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Original Article

Examining the Effectiveness of Acceptance and Commitment Therapy on the Cognitive Functions of Patients with Systemic Lupus Erythematosus

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Abstract

Objective: This study was administrated with the goal of examining the efficacy of acceptance and commitment therapy (ACT) on cognitive functions of patients with systemic lupus erythematosus.
Method: In a single-blind experimental research, 90 adult patients with lupus were randomly divided into the three ACT (n = 30), general health education (GHE) (n = 30) and waitlist (n = 30) groups. Both treatment groups received individual treatment with a specific protocol for four weeks. Before and after treatment, all participants were assessed using the Wisconsin Card Sorting Test (WCST) and the Stroop Color Word Test (SCWT).
Results: Both ACT and GHE groups had a significantly better post-intervention cognitive performance compared to the waitlist group in terms of WCST and SCWT scores ($P < 0.05$). Cohen's d for the effects of ACT on WCST total errors and completed categories were 0.86 and 0.80, respectively. Cohen's d for the effect of ACT on SCWT was 0.70. Furthermore, Cohen's d for the effects of GHE on WCST total errors and completed categories were 0.65 and 0.58, respectively. Also, Cohen's d for the effect of GHE on SCWT was 0.55. The ACT and GHE interventions differed significantly only in total errors on WCST, with the ACT group demonstrating significantly better cognitive functioning at post-intervention ($P = 0.04$).
Conclusion: The ACT approach has a large effect on the cognitive performance of lupus patients, while the GHE has a moderate effect on these functions. Therefore, these intervention methods, especially ACT, could be considered alongside usual treatment methods as suitable options to improve the daily affairs of people with lupus.

Key words: *Acceptance and Commitment Therapy; Attention; Cognitive Function; Lupus Erythematosus Disseminatus; Psychotherapy*

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Lupus is an autoimmune disease that can cause pain and inflammation in various parts of the human body where the immune system mistakenly attacks healthy tissue (1). Lupus symptoms vary from patient to patient, from joint or skin damage to damage in multiple parts of the body (2). The prevalence of lupus varies globally. For context, while it is estimated at 40 per 100,000 in Iran (3), studies in India have reported rates ranging from 3.2 to over 30 per 100,000 (4). The literature showed that common pharmacotherapy used for lupus patients can lead to mild to severe cognitive impairment that affects memory and executive functions in these patients (5). For example, in a prospective observational research, Kakati *et al.* found that cognitive impairment was the most common neurological manifestation in lupus patients (6). Palagini *et al.* also showed that lupus diseases significantly reduce the executive function of affected patients through stressful events (7). Many other researches have confirmed these observations and found that some people with lupus suffer from severe deficits in executive cognitive functions and attentional processes (8-10). In addition, several affected individuals showed abnormalities in their peripheral and central nervous systems. Such abnormalities may induce a wide range of physical and mental symptoms in patients with lupus, such as confusion, headaches, memory loss, impaired auditory and visual attention, and depression (11). Most researchers attribute this cognitive impairment to the pharmacotherapy used, while some attribute it to the nature of lupus (12-14).

Considering the proven psychological and cognitive problems in lupus patients, it seems that various interventions should be applied to improve the cognitive deficits and quality of life of patients. Accordingly, some studies have used psychological interventions such as intensive short-term dynamic psychotherapy (ISTDP) or acceptance and commitment therapy (ACT) to improve mental symptoms in lupus patients (15). ACT is an intervention technique that can be especially well-suited for the needs of lupus patients. It has been shown to be effective in treating the main symptoms of lupus, including chronic pain, anxiety and depression (16, 17). For example, Sahebari *et al.* showed that ACT intervention can significantly reduce psychological distress, disappointment and psychasthenia in adult women with lupus (18). Akhtar and Majid also reported a significant reduction in psychological distress in lupus patients following an ACT intervention (19). Arjol and Barbero-Rubio investigated the effectiveness of a brief 10-hour ACT intervention in lupus patients and reported a significant improvement in patients' quality of life after the intervention (20). ACT focuses on the acceptance of external and internal events, considering psychological flexibility as the main component through six well-known processes (i.e., acceptance, defusion, self-as-context, flexible attention to the present time, chosen values and committed actions). Based on ACT theory, when these processes work together, patients experience better psychological flexibility and functioning as well as quality of life (21).

Although studies have reported positive effects of the ACT approach on cognitive functions in lupus and other populations (22, 23), the validity and generalizability of these findings are called into question by significant methodological limitations. A critical review of the extant literature reveals two primary scientific gaps. First, many prior studies employed small, underpowered sample sizes, increasing the risk of Type II errors and limiting the reliability of their conclusions. Second, a common weakness has been the lack of robust control conditions; many trials compared ACT only to waitlist controls. While this demonstrates efficacy over no treatment, it fails to ascertain whether observed benefits are specific to ACT's unique processes or are merely non-specific effects common to any structured therapeutic intervention, such as general health education (GHE) or clinician attention. To address these gaps, the present study introduces key methodological innovations. First, it utilizes a relatively larger sample size, enhancing statistical power and the reliability of the findings. Second, and most critically, it employs a three-armed randomized controlled trial (RCT) design, comparing ACT against both an active control group (GHE) and a passive waitlist control. This rigorous design allows us to isolate the specific effects of ACT beyond those achieved by non-specific therapeutic factors. The primary objective of this trial is to test the specific efficacy of ACT against an active comparator. Therefore, our primary hypothesis is that patients receiving ACT will demonstrate significantly greater improvement in cognitive function post-intervention compared to those receiving GHE. Furthermore, cognitive function is assessed using objective, performance-based neuropsychological tests, which provide a more robust and quantifiable measure of executive function and attention than subjective self-reports alone. Therefore, the primary objective of this trial is to conduct a robust evaluation of the efficacy of ACT on the cognitive functions of patients with systemic lupus erythematosus.

Materials and Methods

Participants and procedure

The statistical population of the present study was all lupus patients who were members of the Lupus Trust India in Kochi. The sample size was determined a priori using G*Power software (version 3.1). For a repeated measures ANOVA (within-between interaction) with an alpha of 0.05, a power of 0.80, and a conservative estimated effect size of f = 0.25 (based on prior research examining psychotherapy effects on cognitive outcomes in chronic illness populations (24)), a total sample of 84 participants was required (28 per group). To account for an anticipated attrition rate of approximately 10%, we aimed to recruit 90 participants (19). These 90 patients

were selected as participants using the available non-probability sampling method based on the inclusion criteria. Participants were eligible for the study if they were between 18 and 60 years old, had no history of psychiatric disease before developing lupus (according to medical records), and possessed a high school diploma or higher degree. Eligible participants were then matched to the group by age, disease characteristics (type, duration, severity), and socioeconomic status. Exclusion criteria were declining to participate in the study, missing more than one treatment session, and failing to complete measurement tests. As mentioned, 90 patients were selected and randomly divided into the three ACT (n = 30), GHE (n = 30) and waitlist (n = 30) groups through computer generated random numbers. Both treatment groups (ACT and GHE) received individual treatment with a specific protocol for four weeks. The waitlist group had no intervention and received the routine treatment for patients with lupus. Before and after treatment, all participants were assessed using the Wisconsin Card Sorting Test (WCST) and the Stroop Color Word Test (SCWT). All the assessments were conducted by a trained psychologist who was blinded to intervention conditions and to the hypotheses of the research.

Acceptance and commitment therapy

ACT consists of eight 90-minute sessions held over four consecutive weeks (two sessions per week). This treatment package was designed by Hayes *et al.* (25). It can be delivered in either a group or an individual format; the present study used the individual format. Table 1 shows the ACT treatment protocol used in this study.

Table 1. Acceptance and Commitment Therapy Protocol Adopted in This Trial for Lupus Patients

Session	Aim	Contents and Activities
1	Introduction	The initial session focused on building rapport between the patient and therapist and outlining the study's objectives and the foundational principles of the therapeutic model. As a first homework assignment, patients were asked to identify and list five significant life challenges they encountered.
2	Examining the inner and outer world in the ACT	The therapist initiated the session by discussing the patient's completion of the previous homework. Together, they reframed the patient's challenges within the ACT model, pinpointing patterns of avoidance, cognitive fusion, and value-driven directions. To foster insight, the patient's new homework was to compile a list analyzing the benefits and drawbacks of their current approaches to controlling problems.
3	Specifications of values, objectives, actions and obstacles	This session involved reviewing the previous homework and educating the patient on the futility of controlling unwanted thoughts and feelings, facilitated by therapeutic metaphors. The core skill of accepting emotions, rather than resisting them, was taught. The corresponding homework was to log examples of successfully letting go of unworkable control methods.
4	Examining the values of each person and deepening the previous concepts	This session involved reviewing the previous homework and teaching patients to differentiate between actual experiences and their subjective evaluations through the "bad cup" metaphor. The core skill developed was learning to notice thoughts from a detached perspective without evaluation. The homework assignment was to document examples of successfully maintaining this observational stance toward emotions and experiences.
5	Understanding fusion and defusion and practice for defusion	Following a review of the prior session's assignment, this session focused on cultivating present-moment connection and establishing a transcendent sense of self using the chessboard metaphor. Patients learned specific mindfulness exercises. Their homework was to log examples of effectively employing these mindfulness techniques to neutrally observe their thoughts.
6	Understanding fusion with self-conceptualization and teaching how to defuse from it	The session began with a review of the patient's homework. The therapist then facilitated a process to help the patient identify their core life values and prioritize them according to personal significance. For homework, the patient was instructed to compile a list of challenges that impede living in accordance with these identified values.
7	Emphasis on being in the present	Following a review of the prior assignment, this session focused on generating practical solutions to overcome obstacles, aided by therapeutic metaphors, and creating a specific plan for value-driven action. The homework required patients to report on their implementation of these value-based steps and to reflect on their therapeutic achievements.
8	Investigating the story of life and committed action	The final session was dedicated to consolidating the key concepts covered throughout the therapeutic program. Participants were invited to articulate the personal gains they had made during treatment and to outline their intentions for maintaining these changes and pursuing their values in the future.

General Health Education

Participants in the GHE group underwent a structured program designed to serve as an active control condition. This intervention, administered by a research assistant to small groups of three to five individuals, consisted of eight 60-minute sessions, held twice weekly. The curriculum was specifically adapted to address general health and wellness topics relevant to managing a chronic autoimmune condition like lupus. The content was delivered through diverse methods such as audiovisual presentations, demonstrations, and videos, supplemented by educational pamphlets and posters. This active control was crucial to isolate the specific effects of ACT by controlling for non-specific therapeutic factors, such as clinician attention, group support, and time spent in a structured activity. The schedule of topics is provided in Table 2.

Table 2. General Health Education Protocol Adopted in This Trial for Lupus Patients

Session	Topic	Contents and Activities
1	Managing Fatigue	Provide education on the nature of lupus-related fatigue and strategies for energy conservation and pacing to manage daily activities.
2	Lupus & Nutrition	Offer guidance on anti-inflammatory dietary choices, interpreting nutritional labels for hidden additives, and managing common food sensitivities that may affect lupus symptoms.
3	Sun Protection	Discuss the critical importance of photoprotection in lupus, including the use of broad-spectrum sunscreen, protective clothing, and managing photosensitivity to prevent disease flares.
4	Joint Care	Introduce principles of protecting joints and managing pain and inflammation through gentle, lupus-appropriate range-of-motion exercises and ergonomic adaptations for daily tasks.
5	Skin Care	Emphasize the importance of gentle dermatological care for sensitive and lesion-prone skin, including product selection and management of common cutaneous manifestations of lupus.
6	Infection Prevention	Provide information on recognizing early signs of infection—a critical concern for immunocompromised individuals—and strategies for prevention, including hand hygiene and flu vaccination advisability.
7	Stress & Lupus	Discuss the bidirectional relationship between stress and lupus symptoms, introducing general education on the impact of stress on the immune system and basic relaxation techniques.
8	Building a Routine	Discuss the benefits of establishing predictable daily routines to manage variable lupus symptoms, followed by a demonstration of a simple, low-energy hobby suitable for periods of high fatigue.

Outcome Measures

Wisconsin Card Sorting Test (WCST). In the present study, WCST was used to measure executive function. This test is used to measure abstract reasoning, conceptualization, and repetitive responding in people aged 6.5 to 89 years. In this test, patients are asked to classify the cards presented to them based on one of the three principles related to class membership. The WCST utilizes a deck of 64 distinct cards featuring one to four instances of four different symbols: a red triangle, a green star, a yellow cross, and a blue circle. The examinee must sort the cards to match one of four key cards, inferring the current correct category (color, shape, or number) from the examiner's feedback. A key feature of the test is that after ten consecutive correct sorts, the valid sorting principle is changed without warning, requiring cognitive flexibility to adapt to the new rule. Previous studies have shown that this test has good validity and reliability in different populations, including the Indian population (26, 27). The analysis included four WCST measurements as defined in the manual: perseverative errors, perseverative responses, non-perseverative errors and categories completed.

Stroop Color Word Test (SCWT). This test is used to measure cognitive flexibility, resistance to the interference of external stimuli, and the ability to inhibit a dominant verbal response. Subject performance is compared in three tasks: reading words (W), naming colors (C) and naming color words (CW). In the last task, instead of reading the word, the patient must say the color of the ink in which the word is written (even when the word itself is the name of a different color) as fast as possible. Currently, normative data for this test are available for individuals aged 7 to 80. SCWT has three stages. In the first stage, the names of a number of colors appear randomly and the subject must read the words as quickly as possible. In the second stage, the same colors are painted and the subject must name them. In the third stage, color words are presented, but the ink color does not match the word (for example, blue is

written as green). The subject has to ignore the words and just name the color. Previous studies on Indian populations have confirmed the validity and reliability of this test (28). Recorded reaction times (RTs) of the SCWT in each three stages were included in the analysis.

Statistical Analysis

The primary null hypothesis (H_0) for the trial was that there would be no difference in the mean change in cognitive function scores from pre- to post-intervention across the three groups (ACT, GHE, and waitlist). The alternative hypothesis (H_1) was that at least one group would differ from the others. Specific contrasts were planned to test the primary research question of whether ACT was superior to GHE. Data normality was investigated with Kolmogorov-Smirnov criteria. Multivariate and univariate outliers were identified through Tabachnick and Fidell's criteria (29). Differences between groups before treatment were evaluated by independence tests (t-test and chi-square) and analyses of variance. Differences in outcome measures were evaluated through linear mixed models with maximum likelihood estimation and random intercepts. Group (ACT, GHE and waitlist), assessment time (pre- and post-intervention), and time × group interaction were considered as fixed effects, and patients were considered as random effects. Effects size was also computed through Cohen's d method. Stata 11 software was utilized for statistical analysis and significance level was set at 0.05.

Ethical Considerations

This study was approved by the Human Participants Ethics Committee of Symbiosis International (Deemed University) (SIU) and registered in the clinical trial registry of this university. We carried out the research project in strict accordance with the Declaration of Helsinki (1996) and prevailing Good Clinical Practice guidelines. We characterized the study's goal and overview to potential participants upon first contact. After providing all necessary details to interested individuals, we obtained written informed consent. We utilized all subject information anonymously and solely for the stated research purposes.

Results

90 patients who met the inclusion criteria were randomly assigned to ACT (n = 30), GHE (n = 30) or waitlist (n = 30) groups. However, the analysis included patients who completed the entire study procedure (n = 27 for ACT, n = 26 for GHE and n = 29 for waitlist group). Three patients from the ACT group and four patients from the GHE group were excluded from the study due to failure to complete the treatment sessions (Figure 1). Also, one patient from the waitlist group was excluded due to incomplete post-intervention assessments. As depicted in Figure 1, 82 of the 90 subjects (91.11%) completed the research procedure and were evaluated post-intervention. The proportion of completers was similar between the GHE and ACT groups at post-intervention ($\chi 2 = 5.88$, $P = 0.92$). Normality test along with kurtosis and skewness data showed that all variables had normal distribution. Moreover, no multivariate or univariate outlier was identified ($P < 0.01$).

As summarized in Table 3, no significant differences were found in sociodemographic parameters among the three groups at baseline ($P > 0.05$). These parameters included age, gender, duration of illness, educational level and marital status.

Table 3. Comparison of Acceptance and Commitment Therapy (ACT), General Health Education (GHE) and Waitlist Groups at Pre-Intervention Assessment

Variable	ACT group (n = 27)	GHE group (n = 26)	Waitlist group (n = 29)	F-value (P)	χ^2 (P)
Age (mean ± SD), year	43.56 ± 10.26	44.10 ± 11.51	44.61 ± 12.20	0.038 (0.96)	
Duration of illness (mean ± SD), year	8.51 ± 3.33	7.42 ± 2.98	9.12 ± 4.65	0.890 (0.41)	
Gender (female), n (%)	15 (88.23)	15 (93.75)	17 (89.47)		1.84 (0.65)
Education (with college education), n (%)	12 (70.58)	12 (75.00)	14 (73.68)		5.91 (0.81)
Marital status (single), n (%)	3 (17.64)	2 (12.50)	2 (10.52)		11.02 (0.20)

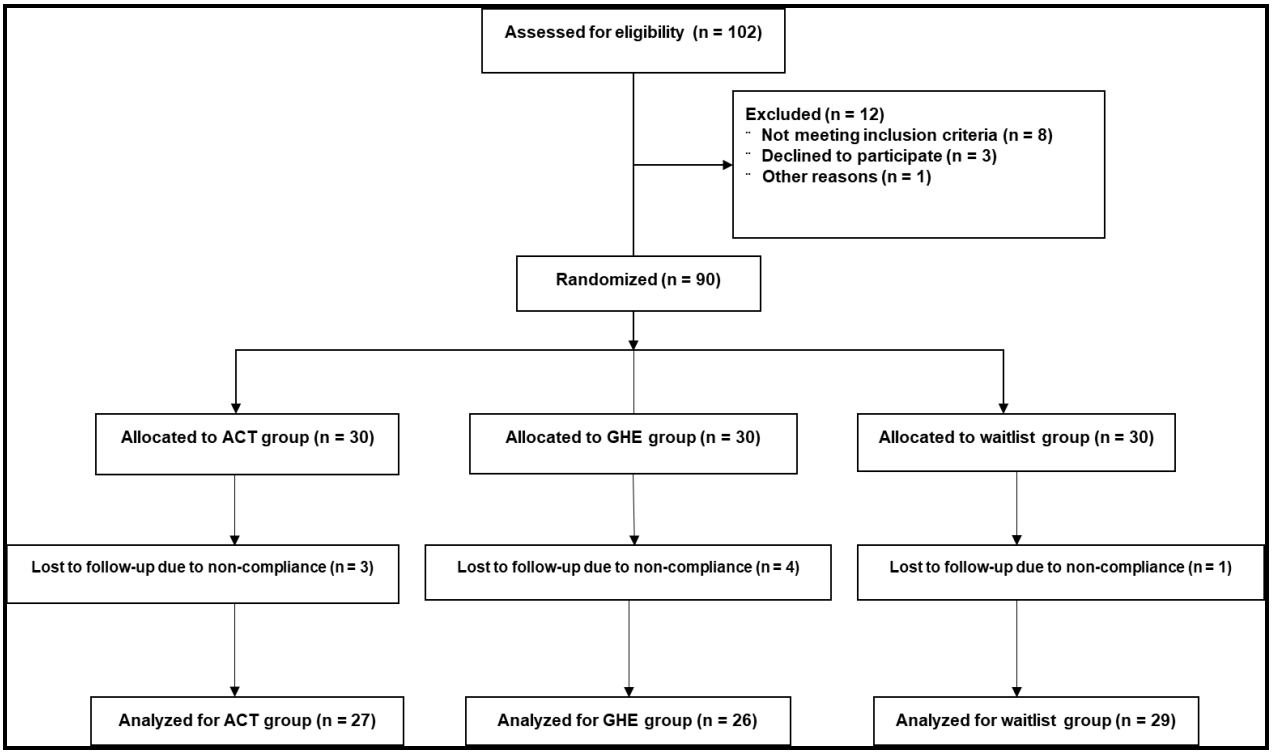

Figure 1. CONSORT Flow Diagram of the Experimental Study Assessing the Effects of Acceptance and Commitment Therapy on Attention and Executive Functions in Lupus Patients

ACT versus waitlist

Table 4 presents the mean values for intervention conditions across time for all outcome measures. No significant difference was observed in the research variables at pre-intervention ($P > 0.05$). For changes in WCST variables, contrasts showed that the ACT group had significantly better cognitive performance at post-intervention compared to the waitlist group [time × group effect estimation for total errors = -7.96, t (161.35) = 4.12, $P < 0.001$); time × group effect estimation for categories = 5.85, t (134.63) = 3.25, $P < 0.01$)]. Cohen's d for these effects were 0.86 and 0.80, respectively, which represent a large effect size for ACT intervention. Comparison of changes in reaction time from baseline to post-intervention revealed that the ACT group had a significantly faster reaction time only in stage I compared to the waitlist group [time × group effect estimation = -4.59, t (142.21) = 3.08, $P < 0.01$)]. Cohen's d for this effect was 0.70, which represents a moderate effect size. However, no significant difference was observed between the ACT and waitlist groups in terms of reaction times in stages II and III of the SCWT ($P > 0.05$).

GHE Versus Waitlist

For changes in WCST variables, contrasts comparing the GHE and waitlist group showed that the GHE group had significantly better cognitive performance from baseline to post-intervention [time × group effect estimation for total errors = -4.96, t (151.05) = 3.12, $P < 0.01$); time × group effect estimation for categories = 3.46, t (142.97) = 2.84, $P = 0.028$)]. Cohen's d for these effects were 0.65 and 0.58, respectively, which represents a moderate effect size for the GHE intervention. Comparison of changes in reaction time from baseline to post-intervention revealed that the GHE group had a significantly faster reaction time only in stage I compared to the waitlist group [time × group effect estimation = -3.59, t (163.28) = 3.01, $P < 0.01$)]. Cohen's d for this effect was 0.55, representing a moderate effect size. However, no significant difference was observed between the GHE and waitlist groups in terms of reaction times in stages II and III of the SCWT ($P > 0.05$).

ACT Versus GHE

The ACT group demonstrated significantly better cognitive function than the GHE group post-intervention, with the only significant difference being on the WCST total errors score [time × group effect estimation = -3.81, t (174.35) = 2.39, $P = 0.04$)]. Cohen's d for this effect was 0.54. However, no other significant differences were observed between the ACT and GHE groups on the remaining WCST measures (perseverative errors, perseverative responses, non-perseverative errors, categories completed) or on any of the three stages of the SCWT (all $P > 0.05$).

Table 4. Executive Cognitive Functioning of Lupus Patients before and after Intervention in Wisconsin Card Sorting Test and Stroop Color Word Test

Measure	Condition	Pre-intervention	Post-intervention
	WCST		
Perseverative errors	ACT (n = 27)	22.10 ± 12.69	15.84 ± 10.25
	GHE (n = 26)	21.87 ± 13.36	17.35 ± 12.57
	Waitlist (n = 29)	22.81 ± 15.17	21.14 ± 16.43
Perseverative responses	ACT (n = 27)	25.21 ± 14.52	16.25 ± 8.63
	GHE (n = 26)	25.36 ± 18.98	19.34 ± 12.11
	Waitlist (n = 29)	26.08 ± 16.82	24.63 ± 17.98
Non-perseverative errors	ACT (n = 27)	34.96 ± 22.36	23.88 ± 13.25
	GHE (n = 26)	35.72 ± 25.49	28.05 ± 10.33
	Waitlist (n = 29)	35.17 ± 21.30	33.23 ± 25.71
Categories completed	ACT (n = 27)	2.42 ± 1.79	4.10 ± 2.32
	GHE (n = 26)	2.50 ± 1.43	3.82 ± 2.31
	Waitlist (n = 29)	2.63 ± 1.29	2.89 ± 1.80
	SCWT		
Stage I (sec)	ACT (n = 27)	14.37 ± 3.59	9.41 ± 2.78
	GHE (n = 26)	13.80 ± 3.01	10.22 ± 2.62
	Waitlist (n = 29)	14.46 ± 4.21	13.51 ± 3.63
Stage II (sec)	ACT (n = 27)	17.18 ± 4.30	16.05 ± 4.22
	GHE (n = 26)	18.54 ± 4.29	16.94 ± 4.59
	Waitlist (n = 29)	17.70 ± 4.85	17.93 ± 5.26
Stage III (sec)	ACT (n = 27)	26.95 ± 9.65	24.11 ± 10.25
	GHE (n = 26)	27.42 ± 8.63	24.96 ± 9.84
	Waitlist (n = 29)	26.58 ± 9.10	26.88 ± 11.16

ACT = Acceptance and commitment therapy; GHE = General health education.

Discussion

The aim of this study was to examine the effectiveness of ACT for executive cognitive function in patients with lupus. Both ACT and GHE were delivered in an individualized treatment protocol and compared to a waitlist group. Both interventions had a positive and significant effect on the cognitive outcomes of lupus patients compared to the control conditions. However, ACT appears to have a larger effect size and is probably a better intervention approach for improving attention and cognitive functions in lupus patients. Previous studies have also reported the positive effects of ACT on executive cognitive functions in patients with cancer (30), epilepsy (31) and depression (32). Consistent with our findings, a recent systematic review supported the effectiveness of ACT in improving several cognitive

domains across different populations, a benefit that is attributable to its transdiagnostic focus on promoting psychological flexibility (23). The effectiveness of the ACT approach in improving the attention and cognitive functions of lupus patients can be attributed to several key factors. First, removing unwanted experiences in the process of ACT therapy preserves health and energy and improves performance in facing high-risk problems and ultimately increases cognitive, emotional, and psychological regulation (33). Second, the effectiveness of ACT in reducing and managing anxiety should be considered. This is critical because excessive anxiety disrupts cognitive structures and effective perception of the environment, while also causing excessive secretion of systemic adrenaline and noradrenaline (34-36). However, by creating mental peace and positive thinking in patients, ACT may help adjust their cognitive structures (37). It is important to note that these are proposed mechanisms; the current study did not directly measure anxiety or physiological stress markers to confirm these pathways. Future research should directly test these mediators. Third, it should be noted that paying attention to past performance is one of the internal factors of attention deviation (38). Because one of the stages of ACT training is contact with the present moment, this intervention can help control this internal factor of attention deviation in lupus patients. Moreover, another step of ACT is determining values and committed action, and determining values prevents indifference and apathy in the patient, which is one of the factors of attention deviation (31). On the other hand, the improvement of mental health and well-being caused by ACT allows patients to achieve a higher cognitive and metacognitive focus, which enhances mental organization, and in turn, improves their executive functions (25).

The specific pattern of improvement on the SCWT offers a nuanced insight into the cognitive benefits observed. Significant post-intervention improvements were found specifically in Stage I (word reading), which is a measure of basic processing speed and reading automaticity. In contrast, no significant group differences emerged in Stage II (color naming) or, more notably, in Stage III (interference condition), which is the key measure of cognitive inhibition and executive control. This pattern suggests that the interventions, particularly ACT, may have enhanced fundamental processing speed but did not significantly improve the more complex executive functions of cognitive flexibility and resistance to interference. A potential explanation is that the four-week intervention duration was sufficient to impact baseline attentional efficiency but insufficient to alter the more entrenched inhibitory control processes that are often affected by chronic autoimmune conditions like lupus. The absence of improvement in the interference condition indicates that while ACT may help patients become more efficient in straightforward tasks, targeting the specific cognitive deficits related to executive control may require longer or more directly focused interventions.

In addition, GHE also had a moderate effect on cognitive executive functions in lupus patients, which is consistent with previous research (38-41). This finding is consistent with the design of GHE as an active control condition, which effectively controls for non-specific factors such as therapeutic alliance, group support, and the simple act of participating in a structured protocol. These elements can positively influence a patient's mood, engagement, and perceived support, potentially leading to secondary improvements in cognitive test performance. However, the significantly larger effect sizes observed in the ACT group suggest that the mechanisms of change in ACT—such as promoting psychological flexibility, reducing cognitive fusion, and enhancing committed action—are actively and specifically responsible for cognitive improvement, above and beyond these non-specific effects.

Beyond statistical significance, the clinical meaning of the observed improvements warrants consideration. The reduction in WCST total errors for the ACT group (approximately 8 errors) represents a large effect (Cohen's $d > 0.80$). While specific benchmarks for clinically significant change on the WCST in lupus populations are not yet established, improvements of this magnitude in other clinical conditions have been associated with measurable enhancements in daily life, such as better problem-solving in unstructured situations, reduced perseveration on ineffective strategies, and improved mental flexibility in managing complex tasks (42). Similarly, the faster reaction time on the SCWT Stage I suggests improved processing speed, which can facilitate quicker comprehension of information and more efficient task engagement. Future studies should include measures of functional capacity or quality of life to directly correlate these cognitive gains with improvements in patients' daily activities.

Limitation

The use of a convenience sample from a single trust in Kochi, India, while necessary due to difficulties in accessing this patient population, may introduce selection bias. For instance, individuals who volunteer for an intervention study may be more motivated or have different baseline characteristics than the general lupus population, potentially limiting the generalizability of the findings. In addition, it should be noted that this study was limited to people aged 20 to 60 years with lupus, and caution should be exercised in generalizing its results to other age ranges and clinical populations. Also, although the sample size was an improvement over previous studies, a larger sample would enhance the generalizability of the findings. Furthermore, lack of follow-up of patients due to time and budget constraints is another serious problem of this study. While the interventions demonstrated efficacy immediately post-treatment, it remains unknown whether the observed

cognitive improvements were maintained over time. The sustainability of these effects is a crucial clinical question, and determining the long-term impact of ACT on cognitive function in lupus patients is an essential goal for future longitudinal research.

Conclusion

In summary, this RCT demonstrates that ACT is a promising intervention for improving cognitive function in patients with systemic lupus erythematosus, showing a large effect size that was superior to that of GHE on a key measure of executive function. These findings support the integration of ACT into comprehensive care plans for lupus patients to address cognitive deficits. To build upon this work, future research should prioritize several key directions: (I) conducting longitudinal studies with long-term follow-up assessments to determine the durability of cognitive improvements; (II) employing neuroimaging techniques to correlate behavioral changes with underlying neural mechanisms; and (III) investigating the optimal dose and format of ACT required for maximal cognitive benefit. Such studies will be crucial for consolidating ACT's role in managing the cognitive sequelae of lupus.

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Conflict of Interest

None.

Author's Contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Suleiman Ibrahim Mohammad, Asokan Vasudevan, Zhanna R. Gardanova, and Hamza Fadhel Hamzah. The first draft of the manuscript was written by Bahira Abdulrazzaq Mohammed and KDV Prasad and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References

1. Bakshi J, Segura BT, Wincup C, Rahman A. Unmet Needs in the Pathogenesis and Treatment of Systemic Lupus Erythematosus. Clin Rev Allergy Immunol. 2018;55(3):352-67.
2. Jolly M, Pickard SA, Mikolaitis RA, Rodby RA, Sequeira W, Block JA. LupusQoL-US benchmarks for US patients with systemic lupus erythematosus. J Rheumatol. 2010;37(9):1828-33.
3. Akbarian M, Faezi ST, Gharibdoost F, Shahram F, Nadji A, Jamshidi AR, et al. Systemic lupus erythematosus in Iran: a study of 2280 patients over 33 years. Int J Rheum Dis. 2010;13(4):374-9.
4. Fatoye F, Gebrye T, Mbada C. Global and regional prevalence and incidence of systemic lupus erythematosus in low-and-middle income countries: a systematic review and meta-analysis. Rheumatol Int. 2022;42(12):2097-107.
5. Seet D, Allameen NA, Tay SH, Cho J, Mak A. Cognitive Dysfunction in Systemic Lupus Erythematosus: Immunopathology, Clinical Manifestations, Neuroimaging and Management. Rheumatol Ther. 2021;8(2):651-79.
6. Kakati S, Barman B, Ahmed SU, Hussain M. Neurological Manifestations in Systemic Lupus Erythematosus: A Single Centre Study from North East India. J Clin Diagn Res. 2017;11(1):Oc05-oc9.
7. Palagini L, Mauri M, Faraguna U, Carli L, Tani C, Dell'Osso L, et al. Insomnia symptoms, perceived stress and coping strategies in patients with systemic lupus erythematosus. Lupus. 2016;25(9):988-96.
8. Ceccarelli F, Perricone C, Pirone C, Massaro L, Alessandri C, Mina C, et al. Cognitive dysfunction improves in systemic lupus erythematosus: Results of a 10 years prospective study. PLoS One. 2018;13(5):e0196103.
9. Petri M, Naqibuddin M, Carson KA, Wallace DJ, Weisman MH, Holliday SL, et al. Depression and cognitive impairment in newly diagnosed systemic lupus erythematosus. J Rheumatol. 2010;37(10):2032-8.
10. Sweet JJ, Doninger NA, Zee PC, Wagner LI. Factors influencing cognitive function, sleep, and quality of life in individuals with systemic lupus erythematosus: a review of the literature. Clin Neuropsychol. 2004;18(1):132-47.
11. Garcia RJ, Francis L, Dawood M, Lai ZW, Faraone SV, Perl A. Attention deficit and hyperactivity disorder scores are elevated and respond to N-acetylcysteine treatment in patients with systemic lupus erythematosus. Arthritis Rheum. 2013;65(5):1313-8.
12. Barraclough M, McKie S, Parker B, Jackson A, Pemberton P, Elliott R, et al. Altered cognitive function in systemic lupus erythematosus and associations with inflammation and functional and structural brain changes. Ann Rheum Dis. 2019;78(7):934-40.
13. Watson P, Storbeck J, Mattis P, Mackay M. Cognitive and emotional abnormalities in systemic lupus erythematosus: evidence for amygdala dysfunction. Neuropsychol Rev. 2012;22(3):252-70.
14. Benedict RH, Shucard JL, Zivadinov R, Shucard DW. Neuropsychological impairment in systemic lupus erythematosus: a comparison with

multiple sclerosis. Neuropsychol Rev. 2008;18(2):149-66.
15. Ghazagh M, Vazir S, Zareh H. A Review of the Effect of Acceptance and Commitment Therapy (ACT) and Intensive Short-Term Dynamic Psychotherapy (ISTDP) on Executive Cognitive Functions in Lupus Patients. Clinical Schizophrenia & Related Psychoses. 2022;16.
16. Beygi Z, Tighband Jangali R, Derakhshan N, Alidadi M, Javanbakhsh F, Mahboobizadeh M. An Overview of Reviews on the Effects of Acceptance and Commitment Therapy (ACT) on Depression and Anxiety. Iran J Psychiatry. 2023;18(2):248-57.
17. van de Graaf DL, Trompetter HR, Smeets T, Mols F. Online Acceptance and Commitment Therapy (ACT) interventions for chronic pain: A systematic literature review. Internet Interv. 2021;26:100465.
18. Sahebari M, Asghari Ebrahimabad MJ, Ahmadi Shoraketokanlo A, Aghamohammadian Sharbaf H, Khodashahi M. Efficacy of Acceptance and Commitment Therapy in Reducing Disappointment, Psychological Distress, and Psychasthenia among Systemic Lupus Erythematosus (SLE) Patients. Iran J Psychiatry. 2019;14(2):130-6.
19. Akhtar Z, Majeed S. Efficacy of Acceptance and Commitment Therapy for Psychological Distress in Patients with Systemic Lupus Erythematous. Pakistan Journal of Medical & Health Sciences. 2022;16(09):96-.
20. Arjol D, Barbero-Rubio A. A brief acceptance and commitment therapy group intervention on systemic lupus erythematosus. Revista de Psicoterapia. 2022;33(122):105-27.
21. Zhang CQ, Leeming E, Smith P, Chung PK, Hagger MS, Hayes SC. Acceptance and Commitment Therapy for Health Behavior Change: A Contextually-Driven Approach. Front Psychol. 2017;8:2350.
22. Sarihi N, Manavipour D, Sdaghatifard M. Comparing the effectiveness of ISTDP intervention program, awareness training, and its application on executive functions. Psychol Sci. 2020;19(87):339-48.
23. Liu H, Liu N, Chong ST, Boon Yau EK, Ahmad Badayai AR. Effects of acceptance and commitment therapy on cognitive function: A systematic review. Heliyon. 2023;9(3):e14057.
24. Cuevas H, Heitkemper E, Kim J. Subjective Cognitive Dysfunction in Chronic Illness: A Systematic Review and Meta-Synthesis. West J Nurs Res. 2024;46(9):708-24.
25. Hayes SC, Luoma JB, Bond FW, Masuda A, Lillis J. Acceptance and commitment therapy: model, processes and outcomes. Behav Res Ther. 2006;44(1):1-25.
26. Kohli A, Kaur M. Wisconsin Card Sorting Test: Normative data and experience. Indian J Psychiatry. 2006;48(3):181-4.
27. Singh S, Aich TK, Bhattarai R. Wisconsin Card Sorting Test performance impairment in schizophrenia: An Indian study report. Indian J Psychiatry. 2017;59(1):88-93.
28. Rao A, Rao AR, Painkra B, Kiruthika S, Kumar S, Thakral M, et al. Cognitive assessment across normal aging and subjective cognitive decline using PGIMS and Stroop color-word test: A cross-sectional study. Arch Gerontol Geriatr Plus. 2025;2(2):100133.
29. Fidell LS, Tabachnick BG. Preparatory data analysis. Handbook of psychology. 2003:115-41.
30. Shari NI, Zainal NZ, Ng CG. Effects of brief acceptance and commitment therapy (ACT) on subjective cognitive impairment in breast cancer patients undergoing chemotherapy. J Psychosoc Oncol. 2021;39(6):695-714.
31. Rahbar Karbasdehi F, Hosseinkhanzadeh AA, Shakerinia I. The Efficacy of Acceptance and Commitment Therapy on Cognitive Emotion Regulation and Social Self-Efficacy in Adolescents with Epilepsy. Journal of Applied Psychological Research. 2022;13(2):1-16.
32. Amiri S, Ehtesham Zadeh P, Hafezi F, Borna MR. Comparison of the Effectiveness Behavioral Activation Treatment Therapy and Acceptance and Commitment Therapy on Executive Functions of Learning the Rules, Inhibiting Impulsivity, and Flexibility in Patients with Depression. Shefaye Khatam. 2021;9(2):68-78.
33. Alizadeh S, Taklavi S, Mahmoud Alilou M. Effectiveness of Online Existential Therapy on Attitude toward Life and Perplexities related to Death in Recovered Patients of Covid-19. Research in Cognitive and Behavioral Sciences. 2021;11(1):145-62.
34. Twohig MP, Levin ME. Acceptance and Commitment Therapy as a Treatment for Anxiety and Depression: A Review. Psychiatr Clin North Am. 2017;40(4):751-70.
35. Khaleghi A, Mohammadi MR, Shahi K, Nasrabadi AM. Computational Neuroscience Approach to Psychiatry: A Review on Theory-driven Approaches. Clin Psychopharmacol Neurosci. 2022;20(1):26-36.
36. Khaleghi A, Shahi K, Saidi M, Babaee N, Kaveh R, Mohammadian A. Linear and nonlinear analysis of multimodal physiological data for affective arousal recognition. Cogn Neurodyn. 2024;18(5):2277-88.
37. Kelson J, Rollin A, Ridout B, Campbell A. Internet-Delivered Acceptance and Commitment Therapy for Anxiety Treatment: Systematic Review. J Med Internet Res. 2019;21(1):e12530.
38. Kozora E, Zell JL, Baraghoshi D, Smith RM, Strand M. Improved executive function in patients with systemic lupus erythematosus following interactive digital training. Lupus. 2022;31(8):910-20.
39. Zahiri S, Jahani S, Sayadi N, Cheraghian B, Rajaei E. The effects of an educational intervention on fatigue and activities of daily living in patients with systemic lupus erythematosus. Nurs Midwifery Stud. 2022;11(1):24-30.
40. Tsoi A, Gomez A, Boström C, Pezzella D, Chow JW, Girard-Guyonvarc'h C, et al. Efficacy of

lifestyle interventions in the management of systemic lupus erythematosus: a systematic review of the literature. Rheumatol Int. 2024;44(5):765-78.
41. Tajik E, Mohammadi MR, Rahmanian H. A Randomized Controlled Trial of a Healthy Lifestyle Intervention to Improve Mental Health among School-Going Adolescents. Iran J Psychiatry. 2025;20(3):289-303.
42. Cai H, Li G, Hua S, Liu Y, Chen L. Effect of exercise on cognitive function in chronic disease patients: a meta-analysis and systematic review of randomized controlled trials. Clin Interv Aging. 2017;12:773-83.