The effectiveness of brief mindfulness training in reducing test anxiety among high school students

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Abstract

Background For many high school students, test anxiety is a prevalent issue that adversely affects their exam performance. Previous research has explored the effectiveness of mindfulness training in alleviating test anxiety; however, the lack of real-life exam scenarios and lengthy training sessions has limited its application. This study examines the effects of a brief, five-day mindfulness training and immediate session on enhancing students' mindfulness levels and reducing their test anxiety.

Methods The participants were recruited and divided into an experimental group ($n = 29$) and a control group ($n = 32$). The experimental group underwent a daily eight-minute mindfulness training for five consecutive days, while the control group engaged in a passive waiting period. To assess changes in mindfulness levels and exam performance, two exams were administered before and after the five-day mindfulness intervention, accompanied by the completion of the Five Facet Mindfulness Questionnaire. To evaluate changes in test anxiety levels, the State Anxiety Inventory was filled out on days 1, 3, and 5 of the training.

Results After five days of mindfulness training, the mindfulness group showed significant improvements in overall mindfulness levels (particularly in observing and describing skills), a significant reduction in test anxiety and notable improvements in exam performance. Furthermore, the effects on test anxiety were observed after just one training session.

Conclusions The study demonstrates that a brief, five-day mindfulness training can significantly enhance mindfulness levels, reduce test anxiety, and improve exam performance in high school students. The positive effects on test anxiety were noticeable after a single session.

Keywords Brief mindfulness training, Test anxiety, High school students, Ecological validity

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Introduction

Test anxiety, a type of academic anxiety, refers to the fear and worry triggered by negative evaluations of exams, leading to adverse behavioral, physiological, and emotional reactions [1]. Between 10 and 40% of students experience varying degrees of test anxiety [2], with 15-22% exhibiting symptoms of severe test anxiety [3]. Students with high anxiety levels are more prone to confidence issues and judgment errors during exams, resulting in lower exam scores [4, 5, 6]. A meta-analysis spanning 30 years has demonstrated a significant negative correlation between test anxiety and academic performance in various exams, including midterms, finals, high-stakes testing, and grade point averages (GPA) [7]. High school students, facing substantial academic pressures and undergoing a period of psychological vulnerability during adolescence, are more likely to experience anxiety and depression, leading to heightened test anxiety [8, 9]. Therefore, addressing test anxiety in this demographic is both severe and urgent.

Mindfulness is defined as the non-judgmental, moment-to-moment awareness of one's inner experiences, perceptions, and actions [10]. Previous studies have found that individuals with high levels of mindfulness exhibit lower levels of anxiety [11]. This is attributed to mindfulness guiding individuals to continuously perceive their emotions non-judgmentally, replacing negative emotions and self-evaluations with new sensory information, and equally regarding all emerging emotions to achieve a balanced emotional state [12].

Bishop et al. (2004) argued that mindfulness is not merely a passive state of perceiving the present reality but emphasizes the active, deliberate cultivation of self-awareness, compassion, and insight [13]. This psychological capacity helps individuals manage their attention by noticing ongoing negative thoughts without judgment and focusing on the current activity, thus avoiding further processing of these thoughts. Additionally, the cognitive resources saved can be used to process information related to current experiences better, enhancing self-understanding and present-moment awareness [14]. Therefore, mindfulness training not only directly reduces negative emotions like anxiety [15, 16], but also improves attention allocation [17, 18], reducing the impact of emotions and negative thoughts on the individual's current state [19]. This enables individuals to face ongoing or impending situations with equanimity.

Previous research has demonstrated that mindfulness training can enhance GRE scores [20] and is effective in alleviating test anxiety [21, 22, 23]. While both study skills and mindfulness training can reduce test anxiety, the effects of mindfulness training were significantly more pronounced [22]. Priebe and Kurtz-Costes (2022) conducted a control group with sham mindfulness training (physical activities similar to mindfulness training without psychological intervention) to compare mindfulness training with relaxation training [23]. Their results indicated that mindfulness training's benefits extend beyond mere physical relaxation, notably reducing rumination and distraction cognitively. These studies have repeatedly confirmed the efficacy of mindfulness training in reducing test anxiety, but they are not without limitations: first, past studies were not conducted in genuine exam settings, often requiring participants to self-report retrospectively, which may affect ecological validity or may not accurately reflect the levels of test anxiety just before an exam [21]. Second, traditional mindfulness training programs last 4–8 weeks, which may be impractical during tight exam preparation periods, making it difficult to implement in schools [21]. Previous research indicates that brief mindfulness training spanning several days has shown promising results in improving attention, enhancing inner peace, and alleviating negative emotions [15, 16, 17, 18]. Therefore, this study explores the effects of a five-day brief mindfulness training in a real exam setting on alleviating state test anxiety and improving exam performance. Continuous assessments will be conducted after training on the first, third, and fifth days to better examine the effects. The assessment results from the first day of training can serve as the effects of a single session of brief mindfulness training.

This study proposes the following specific hypotheses:

1. There is a significant negative correlation between mindfulness trait levels and test anxiety levels, with students having higher mindfulness trait levels experiencing lower levels of test anxiety.
2. Brief mindfulness training (consecutive 5 days, 8 min each day) can effectively improve test anxiety and enhance their academic performance among high school students.
3. A single session of brief mindfulness training (8 min) can effectively improve test anxiety among high school students.

Methods

Participants

The sample size was determined using G*Power 3.1 with parameters set to f = 0.25 and power = 0.95, indicating a need for 54 participants for a 2 (group: experimental vs. control) × 2 (time: pre-test vs. post-test) ANOVA. Participants were 74 first-year high school students from an ethnic minority high school in Guizhou Province, of which 13 withdrew during the experiment, leaving 61 valid participants (29 in the experimental group and 32 in the control group). The participants consisted of 35 males and 26 females, aged 17–18 years (M = 17.20, SD = 0.40), with no prior mindfulness training experience,

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predominantly from the Miao and Dong ethnic minorities. The study was approved by the Ethics Committee of the Psychological Institute of the Chinese Academy of Sciences. Written informed consent was obtained from all participants before the study commenced.

To ensure better ecological validity and facilitate training, the study adopted a convenience sampling method, selecting two parallel classes that were originally matched in terms of academic teachers, educational resources, and had similar exam scores. The integrity of the classes was preserved. By lottery, the two classes were assigned to the mindfulness group and the control group, respectively. Unfortunately, despite being matched in multiple aspects at the beginning of the experimental design, the two classes unexpectedly showed differences in their scores during the pre-experimental real exam. Despite this baseline difference, we still chose to compare the two classes because: (1) perfectly matched control groups are often difficult to achieve in practical applications; (2) by comparing groups with baseline differences, we can more deeply explore the effects of mindfulness training and its applicability among students with different academic performances.

Measures

The study employed four assessment tools: the Chinese version of the Five Facet Mindfulness Questionnaire, State Anxiety Inventory, Peace of Mind Scale, and academic performance. The State Anxiety Inventory serves as a direct indicator of test anxiety, whereas the Peace of Mind Scale and academic performance serve as indirect indicators. The Five Facet Mindfulness Questionnaire also acts as a direct indicator of mindfulness levels.

The Five Facet Mindfulness Questionnaire (FFMQ) comprises 39 items, with higher scores indicating higher mindfulness capability [24]. It includes five dimensions: Observing (e.g., "I notice the smells and aromas of things"), Describing (e.g., "I am good at finding words to describe my feelings"), Acting with awareness (e.g., "I find myself doing things without paying attention"), Nonjudging (e.g., "I think some of my emotions are bad or inappropriate and I shouldn't feel them"), and Non-reactivity (e.g., "I can perceive my feelings and emotions without having to react to them"). Participants rated how true each statement was for them on a 5-point Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). Facet scores were calculated by summing the scores of each item. The Chinese version of the FFMQ has demonstrated good reliability and validity (Deng et al., 2011), with Cronbach's alpha coefficients for the subscales and overall score ranging from 0.809 to 0.908 in this study.

The State Anxiety Inventory (SAI) consists of 20 items assessing current or short-term states of displeasure,

including tension, fear, worry, and neuroticism. It is scored on a 4-point scale where 1 indicates 'not at all' and 4 'very much so', with items 1,2,5,8,10,11,15,16,19,20 reverse scored. Higher total scores indicate higher levels of anxiety; lower scores indicate lower levels of anxiety [25]. The Chinese version was adapted by Li and Qian in 1995, and the internal consistency coefficient in this study was 0.795.

Academic performance was measured by compiling total scores from exams taken before and after the 5-day brief mindfulness training, with each exam conducted under identical conditions in the same classrooms. Subjects included mathematics, physics, chemistry, political science, history, Chinese, and English, scored out of 150, with physics and chemistry out of 60, and political science and history out of 100. To study the effect of brief mindfulness training on alleviating test anxiety under real exam conditions, the intervention study was conducted between two weekly tests. A test-retest reliability is measured by the correlation between each student's performance on two weekly tests. The test-retest reliability of the overall exam scores was 0.956.

Experimental design

This study involved two first-year classes (61 participants in total), conducted as a controlled experiment where one class served as the mindfulness group receiving mindfulness training, and the other as the control group receiving no experimental intervention. The mindfulness group consisted of 29 students, and the control group 32 students. This study was conducted in October 2021.

During the five days between two exams, the mindfulness training group received daily 8-minute mindfulness training, while the control group engaged in an 8-minute waiting. The content of mindfulness training primarily encompasses mindful body scans and mindful breathing. It is relatively easy to master both the mindful body scan and mindful breathing during brief mindfulness training sessions. This practice redirects attention away from anxiety and towards bodily sensations and breathing patterns. Prior to engaging in mindfulness exercises, a brief introduction to the principles of mindfulness and precautions for practice was provided. To ensure consistency in the guidance, pre-recorded audio was utilized for delivering the instruction. The audio was recorded by a mindfulness expert (the corresponding author) with over 10 years of guiding experience. The experimental procedure is illustrated in Fig.1. The instruction of mindfulness is in the supplementary materials.

Data collection and analysis

All experimental data were statistically analyzed using IBM SPSS ver. 25.0 (IBM Co., Armonk, NY, USA). Descriptive statistics were expressed as mean ± standard
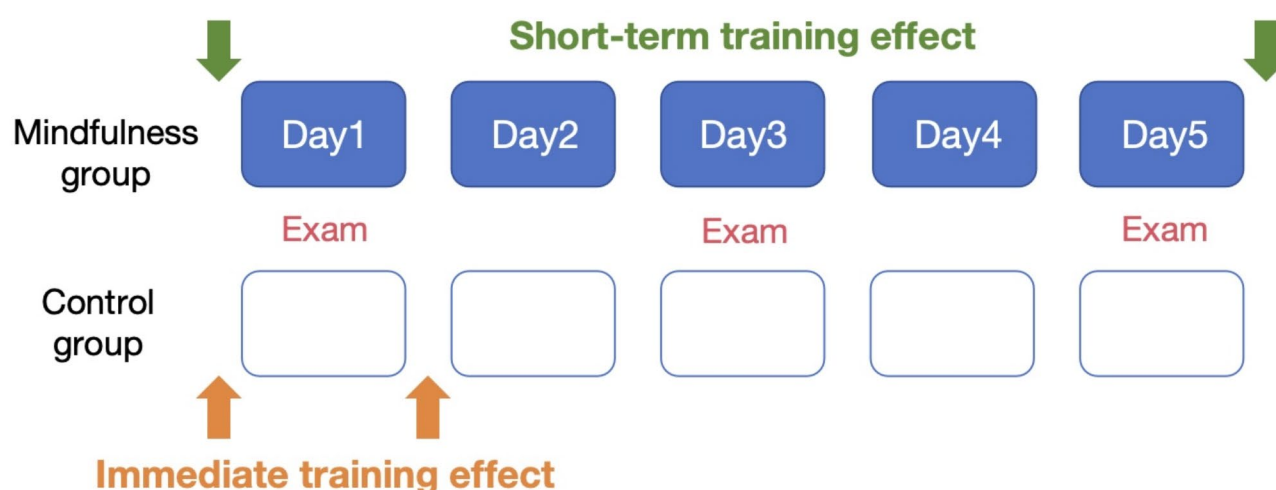
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Fig. 1 Illustrates the experimental procedure in detail

Table 1 Demographic data of two groups of subjects

	Mindfulness group	Control group	Statistical test	*p*
Gender (male/female)	29 (15/14)	32 (20/12)	$\chi^2 = 1.328$	0.249
Age (M ± SD)	17.24 ± 0.44	17.16 ± 0.37	$t = 0.826$	0.412

deviation. Pearson correlations were used to assess the relationships between variables. Due to natural grouping by class, there were statistical differences in some indicators between the groups at baseline. To control for baseline differences, ANCOVA was utilized, with pre-test data serving as covariates. A 2 (mindfulness group vs. control group) × 4 (before training, after the first day, after the third day, after the fifth day) repeated measures ANOVA was conducted to compare the effects of the practice.

Results

Demographic data
A comparison of baseline conditions between the two groups revealed no significant differences in age and gender, as detailed in Table 1. Differences were found between the mindfulness group and the control group in scores on the Five Facet Mindfulness Questionnaire's describing dimension ($t_{(59)} = 3.592$, $p = 0.010$), nonjudging dimension ($t_{(59)} = -2.416$, $p = 0.019$), State Anxiety Inventory scores ($t_{(59)} = -2.072$, $p = 0.043$) and academic performance ($t_{(59)} = 6.438$, $p < 0.001$). ANCOVA analysis was used to adjust for baseline differences, yielding statistically significant results for each indicator.

Correlation analysis of change scores between pre-test and post-test in various scales
This study utilized a 2 (group) × 2 (time) experimental design, with participants completing a series of questionnaires both before the first day of training and after the fifth day of training. To further investigate the

relationship between changes in different indicators before and after the experimental intervention (5 days of training), as well as their mutual influences, we specifically conducted a correlation analysis using the differences between pre-test scores (collected before the first day of training) and post-test scores (collected after the fifth day of training) for each indicator. This approach provides a precise measure of the impact of the 5-day training on each indicator, as well as the correlations among them.

The change in mindfulness levels from pre-test to post-test was significantly negatively correlated with the change in state anxiety levels, and significantly positively correlated with the total exam scores from pre-test to post-test. This indicates that higher levels of mindfulness are associated with lower levels of state anxiety and better overall exam performance, while lower levels of mindfulness are associated with higher levels of state anxiety and poorer exam performance.

Furthermore, the change in total exam scores from pre-test to post-test was significantly negatively correlated with the change in state anxiety levels, and significantly positively correlated with the change in mindfulness levels from pre-test to post-test. This suggests that lower levels of state anxiety and higher levels of mindfulness are associated with higher exam scores, whereas higher levels of state anxiety are associated with lower levels of mindfulness and peace of mind. Results are presented in Table 2.

We also conducted the correlation analysis of pre-post differences using the standardized residualized change

Table 2 Correlation analysis results of changes scores between variables (Pre- to Post-test)

	FFMQ	SAI	Academic performance
FFMQ	-		
SAI	-0.547**	-	
Academic performance	0.313*	-0.412**	-

Note: *$p < 0.05$, **$p < 0.01$

Table 3 Correlation analysis results of the standardized residualized change scores

	FFMQ	SAI	Academic performance
FFMQ	-		
SAI	-0.452**	-	
Academic performance	0.022	-0.132	-

Note: *$p < 0.05$, **$p < 0.01$

Figure 2

scores. The correlation between standardized residualized change scores mirrors that of the original scores, except for the disappearance of correlation between academic performance's standardized residualized change scores and those of other variables. Results are presented in Table 3.

Effects of mindfulness training on test anxiety and exam performance

Enhancing effects of mindfulness levels

ANCOVA was conducted to analyze the effects of mindfulness training on FFMQ. After controlling for baseline data as covariates, significant differences were found in the total scores of the Five Facet Mindfulness Questionnaire between the mindfulness group and the control group $F(1,59) = 6.084$, $p = 0.017$, partial $\eta^2 = 0.095$), Post hoc results indicated that the FFMQ total score of the mindfulness group significantly increased (114.83 ± 11.23 vs. 119.07 ± 13.33, $p = 0.023$), while there was no significant change in the FFMQ total score of the control group (109.75 ± 10.82 vs. 110.41 ± 8.14, $p = 0.649$). Specifically, the mindfulness group showed significant improvements in the describing (24.79 ± 6.76 vs. 26.41 ± 6.59, $p = 0.047$), whereas the control group showed no significant change. Additionally, there was no significant change in the
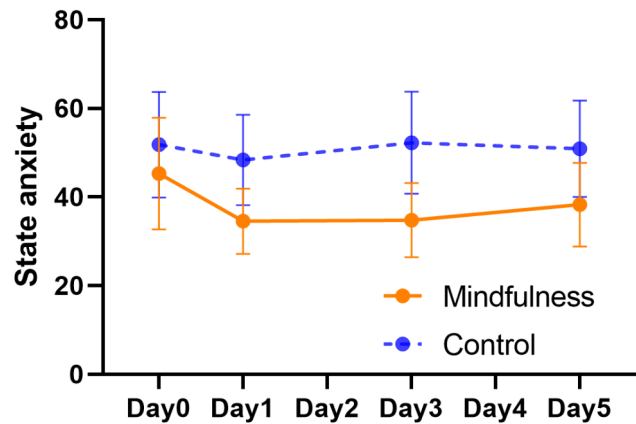
observation scores for the mindfulness group. However, the control group exhibited a significant decline in the observation score (25.47 ± 5.90 vs. 23.97 ± 5.90, $p = 0.012$). Results are shown in Table 4.

Reduction of test anxiety

For state anxiety, a multivariate analysis of covariance, controlling for baseline score, resulted in significant differences for Time, $F(2, 57) = 6.95$, $p = 0.002$, Group, $F(1, 58) = 52.97$, $p < 0.01$ and Time × Group, $F(2, 57) = 3.11$, $p = 0.025$. The mindfulness group exhibited significant differences at various time points. The levels of state anxiety at Time 4 (38.28 ± 9.45), Time 3 (34.79 ± 8.34), and Time 2 (34.55 ± 7.38) were all significantly lower than at Time 1(45.31 ± 12.62). This not only demonstrates the effects of brief mindfulness training on reducing test anxiety, but also showcases the efficacy of immediate (8-minute) mindfulness training in alleviating test anxiety. The control group showed no significant changes across different time points. See Fig. 2 for details.

Fig.2 Comparative reduction in state anxiety over mindfulness intervention

Table 4 Descriptive statistics of scale indicators for both groups

	Mindfulness group		Control group		Covariance analysis		
	Pre-test	Post-test	Pre-test	Post-test	F	η^2	P
FFMQ Total score	114.83 ± 11.23	119.07 ± 13.33	109.75 ± 10.82	110.41 ± 8.14	6.084*	0.095	0.017
Observation	27.34 ± 6.57	27.76 ± 6.46	25.47 ± 5.90	23.97 ± 5.90	5.223*	0.083	0.026
Description	24.79 ± 6.76	26.41 ± 6.59	18.91 ± 6.04	19.03 ± 5.69	7.454**	0.114	0.008
Acting with awareness	23.03 ± 7.36	23.89 ± 7.57	21.78 ± 6.55	24.40 ± 6.07	1.196	0.020	0.279
Nonjudging	19.86 ± 6.09	20.79 ± 6.59	23.44 ± 5.47	24.03 ± 5.67	0.018	<0.001	0.892
Nonreactivity	19.76 ± 3.99	20.20 ± 4.48	20.16 ± 4.97	18.97 ± 4.78	3.085*	0.050	0.084
SAI	45.31 ± 12.62	38.28 ± 9.45	51.81 ± 11.89	50.91 ± 10.89	17.354**	0.230	<0.001
Academic performance	620.95 ± 34.85	629.78 ± 47.02	466.77 ± 124.54	448.86 ± 122.30	9.266**	0.138	0.004

Note: *$p < 0.05$, **$p < 0.01$

Improvement in exam performance

After controlling for pre-test exam scores as covariates, there was a significant difference in the post-test total exam scores between the mindfulness and control groups $F(1,59) = 9.266$, $p = 0.004$, partial $\eta^2 = 0.138$). Post hoc results indicated that the academic performance of the control group significantly declined (466.77 ± 124.54 vs. 448.86 ± 122.30, $p = 0.019$), while there was no significant change in the academic performance of the mindfulness group (620.95 ± 34.85 vs. 629.78 ± 47.02, $p = 0.128$). Detailed results are displayed in Table 4.

Discussion

This study validated the effectiveness of brief mindfulness training in alleviating test anxiety among high school students in real-life scenarios. The results showed significant improvements in overall mindfulness levels, particularly in observation and description abilities, after five days of mindfulness training. There was a noticeable reduction in test anxiety, an increase in inner peace, and an improvement in exam performance, with effects on test anxiety and inner peace noticeable after just one training session.

Previous studies have already found that individuals with high levels of mindfulness exhibit lower levels of anxiety [11]. Building on this foundation, the present study further explored the relationship between mindfulness trait levels and test anxiety, and proposed Hypothesis 1, which states that there is a significant negative correlation between mindfulness trait levels and test anxiety levels. Through analysis of the data, we found that this hypothesis was supported. Specifically, students with higher mindfulness trait levels were able to perceive their emotions more non-judgmentally when facing tests, replacing negative emotions and self-evaluations with new sensory information, and equally regarding all emerging emotions to achieve emotional balance [12]. This emotional regulation mechanism resulted in them experiencing relatively lower levels of test anxiety.

The study found that brief mindfulness training enhances individual mindfulness levels, consistent with previous research [26, 27]. In this study, brief mindfulness training increased overall mindfulness levels and specifically improved observation and description abilities, with a trend towards increased non-reactivity. This could be because the abilities to act with awareness and non-judgment require more prolonged experience and practice to enhance. In the study by Baer, Carmody, and Hunsinger (2012), the sequence of changes in mindfulness skills was also observed [28]. During the eight-week mindfulness training, observation, acting with awareness, and nonreactivity developed first, followed by nonjudging and description. In the present study, the five-day brief mindfulness training prioritized the cultivation of observation and description. This may be due to the fact

that the participants were directly facing the imminent exam situation, which induced more pronounced anxiety, thus making it easier to be perceived and named emotionally. The FFMQ primarily measures trait mindfulness, which is generally relatively stable. Future research could make greater use of measurement tools for state mindfulness, such as the State Mindfulness Scale [29, 30], or combine other assessment methods [31], to more comprehensively evaluate the impact of interventions on mindfulness levels.

Post five days of mindfulness training, there was a significant reduction in students' test anxiety and an increase in inner peace, leading to improved academic performance, which is consistent with hypothesis 2. Previous research has confirmed mindfulness's effectiveness in easing test anxiety [23, 32], but its application in brief mindfulness training has not been explored until now. Our study confirms that brief mindfulness training not only requires less time than traditional practices but also reliably alleviates test anxiety. According to Chambers (2009), increased mindfulness levels enable students to focus on the present state, perceive more information, and cover or ignore their negative thoughts, reducing the impact of anxious emotions and catastrophic thoughts [33]. This refocusing of attention on the task at hand helps maintain a calm demeanor during exams [34, 35], thus enabling a peaceful emotional state during tests. Even individuals who are already anxious can achieve significant improvements with concise mindfulness training [36]. According to Bishop's (2004) theory of attention, mindfulness training can regulate students' attention, preventing them from overly focusing on negative thoughts and emotions and allowing them to concentrate on preparing for the exam, effectively reducing test anxiety from a cognitive-emotional aspect [13, 22]. Additionally, the conserved attention resources could then be redirected towards exam preparation, potentially enhancing performance and further reducing test anxiety, creating a positive cycle of decreasing test anxiety [37, 38]. It should be noted that, despite selecting two classes with comparable teaching staff and educational conditions for this study, significant baseline differences emerged. Since mindfulness training commenced prior to the first exam, it was not possible to pre-control the baseline academic performance of the two classes. Instead, covariance analysis was employed to control for baseline levels. The results of the covariance analysis indicated that, even after controlling for baseline levels, there were still significant differences between the two groups, suggesting that these differences were attributed to the mindfulness training. Of note, test anxiety is a multifaceted phenomenon influenced by various factors. In future research, it is imperative to incorporate other potential variables that

may impact test anxiety, including personality traits and emotion regulation strategies, among others.

Test anxiety, driven by negative comments leading to fear and worry about exams, primarily affects the cognitive component of emotions. Mindfulness likely interacts with cognition and emotion to improve the state of test anxiety. Pekrun et al. (2006) proposed a model of motivation-emotion theory of achievement, suggesting that students' test anxiety originates from their prior achievement motivation types [39]. Internal motivation (e.g., mastery motivation) predicts positive emotions such as enjoyment and pride and negatively predicts boredom and anger. External motivation (e.g., performance-approach goals) can lead to pride when met and frustration and anxiety when unmet, indicating that students with higher external motivation are more likely to experience test anxiety [7, 40]. Mindfulness not only promotes higher internal motivation [41], but also plays a positive regulatory role in the interplay between students' achievement motivation and emotions, leading to more positive emotional experiences and reducing test anxiety [42]. For example, when students' achievement motivation manifests as a desire to achieve higher grades, not meeting this motivation can lead to discouragement, anxiety, and depression, but individuals with higher levels of mindfulness are less likely to experience these emotions or experience them with less intensity [43]. When anxiety is high, individuals with higher mindfulness levels require fewer cognitive resources to mitigate emotional arousal [44].

This study initially discovered the immediate effects of mindfulness training on alleviating test anxiety, demonstrating that a brief 8-minute mindfulness exercise significantly reduces state anxiety and enhances inner peace just before an exam, which supports hypothesis 3. This finding has substantial practical significance and applicative value. As examinees face various pressures, negative thoughts, and physiological responses immediately before testing, these phenomena can lead to judgment errors and suboptimal test outcomes [1]. Furthermore, due to various constraints, many students do not have sufficient time and energy to participate in long-duration psychological adjustment training, making quick and immediate training methods highly desirable. Previous research has shown that mindfulness can not only provide long-term treatment for negative emotions such as depression [45, 46, 47], but also offers immediate emotional relief [48, 49](Shapiro, 2006; Grabovac et al., 2011). For convenience, brief mindfulness training has also begun to be applied to regulate negative emotions with notable effectiveness [15], though its immediate effects on alleviating test anxiety had not been discovered until now. This study provides empirical support that demonstrates the efficacy of mindfulness training, particularly immediate mindfulness exercises, in reducing test anxiety and enhancing inner calm.

This research has some limitations: First, no medium- and long-term surveys were conducted among the participants, and thus, we were unable to assess the medium- and long-term effects of mindfulness training on reducing exam anxiety. This omission not only limits our in-depth understanding of the duration of the training effects but also potentially masks some latent effects of mindfulness training that may not have fully manifested in the current short-term training. Therefore, to gain a more comprehensive understanding of the impact of mindfulness training on exam anxiety, future research should consider designing experiments that include medium- and long-term follow-up surveys. Second, the study used a blank control group due to limited research conditions, which did not include an active control group (e.g., other forms of relaxation training or cognitive behavioral intervention), potentially introducing a placebo effect [50]. Future studies could introduce additional training groups to better validate the effects of brief mindfulness training on alleviating high school students' test anxiety. Third, since this study was conducted in an actual exam setting and no random grouping was implemented, despite choosing the same teaching environment and instructors, it was observed that the mindfulness group exhibited lower anxiety levels and higher levels of mindfulness describing and nonjudging. This has led to the inability to rule out whether students in the mindfulness group inherently had less exam stress, thus making it easier for mindfulness training to be effective on them. Future studies should validate this in real-world settings by selecting parallel classes with no differences in exam anxiety and mindfulness levels, and randomized controlled trials can be adopted to further verify the effectiveness of mindfulness training in alleviating exam anxiety. Lastly, the study primarily used subjective reports from questionnaires, which could be influenced by social expectations. Future studies should incorporate physiological indicators to seek more objective data.

As mentioned above, test anxiety is a highly complex phenomenon. This study, serving as an exploration, has uncovered the effectiveness of mindfulness training in alleviating test anxiety. Future research can endeavor to examine the impact of mindfulness training across varying levels of test anxiety and delve into more intricate influencing factors, such as past history of test anxiety, previous test scores, the importance of the exam, personality traits, emotion regulation skills, rumination levels.

Supplementary Information

Supplementary Material 1

Data availability
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
All procedures performed in the study involving human participants adhered to the Declaration of Helsinki guidelines and were approved by the Institutional Review Board (or Ethics Committee) of The Institute of Psychology, Chinese Academy of Sciences. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Informed consent was obtained from all participants involved in the study.

Competing interests
The authors declare no competing interests.

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