

Risk factors for postpartum PTSD

Figure 2 outlines the risk and protective factors of postpartum PTSD following PHCP. Evidence across studies was mixed regarding the impact of factors such as age, educational status, parity, and months since child birth, with the risk of developing postpartum PTSD symptoms. For example, seven studies reported age was not a risk factor for postpartum PTSD (Christodoulou-Smith et al., 2011; Engelhard et al., 2002; Farren et al., 2020; Gaugler-Senden et al., 2012; Porcel et al., 2013; Stamrood et al., 2011a; Tol et al., 2019). Comparatively, five studies reported that older maternal age (ranging from 30 – 35 years or older) was protective (Baecke et al., 2009; Hernandez-Martinez et al., 2019a; 2019b; Hoedjes et al., 2011; Mullin et al., 2012), and one did not report on associations between maternal age and postpartum PTSD symptoms (Donnenwirth et al., 2020). Evidence regarding the association between parity and postpartum PTSD was similarly mixed (Table 3).

Four studies (ranging from 12 weeks to over 4 years in their assessment of PTSD symptoms) indicated that increased time since pregnancy was associated with a reduction in postpartum PTSD symptomatology (Farren et al., 2020; Hernández-Martínez et al., 2019a; 2019b; Stamrood et al., 2011a), although increased time since pregnancy was associated with a reduction of PTSD symptoms for women who experienced PPROM and controls only (Stamrood et al., 2011a). Two studies reported no significant effect of time (Donnenwirth et al., 2020; Stamrood et al.,

2011a), with Stamrood et al. reporting this effect for women who had experienced PE only. Comparatively, one study reported increased time (average seven years postpartum) was a risk factor for increased postpartum PTSD symptom severity for women who had experienced PE and PT births, when compared with postpartum PTSD assessed shortly after birth (Gaugler-Senden et al., 2012).

A single study reported lower levels of educational attainment to be risk factor for postpartum PTSD, with women who had experienced PTSD symptoms following PPCM being significantly less likely to have attained a college degree (Donnenwirth et al., 2020). Seven studies reported no association between educational level and postpartum PTSD (Baecke et al., 2009; Engelhard et al., 2002; Hernández-Martínez et al., 2019a; 2019b; Hoedjes et al., 2011; Porcel et al., 2013; Stamrood et al., 2011a). Of the two of the studies that assessed for prior psychiatric history, both reported that a history of depression was a significant risk factors for postpartum PTSD (Porcell et al., 2013; Stamrood et al., 2011a). Five studies reporting on ethnicity reported this was not a risk factor, however these studies sampled predominantly White women (Christodoulou-Smith et al., 2011; Donnenwirth et al., 2020; Hoedjes et al., 2001; Mullin et al., 2012; Porcel et al., 2013). Three studies indicated being married or cohabiting was did not affect reporting of postpartum PTSD symptoms (Donnenwirth et al., 2020; Engelhard et al., 2002; Stamrood et al., 2011a). Two studies suggested that employment status was not a risk factor for postpartum PTSD (Donnenwirth et al., 2020; Stamrood et al., 2011a).

Ehlers and Clark's cognitive model of PTSD

Across the seven the studies that investigated PTSD subscale symptoms of hyperarousal, avoidance and intrusions, six reported on the level of endorsement women gave these symptoms (Baecke et al., 2009; Christodoulou-Smith et al., 2011; Donnenwirth et al., 2020; Engelhard et al., 2002; Gaugler-Senden et al., 2012; Hoedjes et al., 2001; Porcell et al., 2013). One study did not report on subscale symptom prevalence for PTSD symptoms alone, instead reporting symptoms only in relation to a depressive symptom development pathway (Gaugler-Senden et al., 2012). Findings across studies were mixed regarding which PTSD symptoms were most frequently reported by women, with three studies indicating women experienced higher levels of intrusive symptoms following conditions of preeclampsia, HG and PPCM (Baecke et al., 2009; Christodoulou-Smith et al., 2011; Donnenwirth et al., 2020), two studies reporting comparatively higher levels of avoidance symptoms following preeclampsia and HDP (Engelhard et al., 2002; Porcel et al., 2013), and a single study reporting higher levels of avoidance symptoms following preeclampsia (Hoedjes et al., 2001). The use of different assessment measures to assess PTSD symptoms affects subscale symptom reporting and comparison. The IES, which was used by three studies (Baecke et al., 2009; Donnenwirth et al., 2020; Gaugler-Sendend et al., 2012), does not measure levels of hyperarousal, and the Breslau Short Screening Scale, which was used by Porcel et al. (2013), does not measure intrusive symptoms (Table 3).

A single study investigated additional key factors identified by Ehlers and Clark's (2000) cognitive model as important in the development and maintenance of PTSD. Engelhard et al. (2002) reported that key factors identified by the model, such

as peritraumatic dissociation, negative interpretations of symptoms and thought suppression were all significant unique predictors of PTSD variance in and collectively accounted for 61% of the variance of PTSD symptoms in women. Peritraumatic distress was an additional correlate, but was not a unique predictor of PTSD symptom severity in the final model.

In regard to stressor severity and PTSD, three studies reported greater severity of a PHCP to be a risk factor for postpartum PTSD symptomatology (Hoedjes et al., 2011; Mullin et al., 2012; Porcel et al., 2013). However, one study did not explore if the difference in symptom prevalence was significant between groups (Hoedjes et al., 2011). Furthermore, as these studies did not report on individual psychological processing characteristics, conclusions regarding individual processing characteristics and severity of pregnancy conditions cannot be estimated. A single study investigating both psychological factors and condition severity reported that PTSD symptoms to be more strongly related to individual psychological characteristics than with objective indicators of condition-severity (Engelhard et al., 2002).

Psychosocial impact of postpartum PTSD following PHCP
























Eight studies investigated the impact of postpartum PTSD on women and their families (Baecke et al., 2009; Christodoulou-Smith et al., 2011; Engelhard et al. 2002; Hoedjes et al., 2011; Farren et al., 2020; Gaugler-Senden et al., 2012; Stamrood et al., 2011a; Mullin et al., 2012). Three studies suggested postpartum PTSD was not a risk factor for postpartum depression (Baecke; Engelhard; Gaugler-

Senden et al., 2010; Stamrood et al., 2011a), although three studies reported higher levels of psychiatric problems following PHCP and postpartum PTSD (Christodoulou-Smith et al., 2011; Farren et al., 2020; Mullin et al., 2012). Two studies reported a negative effect on family planning and future pregnancies (Baecke et al., 2009; Gaugler-Senden., 2010), with a sixfold increase in worries of possible next pregnancy (Baecke et al., 2009). Postpartum PTSD following PHCP was also associated with higher rates of unemployment and increased marital problems (Christodoulou-Smith et al., 2011; Gaugler-Senden et al., 2012).

Figure 2.

Risk and protective factors of postpartum PTSD symptoms following PHCP

*Note: * indicates this was a recruitment exclusion criterion*

Key:														Total associated Risk (n = 21)	Total no associated risk (n = 37)	Total protective (n = 10)
	1. Baecke et al. (2009)	2. Christodoulou-Smith et al. (2011)	3. Donnenwirth et al. (2020)	4. Engelhard et al. (2002)	5. Farren et al. (2020)	6. Gaugler-Senden et al. (2012)	7. Hernández-Martínez et al. (2019a)	8. Hernández-Martínez et al. (2019b)	9. Hoedjes et al. (2011)	10. Mullin et al. (2012)	11. Porcell et al. (2013)	12. Stamrood et al. (2011)	13. Tol et al., (2019)			
 Risk factor for PTSD symptoms																
• Not a risk factor for PTSD symptoms																
 Protective factor against PTSD symptoms																
Abnormally Invasive Placenta (AIP)														1	0	0
Ectopic Pregnancy														1	0	0
Hyperemesis Gravidarum (HG)														2	0	0
Hypertension / eclampsia/ Preeclampsia / HELLP	•						•	•						5	3	0
Peripartum Cardiomyopathy (PPCM)														1	0	0
Preterm Premature rupture of membranes (PPROM)														1	0	0
Severity of PHCP condition				•										3	1	0
Age (years)	> 34	•		•	•	•	> 35	> 35	> 30	> 34	•	•	•	0	7	5
Ethnicity		•	•						•	•	•			0	5	0
Lower educational level	•			•			•	•	•		•	•		1	7	0
Married/cohabiting			•	•								•		0	3	0
Income/ employment status			•									•		0	2	0
Prior Psychiatric History														2	0	0
Multiparity	*	*	•						•	*	•	*		0	3	2
Primiparous			•						•		•	•		2	4	0
Increased time since PHCP			•		> 9 months			> 3 years	> 12 weeks				• PE	2	2	3

Discussion

This systematic review crucially evaluated quantitative research regarding the association between PHCP and postpartum PTSD. With the exception of HDP which had inconsistent findings, all other conditions identified by this review were associated with symptoms of postpartum PTSD. The severity of the PHCP, whether the index pregnancy was primiparous, prior psychiatric history, the duration of time since the PHCP was experienced, and a women's age and education level were found to affect the development of postpartum PTSD symptomatology, although results across studies were inconsistent. A single study investigated the applicability of factors identified as key in the cognitive model of PTSD (Ehlers and Clark, 2000) and reported this model was suitable in understanding postpartum PTSD symptoms for woman following preeclampsia (Engelhard et al., 2002). Postpartum PTSD was found to detrimentally affect maternal wellbeing, family planning decisions and occupational functioning. Evidence regarding conditions such as ectopic pregnancy, AIP, PPCM and PPRM came from single studies and therefore require further replication.

Inconsistencies and variations in relation to the prevalence of postpartum PTSD symptomatology could be due to methodological variations, with the quality rating of included studies ranging from low to medium. Only three studies were prospective in design, with the majority using a cross-sectional design to assess concurrent or retrospective exposure to a pregnancy related health condition and PTSD symptomatology. As such, causal inference is limited and the accuracy of reporting could be affected by recall bias (Van den Bergh & Walentynowicz, 2016).

The sample sizes employed by studies ranged from 69-2990, with four studies commenting on whether they had sufficient power to determine a clinically meaningful difference (Farren et al., 2020; Hoedjes et al., 2011; Stamrood et al., 2011a; Tol et al., 2019). Two studies reported that low power affected the ability to detect clinically meaningful significance (Hoedjes et al., 2011; Tol et al., 2019). The majority of studies included a control group as part of their sample (n = 8), which enabled postpartum PTSD prevalence rates following PHCP to be compared with prevalence rates of postpartum PTSD that may have occurred for other reasons.

There were discrepancies regarding demographic and obstetric characteristics and postpartum PTSD symptomology, with inconsistent findings regarding older age, parity, time since pregnancy, education level, and postpartum PTSD. Five studies reporting on ethnicity reported this was not a risk factor, however these studies sampled predominantly White women (Christodoulou-Smith et al., 2011; Donnenwirth et al., 2020; Hoedjes et al., 2001; Mullin et al., 2012; Porcel et al., 2013), affecting generalisability of findings. Notably, the majority of studies reported did not capture the ethnicity of the participants. Where diversity was monitored, the participants were predominantly White American or White European, as such caution must be applied when generalising findings across countries and populations.

The assessment of postpartum PTSD symptoms ranged across studies from one month postpartum (Christodoulou-Smith et al. 2011) to nine years postpartum (Gaugler-Senden et al., 2012; Stamrood et al., 2011a). Four studies indicated that postpartum PTSD symptoms were less likely to be reported with increased time since the PHCP was experienced (Donnenwirth et al., 2020; Farren et al., 2020;

Hernández- Martínez et al. 2019b; Hoedjes et al., 2011), and two studies indicated that increased time resulted in a worsening of PTSD symptoms for the conditions of HDP and PPRM (Gaugler-Senden et al., 2012). These findings are consistent with conflicting reports in the wider PTSD literature regarding the trajectory of postpartum PTSD for veterans (e.g., Yehuda et al., 2009 vs. O'Donnell et al., 2004), where studies indicate that heterogeneous trajectories of PTSD symptom clusters affect outcomes (O'Donnell et al., 2007).

Ehlers and Clarke's cognitive model of PTSD posits that the characteristics of trauma, the negative appraisal of the trauma and its sequelae, and unhelpful behavioural and cognitive strategies, such as avoidance and hyperarousal, contribute towards the development and maintenance of PTSD symptoms (Ehlers & Clark, 2000). Three studies identified by this review also indicated that the severity of the pregnancy condition was a risk factor for postpartum PTSD (Hoedjes et al., 2011, Mullin et al., 2012; Porcell et al., 2013), which is aligned with wider evidence regarding postpartum PTSD and severity of birth-trauma (Andersen et al., 2019; Stamrood et al., 2011b).

One study (Engelhard et al., 2002) reported no such effect of condition severity and found no significant differences in PTSD symptomatology between women with preeclampsia only compared with women who experienced preeclampsia and preterm birth. Furthermore, Englehard et al. (2002) was the only study to explore significant factors identified by the cognitive model as important in the development and maintenance of PTSD. Their final model found peritraumatic dissociation, negative interpretations of symptoms and thought suppression

accounted for 61% of PTSD symptoms in patients. Authors reported that PTSD symptoms were more strongly associated with psychological factors than with objective indicators of condition-severity. Findings may, however, be affected by ceiling effects given the reported rates of PTSD symptoms were high across both cohorts. Additionally, as the PE and PT groups were pooled for further analyses the final regression model does not account for the condition of PE alone. Consequently, the relationship between the characteristics of PHCP and postpartum PTSD warrants further investigation.

Collectively, findings regarding the development and maintenance of postpartum PTSD following PHCP indicate that the cognitive model of PTSD (Ehlers and Clark, 2000) is clinically viable for women who have experienced PHCP. Overall, the pattern of findings are remarkably similar to other PTSD populations, such as women experiencing birth trauma (Cook et al., 2018; King et al., 2017), as well as veterans (O'Donnell et al., 2007; Tsai & Pietrzak, 2017; Yehuda et al., 2009), with little or no negative data, and some missing data. Collectively, the findings support using NICE guidance approach within this population and lend support for the suitability of the cognitive model in conceptualising the development of postpartum PTSD for women following PHCP. Furthermore, findings suggest that postpartum PTSD following PHCP follow similar processes that are well-established in other populations, such as veterans (Vyas, Murphy, & Greenberg, 2020), although the role of individual psychological characteristics and postpartum PTSD symptomatology would benefit from further research.

Evidence regarding the impact of postpartum PTSD on maternal wellbeing and family functioning was mixed. Postpartum PTSD following PHCP was associated with worse negative psychosocial outcomes for women and their families, including a detrimental impact on work, higher rates of unemployment, increased marital problems, and worries regarding future family planning (Christodoulou-Smith et al., 2011; Gaugler-Senden et al., 2012). This is consistent with the wider literature regarding postpartum PTSD (Ayers et al., 2016; Cook et al., 2018; Ruffell, Smith & Wittkowski, 2019; Simpson et al., 2018).

Strengths and Limitations

This systematic review is the first to specifically synthesise and evaluate quantitative research regarding the association between maternal PHCP and postpartum PTSD. Strengths of the review include the robust and comprehensive search strategy, which adhered to the PRISMA guidelines to ensure methodological rigor. A range of studies conducted in a variety of countries, which were published in peer reviewed journals were identified and sample sizes represented women of a broad range of ages—thereby improving generalisability. The quality of the measurement of postpartum PTSD was generally high because well validated and standardised instruments were used, however none of the studies employed a the ‘gold standard’ structured psychiatric interview to identify PTSD (Nordgaard et al., 2012). Whilst self-reporting can reduce the risk of researcher bias, results are potentially affected by increased risk of responder bias as there may be differing interpretations of questions, affecting generalizability of findings.

There are several limitations to consider. First, the quality of studies incorporated in this review ranged from acceptable to high, with large heterogeneity. For example, measurement of postpartum PTSD across all studies relied entirely on self-report, which may increase the risk of reporting bias. Studies also employed a range of outcome measures to assess postpartum PTSD, with two studies not using a validated measure. Furthermore, there was variation between the four studies that used the IES for the assessment of PTSD, with one study using totalled subscale scores to estimate PTSD severity (Baecke et al., 2008), and others using different threshold cut-offs >19 (Gaugler-Senden et al., 2012), >25 (Christodoulou-Smith et al. 2011; Donnenwirth et al., 2020), and ≥ 33 (Tol et al.'s, 2019).

Evidence regarding the impact of PHCP also came from single/limited studies, with the exclusion of grey literature and the specification that studies incorporated in this review were printed in English. Furthermore, only six PHCP were identified by this review, which does not encapsulate the broad range of health complications that can arise in pregnancy. The comparison of different PHCPs and postpartum PTSD symptoms may also be affected by the differences in presentation and severity of symptoms associated with different PHCP. For example, HDP affects women differently to HG. Furthermore, only two studies investigated symptom severity (HG, Mullin et al., 2012 and PE, Hoedjes et al., 2011), with studies regarding HDP being mixed in their assessment of PE on its own and the comparison of PE with PPT. Collectively these studies may affect the generalisations of postpartum PTSD findings both between and within PHCP. The use of methodologically weaker studies did not affect overall findings of the review, and it was felt important to include studies of a lower quality due to the general paucity of research in this area.

Nonetheless, conclusions must be made conservatively, and further research and replication is warranted to verify conclusions. Conditions such as stillbirth and birth-related trauma were also excluded from this review, but may be a consequence of PHCP as these are potential triggers or mediators of PTSD (Cook et al., 2018; Simpson et al., 2018; Yildiz et al., 2017). The exclusion of these studies might therefore affect conclusions regarding the complexities of postpartum PTSD following PHCP. Furthermore, it is theorised that the findings of this review could be generalised to support understanding of the psychological impact of viral infections, such as Zika and Coronavirus on maternal risk of PTSD. Outcomes would be expected to follow a similar pattern as PHCP and result in PTSD, although further research is warranted.

Limitations also pertain to potential publication bias, arising from language restrictions, the inclusion of peer reviewed articles, the relative lack of publications from non-western countries, and the non-inclusion of grey literature. Furthermore, including qualitative research could have helped to enrich understanding of the impact and experiences of women with postpartum PTSD following pregnancy related health complications.

Due to the wide variability in healthcare systems across the globe, findings from a study reported in one country cannot necessarily be generalised to other nations. The studies identified by this review were predominantly conducted in European countries with primarily White women, and findings may therefore not be generalisable to women of different cultures. Women from ethnic minority groups are more likely to experience greater health disparities during pregnancy and healthcare

inequalities in regard to perinatal mental health support (Anderson et al., 2017; Prady et al., 2016; Watson et al., 2019). To ensure appropriate treatment for all women, it is important to explore the experiences of women from diverse ethnic backgrounds.

None of the identified studies used current DSM-V criteria to assess postpartum PTSD (APA, 2013). The DSM-V retains all 17 PTSD criteria of the DSM-IV, but expands the definition to improve diagnostic accuracy, with a greater focus on accompanying behavioural symptoms (for a comprehensive summary see Friedman, 2013; Friedman, Resick, Bryant, & Brewin, 2011). Alcorn et al. (2010) report that around 43% of women appraising their childbirth as a traumatic event meet current DSM-V criteria, however only 3.6% of these women met full criteria for PTSD according to the DSM-IV. The focus on DSM-IV diagnostic criteria by the selected studies may result in the under-estimation of the public health burden of postpartum PTSD. Thus, a more updated assessment tool may support the identification of more women who would benefit from support.

Recommendations for research

Research investigating the association between PHCP and postpartum PTSD is in its infancy with further replication required. Whilst evidence indicates PHCP are a risk factor for postpartum PTSD, there is a need for further prospective research using DSM-V criteria, which is conducted across low-income countries, middle-income countries and high-income countries, and with more homogenous and stringent research designs.

The findings of this review suggest that Ehlers and Clark's (2000) cognitive model of PTSD is applicable for women in the postpartum period following PHCP, and that National Institute for Health and Care Excellence (NICE) guidance regarding the treatment of PTSD would be beneficial for this population (NICE, 2018). To ensure intervention is best targeted to alleviate symptoms, further research is warranted regarding the specific risk and maintaining factors in women exposed to a PHCP. Furthermore, based on the multitude of identified risk factors for women who may develop postnatal PTSD, it would be advantageous to develop a specific predictive model of PTSD following exposure to PHCP. Such a model could help women experiencing postpartum PTSD to access needs-led evidence-based support, which is aligned with government healthcare objectives of improving access, outcomes and cost-efficacy of perinatal mental health care (NHS England and NHS Improvement, 2018; The Mental Health Taskforce, 2016).

Implications for clinical practice, policy and research

Postpartum PTSD can have a significant negative impact on women and their families (Cook et al., 2018; Simpson et al., 2018; Yildiz et al., 2017). Early detection and screening of PTSD however, improves symptom management, which in turn improves the physical and mental wellbeing of women and their families (O'Hara and Wisner, 2014). The findings of this review show that PHCP are a significant risk factor for postpartum PTSD and consequently, it would be advantageous for postpartum PTSD to be routinely screened in high-risk perinatal populations in order to support early detection and intervention. Evidence has shown that midwives are

often best placed to discuss perinatal mental health risk with pregnant women and yet they often receive inadequate perinatal mental health education and training, with a high proportion reporting receiving no mental health training at all (Higgins et al., 2018; Noonan et al., 2017; Smith et al., 2019). Consequently, in line with Public Health England directives (Care Quality Commission, Public Health England, National Health Service, 2015; Health Education England, 2017), raising awareness regarding the mental-health risks of exposure to PHCP could improve knowledge and understanding of the risks of postpartum mental health conditions, minimising the subsequent long-term burden of PTSD for women, children, and families, and reducing healthcare costs.

Conclusions

Findings from this review indicate that women are at risk of experiencing postpartum PTSD following exposure to PHCP, with prevalence rates as high as 88.3% reported. However, the aforementioned heterogeneity between studies, including differences in sample sizes, study design, measures of postpartum PTSD and assessment timings, affect comparisons between studies and limit the conclusions drawn regarding the relationship between PHCP and postpartum PTSD symptoms. The findings from this review indicate that it would be advantageous for healthcare professionals to monitor women for PTSD symptoms following PHCP to support health outcomes for both mother and baby.

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Paper Two: Empirical Study

Assessing the role of cognitive processing, trauma memory, and cognitive and behavioural responses and their association with postpartum PTSD following HG in pregnancy: ~~a prospective study~~

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Paper two has been prepared in accordance with the submission guidelines for the *Journal of Consulting and Clinical Psychology* (Appendix 5). APA 7th formatting has been used throughout, in line with both the DClinPsy submission and journal guidelines. For the purpose of the thesis submission, the 8000-word count limit has been used to ensure all relevant information has been included for the examiner. For ease of reading, Tables and Figures have also been embedded in the main body of the paper, however will be placed in supplementary information for journal submission.

Abstract

Objective: Hyperemesis gravidarum (HG) is a complication of pregnancy characterised by severe nausea and vomiting. Psychological morbidity is associated with the condition, although there is little investigation regarding posttraumatic stress disorder (PTSD) following HG. This study aimed to investigate whether successive levels of the theoretically-derived variables of Ehlers and Clark's cognitive model explained unique variance in postpartum PTSD symptoms following pregnancies affected by HG.

Method: In this online study, N = 50 women completed minimum number of measures across the three assessment timepoints, however sample size increased to 85 women following multiple imputation. Women completed the first set of assessment measures (time-1) when they were less than three months postpartum ($M = 1.8$ months postpartum). Questionnaires assessed characteristics of HG, PTSD symptom severity, and factors evidenced as important in the development and maintenance of PTSD according to Ehlers and Clark's cognitive model, such as peritraumatic cognitive processing, trauma memory quality, persistent dissociation and post-trauma cognitive and behavioural factors. Women were assessed again at three- and six-months post-initial assessment.

Results: PTSD symptoms were persistent, with 50.6% of women met criteria for PTSD at some point during the study. PTSD symptom severity was associated with processes specified in the Ehlers and Clark's cognitive model of PTSD, with the

exception of deficits in intentional trauma-memory recall. Trait dissociation, negative self-cognitions and responding to intrusions using thought suppression and numbing were associated with PTSD symptom severity at six-months. This final hierarchical multiple regression model accounted for 51.2% of the variance.

Conclusions. PTSD is highly prevalent amongst women who have experienced HG. Ehlers and Clark's theoretical model of PTSD is suitable for understanding and formulating PTSD symptom development and maintenance following exposure to HG during pregnancy.

Keywords

Hyperemesis Gravidarum, Postnatal, PTSD, Cognitive model, Traumatic, Dissociation, Cognitive predictors, Risk factors

Public Health Significance Statement:

This study strongly suggests that PTSD symptoms are highly prevalent and persistent amongst women who have experienced HG. The findings of the study also indicate that the Ehlers and Clark theoretical model of PTSD is suitable for understanding and formulating PTSD symptom development and maintenance following exposure to HG during pregnancy. Obstetric care workers need to be aware of possible PTSD symptoms for this population, with women being referred for further psychological assessment and treatment where appropriate.

Introduction

Nausea and vomiting in pregnancy are common, affecting up to 91% of pregnancies (Einarson et al., 2013). For most women, these symptoms will usually subside and do not cause significant problems. However, approximately 1%-3% of pregnancies are affected by hyperemesis gravidarum (HG), a maternal physical health condition of pregnancy that is characterised by severe and prolonged nausea and vomiting, typically occurring before the 22nd week of gestation (Einarson et al., 2013; McCarthy et al., 2014). HG can result in significant maternal morbidity and metabolic disturbances, including carbohydrate depletion, dehydration, electrolyte imbalance, large ketonuria, low infant birth weight, preterm birth, lower Apgar scores, and perinatal death (Dean et al., 2017; Dean & Murphy, 2015; Grooten et al., 2015; McCarthy et al., 2014; Neutel & Johansen, 2000; Niemeijer et al., 2014; Vandraas et al., 2013). Furthermore, HG has been shown to have a significant and prolonged impact regarding psychological, social and economic outcomes for women and their families (Christodoulou-Smith et al., 2011; Mitchell-Jones et al., 2017; 2020; Poursharif et al., 2008). The condition is the leading cause of hospitalization in the first half of pregnancy, second only to preterm labour (Fiaschi et al., 2016; McCarthy et al., 2014), with medical intervention serving to palliate HG symptoms, as presently there is no cure.

Post-traumatic stress disorder (PTSD) is a mental health condition that can arise following a traumatic event (American Psychiatric Association, APA, 2013; World Health Organisation, WHO, 2019). For most women, the experience of pregnancy is not traumatic and culturally has positive connotations. However, PTSD following pregnancy and/or birth has been shown to affect around 4-17% of women

during the postpartum period, or up to 43% of women identified as high-risk (Dikmen-Yildiz et al., 2017; Grekin & O'Hara, 2014; Khoramroudi, 2018).

Current diagnostic criteria for PTSD indicate a required exposure to actual or threatened death, serious injury, or sexual violence. The event must be preceded by symptoms from each of the following three core clusters: intrusions regarding the traumatic event; avoidance of traumatic reminders; and sense of a current threat manifested as hypervigilance and/or an exaggerated startle response (APA, 2013; International Classification of Diseases, ICD-11, WHO, 2019). The condition of HG is associated with numerous life-threatening complications for the mother and her infant (see Popa et al., 2021), with a recent qualitative review regarding women's experiences of HG identifying a theme of women fearing the possibility of their own death (Dean, Bannigan & Marsden, 2018). HG would therefore qualify as meeting the initial stressor criterion of exposure to actual or threatened death. Consequently, it is understandable how the condition of HG in pregnancy could result in development of PTSD in the postpartum period.

Research regarding psychological morbidity associated with HG is lacking and identified as a research priority (Dean et al., 2021). Particularly, there is a dearth of evidence for PTSD following HG, especially in comparison with other forms of psychological morbidity, such as depression and anxiety (Mitchell-Jones et al., 2017). A review of the literature identified only four studies investigating PTSD following exposure to HG during pregnancy (Christodoulou-Smith et al., 2011; Kjeldgaard et al., 2019; MacGregor, et al., 2019; Mullin et al., 2012). In each of these, exposure to HG during pregnancy was consistently associated with

postpartum PTSD symptoms. Two studies, which were cross-sectional in design and therefore cannot account for changes over time, reported postpartum PTSD prevalence rates ranging from 1.2%-18% following pregnancies affected by HG (Christodoulou-Smith et al., 2011; Mullin et al., 2012). An additional cross-sectional study, published as part of a clinical psychology doctoral research, reported a higher prevalence rate of symptoms indicative of postpartum PTSD of 40.6% (MacGregor, Waters & Penny, 2019). Only one study used a prospective cohort design, however this study prospectively investigated PTSD in relation to childbirth following a HG pregnancy and did not explore PTSD in relation to the condition of HG itself (Kjeldgaard et al., 2019).

Maternal PTSD has been linked to a wide range of negative perinatal outcomes, such as low birth weight and preterm birth (Cook et al., 2018; Oyetunji & Chandra, 2020), mother-infant bonding difficulties (Cook et al., 2018; Handelzalts et al., 2021; Ponti et al., 2020; Radoš et al., 2020), lower rates of breastfeeding (Cook et al., 2018; Garthus-Niegel et al., 2018; Oyetunji & Chandra, 2020), adverse developmental outcomes for offspring (Cook et al., 2018; Garthus-Niegel et al., 2018; Oyetunji & Chandra, 2020; Rees et al., 2019), and increased difficulties regarding partner relationships (Cook et al., 2018; Garthus-Niegel et al., 2018; Pisoni et al., 2020). Regarding HG, a single study reported postpartum PTSD following HG to be associated with increased difficulties with breastfeeding, elevated problems in the marital relationships and reduced levels of self-care (Christodoulou-Smith et al., 2011). Improving understanding of the mechanisms that are associated with the development and maintenance of postpartum PTSD symptoms following HG would

help to support maternal and infant outcomes, and improve access to effective treatment interventions where necessary.

Ehlers and Clark's (2000) cognitive model is widely used in the formulation of PTSD for adult populations who do not recover naturally following trauma. The model conceptualises how individual differences in cognitive responses can result in the development and maintenance of PTSD. It is theorised that during trauma, mechanisms such as state-dissociation and peritraumatic processing result in the creation of a fragmented and poorly integrated trauma memory. This trauma memory can become intrusive in nature and inadvertently be triggered by situations resembling similar aspects to the traumatic event. Unhelpful cognitive and behavioural responses that occur post-trauma, such as thought suppression, persistent dissociation and avoidance, serve to maintain feelings of distress. They also prevent the trauma memory and associated negative appraisals from being updated, which maintains a sense of current threat. Consequently, PTSD persists, resulting in increased levels of arousal and anxiety (Beierl et al., 2020; Halligan et al., 2003; Hiller et al., 2019; King et al., 2017; Marks et al., 2018; Wiedemann et al., 2020).

In the wider literature, theoretically derived factors identified by Ehlers and Clark's (2000) cognitive model have been shown to be helpful in understanding the development and maintenance of maternal postpartum PTSD symptoms following exposure to a birth-related trauma (Andersen et al., 2012; Cook et al., 2018; Furuta et al., 2012; Grekin & O'Hara, 2014; Olde et al., 2005; Simpson et al., 2018). However, only two cross-sectional studies have investigated theoretically derived

variables of the Ehlers & Clark model following exposure to HG (Christodoulou-Smith et al., 2011; MacGregor et al., 2019). In these studies, women who had experienced HG in pregnancy and met the full criteria for symptoms indicative of PTSD in the postpartum period, reported greater levels of hyperarousal, intrusions, negative cognitions about the self, and avoidance symptoms. Macgregor et al. (2019) reported that cognitive behavioural predictors accounted for 62.3% of the variance of postpartum PTSD symptoms. Evidently, a prospective design would further support understanding regarding the development, course and maintenance of PTSD symptoms following HG in the postpartum period.

The present study aims to test the applicability of the Ehlers and Clark's (2000) cognitive model of PTSD for women who have been exposed to HG during pregnancy. Each of the theorised components of Ehlers and Clark's cognitive model are investigated following the birth of women's babies, including the relationship between cognitive processing variables (e.g., data-driven processing, self-referent processing, and dissociation), the quality of trauma memory, persistent dissociation, and posttraumatic cognitions and behavioural responses to intrusions in maintaining PTSD symptoms. The study aims to determine which of these factors are associated with PTSD symptom severity following a pregnancy complicated by HG.

The following hypotheses are addressed:

1. Women exposed to HG in pregnancy will display elevated rates of PTSD during the postnatal period.

2. Peritraumatic cognitive processing and disorganized trauma memories assessed at time 1 will be associated with severity of PTSD symptoms following HG
3. Persistent dissociation will be associated with the severity of PTSD symptoms over and above peritraumatic cognitive processing
4. Posttraumatic cognitions and behavioural responses to intrusions will predict additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation.

Method

Design

A longitudinal design was employed with questionnaire assessments at three time points. Women were assessed following the birth of their babies, with women on average completing the first assessment regarding cognitive processing variables (Time 1) at 1.8 months postpartum, with subsequent assessments regarding PTSD symptoms severity completed at three and six months post-initial assessment. Women were recruited between April 2019 and May 2019. The study had been approved by Cardiff University Research Ethics Committee.

A survey was developed using Qualtrics, an online survey tool that enables anonymous participation. Women were recruited from a variety of online platforms with advertisements and a weblink to the study placed on mumsnet, Instagram, and multiple Facebook groups. The study was also promoted by the charity HG

Pregnancy Sickness Support. Women accessed a weblink that directed them to the Qualtrics survey, where full details of the study were available and women could provide formal consent to participate. Women were automatically redirected to an exit page if any of the consent items were not endorsed, with a list of organisations offering support and relevant contact information being provided to individuals when the survey ended. An a priori power calculation assuming a medium effect size of 0.15, α error probability = .05, power ($1 - \beta$ err prob) = .80 for a hierarchical regression analysis using 29 predictor variables was used and estimated a recruitment target of 184 women.

Participants

Women were eligible for inclusion if they were aged over 18 years, could speak English, and self-reported experiencing HG in pregnancy in accordance to the study criteria. In order to participate women had to either be experiencing HG currently or have experienced HG less than three months ago.

Characteristics of the sample are summarised in Table 1. In total following MI $n = 85$ women participated in the current study. The mean age of the women at the first assessment was 31.55 years, $SD = 4.68$ (range = 21-42 years), with 96.4% ($n = 82$) of women being of white ethnic origin and 89.41% ($n = 76$) reporting English being their first language. The modal income ranged between £30-60000, with women from a wide range of incomes being represented. None of the women who participated were single, with 77.65% ($n = 66$) of women being married, 18.82% ($n = 16$) living with their partner, and 2.35% ($n = 2$) of women not living with their partner.

Forty five percent of women (n = 39) reported seeing a GP for problems pertaining to functional mental health, with 7.1% (n = 6) women specifically seeking support for PTSD in relation to HG. All of the women who partook in the study reported being prescribed medication for HG.

Measures and Procedure

Participants completed a battery of self-report questionnaires pertaining to demographic and obstetric history. Demographic data collected included age, marital status, educational level, household income, country of residence, ethnicity, and whether English was the woman's first language. Data related to mental health history and prior treatment for PTSD was also collected. Pregnancy and HG related information included: whether or not a formal diagnosis of HG had been made by a healthcare professional, when symptoms of HG were first experienced and for how long they lasted, number of times vomiting a day, number of hours felt nauseous for, total weight loss experienced because of HG, whether expected weight gain was met, whether medication was prescribed to manage HG, weeks since HG symptoms were last experienced, number of previous pregnancies, number of pregnancies where HG was experienced, familial history of HG, and whether professional support services were accessed.

Posttraumatic Stress Disorder Symptoms

The Posttraumatic Diagnostic Scale for DSM-5 (PDS-5; Foa et al. 2016) is a validated self-report measure of DSM-5 PTSD criteria (range 0–80) (APA, 2013). The PDS-5 has been shown to have excellent internal consistency ($\alpha = .94$) and test-

retest reliability (0.88; Foa et al., 2016), with good psychometric properties reported for a postpartum population (Tasuji et al., 2020). PTSD symptom severity is determined by totalling the 20 PDS-5 symptom ratings, with a score of 28 or above indicating a probable diagnosis of PTSD. In the present study, the internal consistency (Cronbach's α) for PDS-5 was high, rated .937 for the initial assessment (time 1), .948 for the second assessment (three-months post time 1), and .962 for the third assessment (six-months post time 1).

Peritraumatic cognitive processing measures (assessed at time 1 only)

Three questionnaires with good psychometric properties (Halligan et al., 2002; Halligan et al., 2003; King et al., 2017; Murray et al., 2002; Murray, 1997), were used to assess peritraumatic processing:

The State Dissociation Questionnaire (SDQ; Murray et al., 2002) comprises of 9-items, which measure dissociative experiences such as detachment, depersonalisation, derealisation, emotional numbing and an altered sense of time.

The Data-Driven Processing Scale (DDPS; Halligan et al., 2003) is an 8-item questionnaire that measures the level of perceptual processing a person is engaged with during a traumatic experience. Higher levels of data-driven processing increase the risk of PTSD development as processing is less likely to be detailed and elaborative.

The Lack of Self-Referent Processing Scale (LSRP; Halligan et al., 2003) is an 8-item questionnaire that evaluates the extent to which a person processes a traumatic experience as happening to themselves and their integration of the experience with other autobiographical information. These three measures have been shown to have adequate psychometric properties in a postpartum population (King et al., 2017). For the current study, Cronbach's alpha reliability coefficients were .917 (SDQ), .920 (DDPS), .879 (LSRP).

Nature of Trauma Memory Quality

The Trauma Memory Questionnaire (TMQ; Halligan et al., 2002) is a 16-item questionnaire that contains three subscales measuring the nature of the trauma memory: deficits in intentional recall (the extent to which the trauma memory is incomplete or disorganised), intrusions, and negative appraisals of deficits in recall (e.g., I find my inability to remember things about the trauma frustrating/distressing). Participants rate their response to each item on a five-point Likert scale (0 = not at all to 5 = very strongly). The TMQ has good reliability (Halligan et al., 2002; Halligan et al., 2003), and been shown to have good psychometric properties in a postpartum population (King et al., 2017). Cronbach's alpha reliability coefficients for the subscales in current study were .948 (deficits in intentional recall), .719 (negative appraisal of deficit in intentional recall), and .933 (intrusions), with .915 for the total score.

Levels of persistent dissociation

The Trait Dissociation Questionnaire (TDQ; Murray, 1997) is a 38-item questionnaire that measures seven aspects of persistent dissociation:

detachment from others and the world, sense of split self, labile mood and impulsiveness, inattention and memory lapses, emotional numbing, confusion and altered sense of time, and amnesia for important life events. For the current study, Cronbach's alpha reliability for the total score was .966.

Negative appraisals of trauma and/or its sequelae

The Post-Traumatic Cognitions Inventory (PTCI; Foa et al., 1999) is a 36-item measure of trauma-related thoughts and beliefs. The scale assesses three dimensions of traumatic thoughts: negative cognitions about the self (including questions regarding general negative self-view, permanent change, alienation, hopelessness, self-trust and negative interpretation of symptoms), negative cognitions about the world (including questions regarding an unsafe world and mistrust of other people) and self-blame. Questions are answered on a 7-point Likert scale, ranging from "totally agree" to "totally disagree". Good psychometric properties in postpartum populations have been reported (Ford et al., 2010; King et al., 2017). In the present study, Cronbach's alpha reliability coefficients were calculated to be .955 (negative self-cognitions), .896 (negative world cognitions), and .809 (self-blame), with .972 for the total.

Dysfunctional cognitive and behavioural strategies

The Response to Intrusions Questionnaire (RIQ; Clohessy & Ehlers, 1999) was adapted for perinatal context by King et al. (2017). The self-report questionnaire consists of 19-items and has been validated in a perinatal population (King et al.,

2017). The Perinatal RIQ contains three subscales: efforts to suppress thoughts and intrusions, rumination and numbing. In the present study, Cronbach's alpha reliability coefficients were calculated to be .908 (thought suppression), .889 (rumination), and .780 (numbing), with .923 for the total.

Reliability Measure

Conscientious Responders Scale (CRS; Marjanovic et al., 2014). To support the validity of responses, two questions from the CRS were embedded throughout the questionnaire batteries across the three-assessment time-points. The CRS has been shown to correctly classify responses as either conscientious or random with more than 93% accuracy (Marjanovic et al., 2014). Results indicated that at across each of the three assessment time points there were only two random answers on the CRS by two separate women, giving an accuracy response rate across the three time points of 99.61%, supporting the validity of responses.

Statistical analyses

Data was analysed using Statistical Program for Social Sciences (SPSS) version 26. Descriptive statistics were generated for all demographic, obstetric, HG, and pregnancy-related outcome variables, with participants categorized as exhibiting full criteria for PTSD if they scored above the threshold of 28 on the PDS-5 (Foa et al., 2016). Statistical significance was assumed at a p value of 0.05 or less unless stated otherwise. Log transformations were performed and normality reassessed for the 26 variables that violated normality assumptions, however following this procedure only an additional two variables met the assumption of normality, with the

dependent variable of PTSD severity continuing to violate normality assumptions. Consequently, non-parametric testing was used to analyse univariate relationships.

Hierarchical regression was used to assess the four hypotheses that tested whether successive levels of the proposed model would be associated with unique variance in PTSD symptom severity. It was hypothesised that (1) Women exposed to HG in pregnancy will display elevated rates of PTSD during the postnatal period; (2) Peritraumatic cognitive processing and disorganized trauma memories assessed at time-1 will be associated with severity of PTSD symptoms following HG; (3) Persistent dissociation will be associated with the severity of PTSD symptoms over and above peritraumatic cognitive processing; (4) Posttraumatic cognitions and behavioural responses to intrusions will be associated with additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation.

Only variables that had a significant relationship with the post-traumatic stress (PDS-5) total score at final assessment phase were included in subsequent regression analyses. Correlation coefficients were calculated between all independent continuous variables and assumptions for regression were assessed. The final regression model met assumptions regarding the linearity of relationships, absence of collinearity, independence of errors and homoscedasticity. Due to recruitment targets not being met, post-hoc power calculations indicated the final hierarchical regression analysis had sufficient strength and power ($1 - \beta$ err prob) = 1.00, attributable to the medium reported effect size ($F^2 = 1.05$).

Data from this study is drawn from a larger dataset collected by author. Of the total sample selected for this study ($n = 85$ following multiple imputation), 58.82% ($n = 50$) of women completed the minimum amount of data necessary for the present study across each of the three time-points. A total of 24.71% ($n = 21$) of women did not complete the second survey and 16.47% ($n = 14$) of women completed only the first and final assessment. The attrition rate reported by this study is similar to other longitudinal studies in perinatal research (Gustavson et al., 2012; Underwood et al., 2016; Wolke et al., 2009).

The coronavirus pandemic occurred during the latter stages of data collection and was concurrent with the collection of five women's final assessments. Analyses showed that there were no significant differences in regard to PTSD symptom prevalence $\chi^2(1) = .625$, $p = .676$ or PTSD symptom severity ($p < .05$) between women whose responses were collected during the pandemic and women whose responses were collected before it.

Analyses of missing values at the item level of raw data indicated missing values of 6.573% ($n = 1190/16195$). Little's missing completely at random (MCAR) test indicated that results were missing at random and that missing responses were not dependent on observed values of other variables in the analysis ($\chi^2(4719) = 39.773$, $p = 1.00$). Additional comparisons between the three groups (those who completed all three time points and those who completed the initial assessment and at least one other time point) were conducted across all outcome variables at the initial assessment (T1) and indicated no significant differences between groups.

Multiple imputation (MI) can be used when a large proportion of data are missing and does not increase bias, even when the proportion of missingness is large (Madley-Dowd et al., 2019; Sterne et al., 2009). Missing data often occurs in longitudinal studies and can result in bias and reduced statistical power and sample representativeness. There are a variety of approaches for dealing with missing data, such as listwise-deletion, last observation carried forward or mean substitution case analysis (for a summary see Kang, 2013). However, dissimilar to more commonly used single-imputation methods, MI serves to maintain the relationship between the imputed data values and other auxiliary variables in the dataset using a bayesian approach to predict missing values (Sterne et al., 2009). This means that imputed data values are predicted using the distribution based on the existing values in the observed dataset. Multiple imputed data sets are generated (hence "multiple imputation"), which are then combined to give a single overall analysis result. The creation of several different plausible imputed data sets and the effective amalgamation of results obtained from each of them helps to maintain the variability and uncertainty of missing values (Kang, 2013). Consequently, MI is increasingly recognised as an effective means of increasing precision and helping to reduce bias when datasets are incomplete (Sterne et al., 2009).

Analysis indicated that groups did not differ in regard to the four severity indicators of HG and did not differ in regard to any outcome scores at the initial assessment, including the dependent variable of PTSD severity, MI by predictive mean matching was performed to estimate missing values of both outcome and

subscale predictor variables. To retain the largest number of cases in the sample and improve power and reduce bias, women who had completed at least the initial assessment and one other subsequent assessment (e.g., the initial assessment and either the second or third assessment) who had data missing, had their data imputed (Azur et al., 2011; Little & Rubin, 2002; Schafer, 1999). This increased the initial sample size from 50 women who had completed the minimum data necessary across the three assessment time periods, to a total sample of 85 women for subsequent analysis. Analyses were performed on the imputed and original datasets. All reported outcomes are derived from the imputed dataset, with comparisons made between the imputed and original datasets. Any statistically significant differences between the imputed and the original dataset are reported. Ten imputations were performed on a total of 19 variables to avoid producing a large Monte Carlo error (Van Buuren, 2018; White et al., 2011). These imputations were then pooled into a single dataset using mathematically derived formulas (Little & Rubin, 2002), which was then used for analysis.

Results

Tests of hypotheses

(H1) Women exposed to HG in pregnancy will display elevated rates of PTSD during the postnatal period.

Using the PDS5 threshold of ≥ 28 to indicate a possible diagnosis of PTSD, 50.6% of women ($n = 43$) met the criteria for PTSD at some point during the study. Of the sample, the PDS-5 screening measure indicated that 23.53% ($n = 20$) of women consistently reported symptoms indicative of PTSD across all three time

points, 10.56% (n = 9) had symptoms indicative of delayed onset of PTSD (did not meet the threshold for PTSD at the initial assessment, but had by either the second or third assessment). The screening measure indicated that a total of 14.12% (n = 12) of women who experienced PTSD symptoms had scores that became subclinical by the final assessment, 36.47% (n = 31) of women had not recovered, and 49.41% (n = 42) of women never experienced PTSD symptoms severe enough to meet the threshold of possible postpartum PTSD. Of the women who experienced delayed onset PTSD, four developed symptoms indicative of PTSD at the second assessment and five scored above the clinical cut-off by the third assessment. A repeated measures Friedman's test indicated a persistence of PTSD symptoms across the 3 assessments, with no significant change in PTSD symptom scores over time ($\chi^2(2) = 2.619, p < .270$). The percentage of women self-reporting symptoms indicative of PTSD are illustrated in Figure 1.

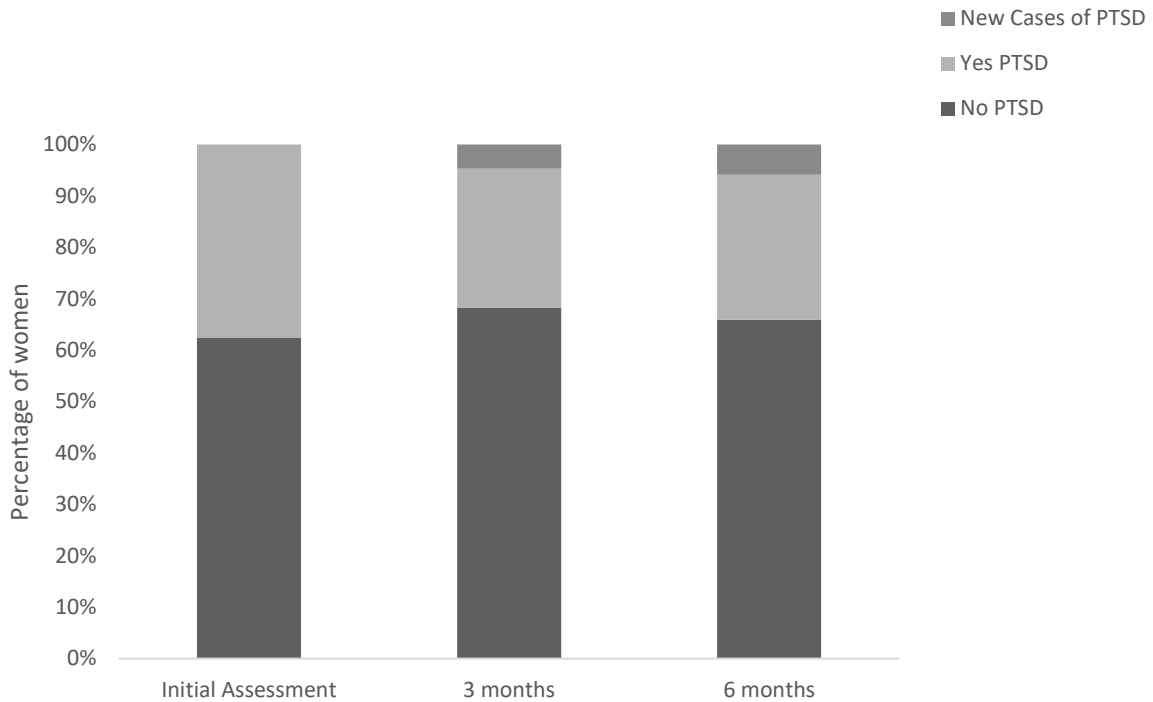


Figure 1: *Percentage of women self-reporting symptoms indicative of PTSD and women who did not meet the threshold for PTSD, across the three assessment time points*

Note: At the three-month assessment, three of the four women who developed PTSD had scores ≥ 23 at initial assessment, and at six-months three of the five women who developed PTSD had scores ≥ 23 at three-months.

Demographic and HG related variables and their association with postpartum PTSD symptoms

Demographic and HG characteristics related to the development of symptoms indicative of postpartum PTSD were examined by comparing women who had experienced PTSD symptoms above the clinical cut-off versus women who did not. Women who experienced symptoms indicative of PTSD were slightly older, although not significantly so; 33.22 years (SD = 4.49) vs. 30.82 years (SD = 4.90). Tests indicated that women who experienced PTSD were also significantly more likely to have received a formal diagnosis of HG ($\chi^2(1) = 7.469, p = .007$) and had

experienced more pregnancies affected by HG ($U = 1139, p = .022$). Groups were comparable across all other demographic characteristics and HG related measures including; ethnicity, country of residence, English as a first language, marital status, education level, employment status, income, prior mental problems (including PTSD unrelated to HG), and total number of pregnancies. See Table 1 for additional HG and pregnancy characteristics.

Table 1

Pregnancy and HG characteristics of the sample

Variable	No PTSD <i>n</i> = 42		Yes PTSD <i>n</i> = 43		Chi square (df)	Mann-Whitney U	<i>p</i>
	N	%	n	%			
Received a formal HG diagnosis							
Yes	33	78.6	42	97.7	7.469(1)		.007*
No	9	21.4	1	2.3			
	Md	IQR	Md	IQR			
Total number of pregnancies affected by HG	1	1	2	1		1139.00	.022*
Number of months HG experienced	8	3	8	2		892.00	.920
Number of times hospitalised due to HG (either inpatient or outpatient)	2	7	2	4		981.00	.485

Correlation coefficients were used to determine the relationship of between the number of pregnancies affected by HG and PTSD symptom severity across the three-assessment time-points. A significant weak negative correlation was observed

between postpartum PTSD symptoms reported at the three-months ($r_s = .225$, $n = 85$, $p = .019$) and six-months post ($r_s = .222$, $n = 85$, $p = .032$) only, with no significant correlation found between postpartum PTSD symptoms ($r_s = .211$, $n = 85$, $p = .052$).

Predictors of PTSD severity at six-months post initial-assessment

Non-parametric tests were conducted to assess the relationship between PTSD severity scores at six-months post with demographic, clinical and HG risk factors assessed at time 1 (Table 2). Receiving a formal diagnosis of HG ($p = .004$) and total number of pregnancies affected by HG ($p = .014$) were significant risk factors regarding PTSD severity at six-months post. A significant moderate correlation was observed between clinical depression scores at the initial assessment and PTSD severity at six-months post ($r_s = .471$, $n = 85$, $p < .001$). One discrepancy between the original and imputed dataset was identified, with the original dataset identifying a significant weak correlation between number of months HG was experienced and PTSD severity at six-month post ($r_s = .253$, $n = 62$, $p = .047$), whereas the imputed dataset reported no significant association ($p = .055$). No other inconsistencies were reported between the imputed and non-imputed data.

Table 2

Demographic, clinical and HG risk factors for PTSD symptom frequency at six-months post initial-assessment

Demographic Variables	Spearman's correlation	Mann-Whitney	Kruskal Wallis	p
	r_s	$U(z)$	$\chi^2(df)$	
Age	-.204			.065
Ethnicity			2.328(3)	.507
Country of residence			10.893(10)	.366
First language English		398.500 (.807)		.420
Education level			5.791(5)	.327
Employment status			1.361(4)	.851
Marital Status			4.260 (2)	.119
Income			2.701 (6)	.845
Previously sought support from GP regarding depression or anxiety			3.281(3)	.359
Previously sought support from GP regarding PTSD		63.000 (-.587)		.592
Pregnancy and HG variables				
Number of times pregnant	.182			.104
Total number of pregnancies affected by HG	.274*			.014*
Received a formal HG diagnosis		586.500 (2.886)		.004**
Number of months HG experienced	.211			.055^
Number of times hospitalised due to HG (either inpatient or outpatient)	.164			.139
Previously sought support from GP regarding PTSD pertaining the HG		275.500 (.661)		.509

Note: ^original dataset reported a significant correlation ($r_s = .253$, $n = 62$, $p = .047$)

A simultaneous multiple regression analysis was conducted to identify whether the significant HG variables ($n = 2$) assessed at the initial assessment were associated with a significant amount of the variance in PTSD symptom severity at six-months post. A formal diagnosis of HG and the number of pregnancies affected

by HG were significantly associated with PTSD severity at six-months post, although the effect was small, $F(2, 82) = 4.752, p < .011, \text{adj } R^2 = .082$, accounting for 8.2% of the variance. Only receiving a formal diagnosis of HG ($p = .014$) was a significant individual predictor of PTSD symptom severity at six-months post when both indicators of HG severity were included in the same model. Regression coefficients and standard errors are reported in Table 3.

Table 3

Regression coefficients and standard errors for HG variables and depression scores pertaining to PTSD severity at six-months post initial-assessment

Variable	PTSD severity at 6 months postpartum			
	β	SE	t	p
Constant		10.546	-.835	.406
Formal diagnosis of HG	.264	5.390	2.510	.014
Total number of pregnancies affected by HG	.155	2.219	1.476	.144

Note: β = regression coefficient, SE = standard error, t = t-test statistic, p = probability

(H2) Peritraumatic cognitive processing and disorganized trauma memories assessed at time-1 will be associated with severity of PTSD symptoms following HG

Zero-order correlations between measures of cognitive processing during HG and PTSD symptom scores on the PDS-5 at the three assessment time points are reported in Table 4. As expected, all peritraumatic cognitive processing variables, persistent dissociation (as measured by the TDQ), posttraumatic cognitions (PTCI) and behavioural responses to intrusions (RIQ), were significantly correlated with

postpartum PTSD symptom scores across each of the three time points. Two of three trauma memory quality subscales were correlated significantly with PTSD symptoms both concurrently and prospectively, negative appraisals of deficits in recall and intrusions ($p < .05$). Deficits in intentional recall was not significantly associated with PTSD severity across any of three timescales ($p > .05$).

Table 4

Spearman's correlation coefficients for clinical and cognitive processing variables and postpartum PTSD symptoms

Variable	PTSD Symptoms (PDS-5)		
	Initial (n = 85)	3 months (n = 85)	6 months (n = 85)
	r_s	r_s	r_s
Cognitive Processing Variables			
Data Driven (DDPS)	.296** $p = .006$	.351** $p = .001$	.316** $p = .004$
State Dissociation (SDQ)	.327*** $p = .002$	.350* $p = .001$	.245** $p = .026$
Lack of self-referent (LSRPS)	.317** $p = .003$	.358* $p = .001$	.336** $p = .002$
Persistent Dissociation (TDQ)	.673*** $p < .001$	.459*** $p < .001$	.562*** $p < .001$
Trauma Memory Quality (TMQ)			
Deficits in intentional recall	.183 $p = .093$	.163 $p = .142$	.115 $p = .303$
Negative appraisals of deficits in recall	.379*** $p < .001$	.275*** $p = .001$	.234* $p = .034$
Intrusions	.597*** $p < .001$	.489*** $p < .001$	.538*** $p < .001$
Posttraumatic cognitions and behavioural responses to intrusions			
Post-traumatic Cognitions Inventory (PTCI)			
Negative self-cognitions	.678*** $p < .001$	.368*** $p = .001$	.391*** $p = .001$
Negative world cognitions	.635*** $p < .001$	.429*** $p < .001$	.499*** $p < .001$
Self-blame	.594*** $p < .001$	.324* $p = .003$	.367*** $p = .001$
Response to Intrusions Questionnaire (RIQ)			
Thought suppression	.365*** $p = .001$	.439*** $p < .001$	.567** $p < .001$
Rumination	.615*** $p < .001$	.522*** $p < .001$	.508*** $p < .001$
Numbing	.565*** $p < .001$	.485*** $p < .001$	.473*** $p < .001$

A simultaneous multiple regression analysis was conducted to identify whether trauma memory quality, persistent dissociation, posttraumatic cognitions, and behavioural responses to intrusions, assessed at time 1 was associated with variance in PTSD symptom severity at six-months post initial assessment. Only variables that had a significant correlational relationship with PTSD scores at six-months post both in the original and imputed datasets were included in the analysis ($n = 11$). The model accounted for 52% of the variance, $F(11, 73) = 9.288$, $p < .001$, $\text{adj } R^2 = .520$. Using a significance value of $p < .10$ (Bursac et al., 2008), four variables were uniquely associated with PTSD symptoms at six-months post; total trait dissociation ($p = .014$), negative world cognitions ($p = .005$), and responding to intrusions with thought suppression ($p = .032$) and numbing ($p = .088$). These four variables were included in final model, which accounted for 50.5% of the variance, $F(4, 80) = 22.485$, $p < .001$, $\text{adj } R^2 = .505$. Receiving a formal diagnosis of HG was not uniquely account for any variance in the model ($p = .097$) or explain any significant increase in variance once other variables had been controlled for. See Table 5 for regression coefficients.

Table 5

Regression coefficients and standard errors for trauma memory quality, persistent dissociation, posttraumatic cognitions and behavioural responses to intrusions pertaining to PTSD severity at six-months post initial-assessment

Variable	PTSD severity at 6 months postpartum			
	β	SE	<i>t</i>	<i>p</i>
Constant		3.116	-1.072	.287
Trait Dissociation Questionnaire (TDQ)	.220	.048	2.733	.008
Negative world cognitions (PTCI)	.254	.140	2.843	.006
Thought suppression (RIQ)	.324	.318	3.427	.001
Numbing (RIQ)	.225	.547	2.275	.026

*Note: β = regression coefficient, SE = standard error, *t* = t-test statistic, *p* = probability*

(H3 and H4) Persistent dissociation will be associated with increased severity of PTSD symptoms over and above peritraumatic cognitive processing (H3) and Posttraumatic cognitions and behavioural responses to intrusions will be associated with additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation (H4)

A hierarchical stepwise regression analysis was conducted to investigate whether persistent dissociation, posttraumatic cognitions and behavioural responses to intrusions assessed at time 1 was associated with severity of PTSD symptoms at six-months post, over and above the variance accounted for by HG severity factors and persistent dissociation, and to test whether successive levels of the proposed model accounted for unique variance in PTSD severity (Table 6).

Table 6

Variables included in the final stepwise hierarchical regression model associated with variance in PTSD symptom severity at six-months post initial-assessment

Variable entered	Regression coefficients					
	β	SE	t	p	β at step 3	p at step 3
Constant		1.291	-.482	.631		.056
Step 1: Received a formal diagnosis of HG	.283	5.389	2.688	.009	.142	.090
Step 2: Trait Dissociation Questionnaire	.398	.057	4.126	.000	.246	.003
Step 3: Posttraumatic cognitions and behavioural responses to intrusions						
<i>Negative self-cognitions (PTCI)</i>	.297	.139	3.334	.001		
<i>Thought suppression (RIQ)</i>	.242	.326	2.471	.016		
<i>Numbing (RIQ)</i>	.203	.543	2.046	.044		

The final model included the HG severity measure of receiving a formal diagnosis of HG in the first step, which explained 6.9% of the variance of PTSD severity at 6 months, $F(1, 83) = 7.224, p = .009$. As expected, when the measure of trait-dissociation was included in the second step, the amount of variance explained rose significantly to 22.0% $F(1, 82) = 17.026, p < .001$. The addition of posttraumatic cognitions and behavioural responses to intrusions in the third step accounted for an additional 30.3% increase in variance over and above the percentage explained by measures of HG severity and trait-dissociation, with the final model accounting for 51.2% of the variance of PTSD severity at six-months post, $F(3, 79) = 17.356, p = .046$, $\text{adj } R^2 = .512$.

Regression coefficients are displayed in Table 7. Receiving a formal diagnosis of HG was significantly associated with PTSD severity variance at six-months post in the first step ($p = .020$), but was insignificant in the final third ($p = .090$). Trait-dissociation was a significantly associated with PTSD symptom severity in both the second and final step ($p = .003$). The posttraumatic cognitions and behavioural responses to intrusions factors of negative self-cognitions ($p = .001$), and responding to intrusions with thought suppression ($p = .016$) and numbing ($p = .044$), were also significantly associated with postpartum PTSD at six-months post.

Table 7

Hierarchical Regression Analysis of variables significantly associated with PTSD Severity at six-months post initial-assessment

Variable entered	Model					
	Adj R ₂	SE	R ₂ change	F	df	<i>p</i>
Step 1: Received a formal diagnosis of HG	.069	16.001	.080	7.224	1, 83	.090
Step 2: Trait Dissociation Questionnaire	.220	14.654	.158	17.026	1, 82	.000
Step 3: Posttraumatic cognitions and behavioural responses to intrusions <i>Negative self-cognitions (PTCI)</i> <i>Thought suppression (RIQ)</i> <i>Numbing (RIQ)</i>	.512	11.591	.303	17.356	3, 79	.000

Discussion

This study is the first to investigate theoretically-derived variables of Ehlers and Clark's (2000) cognitive model of PTSD for women who have experienced HG in pregnancy over a period of 6-months post-initial assessment. It was hypothesised

that (1) Women exposed to HG will display elevated rates of PTSD during the postnatal period; (2) Peritraumatic cognitive processing and disorganized trauma memories assessed at time-1 will be associated with severity of PTSD symptoms following HG; (3) Persistent dissociation will be associated the increased severity of PTSD symptoms over and above peritraumatic cognitive processing; (4) Posttraumatic cognitions and behavioural responses to intrusions will account for additional unique variance in PTSD symptoms over and above peritraumatic cognitive processing, disorganised trauma memory and persistent dissociation.

The finding that 50.6% of women met the criteria for PTSD at some point during the study is substantial. Furthermore, symptoms of PTSD were persistent, with no significant changes in scores over time. Results are aligned with the wider literature evidencing that women experience the condition of HG as traumatic (Christodoulou-Smith et al., 2011; Macgregor et al., 2019; Mullin et al., 2012). The prevalence rates of symptoms indicative of postpartum PTSD reported by this study are comparatively higher than other studies investigating postpartum PTSD following HG (Christodoulou-Smith et al., 2011; Macgregor et al., 2019; Mullin et al., 2012). The prevalence rates of this study are also slightly higher than those reported in the wider literature regarding the prevalence of postpartum PTSD symptoms for high-risk women following complications in pregnancy or childbirth (Grekin & O'Hara, 2014; Khoramroudi, 2018; Yildiz et al., 2017), although individual studies regarding other physical health conditions of pregnancy have reported higher (Donnenwirth et al., 2020; Gaugler-Senden et al., 2012). There is the possibility that the method of recruitment and the use of self-report questionnaires may have contributed an over-estimation of PTSD symptom severity in the present study (e.g., Furata, Sandall,

Cooper & Bick, 2014; Susan et al., 2009), as women who were more affected by HG may have been more motivated to participate than those who were not. However, the use of a longitudinal design and the employment of MI to retain participant data that might otherwise have been excluded, serves to mitigate some of the bias associated with PTSD symptom report (e.g., Madley-Dowd et al., 2019; Tamm & Hilgers, 2014).

Results indicate a relationship between all variables of the Ehlers and Clark's (2000) cognitive model and post-traumatic stress symptoms across all time points, with the exception of deficits in intentional trauma-memory recall. HG characteristics alone accounted for 8.2% of the variance, and posttraumatic cognitions and behavioural responses to intrusions considered alone accounted for 52% of the variance. When HG factors, persistent dissociation, and posttraumatic cognitions and behavioural responses to intrusions were added into a hierarchical regression, the final overall model explained 51.2% of the variance of PTSD severity at six-months post initial-assessment. Posttraumatic cognitions and behavioural responses to intrusions explained 30.3% unique variance in PTSD symptoms in the final hierarchical model. Peritraumatic cognitive processing and trauma memory quality were not significantly associated factors, and whilst receiving a formal diagnosis of HG was significant in the first step, it was not a significant in the final model. Successive levels of the cognitive model was associated with unique variance at each stage, lending support to the suitability of successive levels of the cognitive model and its association with postpartum PTSD symptoms.

The present study did not identify any demographic variables as risk factors for symptoms indicative of postpartum PTSD following HG in pregnancy. This finding is aligned with two other studies regarding HG and PTSD (Christodoulou-Smith et al., 2011; Kjeldgaard et al., 2019), although Mullin et al. (2012) reported women with prolonged HG were significantly younger (< 34 years) than women who experienced short-HG and controls. Findings from the wider literature pertaining to postpartum PTSD following complications in pregnancy and/or birth indicate variability regarding the association between demographic and pre-pregnancy factors and postpartum PTSD. Studies have suggested that risk factors may include parity, socioeconomic status, age, ethnicity, and psychiatric history (Andersen et al., 2012; Cook et al., 2018; Simpson et al., 2018), however their influence appears small and inconsistent. This may account for the variability in findings regarding demographic risk factors the development of postpartum PTSD following HG in pregnancy.

In regard to HG characteristics, the finding that women who experienced PTSD at six-months post initial-assessment were significantly more likely to have experienced HG more times in pregnancy is perhaps unsurprising, given the high prevalence of symptoms indicative of postpartum PTSD following HG identified by the present study. Furthermore, women who had received a formal diagnosis of HG were more likely to report symptoms indicative of postpartum PTSD than women who had not. No other factors pertaining to HG severity were identified as risk factors for symptoms indicative of postpartum PTSD either concurrently or prospectively. The two significant HG related factors explained 6.9% of the variance in PTSD symptoms at six-months post initial-assessment, although neither were significantly associated with PTSD in the final hierarchical model once cognitive and behavioural

variables were included. Experiencing a prior trauma has been shown to be a risk factor for postpartum PTSD symptoms in the wider literature (Simpson et al., 2018), although findings are not consistent (Schwab et al., 2012; Sumner et al., 2012). More research is needed to understand HG characteristics and postpartum PTSD outcomes.

Findings of the study also emphasise a pertinent issue regarding the quantification and assessment of HG related factors. At present there is a lack of formal and unanimously agreed diagnostic criteria for HG, with no measure that is validated for the specific assessment and evaluation of HG severity. Consequently, recruitment of HG cases can be open to interpretation and may vary across studies, affecting between study comparisons and preventing firm conclusions regarding the role of HG factors and postpartum PTSD development (e.g. Mitchell-Jones et al., 2017). Whilst findings from the present study suggest that there is a level of accuracy in receiving a formal diagnosis of HG, as receipt of diagnosis as a diagnosis of HG was a risk factor for postpartum PTSD symptoms, a need for a validated measure of HG is warranted to support conclusions regarding the relationship between HG characteristics and postpartum PTSD.

Peritraumatic factors of cognitive processing and dissociation are identified as a significant factors in the cognitive model of PTSD development (Ehlers & Clark, 2000). However, whilst these factors were related to postpartum PTSD symptoms, they were not associated with variance in PTSD at six-months post in the final model. This suggests that peritraumatic factors are not as key as persistent

dissociation and post-trauma cognitive behavioural processes in the development and maintenance of postpartum PTSD symptoms following HG. This finding is dissimilar to a metaanalysis regarding predictors of PTSD in adults, which have identified peritraumatic processes as strong predictors of PTSD (Ozer et al., 2003), although is consistent with several individual studies investigating the role of peritraumatic processes and PTSD development (Briere et al., 2005; Halligan et al., 2003; Harvey & Bryant, 2002; King et al., 2017).

Interestingly, only two of three trauma memory quality subscales significantly correlated significantly with PTSD symptoms both concurrently and prospectively ($p < .05$). Furthermore, trauma memory quality was not found to be significantly associated with PTSD symptom variance. Fragmented trauma memories are identified as key factors in the development and maintenance of PTSD (Ehlers & Clark, 2000), however investigations pertaining to the coherence of trauma memories in postpartum populations following birth-trauma have been mixed (Ayers, 2007; Ayers et al., 2015; Briddon et al., 2011; King et al., 2017). Previous studies have also reported inconsistencies between aspects of trauma memory quality as assessed by the TMQ, which was employed by this study, and the relationship of trauma memories with postpartum PTSD symptoms for women who have experienced birth trauma (Briddon et al., 2011; King et al., 2017). King et al. (2017) reported a lower endorsement of negative appraisals regarding deficits in trauma memory to be a predictor of increased PTSD symptom frequency, rather than a positive predictor. Findings from the present study regarding the role of trauma memory should be interpreted with caution, however investigation regarding the

reliability of the TMQ in evaluating trauma memories for postpartum women would be advantageous.

The present study provides strong evidence to support the role of persistent dissociation in maintaining PTSD symptoms, with this factor being the strongest associated with PTSD symptoms at six-months post. This finding is aligned with other studies regarding PTSD (Briere et al., 2005; Murray et al., 2002; Panasetis & Bryant, 2003), including one with a female only cohort (Werner & Griffin, 2012). Findings are also similar to the wider literature suggesting that persistent dissociation is more related to PTSD than peritraumatic state-dissociation (Briere et al., 2005; Koopman et al., 1994; Panasetis & Bryant, 2003; Werner & Griffin, 2012). Persistent dissociation may contribute to the development and continuation of PTSD symptoms following HG due to the long-term disruption of cognitive processing over an extended time period.

In the final regression model, negative self-cognitions and responding to intrusions using thought suppression and numbing were significantly associated with PTSD symptom severity at six-months post-initial assessment. Findings from the present study lend support to the relevance of cognitive appraisals and postpartum PTSD symptoms, where responses to intrusions and post-traumatic cognitions are evidenced as being key variables in the maintenance of PTSD symptom severity (Beck et al., 2004; Christodoulou-Smith et al., 2011; Diehle et al., 2014; Hatcher et al., 2009; King et al., 2017). The significant association of negative self-cognitions is of particular clinical importance as feelings of shame, self-blame, guilt and responsibility have been expressed by women sharing their experiences of distress

associated with HG in qualitative research (Dean et al., 2018). Findings from the present study suggests that addressing these cognitions is likely to be a valuable intervention to support psychological wellbeing. Furthermore, behavioural strategies of using thought suppression and numbing in response to intrusions may serve to maintain PTSD symptoms for women who have experience HG. Addressing posttraumatic cognitions and behavioural responses to intrusions may help to prevent a traumatic response for women.

Strengths and limitations

This study is the first to test the validity of Ehlers and Clark (2000) cognitive model of PTSD for women with a history of HG, an area pertaining to HG that is identified as a research priority (Dean et al., 2021). Strengths of the study include a prospective-type design, which enabled the evaluation of potential risk factors for postpartum PTSD symptoms over time. Furthermore, the study was adequately powered and included multiple risk factors within one regression model. We comprehensively tested the validity of the most established theoretical model of PTSD in a postnatal population, including negative cognitive appraisals, dysfunctional cognitive and behavioural strategies, and trauma memory, all of which could potentially be targeted in the prevention or treatment of PTSD. The prospective nature of the study enables the monitoring of PTSD symptoms over time and supports the identification of how cognitive factors relate to the development and maintenance of PTSD following HG. Furthermore, the use of a validated measure of PTSD that reflects current DSM-V criteria (APA, 2013) is aligned with the need for the use of current diagnostic criteria in PTSD research (Beck & Casavant, 2019).

The present study has several limitations, most notably the representativeness of the self-selecting sample that was recruited through the internet. This may affect the representativeness of findings as there is a possibility that women with an interest in research, reflecting on the experience of HG, or mental health issues, were more likely to complete the survey. Furthermore, the use of an online survey, which demand literacy, engagement and organisation, as well as individuals having access to a computer, may also affect the representativeness of the recruited sample. Consequently, symptom reports may have been inflated due to bias associated with sample recruitment and self-assessment (Furata et al., 2014; Susan et al., 2009). However, online data collection assisted with the capturing the experiences of the dispersed and relatively small HG community, which would have otherwise been hard to access. Additionally, the prospective nature of the study helps to mediate certain biases associated with PTSD symptom report, such as chronological bias, due to the evaluation of symptoms that are recent and/or current (Tamm & Hilgers, 2014).

MI further serves to address issues pertaining to bias, as it provides a robust method of incorporating data into the analyses, that might have otherwise been excluded due to missingness (Madley-Dowd et al., 2019). Comparison between analyses of the imputed and non-imputed data identified only one discrepancy between the original and imputed dataset, with the original dataset identifying a significant weak correlation between number of months HG was experienced and PTSD severity at six-month post, whereas the imputed dataset reported no significant association. This difference did not affect the regression analyses, with both the imputed and the non-imputed models identifying the same associations

between variables, suggesting that the method of multiple imputation was not detrimental in terms of efficiency.

The lack of an internationally agreed diagnostic definition of HG and no validated measure of HG is another limitation, as this can make it difficult to establish distinct differences between HG and experiences nausea and vomiting. The Pregnancy-Unique Quantification of Emesis (PUQE; Koren et al., 2002; Lacasse et al., 2008) is an objective measures that can be used to evaluate the severity of nausea and vomiting of pregnancy for both clinical practice and research and could be incorporated in future studies, although a clearly defined and unanimously agreed diagnostic criteria pertaining to the condition of HG would be advantageous.

Finally, the present study did not look at wider factors that have been shown to affect postpartum PTSD, such as levels of perceived support during pregnancy, mindfulness, and general self-efficacy in regard to PTSD symptom severity (Mystakidou et al. 2015; Koopman et al. 2002; Roseboom et al. 2011). Other studies have highlighted the importance of poor social support and relationship status in predicting perinatal anxiety, depression and PTSD following HG (Hammond & Crozier, 2007; Grekin & O'Hara, 2014), and further research in this area in relation to HG would be beneficial.

Clinical implications

HG can significantly impact on women's lives, although the true burden of HG can often be underappreciated by health professionals and the general public (Dean,

2016; Dean & Marsden, 2017; Sykes et al., 2013). Findings from the present study evidence a need for greater awareness regarding the psychological impact of HG, as over half of women sampled reported symptoms indicative of PTSD following their experiences of HG. Secondly, findings confirm that the cognitive model of PTSD is relevant for women who experience PTSD symptoms following HG, with findings supporting multilevel conceptualization of the cognitive processes involved in the development and maintenance of PTSD. Findings from the present study indicate that mechanisms occurring after the traumatic event has occurred (e.g., persistent dissociation, posttraumatic cognitions and behavioural responses to intrusions) are more important to address than factors occurring at the time of the trauma (e.g., problems affecting cognitive processing) in the development and maintenance of PTSD symptoms. Consequently, Cognitive Behavioural Therapy (CBT) for PTSD is therefore indicated as being clinically useful for this population, as evidenced-based interventions can target factors pertaining to persistent dissociation, negative self-cognitions, thought suppression and numbing.

Future research

This study is preliminary, so findings would benefit from further replication using larger, more robust research designs. Further research exploring evidenced protective factors would also be advantageous, such as perceived levels of social support after birth (Furuta et al., 2012; King et al., 2017; Simpson et al., 2018) and mindfulness (Hopwood & Schutte, 2017; Taylor et al., 2020), to explore how these can mediate PTSD severity for this population.

Given the cognitive behavioural model provides significant additional value in furthering understanding of PTSD following HG, further research regarding investigating cognitive behavioural factors that were identified as significant would be beneficial in informing clinical interventions for women experiencing PTSD following HG, as well as the evaluation of efficacy regarding evidence based psychological intervention for PTSD for women who have experienced HG, such as CBT for supporting recovery from PTSD symptoms.

Conclusions

The present study shows that all variables derived from Ehlers and Clark's cognitive model are significantly related to PTSD symptom severity, with factors of persistent dissociation, post-cognitive processing and responses to intrusions explaining variance in PTSD symptoms approximately six-months post-initial assessment, even when clinical, demographic and HG factors were controlled for. Our findings suggest that the CBT model is applicable and useful as a way of understanding and informing the treatment of PTSD following HG. Potential psychological intervention with an emphasis on addressing persistent dissociation, and postpartum cognitive and behavioural processes, such as negative self-cognitions, thought suppression and numbing may be particularly beneficial for women who have experienced HG in pregnancy and support the amelioration of associated postpartum PTSD symptoms.

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Declaration of interest

The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper. The research was conducted as part of a Clinical Psychology Doctorate programme.

Ethics

Ethical approval was granted for the current study by Cardiff University School of Psychology Research Ethics Committee (EC.19.01.08.5550).

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Appendices

List of appendices

Appendix 1: Submission guidance for the British Medical Journal.....	128
Appendix 2: Example of search strategy.....	131
Appendix 3: Description of pregnancy related illnesses.....	134
Appendix 4: CASP and STROBE quality rating scores.....	135
Appendix 5: Submission guidance for the Journal of Consulting and Clinical Psychology	140
Appendix 6: Copy of informed consent sheet.....	143
Appendix 7: Copy of debriefing form.....	149
Appendix 8: Copy of ethical approval.....	153

Appendix 1: Submission guidance for the British Medical Journal

Requirements for ALL manuscripts

Please ensure that anything you submit to *The BMJ* conforms to the International Committee of Medical Journal Editors' [Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals](#) uniform recommendations for manuscripts submitted to biomedical journals.

Before submitting an article, please ensure that you have followed all guidelines below. We recommend learning about our [house style](#) and ways to [incorporate images into your submission](#).

“Analysis” is a distinct article type at *The BMJ*, and differs from other sections such as Research, Education, Editorials, and Personal Views. A great Analysis article makes an argument and supports it with reference to a robust (not cherry picked) evidence base. It has academic heft yet is a journalistic read. 'Academic heft' means the argument is evidence-based and supported by data. 'Journalistic read' means the article is really engaging (not dry nor dull; written in clear language and avoiding technical jargon; and pitched to our international audience of doctors of all specialties, academics, and policy makers). Keep in mind that Analysis articles are “long reads” at around 1800-2000 words, so they need to be absolutely great reading to keep readers’ attention, particularly readers that may not be familiar with the topic.

House Style

General writing style

Please write in a clear, direct, and active style. The *BMJ* is an international journal, and many readers do not have English as their first language. Our preferred dictionaries are Chambers 21st Century Dictionary for general usage and Dorlands for medical terms.

Punctuation

- No full stops in initials or abbreviations.
- Minimal commas, but use commas before the "and" and "or" in lists: The bishops of Durham, Canterbury, Bath and Wells, and York were invited.
- Use commas on both sides of parenthetical clauses or phrases, and with commenting clauses.
- Know the difference between defining clauses (no comma) and commenting clauses (commas needed):

Medical staff who often work overtime are likely to suffer from stress.

Medical staff, who often work overtime, are likely to suffer from stress.

- Use commas before "and," "or," "but" in two-sentence sentences (when the coordinate conjunction joins two main clauses):

Half received drug treatment, but their symptoms did not resolve more quickly.

We could make an omelette, or you could go and get a takeaway.

- Note that when a comma is used, both main clauses must have a subject:
The patients stopped smoking, and they felt better for it.
The patients stopped smoking and felt better for it.
- Minimal hyphenation - use hyphens only for words with non-, -like, -type, and for adjectival phrases that include a preposition (one-off event, run-in trial). Not using hyphens will help you to avoid noun clusters (see Grammar below).
- Quotation marks - please use double, not single, inverted commas for reported speech. Full stops and commas go inside quotation marks:
She said, "We will."
- No exclamation marks, except in quotes from other sources.
- Reference numbers go after commas and full stops, before semicolons and colons.
- Minimal capitalisation. Use capitals only for names and proper nouns.

Technical Terms

Numbers under 10 are spelt out, except for measurements with a unit (8 mmol/l) or age (6 weeks old), or when in a list with other numbers (14 dogs, 12 cats, 9 gerbils).

Raw numbers should be given alongside percentages, and as supporting data for P values.

Numbers under 10 are spelt out, except for measurements with a unit (8 mmol/l) or age (6 weeks old), or when in a list with other numbers (14 dogs, 12 cats, 9 gerbils).

Raw numbers should be given alongside percentages, and as supporting data for P values.

References

Authors must verify references against the original documents before submitting the article.

References should be numbered in the order in which they appear in the text. At the end of the article the full list of references should follow the [Vancouver style](#).

Please give the names and initials of all authors (unless there are more than six, when only the first three should be given followed by et al).

The authors' names are followed by the title of the article; the title of the journal abbreviated according to the style of Index Medicus; the year of publication; the volume number; and the first and last page numbers.

References to books should give the names of any editors, editor, and year.
Examples:

21 Soter A, Wasserman SI, Austen KF. Cold urticaria: release into the circulation of histamine and eosinophil chemotactic factor of anaphylaxis during cold challenge. *N Engl J Med* 1976;294:687-90.

22 Osler AG. Complement: mechanisms and functions. Prentice-Hall, 1976.

For material published online, give the authors, title, date or year of publication as given on the web page, and URL.

Please add the URL if material (such as official reports) is available online as well as in print.

Information from manuscripts not yet in press or not yet published online, papers reported at meetings, or personal communications should be cited only in the text, not as a formal reference.

Tables

Tables should be simple and should fit across a maximum of two landscape pages, and they should not duplicate information in the text of the paper. Any caption text should be concise and relevant to the table. Ideally, columns should not change headings midway down a table.

Appendix 2: Example of search strategy.

The following search was conducted using the PsychINFO database (1806 to September Week 1 2019), similar searches were conducted in MEDLINE(R), EMBASE and CINAHL

1	Pregnancy/	21206
2	antepartum period/	129
3	Perinatal Period/	2553
4	(pregnan* or antenatal or gestation* or prenatal or antepartum or perinatal).ti,ab,id.	66456
5	1 or 2 or 3 or 4 (Pregnancy)	67390
6	(Eclampsia or preeclamp* or pre-eclamp*).ti,ab,id.	546
7	Severe bleed*.ti,ab,id.	21
8	preeclampsia/ or obstetrical complications/ or hypertension/	7746
9	diabet*.ti,ab,id. or Gestational Diabetes/	29603
10	Hyperemesis.ti,ab,id.	149
11	Spontaneous abortion/ or spontaneous abortion.ti,ab,id.	928
12	(Miscarriage or Trauma* or Condition* or Complication* or Disorder* or Loss* or Problem* or incident*).ti,ab,id.	1466898
13	Intrauterine f?etal death.ti,ab,id.	15
14	Ectopic.ti,ab,id.	1261
15	Premature Birth/ or (preterm contractions or preterm labo?r or preterm birth).ti,ab,id.	198
16	Excessive f?etal growth.ti,ab,id.	6
17	macrosomia.ti,ab,id.	67
18	(Placenta praevia or Abruption placentae or Placental abruption).ti,ab,id	4

19	(sepsis or toxemia or infection).ti,ab,id.	27881
20	(Chorioamnionitis or intra-amniotic infection).ti,ab,id.	49
21	Molar.ti,ab,id.	1133
22	trophoblastic neoplas* or trophoblastic disease or GTD.ti,ab,id.	3
23	Abnormal f?etal heart rate.ti,ab,id.	44
24	hypertension.ti,ab,id.	15082
25	Folate deficiency or folic acid deficiency.ti,ab,id.	189
26	(Anti?phospholipid syndrome or APS).ti,ab,id.	1557
27	Poor f?etal growth.ti,ab,id.	23
28	HELLP syndrome or help or (haemolysis elevated liver enzymes and low platelets) or (hemolysis elevated liver enzymes and low platelets).ti,ab,id.	13
29	PPROM.ti,ab,id.	4
30	Premature Rupture of Membran*.ti,ab,id.	47
31	premature birth.ti,ab,id.	844
32	Major obstetric (haemorrhage/ or Hemorrhage).ti,ab,id.	1
33	Deep vein thrombosis.ti,ab,id.	174
34	An?emi*.ti,ab,id.	2104
35	(Peripartum cardiomyopathy or PPCM).ti,ab,id.	8
36	Hypothyroidism.ti,ab,id.	1435
37	(Pelvic girdle pain OR PGP OR symphysis pubis dysfunction OR SPD).ti,ab,id.	101
38	Placenta accreta.ti,ab,id.	2
39	(Vertically transmitted infection or urinary tract infection or UTI).ti,ab,id.	0
40	Hemorrhage/ or Haemorrhage.ti,ab,id.	2059

41	Prolapsed cord.ti,ab,id.	0
42	Threatened abortion.ti,ab,id.	20
43	Polyhydramnios.ti,ab,id.	19
44	F?etal death.ti,ab,id.	156
45	Excess amniotic fluid*.ti,ab,id.	0
46	F?etal distress or f?etal anomal*.ti,ab,id.	76
47	6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 (complications)	1496297
48	5 and 47 (Pregnancy AND Conditions)	27019
49	Postnatal Period/	4281
50	(postpartum or post-partum).ti,ab,id.	12054
51	(postnatal or post-natal).ti,ab,id.	20111
52	49 or 50 or 51 (post-natal variations)	30728
53	posttraumatic stress disorder/ or "stress and trauma related disorders"/ or complex ptsd/ or desnos/ or emotional trauma/ or post-traumatic stress/ or trauma/	56973
54	(posttraumatic stress or post-traumatic stress).ti,ab,id.	38187
55	(PTSD or PTS*).ti,ab,id.	32558
56	53 or 54 or 55 (PTSD variations)	44344
57	52 and 56 (post-partum AND PTSD)	361
58	48 and 57 (Post-partum PTSD AND Pregnancy)	243

Appendix 3: Description of pregnancy related illnesses

Pregnancy Illness	Definition
Abnormally Invasive Placenta (AIP)	The placenta grows too deeply into the muscles of the uterus and does not separate during birth
Ectopic Pregnancy	A fertilised egg implants itself outside of the womb, usually in one of the fallopian tubes.
Hyperemesis Gravidarum (HG)	Severe and extreme levels of nausea and vomiting in pregnancy.
Hypertensive disorders of pregnancy (HDP) can be split into the following categories:	
Eclampsia	Eclampsia describes a type of convulsion or fit (involuntary contraction of the muscles) that pregnant women can experience, usually from week 20 of the pregnancy or immediately after the birth.
Preeclampsia (PE)	Preeclampsia is a pregnancy complication characterized by high blood pressure and signs of damage to another organ system, most often the liver and kidneys.
HELLP syndrome (hemolysis elevated liver enzymes and low platelets)	HELLP syndrome is a liver and blood clotting disorder of pregnancy characterised by hemolysis, elevated liver enzymes, and a low platelet count. It usually begins during the last three months of pregnancy or shortly after childbirth. Symptoms may include feeling tired, retaining fluid, headache, nausea, upper right abdominal pain, blurry vision, nosebleeds, and seizures.
PPROM (preterm premature rupture of membranes)	When waters have broken before the 37th week of pregnancy
Peripartum Cardiomyopathy (PPCM)	A form of heart failure that happens during the last month of pregnancy or up to five months after giving birth.

Appendix 4: CASP and STROBE quality rating scores

CASP quality rating scores	5. Hoedjes et al. 2011	6. Kjelgaard et al. (2019)	7. Meltzer-Brody et al. (2017)	8. Polachek et al. (2016)	11. Stramrood et al. (2011)
Study (Yes - 2, no - 0 , can't tell - 1)					
1. Did the study address a clearly focused issue? /2	2	2	2	2	2
<i>Focused in terms of the population studied</i>	Y	Y	Y	Y	Y
<i>Focused in terms of the risk factors studies</i>	Y	Y	Y	Y	Y
<i>Are the outcomes considered focused?</i>	Y	Y	Y	Y	Y
<i>Is it clear whether the study tried to detect a beneficial or harmful effect?</i>	Y	Y	Y	Y	Y
2. Was the sample recruited in an acceptable way? /2	2	2	2	1	1
Look for bias in recruitment, are they representative of a defined population?	Y	Y	Y	?	Y
Anything special about the cohort? Was everybody included who should have been included?	Y	Y	N	Convenience Sample	Convenience Sample
Section A: Is it worth continuing? Y/N	Y	Y	Y	Y	Y
3. Was the exposure accurately measured to minimise bias? /2	2	1	2	2	2
Did they use subjective (S) or objective (O) measurements?	O (medical records)	S	O (medical codes)	Both	Both
Are they valid measures?	Yes	Y	Y	Pregnancy conditions undefined	Y
Were all subjects classified into exposure groups using the same procedure?	Y	Y	Y	Y	Y
4. Was the outcome accurately measured to minimise bias? /2	1	1	2	1	2
Were the measurements methods similar in the different groups?	Y	Y	Y	Y	Y
5. Confounding Factors /4	2	4	4	4	3
a. Have the authors identified all confounding factors? (Most very thorough except prenatal psychological distress)	N	Y	Y	Y	Most
b. Have the authors taken into account confounding factors in the design and/or analysis?	Y	Y	Y	Y	Y
6. Follow-up/4	3	3	4	2	3
a. Was the follow up of subjects complete enough?	Y	Y	Y	Y	N
Were the persons who dropped out or lost to follow up analysed to check whether their leaving would impact overall findings?	N	N	NA	No	Y
b. Was the follow up of subjects long enough?	Y	Y	Y	Y	Y

9. Do you believe the results? /2	1	1	2	1	1
Effect size large? How precise are the results (look for the range of the confidence intervals, if given)	Wide confidence intervals	Good	Small range of confidence intervals	P levels only	Chi-squared tests
Can results be due to bias, confounding, or chance (No if adjusted for the ones they've measured=1)	?	No	No	Small sample size	N
Could design and methods make results unreliable?	Y	Y	No	Y	?
10. Can the results be applied to the local population (external validity)? /2	1	1	2	1	1
Was a cohort population appropriate to answer this question	Y	Y	Y	Y	Y
Could the subjects in the study significantly differ to the population to cause concern?	?	?	N	?	?
Is the local setting likely to differ from that of the study?	?	?	N	?	?
11. Do the results fit with other available evidence? (if Y & N I have scored Y)/2	2	2	2	2	2
Total Quality Score across 11 quality domains /22	16	17	22	16	17
<p>ND not defined, NA not applicable, P partly a score of two was given for 'yes' a score of one was given for 'can't tell' (suggesting there is partial support for the quality domain) and a score of zero was given to 'no'.</p>					

STROBE quality rating scores Yes -2, Unsure -1, No- 0	1. Christodoulou-Smith et al. (2011)	Donnenwith et al., 2020	2. Engelhard et al. (2002)	3. Hernández-Martínez et al. (2019a)	4. Hernández-Martínez et al. (2019b)	8. Mullin et al. (2012)	9. Porcel et al. (2013)	12. Tol et al. (2019)
1. Title and abstract /4	2	2	2	2	2	2	4	2
(a) Indicate the study's design with a commonly used term in the title or the abstract	N	N	N	N	N	N	Y	N
(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Y	Y	Y	Y	Y	Y	Y	Y
2. Introduction /2	2	2	2	2	2	2	2	2
Explain the scientific background and rationale for the investigation being reported	Y	Y	Y	Y	Y	Y	Y	Y
3. Objectives /2	2	2	2	2	2	2	2	2
State specific objectives, including any pre-specified hypotheses	Y	Y	Y	Y	Y	Y	Y	Y
Methods /16	10	9	13	10	12	11	12	14
4. Present key elements of study design early in the paper	Y	Y	Y	Y	Y	Y	Y	Y
5. Describes the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Y	Y	Y	Y	Y	Y	Y	Y
6. (a) Give the eligibility criteria, and the sources and methods of selection of participants	Y	N	Y	Y	Y	Y	Y	Y
7. Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	?	?	?	?	?	?	?	N

8. For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	?	Y	Y	?	?	?	Y	Y
9. Describe any efforts to address potential sources of bias	N	N	Y	N	N	Y	Y	Y
10. Explain how the study size was arrived at	N	N	N	N	Y	N	N	Y
11. Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Y	Y	Y	Y	Y	Y	Y	Y
Statistical Analysis /10	4	4	4	6	6	8	6	4
(a) Describe all statistical methods, including those used to control for confounding	Y	Y	Y	Y	Y	Y	Y	Y
(b) Describe any methods used to examine subgroups and interactions	Y	Y	Y	Y	Y	Y	Y	Y
(c) Explain how missing data were addressed	N	N	N	N	N	Y	N	N
(d) If applicable, describe analytical methods taking account of sampling strategy	N	N	N	N	N	N	N	N
(e) Describe any sensitivity analyses	N	N	N	Y - Confidence intervals	Y - Confidence intervals	Y - confidence intervals	Y	N
Results /4	1	1	3	1	1	1	1	1
(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Partially	Partially	Partially	Partially	Partially	Partially	Partially	Partially
(b) Give reasons for non-participation at each stage	N	N	Y	N	N	N	N	N
Descriptive data /4	2	2	2	2	2	2	4	1
(a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders	Y	Y	Y	Y	Y	Y	Y	Partially

(b) Indicate number of participants with missing data for each variable of interest	N	N	N	N	N	N	Y	N
Outcome data /2	2	2	2	2	2	2	2	2
Report numbers of outcome events or summary measures	Y	Y	Y	Y	Y	Y	Y	Y
Main results /4	3	1	2	4	4	2	4	2
(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Partially	Partially	N	Y	Y	Y	Y	N
(b) Report category boundaries when continuous variables were categorized	NA	NA	Y	Y	Y	N	Y	Y
17. Other analyses /2	0	2	2	0	0	0	2	2
Report other analyses done—e.g. analyses of subgroups and interactions, and sensitivity analyses	N	Y	Y	N	N	N	Y	Y
Discussion /8	8	8	8	8	8	8	8	8
18. Summarise key results with reference to study objectives	Y	Y	Y	Y	Y	Y	Y	Y
19. Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Y	Y	Y	Y	Y	Y	Y	Y
20. Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Y	Y	Y	Y	Y	Y	Y	Y
21. Discuss the generalisability (external validity) of the study results	Y	Y	Y	Y	Y	Y	Y	Y
Other information /2	0	0	0	0	2	0	2	2
Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	No	No	No	No	None Declared	No	Not applicable	Y
Total / 60	36	35	42	39	43	40	49	42

Appendix 5: Submission guidance for The Journal of Consulting and Clinical Psychology

Prepare manuscripts according to the *Publication Manual of the American Psychological Association* using the 7th edition. Manuscripts may be copyedited for bias-free language (see Chapter 5 of the *Publication Manual*). [APA Style and Grammar Guidelines](#) for the 7th edition are available.

Masked Review

This journal uses a masked reviewing system for all submissions. The first page of the manuscript should omit the authors' names and affiliations but should include the title of the manuscript and the date it is submitted.

Footnotes containing information pertaining to the authors' identities or affiliations should not be included in the manuscript, but may be provided after a manuscript is accepted.

Make every effort to see that the manuscript itself contains no clues to the authors' identities.

Please ensure that the final version for production includes a byline and full author note for typesetting.

Keep a copy of the manuscript to guard against loss.

Cover Letter

The cover letter accompanying the manuscript submission must include all authors' names and affiliations to avoid potential conflicts of interest in the review process.

Addresses and phone numbers, as well as electronic mail addresses and fax numbers, if available, should be provided for all authors for possible use by the editorial office and later by the production office.

Length and Style of Manuscripts

Full-length manuscripts should not exceed 35 pages total (including cover page, abstract, text, references, tables, and figures), with margins of at least 1 inch on all sides and a standard font (e.g. Times New Roman) of 12 points (no smaller). The entire paper (text, references, tables, etc.) must be double spaced.

Authors submitting manuscripts that report new data collection, especially randomized clinical trials (RCTs), should comply with the newly developed [Journal Article Reporting Standards for Quantitative Research in Psychology: The APA Publications and Communications Board Task Force Report \(PDF, 222KB\)](#) (JARS; see *American Psychologist*, 2018, 73(1), 3–25 or Appendix in the *APA Publication Manual*).

For papers that exceed 35 pages, authors must justify the extended length in their cover letter (e.g., reporting of multiple studies), and in no case should the paper exceed 45 pages total. Papers that do not conform to these guidelines may be returned without review.

The References section should immediately follow a page break.

Required Use of JARS and MARS Guidelines

In order to maintain consistency and fairness in the review process and in the reporting of scientific findings, *JCCP* requires that ALL manuscripts conform to Journal Article Reporting Standards (JARS) and Meta-Analysis Reporting Standards (MARS) as described in Applebaum et al. (2018):

Applebaum, Cooper, Kline, Mayo-Wilson, Nezu, & Rao (2018). [Journal Article Reporting Standards for Quantitative Research in Psychology: The APA Publications and Communications Board Task Force Report](#). *American Psychologist*, 73(1), 3-25. Upon submission, authors will be required to affirm (on the submission portal and in their cover letter) that they have followed JARS/MARS guidelines and that the submitted manuscript contains and/or addresses ALL required information as relevant for the study, including flow diagrams where relevant.

The editorial team will use consistency with the JARS/MARS guidelines as a review criterion, and manuscripts may be rejected if guidelines are not followed.

Title of Manuscript

The title of a manuscript should be accurate, fully explanatory, and preferably no longer than 12 words. The title should reflect the content and population studied (e.g., "treatment of generalized anxiety disorders in adults").

If the paper reports a randomized clinical trial (RCT), this should be indicated in the title. Note that JARS criteria must be used for reporting purposes.

Abstract and Keywords

All manuscripts must include an abstract containing a maximum of 250 words typed on a separate page. After the abstract, please supply up to five keywords or brief phrases.

Manuscripts published in the *Journal of Consulting and Clinical Psychology* will include a structured abstract of up to 250 words.

For studies that report randomized clinical trials or meta-analyses, the abstract also must be consistent with the guidelines set forth by JARS or MARS (Meta-Analysis Reporting Standards) guidelines, respectively. Thus, in preparing a manuscript, please ensure that it is consistent with the guidelines stated below.

Please include an Abstract of up to 250 words, presented in paragraph form. The Abstract should be typed on a separate page (page 2 of the manuscript), and must include each of the following sections:

- **Objective:** A brief statement of the purpose of the study
- **Method:** A detailed summary of the participants (N, age, gender, ethnicity) as well as descriptions of the study design, measures (including names of measures), and procedures
- **Results:** A detailed summary of the primary findings that clearly articulate comparison groups (if relevant), and that indicate significance or confidence intervals for the main findings
- **Conclusions:** A description of the research and clinical implications of the findings

Public Health Significance Statements

Authors submitting manuscripts to the *Journal of Consulting and Clinical Psychology* are required to provide 2–3 brief sentences regarding the public health significance of the study or meta-analysis described in their paper. This description should be included within the manuscript on the abstract/keywords page. It should

be written in language that is easily understood by both professionals and members of the lay public.

When an accepted paper is published, these sentences will be boxed beneath the abstract for easy accessibility. All such descriptions will also be published as part of the Table of Contents, as well as on the journal's web page. This new policy is in keeping with efforts to increase dissemination and usage by larger and diverse audiences.

Examples of these 2–3 sentences include the following:

- "This study strongly suggests that (description of a given psychosocial treatment) is an effective treatment for anxiety, but only if it is of mild to moderate severity. For persons with severe anxiety, additional treatments may be necessary."
- "When treating individuals of (name of a particular ethnic minority group) who are experiencing PTSD, this study demonstrated the importance of taking into account cultural factors, especially those that involve one's spiritual beliefs."
- "This study highlights the importance of directly including one's family in treatment when helping adults diagnosed with cancer overcome their depression."

To be maximally useful, these statements of public health significance should not simply be sentences lifted directly out of the manuscript.

They are meant to be informative and useful to any reader. They should provide a bottom-line, take-home message that is accurate and easily understood. In addition, they should be able to be translated into media-appropriate statements for use in press releases and on social media.

Prior to final acceptance and publication, all public health significance statements will be carefully reviewed to make sure they meet these standards. Authors will be expected to revise statements as necessary.

Participants: Description and Informed Consent

The Method section of each empirical report must contain a detailed description of the study participants, including (but not limited to) the following: age, gender, ethnicity, SES, clinical diagnoses and comorbidities (as appropriate), and any other relevant demographics.

In the Discussion section of the manuscript, authors should discuss the diversity of their study samples and the generalizability of their findings.

The Method section also must include a statement describing how informed consent was obtained from the participants (or their parents/guardians) and indicate that the study was conducted in compliance with an appropriate Internal Review Board.

Measures

The Method section of empirical reports must contain a sufficiently detailed description of the measures used so that the reader understands the item content, scoring procedures, and total scores or subscales. Evidence of reliability and validity with similar populations should be provided.

Statistical Reporting of Clinical Significance

JCCP requires the statistical reporting of measures that convey clinical significance. Authors should report means and standard deviations for all continuous study variables and the effect sizes for the primary study findings. (If effect sizes are not available for a particular test, authors should convey this in their cover letter at the time of submission.)

JCCP also requires authors to report confidence intervals for any effect sizes involving principal outcomes (see Fidler et al., *Journal of Consulting and Clinical Psychology*, 2005, pp. 136–143 and Odgaard & Fowler, *Journal of Consulting and Clinical Psychology*, 2010, pp.287–297).

In addition, when reporting the results of interventions, authors should include indicators of clinically significant change. Authors may use one of several approaches that have been recommended for capturing clinical significance, including (but not limited to) the reliable change index (i.e., whether the amount of change displayed by a treated individual is large enough to be meaningful; see Jacobson et al., *Journal of Consulting and Clinical Psychology*, 1999), the extent to which dysfunctional individuals show movement into the functional distribution (see Jacobson & Truax, *Journal of Consulting and Clinical Psychology*, 1991), or other normative comparisons (see Kendall et al., *Journal of Consulting and Clinical Psychology*, 1999).

The special section of JCCP on "Clinical Significance" (*Journal of Consulting and Clinical Psychology*, 1999, pp. 283–339) contains detailed discussions of clinical significance and its measurement and should be a useful resource (see also Atkins et al., *Journal of Consulting and Clinical Psychology*, 2005, pp. 982–989).

Discussion of Clinical Implications

Articles must include a discussion of the clinical implications of the study findings or analytic review. The Discussion section should contain a clear statement of the extent of clinical application of the current assessment, prevention, or treatment methods. The extent of application to clinical practice may range from suggestions that the data are too preliminary to support widespread dissemination to descriptions of existing manuals available from the authors or archived materials that would allow full implementation at present.

Data Transparency

In order to reduce the likelihood of duplicate or piecemeal publication, authors are required to provide, in their cover letter, a list of published, in press, and under review studies that come from the same dataset as the one in the submitted manuscript, as well as a narrative description of how the submitted manuscript differs from the others.

This narrative description should include how the manuscript differs (or does not) in terms of research question and variables studied.

Authors also are required to submit a masked version of the narrative description that can be provided to reviewers. Please add this as an appendix table on the last page of the submitted manuscript. Please base your description on the following examples, edited according to your specific data circumstances.

Do not provide the title of the manuscript, authors, or journal in which it was published. Do provide the names of the relevant variables (i.e., substitute the numbers in the examples below for actual names, such as depressive symptoms, therapeutic alliance, etc.).

Narrative Example: Multiple uses of data collected from the same sample

The data reported in this manuscript have been previously published and/or were collected as part of a larger data collection (at one or more points in time). Findings from the data collection have been reported in separate manuscripts. MS 1 (published) focuses on variables 1, 2, and 3; while MS 2 (in press) focuses on variables 4, 5, and 6. MS 3 (the current manuscript) focuses on

variables 8, 9, and 15. MS 4 (soon to be submitted) will focus on variables 10, 12, and 14.

Narrative Example: Publicly available dataset

The data reported in this manuscript were obtained from publicly available data, [name of project, along with website link to project description]. A bibliography of journal articles, working papers, conference presentations, and dissertations using the [name of project] is available at [website link to bibliography list]. The variables and relationships examined in the present article have not been examined in any previous or current articles, or to the best of our knowledge in any papers that will be under review soon.

[Alternatively, clarify any overlap of variables, as done in the narrative example above].

Upon submission of the manuscript, authors will be required to attest to the provision of the required information described above.

Finally, upon acceptance of a manuscript, authors will be required to provide, as part of the Author Note, a list of related published papers that come from the same dataset, unless such papers are clearly described and referenced in the manuscript (specifically noting that findings come from the same dataset).

Data and Stimulus Materials

Should your paper ultimately be accepted for publication, *JCCP* would like to encourage you to determine if posting materials and/or data is right for your study and, if so, to make your data and materials publicly available, if possible, by providing a link in your paper to a third-party repository.

Making your data and materials publicly available can increase the impact of your research, enabling future researchers to incorporate your work in model testing, replication projects, and meta-analyses, in addition to increasing the transparency of your research.

The APA's data sharing policy does not require public posting, so you are free to decide what is best for your project in terms of public data, materials, and conditions on their use. Note, however, that APA policy does require that authors make their data available to other researchers upon request.

Manuscript Preparation

Prepare manuscripts according to the [Publication Manual of the American Psychological Association](#) using the 7th edition. Manuscripts may be copyedited for bias-free language (see Chapter 5 of the *Publication Manual*).

Review APA's [Journal Manuscript Preparation Guidelines](#) before submitting your article.

Double-space all copy. Other formatting instructions, as well as instructions on preparing tables, figures, references, metrics, and abstracts, appear in the *Manual*. Additional guidance on APA Style is available on the [APA Style website](#).

Appendix 6: Informed consent sheet

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Ysgol Seicoleg

South Wales Doctoral Programme in Clinical Psychology
De Cymru Rhaglen Doethuriaeth mewn Seicoleg Glinigol



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Prifysgol Caerdydd
Adeilad y Tŷr
Plas y Parc
Caerdydd CF10 3AT
Cymru Y Deyrnas Unedig

Informed Consent

Hello, you have been invited to take part in a Cardiff University Clinical Psychology research study focussing on the psychological impact of having experienced Hyperemesis Gravidarum (HG). HG is a pregnancy condition that affects 0.3-2% of the pregnant population and is characterised by extreme levels of nausea and vomiting, which are often prolonged. We are therefore looking to recruit women who have experienced HG in pregnancy, as well as women who have been pregnant and did not experience HG.

In order for clinical research to have sufficient weighting to be published and inform healthcare, it is important that inclusion criteria are strict. For the purpose of this study therefore, it has been necessary to define HG as occurring when **a woman has lost more than 5% of her pre-pregnancy body weight due to feelings of nausea and vomiting or if a woman has had been in receipt of inpatient or outpatient care due to the severity of symptoms associated with nausea and vomiting**. This does not mean that women who fail not met the study's criteria have not had HG, however, it is hoped that the strict research criteria will support the validity of the study. It is recognised that the definition adopted by the study may result in women who have had HG being unable to take part in this particular piece of research.

Before you decide if you would like to take part it is important that you understand why the research is being done and what it will involve for you.

Reason for conducting this research

This study hopes to find out more about the impact of people's experiences of Hyperemesis Gravidarum (HG) on their psychological wellbeing and seeing how this might differ to women who have been pregnant, but did not experience HG. It is hoped that this research will inform healthcare professionals of the psychological impact of HG and will enable clinical recommendations to be made that will improve perinatal psychological support for women who experience HG during pregnancy.

Can I take part?

This study is split into two parts and you may eligible to take part in either **Study 1** or **Study 2**.

You are invited to participate in either of the studies if you meet the following criteria:

- a) You are a woman over the age of 18
- b) You are able to speak English

You are invited to take part in Study 1 if you have also:

- a) Been pregnant and your baby was born **4 or more months ago** and you have never experienced HG in pregnancy. You may have experienced mild pregnancy-related sickness or "morning sickness" with symptoms improving by 16 to 18 weeks of pregnancy

OR

- b) You have been pregnant and had to seek medical support (e.g. visiting your GP **or** referred to hospital) for severe morning sickness/HG **and** your symptoms of HG stopped **4 or more months ago**

You are invited to take part in Study 2 if:

- a) You have never experienced HG/severe morning sickness in pregnancy and you have given birth within the last **3 months**. You may have experienced mild pregnancy-related sickness or “morning sickness” with symptoms improving by 16 to 18 weeks of pregnancy

OR

- b) You have sought medical support (e.g. visiting your GP **or** referred to hospital) for severe morning sickness/Hyperemesis Gravidarum **and** your symptoms of HG stopped **within the last 3 months**

If you meet the above criteria, please continue reading this page to find out more about this research. If you would like to participate, please tick the informed consent box at the end the page. Once you have ticked the box, the online questionnaire will open for you to complete.

What will happen if I take part?

You will be asked to complete a secure online questionnaire. All responses to the questionnaire are confidential. The questionnaire will take about 45 minutes to complete. We will contact you again in three, six and nine months time to ask you to repeat some of the questionnaires again. This is to explore how psychological wellbeing may change over time. At the end of the study, if you agree, you will be entered into a prize draw to win one of six £25 amazon vouchers. This is to acknowledge the time you have taken out form your day to participate and to show you our appreciation for this.

I understand that the personal data will be processed in accordance with GDPR regulations (see privacy statement below).

If you have a difficulty or disability which means that accessing this study online is troublesome for you, then additional paper or telephone access can be made available. Please contact Jerrie for more information.

Do I have to take part?

Your participation in this study is entirely voluntary.

We may wish to contact you in the future to collect further information, this is helpful as it can allow us to see if and how things change over time. If you are willing to be contacted in the future then you will be invited to leave your email address at the end of the survey. If you leave your email address your data will be stored confidentially and if you would like us to delete your data in the future, then we will be able to. If you do not leave your email, your responses will be stored anonymously so we will not be able to identify and withdraw your data once it has been entered into Qualtrics (this survey program).

What are the risks of taking part?

This research has been reviewed and approved by Cardiff University School of Psychology Ethics Committee. The questionnaire has been tested by several members from the charity Pregnancy Sickness Support. It is not expected that this study will cause any distress, but should reflecting on the questionnaire items be upsetting, you are encouraged to seek support from your GP or Pregnancy Sickness Support Charity. A list of support organisations will be provided at the end of the survey. If there is a disclosure of risk during the study process then researchers will need to break participant confidentiality in line with risk and safeguarding procedures. This is to ensure the safety of participants throughout.

How will information about me be used?

The results of the study will be written up as part of a Clinical Psychology Doctorate project and may be published in professional journals and/or shared at relevant conferences. A general summary of the findings will be shared through Pregnancy Sickness Support charity's website. You will not be identified by name in the dissemination of the results. If you would like to receive a copy of the final report when it is completed, please follow the link at the end of the survey.

Who will have access to information about me?

Survey responses are confidential as the Qualtrics system automatically generates numerical code for each participant. All research data will be stored in accordance with national policy and legislation (The Data Protection Act_1998) and BPS Ethics guidelines for internet-mediated research (BPS, 2013). Any email addresses provided by participants for follow up studies in the future will be stored in secure password protected file that is not connected to their questionnaire data. The researcher and research supervisors will have access to the electronic research data. Research data will be stored for 15 years after completion of the study for academic purposes in accordance with Cardiff University Policy and destroyed thereafter.

What is there is a problem, or you have further questions?

If you have any concern or require additional information about any aspect of this study, please contact the researcher or research supervisor. If you would like to complain about this project, please contact Cardiff University School of Psychology Ethics Committee.

Researchers:

Jerrie Serrell, Trainee Clinical Psychologist

Email: richardsj25@cardiff.ac.uk

Research Supervisors:

Dr Helen Penny, Senior Research Tutor, Doctorate in Clinical Psychology, Cardiff University

Email: pennyH@cardiff.ac.uk

Dr Cerith Waters, Clinical Psychologist, Lecturer at Cardiff University

Email: watersCS@cardiff.ac.uk

Complaints:

If you should have any complaints about the study, please contact:

Cardiff University School of Psychology Ethics Committee

Ethics Secretary Mark Jones

Email: psychethics@cardiff.ac.uk

Please declare below that you are providing informed consent

I have read the above participant information and I therefore agree to provide my consent to participate in this study

I provide my consent to be contacted in the future for potential follow up research

Privacy Notice:

The information provided will be held in compliance with GDPR regulations. Cardiff University is the data controller and Matt Cooper is the data protection officer (inforequest@cardiff.ac.uk). The lawful basis for processing this information is public interest. This information is being collected by Jerrie Serrell.

The information on the consent form will be held securely and separately from the research information. Only the researchers will have access to this form and it will be destroyed after 7 years.

The research information you provide will be used for the purposes of research only and will be stored securely. Only the principal researcher, Jerrie Serrell, and her research supervisors, Dr Helen Penny and Dr Cerith Waters, will have access to this information.

Appendix 7: Participant Debriefing Form

School of Psychology
Ysgol Seicoleg

South Wales Doctoral Programme in Clinical Psychology
De Cymru Rhaglen Doethuriaeth mewn Seicoleg Glinigol



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*Prifysgol Caerdydd
Adellad y Tŵr
Plas y Parc
Caerdydd CF10 3AT
Cymru Y Deyrnas Unedig*

Psychological Impact of experiencing Hyperemesis Gravidarum

Debriefing Information Sheet

Thank you very much for taking part in this study.

The study aimed to explore women's experiences of Hyperemesis Gravidarum (HG) during pregnancy. It is hoped that this research will inform healthcare professionals of the psychological impact of Hyperemesis Gravidarum (HG) and provide some clinical recommendations to improve support for women who experience HG during pregnancy. The findings will be published on Pregnancy Sickness Support website.

Further Support

Reflecting on your pregnancy or your experiences of having had Hyperemesis Gravidarum may have been difficult. This is understandable and you may find that you feel low after completing the questionnaires. If you do feel upset here are some suggested sources of support you may want to consider calling upon:

- Your friends and family may be able to provide you with immediate support.
- Your GP is also a potential source of support if you feel upset about what has been discussed for a longer than you feel comfortable with.
- Your GP can refer you to a Clinical Psychologist for support to talk through any difficulties that you experience and support you to cope with these
- There are also a number of organisations and charities that offer support. You may find some of these helpful.

Pregnancy Sickness Support (www.pregnancysicknesssupport.org.uk)

Pregnancy sickness support are a national Support Network for women suffering any degree of nausea and

vomiting in pregnancy to access support and comfort at times of isolation and distress. The network is made up

of volunteers who know first-hand the trials of nausea and vomiting in pregnancy. The website also provides

information on treatments to discuss with your doctor and advice for coping strategies at home. The website

hosts an online forum where you can access support from a number of women at almost any time of the day or

night. PSS has developed leaflets and information for carers and partners and carers can register with their forum

to access an area specifically for them.

PSS Helpline - 02476382020

Lines are open 9am-4.30pm Monday to Friday.

Mindline (<https://www.mind.org.uk/>)

Mindline is a confidential listening service to support anybody who is in distress. Mindline can guide you where to get help, discuss medication and alternative treatments, offer advocacy and look for details of help and support in your own area.

Mindline- phone 0300 123 3393 or text 86463

Lines are open 9am to 6pm, Monday to Friday (except for bank holidays).

The Samaritans (www.samaritans.org)

The Samaritans is a national charity and the co-ordinating body for the 201 Samaritans branches across the UK. The Samaritans aims to help alleviate emotional distress- you do not have to be suicidal to call

Samaritans helpline- call 116 123 from any phone for free

Lines are open 24 hours a day, 365 days a year.

If you have any further questions in relation to this study please contact us on the details below.

Contact details:

Name: Jerrie Serrell, Trainee Clinical Psychologist

Email: richardsj25@cardiff.ac.uk

Address: Doctorate in Clinical Psychology, 11th Floor, Tower Building, School of Psychology, 70 Park Place, Cardiff, CF10 3AT

If you have any concerns that you would like to raise about the research you can also contact our academic supervisor:

Contact details:

Name: Dr Helen Penny, Senior Clinical Tutor Cardiff University

Email address: PennyH@cardiff.ac.uk

Address: Doctorate in Clinical Psychology, 11th Floor, Tower Building, School of Psychology, 70 Park Place, Cardiff, CF10 3AT.

Thank you again for taking the time to participate

Privacy Notice: All personal data will be processed in accordance with GDPR regulations

The information provided will be held in compliance with GDPR regulations. Cardiff University is the data controller and Matt Cooper is the data protection officer (inforequest@cardiff.ac.uk). The lawful basis for processing this information is public interest. This information is being collected by Jerrie Serrell. The information on the consent form will be held securely and separately from the research information. Only the researchers will have access to this form and it will be destroyed after 7 years.

The research information you provide will be used for the purposes of research only and will be stored securely. Only the principal researcher, Jerrie Serrell, and her research supervisors Dr Helen Penny and Dr Cerith Waters, will have access to this information.

Appendix 8: Copy of ethical approval

From: psychethics
Sent: 24 January 2019 10:03
To: Jerrie Serrell <RichardsJ25@cardiff.ac.uk>
Cc: Helen Penny <PennyH@cardiff.ac.uk>
Subject: Ethics Feedback - EC.19.01.08.5550R

Dear Jerrie,

The Ethics Committee has considered your revised PG project proposal: Psychological trauma following HG: The role of cognitive processing, trauma memory, appraisals and coping strategies (EC.19.01.08.5550R).

The project has now been approved.

Please note that if any changes are made to the above project then you must notify the Ethics Committee.

Best wishes,
Adam Hammond

School of Psychology Research Ethics Committee
Cardiff University

Tower Building

70 Park Place

Cardiff

CF10 3AT

Tel: +44(0)29 208 70360

Email: psychethics@cardiff.ac.uk

<http://psych.cf.ac.uk/aboutus/ethics.html>

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