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### Citation

Moulds, Michelle L; Bisby, Madelyne A; Black, Melissa J; Jones, Katie; Harrison, Virginia; Hirsch, Colette R and Newby, Jill M (2022). Repetitive negative thinking in the perinatal period and its relationship with anxiety and depression. *Journal of Affective Disorders*, 311 pp. 446–462.

### URL

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Repetitive negative thinking in the perinatal period and its relationship with  
anxiety and depression

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**RUNNING HEAD:** RNT in perinatal period

**WORD COUNT:** 7 060 (excluding references and tables)

## Abstract

**Background:** Rumination and worry represent two types of repetitive negative thinking (RNT), and their predictive and maintaining roles are well-established in depression and anxiety, respectively. Furthermore, there is an emerging literature on the link between RNT and psychological wellbeing in the perinatal period. **Methods:** We conducted a scoping review of studies that have investigated the relationship between RNT and perinatal depression and anxiety. We identified 87 papers eligible for inclusion in the review; they included cross-sectional and longitudinal studies, as well as treatment evaluations (pilot trials and randomised controlled trials). **Results:** Cross-sectional studies provided evidence of an association between RNT (i.e., rumination and worry) and depression and anxiety, in both pregnancy and postpartum. Longitudinal findings were mixed. Whilst antenatal worry consistently predicted subsequent depression and anxiety (both later in pregnancy and postpartum), rumination did not consistently predict depression. However, there was some evidence that RNT interacted with other processes to predict later psychopathology. Three randomised controlled trials evaluated whether psychological treatments reduce RNT in the perinatal period, only one of which included a clinical sample. **Limitations:** No experimental investigations were eligible for inclusion in the review. **Conclusions:** Further studies are needed to further our understanding of the nature and role of RNT in pregnancy and postpartum, and its consequences for maternal mental health. These include (but are not limited to) experimental investigations, studies with large clinical samples, and RCTs evaluating the effectiveness of psychological interventions targeting RNT to prevent and treat perinatal depression and anxiety.

**Keywords:** Repetitive thinking, rumination, worry, perinatal, postnatal, pregnancy

## **Repetitive negative thinking in the perinatal period and its relationship with anxiety and depression**

### **Introduction**

The perinatal period – the window of time from conception to one year postpartum – is characterised by significant, profound change. The psychological wellbeing of expectant and new mothers is essential to their capacity to navigate, and adjust to, the myriad of transitions that take place in this period. Depression and anxiety are common mental health problems experienced during pregnancy and postnatally (Fawcett et al., 2019; Howard et al., 2018), with substantial and long-term consequences for both mothers and offspring (e.g., Netsi et al., 2018; Rees et al., 2019). Understanding of the cognitive processes that confer vulnerability to experiencing perinatal depression and anxiety (i.e., predict onset) and drive their persistence (i.e., contribute to maintenance) will position us better to develop interventions to prevent and treat perinatal mental health problems.

Repetitive negative thinking (RNT) refers to perseverative thinking about negative content, from which individuals report difficulty disengaging. Rumination and worry are arguably the two most studied types of RNT. Whilst predominantly conceptualised and studied within the domains of depression and anxiety, respectively, rumination and worry share a number of overlapping features (Watkins et al., 2005), prompting conceptualisations of both under the theoretical banner of RNT (see Ehring & Watkins, 2008; McEvoy et al., 2010). According to Response Styles Theory (Nolen-Hoeksema, 1991), rumination refers to repetitive thinking about the causes, meanings and implications of mood, symptoms, and current concerns. In support of this theory, longitudinal and experimental studies provide evidence that rumination predicts the onset and maintenance of depression (see Nolen-Hoeksema et al., 2008; Watkins & Roberts, 2020). For example, the extent to which participants engaged in RNT prior to a stressful life event (an earthquake) predicted post-

stressor depression, controlling for pre-existing symptoms (Nolen-Hoeksema & Morrow, 1991). Similarly, worry plays a key role in predicting and maintaining anxiety, particularly generalized anxiety disorder – of which worry is the defining symptom (American Psychological Association, 2013).

RNT has also been theorised to play a role in psychological adjustment during the perinatal window. Psychogiou and Parry (2014) hypothesised that rumination mediates the relationship between maternal psychopathology and parenting difficulties. Along similar lines, Stein et al. (2009) proposed maternal ‘preoccupation’ (including rumination and worry) as a potential mechanism responsible for the transmission of psychopathology from a mother to her infant. Building on this, DeJong et al. (2016) proposed potential pathways by which rumination may influence parenting behaviour. They theorised that the preoccupation of thought which characterises ruminative thinking may compromise a mother’s capacity to process and respond to her infant’s cues in a timely manner (see also Stein et al., 2009).

Alongside their theoretical model, DeJong et al. (2016) presented a systematic review of research on the role of rumination in postnatal depression. They identified only ten published studies eligible for inclusion in their review. This review was timely and informative, drew attention to the lack of research in this area and highlighted important unanswered questions. However, the review was restricted to studies of the relationship between rumination and postnatal depression. We see value in extending this line of work in two ways: first, to investigate RNT more broadly (i.e., beyond rumination); second, to investigate the link between RNT and anxiety (as well as depression; Dalglish et al., 2020; Moulds et al., 2018). Indeed, whilst studies of postnatal psychological adjustment have primarily focused on depression, there is increasing evidence that anxiety is more common in both pregnancy and postpartum (e.g., Fairbrother et al., 2016; Fawcett et al., 2019; Martini et

al., 2015), and that depression and anxiety are highly comorbid in this period (Falah-Hassani et al., 2017).

Our goal was to build upon DeJong et al.'s (2016) review and provide an updated and broader review of the current evidence regarding the relationship between RNT and perinatal depression *and* anxiety. Our synthesis therefore differs from DeJong et al.'s review in some important ways. First, it extends the temporal period of focus and includes studies of RNT across the perinatal period, i.e., conducted with samples of pregnant and/or postnatal women. To limit our focus to the unique challenges of the perinatal period, we only included studies with participants who were up to 12 months postpartum. Second, in keeping with the broad and transdiagnostic conceptualisation of RNT, we included studies which assessed either rumination, worry or the general process of RNT (irrespective of its content) – rather than limiting the focus to studies of only one type of RNT. Third, we broadened the scope of psychological distress to include studies in which either depression and/or anxiety were assessed. Finally, we also included treatment studies in which RNT was directly targeted by an intervention, and/or in which an index of RNT was as an outcome measure.

We adopted a narrative synthesis approach in compiling this review, which provided an opportunity to synthesise studies with a variety of methodologies, identify emergent findings, and advance a framework summarising the extant evidence. Our objective was to draw out the primary themes that emerged from the review with respect to: (i) the relationship between RNT and depression/anxiety (cross-sectionally and longitudinally), (ii) the causal role of RNT in driving psychopathology (perinatal depression, anxiety), and (iii) the effectiveness of interventions for perinatal samples in reducing RNT.

## **Methods**

### Literature search strategy

We conducted a literature search on 12<sup>th</sup> July 2021 using PsycINFO, Scopus, and PubMed databases, with (“rumination” OR “worry” OR “repetitive negative thinking”) AND ([“perinatal” OR “postnatal” OR “antenatal” OR “postpartum” OR “pregnancy” OR “prenatal”] OR [“\*natal” OR “\*preg”]) AND (“anxiety” OR “depression”) as search terms. The search yielded 1110 published journal articles, of which 1052 remained following removal of duplicates. Titles and abstracts were used to screen articles for inclusion. 192 articles were identified for full-text screening; 87 were eligible for inclusion. Two authors (MAB, MLM) conducted a blind review of the 192 papers and agreed on the final 87 (see Figure 1 for search strategy).

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Insert Figure 1 about here  
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Articles were included if they were peer-reviewed, published in English, and reported a study which included a sample of perinatal women (i.e., either pregnant or in the first 12 months postpartum). Studies were also included if at least one validated measure (self-report or structured interview) of depression and/or anxiety, and at least one self-report measure of RNT (measure of rumination, worry, or a transdiagnostic measure of repetitive thinking) was administered. RNT measures needed to index the presence, degree, frequency, or severity of RNT (i.e., not be limited to indexing RNT content), so that the findings were more likely to quantify the degree of association between RNT and symptoms, in line with the goal of our review. In most cases, the RNT measure was a validated instrument. However, in some studies RNT was assessed with bespoke rating scales developed for the purpose of the particular study (e.g., to measure worries about COVID-19; Basu et al., 2021; Bo et al., 2021). In order to capture the breadth of research on RNT in the perinatal period, we included studies conducted with ‘process’ measures of RNT (which assess the tendency to engage in

the process of RNT without specifying its content; e.g., Repetitive Thinking Questionnaire, McEvoy et al., 2010; Perseverative Thinking Questionnaire, Ehring et al., 2011), measures of RNT about specific content (e.g., sad mood: Ruminative Response Scale, Nolen-Hoeksema & Morrow, 1991; pregnancy-specific concerns: e.g., Cambridge Worry Scale, Green et al., 2003) and measures assessing the general tendency to engage in RNT (e.g., worry: Penn State Worry Questionnaire; Meyer et al., 1990).

In some studies, the measure of anxiety administered included items or subscales which indexed worry (e.g., GAD-2 contains the item: *not being able to stop or control worrying*). As such instruments were developed to assess anxiety (albeit incorporating worry as a component of anxiety), we conceptualized them as anxiety (rather than RNT) measures. Accordingly, to protect the independence of concepts and avoid circularity, we only included such studies if RNT was also assessed by another questionnaire. That is, to be eligible for inclusion, psychopathology symptoms and RNT needed to be measured by independent instruments, in keeping with our goal of reviewing evidence of their interrelationship. Moreover, to ensure that included studies comprehensively assessed RNT, we excluded studies in which RNT was only measured by a subscale of a questionnaire which indexed a broader construct (e.g., distress: Caparros-Gonzalez et al., 2019; feelings about one's infant: Furman & O'Riordan, 2006), or that measured RNT as one of a range of emotion regulation strategies (e.g., Ghorbani-Marghmaleki et al., 2019). That is, eligible studies needed to include a standalone measure of RNT.

We excluded studies of fathers in the perinatal period (e.g., Bergström, 2013), studies with mixed parent samples (e.g., of expectant mothers and fathers; Lindgren et al., 2017; Warriner et al., 2018), studies of women who recently experienced pregnancy loss (e.g., Nikčević et al., 1999, 2007) and studies in which the sample included women outside the perinatal window (i.e., > 12 months post-partum; Tester-Jones et al., 2015). That said, in such



studies, if data for women within the perinatal window were reported separately, we have included relevant findings for this sub-sample. Finally, we excluded unpublished work (e.g., conference papers) or work published in non-peer reviewed journals, and articles for which the full text was unavailable/inaccessible.

## **Results**

We now present an overview of the papers identified for inclusion in the review. The papers are summarised in Table 1, and classified according to methodology: (i) cross-sectional studies, (ii) longitudinal studies, (iii) experimental studies, and (iv) intervention studies (further categorised as open pilot trials and randomised controlled trials). For each study, we describe the sample (including N), note the measure/s used to index RNT, the instrument/s employed to assess depression and/or anxiety, and summarise the key findings regarding the link between RNT and depression and/or anxiety (irrespective of significance). We note that some of the articles did not include analyses that directly examined this interrelationship. Further, some studies included measures of both depression and anxiety, but the relationship between RNT and symptoms was reported for only one of them. In accord with the aims of our review, we highlight the key findings of each study which speak to the relationship between RNT and psychopathology symptoms. When these associations were not reported, we summarise the study's key RNT findings (i.e., relationships between RNT and other variables besides depression and anxiety; e.g., socio-cultural factors). However, owing to space constraints, we include any such additional findings in Table 1 only, and limit our discussion in the next section to results pertaining to the relationship between RNT and depression and anxiety. We note that we did not include information regarding participants' medication use, as this was rarely reported in the papers reviewed.

### **Cross-sectional studies**

Forty-four papers reported cross-sectional studies (three of which were either a re-analysis of existing data or participants were from a parent study; total  $N = 29,382$  participants; range = 30 – 6894) conducted in a wide range of countries (e.g., Spain, Greece, Nigeria, UK, US, Canada, Iran). A number of the studies used online surveys, enabling the recruitment of large and diverse samples (e.g., Basu et al., 2021:  $n = 6894$  participants from 64 countries). This range of geographical locations is a notable strength, increasing confidence in the generalisability of the findings. Thirty-five of the cross-sectional studies included samples of pregnant women (some of which also included postnatal participants). A range of RNT measures were employed; the Cambridge Worry Scale was the most commonly used (in 17 studies) to assess pregnancy-specific RNT. Given the timing of the review, it is unsurprising that five investigated RNT about COVID-19, using bespoke measures/items to assess degree of worry about the virus. Addressing our first aim, we summarise the findings regarding the relationship between RNT and depression and anxiety.

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Insert Table 1 about here  
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The cross-sectional studies provided consistent evidence of an association between RNT and both anxiety and depression throughout the perinatal period. The Cambridge Worry Scale was commonly used to index worry during pregnancy, and significant correlations with depression and/or anxiety symptoms were replicated across studies (Akinsulore et al., 2021; Carmona Monge et al., 2012; Costa et al., 2020; Gourounti et al., 2012, 2014; Green et al., 2003; Hildingsson & Larsson, 2021; Khoury et al., 2021; Mudra et al., 2019; Peñacoba-Puente et al., 2011; Peñacoba Puente et al., 2015; Petersen et al., 2009). Associations between worry in pregnancy and both antenatal depression and anxiety also emerged when other measures of worry were used (Erickson et al., 2020; Korukcu et al., 2012), including other

instruments which indexed worries focused on a specific concern (e.g., mother's appearance in pregnancy; Zhang et al., 2020).

Specific worries were also associated with psychopathology in postnatal samples. For example, worries about child health (e.g., development, illness, eating) were linked to depression and anxiety symptoms (Gondwe et al., 2018). Enatescu et al. (2014) found that in new mothers, depressive symptoms were associated with increased worry about their own health, as well as that of their baby, while Mohamad Yusuff et al. (2015) reported an association between consistent levels of worry about the newborn and depression in postnatal women. There was also consistent evidence of positive correlations between worry about COVID-19 and both anxiety (Basu et al., 2021; Liu, Erdei et al., 2021; Liu, Hung et al., 2021; Mo et al., 2021) and depression (Basu et al., 2021; Bo et al., 2021; Liu, Erdei et al., 2021; Liu, Hung et al., 2021; Mo et al., 2021) in perinatal samples during the pandemic.

There was some evidence that the general tendency to engage in worry (as indexed by the Penn State Worry Questionnaire) was associated with depression (e.g., in pregnancy; Mourady et al., 2017). In a treatment-seeking sample comprised of both pregnant and postnatal women, Swanson et al. (2011) reported that worry correlated with depressive symptoms, controlling for insomnia. Further, 54% of their pregnant sub-sample and 66% of their postnatal sub-sample scored above the clinical threshold on the PSWQ. The general tendency to worry was also associated with anxiety: Voegtline et al. (in press) reported positive correlations between the PSWQ and both depression and anxiety at multiple timepoints throughout the perinatal period.

Rumination was linked to depression in pregnancy. Kalmbach, Cheng, Ong et al. (2020) reported that pregnant women with high levels of depression symptoms reported high nocturnal rumination and negative perinatal-focused rumination. In another sample, rumination (i.e., brooding subscale of the Ruminative Response Scale) was associated with

postnatal depression symptoms at one-month postpartum, and during the first year postpartum (Denis & Luminet, 2018). Some studies investigated the relationship between RNT and depression and anxiety using transdiagnostic measures which indexed the process of RNT. Replicating findings with measures of worry and rumination, RNT (measured by the Repetitive Thinking Questionnaire) was associated with anxiety and depression symptoms in both pregnant (Harrison et al., 2021a) and postnatal (Harrison et al., 2021b) samples. In the postnatal cohort (Harrison et al., 2021b), social support from friends moderated the relationship between RNT and depression. Specifically, high perceived social support played a protective role: RNT and both depression and anxiety were more strongly associated for women with lower social support. Finally, Harrison et al. (2021a) found that levels of RNT and loneliness during pregnancy mediated the relationship between perceived social support and both antenatal depression and anxiety.

Taken together, the cross-sectional studies reviewed support significant associations between RNT and anxiety/depression symptoms in both pregnant and postnatal samples, and were observed using a range of self-report measures of RNT- i.e., worry (both content-specific and general), rumination and transdiagnostic RNT. Notably, in the bulk of the cross-sectional studies reviewed, the measure of RNT employed indexed specific, pregnancy-related worries (e.g., using the Cambridge Worry Scale).

### **Longitudinal studies**

Thirty-one papers reported longitudinal studies, six of which were either a re-analysis of existing data or participants were from a parent study (total  $N = 20,506$  participants, range = 30 – 10,037), again conducted across a range of countries (e.g., Australia, Sweden, UK, Canada, Jordan, US) - although fewer compared to the cross-sectional studies. For the majority of studies (27/33), the first assessment timepoint was in pregnancy – reflecting that most longitudinal studies tested whether RNT in pregnancy predicts later psychological

adjustment (i.e., later in pregnancy and/or postpartum). There was greater variability in the measures of RNT used; they included pregnancy-specific worry (e.g., Cambridge Worry Scale), rumination about sad mood (Ruminative Response Scale), the general tendency to engage in worry (Penn State Worry Questionnaire), and process measures of RNT without specific content (e.g., Perseverative Thinking Questionnaire). Again addressing our first aim, we summarise the findings of the studies which speak to the relationship between RNT and depression/anxiety.

The majority of the longitudinal studies tested whether RNT prospectively predicted depression and/or anxiety symptoms at a later timepoint. In two studies, worry in early pregnancy predicted symptoms later in pregnancy. Schmidt et al. (2016) found that the tendency to engage in worry (but not rumination) in early pregnancy predicted depression and anxiety in late pregnancy. Interestingly, rumination (but not worry) in the first four months of pregnancy predicted impairments in maternal-foetal attachment in late pregnancy. Similarly, Peñacoba-Puente et al. (2016) found that pregnancy worries at 14 weeks gestation were associated with anxiety symptoms later in pregnancy (i.e., in the third trimester).

Most of the longitudinal studies investigated whether RNT during pregnancy predicted postnatal psychopathology. The findings were relatively consistent for worry. Worry during pregnancy predicted postpartum depression (e.g., Peñacoba-Puente et al., 2016; controlling for antenatal depression, Austin et al., 2007; Erickson et al., 2020), and predicted postnatal anxiety controlling for antenatal anxiety symptoms (Erickson et al., 2020). In only one study antenatal worry was not associated with postnatal depression (Mohammad et al., 2011).

Investigations of the predictive capacity of rumination yielded a mixed picture. Barnum et al. (2013) reported that rumination (i.e., brooding subscale of the Ruminative Response Scale) in the third trimester predicted increased depressive symptoms from

pregnancy to 2 months postpartum, but not from pregnancy to one month postpartum. In contrast, Raes et al. (2014) found that rumination reported in the third trimester did not predict depression at either 12 or 24 weeks postpartum, controlling for baseline depression symptoms and depression history (notably, rumination was measured by the Ruminative Response Scale in both studies). Müller et al. (2013) found that antenatal RNT (assessed by the Perseverative Thinking Questionnaire) did not predict postnatal depression symptoms. However, controlling for age, pre- and postnatal depression symptoms, antenatal RNT predicted perceived impairments in the mother-infant relationship (reported by mothers) in the initial two months postpartum (Müller et al., 2013). Schmidt et al. (2017) found that the overall level of RNT (sampled by the Perseverative Thinking Questionnaire at four timepoints, from early pregnancy to 16 weeks postpartum) predicted maternal anxiety about dealing with the baby and postnatal depression symptoms at 4 months postpartum. Further, women who reported increased RNT during pregnancy reported more postnatal depression symptoms and impairments in bonding, highlighting the importance of the trajectory of RNT as a predictor.

Other studies investigated whether RNT predicts psychopathology symptoms alongside other processes. Testing a structural equation model, Egan et al. (2017) found an indirect effect of antenatal perfectionism on postnatal depression, via antenatal RNT and antenatal depression. In pregnant women at risk of depression, O'Mahen et al. (2010) found that rumination was associated with increased depression three months later for women who were low, but not those who were high, in social functioning (consistent with the findings of Harrison et al., 2021b for social support). In mothers with high-risk premature babies, worry about their infants at hospital discharge was not associated with anxiety (i.e., posttraumatic stress symptoms) when babies were 6 months (Holditch-Davis et al., 2003).

A subset of studies sampled RNT on multiple occasions throughout the perinatal period, shedding light on the course of its relationship with depression/anxiety over time. Müller et al. (2019) compared women with consistently high versus low levels of RNT measured by the Perseverative Thinking Questionnaire) from pregnancy to 14 weeks postpartum. Those with consistently high RNT reported more depression and anxiety symptoms than women with low RNT across the course of the study. Kalmbach and colleagues examined the link between RNT, psychological symptoms and RNT in the context of sleep, sampling at weekly timepoints from late pregnancy to early postpartum. Nocturnal perinatal-focused rumination and perseverative thinking were independently associated with depression (Kalmbach, Cheng, et al., 2021). In women with mild to moderate depression symptoms, nocturnal perinatal-focused rumination was independently related to suicidal ideation (Kalmbach, Ahmedani, et al., 2021); further, women who reported both insomnia and perinatal-focused rumination were at heightened risk of suicidal ideation.

Taken together, these studies provide mixed evidence regarding the capacity of antenatal RNT to predict postpartum depression and anxiety. Although this literature is not extensive, the emerging picture is that antenatal worry more consistently predicts later depression and anxiety (both later in pregnancy, and in postpartum). By comparison, the findings were more mixed for studies in which measures of rumination or process measures of RNT were used. Moreover, although anxiety was assessed less frequently at follow-up than depression, these studies suggest that it was more consistently predicted by RNT (particularly worry). The findings to date also suggest that RNT acts in concert with other processes to predict later psychopathology.

### **Experimental Studies**

No experimental studies were captured by the review. We address this significant gap in the current literature in the Discussion.

## **Intervention Studies**

### *3.3.1. Open (i.e., uncontrolled) trials*

Six papers reported uncontrolled pilot trials, one of which reported follow-up data of another pilot trial included in the review (Luberto et al., 2018). Accordingly, there were five pilot trials in total ( $N = 127$ ; range 7-38). Worry was measured by the Penn State Worry Questionnaire in all but one of the open trials (i.e., Bowen et al., 2014). Given the smaller number, they were conducted across fewer countries (e.g., US, Canada, UK).

Three of the five uncontrolled trials included mixed clinical samples. Green et al. (2015) reported that group CBT resulted in significant pre-posttreatment reductions in worry and depression in a small mixed perinatal sample (two pregnant, eight postnatal women) with a primary anxiety disorder. Misri and Swift (2015) monitored two cohorts of perinatal women who received antidepressant treatment and examined changes in worry from pre- to post-intervention. In the first cohort (non-breastfeeding postnatal women diagnosed with MDD with or without GAD,  $n = 19$ ) who completed an 8-week trial of antidepressants, worry decreased significantly over time across the full sample. However, at the end of treatment, participants with MDD and GAD had higher levels of worry than those without GAD (i.e., with MDD alone, or MDD and another comorbid anxiety disorder). In the second cohort (pregnant women diagnosed with MDD with or without excessive self-reported worry,  $n = 29$ ), the subgroup with excessive worry were less likely to reach remission of depression symptoms following pharmacotherapy. Finally, Goodman et al. (2014) evaluated mindfulness-based cognitive therapy in a mixed sample of pregnant women with either GAD, high levels of self-reported anxiety or high levels of self-reported worry ( $n = 24$ ). Treatment completers reported clinically significant reductions in worry, anxiety, and depression from pre-post intervention (Goodman et al., 2014); gains were maintained for worry and anxiety at three months, while depression further improved (Luberto et al., 2018).



A small uncontrolled trial ( $n = 7$ ) of group CBT with women with elevated depression symptoms found pre-post intervention reductions in worry and depression (Van Lieshout et al., 2020). Bowen et al. (2014) compared two psychotherapy groups (interpersonal therapy, mindfulness-based therapy) with an unselected sample of pregnant women. Both groups reported reductions in depression and worry (measured by the Cambridge Worry Scale) at post-intervention, and the groups did not differ. It is noteworthy that participants were not randomly assigned to condition, nor were they selected on the basis of clinical criteria (i.e., elevated symptoms or diagnosis).

To date only a small number of uncontrolled trials have evaluated the impact of interventions to reduce RNT. Whilst preliminary findings are promising, such that all studies reported reduced worry and symptoms at post-intervention, their limitations should be considered (e.g., sample size, lack of clinical samples, reliance on self-report outcomes).

### *3.3.2. Randomised controlled trials (RCTs)*

Six papers reported RCTs. Four evaluated psychological treatments, one of which reported the findings of a sub-sample of clinical participants from another RCT included in the review (Green et al., 2021). Thus, there were three trials of psychological interventions in total ( $N = 341$ ; range = 70 - 185). An additional two trials evaluated a non-psychological treatment ( $N = 2416$ ;  $N = 390$ ,  $N = 2026$ ). Again, given the small number, trials were conducted in a restricted range of geographical locations (UK, Canada, Sweden).

In the only RCT to include a clinical sample, Green et al. (2020) randomly allocated perinatal women (31 pregnant, 55 postpartum) with a primary diagnosis of an anxiety disorder to group CBT ( $n = 44$ ) or waitlist control ( $n = 42$ ). CBT led to greater reductions in worry, depression, and anxiety at post-treatment compared to the control group. These gains were maintained at three-month follow-up for worry and depression, while anxiety further

improved. Green et al. (2021) examined the subset of women from this trial with GAD ( $n = 58$ ), and similarly found pre-post reductions in worry for those who received group CBT.

Two trials were conducted with unselected samples. Krusche et al. (2018) randomly allocated an unselected sample of pregnant women to an online mindfulness course ( $n = 107$ ) or waitlist control group ( $n = 78$ ). Of the treatment completers, women in the mindfulness condition reported significant reductions in depression, anxiety, and worry about labour from pre-post intervention. Worry did not change in the waitlist condition. However, the drop-out rate was significant: only 21% of participants ( $n = 22$ ) randomised to the mindfulness course completed it. McCusker et al. (2010) found reductions in worry and anxiety at 6-month follow-up (controlling for baseline scores) for postnatal women with babies born with severe congenital heart disease who received early psychosocial interventions (to promote mother-infant interactions;  $n = 35$ ). Worry did not change in the standard care condition ( $n = 35$ ). Again, key methodological details should be noted when interpreting these findings. First, participants were allocated to condition based on order of presentation to the unit (rather than randomisation); second, there were differential rates of attrition in the two conditions (greater attrition in the control condition).

Two trials examined RNT as an outcome of a non-psychological intervention. Georgsson Öhman et al. (2004) compared the outcomes of receiving an ultrasound screening for Down's syndrome ( $n = 1030$ ) or a routine ultrasound scan ( $n = 996$ ) for pregnant women's worries about their baby's health. There were no between-condition differences in worry, depression, or anxiety during pregnancy or at two months postpartum. Worry decreased comparably in both conditions from baseline to mid-pregnancy, and from mid-pregnancy to two-months postpartum. Björklund et al. (2013) evaluated the impact of an information film about prenatal diagnostic testing (e.g., for foetal abnormalities) on pregnant women's subsequent worry. Participants ( $N = 390$ ) were randomly allocated to either view or

not view a film about prenatal testing. After the film, there were no between-group differences in level of worry (i.e., about birth, about something being wrong with the baby). Interestingly, counter to expectations, a higher proportion of participants who viewed the film reported that it *increased* rather than decreased their worry.

Together, these studies highlight critical gaps in the treatment outcome literature. Only three RCTs to date have evaluated whether psychological treatments reduce RNT in the perinatal period. All of them examined RNT in the form of worry as an outcome, only one included a clinical sample, and only one followed participants for six months. Future trials with greater power, and that include clinical samples, longer follow-up periods, and more comprehensive assessment of RNT are clearly needed.

## **Discussion**

The cross-sectional studies provided consistent evidence of an association between RNT and depression and anxiety in both pregnant and postnatal samples. The majority of the cross-sectional studies investigated worry (about perinatal-specific content, as well as the general tendency to worry) in pregnancy rather than postpartum, and more studies employed measures of worry as opposed to rumination. Although the majority of the cross-sectional studies included unselected participants, unsurprisingly, samples of women with (probable) depression (e.g., Kalmbach, Cheng, et al., 2020) and those with GAD (e.g., Goldfinger et al., 2020) reported high levels of RNT, suggesting the value of interventions targeting RNT for these clinical groups.

Most of the longitudinal studies examined whether RNT in pregnancy predicted depression postpartum. Overall, antenatal worry consistently predicted postnatal depression, however the findings were inconsistent for rumination, and also for studies in which RNT was assessed by a transdiagnostic measure (e.g., PTQ). However, we note substantial variability in the timepoints at which measurements were taken both in pregnancy and the

postnatal period, which limits direct comparisons across studies. Moreover, sample sizes and rates of attrition varied significantly across studies, leaving open the possibility that conflicting findings may be due to insufficient power. Some studies suggested that RNT may influence postnatal depression via its interaction with other variables (e.g., perfectionism: Egan et al., 2017; social functioning: O'Mahen et al., 2010), highlighting the importance of considering and assessing other factors alongside RNT when investigating its predictive capacity. Only one study tested the hypothesis that RNT in pregnancy predicts postpartum anxiety symptoms (Erickson et al., 2020; although we note that Schmidt et al. (2017) tested whether RNT in pregnancy and postpartum predicted maternal anxiety about dealing with the baby). Given growing evidence of the prevalence of perinatal anxiety, this is an area in which research is needed.

Only two studies examined whether RNT early in pregnancy predicted psychological symptoms later in pregnancy (Peñacoba-Puente et al., 2016; Schmidt et al., 2016), and no study tested whether RNT in early postpartum predicted later depression symptoms. Similarly, although some studies tracked the course of RNT (i.e., whether RNT increased, decreased or remained consistent) across the perinatal period (e.g., Jomeen & Martin, 2008; Kramer et al., 2013; Müller et al., 2013; Schmidt et al., 2017; Statham et al., 1997), the interrelationship of RNT and depression/anxiety over time has been less investigated (e.g., Müller et al., 2019; Voegtline et al., in press). Future, large scale longitudinal studies are needed. In particular, we see value in compiling datasets across studies (e.g., conducting individual patient meta-analyses) to maximise power and gain a clearer picture of the relationship between RNT and psychopathology over time. Such a dataset would enable researchers to apply sophisticated data modelling to map trajectories of change in the interrelationship of RNT and psychological symptoms, as well as better understand the way

in which a range of other variables (e.g., sleep, infant health, quality of healthcare) may influence their association.

We highlight the novel longitudinal study by Müller et al. (2019) in which RNT was sampled at multiple timepoints throughout pregnancy and postpartum – a design with clear advantage over sampling RNT at only one timepoint, which cannot monitor fluctuations. Moreover, the authors integrated behavioural methods (i.e., observations of mother-infant interactions) into their longitudinal design and compared behavioural task performance of mothers with consistently high versus consistently low RNT. Interestingly, at 14 weeks postpartum, these two groups did not differ in self-reported maternal contingency (i.e., timely responsiveness to infants' cues), and there were no developmental differences in their offspring. However, babies of mothers in the high RNT group protested less frequently, and engaged more with the environment, relative to those of mothers with low RNT. Future studies adopting similarly novel approaches and employing behavioural assessments will address important questions about perinatal RNT. Another key future direction will be to follow participants over longer time periods. Given our interest in the perinatal period specifically, we limited the review to studies with samples of women up to 12 months postpartum. However, recent evidence that pregnancy worries predict child outcomes (e.g. internalizing problems: Szekely et al., 2021) in 4–8-year-old offspring highlights the value of studying whether RNT predicts outcomes (for both mother and child) in the longer term.

Our review did not identify any papers reporting experimental findings. That said, we note that owing to our inclusion criterion that participants needed to complete measures indexing both RNT and depression or anxiety, three experimental investigations that examined RNT (i.e., O'Mahen et al., 2015; Stein et al., 2012; Tester-Jones et al., 2017) were excluded. To illustrate the value of experimental designs in this area: Stein et al. (2012) randomly allocated (i) postnatal women (with 10 month old infants) with either major

depression or generalised anxiety disorder and (ii) healthy controls to either a worry/rumination induction or a neutral induction. Following the worry/rumination prime, participants with GAD and MDD were less responsive to their infant's vocalisations than those who received a neutral prime, and this effect was stronger for women with GAD than those with MDD. These findings identify a role of RNT in driving maternal responsiveness and highlight a critical impact of RNT with potential for negative consequences in the long term. Experimental investigations manipulating RNT and examining the downstream consequences, or manipulating related variables to test whether they causally influence RNT, are needed. Their findings will shed light on the pathways via which RNT may drive psychological distress in the perinatal period, as well as how other related mechanisms trigger, maintain and exacerbate it. By identifying modifiable mechanisms, experimental work will critically inform treatment development. It will also be important for such future work to be conducted with clinical samples of pregnant and postnatal women (e.g., Stein et al., 2012), to ensure generalisability to clinical populations and that the results have scope to meaningfully inform intervention development.

We identified a relatively small number of treatment evaluation studies, including open trials and RCTs. Together, they provide emerging evidence that RNT can be reduced following psychological intervention in the perinatal period. However, multiple limitations prevent firm conclusions based on the current evidence. First, only one RCT was conducted with a clinical sample (Green et al., 2020), and this sample was mixed - both in participants' perinatal status (pregnant, postnatal) as well as diagnosis (participants had a range of anxiety disorders; although we note that Green et al. (2021) reported treatment outcomes for the GAD subsample). Nonetheless, our review demonstrates that the current evidence base for psychological treatments in this area is lacking. This conclusion is consistent with a recent review which highlighted the dearth of studies evaluating treatments for perinatal anxiety

(Loughnan et al., 2018). In addition, the RCTs reviewed had methodological limitations (e.g., small samples, no long-term follow-ups, lack of randomisation). Notably, worry was the only form of RNT indexed as an outcome across all intervention studies. Treatment trials which are well-powered, apply strict randomisation procedures and follow participants for longer periods are clearly needed. Surprisingly, no study to date has directly targeted RNT during pregnancy with the goal of preventing postnatal depression/anxiety in at-risk samples. Trials of interventions which target RNT in high-risk pregnant women and evaluate preventive benefit, as well as evaluations of treatments which target RNT in postnatal mothers to reduce the likelihood of chronic depression and anxiety, should be a priority going forward. Such trials should target RNT as a general, transdiagnostic process, rather than seek to address worry or rumination specifically (Schmidt et al., 2016).

A number of issues emerged from the review regarding the assessment of RNT. Whilst a range of measures were used to index RNT, most assessed worry rather than rumination; in particular, worries about pregnancy. In some studies, RNT measures (e.g., Penn State Worry Questionnaire) were used to classify participants as high or low anxious (e.g., Neri et al., 2015), with implications for the interpretation of findings. It is possible that the content-specific instruments employed to assess RNT may not have adequately captured participants' concerns, and thus may in part be responsible for some of the conflicting findings. For example, in some of the prospective studies rumination was measured with the Ruminative Response Scale (RRS) – a measure of the trait tendency to engage in depressive rumination (i.e., rumination about sad mood). For expectant (in particular, first time) mothers, sad mood may be less of a concern relative to a multitude of other issues that one could potentially face (and repetitively think about) - a possibility raised by Schmidt et al. (2016) to account for their finding that worry but not rumination predicted later depression and anxiety. Pregnancy-related complications, childbirth, concerns about one's capacity to cope, and more

recently, COVID-19 (to name just a few) are perhaps more pressing concerns. Thus, instruments which measure RNT about concerns that are salient and relevant to pregnant women may be more appropriate for this population. Indeed, a growing number of measures have been developed which index RNT about content specific to the perinatal period, such as the PASS (Somerville et al., 2014, which includes a general worry and specific fears subscale), the Pregnancy Related Anxiety Scale (PrAS; Brunton et al., 2018, 2019, 2021), the Postpartum Worry Scale (Moran et al., 2015), and the Postpartum Specific Anxiety Scale (PSAS; Fallon et al., 2016).

That said, measures which index RNT about specific concerns introduce another possibility: that responses are conflated by the extent to which the respondent experiences the specified issue/concern. For example, the endorsement of high levels of RNT about a baby's health may be more likely in pregnant women with significant health concerns. Such measures render it difficult to disentangle the extent to which respondents engage in RNT about the concern from the extent to which the specific concern is a relevant stressor. An alternative approach is to assess the process of, and general tendency to engage in, RNT irrespective of its content. Transdiagnostic measures of RNT (e.g., PTQ, RTQ) were developed for this purpose. The PTQ (Ehring et al., 2011) and RTQ-trait (McEvoy et al., 2014) index the tendency to engage in RNT, whilst the RTQ-state measures RNT about a specific event and could be tailored to anchor responses to experiences in pregnancy/as a new mother (McEvoy et al., 2010). We recommend using these instruments to assess perinatal RNT to rule out the possibility that the documented relationships between pregnancy-specific worry and depression/anxiety are driven by the presence and severity of pregnancy-related stressors.

Overall, our review has highlighted significant variability in the self-report instruments used to assess RNT in this literature, and raised the possibility that the way in



which RNT was measured (e.g., the type of RNT assessed: rumination or worry; the focus of the measure: content-specific – e.g., pregnancy, mood state - or content-independent) had implications for the findings of individual studies. Going forward, greater consistency in the measurement of RNT in investigations of perinatal mental health will facilitate comparisons of the findings obtained across studies, and enable more meaningful conclusions to be drawn from the literature as a whole.

Qualitative research is also needed to shed light on the content of RNT. Newby et al. (2021) highlighted the value of open-ended questions in providing insight into the typical themes of RNT in perinatal women. Our requirement that studies included both a measure of RNT and depression/anxiety resulted in some qualitative papers (e.g., Coates et al., 2015; Giarratano et al., 2019; Phillips et al., 2009) being omitted - nonetheless, a number of studies examining the content of worry were eligible for inclusion (Goldfinger et al., 2020; Wenzel et al., 2003). More studies sampling the content of RNT on multiple occasions (e.g., Asplin et al., 2015) would be informative. Future work should investigate the role of RNT in the psychological adjustment of fathers. Paternal postnatal depression has received increased research attention (e.g., Darwin et al., 2017), and there is evidence that the offspring of fathers who experienced postpartum depression are at elevated risk of emotional and behavioural difficulties 3.5 years (Ramchandani et al., 2005) and 7 years later (Ramchandani et al., 2008), controlling for maternal depression. This underlines the need to understand the mechanisms that contribute to depression and anxiety in new fathers; future studies could investigate RNT as a potential predictor of paternal mental health.

We have provided an overview of the literature on RNT in the perinatal period, highlighted gaps in current knowledge and posed empirical questions which remain to be addressed. This area of research needs experimental investigations, more studies with large clinical samples, and RCTs evaluating the effectiveness of psychological interventions

targeting RNT to prevent and treat perinatal depression and anxiety. The unique stressors and circumstances characteristic of the perinatal period (e.g., significant hormonal changes, fatigue), coupled with the fact that a degree of anticipatory RNT during pregnancy and as one adjusts to the challenges of new motherhood is arguably adaptive and appropriate, mean that we cannot merely extrapolate from findings in non-perinatal samples and assume the same relationships between RNT and psychopathology in the perinatal period. We hope this review will prompt more research on RNT, leading to an improved understanding of its role in influencing perinatal mental health.

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