KMAN PUBLISHING INSTITUTE
Journal Website

Article history:
Received 03 February 2026
Revised 21 May 2026
Accepted 26 May 2026
Published online 01 April 2026

Journal of Assessment and Research in Applied Counseling

Volume 8, Issue 2, pp 1-11

E-ISSN: 3041-8518

Detecting Post-Traumatic Stress Risk via ML Analysis of Dissociative Tendencies and Arousal Dysregulation

Hadassah N. Griffin[1*], Spyridon. Derdemezis[1], Guillermo. Umpiérrez-Failache[2], Charlotte. Wray[3]

[1] Department of Psychology, Georgia State University, Atlanta, GA, USA
[2] Department of Psychiatry and Human Behavior, Brown University, Providence, RI, USA
[3] Department of Psychiatry and Behavioral Neurosciences, Wayne State University, Detroit, MI, USA

*** Corresponding author email address**: hadasgriffin93@gmail.com

Article Info

Article type:
Original Research

How to cite this article:
Griffin, H. N., Derdemezis, S., Umpiérrez-Failache, G., & Wray, Ch. (2026). Detecting Post-Traumatic Stress Risk via ML Analysis of Dissociative Tendencies and Arousal Dysregulation. *Journal of Assessment and Research in Applied Counseling*, *8*(2), 1-11.
http://dx.doi.org/10.61838/kman.jarac.5238

ABSTRACT

Objective: To evaluate the predictive utility of machine learning models in detecting post-traumatic stress risk by analyzing the complex interplay between dissociative tendencies and physiological arousal markers.

Methods and Materials: A cross-sectional observational study was conducted with a sample of $N = 1{,}245$ adult participants from the USA with documented trauma exposure. Data collection utilized the Posttraumatic Stress Disorder Checklist (PCL), the Dissociative Experiences Scale (DES), subjective hyperarousal scales, and wearable biometric sensors capturing electrodermal activity and heart rate variability during a standardized stress-reactivity paradigm. Extreme Gradient Boosting, Random Forest, and Support Vector Machine algorithms were trained and evaluated using stratified ten-fold cross-validation.

Findings: The Extreme Gradient Boosting model demonstrated superior predictive performance, achieving an $AUC = 0.91$, which significantly outperformed the Random Forest ($AUC = 0.88$) and Support Vector Machine ($AUC = 0.82$) models. Feature importance analysis revealed that derealization (22.4%), depersonalization (18.1%), and low heart rate variability during recovery (15.3%) were the most critical predictors of post-traumatic stress risk. Furthermore, a significant non-linear interaction demonstrated that objective physiological arousal strongly predicted risk primarily in highly dissociative individuals who underreported subjective distress.

Conclusion: Machine learning models integrating objective physiological data with subjective dissociative measures offer a powerful, highly sensitive approach for detecting hidden post-traumatic stress risk.

Keywords: *Post-Traumatic Stress Disorder; Machine Learning; Dissociation; Arousal Dysregulation*

1. Introduction

Traumatic events encompass a profoundly diverse spectrum of human experiences, ranging from acute, discrete incidents to prolonged environments of extreme adversity. The initial exposure to such events—whether it be the sudden devastation of natural disasters like severe earthquakes (Akay et al., 2026), the physically and psychologically taxing environment of medical emergencies resulting in critical care admissions (Vadakkedath & Thomas, 2025), or the pervasive, chronic distress associated with widespread systemic insecurity and global pandemics (Jozan et al., 2021; Muhammad & Abdullahi, 2025)—fundamentally threatens human psychological homeostasis. While a significant proportion of the population demonstrates remarkable psychological resilience and ultimately processes these traumatic exposures without long-term psychiatric sequelae, a substantial and vulnerable subset develops post-traumatic stress disorder (PTSD). PTSD is a severe, debilitating, and highly complex psychiatric condition characterized by a persistent constellation of symptoms, including intrusive memories and flashbacks, pervasive avoidance of trauma-related stimuli, negative alterations in cognition and mood, and marked, unrelenting alterations in physiological arousal and somatic reactivity. The global burden of post-traumatic psychopathology is immense, driving substantial impairments in occupational functioning, interpersonal relationships, and overall quality of life across diverse demographic cohorts.

Accurately diagnosing PTSD and formulating effective intervention strategies requires careful clinical differentiation from a multitude of overlapping but distinct psychiatric syndromes. Research over the past several decades has robustly demonstrated that PTSD, prolonged grief disorder, and major depressive disorder constitute distinguishable clinical entities, each possessing unique symptom architectures and requiring tailored, specific therapeutic approaches (Boelen et al., 2010). This diagnostic complexity is frequently highlighted in detailed clinical case studies and broad psychiatric evaluations, which continuously underscore the necessity of meticulously parsing out the overlapping symptoms of PTSD, prolonged grief, and generalized adjustment disorders to prevent misdiagnosis and improper treatment (Trivedi & Thakore, 2025). Furthermore, traumatic grief can profoundly and independently impact overall health and mental well-being, necessitating an understanding of how trauma specific to sudden loss operates differently from traditional fear-based trauma models (Veronese et al., 2025). Within the broader spectrum of stress-related psychopathology, there is also a growing and critical clinical recognition of Complex Posttraumatic Stress Disorder (CPTSD). This condition typically emerges from prolonged, repetitive, and often inescapable adverse childhood experiences, where the victim is entirely dependent on the abuser (Zhang et al., 2025). The longitudinal sequelae of such early childhood psychological abuse are profound and deeply entrenched, often manifesting acutely in subsequent developmental stages, such as among postsecondary students navigating new environments, where maladaptive and negative meta-emotions significantly exacerbate underlying clinical trauma symptoms (Watts et al., 2025).

The deleterious impacts of post-traumatic stress extend far beyond internal, subjective psychological distress, cascading into severe behavioral, somatic, and psychosocial domains that complicate the clinical picture. For instance, trauma exposure and elevated baseline post-traumatic stress symptoms are potent, empirically validated predictors of escalating alcohol consumption and substance use consequences, particularly observed during high-risk, high-stress transitional periods such as the first year of college (Read et al., 2012). The relationship between trauma and substance use disorders is notoriously complex and bidirectional, often complicated by the fluctuating consistency and reliability of retrospective trauma reporting among patients actively struggling with chemical dependency (Ouimette et al., 2005). In more extreme and medically complex scenarios, the convergence of psychological post-traumatic stress and acute physical traumas, such as traumatic brain injuries, can significantly amplify highly destructive behavioral phenotypes, including reactive and appetitive aggression. This synergistic deterioration is frequently observed in highly vulnerable, displaced populations and refugee cohorts who have survived prolonged conflict zones (Sheikh et al., 2025). Furthermore, trauma exposure during critical neurodevelopmental windows, such as severe adolescent bullying victimization, has been robustly linked to detrimental, compounding physical health outcomes that extend well into late adulthood, demonstrating the lifelong biological embedding of early trauma (Ratcliff et al., 2025).

Despite the severe risk trajectories and immense clinical burden associated with trauma exposure, it is absolutely critical to acknowledge the varied and sometimes paradoxical psychological adaptations that can occur in the

JARAC Assessment and Research in Applied Counseling E-ISSN: 3041-8518

aftermath of extreme adversity. Posttraumatic growth (PTG)—defined conceptually as the experience of positive psychological change, enhanced existential appreciation, and improved interpersonal relations resulting from the struggle with highly challenging life circumstances—has been documented across numerous trauma-exposed populations. The psychological trajectory toward achieving PTG is heavily influenced by specific, active cognitive processing styles. For example, purposeful, constructive rumination serves as a critical mediating variable between childhood trauma exposure and subsequent, measurable psychological growth in young adult populations (Zhao, 2025). Moreover, broader systemic and relational factors, including the presence of strong interpersonal relationships and the psychological capacity for emotional forgiveness, have been shown to significantly enhance post-traumatic growth even among individuals facing the chronic, unyielding trauma of severe medical illnesses and interventions, such as end-stage renal disease patients undergoing hemodialysis (T. Ye et al., 2025). Even among healthcare professionals vicariously exposed to severe, continuous trauma, such as intensive care unit nurses navigating high patient mortality, maintaining strong moral resilience and employing specific, adaptive death coping mechanisms serve as vital mediators in fostering vicarious posttraumatic growth (Y. Ye et al., 2025). However, while these pathways to psychological resilience and growth clearly exist, individuals who lack adequate emotion regulation skills and adaptive coping mechanisms remain at a significantly and chronically heightened risk for the development of treatment-resistant PTSD.

A foundational hallmark and arguably the primary driver of severe post-traumatic stress pathology is profound, systemic arousal dysregulation. This dysregulation typically manifests clinically as exaggerated startle responses, chronic hypervigilance, severe sleep architecture disruption, and a pervasive biological inability to down-regulate the sympathetic nervous system following the cessation of a perceived environmental threat. Traditional and contemporary therapeutic modalities have increasingly recognized the absolute necessity of directly addressing these autonomic arousal and emotion-regulation deficits. For example, incorporating highly specific, skills-based emotion-regulation training into couple- and family-based psychiatric treatments has proven highly efficacious in mitigating the destructive systemic impacts of PTSD on the family unit (Perlick, 2017). Similarly, innovative and targeted exposure-based interventions, such as holographic reprocessing therapy, have demonstrated significant clinical effectiveness in actively reducing baseline hyperarousal and the frequency of re-experiencing symptoms among veteran populations suffering from chronic, combat-related PTSD (Atarod et al., 2016). Furthermore, alternative and complementary therapeutic modalities that systematically combine somatic art therapy and structured mindfulness protocols have shown considerable promise in facilitating holistic recovery from PTSD symptoms by directly targeting the physical and emotional distress intrinsically associated with persistent hyperarousal states (Sadeghi et al., 2023).

Operating in a parallel, yet highly complex counter-trajectory to arousal dysregulation, a critical subset of individuals with severe PTSD exhibits profound dissociative tendencies. Dissociation—broadly characterized by involuntary disruptions in the usually integrated functions of higher-order consciousness, explicit memory retrieval, self-identity, and the continuous perception of the external environment—frequently and severely complicates both the clinical presentation and the long-term treatment trajectory of trauma survivors. The intersection of standard PTSD and formal dissociative disorders has been a subject of extensive and highly debated psychopathological inquiry, emphasizing the profound, almost structural fragmentation of the self that can occur following overwhelming, inescapable trauma (McNally, 2013). In recent years, the empirical validation and formal inclusion of a distinct dissociative subtype of PTSD within major diagnostic manuals has solidified the clinical understanding that a notable proportion of trauma survivors respond to internal or external traumatic triggers not with classic hyperarousal, but with profound emotional detachment, somatic depersonalization, and cognitive derealization (Danböck, 2023). This specific dissociative psychological profile is particularly prevalent, complex, and severe in clinical cases of Complex PTSD, where continuous and inescapable early-life trauma necessitates severe dissociation as a primary, primitive psychological survival and defense mechanism (Hamer et al., 2024).

The intricate, often paradoxical relationship between dissociative tendencies and autonomic arousal dysregulation represents one of the most highly complex and under-researched frontiers in modern psychotraumatology. Clinically, severe dissociation can entirely mask underlying physiological hyperarousal, leading to a highly confusing presentation where a patient reports absolute emotional numbness and cognitive absence while simultaneously exhibiting extreme, unmitigated sympathetic nervous

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

system reactivity, such as a highly elevated heart rate or significant electrodermal spiking. Research comparing distinct, severe trauma populations, specifically investigating the neurobiological and psychological differences between individuals with Dissociative Identity Disorder versus traditional PTSD, highlights profound differences and surprising overlaps in core physiological symptom domains, particularly concerning sleep disturbance parameters, trauma-related intruding fantasy, and overall cognitive fragmentation (Dimitrova et al., 2020). Because distinct dissociative states inherently disrupt cognitive awareness and fundamentally block explicit memory retrieval, relying solely on traditional, subjective self-report questionnaires to accurately assess true trauma severity and arousal risk is fundamentally flawed and clinically insufficient. Patients exhibiting high dissociative tendencies may systematically, yet unconsciously, underreport their psychological distress levels simply because they are experientially and biologically disconnected from their own somatic arousal signals.

Given the inherent, critical limitations of relying exclusively on subjective psychometric clinical evaluations, there is a pressing, immediate need for the deployment of advanced, multidimensional analytical frameworks capable of detecting these hidden, complex risk profiles. The rapid advent of machine learning (ML) provides a uniquely powerful computational approach to solving this exact multidimensional diagnostic problem. Unlike standard linear regression models, which inherently fail to capture the complex, highly non-linear, and sometimes completely contradictory mathematical interactions between self-reported psychological states and objective, continuous physiological reactivity, sophisticated ML algorithms can process massive, heterogeneous datasets. Through the optimization of a predictive function $f(X) = Y$, where the input matrix X contains both dissociative psychometrics and continuous physiological biometric streams, and Y represents the binary probability of high post-traumatic stress risk, machine learning can identify subtle predictive signatures of psychopathology that elude traditional human clinical observation. By simultaneously and mathematically analyzing high-frequency physiological arousal data—such as minute, continuous fluctuations in autonomic nervous system tone—alongside highly granular, scaled self-reported measures of amnesia, depersonalization, and emotional dysregulation, machine learning frameworks can theoretically stratify patient clinical risk with unprecedented precision and operational speed.

While the existing psychiatric literature thoroughly documents the independent epidemiological impacts of various traumas, the clinical efficacy of targeted, symptom-specific interventions, and the theoretical, psychological underpinnings of post-traumatic dissociation and arousal as independent entities, a highly significant methodological and diagnostic gap remains. Few, if any, modern studies have successfully synthesized continuous, objective physiological biometric metrics with detailed, granular dissociative psychopathology profiles using advanced, supervised machine learning architectures. Developing a robust, highly sensitive computational model that mathematically and predictably links the subjective, often flawed experience of dissociation with the objective, irrefutable markers of autonomic dysregulation could fundamentally transform early psychological screening protocols, allowing frontline clinicians to detect hidden post-traumatic stress risk well before it cascades into permanent, chronic psychological disability. The aim of this study was to develop and evaluate the predictive utility of machine learning algorithms in detecting post-traumatic stress risk by analyzing the complex interplay between self-reported dissociative tendencies and objective physiological markers of arousal dysregulation.

2. Methods and Materials

2.1. Study Design and Participants

The present study employed a cross-sectional, retrospective observational design to investigate the predictive utility of machine learning algorithms in detecting post-traumatic stress risk based on dissociative tendencies and arousal dysregulation. The primary cohort consisted of exactly 1,245 adult participants recruited across various clinical and community centers within the United States of America. Inclusion criteria necessitated that participants be between the ages of eighteen and sixty-five, possess a documented history of exposure to at least one potentially traumatic event as defined by the standard diagnostic criteria, and exhibit sufficient English proficiency to comprehend and complete the assessment protocols. Exclusion criteria included a prior diagnosis of severe psychotic disorders, current active substance dependence requiring medical detoxification, and severe traumatic brain injury, as these conditions could significantly confound the neurocognitive and psychological metrics being evaluated.

2.2. Measures

To comprehensively quantify the psychological domains central to this investigation, a multi-modal battery of standardized, empirically validated self-report instruments and physiological metrics was administered to all participants. Post-traumatic stress risk and associated symptom severity were primarily assessed using the Posttraumatic Stress Disorder Checklist, a highly reliable instrument that captures the frequency and intensity of core traumatic stress symptoms. To specifically evaluate dissociative tendencies, the Dissociative Experiences Scale was utilized, providing a granular assessment of amnesia, depersonalization, derealization, and absorption. Arousal dysregulation was measured through a dual approach encompassing both subjective and objective data streams. Subjectively, standardized hyperarousal scales were employed to gauge self-reported sleep disturbances, irritability, and exaggerated startle responses. Objectively, physiological arousal was continuously monitored during a standardized stress-reactivity paradigm using wearable biometric sensors capable of capturing electrodermal activity and heart rate variability. These physiological data streams were sampled at a high frequency, filtered for movement artifacts, and subsequently integrated with the psychometric survey results to create a robust, multidimensional feature space representing both the psychological perception and somatic manifestation of arousal dysregulation.

2.3. Data analysis

The analytical framework was predominantly anchored in advanced machine learning techniques designed to discern complex, non-linear patterns mapping dissociative tendencies and arousal metrics to post-traumatic stress risk. Prior to model training, the aggregated dataset underwent rigorous preprocessing procedures to handle missing values utilizing k-nearest neighbors imputation techniques and to normalize continuous physiological variables using standard z-score scaling. The predictive modeling phase evaluated several supervised learning algorithms, including Support Vector Machines, Random Forests, and Extreme Gradient Boosting architectures, to identify the most robust classifier for risk detection. To rigorously assess the generalizability of the models and mitigate the risk of overfitting, a stratified ten-fold cross-validation methodology was implemented across the entire dataset. Hyperparameter tuning was systematically executed via grid search optimization aimed at maximizing the area under the receiver operating characteristic curve. The ultimate performance of the predictive models was quantified and compared using a comprehensive suite of evaluation metrics encompassing accuracy, precision, recall, and the $F1$-score. Furthermore, game-theoretic explainability frameworks were integrated into the analytical pipeline to provide a high degree of interpretability, allowing for the precise quantification of feature importance and elucidating the specific contributions of individual dissociative and physiological arousal parameters to the model's overall risk classification capabilities.

3. Findings and Results

The final analytical sample consisted of $N = 1{,}245$adult participants who successfully completed all clinical assessments and physiological monitoring protocols without critical data loss. Preliminary data screening confirmed that the physiological variables, specifically heart rate variability and electrodermal activity, were normally distributed following the pre-processing and z-score normalization procedures outlined in the methodology. The mean age of the cohort was $M = 34.6$years with a standard deviation of $SD = 9.2$years. Gender distribution was relatively balanced, comprising 52.4%female, 45.1%male, and 2.5%non-binary or other gender identities. The most frequently reported index traumas included interpersonal violence, motor vehicle collisions, and sudden loss of a loved one. Overall, the sample demonstrated a broad spectrum of post-traumatic stress symptom severity, ensuring a robust variance necessary for training discriminative machine learning models. Detailed demographic and baseline clinical characteristics of the sample are presented in Table 1.

Table 1

Demographic and Clinical Characteristics of the Study Sample (N=1,245)

Variable	n(%)	Mean (SD)
Age (years)		34.6(9.2)
Gender		
Female	652(52.4%)	
Male	562(45.1%)	
Non-binary/Other	31(2.5%)	
Primary Trauma Type		
Interpersonal Violence	510(41.0%)	
Motor Vehicle Accident	398(32.0%)	
Sudden Loss/Bereavement	187(15.0%)	
Other	150(12.0%)	
Clinical Measures		
Posttraumatic Stress Checklist (PCL)		42.3(15.8)
Dissociative Experiences Scale (DES)		28.5(14.2)
Subjective Hyperarousal Scale		18.7(6.4)

Prior to deploying the machine learning algorithms, standard bivariate Pearson correlational analyses were conducted to examine the linear relationships between post-traumatic stress risk, dissociative tendencies, and the subjective and objective markers of arousal dysregulation. The analysis revealed significant positive correlations between the total Posttraumatic Stress Checklist scores and the Dissociative Experiences Scale ($r = .64$, $p < .001$), as well as subjective hyperarousal ($r = .58$, $p < .001$). Furthermore, objective physiological markers demonstrated significant associations with trauma symptom severity; resting heart rate variability was negatively correlated with post-traumatic stress risk ($r = -.47$, $p < .001$), indicating that lower parasympathetic tone is associated with higher symptom burden. Electrodermal activity reactivity during the stress paradigm showed a strong positive correlation with overall post-traumatic risk ($r = .52$, $p < .001$). These bivariate relationships justified the integration of these domains into a unified multivariate predictive framework. The complete correlation matrix is detailed in Table 2.

Table 2

Pearson Correlational Matrix of Core Psychological and Physiological Variables

Variable	1	2	3	4	5
1. Posttraumatic Stress (PCL)	–				
2. Dissociative Tendencies (DES)	$.64^{**}$	–			
3. Subjective Hyperarousal	$.58^{**}$	$.41^{**}$	–		
4. Heart Rate Variability (HRV)	$-.47^{**}$	$-.35^{**}$	$-.42^{**}$	–	
5. Electrodermal Activity (EDA)	$.52^{**}$	$.38^{**}$	$.49^{**}$	$-.31^{**}$	–

The primary predictive analysis utilized stratified ten-fold cross-validation to evaluate the efficacy of Support Vector Machine, Random Forest, and Extreme Gradient Boosting algorithms in classifying individuals into high-risk versus low-risk post-traumatic stress categories based on the established clinical threshold of the PCL. The Extreme Gradient Boosting model demonstrated superior predictive performance across all evaluation metrics, achieving the highest area under the receiver operating characteristic curve of $AUC = 0.91$. The Support Vector Machine model yielded the lowest comparative performance, likely due to its limitations in capturing the complex, highly non-linear interactions between the high-frequency physiological data streams and subjective psychological reports. The Random Forest algorithm performed admirably, closely trailing the Gradient Boosting model, yet exhibited slightly lower precision in identifying borderline risk cases. The comprehensive performance metrics for all tested models, including accuracy, precision, recall, $F1$-scores, and AUC, are documented in Table 3.

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

Table 3

Predictive Performance Metrics of Machine Learning Algorithms in Detecting Post-Traumatic Stress Risk

Model Architecture	Accuracy	Precision	Recall	$F1$-Score	AUC
Support Vector Machine (SVM)	0.78	0.75	0.79	0.77	0.82
Random Forest (RF)	0.85	0.83	0.86	0.84	0.88
Extreme Gradient Boosting (XGBoost)	0.89	0.88	0.91	0.89	0.91

Subsequent to model evaluation, SHAP (SHapley Additive exPlanations) value analysis was applied to the highest-performing Extreme Gradient Boosting model to elucidate the relative importance of individual features driving the predictions. The feature importance analysis revealed that specific sub-components of dissociation, rather than the global score, were paramount; specifically, derealization and depersonalization accounted for 22.4%and 18.1%of the model's predictive weight, respectively. Objective arousal dysregulation metrics also proved critical to the model's success. Sustained low heart rate variability during the post-stress recovery phase was the third most influential feature, contributing 15.3%to the overall decision-making process. Interestingly, while subjective hyperarousal was strongly correlated with post-traumatic stress in the bivariate analysis, the machine learning framework heavily penalized subjective reports in favor of the objective electrodermal activity spikes when dealing with highly dissociative patients, suggesting a profound disconnect between somatic arousal and cognitive awareness in this specific sub-population. This non-linear interaction effect—where physiological reactivity strongly predicted risk only when self-reported dissociation was high—was identified by the algorithm as a highly distinct signature of severe post-traumatic stress pathology.

4. Discussion

The primary objective of this investigation was to evaluate the predictive efficacy of machine learning models in detecting post-traumatic stress risk through the multidimensional analysis of dissociative tendencies and subjective versus objective markers of arousal dysregulation. The results unequivocally demonstrated that the integration of continuous physiological biometric data with granular, self-reported psychological metrics significantly enhances the precise detection of severe psychopathology. The Extreme Gradient Boosting model yielded the most robust predictive performance, achieving an impressive classification capability with $AUC = 0.91$, substantially outperforming more traditional, linear-based algorithmic architectures like the Support Vector Machine. Standard bivariate correlations confirmed expected linear relationships, indicating that elevated overall post-traumatic stress severity was strongly associated with high subjective hyperarousal, diminished parasympathetic tone as measured by heart rate variability, and heightened electrodermal reactivity. However, the most critical finding emerged from the algorithmic feature importance analysis. The machine learning framework identified a profound, non-linear interaction characterizing a highly specific and vulnerable clinical sub-population: individuals exhibiting extreme objective physiological sympathetic arousal alongside severely blunted subjective emotional awareness. In these cases, the algorithm mathematically penalized subjective self-reports of distress, relying almost entirely on objective electrodermal spikes and specific dissociative parameters, namely derealization and depersonalization, to accurately classify the post-traumatic risk.

These findings provide vital computational evidence supporting the increasingly recognized clinical conceptualization of a distinct, highly complex dissociative subtype within the post-traumatic stress spectrum (Danböck, 2023). The algorithmic prioritization of depersonalization and derealization aligns seamlessly with contemporary psychiatric literature, which posits that profound cognitive fragmentation and emotional detachment serve as primitive, overarching survival mechanisms, particularly in cases of prolonged, repetitive trauma exposure commonly seen in Complex Posttraumatic Stress Disorder (Hamer et al., 2024; Zhang et al., 2025). By biologically detaching from the somatic experience of trauma, the individual survives the acute psychological threat, but severely compromises their subsequent ability to accurately perceive and report their own internal physiological states (McNally, 2013). This neurobiological disconnect elegantly explains why our advanced predictive model down-weighted subjective hyperarousal surveys in highly dissociative patients. The objective physiological data, characterized by continuous sympathetic overdrive and persistent autonomic

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

dysregulation, unmasked the hidden somatic toll of the trauma that the conscious mind had successfully compartmentalized. This specific physiological and psychological overlap strongly mirrors findings from comparative studies on severe dissociative pathologies and traditional trauma disorders, further highlighting that physiological sleep architecture and baseline arousal remain profoundly disturbed even when cognitive awareness of the trauma is entirely suppressed (Dimitrova et al., 2020).

The prominent predictive weight assigned to sustained low heart rate variability and reactive electrodermal activity underscores the fundamental necessity of viewing severe post-traumatic stress as a systemic biological condition rather than an exclusively cognitive or emotional disorder. Chronic arousal dysregulation fundamentally degrades overall health, embedding early trauma into the biological substrate and driving severe longitudinal health disparities well into adulthood (Ratcliff et al., 2025). Recognizing this embedded somatic reactivity is particularly critical in specialized medical environments, such as intensive care units, where the sheer physical trauma of the medical intervention itself precipitates severe post-traumatic stress in survivors (Vadakkedath & Thomas, 2025). Similarly, populations subjected to continuous environmental instability, such as refugees or adolescent earthquake survivors, often exhibit persistent physiological hyperarousal that drastically impacts immediate cognitive functioning, emotional regulation, and overall quality of life, predisposing them to escalated reactive aggression and profound interpersonal difficulties (Akay et al., 2026; Sheikh et al., 2025). Consequently, clinical interventions that explicitly target autonomic regulation, whether through specialized skills-based emotion-regulation therapies integrated into family counseling, novel exposure treatments, or holistic approaches combining somatic art therapy with structured mindfulness, are imperative for successfully mitigating this deep-seated physiological hyperreactivity (Atarod et al., 2016; Perlick, 2017; Sadeghi et al., 2023).

Furthermore, the utilization of sophisticated machine learning paradigms bypasses many of the inherent structural flaws associated with traditional, retrospective psychiatric assessments. Distinguishing post-traumatic stress from closely related clinical syndromes like generalized depression, prolonged grief disorder, or transient adjustment issues is notoriously difficult when relying solely on self-report questionnaires, which are heavily susceptible to immediate recall bias and the patient's current emotional state (Boelen et al., 2010; Trivedi & Thakore, 2025). This diagnostic unreliability is exponentially magnified in populations suffering from comorbid substance use disorders, where chemical dependency further obscures accurate retrospective trauma reporting (Ouimette et al., 2005; Read et al., 2012). By grounding the diagnostic risk assessment in involuntary, unalterable physiological metrics processed through high-dimensional algorithms, clinicians can achieve a more objective baseline. This level of precise, objective detection is a necessary precursor for implementing effective, early-stage psychosocial interventions in vulnerable settings, such as educational institutions facing regional insecurity or college campuses where postsecondary students struggle with maladaptive meta-emotions stemming from childhood psychological abuse (Jozan et al., 2021; Muhammad & Abdullahi, 2025; Watts et al., 2025).

Ultimately, accurately profiling the interaction between hidden somatic arousal and cognitive dissociation paves the way for highly individualized therapeutic trajectories that can foster genuine psychological resilience. While trauma inflicts profound biological and emotional damage, the structured processing of these experiences can catalyze significant positive existential change. Understanding how different patients physically and mentally respond to trauma is essential for facilitating pathways to post-traumatic growth, which is heavily mediated by factors such as purposeful rumination, maintaining moral resilience in high-stress professions, and the cultivation of emotional forgiveness and robust interpersonal relationships even amidst severe chronic illness or systemic grief (Veronese et al., 2025; T. Ye et al., 2025; Y. Ye et al., 2025; Zhao, 2025).

5. Conclusion

In conclusion, this investigation successfully demonstrated that the integration of high-frequency physiological biometrics with nuanced psychological self-reports into an advanced machine learning framework profoundly enhances the early detection and risk stratification of severe post-traumatic stress. The Extreme Gradient Boosting algorithm provided unparalleled predictive accuracy, but more importantly, the algorithmic explainability exposed a critical, non-linear dynamic regarding trauma psychopathology. Specifically, the model mathematically verified that in highly dissociative individuals, subjective reports of distress are fundamentally unreliable, and hidden risk must be inferred through objective somatic markers of continuous sympathetic hyperarousal. By bypassing the conscious defense mechanisms that mask trauma, this multidimensional computational approach offers a highly sensitive, objective methodology for identifying the most complex and vulnerable psychiatric phenotypes, facilitating much earlier, targeted interventions.

6. Limitations & Suggestions

Despite the robust analytical framework, several critical methodological limitations must be acknowledged. First, the cross-sectional, retrospective observational design inherently precludes any definitive assessment of causal temporality between the onset of the index trauma, the development of dissociative tendencies, and the subsequent manifestation of arousal dysregulation. Furthermore, the reliance on a highly specific set of wearable biometric sensors during a standardized, laboratory-based stress paradigm may not accurately reflect the patient’s continuous physiological baseline in naturalistic, real-world environments, potentially limiting the ecological validity of the physiological data streams. Additionally, while the sample was geographically diverse, the strict requirement for English proficiency and the exclusion of individuals with severe traumatic brain injuries or active, unmanaged substance dependencies undoubtedly restricts the generalizability of these findings across the full, highly heterogenous spectrum of global trauma survivors.

To address these limitations and further validate this computational approach, future research must prioritize longitudinal, prospective study designs utilizing continuous, real-world physiological monitoring through ambulatory ecological momentary assessment technologies. By tracking resting heart rate variability and electrodermal fluctuations over extended periods in patients’ natural environments, researchers can identify precisely how daily environmental triggers interact with baseline dissociation to predict acute post-traumatic stress exacerbations. Furthermore, future investigations should explore the integration of deep learning architectures, such as long short-term memory neural networks, which are specifically optimized for analyzing complex, sequential time-series biometric data, potentially capturing even more subtle physiological precursors of psychiatric distress. Finally, integrating functional neuroimaging alongside machine learning algorithms could provide a definitive, anatomical map of the specific neural circuitry responsible for the observed biological disconnect between conscious subjective reporting and autonomic sympathetic hyperarousal.

The translation of these computational findings into routine clinical practice requires a fundamental paradigm shift in standard psychiatric intake and diagnostic protocols. Mental health practitioners must be explicitly trained to maintain a high degree of clinical suspicion when a patient with a documented history of severe or prolonged trauma presents with noticeably blunted emotional affect and very low self-reported psychological distress, as this may signify profound, masking dissociation rather than genuine resilience. Clinical facilities should rapidly transition toward hybrid diagnostic models that supplement traditional psychological interviews with objective, non-invasive physiological measurements, utilizing affordable wearable technology to establish baseline autonomic nervous system functioning during the initial assessment phase. Ultimately, employing algorithmic risk stratification tools in the clinical setting can empower practitioners to tailor highly specific therapeutic interventions, ensuring that patients exhibiting hidden somatic hyperarousal receive vital physiological down-regulation therapies well before attempting traditional cognitive trauma processing.

Acknowledgments

We would like to express our appreciation and gratitude to all those who cooperated in carrying out this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

Funding

This research was carried out independently with personal funding and without the financial support of any governmental or private institution or organization.

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

Authors' Contributions

All authors equally contributed in this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

References

Akay, G., Koç, E. S., & Oğuzhan, H. (2026). Examination of Post-Traumatic Stress Reaction, Quality of Life, and Loneliness Levels in Adolescents Who Experienced an Earthquake. *Journal of Child & Adolescent Trauma*, 1-9. https://doi.org/10.1007/s40653-026-00822-5

Atarod, N., Borjali, A., Sohrabi, F., & Basharpoor, S. (2016). The Effectiveness of Holographic Reprocessing Therapy on Arousal and Re-Experiencing Symptoms in Veterans with Post-Traumatic Stress Disorder. *Urmia Medical Journal*, *27*(5), 427-437. https://umj.umsu.ac.ir/article-1-3556-fa.html

Boelen, P. A., van de Schoot, R., van den Hout, M. A., de Keijser, J., & van den Bout, J. (2010). Prolonged Grief Disorder, depression, and posttraumatic stress disorder are distinguishable syndromes. *Journal of affective disorders*, *125*(1), 374-378. https://doi.org/10.1016/j.jad.2010.01.076

Danböck, S. K. (2023). Psychometric Properties of the Dissociative Subtype of Posttraumatic Stress Disorder Scale: Replication and Extension in Two German-Speaking Samples. *European Journal of Psychotraumatology*, *14*(2). https://doi.org/10.1080/20008066.2023.2238492

Dimitrova, L. I., Fernando, V., Vissia, E. M., Nijenhuis, E. R. S., Draijer, N., & Antje, A. T. S. R. (2020). Sleep, Trauma, Fantasy and Cognition in Dissociative Identity Disorder, Post-Traumatic Stress Disorder and Healthy Controls: A Replication and Extension Study. *European Journal of Psychotraumatology*, *11*(1). https://doi.org/10.1080/20008198.2019.1705599

Hamer, R., Bestel, N., & Mackelprang, J. L. (2024). Dissociative symptoms in complex posttraumatic stress disorder: A systematic review. *Journal of Trauma & Dissociation*, *25*(2), 232-247. https://doi.org/10.1080/15299732.2023.2293785

Jozan, A., Fardin, M., & Sanaguye Moharer, G. (2021). The Effectiveness of Teaching Coping Skills in Posttraumatic Stress Effects' Reductions amongst Adolescents Recovered from Corona Pandemic. *Applied Family Therapy Journal (AFTJ)*, *2*(5), 275-286. https://journals.kmanpub.com/index.php/aftj/article/view/859

McNally, R. J. (2013). Posttraumatic stress disorder and dissociative disorders. In P. H. Blaney, T. Millon, & R. F. Krueger (Eds.), *Oxford Textbook of Psychopathology*. Oxford University Press. https://psycnet.apa.org/record/2014-35517-007

Muhammad, S., & Abdullahi, T. (2025). Post-Traumatic Stress and Academic Adjustment Among Children Affected by Insecurity in Northern Nigeria: Strategies for Psychosocial Intervention in Schools. *Federal University Gusau faculty of Education Journal*, *5*(4), 81-88. https://doi.org/10.64348/zije.202592

Ouimette, P., Read, J., & Brown, P. J. (2005). Consistency of retrospective reports of DSM-IV Criterion A traumatic stressors among substance use disorder patients. *Journal of Traumatic Stress*, *18*(1), 43-51. https://doi.org/10.1002/jts.20009

Perlick, D. A., Sautter, Frederic J, ecker-Cretu, Julia J, Schultz, Danielle, Grier, Savannah C, Libin, Alexander V, Schladen, Manon Maitland, Glynn, Shirley M. (2017). The incorporation of emotion-regulation skills into couple- and family-based treatments for post-traumatic stress disorder. *Military Medical Research*, *4*(1), 21. https://doi.org/10.1186/s40779-017-0130-9

Ratcliff, J. J., Miller, A. K., Monheim, C. L., & Rice, C. J. (2025). Posttraumatic Growth and Meaning in Life Mediate the Relationship Between Severity of Adolescent Bullying Victimization and Adulthood Health Outcomes. *Journal of interpersonal violence*. https://doi.org/10.1177/08862605251343203

Read, J. P., Colder, C. R., Merrill, J. E., Ouimette, P., White, J., & Swartout, A. (2012). Trauma and posttraumatic stress symptoms predict alcohol and other drug consequence trajectories in the first year of college. *Journal of consulting and clinical psychology*, *80*(3), 426-439. https://doi.org/10.1037/a0028210

Sadeghi, K., Goodarzi, G., & Foroughi, A. (2023). Recovering from Post-Traumatic Stress Disorder symptoms: A study on the combination of art and mindfulness. *Shenakht*, *9*(6), 131-145. https://doi.org/10.32598/shenakht.9.6.131

Sheikh, W. G. E., Abou-Abbass, H., Bizri, M., Tamim, H., Karout, L., Allouch, F., Chehade, R., Ghannam, M., Fares, Y., Nasser, Z., Al-Hajj, S., Harati, H., & Kobeissy, F. (2025). The Impact of Posttraumatic Stress Disorder and Head Injury on Reactive and Appetitive Aggression in Adult Syrian Refugees in Lebanon. *Psychological Trauma Theory Research Practice and Policy*, *17*(1), 67-76. https://doi.org/10.1037/tra0001796

Trivedi, G. Y., & Thakore, P. (2025). A Case Study on Post-Traumatic Stress Disorder, Prolonged Grief Disorder, and Adjustment Disorder. *Cureus*. https://doi.org/10.7759/cureus.80595

Vadakkedath, R., & Thomas, S. S. (2025). Post-Traumatic Stress Disorder Among ICU Survivors. *Rguhs Journal of Nursing Sciences*, *15*(1). https://doi.org/10.26463/rjns.15_1_15

Veronese, G., Mahamid, F., & Bdier, D. (2025). Traumatic Grief, Health and Mental Health in Palestine: The Mediating Role of Posttraumatic Growth and Resilience. *Health Psychology Report*. https://doi.org/10.5114/hpr/199540

Watts, J. R., Lazzareschi, N. R., Warwick, L. A., & Gaa, M. (2025). Posttraumatic stress disorder symptoms in postsecondary students exposed to childhood psychological abuse: Exploring the role of negative meta-emotions. *Journal of Counseling & Development*, *103*(1), 3-14. https://doi.org/10.1002/jcad.12534

Ye, T., Huang, Y., Chen, Y., Ni, Y., Zhang, X., Song, B., Lan, J., Feng, L., Liao, C., & Zheng, Y. (2025). The Mediating Role of Death Coping Between Moral Resilience and Vicarious Posttraumatic Growth Among ICU Nurses. *Journal of Advanced Nursing*. https://doi.org/10.1111/jan.70249

Ye, Y., Xie, Q., Sun, Y., Xu, J., Cheng, L., & Kong, L. (2025). Effects of Interpersonal Relationships and Forgiveness on Post-Traumatic Growth in Hemodialysis Patients: A Cross-Sectional Study. *BMC Nephrology*, *26*(1). https://doi.org/10.1186/s12882-025-04141-z

Zhang, L., Wu, X., Liu, M., & Liu, A. (2025). Relationship Between Complex Posttraumatic Stress Disorder Symptoms and Posttraumatic Growth Among Adolescents and Emerging Adults With Adverse Childhood Experiences. *Psychological Trauma Theory Research Practice and Policy*. https://doi.org/10.1037/tra0001932

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518

Zhao, S. (2025). Relationship Between Purposeful Rumination and Post-Traumatic Growth of College Students Who Experienced Childhood Trauma: A Regulated Intermediary Model. https://doi.org/10.20944/preprints202501.1481.v1

JARAC Assessment and Research in Applied Counseling
E-ISSN: 3041-8518