
Application and effect evaluation of artificial intelligence combined with online cognitive behavioural therapy in depression intervention for college students

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Abstract: This study examines the intervention effect of online CBT on depressive symptoms in college students. Forty-eight students with obvious depressive symptoms at a Nanchang-based university were randomly divided into online and control groups. The intervention group received eight online interventions over six weeks using communication tools such as WeChat and artificial intelligence tools. After intervention, the HAMA-14 and BDI scores of the intervention group were significantly lower than those of the control group, and the improvement effect in sleep time, sleep efficiency, and total score of the emotion regulation difficulty scale was better than that of the control group ($p < 0.05$). The total effective rate of the intervention group reached 91.67%, significantly higher than the control group's 37.50% ($p < 0.05$). Online cognitive behavioural therapy can effectively relieve college students' depressive symptoms, enhance sleep quality and emotion regulation capacity, yet exerts no notable impact on the dimension of recognising their own emotional responses.

Keywords: online cognitive behavioural therapy; depressive symptoms; emotion regulation; psychological health intervention.

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1 Introduction

Depression, as a psychological state with negative effects and unpleasant, may exist from ordinary individuals to morbid patients (Mirchandaney et al., 2022). According to the differences in intensity and duration, ordinary individuals occasionally suffer from depression; people with mild depression tend to be pessimistic and frequently blame themselves; people with severe depression not only suffer from extreme sadness and despair, accompanied by a strong sense of self blame and thinking disorder, but also often show symptoms such as sleep disorders, loss of interest, memory loss, loss of appetite, negative emotions, thinking retardation, changes in cognitive function and excessive anxiety in clinical practice (Tolin et al., 2024). Therefore, the concept of depression can be regarded not only as an emotional state, but also as a representation of clinical diseases. College students at the critical stage of psychological development and adaptation are prone to depression when facing multiple challenges such as bad interpersonal relationships, love setbacks, academic and employment pressures. Although such depression has not yet reached the diagnostic criteria of clinical depression, its negative impact on college students' daily life and learning cannot be ignored. When college students fall into depression, they usually feel pessimistic and helpless, accompanied by self-reproach (Seshadri et al., 2021). If immersed in such emotional state for a long time, it will not only damage the physical and mental health of college students, but also in extreme cases, it may further develop into clinical depression, leading to suicidal ideation or behaviour (Surkan et al., 2024). According to the data of the World Health Organization (WHO), there are about 350 million patients with

depression in the world, while there are about 95 million in China, and it is on the rise (Nishi et al., 2022). In the blue book of mental health ‘China National Mental Health Report 2022’ issued by the Chinese Academy of Sciences, the survey of the mental health status of nearly 80,000 college students found that the detection rate of depression risk was about 21.48% (Hazell, 2021). The recognition rate and treatment rate of depression among college students are still low. The response and attention of society, schools and families to college students suffering from depression also need to be more scientific and reasonable. It can be seen that college students’ depression has become a social phenomenon that cannot be ignored.

There are three major directions for the treatment of depression: drug therapy, psychotherapy and physical therapy. Most of the drug treatment programs show adverse risk-benefit ratio due to their potential increased suicide risk. Therefore, clinicians should carefully weigh the relationship between clinical benefit and suicide risk when using drug therapy. Therefore, psychotherapy is usually the first choice for the treatment of depression in college students. Among them, cognitive behavioural therapy as an intervention means has been frequently recommended in many studies. Research evidence has fully shown that cognitive behavioural therapy has a significant effect on the regulation of depression, but these studies mainly focus on the traditional face-to-face, structured curriculum (van der Velden et al., 2023). The fast pace of modern life and heavy academic burden set many obstacles for depressed college students participating in the ground course. And studies have shown that individuals troubled by depression often rarely seek professional help (Smárason et al., 2024). With the deep integration of computer technology and the field of mental health, online intervention models have become an important direction to break through traditional limitations. The development of artificial intelligence tools, such as text semantic analysis and personalised problem sorting, provides technical support for the optimisation of online CBT. With the help of convenient communication tools such as WeChat, combined with artificial intelligence tools, multimodal intervention content delivery, real-time emotional state assistance analysis, and personalised task push can be achieved, breaking the constraints of time and space while improving the accuracy of intervention and user compliance.

However, there is currently a lack of research on online CBT based on artificial intelligence tools in China, especially in terms of system design, security mechanisms, and long-term effectiveness verification for college students, which cannot fully leverage the value of technology in empowering mental health services. The core objective of this study is to construct a six-week online cognitive-behavioural course that integrates artificial intelligence tools, clarify its intervention effect and sustainability on depression symptoms in college students, and improve the safety and ethical guarantees during the intervention process. The scientific value of this study lies in enriching the application scenarios of artificial intelligence in the field of mental health, providing efficient, safe, and scalable technical solutions for large-scale psychological intervention of college students, and having important practical significance for improving the mental health level of college students and cultivating high-quality talents.

2 Test method

2.1 Research design

The recruitment object of this study is the college students of a university in Nanchang. The recruitment method is to paste research posters everywhere in the school and issue questionnaires on site. Through the preliminary screening of students with the centre for emotional studies depression scale (CES-D), 48 students with obvious depressive symptoms are selected as the formal research objects. The 48 students were randomly divided into online group and face-to-face group with 24 students in each group. In the intervention group, there were 11 males (45.83%) and 13 females (54.17%); the average duration of symptoms was (3.2 ± 1.5) months. In the control group, there were 10 males (41.67%) and 14 females (58.33%); the average duration of depressive symptoms was (3.4 ± 1.6) months. There was no significant difference in gender ratio and duration of depressive symptoms between the two groups ($p > 0.05$).

All patients have signed the informed consent, and follow the principle of voluntariness and confidentiality during the study. In the process of assessment or psychological intervention, the subjects choose to suspend or withdraw from the study at any time, and will not be subject to any fine or blame, which will not affect their subsequent medical treatment.

2.2 Inclusion and exclusion criteria

Inclusion criteria:

- 1 the score of beck depression scale ≥ 14 and ≤ 28 , if ≥ 29 , the interview evaluation will determine whether to join the group.
- 2 They are 18–24 years old.

Exclusion criteria

- 1 there is a clinical diagnosis of mental illness
- 2 taking psychotropic drugs
- 3 they are receiving other psychological intervention, such as psychological counselling.

2.3 Research tools

- 1 Hamilton anxiety Scale-14 (HAMA-14) (Hack et al., 2023): this scale is used to assess the severity of anxiety symptoms, with a total score of 0–56 points. If the total score exceeds 29 points, it may be serious anxiety; if it exceeds 21 points, there must be obvious anxiety; if it exceeds 14 points, there must be anxiety; If the score exceeds 7, there may be anxiety; If the score is less than 7, there are no anxiety symptoms.
- 2 Beck depression inventory (BDI) (Furukawa et al., 2024): BDI is one of the most widely used scales in clinical evaluation of depression, with high reliability and validity. The scale contains 21 items, which quantitatively assess the degree of

depression from multiple dimensions such as depression, cognition, physical symptoms, etc. each item adopts the 4-level scoring method of 0–3 points. 0–13 represents no depression, 14–19 represents mild depression, 20–28 represents moderate depression, and ≥ 29 represents severe depression.

- 3 Pittsburgh sleep index scale (PSQI) (Ng et al., 2023): this scale is used to evaluate the sleep status of the two groups of subjects. Through 19 self-evaluation and five other review items, including 5 items and 19 self-evaluation items, he will not participate in the scoring. Here, we introduce that there are only 18 self-reported items in the scoring. The 18 items are composed of seven components. The score of each component is 0–3 points, and the total score is 0–21. The score is directly proportional to the quality of sleep.
- 4 Emotional regulation difficulties scale (DERS): the measurement of emotional regulation difficulties in this study adopts the DERS translated and revised by Feng in 2008. The revised scale has five dimensions. The internal consistency coefficient of the research report scale is 0.88, and the internal consistency reliability between the five dimensions is more than 0.70, accounting for 50.76% of the total variation, which has ideal reliability and validity. The five dimensions of the scale are: it is difficult to be aware of their own emotional response; do not accept their own emotional reactions; lack of effective emotion regulation strategies; it is difficult to control their own impulsive response; it is difficult to book the target behaviour. The scale is a self-assessment scale, which uses the accumulated total score to evaluate the difficulty of individual emotion regulation. Grade 5 scoring method is adopted: completely non-conforming (1 point); basically unqualified (2 points); uncertain (3 points); basically met (4 points); fully met (5 points).
- 5 Treatment effect: divided into 4 levels, based on the comprehensive judgment of BDI score changes and user self-report. Recovery: BDI score < 14 points, and users report complete disappearance of depressive symptoms; Significant effect: BDI score decreased by $\geq 50\%$, and users reported significant improvement in symptoms; Effective: BDI score decreased by 30% to 49%, and users reported improvement in symptoms; Invalid: BDI score decreases by $< 30\%$, or scores increase, and users report no improvement or worsening of symptoms.

2.4 Intervention plan

This study divided the treatment into two groups, with a total of 8 online intervention courses (with two leave allowances allowed). The intervention group relied on communication tools such as WeChat and combined with artificial intelligence tools to carry out online intervention, with a duration of 60 minutes each time. The intervention process was ‘WeChat task transmission + phone deep intervention + homework extension’, and the specific process was as follows:

- 1 Notification and preparation (5 min): Send a text notification, indicating the core objectives and the required thinking materials to be carried, and confirm that the visitor is in a quiet and undisturbed place.

- 2 Telephone communication (45 min): Based on the AI cognitive report submitted during the visit, dismantle unreasonable beliefs; explain the core technology of CBT; Practical teaching of AI tools.
- 3 Homework assignment (10 min): Clarify the goals for the next stage and specify the requirements for submitting homework.

The specific situation of the course is shown in Table 1. The control group of students received at least 20 minutes of telephone follow-up per week during the study period, with a focus on addressing the patients' existing psychological issues; provide cognitive behavioural courses or individual psychological counselling according to their wishes after the research is completed.

2.5 Safety emergency plan

Risk screening: before intervention, suicide risk is assessed through the BDI scale and face-to-face interviews, and high-risk individuals are excluded or referred to professional medical institutions.

Real-time monitoring: during the intervention process, AI tools analyse risk signals in communication texts and homework content in real time (such as suicide related statements), and issue timely warnings; counsellors closely monitor emotional fluctuations during phone conversations and intervene promptly if any abnormalities are detected.

Graded response: if there are slight emotional fluctuations, increase communication frequency and adjust intervention content; If there is a serious emotional breakdown or suicidal ideation, immediately contact their counsellor and family members, assist in referral to the school's psychological counselling centre or professional mental health institution, and continue follow-up.

Confidentiality and disclosure: clarify the confidentiality boundary, break the confidentiality principle when it comes to life safety, and inform the research subjects and their families in advance.

2.6 Follow up design

A second follow-up evaluation will be conducted 3 months after the intervention, using the same scale to assess both groups of study subjects and verify the sustainability of the intervention effect.

2.7 Statistical methods

SPSS 25.0 statistical software package was used for data statistical analysis. The measurement data were expressed by ' $x \pm s$ '. If the distribution was in line with the normal distribution, the 't test' was used for the comparison between groups; the counting data were expressed by 'n' and '%' and the comparison between groups was performed by 'x² test'. $p < 0.05$ is statistically significant.

Table 1 Curriculum design of online cognitive behavioural therapy

<i>Number</i>	<i>Course topic</i>	<i>Notification and preparation</i>	<i>Phone communication</i>	<i>Homework assignment</i>
1	Introduction to mind perception	Send a course notification requesting to bring a record of one recent life event that triggered negative emotions; confirm that the patient is in a quiet and undisturbed independent space to ensure smooth telephone communication.	Therapists introduce themselves and establish trust relationships; comprehensively evaluate the patient's personal situation and analyse the main psychological distress they face; explain the relevant knowledge of depression and self-harm behaviour, and introduce the basic principles of cognitive-behavioural therapy; introduce the concept of 'automatic thinking' and provide examples of the manifestations of automatic thinking based on patient case studies.	Record one daily negative emotional event; learn to use AI tools to complete emotional intensity scoring
2	Automated mind recognition	Prepare three recent life events that have triggered significant negative emotions and briefly record the event summary; confirm that the patient is familiar with the basic operations of AI tools.	Guide patients to review their 'automatic thinking' through questioning; explain common types of cognitive distortions and classify them based on patients' thinking cases; by constructing an interactive exercise called 'happy event table', patients are asked to record three recent positive events and their corresponding emotions, helping them understand the importance of behaviour change for emotional improvement.	Extract automated ideas from three negative events and label the initial judgment of the thinking type; use AI to generate cognitive distortion recognition results, compare the annotated thinking types with AI analysis results, mark the differences and think about the reasons.
3	Dismantling of unreasonable beliefs	Prepare two cases of strong negative emotions triggered by negative automatic thinking; confirm that the patient is in a quiet environment and can focus on participating in case analysis and planning.	Based on patient prepared cases, teach them to distinguish between 'automatic thinking' and 'irrational beliefs', and explain methods for identifying irrational beliefs; guide patients to evaluate whether there are unreasonable beliefs in their thinking habits when facing daily events.	For a single negative event involving catastrophic thinking, list objective evidence supporting and opposing the belief. Use AI to generate a belief rationality score and create a complete evidence analysis report.
4	Constructing rational alternative beliefs	Prepare two core negative events and briefly record the original unreasonable beliefs and emotions they triggered.	Using the two core negative events of the patient as a case study, guide them to start from objective evidence and attempt to construct alternative beliefs that are opposite or more objective than their original unreasonable beliefs; help patients establish a complete cognitive model of 'event → automatic thinking → emotion → adversarial thinking', and strengthen understanding through case exercises.	Design three alternative beliefs for two core negative events and evaluate the effect of emotional improvement; utilise AI to obtain reference solutions, compare and screen the best options.

Table 1 Curriculum design of online cognitive behavioural therapy (continued)

<i>Number</i>	<i>Course topic</i>	<i>Notification and preparation</i>	<i>Phone communication</i>	<i>Homework assignment</i>
5	Multidimensional attribution practice	Prepare one recent failed event; confirm that the patient has sufficient time for narrative writing and attribution analysis.	Guide patients to write a narrative about the prepared failure event, fully describing the process of the event, their thoughts and emotions at the time; explain the theory of 'multidimensional attribution' and break it down based on the patient's initial attribution; help patients extract 1–2 useful keywords from adversarial thinking and form a unique positive motto.	Analyse the multiple causes of a failed event; using AI to perform 'attribution dimension decomposition'; verify whether there is an 'excessive internal responsibility' bias in one's own attribution; record AI feedback, and adjust attribution methods.
6	Behavioural experiment design	Prepare a rational belief validated through behaviour; confirm that the patient can focus on participating in the experimental design.	Guide patients to repeat the adversarial thinking training from the previous week in the form of retrospective exercises, and strengthen rational beliefs based on attribution results; by analysing the patient's past thinking and behaviour cases, help them identify their core beliefs; explain the purpose and design methods of the 'behavioural experiment'; and determine the core hypotheses and variables of the experiment together with the rational beliefs that patients hope to verify.	Based on the analysis of core beliefs using AI, design a small behavioural experiment to clarify the experimental steps, expected results, and key points for recording; utilise AI to obtain execution step suggestions, improve experimental design, and record behavioural and emotional changes during the experimental process.
7	Cognitive behavioural linkage training	Carry the homework records of the first six courses; confirm that the patient's environment is undisturbed and can focus on participating in the review and summary.	Guide patients to review the core content of the first six courses and sort out their learning gains; Based on the results of behavioural experiments, analyse the impact of cognitive adjustment on behavioural change and explain the mechanism of 'cognitive behavioural linkage'; summarise the progress of patients in the social support system and propose improvement suggestions for deficiencies.	Record the emotional changes after the behavioural experiment and analyse the impact of cognitive adjustment on behaviour; use AI to generate a 'cognitive emotional behavioural triangle', generate linkage relationship reports, annotate key intervention nodes, and summarise patterns.
8	Integration and consolidation of intervention effects	Carry all course assignments and records; confirm that the patient can focus on participating in the effectiveness evaluation and goal setting.	Systematically review the core techniques of the first seven courses and teach patients how to use these techniques to adjust cognition, emotions, and behaviour when they encounter emotional problems in the future; customise short-term and long-term mental health goals with patients and explore feasible methods to achieve these goals.	Summarise one's own core cognitive biases and the key role of AI intervention; use AI to generate an 8-week cognitive improvement curve and form a complete intervention summary report.

3 Experimental results

3.1 Improvement of anxiety and depression

All patients completed the intervention, and the dropout rate in both groups was 0. The results showed that before the intervention, there was no significant difference in hama-14 and BDI scores between the online group and the control group ($p > 0.05$). See Table 2 for details. After the intervention, the scores of each scale in the two groups were lower than those before the intervention, and the intervention effect of the online group was better. After the intervention, HAMA-14 score in the online group decreased to 9.04 ± 3.76 , and that in the control group was 13.73 ± 4.01 ; The BDI score of the online group decreased to 9.69 ± 3.14 , and that of the control group was 17.52 ± 5.10 , the difference was statistically significant ($p < 0.05$). This indicates that online cognitive-behavioural therapy incorporating artificial intelligence can more effectively reduce anxiety and depression among college students, reducing depression levels from moderate to mild.

Table 2 Comparison of anxiety and depression between the two groups before and after intervention

Group	HAMA-14		BDI	
	Before	After	Before	After
Online group	19.81 $\pm$ 4.58	9.04 $\pm$ 3.76	21.23 $\pm$ 4.39	9.69 $\pm$ 3.14
Control group	19.35 $\pm$ 4.12	13.73 $\pm$ 4.01	21.65 $\pm$ 4.11	17.52 $\pm$ 5.10
x	0.365	-4.184	-0.339	-6.109
p	0.717	0.000	0.736	0.000

Table 3 Comparison of sleep status between the two groups before and after intervention

Group	Sleep quality		Sleep time	
	Before	After	Before	After
Online group	2.08 $\pm$ 0.72	1.70 $\pm$ 0.74	1.87 $\pm$ 0.68	1.26 $\pm$ 0.61
Control group	2.21 $\pm$ 0.66	2.00 $\pm$ 0.72	1.91 $\pm$ 0.58	1.65 $\pm$ 0.70
x	0.629	0.297	-0.228	-2.075
p	0.532	0.161	0.821	0.044

Group	Sleep efficiency		Sleep disorders	
	Before	After	Before	After
Online group	2.13 $\pm$ 0.85	1.30 $\pm$ 0.69	1.26 $\pm$ 0.53	0.74 $\pm$ 0.61
Control group	1.99 $\pm$ 0.84	1.83 $\pm$ 0.82	1.22 $\pm$ 0.66	1.04 $\pm$ 0.69
x	0.548	-2.392	0.242	-1.623
p	0.586	0.021	0.810	0.111

3.2 Sleep improvement

There was no significant difference in PSQI score between the two groups before intervention ($p > 0.05$). See Table 3 for details. After the intervention, the scores of sleep in the online group decreased, and there were significant differences in sleep time and sleep efficiency between the two groups ($p < 0.05$). This indicates that online

cognitive-behavioural therapy has a clear improvement effect on the sleep time and sleep efficiency of college students.

3.3 Improvement of emotional regulation difficulties

Before the intervention (see Table 4), there was no difference between the two groups in each dimension and total score of emotion regulation difficulty scale ($p > 0.05$); after the intervention, the improvement of symptoms and total scores in the online group were better than those in the control group (Table 5), and the difference was statistically significant ($p < 0.05$). This indicates that online cognitive-behavioural therapy can effectively improve the emotional regulation ability of college students, especially in terms of emotional acceptance and strategy application, but its effect on improving emotional self-awareness is limited.

Table 4 Comparison of emotional regulation difficulties between the two groups before intervention

<i>Symptom</i>	<i>Online group</i>	<i>Control group</i>	<i>x</i>	<i>p</i>
Difficult to realise their emotional reactions	24.25±4.42	24.79±5.17	-0.390	0.698
Not accepting your emotional reactions	14.46±3.27	14.04±3.84	0.405	0.688
Lack of effective emotion regulation strategies	29.21±8.25	30.13±8.75	-0.373	0.711
Difficult to control their impulsive reactions	19.17±5.74	18.04±4.53	0.754	0.455
It is difficult to carry out targeted behaviour	22.58±1.21	23.04±0.86	-1.511	0.138
DURS total score	112.46±24.20	111.63±20.34	0.129	0.898

Table 5 Comparison of emotional regulation difficulties between the two groups after intervention

<i>Symptom</i>	<i>Online group</i>	<i>Control group</i>	<i>x</i>	<i>p</i>
Difficult to realise their emotional reactions	21.04±5.83	24.75±6.39	-2.101	0.041
Not accepting your emotional reactions	9.29±4.46	12.58±4.26	-2.615	0.012
Lack of effective emotion regulation strategies	20.13±6.78	25.96±6.31	-3.083	0.003
Difficult to control their impulsive reactions	11.63±4.31	14.54±5.24	-2.105	0.041
It is difficult to carry out targeted behaviour	17.54±1.64	20.83±2.16	-5.944	0.000
DURS total score	82.33±20.81	101.42±20.73	-3.183	0.003

3.4 Treatment effect analysis

In the online group, 11 were markedly effective and 11 were effective, and the total effective rate was 91.67%. In the control group, five cases were markedly effective, four cases were effective, and the total effective rate reached 37.50% (Table 6). The intervention effect of the online group was significantly better than that of the control group, and the difference between the two groups was significant ($p < 0.05$). This indicates that online cognitive-behavioural therapy has a significantly better intervention effect on depression symptoms in college students than simple telephone follow-up.

Table 6 Comparison of intervention effects of online cognitive behavioural therapy

Group	n	Recovery	Remarkable effect	Effective	Invalid
Online group	24	0	11 (45.83%)	11 (45.83%)	2 (8.33%)
Control group	24	0	5 (20.83%)	4 (16.67%)	15 (62.50%)
x ²	-	15.458			
p	-	0.000			

3.5 Follow up results

Three months after the intervention, the HAMA-14, BDI, PSQI, and DERS scores in the intervention group remained at low levels after the intervention, with no significant rebound ($p > 0.05$); the control group’s score slightly increased after intervention, but remained lower than before intervention ($p < 0.05$). The intervention effect of online cognitive-behavioural therapy has good sustainability and can improve the mental health status of college students in the long run.

4 Discussion

Cognitive behavioural therapy is considered to be the shortest treatment time, the most rapid effect and the most convenient treatment method in psychotherapy (Ching et al., 2023). Its core goal is to change the cognitive mode of depressed individuals, identify and correct their improper thinking patterns and negative ideas, encourage patients to adopt rational thinking, abandon negative emotions and thinking, and then reshape the neuronal connection, so as to realise the positive adjustment of cognition and behaviour (Lin et al., 2023). The results of this study show that online cognitive-behavioural therapy integrating artificial intelligence can significantly reduce anxiety and depression in college students, improve sleep quality and emotional regulation ability, and the effect lasts for more than three months. This result is attributed to the multiple advantages of the intervention program: on the one hand, the online mode breaks the limitations of time and space, improves the convenience of participation, and fits the pace of college students’ lives. On the other hand, the application of artificial intelligence tools has achieved personalised intervention, helping college students more accurately perceive their own thinking and emotional patterns through functions such as emotional labelling and cognitive distortion recognition, and improving the targeted intervention. In terms of emotional regulation, intervention programs focus on cultivating operable skills such as emotional acceptance and strategy application, resulting in significant improvements in relevant dimensions. The lack of significant improvement in the dimension of ‘difficulty in perceiving one’s own emotional response’ may be related to the insufficient depth of emotion recognition training in the intervention and the low completion rate of some research subjects’ homework. In terms of sleep, interventions have reduced bedtime anxiety through relaxation training and cognitive adjustment, thereby improving sleep time and efficiency. However, sleep quality is influenced by multiple factors and requires longer cycles of intervention to achieve comprehensive improvement.

The results of this study are consistent with multiple previous studies. Previous studies have confirmed that traditional CBT can effectively alleviate depression and

anxiety, while online CBT has further expanded intervention coverage by breaking through temporal and spatial limitations (Dafsari et al., 2023). Foreign studies have shown that online cognitive-behavioural therapy has achieved positive results in the intervention of mental disorders (Sverre et al., 2023), while this study focuses on college students and verifies the effectiveness of online CBT integrated with artificial intelligence. In addition, the newly added follow-up data in this study further validated the long-term effects of online CBT, indicating that cognitive-behavioural therapy can achieve long-term improvement in mental health by reshaping thinking patterns. The integration of artificial intelligence tools further enhances the precision and efficiency of intervention.

The sample of this study comes from only one school, which does not cover college students in different regions and different types of universities. The representativeness of the sample has certain limitations. Students from different universities may have differences in cultural background, educational resources, campus atmosphere and other aspects, which may affect the intervention effect of online cognitive behaviour therapy. With the further development of artificial intelligence and IoT technology, future research should include college students from different regions and types of universities, covering more majors and levels of depression. Differentiated content should be designed based on the stress characteristics of college students from different majors, and the follow-up period should be extended to one year to further verify the long-term stability of intervention effects and provide a basis for the continuous optimisation of the plan.

Declarations

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This study complies with ethical standards and is approved by the Ethics Committee of Jiangxi University of Science and Technology (No. EA23228).

This study obtains written informed consent from participants. The study was conducted in accordance with the Declaration of Helsinki.

All authors declare that they have no conflicts of interest.

Notes

An earlier version of this article contained some minor inaccuracies which have been corrected as follows:

Page 42: In the original published version of this article, the affiliations of all the authors were listed as Jiangxi University of Science and Technology. This has been corrected to Jiangxi Institute of Technology.

This correction has been made at the request of the authors. The publisher apologises for any inconvenience caused.

References

- Ching, H., Chua, J.Y.X., Chua, J.S. and Shorey, S. (2023) 'The effectiveness of technology-based cognitive behavioral therapy on perinatal depression and anxiety: a systematic review and meta-analysis', *Worldviews on Evidence-Based Nursing*, Vol. 20, No. 5, pp.451–464.
- Dafsari, F.S., Bewernick, B., Böhringer, S., Domschke, K., Elsaesser, M., Löbner, M., Lupp, M. et al. (2023) 'Cognitive behavioral therapy for late-life depression (CBTlate): Results of a multicenter, randomized, observer-blinded, controlled trial', *Psychother. Psychosom.*, Vol. 92, No. 3, pp.180–192.
- Feng, Y. (2008) *The Relationship between Adolescent Self-Injurious Behavior and Individual Emotional Factors and Family Environment Factors*, Master's thesis, Vol. 72, Central China Normal University, China, Wuhan.
- Furukawa, Y., Nagaoka, D., Sato, S., Toyomoto, R., Takashina, H.N., Kobayashi, K. et al. (2024) 'Cognitive behavioral therapy for insomnia to treat major depressive disorder with comorbid insomnia: a systematic review and meta-analysis', *Journal of Affective Disorders*, Vol. 367, pp.359–366.
- Hack, L.M., Tozzi, L., Zenteno, S., Olmsted, A.M., Hilton, R., Jubeir, J. et al. (2023) 'A cognitive biotype of depression and symptoms, behavior measures, neural circuits, and differential treatment outcomes: a prespecified secondary analysis of a randomized clinical trial', *JAMA Network Open*, Vol. 6, No. 6, p.e2318411.
- Hazell, P. (2021) 'Updates in treatment of depression in children and adolescents', *Current Opinion in Psychiatry*, Vol. 34, No. 6, pp.593–599.
- Lin, Z., Cheng, L., Han, X., Wang, H., Liao, Y., Guo, L. et al. (2023) 'The effect of internet-based cognitive behavioral therapy on major depressive disorder: randomized controlled trial', *Journal of Medical Internet Research*, Vol. 25, p.e42786.
- Mirchandaney, R., Barete, R. and Asarnow, LD. (2022) 'Moderators of cognitive behavioral treatment for insomnia on depression and anxiety outcomes', *Current Psychiatry Reports*, Vol. 24, No. 2, pp.121–128.
- Ng, M.Y., DiVasto, K.A., Cootner, S., Lipsey, M.W. and Weisz, J.R. (2023) 'How do cognitive behavioral therapy and interpersonal psychotherapy improve youth depression? Applying meta-analytic structural equation modeling to three decades of randomized trials', *Psychological Bulletin*, Vol. 149, Nos. 9–10, pp.507–548.
- Nishi, D., Imamura, K., Watanabe, K., Obikane, E., Sasaki, N., Yasuma, N. et al. (2022) 'The preventive effect of internet-based cognitive behavioral therapy for prevention of depression during pregnancy and in the postpartum period (iPDP): a large scale randomized controlled trial', *Psychiatry and Clinical Neurosciences*, Vol. 76, No. 11, pp.570–578.
- Seshadri, A., Orth, S.S., Adaji, A., Singh, B., Clark, M.M. and Frye, M.A. (2021) 'Mindfulness-based cognitive therapy, acceptance and commitment therapy, and positive psychotherapy for major depression', *American Journal of Psychotherapy*, Vol. 74, No. 1, pp.4–12.
- Smáráson, O., Skarphedinsson, G. and Storch, E.A. (2024) 'Cognitive behavioral therapy for anxiety and depression in children and adolescents', *Psychiatric Clinics*, Vol. 47, No. 2, pp.311–323.
- Surkan, P.J., Malik, A., Perin, J., Atif, N., Rowther, A., Zaidi, A. et al. (2024) 'Anxiety-focused cognitive behavioral therapy delivered by non-specialists to prevent postnatal depression: a randomized, phase 3 trial', *Nature Medicine*, Vol. 30, No. 3, pp.675–682.
- Sverre, K.T., Nissen, E.R., Farver-Vestergaard, I., Johannsen, M. and Zachariae, R. (2023) 'Comparing the efficacy of mindfulness-based therapy and cognitive-behavioral therapy for depression in head-to-head randomized controlled trials: a systematic review and meta-analysis of equivalence', *Clinical Psychology Review*, Vol. 100, p.102234.
- Tolin, D.F., Lord, K.A. and Knowles, K.A. (2024) 'Cognitive-behavioral therapy enhancement strategies', *Psychiatric Clinics*, Vol. 47, No. 2, pp.355–365.
- van der Velden, A.M., Scholl, J., Elmholt, E.M., Fjorback, L.O., Harmer, C.J., Lazar, S.W. et al. (2023) 'Mindfulness training changes brain dynamics during depressive rumination: a randomized controlled trial', *Biological Psychiatry*, Vol. 93, No. 3, pp.233–242.