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The aetiology of posttraumatic stress following childbirth: a meta-analysis and theoretical framework

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Abstract

There is evidence that 3.17% of women report posttraumatic stress disorder (PTSD) after childbirth. This meta-analysis synthesizes research on vulnerability and risk factors for birth-related PTSD and refines a diathesis-stress model of its etiology. Systematic searches were carried out on PsychInfo, PubMed, Scopus and Web of Science using PTSD terms crossed with childbirth terms. Studies were included if they reported primary research that examined factors associated with birth-related PTSD measured at least one month after birth. 50 studies (N=21,429) from 15 countries fulfilled inclusion criteria. Pre-birth vulnerability factors most strongly associated with PTSD were depression in pregnancy (.51), fear of childbirth (.41), poor health or complications in pregnancy (r = .38), and a history of PTSD (.39) and counselling (.32). Risk factors in birth most strongly associated with PTSD were negative subjective birth experiences (.59), having an operative birth (assisted vaginal or caesarean, .48), lack of support (-.38), and dissociation (.32). After birth, PTSD was associated with poor coping and stress (.30), and was highly comorbid with depression (.60). Moderator analyses showed that the effect of poor health or complications in pregnancy was more apparent in high-risk samples. The results of this meta-analysis are used to update a diathesis-stress model of the etiology of postpartum PTSD and can be used to inform screening, prevention and intervention in maternity care.

Introduction

Approximately 136 million women give birth to a live or stillborn baby every year (World Health Organisation, 2005) with 4.5 million of these births occurring in North America and 5.4 million in Europe (European Commission, 2011; United Nations, 2011). There is now substantial evidence that women can suffer from a range of psychological problems during this time. Postpartum depression is most widely recognised and affects between 10 and 15% of women (Gavin, Gaynes, Lohr, Meltzer-Brody, Gartlehner & Swinson, 2005). There is also evidence that women are more vulnerable to anxiety and adjustment disorders (Brockington, 2004; Brockington, Macdonald & Wainscott, 2006; Wenzel, Haugen, Jackson & Brendle, 2005). Maternal mental health problems are usually higher in low and middle income countries – particularly women in socially and economically disadvantaged circumstances (Fisher, Cabral de Mello, Patel, Rahman, Tran, Holton & Holmes, 2011).

The causes of maternal mental health problems are multifactorial and include individual vulnerability factors, such as previous psychological problems, and psychosocial circumstances, such as socioeconomic deprivation, intimate partner violence or other chronic stressors. In some instances the events of birth may also contribute to postpartum adjustment problems and mental health disorders. There is increasing evidence that some women develop post-traumatic stress disorder (PTSD) in response to events of birth (Alcorn, O'Donovan, Patrick, Creedy, & Devilly, 2010; Ayers & Pickering, 2001). Reviews of this research suggest it affects 3% of women postpartum (Grekin & O'Hara, 2014). Unlike other postpartum psychopathology, this is therefore an area where there is clear potential to prevent or minimise postpartum PTSD by changing maternity and early postpartum care to improve women's

experiences of birth. However, in order to do this we first need to identify the risk factors for birth-related PTSD.

Conceptual frameworks of the aetiology of postpartum PTSD draw together key vulnerability, risk and maintaining factors that are thought to be important in the development of birth-related PTSD (Ayers, 2004; Slade, 2006; van Son, Verkerk, van der Hart, Komproe, & Pop, 2005). These usually draw on psychological approaches, such as the diathesis-stress model which explains health outcomes as an interaction between an individual's predispositional vulnerability and stressful experiences. In a previous paper, we used a diathesis-stress approach to propose a model of postpartum PTSD that incorporates vulnerability factors in pregnancy, risk factors during birth, and maintaining factors after birth in the onset and maintenance of PTSD (Ayers, 2004). Vulnerability factors in pregnancy were specified as previous psychological problems, a history of trauma or sexual abuse, anxiety, and having a first baby (nulliparity). These vulnerability factors are proposed to interact with birth events to determine appraisal of birth as traumatic, and subsequent traumatic stress responses. Birth risk factors were specified as type of birth (as a broad indicator of level of intervention and complications), poor support, high levels of negative emotion, perceived threat, and dissociation. Postpartum factors that might maintain initial PTSD symptoms were specified as additional stress, maladaptive coping, and poor support (Ayers, 2004).

Evidence broadly confirms the associations between the factors outlined above and postpartum PTSD (Cigoli, Gilli, & Saita, 2006; Cohen, Ansara, Schei, Stuckless, & Stewart, 2004; Creedy, Shochet, & Horsfall, 2000; Czarnocka & Slade, 2000; Lev-Wiesel, Chen, Daphna-Tekoah, & Hod, 2009; Soderquist, Wijma, Thorbert, & Wijmad, 2009; Soderquist, Wijma, & Wijma, 2002; Wijma, Soderquist, & Wijma, 1997). Very few studies have looked at the interaction between vulnerability and risk

factors. Those studies that have done so are consistent with the idea that trauma history interacts with birth intervention to increase risk of PTSD after birth (Ayers, Harris, Sawyer, Parfitt, & Ford, 2009; Ford & Ayers, 2011). Likewise support during birth can mediate the relationship between previous trauma and birth-related PTSD; as well as the relationship between birth intervention and postpartum PTSD (Ford & Ayers, 2011).

Overviews of factors associated with postpartum PTSD have been provided in various narrative reviews (Andersen, Melvaer, Videbech, Lamont, & Joergensen, 2012; Ayers, 2004; Bailham & Joseph, 2003; Olde, Van Der Hart, Kleber, & Van Son, 2006) and a meta-analysis (Grekin & O'Hara, 2014). The meta-analysis looked at risk factors for PTSD in postpartum women who reported PTSD in response to a range of traumatic stressors, including childbirth (Grekin & O'Hara, 2014). This reviewed 78 studies which reported prevalence and/or risk factors for PTSD and analysed risk factors for PTSD separately in community or high-risk samples. The authors concluded the main factors associated with PTSD in community samples were birth experiences and postpartum depression. In high-risk samples the main factors were infant complications and postpartum depression. These results of this meta-analysis highlight the co-morbidity between postpartum PTSD and depression, and are broadly consistent with the vulnerability and risk factors outlined in the diathesis-stress model with the exception of parity, which was not found to moderate prevalence rates. However, this meta-analysis did not focus on birth-related PTSD and therefore understandably did not examine all the factors proposed to be important by models of birth-related PTSD, such as dissociation, postpartum stress, and maladaptive coping. The most recent review of evidence focussing on birth-related PTSD was carried out by Andersen and colleagues (2012) who concluded that subjective distress during labour and obstetric emergencies are the main risk factors

for birth-related PTSD. Other risk factors included poor support during birth and complications with the baby. Vulnerability factors were a history of trauma or psychological problems in pregnancy (Andersen et al., 2012). Again, this is broadly consistent with the diathesis-stress model but no meta-analyses were conducted.

These reviews provide useful syntheses of research and promising evidence towards refining the diathesis-stress model of the etiology of birth-related PTSD. The amount of evidence available means meta-analyses are now possible and the meta-analysis by Grekin & O'Hara (2014) provides a valuable overview of postpartum PTSD regardless of the trigger event. What is needed now is a more detailed meta-analyses of all the vulnerability and risk factors for birth-related PTSD proposed by the diathesis-stress model, and examination of a wider range of co-morbid symptoms. Methodological and sampling differences also need to be considered. This review and meta-analysis therefore has three aims. The first is to systematically review and identify the effect sizes for vulnerability and risk factors for birth-related PTSD symptoms and update the diathesis-stress model of birth-related PTSD. The second is to examine the association between birth-related PTSD and co-morbid symptoms. The third is to examine methodological and individual factors that might moderate these relationships. In doing so the review will identify the critical vulnerability and risk factors that put women at risk of developing birth-related PTSD symptoms; and therefore which women may need additional support and care during birth. The results will inform understanding and clinical practice by highlighting vulnerability factors to screen for in pregnancy; those elements of maternity services that can be targeted for most effective prevention; and which vulnerability or risk factors perinatal psychology services may need to incorporate into assessment and treatment of birth-related PTSD.

Method

Selection of studies

A systematic search was conducted to identify studies of PTSD in women following childbirth. Computerized databases PsychInfo, PubMed, Scopus and Web of Science were searched up to May 2015 using terms related to PTSD (posttraumatic stress, post-traumatic stress, trauma*, PTSD) crossed with childbirth-related terms (birth, pregnancy, partum, postpartum, prenatal, postnatal, stillbirth, miscarriage, gestation, partus, labor). Additional studies (n = 40) were located through inspecting references and citations of key publications. Figure 1 summarizes results of the search which yielded a preliminary database of 8044 papers. Of these, 6836 were excluded from the title as not relevant to childbirth. These were predominantly animal studies or occupational studies of work labor/labour. This left a database of 1208 papers of which examination of abstracts showed that 785 did not meet inclusion criteria, leaving 423 papers where the full text was examined to determine eligibility.

- Insert Figure 1 here -

Inclusion and exclusion criteria

Inclusion criteria were that papers reported primary research that included a quantitative measure of birth-related PTSD taken at least one month after birth to exclude confounding with acute stress disorder. Research had to be with women 18 years of age or over, and published in English. Papers were excluded if they were qualitative or case studies, reviews or discussion papers, dissertations, conference abstracts, or only measured PTSD in pregnancy. Intervention studies were excluded unless they reported relationships between PTSD and risk factors prior to the intervention (n = 0). Control-comparison papers were excluded if the PTSD group was selected on the basis of non-standard cut-offs for subclinical symptoms. Studies on high-risk samples where *all* women had experienced pregnancy loss, stillbirth, or

severe complications with the baby (e.g. all preterm births or very low birth weight babies) were excluded to avoid potential confounding with traumatic bereavement or perceived threat to the baby rather than self. It is also possible that different factors are associated with the development of PTSD after loss of a baby (Daugirdaite, van den Akker & Purewal, 2015).

Studies had to report the correlation coefficient *r* or odds ratio, or sufficient statistical information to compute these statistics. Authors of papers with unclear statistical information (n = 16) were contacted to request further information. Half these authors provided the data requested where available (n = 8) [1]. Where data were not available these effects or the study were excluded (n =1; Leeds & Hargreaves, 2008). Longitudinal studies which measured PTSD at different time points were included and effect sizes taken from the shortest time between measurement of risk factors and PTSD. Thus concurrent and longitudinal relationships were included in the analyses and time between measures of risk and PTSD was examined as a potential moderator.

Variables coded

A number of variables were extracted for analysis. Detailed information on coding is given in Supplementary file 1. *Sample characteristics* extracted were country of origin, clinical status of the sample, age, ethnicity, marital status, education and socio-economic status. Clinical status was classed as low risk, normal risk, or high risk. *Methodological variables* extracted were methodological quality, design (cross-sectional or longitudinal), recruitment (antenatal or postnatal), sampling (via the internet or community), sample size, and time frame of the effect size (i.e. months

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elapsed between the measure of risk and PTSD). *PTSD measures* were coded for quality (0 to 3). Measures that did not measure all symptoms of PTSD and included items that are not part of diagnostic criteria were scored 0; measures of PTSD symptoms but not full diagnostic criteria scored 1; questionnaire measures of all diagnostic criteria scored 2; and clinical interviews scored 3. *Birth variables* extracted included objective birth experience, subjective birth experience, type of birth (operative or normal vaginal), length of labor (hours), pain, complications with the baby, presence of partner, dissociation during birth, and support from staff during birth. Subjective birth experience included: (i) overall ratings of birth experience; (ii) negative emotions and distress; and (iii) control and agency. *Vulnerability factors* extracted were in four domains. The first domain was prior history and included history of traumatic events, PTSD, sexual abuse, or psychological problems. The second domain was vulnerability due to poor mental health in pregnancy. These variables were depression in pregnancy, anxiety in pregnancy, fear of childbirth, and counseling for problems associated with a previous pregnancy/birth. The third domain was pregnancy-related vulnerability which included: being primiparous, whether the pregnancy was planned, poor physical health in pregnancy, and problems in a previous pregnancy/birth. The final domain was psychosocial vulnerability which included coping and stress, and social support. *Comorbid symptoms* included depression, anxiety, general psychological health, and physical health. *Potential moderators* of clinical status of the sample, quality of PTSD measure, and time between measuring risk factors and PTSD were also extracted.

Methodological quality

Methodological quality of each study was assessed using a checklist based on Sawyer, Ayers and Field (2010) and Andersen et al. (2012). Nine criteria were assessed of: clear study aims; clear inclusion/exclusion criteria; method of data

collection; measure of PTSD; sample representativeness; response rate; examination of bias in participants who did not take part or dropped out; prospective design; more than one postpartum data collection point (each rated from 0 – 3; total score 0 - 27). Most studies were of reasonable or good quality with 70% (n = 35/50) scoring over the mid-point of 14 or more (see Table 1).

Computation and analysis of effect sizes

The majority of effect sizes were reported as Pearson correlation coefficients, although some used odds ratios or rank correlations. Odds ratios were therefore converted to r [2] and rank correlations were treated as equivalent to Pearson correlations. The effect size for all studies was therefore r. To ensure this approach did not influence results, we conducted analyses separately for r and odds ratios and they did not differ appreciably. A few studies reported correlation coefficients only for symptom subscales of PTSD. Therefore to guarantee the independence assumption among effect sizes the coefficients were averaged to produce a single effect size associated with overall PTSD.

In meta-analysis, there is a choice between fitting either fixed-effect or random-effect models (Borenstein, Hedges, Higgins, & Rothstein, 2010; Hedges & Vevea, 1998; Hunter & Schmidt, 2004). Random effects models are more usually recommended (National Research Council, 1992) because it is likely that there is heterogeneity in the population effect sizes as a consequence of differences in, for example, study design and the measures used. However, Hedges and Vevea (1998) point out that it is not the presence of heterogeneity *per* se that should influence the choice of a fixed or a random effects model. Rather, the issue is which population we wish to make inferences to. In a fixed effects model, inference is confined to the set of

[2] The formula used was r = cos (180/(1+sqrt(*ad/bc*)), where *ad*/*bc* is the odds ratio (DeCoster, 2013). Downloaded 4th November, 2013 from http://www.bama.ua.edu/~jamie/meta/

studies included in the analysis whereas in a random effects model inference can be made to a broader population from which the studies included in the analysis may be considered a random sample. However, a random effects model can be problematic when the number of studies is small because, in comparison to a fixed effects model, the variability between population effect sizes is also estimated and, with limited numbers of studies, this estimate will be imprecise and can provide misleading results (Borenstein, Hedges, Higgins, & Rothstein, 2009; Rothstein, 2009). We therefore decided to use a fixed effects model and confine inference to the set of study characteristics present in our sample[3]. In analysing correlations, we use the Fisher z transformation for the analysis (Lipsey & Wilson, 2001) and an integral *z*-to-*r* transformation for converting our results back to the *r* metric (Hafdahl, 2009). Moderator analyses were also conducted using a fixed-effects general linear model on the *z* – transformed effect size. Analyses were carried out with the Metafor package in R (Viechtbauer, 2010).

- insert Table 1 about here -

Results

Study Characteristics

Fifty studies, reported in 60 papers, met inclusion criteria with a total of 21,429 participants. Studies included in the meta-analysis are listed in Table 1. Sample sizes of studies ranged from 40 to 3,751 and studies were carried out in the UK (*n* = 12), Netherlands (*n* = 7), Sweden (*n* = 6), USA (*n* = 4), Canada (*n* = 3), Israel (*n* =3), Italy (*n* = 3), Australia (*n*= 2), France (*n* = 2), Iran (*n* =2), Switzerland (*n* = 2), Austria (*n* =1), Germany (*n* = 1), Norway (*n* = 1) and Nigeria (*n* = 1). Most studies

[3] In fact, we ran all analyses using both a fixed effects and random effects model (using a REML estimator of population heterogeneity). On the whole, the choice of model made little difference to our conclusions

were longitudinal (*n* = 36, 72%). Samples predominantly included white women (range 0 to 100%; mean 80.65% white) with a mean age 30.41 years (SD = 1.82). Women were mostly cohabiting or married (range 80 to 100%, mean 93.36%). On average, 32.76% of samples had university level qualifications (range 7.6% to 68.5%). Most studies were on normal populations, with ten (20%) on high risk groups and three (6%) on low risk groups. Samples were mixed in terms of parity (range 21 to 100% primiparous, mean 58.47%).

Vulnerability and risk factors for postpartum PTSD

The results of the meta-analyses are shown in Table 2 which gives the number of effects included (*k*), the effect size (*r*), lower and upper confidence limits of the effect size (LL, UL). In this analysis, *k* is equivalent to the number of studies because only one effect was entered per study. *Qe* gives the residual heterogeneity so if it is significant it suggests the heterogeneity in effect sizes is greater than expected from sampling variation and there are likely to be moderators of the effect.

Vulnerability factors during pregnancy that were most strongly associated with birth-related PTSD were depression in pregnancy (.51), fear of childbirth (.41), poor health or complications in pregnancy (.38), a history of PTSD (.39) or previous counselling (.32). Risk factors during birth most strongly associated with PTSD were subjective birth experience (.59), operative birth (.48), lack of support from staff during birth (-.38), and dissociation (.32), The effect of subjective birth experience was mostly due to negative emotions during birth (.34) but lack of control or agency was also important (-.23). After birth, PTSD symptoms were associated with depression (.60) and poor coping and stress (.30). PTSD was not associated with time since birth, although this is only based on two studies so should be interpreted with caution. Vulnerability and risk factors with the strongest effect sizes are summarized in Figure 2.

One study in the meta-analysis was carried out in Nigeria (Adewuya, Ologun, & Ibigbami, 2006) which has a different social demographic and increased risk of maternal and infant morbidity compared to other studies. To check that this Nigerian study was not unduly influencing results it was removed and analyses repeated. When this study was removed effect sizes became smaller for poor health/complications in pregnancy (k = 8, r = .23, CI .20 to .26) but larger for control or agency in birth (k = 4, r = -.35, CI -.42 to -.28) and education level (k = 5, r = -.25, CI -.29 to -.22).

- insert Table 2 & Figure 3 about here -

Moderator Analyses

Moderator analyses examined whether methodological variables had an impact on the relationships between risk factors and PTSD. Moderators examined were clinical status of the sample, quality of PTSD measure, and time between measuring risk factors and PTSD. Results showed the amount of time between measuring risk factors and postpartum PTSD significantly moderated many effects (see Supplementary file 2). This means the strength of the relationship between PTSD and some risk factors changed significantly over time, irrespective of whether this relationship was originally significant. Medium or large moderation effects of time since birth (i.e. greater than .3) showed that more time since birth reduced the effects of subjective birth experience (-.37); but increased the effect of a history of sexual trauma (.30). Clinical status of the sample moderated a few effects. Studies with high risk samples, such as women who had pre-eclampsia or emergency caesarean sections, were more likely to find associations between PTSD and marital status (.43), poor health/complications in pregnancy (.55), and negative emotions in birth (.32). These latter two are perhaps unsurprising as these factors are likely to be more prevalent in high risk samples.

Measures of PTSD that used full diagnostic criteria were more likely to find effects between postpartum PTSD and poor health or complications in pregnancy. Conversely, measures that only looked at PTSD symptoms were more likely to find effects between PTSD and marital status (-.43), previous counseling (-.59), stress and coping (-.38), postpartum emotional health (-.48) and marital status (-.43).

Publication bias

Meta-analysis relies on the published literature so any biases in the selection of studies for publication will be reflected in the studies included in the meta-analysis. Tests of publication bias (see Supplementary File 3) suggested some effect sizes might be affected by publication bias, such as those for educational level, ethnicity, history of sexual trauma, type of birth, infant-related complications, and depression after childbirth. However, trim and fill methods did not result in substantial changes to most effect sizes with only a few analyses where there was funnel plot asymmetry and where trim and fill was indicated. This suggests the majority of findings are quite robust. The result of analyses where trim and fill was indicated was that the small effects between PTSD and age and planned pregnancy became nonsignificant; and the association between PTSD and socioeconomic status, length of labour, and poor postpartum emotional health became significant.

Discussion

This meta-analysis aimed to quantify the key vulnerability and risk factors for postpartum PTSD, co-morbidity, and potential moderators of these relationships. Results confirm that pre-birth and birth factors are important, and that PTSD is associated with poor coping and stress after birth and is highly comorbid with depression in pregnancy and after birth. These results extend our understanding of

postpartum PTSD in a number of ways. First, many of the risk factors identified are consistent with the diathesis-stress model (Ayers, 2004) and have been used to update this model as shown in Figure 3. The revised model now includes factors identified as having the strongest associations with postpartum PTSD, as well as incorporating a pathway to indicate that vulnerability factors may impact on whether women with initial PTSD symptoms resolve their symptoms or develop chronic PTSD. The finding that previous counselling is a risk factor is probably because this identifies women with a history of severe psychological problems. This has therefore been included in the model as a broader category of a history of PTSD or psychological problems. The results of the meta-analysis therefore help refine our understanding of the etiology of postpartum PTSD.

- insert Figure 2 about here -

Second, this meta-analysis identifies factors that could be used for screening, prevention and treatment of birth-related PTSD. Women can be assessed during and after pregnancy for their level of risk. During pregnancy, women could be assessed for depression, fear of childbirth, poor health or complications, and a history of PTSD. If women score high on these factors steps could be taken to reduce the likelihood of them developing PTSD following childbirth. During birth, women who have operative births or show signs of dissociation could be flagged for postpartum follow-up to assess for PTSD. After birth, women could be asked about their subjective birth experiences. The exact nature these assessments take and which steps are most effective in preventing or minimizing PTSD symptoms requires further research. However, the results of this meta-analysis provide a preliminary basis on which to base screening, prevention or treatment.

The role of support during birth is important as a potential protective factor because it can be relatively easily addressed in maternity care. Perceived support

during birth was associated with reduced PTSD and previous research suggests perceived support is even more important for women with a history of trauma or those who have more intervention during birth (Ford & Ayers, 2011). General perceived support during and after pregnancy was also associated with reduced PTSD. However, it is not clear from this meta-analysis whether this association reflects a protective function of support or negative impact of poor support contributing to PTSD. There is evidence to substantiate both views. For example, a study of women's worst hotspots during birth (defined as of peak emotional distress) found that over a third of hotspots were due to interpersonal factors such as feeling abandoned, being ignored and lacking support (Harris & Ayers, 2012) . Similarly, in the PTSD literature there is evidence that interpersonal traumas where a person is perceived as the perpetrator are more likely to result in PTSD (Charuvastra & Cloitre, 2008). Conversely, there is evidence from experimental studies using birth stories that positive support may be critical in improving women's perceived control and reducing perceived trauma (Ford & Ayers, 2009). It is therefore important to look at ways we can increase support for women during birth – particularly for vulnerable women – whilst at the same time reducing the incidence of poor support.

The results of this review therefore extend our knowledge of birth-related PTSD. However, a number of conceptual and methodological issues need to be considered before drawing conclusions. Conceptually childbirth differs to other traumatic events in that it is experienced as positive by many women and viewed positively by society. Childbirth also involves huge physiological changes that may affect women's responses. Normal postpartum symptoms such as sleep deprivation or increased vigilance may confound measurement of PTSD (Ayers, Wright & Ford, 2015). The baby might also act as a reminder of the birth – therein affecting symptoms of avoidance. Results from this meta-analysis may therefore not be

generalizable to PTSD following other events. Despite this, many of the risk factors identified are similar to those found in meta-analyses of postpartum PTSD with a range of traumatic stressors (Grekin & O'Hara, 2014) and PTSD in non-obstetric samples (Brewin, Andrews, & Valentine, 2000; Ozer, Best, Lipsey, & Weiss, 2003). Childbirth also offers an accessible way to prospectively study responses to stressful and potentially traumatic events, as evidenced by the predominance of longitudinal studies in this review.

Moderator analyses (shown in Supplementary file 2) suggest some associations are influenced by type of sample, measurement, and time since birth. High risk samples and those using diagnostic interviews were more likely to find an association between poor health or complications in pregnancy and PTSD. This is probably because a few studies, such as the Nigerian study by Adewuya et al. (2006), were on high risk samples (that are more likely to experience complications in pregnancy) and used diagnostic interviews to measure PTSD. Indeed, removing the Nigerian study from the bivariate analyses showed that the effect of complications in pregnancy reduced and the effects of control in birth increased. This suggests there may be differences in some risk factors between low and middle income countries and high income countries. This is plausible given different rates of maternal morbidity and mortality in these countries.

Moderator analyses of time since birth suggest that the association between birth factors and PTSD reduces over time, whereas the associations with pre-birth vulnerability, such as sexual trauma, and postpartum factors may increase over time. This is consistent with theories of PTSD which distinguish between factors associated with the onset and maintenance of PTSD (Ehlers & Clark, 2000). However, these theories typically emphasize cognitive and coping factors that maintain PTSD, and there is evidence to support these are important in postpartum PTSD (Ford, Ayers, &

Bradley, 2010; Vossbeck-Elsebusch, Freisfeld, & Ehring, 2014). However, these moderator analyses suggest pre-existing vulnerability and postpartum factors may also be important in the resolution of postpartum PTSD.

Methodological issues with this review include that some analyses were based on small numbers of studies so results should be interpreted with caution. This is particularly the case for time since birth and socio-demographic variables so further research is needed examining these. Similarly, studies included in the meta-analysis used diverse measures of similar constructs which were difficult to combine. Therefore some agreement over which measures are most appropriate and valid to use in this population would be useful. Finally, we can only analyse and comment on the variables included in research. It is likely there are variables that warrant further exploration which are not analysed here because of insufficient evidence. For example, cognitive appraisals after birth (Ford et al., 2010; Vossbeck-Elsebusch et al., 2014), anxiety sensitivity (Keogh, Ayers, & Francis, 2002; Verreault et al., 2012) and insomnia (Garthus-Niegel, Ayers, von Soest, Torgersen & Eberhard-Gran, 2014) all appear promising but there was not enough evidence to include them in the meta-analysis. Future research should therefore consider other variables, such as these, which are not included in this review. Finally, little research is available from low and middle income countries so these findings may only be generalisable to American, European and Australasian populations.

Despite these caveats, it can be seen that this meta-analysis has a number of implications for clinical practice and research. This review identifies a number of vulnerability and risk factors for postpartum PTSD that can be used to inform our understanding of the etiology of birth-related PTSD, as well as assessment, prevention and intervention. Although PTSD following birth is unique in some ways, results are broadly comparable to meta-analyses of risk factors for PTSD following other events,

which suggests results might be generalizable. Postpartum PTSD offers a useful paradigm to study responses to stressful and potentially traumatic events prospectively. Support during birth may be a particularly promising area for preventing PTSD and the same might be the case for postpartum support and care but more research is needed.

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Table 1. Characteristics of studies included in the meta-analysis

Study	*N*	Country	Mean Age (range)	Marital status % cohabiting	Racial Composition % White	Time since birth in months[1]	Measure of PTSD	Quality
Adewuya et al. (2006)	876	Nigeria	26.0 (NR)	85.9	NR	1.5	MINI	20
Alcorn et al. (2010); Devilly et al. (2014); O'Donovan et al. (2014)	933	Australia	28.6 (NR)	84.0	86.0	1.3, 3.0, 6.0	PDS	25
Ayers et al. (2014)	57	UK	33.2 (25-46)	100	89.6	3.0	PDS	21
Beck et al. (2011)	1573	USA	NR (18-45)	NR	66.0	7.0 – 18.0[2]	PSS-SR	15
Briddon et al. (2011)	122	UK	28.0 (18-44)	87.7	87.7	1.5	APTSD-Q, IES	17
Cigoli et al. (2006)	160	Italy	NR (NR)	NR	NR	4.5	PTSD-Q	12
Cohen et al. (2004)	253	Canada	NR (NR)	NR	NR	2.0	DTS	19
Creedy et al. (2000)	592	Australia	NR (NR)	NR	NR	1.3	PSS [1]	14
Czarnocka & Slade (2000)	298	UK	28.9 (18-41)	92.0	NR	1.5	PTSD-Q	17

Denis et al. (2011)	239	France	30.4 (NR)	96.0	NR	1.0, 4.0, 9.0	IES-R	14
Edworthy et al. (2008)	121	UK	30.7 (16-41)	95.4	NR	1.5	IES-R	22
Engelhard et al. (2002)	113	Netherlands	31.8 (NR)	95.8	NR	13.7	PSS [2]	13
Fairbrother & Woody (2007)	99	Canada	NR (22-42)	96	86.7	1.0	PSS-SR	14
Ford & Ayers (2011); Ford et al. (2010)	138	UK	32.1 (NR)	89.1	92.6	3.0	PDS	24
Furuta et al. (2014)	1824	UK	32.3 (NR)	NR	60.5	2.0	IES	20
Garthus-Niegel et al. (2013); Garthus-Niegel et al. (2014a; 2014b)	3751	Norway	30.7 (17-46)	97.6	NR	2.0	IES	16
Ghorbani et al. (2014a; 2014b)	82	Iran	27.9 (NR)	100	NR	2.0	IES	12
Goutaudier et al. (2012)	123	France	30.5 (19-41)	96	NR	1.5	IES-R	15
Harris & Ayers (2012)	675	UK	31.6 (19-66)	93.6	98.6	2.5 – 566.0[2]	PDS	11

Hauer et al. (2009)	54	Netherlands	31.7 (NR)	NR	NR	1.5	IES, PSS-SR	17
Hoedjes et al. (2011)	128	Netherlands	31.0 (NR)	NR	NR	1.3, 3.0	SRIP	17
Iles et al. (2011)	303	UK	31.7 (19-44)	100.0	97.6	1.5, 3.0	IES, PTSD-Q	16
Lemola et al. (2007)	458	Switzerland	32.4 (NR)	99.5	NR	5.0	IES-R	14
Leeds & Hargreaves (2008)	102	UK	30.06 (NR)	86.3	NR	6.0 – 12.0	PPQ, PCL	12
Lev-Wiesel, Daphna-Tekoah et al. (2009) Lev-Wiesel et al. (2009); Lev-Wiesel & Daphna-Tekoah (2010)	1586	Israel	30.5 (18-44)	NR	NR	2.0	PSS [2]	20
Lyon (1998)	62	UK	29.0 (20-39)	NR	100.0	1.0	IES	17
Maclean et al. (2000)	40	UK	29.2 (NR)	80.0	NR	NR	IES	12
Maggioni et al. (2006)	93	Italy	33.0 (20-40)	NR	NR	4.5	PTSD-Q	12
Mautner et al. (2013)	67	Austria	32.2 (23-43)	NR	NR	1.0 - 48.0	IES	16
Modarres et al. (2012)	218	Iran	26.9 (NR)	NR	NR	2.0	PSS-I	12

Noyman-Veksler et al. (2015)	142	Israel	28.7 (NR)	NR	NR	1.5, 3.0	PDS	23
Olde et al. (2005)	219	Netherlands	31.5 (22-40)	100	NR	3.0	PSS-SR	16
Onoye et al. (2009)	54	Hawaii	26.9 (NR)	NR	NR	1.5	PCL-C	14
Polachek et al. (2012)	102	Israel	32.0 (20-40)	NR	NR	1.0	PDS	13
Ryding et al. (1998)	354	Sweden	29.0 (18-46)	NR	NR	1.0	IES	17
Sawyer & Ayers (2009)	216	UK	28.1 (18-42)	95.4	97.3	1.0 – 36.0[2]	PDS	12
Sawyer et al. (2012)	125	UK	31.9 (18-42)	88.0	88.8	2.0	PSS-SR	19
Soderquist et al. (2006); Soderquist et al. (2009)	1224	Sweden	28.6 (NR)	97	NR	1.0, 4.0, 7.0, 11.0	TES	22
Sorenson & Tschetter (2010)	71	USA	30.0 (22-42)	NR	NR	6.5	PTCS	10
Stramrood, Paarlberg et al. (2011); Warmelink et al. (2012)	428	Netherlands	32.0 (17-45)	96.5	NR	2.0 – 6.0[2]	TES	14

Stramrood, Wessel et al. (2011)	193	Netherlands	30.7 (NR)	95.9	NR	1.5, 15.0	PSS-SR	20
Sumner et al. (2012)	210	USA	27.7 (NR)	NR	0	7.0, 13.0	PCL-C	15
Suttora et al. (2014)	243	Italy	34.3 (NR)	99.2	NR	1.0 - 36.0	PPQ	11
Tham et al. (2007)	129	Sweden	32.7 (21-45)	95	NR	3.0	IES	18
Van Son et al. (2005)	248	Netherlands	31.0 (19-43)	NR	NR	3.0, 6.0, 12.0	IES	18
Verreault et al. (2012)	367	Canada	32.2 (19-44)	97.1	77.7	1.3, 3.0, 6.0	PSS-SR	20
Vossbeck-Elsebusch et al. (2014)	224	Germany	30.54 (NR)	72.3	NR	1.0 – 6.0	PDS	13
Wijma et al. (1997); Soderquist et al. (2002)	1640	Sweden	28.7 (17-45)	96.0	NR	1.0 – 15.0[2]	TES	18
Wijma et al. (2002)	40	Sweden	30.0 (19-43)	93.0	NR	1.0	IES	19
Zaers et al. (2008)	60	Switzerland	30.6 (19-42)	94.0	NR	1.5, 6.0	PDS	13

Note. [1] Timing of PTSD measure. For longitudinal studies, time point(s) used for analysis are underlined. [2] Time point not coded for analysis if range > 3 months. NR = Not reported in the study. PTSD measures: APTSD-Q = Adjusted Post-Traumatic Stress Disorder Questionnaire. DTS = Davidson Trauma Scale. IES = Impact of Event Scale (original or revised version). MINI = MINI International Neuropsychiatric Interview. PCL = Posttraumatic Stress Disorder Checklist. PCL-C = Posttraumatic Stress Disorder Checklist-Civilian Version. PDS = Posttraumatic Diagnostic Scale. PPQ = Perinatal PTSD Questionnaire. PSS-I Posttraumatic Stress Scale Interview. PSS-SR = Posttraumatic Stress Disorder Symptom Scale-Self Report. PTSD-Q Post-Traumatic Stress Disorder Questionnaire. TES = Traumatic Event Scale. Quality = Methodological Quality Score, possible scores: 0-27.

Table 2. Meta-analysis of factors associated with postpartum PTSD

			Mean effect size	95% confidence interval		
	k	N	(*r*)	LL	UL	Q_e , *df* = (*k*-1)
Vulnerability factors						
Age	12	6, 196	-.03*	-.06	-.01	39.36*
Educational level [1]	6	3, 713	-.19*	-.22	-.16	133.22*
Ethnicity	7	4, 348	.16*	.14	.19	94.55*
Marital status	2	1,762	.04	-.01	.08	20.22*
Socio-economic-status	6	2, 737	-.01	-.05	.03	120.01*
Previous PTSD	8	5,807	**.39***	.37	.41	655.85*
History of trauma (general)	14	4,852	.16*	.14	.19	58.85*
History of sexual trauma	8	6, 531	.17*	.15	.20	26.46*
Previous counselling	4	2, 917	**.32***	.29	.35	270.29*
Previous psychological problems	6	4, 458	.25*	.23	.28	92.70*

			Mean effect size	95% confidence interval		
	k	N	(*r*)	LL	UL	Q_e , *df* = (*k*-1)
Social support (general)	16	6, 125	-.19*	-.21	-.16	124.60*
Pregnancy-related vulnerability factors						
Parity	12	7, 654	.08*	.06	.10	168.12*
Pregnancy planned?	5	2, 107	.07*	.02	.11	95.85*
Poor health or complications in pregnancy[1]	9	4152	**.38***	.35	.40	439.91*
Fear of childbirth	6	5,669	**.41***	.39	.43	155.09*
Depression in pregnancy	12	8,093	**.51***	.50	.53	591.67*
Risk factors during birth						
Operative birth	13	4, 904	**.48***	.46	.50	337.29*
Pain	16	8, 491	.16*	.13	.18	58.98*

			Mean effect size	95% confidence interval		
	k	N	(*r*)	LL	UL	Q_e , *df* = (*k*-1)
Length of labour	6	3, 189	-.05*	-.09	-.02	95.67*
Place of birth	3	774	.10*	.02	.19	0.56
Infant-related complications	17	3,354	.23*	.20	.26	172.56*
Subjective birth experience (overall)	6	4,622	**.59***	.58	.61	183.61*
Negative emotions	7	3,691	**.34***	.31	.36	124.32*
Control or agency [1]	5	1,502	-.23*	-.28	-.18	33.48*
Objective birth experience	14	8, 171	.25*	.23	.27	178.65*
Dissociation	7	2, 964	**.32***	.29	.35	118.25*
Presence of partner/ companion at birth	2	1,903	.04	-.01	.08	5.44*
Support from staff during birth	8	1,868	**-.38***	-.41	-.34	61.15*
Postpartum factors and comorbidity						
Depression after childbirth	11	3,162	**.60***	.57	.62	99.37*

			Mean effect size	95% confidence interval		
	k	N	(*r*)	LL	UL	Q_e , *df* = (*k*-1)
Anxiety	10	6, 765	.18*	.15	.20	673.23*
Postpartum physical complications	5	3, 794	.06*	.03	.09	18.22*
Postpartum mental health	7	2, 017	.27*	.23	.31	31.59*
Poor coping and stress [2]	10	2, 688	**.30***	.27	.33	316.42*
Emotional health	4	434	.05	-.04	.15	33.50*
Time since birth	2	885	.00	-.06	.07	0.86

Note. Fixed effects model. *k* = number of effect sizes, * $p < .05$ or smaller, medium effect sizes of $\geq .3$ indicated in **bold**. *Q* = heterogeneity statistic.

[1] When the study from Nigeria (Adewuya et al., 2006) was removed effect sizes differed slightly for poor health/complications in pregnancy (*k* = 8, *r* = .23, CI .20 to .26), control or agency in birth (*k* = 4, *r* = -.35, CI -.42 to -.28) and education level (*k* = 5, *r* = -.25, CI -.29 to -.22)

[2] Poor coping and stress was measured in pregnancy and after birth in different studies.

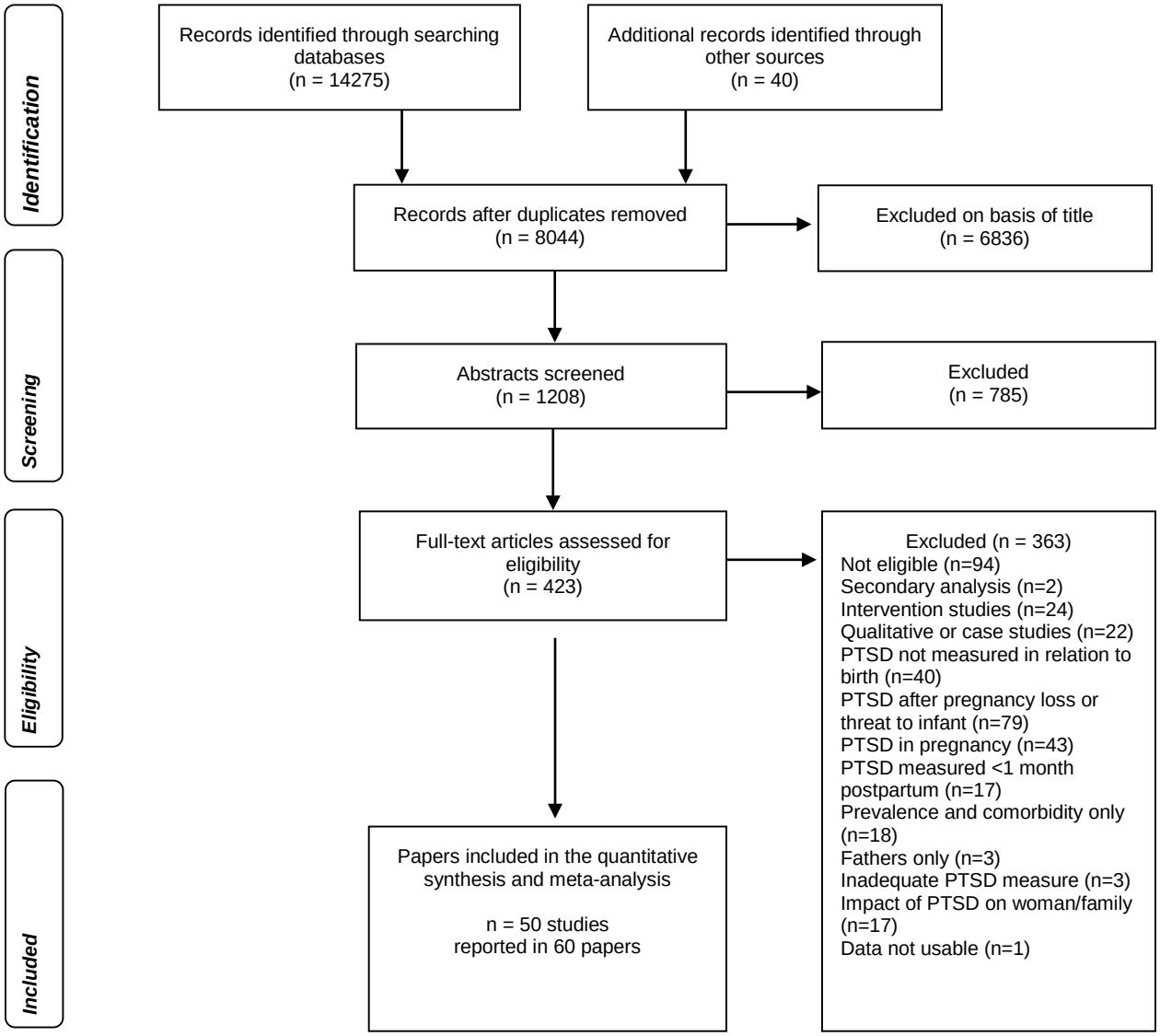
Identification
Screening
Eligibility
Included
Records identified through searching databases (n = 14275)
Additional records identified through other sources (n = 40)
Records after duplicates removed (n = 8044)
Excluded on basis of title (n = 6836)
Abstracts screened (n = 1208)
Excluded (n = 785)
Full-text articles assessed for eligibility (n = 423)
Excluded (n = 363)
Not eligible (n=94)
Secondary analysis (n=2)
Intervention studies (n=24)
Qualitative or case studies (n=22)
PTSD not measured in relation to birth (n=40)
PTSD after pregnancy loss or threat to infant (n=79)
PTSD in pregnancy (n=43)
PTSD measured <1 month postpartum (n=17)
Prevalence and comorbidity only (n=18)
Fathers only (n=3)
Inadequate PTSD measure (n=3)
Impact of PTSD on woman/family (n=17)
Data not usable (n=1)
Papers included in the quantitative synthesis and meta-analysis
n = 50 studies
reported in 60 papers

Figure 2. Effect size (r) for factors with largest associations with postpartum PTSD

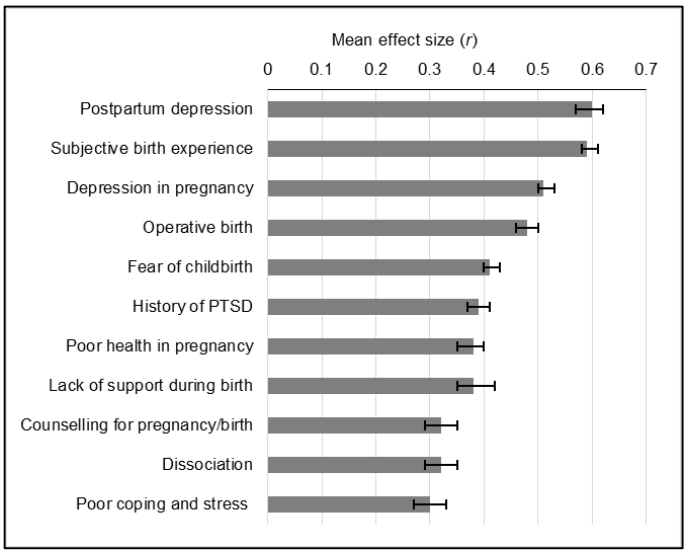

Figure 3. Updated diathesis-stress model of birth-related PTSD