REVIEW ARTICLE

Feeling Safe: A Comprehensive Systematic Literature Review of Psychiatric Disorders through the Lens of Polyvagal Theory

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SUMMARY

Safety on a psychological level is progressively renowned as fundamental to mental health issues and psychological well-being. The concept of feeling safe based on polyvagal theory, proposed by Stephen Porges (2011), has emerged as a comprehensive structure for understanding the autonomic nervous system's role in regulating social behavior, emotional processing, and physiological reactions. This review aims to explore the application of polyvagal theory in the understanding of psychiatric disorders, with a focus on how autonomic nervous system dysregulation influences emotional and behavioral manifestations, thereby contributing to the development of effective therapeutic interventions aimed at enhancing feelings of safety and well-being in the patients suffering from psychiatric disorders. The systematic literature review technique based on the PRISMA model was used for this purpose. Sources were obtained through PubMed, APA PsycArticles, PLOS, Research Gate, Google Scholar, and PubMed Central (PMC) database, using different keywords as the primary descriptor and limiting the sources to English-language articles published in the last ten years from 2013 to 2023. The review synthesized findings from various studies investigating the association between the polyvagal theory and psychiatric disorders, including anxiety disorders, depression, psychotic disorders, post-traumatic stress disorder (PTSD), borderline personality disorder, and childhood disorders including conduct disorder, attention deficit hyperactivity disorder (ADHD), and autism spectrum disorder (ASD). The results exhibit that individual suffering from these psychiatric disorders frequently displayed autonomic nervous system dysregulation, as proposed by the polyvagal theory, which seems to be a shared feature in many psychiatric disorders. The systematic review highlighted the significance of physiological aspects of mental health and indicates that interventions focusing on autonomic regulation may hold the potential to assuage the basic symptoms relevant to psychiatric disorders. Additional research work is defensible to clarify the primary mechanisms and improve the implication of interventions which are based on polyvagal theory for better clinical outcomes.

Keywords: *Autonomic Nervous System, Mindfulness, Psychological Safety, Psychiatric Disorders, Vagus Nerve.*

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Introduction

The polyvagal theory offers a comprehensive explanation of psychological safety based on insights from neurophysiology, psychology, and evolutionary theory.[1] Polyvagal theory provides a framework for understanding the role of the autonomic nervous system in regulating social behavior, emotional states, and physiological responses. While there is a growing body of research examining the link between polyvagal theory and mental disorders, it should be noted that this field is constantly evolving. According to Porges (2009), the polyvagal theory describes "an autonomic nervous system that is influenced by the central nervous system, is responsive to afferent influences, and is characterized by an adaptive responsiveness that depends on the phylogeny of neural circuits".[2] According to this theory, the autonomic nervous system (ANS) is responsible for regulating physiological responses and is divided into three

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branches: the ventral vagus complex, the sympathetic nervous system, and the dorsal vagus complex.

The ventral vagus complex is associated with a sense of security and social engagement. Promotes social interaction, emotional bonding, and the ability to effectively regulate stress responses. The sympathetic nervous system plays a vital role in the "fight-or-flight" response and is activated in situations of threat or danger. The dorsal vagus complex is associated with immobilization and shutdown responses that can occur in response to extreme stress or trauma.[3] Overall, the polyvagal theory established that the nervous system evolved in a way that allows humans to respond appropriately to the environment

In the current literature review, psychiatric disorders, such as anxiety disorders, depression, schizophrenia, post-traumatic stress disorder (PTSD), and some childhood disorders, such as attention deficit hyperactivity disorder (ADHD), conduct disorder, and oppositional defiant behavior (OPD), have been studied within the framework of the polyvagal theory. The theory suggests that dysregulation of the autonomic nervous system, particularly the ventral vagus complex, may contribute to the development and persistence of these disorders. For example, people with anxiety disorders may have an overactive sympathetic nervous system, leading to increased restlessness and hypervigilance. They may have trouble engaging socially and have difficulty regulating their emotional responses. Depression is also associated with dysregulation of the autonomic nervous system.

In some cases, depression may be associated with hypofunction of the ventral vagus complex, resulting in decreased social engagement, feelings of disconnection, and an impaired ability to regulate emotions.[4] PTSD, which can result from experiencing or witnessing a traumatic event, involves a dysregulated autonomic nervous system response. Injury can result in an overactive sympathetic response and impairment of the ventral vagus complex, which can result in symptoms such as hyperarousal, flashbacks, and emotion dysregulation.[5]

The reported incidence of neuropsychiatric disorders in children has increased over the past decade. Many neuropsychiatric disorders appear during childhood, including depression, anxiety, conduct disorders, attention deficit hyperactivity disorder (ADHD), autism spectrum disorders, and others.[6,7] These childhood disorders include a range of disorders that affect behavioral development. Understanding the underlying mechanisms that contribute to these disorders is critical to effective intervention and support. The polyvagal theory offers valuable perspectives by emphasizing the major contribution of autonomic nervous system (ANS) in management of social engagement, emotional regulation, and adaptive behavior.

Combining these lines of research, it is suggested that psychiatric disorders, such as depression, anxiety, ADHD, and autism, are in fact physiological states determined by the state of our nervous system, to which polyvagal theory conforms its role in psychology, psychiatry and functional medicine. This theory evidences exploration as it can have significant public health inference.

Methods

Information Sources and Search

Our findings are presented according to the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines A comprehensive search of electronic databases, including PubMed, APA PsycArticles, PLOS, Google Scholar, Research Gate, and PubMed Central (PMC) was conducted using keywords such as polyvagal theory, neuroception, psychiatric disorders, and specific disorder names (e.g., anxiety, depression, schizophrenia, autism spectrum disorder, attention-deficit/hyperactivity disorder etc.) during June 2023 to July 2023. Articles published in English within the last decade were selected for review. A total of 20 articles were included in this literature review.

Studies Selection

Studies extracted included the primary aim of the study. The study selection process is illustrated in Figure. 1 mentioned below. In the first stage, any duplicates of research were excluded, and abstracts were consequently evaluated for their relevance to the inclusion/exclusion criteria settled for this review by using PRISMA guidelines.

Results

The literature review revealed that the polyvagal theory delivers valuable insights into the underlying

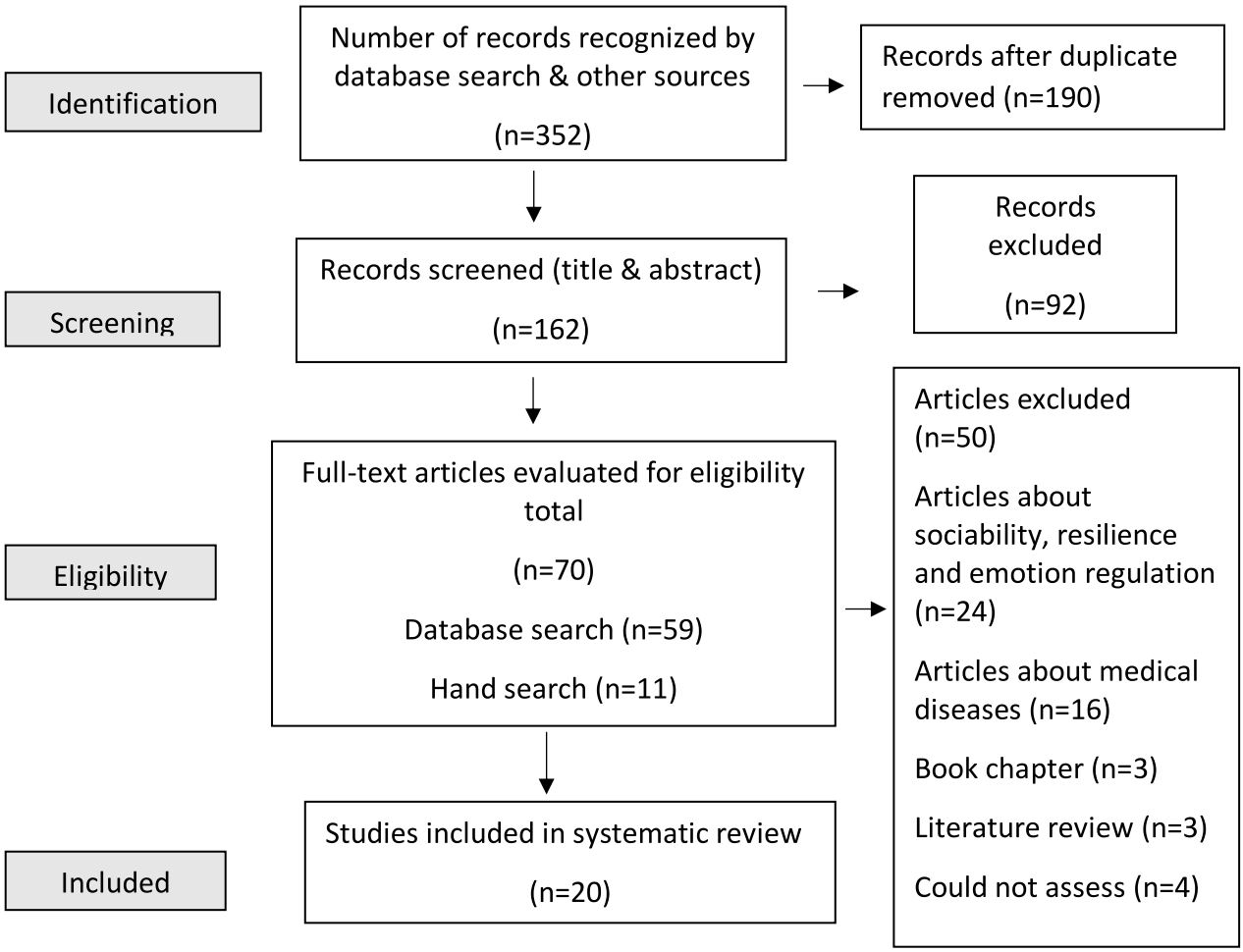

Fig.1: PRISMA flow diagram of the systematic search and review process

mechanisms of various psychiatric disorders. Firstly, dysregulation of the autonomic nervous system, as elucidated by the theory, has been associated with increased vulnerability to several psychiatric conditions, including post-traumatic stress disorder (PTSD), anxiety disorders, depression, and autism spectrum disorders. Additionally, studies have demonstrated altered vagal tone, a crucial component of the polyvagal theory, in individuals with these disorders, suggesting an imbalance in the autonomic regulation of emotions and social engagement.

Furthermore, the review highlighted the significance of the social engagement system in psychiatric disorders. The polyvagal theory posits that impaired social engagement, mediated by the ventral vagal complex, can contribute to the development and maintenance of psychiatric symptoms. Research findings consistently support this notion, with reduced social engagement related to different disorders, including anxiety disorders, depression, conduct disorder, and autism spectrum disorders.

Moreover, the polyvagal theory has provided a framework for understanding the physiological responses associated with psychiatric disorders. Altered vagal regulation has been linked to heightened sympathetic activation and increased stress reactivity, which are characteristic features of several mental health conditions. This dysregulation may contribute to the perpetuation of symptoms and influence treatment outcomes.

Discussion

Polyvagal theory is a concept established by Dr. Stephen Porges to understand the autonomic nervous system's role in the regulation of emotions, social behavior, and psychiatric disorders. It suggests that the nervous system has three distinct response states, which influence our physiological and emotional reactions to stress and social interactions.[3,4]

Table-1: Characteristics and Results of Studies Relevant to Polyvagal Theory and Psychiatric Disorders

Authors	Year	Psychiatric Disorder	Intervention	Outcomes
Simon et al. [8]	2014	PTSD	Distracting bar orientation task (as neural exercise)	Distracting bar orientation task was promoted and conceptualized as neural exercise increasing the ventral vagal capacity to increase resilience level.
Bhatnagar et al.[9]	2013	PTSD	Neural exercises	MBSR PTSD symptoms had decreased from, conceptualized as neural exercises increasing the ventral vagal capacity to increase resilience level.
Kang et al.[10]	2018	PTSD	Transcendental Meditation (TM)	Transcendental Meditation (TM) seems effective as neural exercises increase the ventral vagal capacity and reduce the symptoms of PTSD symptoms. TM increased mindfulness and quality of life of the individual.
King et al.[11]	2016	PTSD	Mindfulness-Based Exposure Therapy (MBET)	Mindfulness-Based Exposure Therapy (MBET) reduced PTSD symptoms.
Williams et al.[12]	2020	OCD	Mindfulness Meditation (MM)	Mindfulness Meditation (MM) was effective in reduction of OCD symptoms
Wahbeh et al.[13]	2016	OCD	Mindfulness Meditation (MM)	Mindfulness Meditation (MM) was effective in the management of hyperarousal symptoms.
Alvares et al.[14]	2013	Social anxiety	The control group and experimental group for investigation of the variability of HRV in social anxiety patients	Heart Rate Variability (HRV) was decreased in females suffering from social anxiety, compared to the control group.
Hamilton et al.[15]	2014	Schizophrenia	Comparative study with the control healthy group and other group of patients with schizophrenia	Findings revealed that physiological flexibility and self-regulatory capacity may compensate for poorer social-cognitive skills among schizophrenia patients
Dale et al.[16]	2022	Psychiatric symptoms	Cross-sectional study In intervention participants were exposed to emotional and physical stressors	Findings highlighted a notable relationship between history of maltreatment and autonomic reactivity like heart rate and respiratory sinus arrhythmia in physical as well as emotional challenges.
Procyk[17]	2020	Childhood trauma	polyvagal theory psycho-education	Psycho-education helps in handling conflict and improvement in relationships.
Beauchaine[18]	2021	All psychopathologies	Theoretical discussion on the	Integrated model (Gray's motivational theory & Porges's polyvagal theory)

			integrated model of Polyvagal theory and Gray's motivational theory	suggested an approach to the study of the autonomic nervous system, behavior, and relations.
Faja et al.[19] (2013)	2013	Autism	Research assessed electro-dermal responses in children with autism spectrum disorders.	Findings revealed how altered autonomic regulation, as proposed by polyvagal theory, may influence emotional dysregulation and social difficulties in children with ASD.
Kolacz et al.[20]	2018	anxiety, depression, and PTSD	CBT, hypnotherapy	Findings revealed potential mechanisms that endorse and uphold socio-emotional and GI dysfunction.
Hadiprodjo[21]	2018	Developmental Trauma	Play therapy	Findings highlighted significance of play therapy in relationships and in management of stress response through the vagus nerve.
Bonilla[22]	2020	PTSD Anxiety and depression (in abused women)	Expressive arts	The polyvagal theory and the expressive arts, combined, are a great tool for allowing survivors to be more present in their bodies and to be able to self-regulate when they are triggered.
Fernandes et al.[23]	2017	Major Depressive Disorder	In this study, ECG recordings and ethogram were used for the assessment of HRV and NVBs	The findings revealed that nonverbal behaviors & vagal activity are connected so highlighted the pathophysiology of major depression.
Kolacz et al.[24]	2022	Social stress	Behavioral distress of infants was assessed through the mother's negative vocalizations, facial expressions, and gaze aversion.	Results highlighted the significance of specific vocal acoustic features of speech that are related to biobehavioral state of infants and validate mother-infant bi-directional dynamics.
Kolacz et al.[25]	2020	PTSD, depression, anxiety symptoms	Data were collected via the survey method to assess the adversity history, subjective experiences of autonomic reactivity, PTSD and depression symptoms.	Findings highlighted the role of autonomic regulation in mediating the impact of adversity on mental health.
Porges[26]	2020	Acute stress disorder	Social engagement to promote connectedness	Strategy to reduce the adversative reactions to threats through social engagement.
Breit et al.[27]	2018	Psychiatric disorders (Mood & Anxiety disorders)	Meditation exercises and Yoga	These techniques validate that moderating the vagus nerve has a therapeutic outcome because of its relaxing and anti-inflammatory potentials.

Schizophrenia and other Psychotic Disorders

Schizophrenia is a complex mental disorder characterized by a range of symptoms, including hallucinations, delusions, disorganized thinking and speech, and impaired social functioning. While the exact causes of schizophrenia are not fully understood, it is believed to involve a combination of genetic, environmental, and neurobiological factors.

There is limited direct research linking polyvagal theory specifically to schizophrenia. However, polyvagal theory offers insights into the autonomic nervous system dysregulation that may be associated with various psychiatric disorders, including schizophrenia. Research suggests that individuals with schizophrenia may experience dysfunctions in their autonomic nervous system, which can lead to abnormal physiological responses to stress and social cues. This dysregulation may manifest as altered heart rate variability, reduced facial expressivity, and impaired social engagement.

Polyvagal theory proposes that the social engagement system, which involves the vagus nerve, is crucial for adaptive social behavior. Dysfunction in this system may result in difficulties in forming social connections and engaging in reciprocal interactions. Some researchers speculate that abnormalities in the autonomic nervous system, including vagal tone and reactivity, could contribute to the social deficits observed in schizophrenia. As mentioned in Table 1, Himilton et al. (2014) observed as polyvagal theory proposes, physiological flexibility and self-regulatory capability may recompense for weaker skills in social and cognitive aspects in patients suffering from schizophreni.[15]

Furthermore, the theory highlights the role of the vagus nerve in body's stress regulation during stress. It suggests that individuals with schizophrenia may exhibit an overactive sympathetic response and impaired parasympathetic regulation, leading to difficulties in emotional regulation and increased vulnerability to stress. Dale et al. (2022) research findings as mentioned in Table 1 revealed that important relationship between the history of maltreatment and autonomic reactivity which encompasses the heart rate and respiratory sinus arrhythmia during any physical and emotional traumas of life; on the other hand, when VE as a covariate was introduced as a covariate these relations were no more significant. Blunted VE reflects the neural path in which mistreatment rearranges autonomic regulation and delivers such a neurophysiological platform that surges the risk for mental health.[16] Berntson and colleagues (2011) research work explored the role of the insula, a brain region intricates in interception and emotional processing, in the context of the Polyvagal theory and its implications for psychiatric disorders.[28]

While polyvagal theory delivers such a theoretical framework for a clear understanding of autonomic dysregulation in psychiatric disorders, including schizophrenia, further research is necessary to establish direct links and determine the specific mechanisms involved. It is an emerging area of investigation that holds promise for deepening our understanding of the physiological underpinnings of schizophrenia and potentially informing treatment approaches.

Depression

When it comes to depression, polyvagal theory suggests that dysregulation in the autonomic nervous system can contribute to depressive symptoms. People with depression may have a heightened sympathetic response, leading to chronic initiation of the fight-or-flight response. This can result in increased anxiety, hypervigilance, and difficulty in regulating emotions.

Additionally, disruptions in the social engagement system, particularly the ventral vagal complex, may play a role in depression. Difficulties in forming and maintaining social networks that can result in to isolation, loneliness, and a lack of support, which are common experiences among individuals with depression. Beauchaine and Thayer (2015) discussed the potential utility of heart rate variability (HRV), a measure associated with the polyvagal theory, as a transdiagnostic biomarker for various psychopathologies, including depression.[29]

Understanding polyvagal theory in the context of depression can help inform therapeutic approaches. Techniques that promote feelings of safety, connection, and social engagement may be beneficial in regulating the autonomic nervous system and reducing depressive symptoms. These can include interventions such as social support, therapy focused on building positive relationships, mindfulness practices, and relaxation techniques.

Fernandes et al. (2017) research findings as mentioned in Table 1 highlighted that depression endophenotypes which included nonverbal behaviors and vagal activity were relevant and this highlighted the pathophysiology involved in major depression, in the framework of the polyvagal theory.[23] As Kolacz et al. (2020) research work highlighted the significant role of autonomic regulation in mediating the effect of traumas on mental well-being stated in Table 1.[25] Kemp et al. (2010) investigate the impact of depression and antidepressants on HRV, providing understanding of the potential dysregulation of the autonomic nervous system in individuals with depression.[30] Similarly Groves & Brown (2005) explored vagal nerve stimulation (VNS) and its effects on the autonomic nervous system, highlighting its potential therapeutic applications in mood disorders.[31]

It's important to note that while polyvagal theory provides a valuable perspective on the association of the autonomic nervous system and mental health, it is just one of many theories and frameworks used to understand depression. Depression is a complex condition with various contributing factors, including genetics, environment, and psychological factors. Treatment approaches should be structured as per needs of individual and may involve a combination of therapy, medication, lifestyle changes, and support networks.

Anxiety

Anxiety, which is a common mental health condition can be understood within the framework of polyvagal theory. When individuals experience anxiety, there may be a disturbance in the autonomic nervous system's response, leading to an overactive sympathetic nervous system or dorsal vagal complex.

In anxiety, the sympathetic nervous system may be overly engaged, causing an increase in heart rate, rapid breathing, and a heightened state of arousal. This response is appropriate in situations where there is an actual threat, but in anxiety disorders, it can be triggered even when there is no immediate danger present. On the other hand, individuals with anxiety may also experience dysregulation in the dorsal vagal complex. This can lead to feelings of dissociation, emotional numbness, or a sense of being overwhelmed. The freeze response can be triggered in situations where the person perceives the environment as threatening or unsafe.

Polyvagal theory suggests that interventions aimed at regulating the autonomic nervous system which facilitate in management of anxiety. Techniques such as deep breathing exercises, mindfulness, meditation, and body-based therapies like yoga or somatic experiencing can help promote a sense of safety and activate the ventral vagal complex. As mentioned in Table 1, Bhatnagar (2013) and Simons et al. (2014) highlight the usefulness of neural exercises in PTSD based on polyvagal theory for the expansion of capability of the central vagal complex in the management of the present state and it also indicates resilience.[8,9] Similarly Kang and colleagues (2018) used Transcendental Meditation (TM) which seemed effective for the reduction in symptoms of post-traumatic disorder and also enhanced the patient's mindfulness and quality of life.[10]

As Stated in Table 1, Williams and colleagues (2020) and Wahbeh et al. (2016) worked with OCD symptoms by using Mindfulness Mediation (MM) as an intervention and found that hyperarousal symptoms imported in the patients.[12,13] Alvares et al. (2013) worked on female patients with social anxiety. Polyvagal theory envisages that psychiatric disorders having social dysfunction are relevant to reduced heart rate variability (HRV), increased social anxiety and psychological distress.[14] Kolacz et al. (2020, 2022) worked on PTSD, anxiety and depression and had similar pattern of results.[24,25]

Childhood Disorders

Childhood disorders encompass a range of conditions that has impact on a child's emotional, cognitive, and behavioral growth. Understanding the underlying mechanisms contributing to these disorders is essential for effective intervention and support. The polyvagal theory offers a valuable perspective by emphasizing the crucial role of the autonomic nervous system in social engagement, emotional regulation, and adaptive behaviors of individual. Dr. Porges, focuses on the clinical implications of the polyvagal theory, including its relevance to trauma, anxiety, depression, and other mental health disorders commonly observed in children and adults.[2,3] This literature review explores the existing research on the application of Polyvagal Theory to childhood disorders, highlighting its

potential implications and therapeutic approaches.

Beauchaine et al. (2007) worked on the adolescent sample with conduct disorder and findings revealed that reward inattentiveness is relevant to adequate vagal modulation of cardiac productivity, proposing further scarcities in emotional regulation.[32] Crowell et al. (2006) conducted research on Preschool children suffering from ADHD and Oppositional Defiant Disorder, and highlighted that the children showed less electro-dermal responses and extended cardiac pre-rejection periods initially and throughout reward.[33]

Faja et al. (2013) examine electro dermal responses in children with autism spectrum disorders as mentioned in Table 1. It discusses how altered autonomic regulation, as proposed by polyvagal theory, may influence emotional dysregulation and social difficulties in children with ASD as mentioned in Table 1.[19] Porges highlighted the relationship between respiratory sinus arrhythmia (RSA), a marker of parasympathetic activity associated with social engagement, and auditory processing in children with ASD.[2,3] It highlights the potential dysregulation of the autonomic nervous system and its impact on social functioning in this population.

This relevant literature provides a solid foundation for understanding the polyvagal theory and its implications for childhood disorders. They offer insights into the underlying neurophysiological mechanisms and how interventions informed by the theory may be applied to promote emotional regulation and social engagement in children with various developmental challenges.

Implications of Polyvagal Theory in the Treatment of Psychiatric Disorders

Polyvagal theory suggests that by targeting the autonomic nervous system and the vagus nerve, therapists can help their clients to regulate their emotional and behavioural responses, leading to improved mental health. As mentioned in Table 1, many research studies highlighted the therapeutic interventions used for psychiatric disorders were mindfulness-based exposure, mindfulness meditation, psycho-education regarding polyvagal theory, social engagement exercises, play therapy, and yoga exercises, as these can help to stimulate the parasympathetic nervous system and promote a sense of safety and connection.[11-13,18,26,27]

By understanding the role of the autonomic nervous system in shaping mental health, clinicians can develop more comprehensive and effective treatment approaches for a wide range of psychiatric disorders.

Conclusion

The polyvagal theory offers a valuable structure for understanding the neurobiological basis of psychiatric disorders. The reviewed literature demonstrated the potential implications of polyvagal theory in explaining the autonomic dysregulation observed in various adult and child psychopathology. Targeted interventions that are based on polyvagal theory such as mindfulness, meditation, deep breathing exercises, and yoga based on the polyvagal theory regulate vagal tone and enhance social engagement in adults and children with various mental health challenges. Overall, polyvagal theory offers a valuable perspective on understanding the physiological underpinnings of psychiatric disorders, highlighting the importance of the autonomic nervous system and its regulation in mental health.

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Authors Contribution

IM: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proofreading