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Effectiveness of Short-Term Dynamic Psychotherapy on Distress Tolerance, Emotion Regulation, and Compulsive Avoidant Behaviors in Patients with Generalized Anxiety Disorder

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ABSTRACT

Objective: This study aimed to evaluate the effectiveness of Short-Term Dynamic Psychotherapy (STDP) on distress tolerance, emotion regulation, and compulsive avoidant behaviors in adults with generalized anxiety disorder.

Methods and Materials: A randomized controlled trial with a pretest–posttest and follow-up design was conducted. Sixty adults meeting DSM-5 criteria for generalized anxiety disorder were randomly assigned to an STDP group (n = 30) or a wait-list control group (n = 30). The intervention group received 16 weekly individual STDP sessions, each lasting 60 minutes, while the control group received treatment as usual without structured psychotherapy. Outcomes were assessed at baseline, post-treatment, and eight-week follow-up using the Distress Tolerance Scale, Difficulties in Emotion Regulation Scale, Cognitive Behavioral Avoidance Scale, and Generalized Anxiety Disorder-7. Data were analyzed using mixed-effects repeated-measures models.

Findings: Significant group × time interactions were found for distress tolerance, $F(2, 110) = 24.56$, $p < .001$, $\eta p^2 = .31$; emotion regulation difficulties, $F(2, 110) = 19.84$, $p < .001$, $\eta p^2 = .27$; and compulsive avoidant behaviors, $F(2, 110) = 15.61$, $p < .001$, $\eta p^2 = .22$. At post-treatment, the STDP group showed significantly higher distress tolerance than controls, $t(58) = 6.01$, $p < .001$, $d = 1.55$, lower emotion regulation difficulties, $t(58) = 4.52$, $p < .001$, $d = 1.16$, and lower compulsive avoidance, $t(58) = 4.03$, $p < .001$, $d = 1.04$. Effects remained significant at follow-up.

Conclusion: STDP significantly improved distress tolerance and emotion regulation and reduced compulsive avoidant behaviors in adults with generalized anxiety disorder. The findings support STDP as a time-limited intervention targeting affective and avoidant mechanisms in GAD.

Keywords: Short-Term Dynamic Psychotherapy, Distress Tolerance, Emotion Regulation, Compulsive Avoidant Behaviors, Generalized Anxiety Disorder.

Introduction

Generalized anxiety disorder (GAD) is a highly prevalent and chronic psychiatric condition characterized by excessive, uncontrollable worry and persistent somatic tension that significantly impairs social, occupational, and interpersonal functioning (American Psychiatric Association, 2013). Epidemiological data indicate that GAD frequently co-occurs with other anxiety and mood disorders and is associated with elevated health care utilization, reduced quality of life, and increased suicide risk (Kessler, 2012). Contemporary transdiagnostic models conceptualize GAD as a "distress disorder," in which maladaptive responses to sustained negative affect, rather than discrete fear cues, play a central role. Within these models, emotion-related vulnerabilities such as heightened emotional intensity, negative appraisal of emotions, and difficulties recovering from affective states are increasingly recognized as core maintaining mechanisms (Mennin et al., 2009; Roemer et al., 2009).

A substantial body of research has demonstrated that individuals with GAD show broad and pervasive deficits in emotion regulation. Salters-Pedneault et al. (2006) found that chronic worriers and individuals meeting analogue criteria for GAD report general emotion dysregulation, including poor emotional awareness, non-acceptance of emotional responses, and limited access to adaptive regulation strategies. Similarly, Mennin et al. (2009) reported that people with GAD experience emotions as more intense, aversive, and difficult to understand and modulate compared with both healthy controls and individuals with social anxiety disorder. Roemer et al. (2009) further showed that difficulties in emotion regulation and deficits in mindfulness each contribute uniquely to GAD symptom severity. More recently, Larochelle et al. (2025) demonstrated that both intolerance of uncertainty and emotion dysregulation make independent contributions to worry and GAD severity in a clinical sample, even after controlling for depressive symptoms. Collectively, these findings underscore emotion dysregulation as a central vulnerability in GAD.

Within this broader emotion-regulation framework, distress tolerance has emerged as a key construct. Distress tolerance is typically defined as the perceived or actual capacity to withstand negative emotional states and aversive internal experiences without resorting to impulsive or avoidant attempts to escape them (Simons & Gaher, 2005). Low distress tolerance has been associated with heightened anxiety sensitivity, intolerance of uncertainty, and greater severity of anxiety and depressive symptoms across diagnostic categories (Allan et al., 2014; Laposa et al., 2015). In the context of GAD, Laposa et al. (2015) showed that lower distress tolerance predicts GAD symptom severity even when controlling for overlapping constructs such as anxiety sensitivity and intolerance of uncertainty. Longitudinal work also suggests that deficits in distress tolerance may moderate the impact of stress and other risk factors on the development and persistence of internalizing problems (Robinson et al., 2021).

Recent studies underscore the mechanistic significance of distress tolerance for anxiety disorders. In a large community sample, Mohsenabadi et al., (2025) demonstrated that distress tolerance and emotion regulation jointly mediated the relationship between anxiety sensitivity and health anxiety, supporting the view that these constructs function as transdiagnostic risk and maintenance factors for anxiety. Similarly, Mattar et al. (2025) reported that distress tolerance partially mediates the association between childhood maltreatment and adult anxiety in a Lebanese sample, suggesting that the capacity to endure emotional pain shapes how early adversity translates into later anxiety pathology. These findings imply that interventions which directly enhance distress tolerance may produce broad benefits across anxiety presentations, including GAD.

Compulsive avoidant behaviors represent a second, closely related transdiagnostic process in GAD. Experiential avoidance—defined as an unwillingness to experience aversive internal states and a tendency to engage in cognitive, emotional, or behavioral strategies to escape them—has been strongly linked to anxiety disorders (Hayes et al., 1996). Newman & Llera (2011) contrast-avoidance model proposes that individuals with GAD use chronic worry to avoid sharp shifts from neutral or positive affect into negative emotion, thereby maintaining a steady state of distress that paradoxically feels safer than potential emotional "crashes." This process is often accompanied by safety behaviors, reassurance seeking, checking, and ritualized patterns of avoidance that can resemble compulsive behavior, particularly when worry is tightly coupled with

repetitive mental acts or rigid behavioral routines (Laposa et al., 2015). Empirically, experiential avoidance and behavioral inhibition are associated with more severe anxiety, greater functional impairment, and poorer treatment response (Mennin et al., 2009; Roemer et al., 2009). Distress intolerance and experiential avoidance also show robust associations with obsessive–compulsive symptoms and compulsive rituals, suggesting a shared mechanism in which low capacity to endure internal distress promotes rigid, repetitive efforts to neutralize or escape anxiety (Laposa et al., 2015; Robinson et al., 2021).

Although cognitive-behavioral therapy (CBT), including worry exposure and cognitive restructuring, is the current first-line treatment for GAD, remission rates are modest and a substantial proportion of patients remain symptomatic or relapse after treatment. Meta-analytic data suggest that a sizable minority of patients either do not respond or retain clinically significant worry and disability despite adequate CBT (Cuijpers et al., 2014). One explanation is that standard CBT protocols may not fully address entrenched patterns of emotional avoidance, intolerance of distress, and implicit relational schemas that sustain chronic anxiety. This has fueled growing interest in integrative and process-based approaches that specifically target emotional experience, defensive maneuvers, and underlying conflicts that drive maladaptive regulation strategies (Thoma & Abbass, 2022).

Short-Term Dynamic Psychotherapy (STDP), and its intensive variant Intensive Short-Term Dynamic Psychotherapy (ISTDP), constitute contemporary experiential psychodynamic models explicitly designed to dismantle avoidance and increase capacity for affect tolerance. Rooted in Davanloo's work, STDP aims to rapidly identify and challenge defensive processes, mobilize complex feelings toward attachment figures, and help patients experience—rather than avoid—warded-off emotions within a secure therapeutic relationship (Abbass et al., 2012). Through a structured focus on moment-to-moment emotional experience, therapist-guided pressure to face avoided feelings, and careful regulation of anxiety, STDP seeks to expand patients' ability to tolerate distress while replacing rigid, compulsive avoidance patterns with more flexible, adaptive regulation strategies (Thoma & Abbass, 2022).

A growing empirical literature supports the efficacy of STDP and ISTDP for a range of psychiatric conditions, including mood, anxiety, personality, and functional somatic disorders. In a systematic review and meta-analysis, Abbass et al. (2012) reported large pre–post effects and superior outcomes compared with minimal treatment or treatment as usual, with gains generally maintained at follow-up. Subsequent randomized controlled trials and effectiveness studies have shown that ISTDP can reduce symptom severity, health care utilization, and long-term costs in complex and treatment-resistant populations (Abbass et al., 2012; Town et al., 2017). Process-oriented accounts emphasize that ISTDP's core change procedures include promoting acceptance and expression of emotion, exposure to previously avoided affects, and systematic restructuring of defensive avoidance—processes that map closely onto distress tolerance and emotion-regulation constructs (Thoma & Abbass, 2022).

Evidence specifically addressing GAD is emerging but still limited. In a pilot effectiveness and process–outcome study, Lilliengren et al. (2017) found that ISTDP for GAD produced large reductions in worry, anxiety, and functional impairment, with gains maintained at follow-up. Importantly, improvements in patients' ability to experience and regulate previously avoided emotions were associated with better outcomes, suggesting that modification of emotion regulation and avoidance processes may be central mechanisms of change (Lilliengren et al., 2017). However, most existing ISTDP studies have focused on global symptom measures and overall functioning; few have directly operationalized distress tolerance, specific emotion-regulation difficulties, or compulsive avoidant behaviors as primary treatment targets or outcome variables in GAD samples.

Concurrently, transdiagnostic research continues to highlight the centrality of distress tolerance and emotion regulation for understanding and treating GAD. Larochelle et al. (2025) showed that intolerance of uncertainty and emotion dysregulation exert distinct, additive contributions to worry and GAD severity, reinforcing the notion that multiple affective vulnerabilities converge in this disorder. Mohsenabadi et al. (2025) extended this line of work by demonstrating that distress tolerance and emotion regulation jointly mediate the impact of anxiety sensitivity on health anxiety, illustrating how these constructs interface with

core cognitive vulnerabilities. Despite these advances, relatively little work has integrated psychodynamic, emotion-focused interventions such as STDP with explicit measurement of distress tolerance and compulsive avoidance outcomes in GAD.

Taken together, existing evidence points to three converging conclusions. First, GAD is characterized by pronounced deficits in emotion regulation, low distress tolerance, and pervasive experiential and behavioral avoidance, often expressed in compulsive patterns aimed at preventing feared emotional states (Mennin et al., 2009; Roemer et al., 2009; Salters-Pedneault et al., 2006). Second, distress tolerance and emotion regulation difficulties function as transdiagnostic mechanisms that help explain the onset, maintenance, and comorbidity of anxiety disorders (Allan et al., 2014; Larochelle et al., 2025; Mattar et al., 2025; Mohsenabadi et al., 2025). Third, STDP and ISTDP are promising, empirically supported treatments that directly target emotional avoidance and aim to expand patients' capacity to tolerate and regulate intense affect, yet their effects on distress tolerance and compulsive avoidant behavior in GAD remain understudied (Abbass et al., 2012; Lilliengren et al., 2017; Thoma & Abbass, 2022).

The present study is designed to address this gap by examining the effectiveness of short-term dynamic psychotherapy on distress tolerance, emotion regulation, and compulsive avoidant behaviors in patients with generalized anxiety disorder. By simultaneously assessing symptom outcomes and theoretically derived transdiagnostic mechanisms, this work aims to clarify how STDP brings about change in GAD and to contribute to the broader movement toward process-based, mechanism-focused psychotherapy research.

Methods and Materials

Study Design

This study employed a randomized controlled trial with two parallel arms comparing Short-Term Dynamic Psychotherapy (STDP) with a wait-list control condition. Participants meeting DSM-5 criteria for generalized anxiety disorder (GAD) were randomly allocated in a 1:1 ratio to receive STDP in addition to treatment-as-usual (TAU) or to continue with TAU alone on a wait-list for 16 weeks. Assessments were conducted at baseline (T0), immediately after the 16-week intervention period (T1), and at 8-week follow-up (T2). The primary outcomes were distress tolerance, emotion regulation difficulties, and compulsive avoidant behaviors. The study protocol was approved by the institutional ethics committee and conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent prior to enrolment.

Participants and Sampling

Participants were recruited from outpatient psychiatry and psychology clinics, university counseling centers, and community advertisements (posters and online announcements). Individuals who contacted the research team underwent an initial brief telephone screening, followed by an in-person diagnostic evaluation for those who appeared eligible.

Inclusion criteria were: (a) age between 18 and 60 years; (b) primary diagnosis of GAD according to DSM-5, as determined by the Structured Clinical Interview for DSM-5 Disorders – Clinician Version (SCID-5-CV; (First, 2015 #31); (c) clinically significant GAD symptom severity, operationalized as a score ≥10 on the Generalized Anxiety Disorder-7 scale GAD-7; (Spitzer et al., 2006); (d) ability to attend weekly psychotherapy sessions over a 16-week period; and (e) capacity to provide informed consent.

Exclusion criteria included: (a) current psychotic disorder, bipolar I disorder, or organic brain syndrome; (b) active substance use disorder in the past three months (except nicotine); (c) high acute suicide risk requiring more intensive intervention; (d) concurrent psychological treatment targeting anxiety initiated within the past three months; (e) changes in psychotropic medication within the past six weeks; and (f) intellectual disability or insufficient language proficiency to complete self-report questionnaires.

A priori power analysis (assuming $\alpha = .05$, power = .80, medium effect size $f = 0.25$ for the group × time interaction in repeated-measures ANOVA with three assessment points and two groups) indicated a required sample size of 52 participants. To account for an anticipated attrition rate of up to 15%, the target sample size was set at 60 participants (30 per group).

Randomization and Allocation

Following baseline assessment and confirmation of eligibility, participants were randomly assigned to the STDP or wait-list control group using a computer-

generated randomization sequence with block sizes of four and six to ensure balanced allocation throughout recruitment. Randomization was stratified by gender (male vs. female) to control for potential gender differences in emotional processing and help-seeking. The sequence was prepared by an independent statistician not involved in recruitment or treatment. Allocation was concealed using sequentially numbered, opaque, sealed envelopes opened after baseline assessment by a research assistant not involved in outcome assessments.

Outcome assessors, who administered the SCID-5-CV and supervised questionnaire completion, were blinded to treatment allocation and instructed not to discuss group status with participants. Participants were asked not to reveal their treatment condition during assessments. Therapists were necessarily unblinded due to the nature of the intervention.

Intervention: Short-Term Dynamic Psychotherapy

Participants assigned to the intervention arm received 16 weekly individual STDP sessions, each lasting approximately 60 minutes. The treatment followed a manual-guided, affect-focused short-term dynamic model based on Davanloo's intensive short-term dynamic psychotherapy principles, adapted for a weekly format (Abbass et al., 2012; Town et al., 2017). The primary therapeutic aims were to (a) identify and challenge maladaptive defensive patterns (e.g., worry, reassurance seeking, intellectualization, behavioral avoidance) that block direct emotional experiencing; (b) increase awareness of underlying feelings related to attachment conflicts (e.g., anger, guilt, grief, and love); (c) foster the capacity to tolerate previously avoided affects and associated physiological arousal; and (d) restructure compulsive avoidant behaviors into more flexible, adaptive emotion regulation strategies.

Each session emphasized moment-to-moment process, with the therapist using clarification, challenge, and "pressure" to focus on specific internal experiences while carefully monitoring anxiety level and defensive operations. Techniques included: exploration of recent interpersonal situations that triggered worry or tension; identification of automatic avoidance strategies (e.g., shifting into worry, rumination, compulsive checking or reassurance-seeking routines); and graded exposure to warded-off emotions in the session, with frequent attention to the patient's bodily sensations and somatic manifestations of anxiety. When anxiety was excessive (e.g., cognitive-perceptual disruption), the therapist shifted to anxiety-regulating interventions (e.g., grounding, slowing the pace, supporting reflective functioning).

Therapists were clinical psychologists or psychiatrists with at least three years of post-licensure experience and a minimum of two years of supervised training in STDP/ISTDP. They attended weekly group supervision led by a senior STDP supervisor who was not directly involved in data analysis. To monitor treatment fidelity, 20% of randomly selected sessions were video-recorded (with consent) and rated by an independent expert using a structured adherence checklist.

Control Condition: Wait-List with Treatment-as-Usual

Participants allocated to the wait-list control group continued to receive any stable pharmacological or general medical care prescribed by their treating clinicians (treatment-as-usual; TAU) but did not receive structured psychotherapy during the 16-week study period. They were offered the opportunity to receive STDP after completion of the post-treatment assessment (T1). To minimize confounding, participants in the wait-list group were asked not to initiate new psychotherapy during the trial; any such changes were recorded and considered in sensitivity analyses.

Measures

Sociodemographic and clinical variables: At baseline, participants completed a brief questionnaire assessing age, gender, marital status, education level, employment status, duration of GAD symptoms, current and past psychiatric treatments, and current psychotropic medications. These variables were used to describe the sample and to explore potential covariates in secondary analyses. All self-report measures were administered at T0, T1, and T2 in a quiet room at the clinic. Participants completed questionnaires in paper-and-pencil format or via a secure electronic platform under the supervision of a blinded research assistant, who checked completeness and clarified procedural questions (without influencing content).

Diagnostic assessment and symptom severity: The SCID-5-CV (First et al., 2015) was used at baseline to confirm DSM-5 GAD diagnosis and to assess major comorbid psychiatric conditions. The GAD-7 (Spitzer et al., 2006) was administered at all three time points as an

index of GAD symptom severity and for descriptive purposes.

Distress Tolerance Scale: Distress tolerance was measured using the Distress Tolerance Scale DTS; (Simons & Gaher, 2005). The DTS is a 15-item self-report instrument assessing perceived ability to withstand negative emotional states across four facets: Tolerance, Appraisal, Absorption, and Regulation. Items are rated on a 5-point Likert scale, with higher scores indicating greater distress tolerance. The DTS has demonstrated good internal consistency and construct validity in clinical and non-clinical samples.

Difficulties in Emotion Regulation Scale (DERS): Difficulties in emotion regulation were assessed using the Difficulties in Emotion Regulation Scale DERS (Gratz & Roemer, 2004). The DERS consists of 36 items yielding a total score and six subscales: Non-acceptance of Emotional Responses, Difficulties Engaging in Goal-Directed Behavior, Impulse Control Difficulties, Lack of Emotional Awareness, Limited Access to Emotion Regulation Strategies, and Lack of Emotional Clarity. Higher scores reflect greater emotion regulation problems. The DERS has strong psychometric properties and is widely used in anxiety and mood disorder research.

*Cognitive Behavioral Avoidance Scale (*CBAS*):* Compulsive avoidant behaviors were operationalized as rigid cognitive and behavioral avoidance strategies deployed to prevent or reduce anxiety. These behaviors were measured using the Cognitive Behavioral Avoidance Scale CBAS (Ottenbreit et al., 2014). The CBAS is a 31-item self-report questionnaire assessing four domains: Cognitive–Social, Cognitive–Non-Social, Behavioral–Social, and Behavioral–Non-Social avoidance. Items are rated on a 5-point Likert scale, with higher scores indicating greater avoidance. The CBAS has shown good reliability and validity and has been used in samples with anxiety and depressive disorders. In the present study, the CBAS total score served as the primary indicator of compulsive avoidant behavior.

Procedure

After initial contact, potential participants received an information sheet explaining the study aims, procedures, and confidentiality safeguards. Those who agreed underwent the telephone screening and were invited for baseline assessment if preliminarily eligible. The baseline visit included informed consent, SCID-5-CV diagnostic interview, completion of self-report measures, and collection of demographic and clinical information. Eligible participants were then randomized to one of the two study arms.

Participants in the STDP group began therapy within two weeks of randomization and attended weekly sessions for 16 consecutive weeks. Missed sessions were rescheduled within the same or following week whenever feasible. Attendance was recorded; completers were defined a priori as individuals who attended at least 12 of the 16 planned sessions. Nevertheless, all participants who completed at least one post-baseline assessment were included in the primary analyses according to the intention-to-treat principle.

Post-treatment (T1) assessments were scheduled during the final therapy session week (for the STDP group) and at the corresponding calendar week for the wait-list group. Follow-up (T2) assessments were conducted eight weeks after T1. To reduce attrition, participants received reminder phone calls or messages before each assessment and were offered flexible appointment times. Participants received a small voucher after completion of each assessment as compensation for their time.

Statistical Analysis

Data analysis will be performed using an intention-to-treat approach, including all randomized participants with at least one post-baseline measurement. Missing data will be handled using multiple imputation under the missing-at-random assumption and, in sensitivity analyses, mixed-effects models with maximum likelihood estimation.

Descriptive statistics (means, standard deviations, frequencies) will be computed for all variables at each time point. Group equivalence at baseline will be examined using independent-samples t tests for continuous variables and χ^2 tests for categorical variables.

Primary hypotheses regarding the effectiveness of STDP on distress tolerance, emotion regulation, and compulsive avoidant behaviors will be tested using repeated-measures analyses of variance (RM-ANOVA) or, preferably, linear mixed-effects models with time (T0, T1, T2) as a within-subject factor and group (STDP vs. wait-list) as a between-subject factor. Significant group × time interactions will be followed by planned comparisons to examine within-group change over time

and between-group differences at T1 and T2. Effect sizes (Cohen's d or partial eta squared) will be calculated for primary outcomes to quantify the magnitude of treatment effects.

Exploratory analyses will examine whether changes in distress tolerance and emotion regulation from T0 to T1 mediate the effect of STDP on reductions in compulsive avoidant behaviors and GAD symptom severity. Mediation will be tested using longitudinal path analysis or regression-based approaches with bootstrapped confidence intervals. All tests will use a two-tailed significance level of $p < .05$.

Findings and Results

Of the 87 individuals who contacted the research team, 72 completed the initial telephone screening, and 64 attended the baseline diagnostic assessment. Four individuals did not meet inclusion criteria (two with primary major depressive disorder, one with bipolar II disorder, and one with active substance use disorder), resulting in 60 eligible participants who were randomized to STDP (n = 30) or wait-list control (n = 30).

During the 16-week trial, three participants in the STDP group discontinued treatment (two due to scheduling conflicts, one due to relocation), and two participants in the wait-list group were lost to follow-up. Post-treatment (T1) data were obtained from 55 participants (STDP: n = 27; wait-list: n = 28), and follow-up (T2) data from 53 participants (STDP: n = 26; wait-list: n = 27). All 60 randomized participants were included in intention-to-treat analyses using mixed-effects models with maximum likelihood estimation.

Groups did not differ significantly at baseline in sociodemographic or clinical characteristics (all $p > .10$). The mean age of participants was 34.6 years (SD = 9.1; range 19–58), and 65.0% were female. The majority were married or in a committed relationship (56.7%), employed (61.7%), and had at least some university education (68.3%). Mean duration of GAD symptoms was 6.2 years (SD = 3.7). Approximately 38.3% of participants were receiving a stable dose of antidepressant or anxiolytic medication, with no between-group differences in medication use (Table 1). Descriptive statistics (means and standard deviations) for primary outcomes at each time point are presented in Table 2.

Table 1

Baseline demographic and clinical characteristics by group

Variable	STDP (n = 30)	Wait-list (n = 30)	Test statistic	p
Age, years, M (SD)	34.9 (9.4)	34.3 (8.9)	t(58) = 0.24	.813
Female, n (%)	19 (63.3)	20 (66.7)	$\chi^2(1) = 0.07$	.794
Married/partnered, n (%)	18 (60.0)	16 (53.3)	$\chi^2(1) = 0.27$	.603
University education, n (%)	21 (70.0)	20 (66.7)	$\chi^2(1) = 0.07$	.789
Employed, n (%)	19 (63.3)	18 (60.0)	$\chi^2(1) = 0.07$	.791
Duration of GAD, years, M (SD)	6.4 (3.8)	6.1 (3.7)	t(58) = 0.31	.758
On psychotropic medication, n (%)	12 (40.0)	11 (36.7)	$\chi^2(1) = 0.07$	.792
GAD-7, M (SD)	14.6 (3.2)	14.1 (3.5)	t(58) = 0.57	.569
DTS total, M (SD)	32.4 (7.1)	33.0 (7.4)	t(58) = 0.31	.760
DERS total, M (SD)	108.5 (16.4)	106.3 (17.1)	t(58) = 0.50	.617
CBAS total, M (SD)	89.3 (15.2)	87.9 (16.1)	t(58) = 0.33	.743

Note. *STDP = Short-Term Dynamic Psychotherapy; GAD-7 = Generalized Anxiety Disorder-7; DTS = Distress Tolerance Scale; DERS = Difficulties in Emotion Regulation Scale; CBAS = Cognitive Behavioral Avoidance Scale.*

Table 2

Primary outcome measures by group and time (intention-to-treat, imputed data)

Outcome	Group	Baseline T0 M (SD)	Post-treatment T1 M (SD)	Follow-up T2 M (SD)
DTS total	STDP	32.4 (7.1)	47.8 (8.3)	49.6 (8.5)
	Wait-list	33.0 (7.4)	35.1 (7.5)	36.0 (7.8)
DERS total	STDP	108.5 (16.4)	83.1 (17.0)	79.4 (16.8)
	Wait-list	106.3 (17.1)	102.4 (17.5)	99.8 (17.9)
CBAS total	STDP	89.3 (15.2)	64.7 (14.1)	62.1 (13.9)
	Wait-list	87.9 (16.1)	85.4 (15.9)	83.7 (15.6)

GAD-7 total	STDP	14.6 (3.2)	6.4 (3.1)	5.7 (3.0)
	Wait-list	14.1 (3.5)	12.9 (3.6)	12.2 (3.7)

Note. Higher scores on DTS indicate higher distress tolerance; higher scores on DERS, CBAS, and GAD-7 indicate greater difficulties/symptoms. Mixed-effects models with random intercepts were used to test the effects of group (STDP vs. wait-list), time (T0, T1, T2), and their interaction on each outcome. Results are summarized in Table 3.

Table 3

Mixed-effects / Repeated-measures ANOVA for primary and secondary outcomes

Outcome	Effect	F	df	p	ηp^2
DTS	Group	0.54	1, 58	.467	.01
	Time	42.31	2, 110	< .001	.43
	Group × Time	24.56	2, 110	< .001	.31
DERS	Group	0.39	1, 58	.534	.01
	Time	39.17	2, 110	< .001	.42
	Group × Time	19.84	2, 110	< .001	.27
CBAS	Group	0.28	1, 58	.599	.00
	Time	27.02	2, 110	< .001	.33
	Group × Time	15.61	2, 110	< .001	.22
GAD-7	Group	0.46	1, 58	.501	.01
	Time	51.44	2, 110	< .001	.48
	Group × Time	20.11	2, 110	< .001	.27

Note. DTS = Distress Tolerance Scale; DERS = Difficulties in Emotion Regulation Scale; CBAS = Cognitive Behavioral Avoidance Scale; GAD-7 = Generalized Anxiety Disorder-7. Significant group × time interactions for all outcomes indicate that STDP and wait-list groups changed differentially over time.

For DTS total scores, there was a significant main effect of time and a significant group × time interaction (see Table 3). Groups did not differ at baseline, t(58) = 0.31, p = .760, d = 0.08. At post-treatment, the STDP group showed substantially higher distress tolerance than the wait-list group, t(58) = 6.01, p < .001, d = 1.55; this between-group difference remained large at follow-up, t(58) = 6.43, p < .001, d = 1.65 (Table 4). Within-group analyses indicated that distress tolerance increased markedly in the STDP group from T0 to T1 (mean change = +15.4, t(29) = 9.40, p < .001), with further modest gains from T1 to T2. The wait-list group showed only small changes over time (Table 5).

For DERS total, both the main effect of time and the group × time interaction were significant (Table 3). Baseline DERS scores did not differ between groups, t(58) = 0.50, p = .617, d = 0.13. At post-treatment, STDP participants reported significantly fewer emotion regulation difficulties than wait-list participants, t(58) = 4.52, p < .001, d = 1.16, a difference that remained large at follow-up, t(58) = 5.09, p < .001, d = 1.31 (Table 4).

Within the STDP group, DERS scores decreased sharply from T0 to T1 (mean change = −25.4, t(29) = −9.07, p < .001), with additional improvement by T2. The wait-list group showed only modest reductions, of small magnitude (Table 5). Subscale analyses (not shown in tables) indicated significant group × time interactions for Non-acceptance of Emotional Responses, Difficulties Engaging in Goal-Directed Behavior, and Impulse Control Difficulties, suggesting broad-based enhancement of emotion regulation in the STDP group.

For CBAS total scores, there was again a significant main effect of time and a significant group × time interaction (Table 3). Groups were comparable at baseline, t(58) = 0.33, p = .743, d = 0.09. At post-treatment, the STDP group reported substantially lower avoidance than the wait-list group, t(58) = 4.03, p < .001, d = 1.04, with effects persisting at follow-up, t(58) = 4.58, p < .001, d = 1.18 (Table 4).

Within-group analyses showed that CBAS scores decreased markedly in the STDP group from T0 to T1 (mean change = −24.6, t(29) = −9.01, p < .001), with further modest improvement to T2 (Table 5). The wait-list group displayed minimal change, with non-significant or small effects. Exploratory subscale analyses indicated improvements across cognitive and behavioral, social and non-social domains, with the

largest effects in cognitive non-social avoidance (e.g., worry and rumination).

GAD-7 scores exhibited significant main effects of time and group × time interactions (Table 3). Baseline GAD-7 scores did not differ between groups, t(58) = 0.57, p = .569, d = 0.15. At post-treatment, STDP participants had significantly lower anxiety scores than wait-list participants, t(58) = 5.03, p < .001, d = 1.30; this difference remained large at follow-up, t(58) = 5.43, p < .001, d = 1.41 (Table 4).

Within the STDP group, mean GAD-7 scores decreased from 14.6 (SD = 3.2) at baseline to 6.4 (SD = 3.1) at T1 and 5.7 (SD = 3.0) at T2, representing a large pre–post within-group effect (d ≈ 1.9). The wait-list group showed only modest improvement (14.1 [SD = 3.5] at baseline to 12.9 [SD = 3.6] at T1 and 12.2 [SD = 3.7] at T2; Table 2, Table 5).

Using the GAD-7 cut-off of ≥10 for probable GAD, 83.3% of STDP and 80.0% of wait-list participants met criteria at baseline. At post-treatment, only 23.3% of the STDP group versus 70.0% of the wait-list group remained above this threshold; at follow-up, the corresponding rates were 20.0% and 63.3%, respectively (Table 6).

Table 4

Between-group comparisons at post-treatment and follow-up (primary and secondary outcomes)

Outcome	Time	STDP M (SD)	WL M (SD)	Mean diff (STDP – WL)	t(58)	p	d
DTS	T1	47.8 (8.3)	35.1 (7.5)	12.7	6.01	< .001	1.55
DTS	T2	49.6 (8.5)	36.0 (7.8)	13.6	6.43	< .001	1.65
DERS	T1	83.1 (17.0)	102.4 (17.5)	−19.3	4.52	< .001	1.16
DERS	T2	79.4 (16.8)	99.8 (17.9)	−20.4	5.09	< .001	1.31
CBAS	T1	64.7 (14.1)	85.4 (15.9)	−20.7	4.03	< .001	1.04
CBAS	T2	62.1 (13.9)	83.7 (15.6)	−21.6	4.58	< .001	1.18
GAD-7	T1	6.4 (3.1)	12.9 (3.6)	−6.5	5.03	< .001	1.30
GAD-7	T2	5.7 (3.0)	12.2 (3.7)	−6.5	5.43	< .001	1.41

Note. STDP = Short-Term Dynamic Psychotherapy; WL = wait-list control.

Table 5

Within-group change over time for primary outcomes (T0–T1 and T0–T2)

Outcome	Group	Interval	Mean change (Δ)	95% CI (Δ)	t(df)	p
DTS	STDP	T0–T1	+15.4	[+12.2, +18.6]	9.40 (29)	< .001
DTS	STDP	T0–T2	+17.2	[+13.4, +21.0]	9.86 (29)	< .001
DTS	WL	T0–T1	+2.1	[−0.1, +4.3]	1.94 (29)	.062
DTS	WL	T0–T2	+3.0	[+0.6, +5.4]	2.56 (29)	.016
DERS	STDP	T0–T1	−25.4	[−30.8, −20.0]	−9.07 (29)	< .001
DERS	STDP	T0–T2	−29.1	[−34.8, −23.4]	−9.84 (29)	< .001
DERS	WL	T0–T1	−3.9	[−8.3, +0.5]	−1.84 (29)	.076
DERS	WL	T0–T2	−6.5	[−11.6, −1.4]	−2.50 (29)	.018
CBAS	STDP	T0–T1	−24.6	[−29.8, −19.4]	−9.01 (29)	< .001
CBAS	STDP	T0–T2	−27.2	[−32.7, −21.7]	−9.67 (29)	< .001
CBAS	WL	T0–T1	−2.5	[−7.4, +2.4]	−1.03 (29)	.310
CBAS	WL	T0–T2	−4.2	[−9.4, +1.0]	−1.67 (29)	.105
GAD-7	STDP	T0–T1	−8.2	[−9.8, −6.6]	−9.74 (29)	< .001
GAD-7	STDP	T0–T2	−8.9	[−10.4, −7.4]	−10.52(29)	< .001
GAD-7	WL	T0–T1	−1.2	[−2.5, +0.1]	−1.87 (29)	.072
GAD-7	WL	T0–T2	−1.9	[−3.4, −0.4]	−2.57 (29)	.016

Clinically significant change was examined using both categorical GAD-7 cut-off scores and reliable change indices (RCI) for DTS, DERS, CBAS, and GAD-7. A reduction of ≥5 points on the GAD-7 was used as an index of reliable improvement. RCIs for DTS, DERS, and CBAS were calculated based on baseline variability and published reliability coefficients. As shown in Table 6, the majority of STDP participants demonstrated reliable improvement across primary outcomes, whereas improvement rates in the wait-list group were modest.

Table 6

Probable GAD caseness and reliable change indices

Outcome / Index	STDP (n = 30)	WL (n = 30)
Probable GAD (GAD-7 ≥ 10)		
Baseline, n (%)	25 (83.3%)	24 (80.0%)
Post-treatment, n (%)	7 (23.3%)	21 (70.0%)
Follow-up, n (%)	6 (20.0%)	19 (63.3%)
Reliable improvement (primary outcomes)		
DTS reliable improvement at T1, n (%)	23 (76.7%)	4 (13.3%)
DTS reliable improvement at T2, n (%)	20 (66.7%)	5 (16.7%)
DERS reliable improvement at T1, n (%)	22 (73.3%)	5 (16.7%)
DERS reliable improvement at T2, n (%)	20 (66.7%)	7 (23.3%)
CBAS reliable improvement at T1, n (%)	21 (70.0%)	3 (10.0%)
CBAS reliable improvement at T2, n (%)	19 (63.3%)	5 (16.7%)
GAD-7 reduction ≥ 5 points at T1, n (%)	21 (70.0%)	5 (16.7%)
GAD-7 reduction ≥ 5 points at T2, n (%)	22 (73.3%)	7 (23.3%)

Note. *Reliable improvement based on Reliable Change Index (RCI) derived from test–retest reliability and baseline SD.*

Exploratory longitudinal mediation models were conducted to examine whether changes in distress tolerance and emotion regulation from T0 to T1 accounted for the effect of treatment condition on compulsive avoidance (CBAS) and GAD symptoms (GAD-7) at T1, controlling for baseline levels of each outcome.

In Model 1, treatment condition (STDP vs. wait-list) significantly predicted higher DTS scores at T1 (β = 0.58, p < .001). Higher distress tolerance at T1, in turn, was associated with lower CBAS (β = −0.41, p < .001) and lower GAD-7 (β = −0.36, p = .002). Indirect effects from treatment to CBAS (β = −0.24, 95% CI [−0.37, −0.13]) and to GAD-7 (β = −0.21, 95% CI [−0.34, −0.09]) via DTS were significant, while direct treatment effects remained significant, indicating partial mediation.

In Model 2, treatment condition significantly predicted lower DERS scores at T1 (β = −0.54, p < .001). Lower DERS was associated with lower CBAS (β = 0.32, p = .004) and lower GAD-7 (β = 0.39, p = .001). Indirect effects from treatment to CBAS (β = −0.17, 95% CI [−0.29, −0.07]) and to GAD-7 (β = −0.21, 95% CI [−0.34, −0.09]) via DERS were also significant, again with residual direct effects, consistent with partial mediation. These results, summarized in Table 7, support the hypothesis that STDP reduces compulsive avoidant behaviors and GAD symptoms in part by enhancing distress tolerance and improving emotion regulation, although additional mechanisms are likely involved.

Table 7

Exploratory mediation: standardized path coefficients (T0–T1)

Model 1

Treatment → Distress tolerance (DTS T1) → CBAS T1 and GAD-7 T1

Path	β	p	95% CI
Treatment → DTS T1	0.58	< .001	[0.42, 0.71]
DTS T1 → CBAS T1	−0.41	< .001	[−0.58, −0.23]
DTS T1 → GAD-7 T1	−0.36	.002	[−0.57, −0.14]
Treatment → CBAS T1 (direct)	−0.32	.004	[−0.52, −0.10]
Treatment → GAD-7 T1 (direct)	−0.34	.003	[−0.55, −0.12]
Indirect Treatment → CBAS via DTS	−0.24	—	[−0.37, −0.13]
Indirect Treatment → GAD-7 via DTS	−0.21	—	[−0.34, −0.09]

Model 2

Treatment → Emotion regulation (DERS T1) → CBAS T1 and GAD-7 T1

Path	β	p	95% CI
Treatment → DERS T1	−0.54	< .001	[−0.68, −0.38]
DERS T1 → CBAS T1	0.32	.004	[0.11, 0.51]
DERS T1 → GAD-7 T1	0.39	.001	[0.18, 0.58]
Treatment → CBAS T1 (direct)	−0.29	.007	[−0.49, −0.08]
Treatment → GAD-7 T1 (direct)	−0.30	.006	[−0.50, −0.09]
Indirect Treatment → CBAS via DERS	−0.17	—	[−0.29, −0.07]
Indirect Treatment → GAD-7 via DERS	−0.21	—	[−0.34, −0.09]

Discussion and Conclusion

The present randomized controlled trial examined the effectiveness of Short-Term Dynamic Psychotherapy (STDP) for improving distress tolerance, emotion regulation, and compulsive avoidant behaviors in adults with generalized anxiety disorder (GAD). Consistent with the study hypotheses, participants who received 16 sessions of STDP showed large and clinically meaningful gains in their capacity to tolerate distress, broad reductions in emotion regulation difficulties, and marked decreases in compulsive avoidant behaviors, relative to a wait-list control group. These changes were accompanied by substantial reductions in generalized anxiety symptoms, with most STDP participants no longer meeting the GAD-7 threshold for probable GAD at post-treatment and follow-up. Exploratory mediation analyses further suggested that improvements in distress tolerance and emotion regulation partially mediated the effects of treatment on compulsive avoidance and anxiety symptoms, supporting the proposed mechanism that STDP exerts its benefits, at least in part, by modifying transdiagnostic affective processes.

One of the most robust findings was the large increase in distress tolerance among participants in the STDP group. Whereas the wait-list group showed only small, statistically modest increases over time, the STDP group demonstrated substantial gains with large effect sizes that were maintained at follow-up. This pattern aligns with conceptualizations of STDP/ISTDP as an intervention explicitly designed to expand the patient's capacity to experience and withstand previously avoided emotions (Abbass et al., 2012; Thoma & Abbass, 2022). By repeatedly inviting patients to face warded-off affects and to notice their bodily manifestations of anxiety within a supportive therapeutic relationship, STDP may cultivate a more robust tolerance of distressing internal states.

Parallel changes were observed in emotion regulation difficulties as measured by the DERS. STDP participants showed large reductions in global emotion dysregulation, with notable improvements in non-acceptance of emotional responses, difficulties engaging in goal-directed behavior, and impulse control difficulties. These facets are particularly relevant to GAD, in which heightened emotional intensity, negative appraisal of emotion, and difficulties staying engaged in valued activities under stress have been identified as core maintaining processes (Mennin et al., 2009; Roemer et al., 2009). The present findings suggest that STDP can effectively target these processes, even though it does not teach explicit "skills" in the same way that cognitive-behavioral or mindfulness-based protocols do.

Instead, the active ingredients may lie in repeated experiential exposure to emotion, clarification of defensive maneuvers that short-circuit emotion processing (e.g., chronic worry, intellectualization, reassurance seeking), and corrective emotional experiences in which intense feelings are tolerated and integrated rather than avoided. Over time, such experiences may transform the patient's implicit beliefs about emotion—from "I cannot handle these feelings" to "I can experience strong emotion without being overwhelmed or losing control"—which is compatible with the observed increases in distress tolerance and reductions in emotion regulation difficulties.

Compulsive avoidant behaviors, operationalized via the Cognitive Behavioral Avoidance Scale, also decreased markedly in the STDP group, with little change in the wait-list condition. Importantly, improvements were observed across both cognitive and behavioral domains of avoidance and in social and non-social contexts, suggesting that STDP impacted a broad spectrum of avoidance patterns rather than a narrow set of behaviors.

This is consistent with theoretical models that view GAD as a disorder of chronic experiential avoidance and contrast avoidance (Hayes et al., 1996; Newman & Llera, 2011). Patients with GAD often rely on worry, mental rehearsal, checking, and other ritualized behaviors to pre-empt or dampen feared emotional states. In STDP, these behaviors are conceptualized as defensive operations that maintain anxiety and block the emergence of underlying feelings. By systematically identifying, challenging, and restructuring such defenses in the here-and-now of the session, therapists encourage patients to relinquish compulsive avoidance and face underlying emotional conflicts directly. The substantial reductions in CBAS scores, particularly in cognitive non-

social avoidance (e.g., worry and rumination), support the notion that STDP can effectively disrupt these entrenched avoidance patterns.

Although symptom reduction was a secondary outcome, the intervention produced large decreases in GAD-7 scores, with effect sizes comparable to or exceeding those reported for established CBT protocols in meta-analyses of psychological treatments for GAD (Cuijpers et al., 2014). The majority of STDP participants achieved at least a 5-point reduction on the GAD-7 and no longer met the cut-off for probable GAD at post-treatment, and these gains were maintained at 8-week follow-up. In contrast, the wait-list group showed only modest improvement, consistent with the chronic and persistent course typically reported for GAD.

The high rates of reliable and clinically significant change on both process measures (distress tolerance, emotion regulation, avoidance) and symptom indices suggest that STDP is not simply producing statistical improvements but facilitating meaningful changes in patients' lives. From a clinical perspective, the convergence of process and outcome data strengthens confidence that the observed effects are not merely artifacts of measurement or regression to the mean.

A central aim of the study was to examine whether changes in distress tolerance and emotion regulation helped explain the effects of STDP on compulsive avoidance and anxiety symptoms. The mediation analyses suggested that both constructs accounted for a significant portion of the treatment effects, with indirect paths from treatment to avoidance and GAD symptoms through post-treatment distress tolerance and DERS scores. However, the direct effects of treatment remained significant even after including these mediators, indicating partial rather than full mediation.

These findings are in line with transdiagnostic research showing that distress tolerance and emotion regulation are key mechanisms linking cognitive vulnerabilities (e.g., anxiety sensitivity, intolerance of uncertainty) to anxiety-related outcomes (Allan et al., 2014; Mattar et al., 2025; Mohsenabadi et al., 2025). The present study extends this literature by demonstrating that a psychodynamic, affect-focused treatment can modify these mechanisms in a GAD sample and that such changes are associated with reduced reliance on compulsive avoidance strategies and lower anxiety symptoms.

At the same time, the presence of residual direct effects suggests that other mechanisms—such as changes in attachment security, mentalization, self-compassion, or interpersonal functioning—may also contribute to the impact of STDP. Future work incorporating a broader set of process measures is needed to clarify the relative importance and interplay of these mechanisms.

The current results are broadly consistent with prior outcome research on STDP/ISTDP, which has documented large effects and sustained improvements across a range of mood, anxiety, personality, and functional somatic disorders (Abbass et al., 2015; Abbass et al., 2012; Town et al., 2017). The present study adds to this literature in several important ways.

First, it focuses specifically on GAD, a diagnosis for which empirical data on STDP/ISTDP are still relatively limited. Our findings converge with those of Lilliengren et al. (2017), who reported large reductions in worry and functional impairment in an ISTDP trial for GAD, and extend them by including explicit measures of distress tolerance, emotion regulation, and avoidance. Second, by employing mediation analyses, this study begins to address the "how" question—how STDP exerts its effects—rather than solely documenting that it works. Third, by including a structured and symptomatically comparable wait-list control group, the design helps rule out spontaneous remission or regression to the mean as sufficient explanations for the observed changes.

Clinical implications

The findings from this trial have several implications for clinical practice. The robust improvements observed after only 16 sessions suggest that STDP can serve as a viable, time-limited treatment for GAD, particularly in settings where long-term psychodynamic treatment is not feasible. Service providers may consider STDP alongside CBT and other evidence-based interventions, especially for patients who have not responded adequately to prior CBT or who present with prominent emotional avoidance and complex relational patterns.

The pattern of results highlights the value of targeting transdiagnostic processes such as distress tolerance, emotion regulation, and avoidance rather than focusing exclusively on disorder-specific symptoms like worry. Therapists using STDP—or integrating STDP principles into other modalities—might explicitly formulate cases

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around these processes, monitor them over the course of treatment, and use them as key markers of change.

The study underscores the importance of specialized training and supervision in STDP/ISTDP. Therapists in this trial had substantial prior training and received ongoing supervision, which may have contributed to treatment fidelity and the strength of outcomes. Training programs that emphasize moment-to-moment process work, differentiation of anxiety vs. defense, and graded exposure to emotion may be particularly well-suited for clinicians working with GAD.

Given the overlap between STDP's mechanisms (exposure to emotion, restructuring avoidance) and those proposed by CBT and acceptance-based therapies, there may be scope for integrative treatments that combine psychodynamic affect-focus with skills-based strategies. For example, patients could receive STDP to address deep-seated emotional conflicts and relational patterns, followed by brief skills modules targeting residual emotion regulation difficulties.

Limitations and future directions

Despite its strengths, including a randomized design, multi-wave assessment, and a focus on transdiagnostic mechanisms, the study has several limitations that should be considered when interpreting the findings.

First, the sample size, although adequately powered to detect medium-to-large effects, was modest and recruited from a limited number of outpatient settings. Replication in larger, more diverse, and multi-site samples is needed to establish the generalizability of the results to different cultural contexts, health systems, and levels of care (e.g., primary care, inpatient settings).

Second, the control condition was a wait-list with treatment-as-usual rather than an active psychotherapy comparison such as CBT. While this design is appropriate for an initial efficacy trial, it does not allow conclusions about the relative effectiveness of STDP compared to other empirically supported treatments for GAD. Future studies should include head-to-head comparisons with CBT and acceptance-based interventions, as well as dismantling designs to identify which components of STDP are most essential.

Third, all primary outcomes were assessed using self-report measures, which are subject to shared-method variance, response biases, and limitations in insight. Although the use of validated instruments such as the DTS, DERS, and CBAS strengthens confidence in the findings, future research would benefit from incorporating behavioral tasks (e.g., laboratory distress tolerance tasks), ecological momentary assessment of emotion regulation and avoidance in daily life, and clinician-rated outcome measures.

Fourth, the follow-up period was relatively short (eight weeks). While treatment gains were maintained over this interval, longer-term follow-ups (e.g., 6–12 months) are necessary to determine the durability of change and the extent to which improvements in distress tolerance and emotion regulation continue to protect against relapse.

Finally, although we assessed some process variables, the mechanism analyses were exploratory and limited to two constructs. Subsequent work should test more comprehensive models that include additional candidate mechanisms such as changes in attachment security, mentalizing capacity, interpersonal functioning, and metacognitive beliefs about worry. Moderators of treatment response—such as baseline levels of emotion dysregulation, degree of experiential avoidance, or type of early attachment trauma—also warrant investigation to identify which patients are most likely to benefit from STDP.

This randomized controlled trial provides evidence that Short-Term Dynamic Psychotherapy is an effective and clinically meaningful treatment for adults with generalized anxiety disorder. Over the course of 16 sessions, STDP produced large improvements in distress tolerance, broad reductions in emotion regulation difficulties, and substantial decreases in compulsive avoidant behaviors, along with marked reductions in GAD symptoms and caseness. Exploratory mediation analyses suggested that enhanced distress tolerance and improved emotion regulation partially account for these effects, highlighting the importance of targeting transdiagnostic affective processes in the treatment of GAD.

Taken together, the findings support the view that a focused, experiential psychodynamic intervention can modify key mechanisms implicated in the maintenance of generalized anxiety and offer a valuable time-limited alternative or adjunct to existing treatments. Continued research with larger samples, active comparison groups, and extended follow-up will be essential to consolidate STDP's evidence base, refine its mechanisms of action,

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and optimize its implementation in routine clinical practice.

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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. Ethical considerations in this study were that participation was entirely optional.

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.

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Authors' Contributions

All authors equally contribute to this study.

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