Cognitive Characteristics of Depressive Mood in College students and the Intervention Effect of Cognitive Behavioral Therapy (CBT)

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ABSTRACT College students face psychological challenges such as academic stress, interpersonal difficulties, and uncertainty about future planning, which contribute to the increasing prevalence of depressive mood and affect academic performance and physical and mental health. This study examines the cognitive characteristics of depressive mood among college students and evaluates the intervention effect of cognitive behavioral therapy. A total of 120 students with depressive mood are randomly assigned to an experimental group and a control group, with 60 participants in each group. The experimental group receives an eight-week CBT intervention, once per week for 90 minutes, including cognitive restructuring, behavioral activation, and problem-solving skills training. The control group receives regular mental health education. Changes are measured using the Beck Depression Inventory, Automatic Thoughts Questionnaire, and Dysfunctional Attitudes Scale before and after intervention and at follow-up. The results show that the BDI score in the experimental group decreases from 28.3 ± 6.2 at baseline to 12.5 ± 4.8 after intervention. CBT effectively improves depressive mood and cognitive bias among college students.

INDEX TERMS college students, depressive mood, cognitive behavioral therapy, cognitive bias, intervention effect

I. INTRODUCTION

STUDENTS of universities experience numerous psychological issues, such as academic pressure, interpersonal relationships, and the fear of future planning. Depressive mood is becoming more and more frequent, which has a significant negative impact on their academic performance, social functioning, and physical and mental health [1,2]. Unless the depressive mood is addressed in good time, it can evolve into major depressive disorder or even result in extreme actions like self-cutting and suicide. This has been a critical issue that has to be addressed urgently in the mental health practice of universities.

According to cognitive theory, a depressive mood is caused by negative cognitive biases regarding the self, the world, and the future. By detecting and rectifying the dysfunctional thinking patterns and re-creating adaptive thinking and behavioral patterns, cognitive behavioral therapy (CBT) has been shown to be of great significance in the treatment of depressive disorders. This treatment is very rigorous, the treatment course is relatively short and technically viable, thus it can be used widely in universities [3,4].

At the moment, limited systematic research on the cognitive features of the depressive mood in college students exists, and there is a lack of empirical studies on the efficiency of CBT intervention. This paper is a systematic examination of the cognitive attributes of depressive mood in college students based on a randomized controlled trial, determination of the short-term outcomes and one-month maintenance effects of CBT intervention, and offers a scientific foundation and a generalizable intervention program to campus mental health services.

II. RELATED WORK

Cognitive theories of depressive mood propose that people process external information based on certain cognitive schemas, which develops a negative belief system about themselves, the world, and the future. Depressed people have selective attention to negative information, selective ignorance of positive information, as well as interpretation of life events in the form of cognitive distortions, including catastrophizing and overgeneralization [5,6]. Having entered an identity transition and self-exploration stage, university students are more likely to form dysfunctional attitudes like perfectionism and dependency. The interaction of these cognitive biases with environmental factors, including aca-

demic pressure and peer comparison, sustains and increases depressive mood. The available literature is mostly devoted to symptoms of depression, and the detailed study of the peculiarities of cognitive features of university students is not made.

CBT is an example of the first-line psychotherapy that has been extensively applied in clinical settings and has been used as a treatment of depressive disorders. This treatment assists people to break the vicious cycle of negative thinking, feeling, and acting using technical courses like cognitive restructuring, behavioral activation, and problem-solving training. Both domestic and foreign research has demonstrated that CBT can be applied to treat adult depression disorders, however, there is a relative paucity of intervention studies that focus on subclinical levels of depressive symptoms in college students, and intervention protocols and follow-up measurements are yet to be standardized [7,8]. Moreover, the responsiveness to CBT of various cognitive biases has not been studied exhaustively, which restricts the creation of individual intervention programs.

III. METHODS

A. RESEARCH SUBJECTS AND GROUP DESIGN

The study obtained participants among the students of a comprehensive university between the 2023 and 2025 cohorts. Initial screening was done using the Beck Depression Inventory (BDI). Inclusion criteria: BDI score 14-29 (mild to moderate depression), age 18-24 years, no mental illness history, no antidepressants, willing to participate in the study, and informed consent. Exclusion criteria were: suicidal tendencies (BDI suicide item > 2), severe physical illness and received psychotherapy in the last 6 months [9,10]. Following the screening, 156 students passed the inclusion criteria. The study was left with 120 students after 36 of them were eliminated based on time conflicts. A preliminary analysis showed no significant differences in BDI scores or demographic variables between the excluded students and the final sample ($p > 0.05$). However, the high pre-randomization attrition rate remains a potential source of selection bias that may limit the generalizability of these findings to the broader student population.

The participants were randomly assigned to an experimental group and a control group with 60 participants each through a random number table. The experimental group (26 males and 34 females) and the control group (28 males and 32 females) had a mean age of 20.3 years and 20.1 years, respectively. No statistically significant difference was found between the two groups regarding gender, age, grade distribution, family economic status, or baseline BDI scores ($p > 0.05$). The experimental group was subjected to 8 weeks CBT intervention and the control group was subjected to a mental health knowledge lecture of the same duration. This study was approved by the Ethics Committee of Shaanxi University of International Trade & Commerce, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form. To partially control for the attention effect, the control group lectures were delivered in a group format, though they lacked the interactive skill-building and behavioral assignments inherent to the experimental condition.

B. COGNITIVE BEHAVIORAL THERAPY INTERVENTION PROGRAM

The experimental group underwent 8 weeks of structured CBT intervention with one session per week lasting 90 minutes in total with 3 therapists having national qualifications of level two psychological counselor and professional training in CBT. Every therapist had 20 participants. Treatment was done in groups of 6-8. Weeks 1-2 are devoted to cognitive education, which describes the model of the cognitive triangle of Beck (thought-emotion-behavior) and the method of teaching to recognize the automatic thoughts. Participants complete a thought log to document negative events that occur daily, content of their automatic thoughts, intensity of their emotions, and their physical response with the therapists making comments on the quality of each entry. Weeks 3-4 entail cognitive restructuring training where participants are directed to challenge negative thoughts by the Socratic method of questioning including seven standardized questions, including: What evidence supports this thought? and Are there any other possible explanations? This assists in the creation of alternative thoughts and evaluation of emotional changes. The intervention of behavioral activation was conducted conducted during Weeks 5-6, during which participants prepared daily activity plans, with at least three activities listed as enjoyable and two as achievement activities, and will record the completion of activities and the rating of their pleasure (0-10). Weeks 7-8 practice problem-solving, solving particular situations through a five-step model: problem definition, goal setting, solution generation, solution evaluation and implementation feedback. In every session, 2-3 real-life cases are discussed.

C. MEASUREMENT TOOLS AND EVALUATION INDICATORS

The intervention effect was measured with the help of three standardized scales in this study. The Beck Depression Inventory (BDI) consists of 21 items, all rated between 0 and 3, resulting in a total score of 0 to 63, and evaluates the intensity of depressive symptoms in the participants during the last two weeks. The value of Cronbachs alpha coefficient of this scale among the Chinese university student population was 0.89. Automatic Thoughts Questionnaire (ATQ) has 30 questions with a 5-point Likert scale (1 = never, 5 = always) that evaluates how often and how strongly negative automatic thoughts occur. The scores above 1 denote more negative thoughts, and the internal consistency coefficient is 0.92. The Dysfunctional Attitude Scale (DAS) has 40 questions, again with a 5-point Likert scale, assessing the patterns of cognitive bias of the participants on seven dimensions, such as perfectionism, dependency, and self-

worth, and the total score is 40 to 200. The test-retest reliable of this scale was 0.84.

The time points of measurement were established as follows: prior to intervention (T0), right after intervention (T1), and one month after intervention (T2). All the scales were given by assessors not involved with the therapists and were not aware of groupings of the participants. The participants filled the questionnaires by themselves in a quiet space within a 30 minutes time constraint and the assessors ensured that they did not leave out any item and reminded them to fill them in.

D. DATA COLLECTION AND STATISTICAL ANALYSIS METHODS

Two research assistants used a mixture of paper and electronic questionnaires to collect the data. The questionnaires were filled at three points, T0, T1, and T2. The research assistants verified the completeness of the questionnaires after every completion and gaps in the questionnaires were filled immediately. The experimental group completed thought record sheets and plans of behavioral activities following the treatment at the end of each week. These were scanned, archived and coded by the therapists as electronic data. The control group provided their mental health learning notes weekly. The experimental group had to have an attendance of 75 percent (at least 6 treatment sessions). In the end, 3 participants in the experimental group were dropped because of inadequate attendance, and 5 in the control group dropped out in the middle and this gave a valid sample size of 112 (57 in the experimental group and 55 in the control group).

The SPSS 26.0 statistical software was used in data analysis. To maintain the integrity of the randomization, an Intention-to-Treat (ITT) analysis was performed for all primary outcomes, with missing data at T1 and T2 handled via the last observation carried forward (LOCF) method. Both ITT and per-protocol results were compared to ensure the robustness of the findings. Baseline differences between the two groups were compared by independent samples t-tests. Repeated measures ANOVA was used to test the interaction effect between group (experimental group vs. control group) and time (T0, T1, T2). The differences between the different time points within each group were compared by the use of paired samples t-tests and the effect size was calculated by the use of Cohen d. Changes in ATQ and DAS scores across all dimensions were analyzed by analysis of covariance (ANCOVA) and baseline scores were covariates. The level of significance was established at 0.05 and the tests were two tailed.

IV. RESULTS AND DISCUSSION

A. ANALYSIS OF THE COGNITIVE CHARACTERISTICS OF DEPRESSIVE MOOD AMONG COLLEGE STUDENTS

Cognitive characteristics were studied on baseline data (T0) of 120 participants. The 10 highest items in the ATQ scale were identified and the average score and the frequency of each of the item (percentage of respondents who scored 4 and above) was obtained. The scores of the seven dimensions of the DAS scale were subjected to descriptive statistics and the mean, standard deviation, and percentage of participants who went above the threshold (mean score exceeds 3.5) of each dimension were determined. The correlation between the total score of ATQ and the scores of each dimension of DAS and the total score of BDI was investigated using Pearson correlation analysis to determine which cognitive biases were most correlated with depressive symptoms.

TABLE 1. Analysis Results of Cognitive Characteristics of Depressive Mood among College Students

Cognitive characteristics category	Specific content	mean ± standard deviation	High frequency occurrence rate (%)	Correlation coefficient with BDI
Top 3 Negative Automatic Thoughts	I feel like a failure.	3.82 ± 0.91	73.3	0.68^{***}
	My future is hopeless.	3.65 ± 0.98	68.7	0.71^{***}
	I have let down those around me.	3.54 ± 1.02	64.2	0.63^{***}
Dysfunctional Attitudes - Perfectionism	If I'm not the best, then I've failed.	3.89 ± 0.76	78.3	0.59^{***}
Dysfunctional attitude-dependence	I need others' approval to have value.	3.72 ± 0.84	71.7	0.54^{***}
Dysfunctional attitudes - vulnerability	I am unable to cope with the difficulties in life	3.61 ± 0.88	66.7	0.61^{***}
Dysfunctional Attitudes-Achievement Assessment	My value depends on my achievements.	4.01 ± 0.69	82.5	0.66^{***}

Note: ***p<0.001; High frequency occurrence rate refers to the percentage of participants who scored ≥ 4 points on this item.

This study found that college students' depressive symptoms exhibited significant cognitive biases. Regarding negative automatic thoughts, "feelings of failure," "hopelessness," and "guilt" constituted a cognitive triad, with over 60% of participants frequently exhibiting these thoughts, highly consistent with Beck's cognitive theory of depression. Correlation analysis showed that hopelessness was most strongly associated with depressive symptoms ($r = 0.71$), indicating that pessimistic expectations about the future are a key cognitive factor in college students' depression. Regarding dysfunctional attitudes, the achievement evaluation dimension scored the highest (4.01 ± 0.69), with 82.5% of participants excessively linking self-worth to external achievements such as academic performance and competition awards, reflecting that the competitive pressure faced by current college students has been internalized into rigid

cognitive schemas.

B. EVALUATION OF THE INTERVENTION EFFECT OF COGNITIVE BEHAVIORAL THERAPY

The effect of CBT intervention was tested by repeated measures ANOVA, where the between group factor was group (experimental group vs. control group) and the within group factor was time (T0, T1, T2). The group and time interaction effect were examined by analyzing the total BDI score, total ATQ score and total DAS score separately. To determine whether the intervention was clinically significant, the effect size (Cohen d) of the intervention was determined at time points T1 and T2 in both the experimental and control group. Paired-samples t-tests were used to compare the differences in changes between T0 and T1 and between T1 and T2 in the experimental group to determine the immediacy and persistence of the intervention effect. The rate of improvement was computed (mean T0 - mean T1)/mean T0 $\times$ 100%) and the percentage participants who had a clinically significant improvement (reduction in BDI score 50 or above) who achieved it statistically.

TABLE 2. Evaluation Results of Cognitive Behavioral Therapy Intervention

Measurement indicators	Group	T0	T1	T2	Group $\times$ Time Interaction Effect	T0-T1 effect size	Improvement rate (%)
BDI Total Score	Experimental group	28.3 ± 6.2	$12.5 \pm 4.8^{***}$	$13.8 \pm 5.1^{***}$	F=45.32, p<0.001	d=2.87	55.8
	control group	26.8 ± 5.9	$23.1 \pm 6.3^{*}$	$22.6 \pm 6.7^{*}$		d=0.61	13.8
ATQ total score	Experimental group	89.6 ± 15.3	$33.8 \pm 12.6^{***}$	$38.2 \pm 13.9^{***}$	F=38.74, p<0.001	d=3.96	62.3
	control group	87.2 ± 16.1	$79.4 \pm 17.8^{*}$	$78.1 \pm 18.2^{*}$		d=0.47	8.9
DAS Total Score	Experimental group	142.8 ± 21.4	$40.7 \pm 18.3^{***}$	$45.6 \pm 19.7^{***}$	F=41.19, p<0.001	d=5.21	71.5
	control group	138.6 ± 23.7	$126.3 \pm 25.1^{*}$	$124.8 \pm 26.4^{*}$		d=0.51	8.9
Number of people with significant clinical improvement (n)	Experimental group	-	41 (71.9%)	38 (66.7%)	$\chi^2 = 35.62$, p<0.001	-	-
	Control group	-	6 (10.9%)	7 (12.7%)		-	-

Note: *p<0.05, ***p<0.001; compared with T0; effect size d<0.5 is small, 0.5-0.8 is medium, >0.8 is large.

The experimental group's BDI score decreased from 28.3 ± 6.2 points at baseline to 12.5 ± 4.8 points after the intervention, a decrease of 55.8%, with an effect size of d=2.87, which is considered a super-large effect. In contrast, the control group only decreased by 13.8%. The interaction effect between group and time was highly significant (F=45.32, p<0.001), proving that the improvement was due to CBT intervention rather than natural recovery over time. In terms of cognition, the total ATQ score decreased by 62.3%, and the total DAS score decreased by 71.5%, with effect sizes of d=3.96 and d=5.21, respectively, far exceeding the effect size of the BDI. While the synchronized measurement at T1 and T2 prevents a definitive temporal precedence analysis, the more robust reduction in cognitive scores compared to symptom scores is consistent with Beck's theoretical model. This finding validates the causal path of Beck's cognitive model: through systematic training to identify and correct dysfunctional attitudes, participants established a more flexible cognitive processing pattern, significantly reducing the frequency of negative automatic thoughts, thereby alleviating depressive symptoms.

C. IMPROVEMENT IN DIFFERENT TYPES OF COGNITIVE BIASES

Each of the seven dimensions of the DAS scale was subjected to repeated measures ANOVA to test the differences in responsiveness to CBT in the various forms of cognitive biases. The rate and size of improvement between T0 and T1 of each dimension were obtained. The differences among the effect sizes of the seven dimensions were compared with one-way ANOVA to determine the most sensitive and hard-to-change types of cognitive bias to use in CBT. The experimental group was stratified into a high-scoring (mean score greater than 4.0) and a medium-to-low-scoring (mean score less than 4.0) group in terms of their baseline scores in each dimension. The improvement magnitude in the two groups was compared with independent samples ttests. Data are shown in Table 3.

TABLE 3. Improvement Data

Cognitive Bias Dimension	Experimental group T0	Experimental group T1	Improvement rate (%)	Effect size (d)	High group improvement rate (%)	Improvement rate (%) in the low-to-medium group
Perfectionism	3.89 ± 0.76	$1.82 \pm 0.64^{***}$	53.2	2.94	58.7	41.3
Dependence	3.72 ± 0.84	$1.15 \pm 0.58^{***}$	69.1	3.51	72.4	63.8
Vulnerability	3.61 ± 0.88	$1.38 \pm 0.71^{***}$	61.8	2.79	65.2	56.1
Achievement Evaluation	4.01 ± 0.69	$2.34 \pm 0.79^{***}$	41.6	2.26	45.1	35.7
Autonomous attitude	3.28 ± 0.92	$1.06 \pm 0.61^{***}$	67.7	2.81	69.3	65.4
The need for love	3.54 ± 0.87	$1.42 \pm 0.68^{***}$	59.9	2.68	62.8	54.2
Philosophy of cognition	3.43 ± 0.95	$1.28 \pm 0.73^{***}$	62.7	2.52	64.1	60.8

The improvement in dependency cognitive bias was the most significant, with an improvement rate of 69.1% and an effect size of d=3.51, indicating that it is relatively easy to help participants identify the logical fallacy that "others' approval does not equal self-worth" through cognitive restructuring. The autonomy attitude dimension also showed high responsiveness, with an improvement rate of 67.7%. In contrast, the achievement evaluation dimension had the lowest improvement rate, at only 41.6%, with an effect size of d=2.26, reflecting that college students' cognitive schema of deeply binding self-worth with external achievements is extremely rigid.

V. CONCLUSION

This study confirms that depressive symptoms among college students exhibit significant cognitive biases, including high-frequency negative automatic thoughts and dysfunctional attitudes, with achievement evaluation and perfectionism being the most prominent. Structured cognitive behavioral therapy (CBT) intervention effectively improved depressive symptoms, negative automatic thoughts, and dysfunctional attitudes, demonstrating clinically significant and sustainable effects. Different cognitive biases showed varying responsiveness to CBT; dependency was the easiest to improve, while achievement evaluation was the most difficult to change, suggesting a need to increase the intensity of intervention targeting rigid cognitive schemas. CBT, through systematic cognitive restructuring, helps participants establish flexible cognitive processing patterns, breaking the vicious cycle of depression and providing evidence-based and actionable intervention programs for campus mental health services.

AUTHOR CONTRIBUTIONS

Yuanyuan He designed, collected and analyzed the data, and drafted the manuscript. Yuanyuan He conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Yuanyuan He participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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HUMAN RESEARCH SUBJECTS

This study was approved by the Ethics Committee of Shaanxi University of International Trade & Commerce, and was performed in accordance with the principles of the Declaration of Helsinki. All eligible participants signed an informed consent form

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