Proceedings of ICMMGH 2026 Symposium: Cell and Molecular Biology: Understanding Immune Cell Functions
DOI: 10.54254/2753-8818/2026.PJ31351

A Review of Major Treatment Approaches and Their Therapeutic Effects for Post-Traumatic Stress Disorder

Yuxuan Li

Biology Department, East Los Angeles College, Monterey Park, USA
Lyuxuan691@gmail.com

Abstract. Post-traumatic stress disorder (PTSD) is a common mental health issue that poses considerable challenges to both patients' personal lives and the public health system. This article sorts out the main treatment methods for PTSD and evaluates the actual effects of these methods in current clinical treatment. The central focus of the research is to integrate the current research evidence related to psychotherapy, pharmacological treatments, neuromodulation techniques, and emerging digital and artificial intelligence interventions, with the aim of comparing their respective advantages and disadvantages. This study employed a narrative literature review and comparative analysis approach to systematically disintegrate the results of randomized controlled trials, meta-analyses, and systematic reviews of PTSD patients in different clinical contexts. Research has found that trauma-focused psychotherapy is stable and consistent in alleviating the core symptoms of PTSD, while pharmacological treatments mainly play an auxiliary role in the relief of specific symptoms. Neuromodulation and digital therapy have shown certain potential as auxiliary or early intervention methods, but the relevant research evidence is still relatively limited. Overall, this study emphasizes the importance of adopting integrated and individualized treatment strategies, and points out that future research should further optimize treatment combinations and focus on long-term treatment effects.

Keywords: post-traumatic stress disorder, psychotherapy, pharmacological treatment, digital interventions

1. Introduction

Post-traumatic stress disorder (PTSD) is a mental disorder that an individual may develop after experiencing a severe traumatic event. According to the Diagnostic and Statistical Manual of Mental Disorders, the main symptoms of PTSD include involuntarily and repeatedly recalling traumatic experiences, deliberately avoiding stimuli related to trauma, negative changes in cognition and emotion, as well as abnormally elevated alertness and reactivity. If these symptoms persist for a long time, they will seriously affect the patient's social skills, job performance and overall quality of life [1].

From the perspective of public health, the prevalence of PTSD is relatively high, imposing a considerable burden on society. Epidemiological studies show that the lifetime prevalence of PTSD in the general population is relatively stable, while in high-risk groups that are more prone to

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/2026.PJ31351

traumatic events, the prevalence is higher [2]. As people's understanding of the neurobiological and psychological mechanisms of PTSD deepens, related treatment models are also constantly evolving, with various methods such as psychotherapy, drug therapy, and neuromodulation emerging. However, existing research also indicates that different treatment methods vary in terms of efficacy, applicable population and long-term effects. A single treatment approach often fails to meet the clinical needs of all patients.

Against such a backdrop, conducting a systematic review of PTSD treatment methods is of significant scholarly and clinical importance. On the one hand, although evidence-based psychotherapy is widely regarded as the first-line treatment for PTSD, there are still many patients who do not respond well to the treatment. On the other hand, biological interventions such as pharmacological treatments and transcranial magnetic stimulation, as well as digital and artificial intelligence-assisted treatments that have emerged in recent years, have provided new possibilities for the treatment of PTSD. However, their clinical value still needs to be further integrated and evaluated.

Therefore, this article conducts a review and analysis of the main treatment methods for PTSD, systematically sorting out the research evidence of the current mainstream psychotherapy, pharmacological treatments, neuromodulation techniques, and emerging digital interventions. By comparing the therapeutic characteristics and limitations of different treatment methods, the potential advantages of the comprehensive treatment strategy are explored to provide references for the optimization of clinical treatment of PTSD and related research directions in the future.

2. Mainstream treatment approaches for post-traumatic stress disorder (PTSD)

2.1. Psychotherapy

Psychotherapy is a widely used and highly effective method in the treatment of PTSD. Its core lies in helping patients deal with the psychological distress caused by trauma through professional psychological intervention, adjusting cognitive and behavioral patterns, and thereby alleviating symptoms. Among them, cognitive behavioral therapy (CBT) and eye movement desensitization and reprocessing (EMDR) are currently the two most recognized methods.

2.1.1. Cognitive behavior therapy (CBT)

Cognitive behavioral therapy (CBT) is one of the most deeply studied and widely applied methods in the psychological treatment of PTSD. The core idea is that the suffering of PTSD patients often stems from maladaptive cognitive appraisals and avoidance behaviors formed after trauma. Through targeted intervention, CBT aims to reduce the continuous distress caused by these psychological mechanisms. During the treatment, clinicians will help patients reorganize their understanding of the trauma, and at the same time, allow patients to gradually confront the memories or clues related to the trauma in a safe environment, gradually reducing the fear response to the trauma.

A large number of empirical studies have proved the effectiveness of CBT in treating PTSD. Ehlers et al. conducted a randomized controlled trial that demonstrated that both 7-day intensive cognitive therapy and standard weekly cognitive therapy could significantly alleviate PTSD symptoms, and this effect was maintained in subsequent follow-ups, indicating that CBT not only provides short-term symptom relief but also brings long-term benefits [3].

Cognitive processing therapy (CPT), as a trauma-focused variant of CBT, has also achieved remarkable results. Resick et al. compared the therapeutic effects of CPT, prolonged exposure

DOI: 10.54254/2753-8818/2026.PJ31351

therapy, and minimal intervention control in female sexual assault survivors. They found that both CPT and prolonged exposure therapy could significantly reduce PTSD and depressive symptoms, and CPT had more advantages than prolonged exposure therapy in alleviating trauma-related guilt and correcting dysfunctional cognitions [4]. This also reflects the unique value of cognitive reconstruction in the treatment of PTSD.

In conclusion, the evidence from randomized controlled trials indicates that CBT is an efficient first-line psychological treatment for PTSD, especially in achieving long-term symptom improvement and correcting trauma-related cognitive biases, which can bring about continuous psychological changes for patients.

2.1.2. Eye movement desensitization and reprocessing (EMDR)

Eye Movement desensitization and reprocessing (EMDR) is another trauma-oriented psychotherapeutic approach that is widely used in the treatment of PTSD. Its theoretical basis is the Adaptive Information Processing (AIP) model, which holds that the symptoms of PTSD persist because traumatic memories are not adequately processed but are stored in a dysfunctional form within the brain. During EMDR treatment, patients undergo bilateral stimuli such as eye movements while recalling traumatic memories. This process is believed to help the brain reprocess and integrate painful traumatic experiences [5].

More and more studies have demonstrated the therapeutic effect of EMDR on chronic PTSD. Meta-analysis shows that EMDR can significantly alleviate PTSD symptoms, with an effect comparable to that of trauma-centered CBT. For instance, Bisson et al., after reviewing controlled studies on the psychotherapy of chronic PTSD, pointed out that EMDR and trauma-focused CBT have similar effects in improving symptoms [6]. This means that for those patients who have a poor response to CBT or cannot tolerate traditional exposure techniques, EMDR is a good option.

In addition to alleviating symptoms, EMDR has also attracted attention due to its relatively fast treatment process and lower burden on patients. The randomized controlled trials summarized by Shapiro show that EMDR usually does not require a large number of treatments, nor does it require patients to complete a large amount of after-school homework or be exposed to trauma for a long time, which helps to improve treatment adherence and acceptability among patients [5]. However, some debate remains regarding the specific mechanism of action of EMDR, especially the actual role of eye movement in treatment. Overall, however, existing research still supports EMDR as an effective and well-established psychotherapeutic treatment of PTSD.

2.2. Pharmacological treatment

Pharmacological treatment is an important supplement to the treatment of PTSD. It mainly alleviates the symptoms of patients by regulating the balance of neurotransmitters in the brain, and is especially suitable for patients who cannot receive psychotherapeutic interventions or have other emotional problems. The commonly used drugs at present mainly include antidepressants, inhibitors targeting specific symptoms, and some adjuvant therapeutic drugs.

2.2.1. Antidepressants (selective serotonin reuptake inhibitors, SSRIs)

Selective serotonin reuptake inhibitors (SSRIs) are the most thoroughly studied and widely used type of medications in the pharmacological treatment of PTSD. Currently, sertraline and paroxetine are the only medications approved by the U.S. Food and Drug Administration (FDA) for the

DOI: 10.54254/2753-8818/2026.PJ31351

treatment of PTSD, which indicates that they have received sufficient evidence-based support in clinical research.

A double-blind, placebo-controlled study conducted by Brady et al. found that compared with placebo, sertraline could significantly reduce the overall severity of PTSD symptoms, especially in terms of avoidance/emotional numbness and hyperarousal symptoms [7]. Patients treated with sertraline also saw significant improvements in overall function and quality of life, with a treatment response rate of 53%, compared to only 32% in the placebo group.

In addition to individual clinical trials, systematic reviews and meta-analyses have further confirmed the efficacy of SSRIs in the treatment of PTSD. Hoskins et al. demonstrated that compared with placebo, SSRIs could bring about moderate but statistically significant improvements in core PTSD symptoms [8]. Among all antidepressants, the efficacy evidence of paroxetine and sertraline is the most consistent and stable, with effects comparable to those of other first-line pharmacological agents [8]. However, it is important to note that the overall efficacy of pharmacological treatment is usually not as good as that of trauma-focused psychotherapies, which also highlights the limitations of medication as a standalone intervention.

Overall, SSRIs are an important component of PTSD treatment, especially suitable for those who cannot receive psychotherapy or have symptoms of depression and anxiety at the same time. However, considering its limited therapeutic effect, combination therapy or individualized treatment strategies are often required in clinical practice.

2.2.2. Adrenergic inhibitors — targeting nightmares and sleep disturbances

Sleep disturbances and recurrent trauma-related nightmares are core symptoms of PTSD, which are closely associated with increased arousal of patients and the dysfunction of the norepinephrine system. Prazosin, an α1-adrenergic receptor antagonist, has received considerable empirical support for targeting these symptoms.

The mechanism of action of prazosin is to reduce the norepinephrine signaling in the central nervous system, thereby decreasing the state of excessive arousal during sleep, and thus alleviating nightmares and improving overall sleep quality. Raskind et al. conducted a placebo-controlled randomized trial and found that among active-duty military personnel with PTSD who had experienced combat trauma, prazosin was significantly more effective than placebo in reducing the severity of nightmares and improving sleep quality [9]. It is worth noting that the study also found that the overall functional level of the patients and the severity of PTSD symptoms improved, indicating that interventions targeting sleep-related symptoms may have a positive impact on the overall treatment outcome. In addition, prazosin was generally well tolerated, and there was no significant difference in blood pressure changes between the treatment group and the placebo group.

However, the study also found that a substantial proportion of patients still had obvious residual symptoms after taking the medicine, suggesting that the effect of single drug treatment is limited. Combining it with evidence-based psychotherapy may achieve better clinical outcomes [9].

2.2.3. Adjunctive treatments: mood stabilizers and related pharmacological agents

For patients with chronic PTSD or those who respond poorly to antidepressant treatment, researchers have attempted to use adjuvant pharmacological interventions to enhance the overall therapeutic effect. Among them, second-generation antipsychotics (e.g., risperidone) are used to relieve persistent symptoms, especially hyperarousal and relapses. However, the current research results on the efficacy of such drugs are not consistent.

DOI: 10.54254/2753-8818/2026.PJ31351

Krystal et al. conducted a large-sample, well-designed, multicenter randomized controlled trial to evaluate the efficacy of risperidone as an adjunctive treatment for patients with chronic military-related PTSD who did not respond well to antidepressants [10]. The results showed that compared with the placebo, risperidone did not significantly reduce the overall severity of PTSD symptoms, nor did it bring about meaningful improvements in indicators such as depression, anxiety or quality of life [10]. Although minor changes were observed in some symptom dimensions, these effects did not reach a clinically significant level. In addition, the use of risperidone for treatment also leads to an increased incidence of adverse reactions such as weight gain and sedation [10].

Consequently, existing evidence indicates that mood stabilizers or antipsychotic medications, as conventional adjunctive treatments for PTSD, should be used with caution, and their widespread application still lacks sufficient evidence-based support.

2.3. Neuromodulation therapy: transcranial magnetic stimulation (TMS)

Neuromodulation therapy is a type of method that treats diseases by regulating the neural activities of the brain. Among these approaches, repetitive transcranial magnetic stimulation (rTMS) is a non-invasive technique that has received increasing attention in the treatment of PTSD in recent years, especially for those patients who have a poor response to conventional pharmacological and psychotherapeutic treatments. The principle of rTMS is to apply magnetic pulses to specific cortical regions of the brain to regulate the frontal - limbic system neural circuits related to the pathogenesis of PTSD. Usually, the dorsolateral prefrontal cortex (DLPFC) is selected as the stimulation target.

The meta-analysis conducted by Berlim and Van den Eynde included multiple randomized, double-blind, sham-controlled trials to systematically evaluate the efficacy of rTMS in the treatment of PTSD. The results show that compared with sham stimulation, patients treated with rTMS have seen significant improvement in core PTSD symptoms, and have also achieved considerable improvement in comorbidities such as anxiety and depression, especially when stimulating the right DLPFC, the effect is more obvious. In addition, there was no significant difference in the dropout rate between the treatment group and the control group, indicating that rTMS has good tolerance [11].

However, this study also pointed out the limitations of the current relevant evidence, such as the generally small sample size of existing studies, significant differences in stimulation parameters, and the lack of long-term efficacy data on rTMS. Therefore, rTMS is currently more suitable as an adjunctive treatment for PTSD. In the future, larger-scale and more standardized randomized controlled studies are still needed to optimize the stimulation protocol and clarify its clinical positioning in the comprehensive treatment system.

2.4. Emerging treatment approaches: ai-assisted and digital interventions

With the development of technology, digital and artificial intelligence (AI) -supported intervention methods have gradually become a promising direction in the treatment of PTSD, especially suitable for scenarios that require early intervention and pursue treatment accessibility and scalability. The PTSD Coach mobile application is a representative example, which integrates psychoeducation, symptom monitoring, and coping strategies based on the principles of cognitive behavioral therapy (CBT).

Pacela-labarbara et al. conducted a randomized controlled pilot study on motor vehicle accident survivors and found that the acceptance and user engagement of PTSD Coach were both high. During the follow-up period, individuals using this application experienced a mild but significant

DOI: 10.54254/2753-8818/2026.PJ31351

decrease in PTSD symptoms. This study highlights the potential role of digital tools in the early post-traumatic phase, suggesting that such interventions may help prevent symptom escalation or assist patients in early symptom management [12].

Beyond self-guided applications, digital psychotherapy models with professional guidance have more solid evidence-based evidence. A large-scale randomized controlled trial conducted by Bisson et al. demonstrated that guided Internet-based trauma-focused cognitive behavioral therapy (TF-CBT) could significantly reduce PTSD symptoms, with therapeutic effects approaching those of face-to-face psychotherapy [13]. This result indicates that digital therapy is not merely a low-intensity self-help tool. With professional guidance, it can fully develop into a structured and evidence-based treatment model.

Overall, AI and digital interventions offer promising approaches to enhancing the accessibility of PTSD treatment. However, further large-sample, long-term follow-up studies are still needed to clarify their long-term efficacy and their optimal positioning in stepped-care or hybrid treatment systems.

3. Comparative analysis and synthesis

3.1. Comparison of treatment effectiveness

Among the current PTSD treatment methods, there are significant differences among various intervention approaches in terms of the intensity of therapeutic effect, the durability of effect, and the degree of evidence-based support. Trauma-focused psychotherapy, especially cognitive behavioral therapy (CBT) and eye movement desensitization and reprocessing (EMDR), has received the most consistent and solid empirical support in reducing the core symptoms of PTSD. A large number of randomized controlled trials and meta-analyses have shown that such interventions can produce significant therapeutic effects, and the improvement of symptoms can also be sustained during the follow-up stage. Therefore, they are widely regarded as the first-line treatment for PTSD [3,4,6].

In contrast, pharmacological treatment, especially selective serotonin reuptake inhibitors (SSRIs), can only achieve moderate efficacy in alleviating PTSD symptoms. Although sertraline and paroxetine have been approved by the US Food and Drug Administration (FDA), the results of meta-analysis show that the overall effect of medication-based interventions is usually not as good as that of trauma-focused psychotherapy, and the risk of symptom recurrence is relatively high after patients stop taking the medication [7,8]. Agents like prazosin, which target specific symptoms, are effective in alleviating trauma-related nightmares, but they have not received consistent support in improving the overall severity of PTSD [9].

Emerging intervention methods, including repetitive transcranial magnetic stimulation (rTMS) and digital therapy, have also shown certain therapeutic potential, but they are currently limited by issues such as small sample sizes and significant differences in research methods. The results of the meta-analysis suggest that rTMS targeting the dorsolateral prefrontal cortex can effectively reduce PTSD symptoms, but its long-term efficacy still needs further validation [11]. Similarly, guided digital interventions have shown clinically significant improvements in reducing symptoms, but additional research in broader and more diverse populations is necessary to establish their generalizability and effectiveness [13].

DOI: 10.54254/2753-8818/2026.PJ31351

3.2. Advantages of combined treatment approaches

The symptoms and underlying neurobiological mechanisms of PTSD are highly heterogeneous. A single treatment approach often fails to meet the needs of all patients, while a combined treatment strategy may lead to better clinical outcomes. Combining pharmacological treatment with psychotherapy can, on the one hand, reduce the severity of patients' symptoms and the level of emotional hyperarousal, and on the other hand, help improve patients' adherence and persistence in participating in trauma-focused psychotherapy, allowing the treatment to proceed more smoothly [8].

In addition, neuromodulation techniques such as transcranial magnetic stimulation can improve patients' cognitive and emotional regulation abilities by regulating the prefrontal - limbic neural circuits. This may lay a good foundation for subsequent psychotherapy and enhance the effectiveness of psychotherapy [11]. Digitalization and AI intervention provide an important supplement for early intervention after trauma exposure by enhancing the accessibility and flexibility of treatment, especially suitable for situations with limited medical resources or inconvenient access to medical care [12].

Overall, these research results support the adoption of a stepped-care or individualized treatment model, flexibly combining different intervention methods based on the severity of patients' symptoms, personal treatment preferences, and treatment responses. This is also a key direction for the future development of PTSD treatment frameworks.

4. Conclusion

This paper systematically reviews the major treatment approaches for PTSD, with a focus on analyzing the mechanism of action, clinical effectiveness, and emerging developments in recent years of different intervention approaches. By integrating multiple treatment approaches such as psychotherapy, pharmacological therapy, neuromodulation techniques, and digital and artificial intelligence intervention, a comprehensive overview of the current PTSD treatment strategies and their relative advantages is provided.

Overall, trauma-focused psychotherapy still demonstrates the most stable and consistent efficacy in alleviating the core symptoms of PTSD, while pharmacological treatments mainly play an adjunctive role in relieving specific symptom clusters. Neuromodulation techniques and digital interventions offer promising supplements to the existing treatment system, especially for individuals who have an insufficient response to traditional treatments or face limitations in medical accessibility. However, the differences in treatment responses among different patients further highlight the complexity and heterogeneity of the pathological mechanism of PTSD.

Although this article encompasses a variety of treatment modalities, it has not delved deeply into their neurobiological mechanisms, nor has it systematically evaluated the long-term treatment effects in different populations. Future research should place greater emphasis on individualized and integrated treatment models, further explore the optimization of intervention sequences, and explore the potential role of emerging technologies in early intervention and long-term management. The continuous advancement of research in these directions is of great significance for improving the therapeutic effect of PTSD and promoting the development of evidence-based clinical practice.

References

[1] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders : DSM-5 (Fifth edition.). American Psychiatric Association.

DOI: 10.54254/2753-8818/2026.PJ31351

[2] Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. (2005). Lifetime Prevalence and Age-of-Onset Distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 62(6): 593–602. doi: 10.1001/archpsyc.62.6.593

[3] Ehlers, A., Clark, D. M., Hackmann, A., Grey, N., Liness, S., Wild, J., … McManus, F. (2010). Intensive Cognitive Therapy for PTSD: A Feasibility Study. Behavioural and Cognitive Psychotherapy, 38(4), 383–398. doi: 10.1017/S1352465810000214

[4] Resick, P. A., Nishith, P., Weaver, T. L., Astin, M. C., & Feuer, C. A. (2002). A comparison of cognitive-processing therapy with prolonged exposure and a waiting condition for the treatment of chronic posttraumatic stress disorder in female rape victims. Journal of consulting and clinical psychology, 70(4), 867.

[5] Shapiro, F. (2017). Eye movement desensitization and reprocessing (EMDR) therapy: Basic principles, protocols, and procedures. Guilford Publications.

[6] Bisson, J. I., Roberts, N. P., Andrew, M., Cooper, R., & Lewis, C. (2013). Psychological therapies for chronic post-traumatic stress disorder (PTSD) in adults. Cochrane database of systematic reviews, (12).

[7] Brady, K., Pearlstein, T., Asnis, G. M., Baker, D., Rothbaum, B., Sikes, C. R., & Farfel, G. M. (2000). Efficacy and safety of sertraline treatment of posttraumatic stress disorder: a randomized controlled trial. Jama, 283(14), 1837-1844.

[8] Hoskins, M., Pearce, J., Bethell, A., Dankova, L., Barbui, C., Tol, W. A., ... & Bisson, J. I. (2015). Pharmacotherapy for post-traumatic stress disorder: systematic review and meta-analysis. The British Journal of Psychiatry, 206(2), 93-100.

[9] Raskind, M. A., Peterson, K., Williams, T., Hoff, D. J., Hart, K., Holmes, H., ... & Peskind, E. R. (2013). A trial of prazosin for combat trauma PTSD with nightmares in active-duty soldiers returned from Iraq and Afghanistan. American Journal of Psychiatry, 170(9), 1003-1010.

[10] Krystal, J. H., Rosenheck, R. A., Cramer, J. A., Vessicchio, J. C., Jones, K. M., Vertrees, J. E., ... & Veterans Affairs Cooperative Study No. 504 Group. (2011). Adjunctive risperidone treatment for antidepressant-resistant symptoms of chronic military service–related PTSD: A randomized trial. Jama, 306(5), 493-502.

[11] Berlim, M. T., & Van den Eynde, F. (2014). Repetitive transcranial magnetic stimulation over the dorsolateral prefrontal cortex for treating posttraumatic stress disorder: an exploratory meta-analysis of randomized, double-blind and sham-controlled trials. The Canadian Journal of Psychiatry, 59(9), 487-496.

[12] Pacella-LaBarbara, M. L., Suffoletto, B. P., Kuhn, E., Germain, A., Jaramillo, S., Repine, M., & Callaway, C. W. (2020). A pilot randomized controlled trial of the PTSD Coach app following motor vehicle crash–related injury. Academic Emergency Medicine, 27(11), 1126–1139.

[13] Bisson, J. I., Ariti, C., Cullen, K., Kitchiner, N., Lewis, C., Roberts, N. P., ... & Williams-Thomas, R. (2022). Guided, internet based, cognitive behavioural therapy for post-traumatic stress disorder: pragmatic, multicentre, randomised controlled non-inferiority trial (RAPID). bmj, 377.