

# Rumination research: a narrative review

## Abstract

This narrative review includes current research on the negative effects of rumination, risk factors/predictors, potential underlying biological mechanisms and interventions. Several negative effects have been reported for rumination including cognitive and physical health problems, sleep problems, anxiety and depression, suicidal ideation, and non-suicidal self-injury. Several risk factors have been identified for rumination including childhood trauma, negative parental behaviors, mind wandering, expressive suppression, self – concealment, and rejection sensitivity. The mechanisms that appear in this current literature include default network activation and connectivity problems across several networks. Surprisingly, given the severity of effects, only a few interventions have been researched including mindfulness meditation, cognitive behavioral therapy, and psychedelics. Methodological problems include the variable definitions and measures of rumination, the extensive use of clinical and university samples and the ethical problem of inducing ruminations in some studies.

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## Introduction

### Rumination research: a narrative review

Rumination has been defined as the act of replaying negative thoughts repeatedly in your mind such as dwelling on past mistakes, replaying old arguments, awkward moments or past failures on a continuous track. Rumination is noted to lead to psychological problems including anxiety and depression as well as physical problems including disturbed sleep patterns.

This narrative review includes current research on the negative effects of rumination, risk factors/predictors, potential underlying biological mechanisms and interventions. This research was found on PubMed and PsycINFO by entering the term rumination and the years 2024-2026. Exclusion criteria were protocols, case studies, and non-English language papers.

The 43 papers in this current literature review can be categorized as definitions of rumination (3 papers), negative effects of rumination (22 papers), risk factors/predictors (8 papers), potential underlying biological mechanisms (5 papers) and interventions (5 papers). These sections are followed by a discussion on methodological limitations of this current literature.

### Definitions

Rumination has been defined differently by some research groups (Table 1). In a paper entitled “Ecological validity of grief rumination measures among bereaved people”, adults were given grief rumination measures (N=65).<sup>1</sup> State measures were given four times per day for 14 days. The **state versus the trait** measures more accurately reflected the grief rumination, likely because state measures capture the current grief rumination.

**Table 1** Definitions of rumination (and first authors)

| Definitions                                          | First authors |
|------------------------------------------------------|---------------|
| State versus trait                                   | Zhou          |
| Brooding, negative attitudes, depression, reflection | Zou           |
| Ruminative response scale                            | Stelmack-Lask |

In a study on gender differences in rumination subtypes, Chinese university students were given rumination scales (N=798).<sup>2</sup> **Brooding, negative attitudes and depression** were prevalent in females and **reflection**, negative attitudes and depression were prevalent in males. Brooding was more unique to females and reflection to males. It’s

not clear why the brooding experience would be more prevalent for females and the reflection more for males. This may be a “faking good” response or a “more socially desirable response” by males as brooding is typically considered negative and reflection is viewed positively.

In a paper entitled “What is high rumination?”, the participants responded to the **Ruminative Response Scale** (N=484).<sup>3</sup> The Ruminative Response Scale scores were highly variable, especially the brooding and the reflection scores. Again, females had higher scores on rumination and brooding.

Most of the research groups in this current literature on rumination have used the Ruminative Response Scale that defines rumination as responding to sad, blue or depressed moods with repetitive, passive thoughts about distress rather than active problem-solving. This self-report questionnaire has two main subscales including a brooding and a reflection subscale.

### Negative effects of rumination

Several negative effects have been reported for rumination (Table 2). They include cognitive and physical health problems, sleep problems, anxiety and depression, suicidal ideation, and non-suicidal self-injury.

**Table 2** Negative effects of rumination (and first authors)

| Negative effects                        | First authors                        |
|-----------------------------------------|--------------------------------------|
| Less cognitive and physical health      | Morse                                |
| Less well-being                         | Akbulut                              |
| Insomnia                                | Bailey                               |
| Nightmares                              | Wang                                 |
| Low sleep quality                       | Zhang                                |
| Social anxiety                          | Edgar                                |
| Posttraumatic stress symptoms           | Thimm                                |
| Obsessive compulsive disorder symptoms  | McNamara                             |
| Depression                              | Bean, Winchell, Kandahar, Battaglini |
| Dysregulated cortisol                   | Trent, Stuart                        |
| Less systolic blood pressure adaptation | Costello                             |
| Glymphatic dysfunction                  | Ma                                   |
| Suicidal ideation                       | Huang, Yao                           |
| Non-suicidal self-injury                | Cheug, Chou, Wang, Chang             |

## Cognitive and physical health problems

In a paper entitled “Rumination, loneliness, task-oriented coping, and mental well-being among university students: a serial mediation model”, the results are in the title.<sup>4</sup> In this sample (N= 750) as many as 74% were females, a frequent gender difference in psychological research sampling. Reflection and brooding rumination led to increased loneliness which contributed to **less task-oriented coping behavior**, which in turn contributed to **less well-being**. The reflection rumination subtype relationship with loneliness was surprising given that reflection rumination is generally viewed as adaptive and brooding rumination as maladaptive.

In a study entitled “Worry and ruminative brooding associations with **cognitive and physical health** in older adults”, the “older adults” averaged only 71 years in age.<sup>5</sup> In this study (N=282 participants including 178 females at 63% of the sample), the results are in the title for subjective measures, but not for the more objective blood pressure measure. It could be that the cognitively unimpaired adults were aware of subtle changes, not captured by the objective measure. But the absence of the blood pressure effect was surprising given that worry and brooding are stressful and stress is frequently accompanied by elevated blood pressure.

## Sleep problems

Several sleep measures have been negatively affected by rumination, including insomnia, nightmares, and sleep quality in general. In a study on rumination, depression and insomnia in youth (N= 364 youth 8 to 16 years-old), the youth experienced all three problems.<sup>6</sup> In this sample, rumination led to depression, which led to **insomnia**. Rumination would be expected to have direct effects on insomnia given that rumination (reviewing the day’s events and problems) often occurs at bedtime.

The rumination and insomnia in the youth may have related to their anticipation of nightmares. **Nightmares** have resulted from distress through rumination.<sup>7</sup> In this sample of university students (N= 758, mean age = 19), neuroticism contributed to nightmares via the mediating effect of rumination. That neuroticism was associated with both rumination and nightmares was not surprising given that neuroticism has been defined as a “long-term tendency to experience negative emotions like anxiety, fear and sadness”. Rumination and nightmares have frequently involved anxiety, fear and sadness.

**Sleep quality** has also been affected by rumination and fear of missing out in college students that have mobile phone addiction.<sup>8</sup> In this sample (N= 1401 college students from five universities in China), the mediators of fear of missing out and rumination make sense. Fear of missing out has been associated with mobile phone addiction in a large literature.<sup>9</sup> And fear of missing out was not surprisingly related to rumination much like other fears have been related to rumination.

## Psychological problems

The negative effects of rumination on sleep may have contributed to psychological problems including social anxiety, depression, and obsessive-compulsive disorder. In a systematic review and meta-analysis of rumination and **social anxiety** that followed a stressful event, the relationship between rumination and social anxiety was significant across studies ( $r=.45$ ).<sup>10</sup> However, the effect sizes varied as a function of the types of questionnaires and the tasks that were given prior to the assessments of rumination and social anxiety. The variability of **Posttraumatic stress symptoms** have also been associated with grief-related rumination and prolonged grief.<sup>11</sup> In this sample (N=110, mean age=43), the longitudinal data suggested that

posttraumatic stress symptoms occurred at the 12-month assessment and were sustained at the 74-month assessment. The posttraumatic stress symptoms included hyper-arousal and avoidance which, not surprisingly, were related to rumination. The rumination would not only prolong grief but, the prolonged grief would, in turn, lead to hyper-arousal and attempts to avoid hyper-arousal for its stressful effects.

Rumination has also predicted **obsessive compulsive disorder symptoms**. In a sample of patients with obsessive compulsive disorder (OCD) (N=283), rumination at discharge predicted the severity of OCD symptoms.<sup>12</sup> This result was not surprising given that rumination itself is a type of obsessive-compulsive disorder symptom, although it is rarely included as a symptom of OCD.

Several studies have reported that **depression** results from rumination. Different rumination factors have contributed to depression including excessive mind wandering, different types of rumination, variability in rumination and co-rumination. Rumination for all of the previously described symptoms would understandably result in depression.

Rumination accompanied by **excessive mind wandering** has mediated the relationship between ADHD symptoms and anxiety and depression in adults with ADHD (N= 159).<sup>13</sup> That rumination and excessive mind wandering were mediators of the relationships between anxiety and depression especially in adults with ADHD would be expected given that rumination and excessive mind wandering are ADHD-like symptoms.

Two different types of rumination including **abstract rumination and concrete rumination** have contributed to depressive symptoms in two different samples (N=412 and N =258).<sup>14</sup> Both abstract and concrete rumination led to aversive indecisiveness which, in turn, led to depression symptoms. Several types of rumination have been defined by different research groups. Understandably any type of rumination might lead to aversive indecisiveness simply because rumination is aversive by definition if only for its distraction and avoidance properties.

In a paper entitled “Ruminative variability predicts increases in depression and social anxiety”, the title suggests the results.<sup>15</sup> In this sample (N=115), participants were assessed over 14 days. In an ecological momentary assessment at a 90-day follow-up, ruminative variability during the 14-day assessment predicted increased social anxiety and depression at 90 days. The ecological momentary assessment has been defined as a “research method that captures participants’ behaviors and emotions in real-time within their natural environment”. That rumination at 14 days predicted **social anxiety and depression** at 90 days suggests that rumination was associated with social anxiety and depression across the intervening 76 days, raising the probability of a chronic relationship between rumination, social anxiety and depression. Social anxiety and depression have been comorbid effects in other literature of less disturbing experiences than rumination.<sup>16</sup>

In **co-rumination**, negative feelings and problems are discussed in a perseverative manner with another person.<sup>17</sup> In a sample of adults (N=109), co-rumination happened primarily in person versus on phone conversations. More in person co-rumination was associated with friendship quality while more phone co-rumination was associated with depression. The nonverbal communication and physical closeness that occurs in person may have lessened the disturbing effects of co-rumination, unlike the phone conversations that would be more limited to the co-rumination negative feelings and problems.

## Physiological effects of rumination

Rumination has also resulted in negative physiological effects including different diurnal cortisol patterns. Typically, cortisol is high at 30 to 45 minutes after awakening and decreases across the day. In a study on daily rumination and diurnal cortisol patterns, greater rumination on problems was related to **flatter diurnal cortisol slopes**.<sup>18</sup> In this sample (N=209), the cortisol awakening response was smaller in males with greater rumination. Both a smaller cortisol awakening response and flatter diurnal cortisol slopes would be expected to disrupt normal circadian rhythms and thereby have stressful effects.

In another study on cortisol and rumination, two types of rumination were described.<sup>19</sup> **Stressor – focused rumination** was said to be “a dwelling on past or current stressors”. **Brooding rumination** was described as “evaluative reactions to sad emotions”. In this sample (N=116 college aged adults), women with greater levels of stressor-focused rumination displayed flatter diurnal cortisol slopes. The opposite was noted for men. This gender difference is difficult to interpret unless the men had less stressor-focused rumination, which they may have not reported as they have been known to be less self-revealing or more “faking good” in psychological research. And, the two types of rumination described by this research group would be expected to have similar effects on the women unless the women experienced stressor-focused rumination more frequently than the brooding rumination.

Another research group focused on an association between rumination and cardiovascular adaptation to repeated psychological stress.<sup>20</sup> In this sample (N= 146) the higher the level of trait rumination, the lower the **systolic blood pressure adaptation**. The trait rumination would be expected to be more currently stressful and, in turn, result in more elevated blood pressure episodes instead of systolic blood pressure adaptation.

Rumination has been noted to negatively affect the **glymphatic system** that is responsible for the removal of waste products from the brain that happens during deep sleep. In a study on the glymphatic-rumination relationship, major depression disorder patients (N= 53), and healthy controls (N= 47) were evaluated for deep sleep.<sup>21</sup> Glymphatic dysfunction enhanced depression. Glymphatic flow was dependent on deep sleep and could be enhanced by physical exercise.

## Suicidal ideation

Suicidal ideation has also resulted from rumination. In a study on Chinese college students (N= 831) scores on the Ruminative Response Scale led to high scores on the Entrapment Scale, which in turn led to high scores on the Self-rating Idea of Suicide Scale.<sup>22</sup> In this moderated mediation model, mindful attentive awareness moderated the relationship between rumination and suicidal ideation.

Rumination has also been a mediator in a study on the relationship between irritability and suicidal ideation in adolescent patients with major depression disorder (N=319).<sup>23</sup> In this sample, 83% experienced irritability. Both rumination and distress tolerance mediated the effects of irritability on suicidal ideation.

## Non-suicidal self-injury

Rumination was a mediator for several problems that led to non-suicidal self-injury (NSSI). At least two of these studies involved childhood trauma. In a study entitled “Gender differentiated pathways from childhood trauma to self-injury, rumination as a mediator in depressed, adolescents”, non-suicidal self-injury had a prevalence as

high as 69% (females at 78%, males at 52%).<sup>24</sup> In this sample (N= 2006, 10 to 19 years-old), emotional neglect, emotional abuse, and physical abuse were associated with non-suicidal self-injury. Females experienced greater emotional neglect and males experienced greater emotional abuse. Females only needed one trauma subtype to experience NSSI while males required more than one. This finding may relate to the data suggesting that emotional neglect may have more long-term negative effects than emotional abuse because of its greater chronicity.

Rumination was a mediator variable in another study on the relationship between childhood trauma and non-suicidal self-injury.<sup>25</sup> In this sample of Chinese adolescents (N= 1270), childhood trauma led to non-suicidal self-injury, which was mediated by both rumination and alexithymia. Rumination and alexithymia by virtue of being more concurrent with NSSI than childhood trauma would be expected to explain more of the variance in NSSI.

In a study entitled “Network perspective on rumination and non-suicidal self-injury among adolescents with depressive disorder”, hospitalized adolescents (N=305, 12 to 28-years-old) were given the Ruminative Response Scale.<sup>26</sup> Based on this scale, symptom-focused rumination, not surprisingly, was the influential factor.

Rumination has also played a mediating role in a relationship between insomnia and non-suicidal self-injury.<sup>27</sup> In this study on college students from China (N=667), insomnia led to rumination, which in turn led to non-suicidal self-injury. This was an unusual relationship as rumination more typically leads to insomnia rather than insomnia leading to rumination and insomnia has led to non-suicidal self-injury more frequently than rumination in other literature.

In a meta- analysis examining the relationships between the subtypes of rumination and non-suicidal self-injury, the subtypes of rumination contributed to non-suicidal self-injury.<sup>24</sup> The subtypes included depressive brooding and reflection rumination. The depressive brooding rumination might be expected to lead to non-suicidal self-injury. The reflection rumination which is more positive would not lead to non-suicidal self-injury.

## Risk factors/predictors of rumination

Several risk factors have been identified for rumination (Table 3). They include childhood emotional neglect, parental criticism, rejection and control, mind wandering, expressive suppression, self – concealment, rejection sensitivity, social anxiety and depression.

**Table 3** Risk factors/predictors of rumination (and first authors)

| Risk factors/predictors                   | First authors |
|-------------------------------------------|---------------|
| Childhood emotional neglect               | Zhang         |
| Parental criticism, rejection and control | Castro        |
| Mind wandering                            | Xu            |
| Expressive suppression                    | Zou           |
| Self-concealment                          | Su            |
| Rejection sensitivity                     | Stuart        |
| Social anxiety                            | Wu            |
| Depression                                | Lo            |

**Childhood emotional neglect** and its relationships to rumination and depression have been studied in Chinese young adults (N=781).<sup>28</sup> In this sample, childhood emotional neglect led to rumination, which in turn led to depression. Resilience lessened the relationship between childhood neglect and depression. These relationships and resilience as a moderating variable are theoretically sound.



In a systematic review of nine longitudinal studies on parenting behaviors and adolescents' rumination, **parental criticism, rejection and control** led to rumination in their adolescents.<sup>29</sup> These authoritarian behaviors would be expected to have negative effects like rumination in adolescents. Authoritative practices, in contrast, were negatively related to rumination as would also be expected.

**Mind wandering**, not surprisingly, is a risk factor for rumination and has been considered an earlier stage of rumination. In a study entitled "The mind wanders to dark places: mind wandering catalyzes rumination in the context of negative affect and impulsivity", young adults with remitted major depression disorder (N= 44) and healthy adults (N= 38) were compared.<sup>30</sup> In this study mind wandering led to negative affect and impulsivity, which in turn led to rumination. Again, the mediators of negative affect and impulsivity would seem to be theoretically and empirically based. Those with major depression disorder reported more mind wandering and rumination, as would be expected.

In a network analysis **expressive suppression** led to rumination traits.<sup>31</sup> In this sample from China (N= 395, mean age = 22) controlling emotions by not expressing them related to rumination, especially brooding rumination. Brooding rumination could be considered a form of internal expression rather than simply expressive suppression.

**Self-concealment**, like expressive suppression, has been associated with brooding, but not with reflection in a study on older adults.<sup>32</sup> The authors referred to brooding as the maladaptive aspect of rumination and reflection as the adaptive aspect of rumination. The depiction of brooding as maladaptive and reflection as adaptive aptly describes the two sides (negative and positive) of rumination.

**Rejection sensitivity** has also been a risk factor for rumination. In a meta-analysis on 21 studies (N=6868), rumination and rejection sensitivity were significantly correlated ( $r=.43$ ).<sup>33</sup> Directionality is not implied here as a correlation would suggest that the variables are related, but not causally related. Rumination precedes rejection sensitivity in the title, suggesting that the research group at least considered rumination a risk factor for rejection sensitivity. Likely rumination and rejection sensitivity are reciprocal variables.

In a cross – lagged analysis of rumination and **social anxiety** among Chinese college students (N=392), social anxiety led to rumination at time 2.<sup>34</sup> Rumination also led to social anxiety at time 2, again suggesting that those variables are reciprocal.

**Depression** has been a significant risk factor for rumination and ultimately for suicidal ideation in a sample of Chinese depressed outpatients (N=165).<sup>35</sup> In this sample, 69% were moderately depressed and 88% were severely depressed. Those two groups reported suicidality. Depression led to rumination and self-critical thoughts which in turn led to suicidal ideation. Rumination and self-critical thoughts would be confounding and compounding mediators as rumination is typically described as self-critical thoughts. Many of these studies would have been more informative if regression analyses or structural equation modelling had been conducted to determine the relative significance of the variables.

### Potential underlying biological mechanisms for rumination

A few potential underlying biological mechanisms have been studied (Table 4). They include activation of several networks and connectivity between several networks.

**Table 4** Potential underlying biological mechanisms for rumination (and first authors)

| Mechanisms                                                            | First authors |
|-----------------------------------------------------------------------|---------------|
| Activation default mode, salience and frontoparietal networks         | Puccetti      |
| Activation default and salience networks                              | Roberts       |
| Connectivity in default mode, frontoparietal and cerebellar networks  | Kang-Ning     |
| Connectivity in default mode, attention control and salience networks | Wei           |

In a study entitled "Worry and rumination elicit similar neural representations: neuroimaging evidence for repetitive negative thinking", young adults were given fMRIs (N=39).<sup>36</sup> The fMRIs showed **activation across the default mode network, the salience network and the frontoparietal network**. These networks were said to encode worry and rumination similarly. In the same study, heart rate also did not differ for worry and rumination. Worry and rumination, not surprisingly, would appear to have similar effects both on activation of neural networks and heart rate.

The **default mode network and the salience network** have also been implicated in high ruminating youth at risk of depression relapses.<sup>37</sup> These high ruminating youth (N=53) were cued by an unresolved goal that provoked state rumination during the fMRIs. State rumination predicted inhibitory control, failures and dysregulation of the default mode network, the salience mode network, and the cognitive control network. Again, these induction studies especially in high ruminating youth at risk of depression relapses are ethically questionable because of their risk to benefit ratios.

Network connectivity problems have also been noted in individuals with remitted major depression episodes (N= 51).<sup>38</sup> The connectivity problems were located in the **default mode network, the frontoparietal network and the cerebellar network**. In this study rumination and distraction states were induced which is, again, likely a violation of human subjects research.

In a paper entitled "Shared and distinctive brain networks underlying trait and state rumination", trait rumination was associated with stronger and broader functional connectivity than state rumination.<sup>39</sup> Trait rumination was associated with the **default mode network, the attention network, the control network and the salience network**. State rumination was associated with functional connectivity in the **dorsal motor network and the control network**. It's not surprising that the more chronic trait rumination versus state rumination was associated with more networks in the brain due to its chronicity.

### Interventions for rumination

Only a few interventions have been researched (Table 5). They include mindfulness meditation, cognitive behavioral therapy, and psychedelics.

**Table 5** Interventions for rumination (and first authors)

| Interventions                                   | First Authors |
|-------------------------------------------------|---------------|
| Mindfulness                                     | Hawley        |
| Rumination-focused cognitive behavioral therapy | Langenecker   |
| Cognitive behavioral therapy                    | Donahue       |
| Psychedelics                                    | Ramarushton   |

In a study entitled “The relationship of rumination, worry and OCD symptoms during **technology supported mindfulness therapy** for OCD”, eight weeks of therapy were provided for patients with OCD (N=71).<sup>40</sup> Based on structural equation modeling, patients with OCD showed a decrease in rumination and a decrease in worry following the eight weeks of therapy. Unfortunately, the online therapy was not compared to in person therapy, but the cost-effectiveness of online therapy alone would make it compelling.

In research entitled “**Rumination-focused cognitive behavioral therapy** reduces rumination and targeted cross-network connectivity in youth with a history of depression”, the results are given in the title.<sup>41</sup> In this sample, youth (N=76) were given 10 to 14 sessions of CBT. Decreases were noted on the Rumination Response Scale. Decreases were also noted in connectivity across the left posterior cingulate cortex and the right inferior frontal gyrus/inferior temporal gyrus. The authors suggested that depressive rumination is a brain – based mechanism that is modifiable by rumination-focused CBT. This conclusion is not surprising given that rumination occurs in the brain and the therapy that reduces rumination also occurs in the brain.

In a systematic review and meta-analysis of 26 studies (N=1524), **CBT** was the most effective treatment for rumination.<sup>42</sup> Both individual and group therapy were effective. Pre-event rumination treatment effects were noted for social anxiety and post-event rumination treatment effects were noted for depression. The equivalent effectiveness of individual and group therapy is well based in the literature. Pre-treatment rumination might be expected to result in anticipatory anxiety just as depression might be expected from rumination after the event.

**Psychedelics** were also effective in treating rumination in a review of six studies.<sup>43</sup> These findings are tenuous given that comparisons were not made with waitlist controls or other therapy groups.

### Methodological limitations of this literature

Several methodological limitations can be noted for this current literature on rumination. They include sampling, measures, types of data as well as targets suggested for therapy.

The studies have been primarily conducted with clinical and university samples which have limited the **generalizability** of the findings. **Gender differences** have suggested that females have higher scores for rumination and brooding than males, and there were more females in the samples which may have biased the negative outcome effects.<sup>44</sup>

The **definitions of rumination have varied** with some researchers focusing on two types of rumination (the positive reflection and the negative brooding) and the others focusing on five different types. Positive and negative ruminations or adaptive and maladaptive ruminations would lead to different findings. The **types of questionnaires and the tasks** prior to the assessments likely influence the effect sizes. The measures have been limited to surveys and questionnaires that have resulted in **no content of the ruminations** being reported. Qualitative interviews or diary data may reveal different rumination themes that would be informative.

**Only a few mechanism studies** have appeared in this literature, most of which are fMRI studies. The fMRI studies have been **highly variable** for the dysfunctional connectivity for different parts of the brain, which may reflect researcher bias for focusing their fMRIs on different regions of the brain.

Despite the severe effects of rumination, **only a few intervention studies** have appeared in this current literature. These have been

effective but would desirably be compared with other interventions for efficacy and cost-effectiveness. Most of the authors have suggested **targeting mediators** for therapy rather than the primary problems which may relate to mediators being considered more accessible or more responsive to therapy. Again, no comparisons have been made. Despite these methodological limitations, this literature has been informative and suggestive of future research on rumination and therapy to reduce the negative effects of rumination.

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### Conflicts of interest

The author declares there is no conflicts of interest.

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