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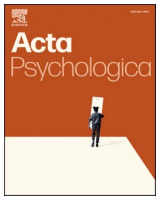

Effectiveness of brief mindfulness training for athletes' mood: The moderating effect of burnout

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ABSTRACT

Objective: To explore the impact of brief mindfulness training on athletes' mood and the moderating effect of burnout between them.

Methods: This study has employed the mixed experimental design of 2 (experimental conditions) × 2 (time points), randomly assigned 60 athletes into a mindfulness training group and a control group (30 athletes in each group), and selected the Five Facets Mindfulness Questionnaire (FFMQ), Profile of Mood States (POMS), and Athlete Burnout Questionnaire (ABQ) to conduct separate tests before and after mindfulness training. The recruitment period began on March 6, 2024 and ended on April 6, 2024.

Results: The results show that: (1) in the pretest, the differences between the mindfulness training group and the control group in the levels of mindfulness, mood, and burnout are not statistically significant; (2) in the posttest, compared with those of the control group, the FFMQ score ($p < 0.001$) of the mindfulness training group improves significantly, while both the ABQ score ($p = 0.040$) and the POMS score ($p = 0.003$) of the mindfulness training group decline significantly; and (3) the Bootstrap analysis of the moderating effect shows that the regression model is significant ($R^2 = 0.355$, $\Delta R^2 = 0.079$, $F = 6.10$, $p = 0.017$), and the regression coefficient of group×ABQ pretest is statistically significant.

Conclusion: The results of this study reveal the effectiveness of brief mindfulness training on athletes' mood and which types of athletes can benefit more from mindfulness training, which provide an empirical basis for intervening on mood.

1. Introduction

Mood is an individual's attitude, experience, and corresponding behavioral response towards objective things, which is the psychological activity process and motivational force that promotes an individual to better adapt and engage in interpersonal communication (Siemer, 2005). Numerous studies have shown that athletes' moods during competitions can have an impact on their performance (Brandt et al., 2017). For examples, negative moods can hinder athletes' fluency, thereby reducing their athletic performance (Ceviker et al., 2020); positive moods can enhance athletes' psychological resilience, indirectly improving their performance (Li et al., 2020), and so on. Therefore, how to mitigate the negative moods of athletes and ensure their optimal psychological state during competitions has become an important research topic in the field of sports.

In order to help athletes achieve their optimal psychological state during competitions, psychological training or intervention has extremely important value and significance. The traditional paradigm of athlete psychological training research advocates for the formation of an optimal psychological state conducive to perfect performance through psychological interventions such as psychological skills training (Jun et al., 2023). However, Si Gangyan has proposed the theory of athletes' coping with adversity (Zhang et al., 2023), which holds that even if an athlete is not in his/her optimal psychological state, as long as he/she can cope with (accept) it reasonably, he/she can achieve ideal competitive performance.

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1.1. The effects of mindfulness training on mood

The psychological behavior training method advocating "acceptance" is represented by "mindfulness training". Mindfulness is a method by which an individual maintains experience by "paying attention in a particular way; on purpose, in the present moment, and non-judgmentally", and is aware of current psychological events (Kabat-Zinn, 2003), that is, focusing on current events every moment, staying alert every minute, and being prepared to accept any circumstance that may occur without judgment (Scott et al., 2004). Similarly, mindfulness training is an intervention method by which an individual focuses his/her attention on current experience based on acceptance (Lutz et al., 2008).

Previous studies have shown that mindfulness training can significantly mitigate athletes' negative moods (Liu, Zhang, & Liu, 2024). For examples, Xu found that mindfulness-acceptance-commitment therapy can significantly decrease athletes' negative moods, such as depression and anxiety by intervening in sport university students (Xu et al., 2018); Bu used the method of MAAE (mindfulness-acceptance-awakening-engagement) to intervene in 49 badminton players, and found that mindfulness training can significantly decrease athletes' negative moods and improve their satisfaction with training and competition (Bu et al., 2020). However, there has been little exploration by previous researchers on which types of athletes can benefit more from mindfulness training. From the perspective of burnout, this study explores the differences in mindfulness training effectiveness among individual athletes with different levels of burnout.

1.2. The moderating role of burnout

Burnout is a negative psychological experience perceived by an individual and can be classified into acute burnout and chronic burnout (Gustafsson et al., 2018). Acute burnout is often manifested as a state in a specific environment, referring to the feeling of exhaustion and burnout after completing a cognitively demanding or physically exhausting task (Choi et al., 2020). For athletes, a single training or competition may cause acute burnout and lead to difficulty concentrating or being easily distracted by irrelevant information, which can have adverse effects on subsequent training and competitions.

Relevant studies on the mechanism of mindfulness effect have shown that mindfulness training can change people's basic sensory and perceptual abilities (Liu et al., 2021). On the one hand, this is manifested as a decrease in sensitivity to adverse stimuli and a greater tolerance and acceptance of changes in internal and external environments; on the other hand, this is manifested as no response to perceived psychological experiences (Williams, 2010). In addition, mindfulness training can enable people to experience the transition from "change" to "coexistence" (Liu et al., 2022). Specifically, athletes can perceive and recognize burnout as an objective event from the capacity and perspective of a third party.

Mindfulness training may be better applicable to athletes with high levels of burnout. Compared to the athletes with low levels of burnout, the individual athletes with high levels of burnout are more prone to negative moods such as tension and panic (Kushnir et al., 2011), which can lead to psychological problems (such as anxiety, and decreased attention and control abilities) and even suicidal ideation (Rao et al., 2015). However, for the athletes with low levels of burnout, their mood state is relatively stable, so mindfulness training can only have limited effect in improving their moods. Moreover, the more severe the burnout symptoms faced by athletes is, the stronger their willingness to seek psychological intervention measures is, the more they can maintain and engage in mindfulness training (Amemiya & Sakairi, 2020), and the more they can benefit more from it. Therefore, the levels of burnout of athletes may moderate the intervention effect of mindfulness training on their moods.

Previous studies have examined the changes in the levels of individual burnout before and after mindfulness training (Liu, Lei, et al., 2024), namely the effect of mindfulness training on alleviating the levels of individual burnout. However, relevant existing studies have mainly focused on examining such groups as medical staff (Green & Kinchen, 2021) and stroke patients (Du et al., 2018), with few studies examining the athletes. In addition, the impact of burnout on the effectiveness of mindfulness training has been rarely explored, and the extent to which the athletes with different levels of burnout benefit from mindfulness training is still unknown. Moreover, previous studies on athlete mindfulness training often used the method of intervening for a duration of 7 or 8 weeks, resulting in higher subject attrition rates regarding the athletes with less free time (Moen et al., 2015). Studies have shown that even brief mindfulness training can effectively change an individual's psychological state, especially for athletes (Liu et al., 2024), and brief training is more convenient and applicable to the athletes, helping them adjust their psychological state in a short period of time before the competition.

Thus, this study is particularly relevant, as it addresses the effectiveness of mindfulness training on athletes' mood, and verifies which types of athletes can benefit more from it, which has not been sufficiently explored in previous research. In summary, this study aims to investigate the effects of brief mindfulness training on athletes' mood and burnout levels, as well as the intervention effects of brief mindfulness training on the athletes with different levels of burnout.

2. Methods

2.1. Subjects

The minimum sample size required for this study was calculated using G*Power 3.1. In this study, ANOVA: Repeated measures, within-between interaction was set in statistical test, the medium effect size $f = 0.25$ was set, the $\alpha = 0.05$ was set, the power of the statistical test took the default value of $1\text{-}\beta = 0.95$, and the number of groups = 2 was set. It was calculated that either the mindfulness training group or the wait-list control group required at least 27 samples. Assuming a loss rate of 10 %, it was finally determined that the number of people in either the group of receiving mindfulness training or the neutral control group was 30. After matching the number of athletes in each group, 60 athletes were randomly divided into two groups by an on-site lottery.

An advertisement was posted at a Sport University for recruiting the subjects, for which the method that was convenient for sampling was used. The criteria for selecting the subjects: (1) at least 18 years old; (2) having no mindfulness study experience; (3) having no medical history of mental disorders; and (4) high level college athletes (at the national level two or above). A total of 60 athletes were selected, all of them were told that they would participate in a study on psychological training, and they signed the Informed Consent of the Subject. The 60 athletes were randomly assigned to the mindfulness training group ($n = 30$) and the control group (n = 30). Of them, 2 athletes failed to show up due to scheduling conflict with the exam, and 1 athlete was removed for missing data. In the end, 57 valid subjects were selected.

2.2. Instruments

2.2.1. Five Facets Mindfulness Questionnaire

This study employs the Chinese-version survey instrument *Five Facets Mindfulness Questionnaire* (FFMQ) for measuring athletes' mindfulness level, which was revised by Deng et al. (2011). The FFMQ consists of five subscales: observing, describing, acting with awareness, nonjudging of inner experience, and nonreactivity to inner experience, with a total of 39 items. And it uses the five-point scale, in which an evaluation of 1–5 points from "Rarely" to "Always" is given. The higher the total score is, the higher the level of athletes' mindfulness is. In this study, the coefficient of internal consistency of FFMQ and five subscales are 0.662, 0.774, 0.725, 0.813, 0.807, and 0.566, respectively.

2.2.2. Profile of Mood States

This study employs the Chinese-version survey instrument *Profile of Mood States* (POMS) for measuring athletes' mood, which was revised by Wang and Lin (2000). The POMS consists of seven subscales: nervous, anger, fatigue, depressed, energy, panic, and self-esteem, with a total of 40 items. And it uses the five-point scale, in which an evaluation of 1–5 points from "Rarely" to "Always" is given. The total mood disorder score (TMD) is equal to the sum of 5 negative mood scores minus the sum of 2 positive mood scores (energy, self-esteem) plus 100. The higher the final score, the more chaotic the mood. In this study, the coefficient of internal consistency of the POMS and seven subscales are 0.934, 0.835, 0.909, 0.870, 0.884, 0.875, 0.774, and 0.642, respectively.

2.2.3. Athlete Burnout Questionnaire

This study employs the Chinese-version survey instrument *Athlete Burnout Questionnaire* (ABQ), which was revised by Zhang and Mao, 2004. The ABQ includes three subscales for the decreased sense of achievement, emotional/physical exhaustion, and negative evaluation of exercise. The ABQ consists of 15 items, and it uses the five-point scale, in which an evaluation of 1–5 points from "Strongly Disagree" to "Strongly agree" is given. The higher the total score, the higher the level of burnout. In this study, the coefficients of internal consistency of ABQ and three subscales are 0.855, 0.682, 0.796, and 0.741, respectively.

2.3. Procedure

The recruitment period began on March 6, 2024 and ended on April 6, 2024. The experiment adopted a double-blind design. The two groups of test subjects did not interfere with each other during the intervention period. The researchers were not allowed to tell the scale surveying experimenters and the subjects about the research hypothesis, study design, or research methods. Before the experiment, the research procedure was introduced to the subjects, and the principle of privacy protection was explained. The athletes were intervened at the same time and in the same environment, trying to eliminate the interference of irrelevant variables as much as possible.

The mindfulness training group listened to 30 min of mindfulness practice recordings, which were recorded in advance by a mindfulness instructor with >10 years of mindfulness intervention experience. The instructor is a Master of Mindfulness Cognitive Therapy at Oxford University. The content of mindfulness practice is body scanning, which requires participants to focus their attention on different parts of the body. By perceiving the sensations of different parts of their body, it aims to better control their attention and feel the external environment. After listening to the recordings, they shared their own feelings and then the practice was finished. And the control group listened to 30 min of neutral news recordings. Both interventions were conducted in groups.

All participants were tested individually. At baseline, each participant completed a brief demographic questionnaire to assess age, gender, and sport level. Afterward, each participant completed a self-report measure of FFMQ, POMS, and ABQ, and was then randomly assigned to one of the two groups. Following the mindfulness or neutral recording, each participant completed a self-report measure of FFMQ, POMS, and ABQ again.

2.4. Statistical methods

The statistical software SPSS 26.0 was used. The descriptive statistics were used to describe the demographic characteristics of the subjects and to test the normal distribution of data. The Pearson correlation analysis on the pre-test results of various variables was used to explore the relationship between athletes' mindfulness level, moods, and burnout. The independent sample *t*-test was used to compare the pretest scores of the mindfulness training group and the control group. The repeated measures ANOVA of 2 (groups: mindfulness training group and control group) × 2 (time of test: pretest and posttest) was used to compare the level of mindfulness, mood, and burnout, and simple effect analysis was used for those with significant differences. In addition, in this study, Andrew Hayes' Process macro for SPSS 26 was used to examine the moderating effect of baseline burnout level between mindfulness training and the mitigation of mood disorder (Bolin, 2014). The model number was 1, the bootstrap sample size was 5000. Under the 95 % confidence interval, the change in TMD (post-test minus pre-test) was used as the dependent variable, the group was used as the independent variable, and the baseline burnout level was used as the moderating variable. In addition, to avoid the potential impact of the demographic characteristics, the gender, age, and sport level were controlled as concomitant variables, too.

The researchers had no access to information that could identify individual participants during or after data collection. Data were collected on April 6, 2024. The data were accessed for research purposes in April 2024, after the data collection had been completed.

3. Results

As shown in Table 1, there were 57 valid subjects in this experiment. Among them, there were 20 men and 9 women in the mindfulness training group, while there were 19 men and 9 women in the control group, and the difference did not reach a significant level ($p > 0.05$). The age range of the mindfulness training group was 17–22 years old, with an average age of 19.9 ± 0.7, while the age range of the control group was 17–20 years old, with an average age of 19.5 ± 0.8. The mean age in the mindfulness training group was significantly higher than in the control group ($p < 0.05$). There were 22 s level athletes and 7 first level athletes in the mindfulness training group, while there were 21 s level athletes and 7 first level athletes in the control group, and the difference did not reach a significant level ($p > 0.05$).

3.1. Correlation analysis of various variables

A Pearson correlation test was conducted on the mindfulness level, moods, and burnout of athletes. As shown in Table 2, the mindfulness level was significantly negatively correlated with negative moods ($r = -0.48$), TMD ($r = -0.55$), and ABQ ($r = -0.43$), and significantly positively correlated with positive moods ($r = 0.35$). That is, the higher the mindfulness level, the lower the levels of negative moods, TMD, and ABQ, and the correspondingly higher the level of positive moods; Secondly, there is a significant positive correlation between TMD and ABQ ($r = 0.46$), that is, the stronger the moods disorder, the higher the level of burnout. The correlation between variables provides a prerequisite for subsequent moderation effect testing.

3.2. Descriptive statistics of the scores in the subscales

The means and standard deviations of the pre-test and post-test scores of the two groups in the subscales are presented in Table 3. The results show that there are no statistically significant differences between the mindfulness training group and the control group in the scores of the FFMQ ($p = 0.240$), TMD ($p = 0.691$), and ABQ ($p = 0.550$) indexes. This indicates that there was no substantial difference between the groups in these variables.

Table 1
Analysis of differences in demographics ($M \pm SD$) of the two groups of subjects.

Variable	Mindfulness training group ($n = 29$)	Control group ($n = 28$)	t	p
Gender	1.31 ± 0.47	1.32 ± 0.48	−0.09	0.93
Age	19.90 ± 0.67	19.46 ± 0.79	2.22	0.03
Sport level	1.24 ± 0.44	1.25 ± 0.44	−0.07	0.94

Table 2
Scores ($M \pm SD$) and Pearson correlation analysis of various variables.

Variables	$M \pm SD$	1	2	3	4	5
1 FFMQ	116.9 ± 10.3	–				
2 Negative moods	65.1 ± 22.3	−0.48**	–			
3 Positive moods	31.4 ± 7.8	0.35**	−0.12	–		
4 TMD	133.8 ± 24.4	−0.55**	0.95**	−0.42**	–	
5 ABQ	30.2 ± 9.4	−0.43**	0.39**	−0.32*	0.46**	–

* $p < 0.05$.
** $p < 0.01$.

3.3. The impact of mindfulness training on athletes' psychological state

The Greenhouse-Geisser correction results of the 2 × 2 variance analysis of the FFMQ scores show that the interaction effect between grouping and surveying time is statistically significant [F (1, 55) = 13.75, $p < 0.001$, partial $\eta^2 = 0.200$] (see Table 4). In other words, there is a trend in FFMQ that change over time, and mindfulness intervention affects this trend.

The results of further simple effect analysis show that the posttest FFMQ score of the control group is lower than that of the pretest, but the difference is not significant ($p = 0.518$), while the posttest FFMQ score of the mindfulness training group is significantly higher than that of the pretest ($p < 0.001$). In summary, compared with that in the control group, athletes' mindfulness level in the mindfulness training group improves significantly. See Fig. 1.

The Greenhouse-Geisser correction results of the 2 × 2 variance analysis of the TMD scores show that the interaction effect between grouping and surveying time is statistically significant [F (1, 55) = 9.77, $p = 0.003$, partial $\eta^2 = 0.151$] (see Table 4). In other words, there is a trend in TMD that change over time, and mindfulness intervention affects this trend.

The results of further simple effect analysis show that the posttest TMD score of the control group is lower than that of the pretest, but the difference is not significant ($p = 0.888$), while the posttest TMD score of the mindfulness training group is significantly lower than that of the pretest ($p < 0.001$). In summary, compared with that in the control group, athletes' TMD in the mindfulness training group mitigates significantly. See Fig. 2.

The Greenhouse-Geisser correction results of the 2 × 2 variance analysis of the ABQ scores show that the interaction effect between

Table 3
Scores of the two groups in the subscales ($M \pm SD$) and pretest comparison.

Variable	Mindfulness training group ($n = 29$)		Control group ($n = 28$)		Pretest comparison	
	Pretest	Posttest	Pretest	Posttest	t	p
observing	24.8 ± 5.4	27.6 ± 4.9	28.3 ± 5.0	27.8 ± 5.2	−2.52	0.015
describing	24.1 ± 4.4	25.6 ± 3.8	24.9 ± 4.4	24.1 ± 3.4	−0.68	0.502
acting with awareness	26.7 ± 4.5	25.2 ± 4.4	24.9 ± 5.7	23.6 ± 5.5	1.35	0.181
nonjudging of inner experience	20.0 ± 5.2	19.3 ± 4.2	19.6 ± 4.7	20.1 ± 4.7	0.30	0.769
nonreactivity to inner experience	19.7 ± 3.5	23.9 ± 4.5	20.9 ± 3.4	22.1 ± 4.4	−1.32	0.192
FFMQ	115.3 ± 11.0	121.5 ± 9.87	118.5 ± 9.4	117.6 ± 8.4	−1.19	0.240
nervous	14.9 ± 4.9	12.5 ± 4.5	14.3 ± 5.2	13.4 ± 5.6	0.48	0.632
anger	13.9 ± 5.5	11.6 ± 4.6	13.5 ± 6.5	13.4 ± 6.7	0.25	0.804
fatigue	12.5 ± 4.5	10.5 ± 4.0	12.5 ± 4.7	12.1 ± 4.5	0.01	0.990
depressed	12.6 ± 4.7	10.8 ± 4.4	12.7 ± 5.8	12.2 ± 6.0	−0.07	0.948
energy	17.3 ± 4.5	18.9 ± 4.6	17.9 ± 5.5	17.3 ± 6.5	−0.42	0.679
panic	11.9 ± 3.6	10.6 ± 3.0	11.4 ± 3.8	11.8 ± 5.0	0.59	0.558
self-esteem	13.5 ± 3.3	14.7 ± 2.9	14.0 ± 3.3	13.6 ± 4.1	−0.59	0.557
TMD	135.0 ± 21.6	122.4 ± 19.1	132.4 ± 27.3	132.0 ± 30.5	0.40	0.691
decreased sense of achievement	1.9 ± 3.5	0.6 ± 3.2	0.8 ± 2.8	1.4 ± 3.0	1.23	0.226
emotional/physical exhaustion	14.4 ± 4.0	12.3 ± 3.8	14.6 ± 4.4	14.2 ± 4.9	−0.17	0.863
negative evaluation of exercise	14.6 ± 3.6	13.9 ± 2.9	13.9 ± 4.5	13.6 ± 4.3	0.61	0.545
ABQ	30.9 ± 9.1	26.7 ± 7.8	29.4 ± 9.8	29.1 ± 10.6	0.60	0.550

Table 4
Results of repeated measures ANOVA of the subscale of the two groups.

Variable	Within group						Between group		
	Time			Time×group			F	p	Partial η^2
	F	p	Partial η^2	F	p	Partial η^2			
observing	7.65	0.008	0.122	16.97	<0.001	0.236	2.01	0.162	0.035
describing	0.74	0.395	0.013	6.06	0.017	0.099	0.14	0.708	0.003
acting with awareness	6.92	0.011	0.112	0.07	0.800	0.001	1.93	0.171	0.034
nonjudging of inner experience	0.16	0.691	0.003	2.06	0.157	0.036	0.03	0.865	0.001
nonreactivity to inner experience	39.80	<0.001	0.420	12.25	0.001	0.182	0.11	0.747	0.002
FFMQ	7.73	0.007	0.123	13.75	<0.001	0.200	0.02	0.886	<0.001
nervous	12.36	0.001	0.183	2.73	0.104	0.047	0.01	0.928	<0.001
anger	8.25	0.006	0.130	6.85	0.011	0.111	0.22	0.639	0.004
fatigue	6.94	0.011	0.112	3.22	0.078	0.055	0.58	0.450	0.010
depressed	6.74	0.012	0.109	2.29	0.136	0.040	0.31	0.580	0.006
energy	0.95	0.334	0.017	4.63	0.036	0.078	0.14	0.707	0.003
panic	1.54	0.220	0.027	5.77	0.020	0.095	0.11	0.747	0.002
self-esteem	1.22	0.275	0.022	5.38	0.024	0.089	0.13	0.720	0.002
TMD	11.07	0.002	0.168	9.77	0.003	0.151	0.31	0.583	0.006
decreased sense of achievement	1.23	0.273	0.022	6.97	0.011	0.112	0.02	0.877	<0.001
emotional/physical exhaustion	9.11	0.004	0.142	3.77	0.057	0.064	0.95	0.333	0.017
negative evaluation of exercise	2.15	0.148	0.038	0.25	0.621	0.004	0.25	0.622	0.004
ABQ	5.81	0.019	0.096	4.42	0.040	0.074	0.04	0.849	0.001

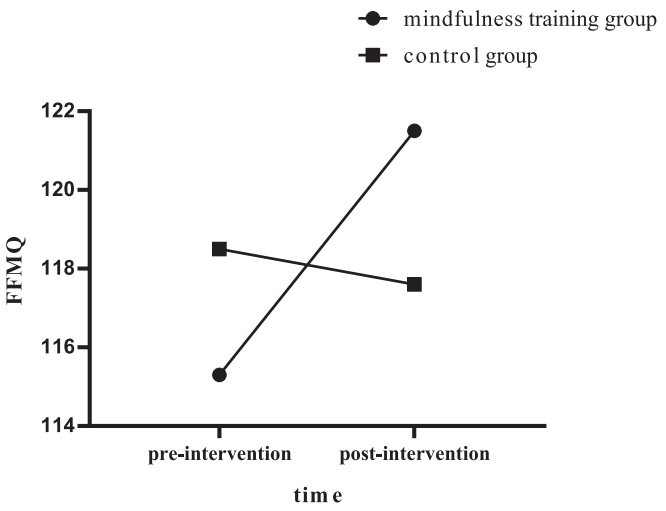

Fig. 1. FFMQ scores of two groups in pre- and post-intervention.

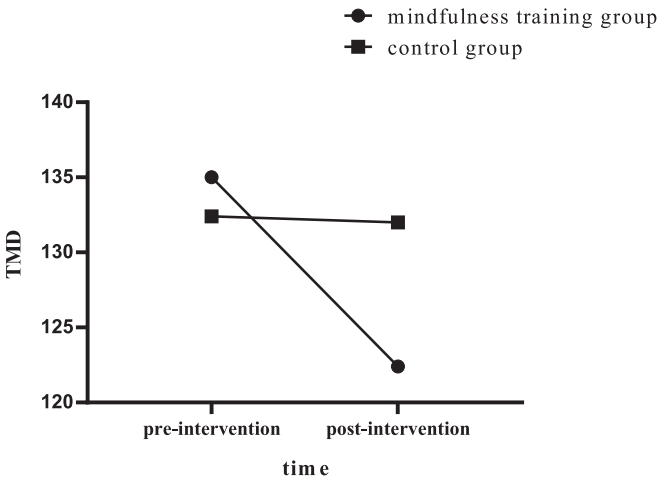

Fig. 2. TMD scores of two groups in pre- and post-intervention.

grouping and surveying time is statistically significant [F (1, 55) = 4.42, p = 0.040, partial η^2 = 0.074] (See Table 4). In other words, there is a trend in ABQ that change over time, and mindfulness intervention affects this trend.

The results of further simple effect analysis show that the posttest ABQ score of the control group is lower than that of the pretest, but the difference is not significant (p = 0.829), while the posttest ABQ score of the mindfulness training group is significantly lower than that of the pretest (p = 0.002). In summary, compared with that in the control group, athletes' burnout level in the mindfulness training group mitigates significantly. See Fig. 3.

3.4. Analysis of the moderating effect of the ABQ

In this study, Andrew Hayes' Process macro for SPSS is employed to examine the moderating effect of the ABQ. The results show that when the Change in TMD was used as the dependent variable, the regression model was significant (R^2 = 0.355, ΔR^2 = 0.079, F = 6.10, p = 0.017), and the regression coefficient of group×ABQ pretest was statistically significant (See Table 5).

Further analysis has found that under low level of burnout, the intervention effect of mindfulness training on athletes' TMD did not significant (p = 0.667, 95 % *CI* [−8.31, 12.88]), while under moderate (p = 0.003, 95 % *CI* [4.07, 19.06]) and high (p < 0.001, 95 % *CI* [10.16, 31.53]) level of burnout, the intervention effects of mindfulness training on athletes' TMD are significant, that is, compared with athletes with lower levels of burnout, those with high levels of burnout had better effects of mindfulness training.

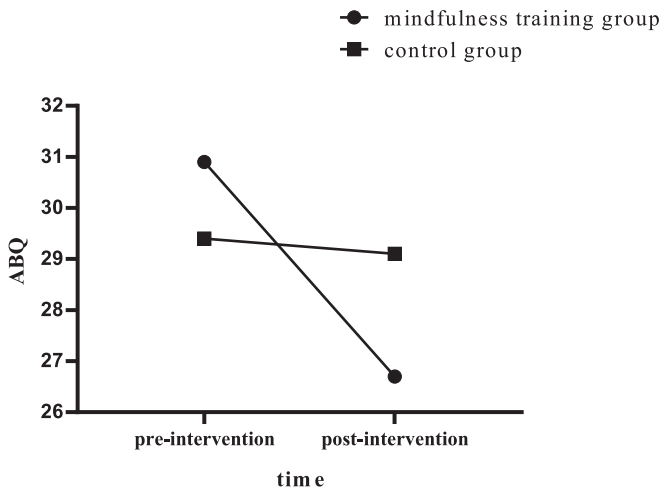

Fig. 3. ABQ scores of two groups in pre- and post-intervention.

4. Discussion

Mindfulness is a complex psychological state related to self-awareness that compensates and promotes positive moods of an individual. Mindfulness can reduce an individual's judgment and response to the surrounding environment, making him/her not be troubled by the past, not be afraid of the future, and live in the present. This study expands the functionality of brief mindfulness training in the field of sports, enriches the motivational outcomes of mindfulness, and focuses on examining the impact of mindfulness training on mood states that are closely related to athletes' athletic performance. The purpose of this study is to explore the boundary conditions under which mindfulness training affects the mood state of athletes. This study is a positive supplement to existing studies in the field of mindfulness training at home and abroad. The results of this study are of great significance for explaining which types of athletes can achieve better results from mindfulness training, and for further developing corresponding psychological training methods.

4.1. The relationship between mindfulness level and mood or burnout

The correlation analysis results show that athletes' mindfulness levels are significantly negatively correlated with their negative moods (r = −0.48), TMD (r = −0.55), or ABQ (r = −0.43), but are significantly positively correlated with their positive moods (r = 0.35). That is to say, on the one hand, the higher the level of an athlete's mindfulness is, the less negative moods he/she has, which is consistent with previous research results (Josefsson et al., 2017). The reason is that mindfulness training focuses on cultivating an individual's de-centering ability (that is, the metacognitive ability that helps the individual perceive negative things his/her brain solely as psychological phenomena). In addition, awareness and non-response are key mechanisms for mindfulness to improve moods. By not responding to negative moods, an individual does not attempt to control or suppress anxiety, so he/she is less likely to suffer from mood disturbance (Fresco et al., 2013). On the other hand, the higher an athlete's mindfulness level is, the lower his/her level of burnout is, for which previous studies have provided supporting evidence (Zhang et al., 2016). Studies have shown that mindfulness training can change people's basic sensory and perceptual abilities. On the one hand, this is manifested as a decrease in sensitivity to adverse

Table 5
Analysis of the moderating effect of ABQ.

Dependent variable	Independent variable	Partial regression coefficient				95 % *CI*
		Coeff	*SE*	*t*	*p*	
Change in TMD	Gender	−1.37	4.18	−0.33	0.744	[−9.76, 7.02]
	Age	−0.00	2.52	−0.00	1.000	[−5.06, 5.06]
	Sport level	−7.93	4.30	−1.85	0.071	[−16.56, 0.70]
	Group	−18.25	12.61	−1.44	0.154	[−43.58, 7.08]
	ABQ pretest	−1.97	0.64	−3.09	0.003	[−3.24, −0.69]
	Group×ABQ pretest	0.99	0.40	2.47	0.017	[0.18, 1.79]

Notes: For gender, 1 = male, 2 = female; for sport level, 1 = level 2, 2 = level 1; for group, 1 = mindfulness group, 2 = control group.

stimuli and a greater tolerance and acceptance of changes in internal and external environments (Garland et al., 2015); on the other hand, this is manifested as no response to perceived psychological experiences (Williams, 2010). In addition, mindfulness training can enable people to experience the transition from “change” to “coexistence” (Garland et al., 2017). Therefore, the athletes with high mindfulness levels are often able to perceive and recognize burnout as an objective event from the capacity and perspective of a third party, thereby reducing exhaustion and burnout, that is, lowering the level of burnout.

4.2. The impact of mindfulness training on the psychological state of athletes

The results of this study show that the FFMQ score of the mindfulness training group after intervention is higher than the baseline level, while there is no difference in the pre-test and post-test scores of the control group. Compared with the control group, the athletes who have received 30 min of mindfulness training show an improvement in their mindfulness level, which is consistent with our hypothesis and previous research results (Watier & Dubois, 2016), that is, brief mindfulness training can also effectively improve an individual's mindfulness level. However, specifically, the athletes in the mindfulness training group have not made improvements in the two dimensions including “acting perceptually” and “non-judgment”, which may be due to the fact that although 30 min of brief mindfulness training can improve individuals' attention, it cannot make them experience under non-judgment and act perceptually (Firth et al., 2023). On the other hand, the results of this study show that brief mindfulness training can significantly improve athletes' mood states and alleviate their burnout levels. Specifically, brief mindfulness training can not only mitigate athletes' negative moods, but also promote their positive moods. That is to say, brief mindfulness training can not only mitigate single negative moods in a specific dimension, but also have an overall improvement effect on the psychological state of athletes, which is consistent with existing research results (Xu et al., 2016). Upon investigation, the moods disorder and burnout of athletes are caused by stressors. When stressors arise, they attract the attention of individuals and activate the stimulus-response connection. Mindfulness training not only enables athletes to more flexibly choose their evaluations on stimuli and block automated conditioned responses, but also enables them to consciously reflect and re-evaluate stress stimuli (Lucy & Crystal, 2019). The evaluation on negative stimuli can significantly reduce the individual's negative moods. In addition, mindfulness training can help an athlete develop better coping ability, and good coping ability can significantly increase the individual's positive moods. This is why mindfulness training can mitigate athletes' moods disorder and lower their burnout levels.

4.3. The moderating effect of burnout

The resulting of further Bootstrap analysis and simple slope analysis show that the level of burnout during the baseline period has a moderating effect on the effect of brief mindfulness training on improving athletes' moods. That is to say, for the athletes with high levels of burnout, mindfulness training can significantly improve their mood state; on the contrary, for the athletes with low levels of burnout, the effect of mindfulness training is not significant. Specifically, the moderating effect involving the athletes with medium and high levels of burnout is statistically significant. However, the effect of mindfulness training is not statistically significant if the athletes' level of burnout is low. Previous studies have shown that athletes' levels of burnout are negatively correlated with their positive mood states (Bueno et al., 2023). Therefore, one possible explanation for the above results is that for the athletes with low levels of burnout, their mood state is relatively good, that is, their level of negative moods is low, so the range of moods that mindfulness training can improve is relatively small; on the contrary, for the athletes with high levels of burnout, they have more negative moods, which means there is more room for mindfulness training to improve their moods. In addition, due to the poor performance of the athletes with high levels of burnout in terms of attention control, mood state, and athletic performance (Barcza-Renner et al., 2016), they are encouraged to have a higher willingness to engage in psychological training, which helps them better engage in mindfulness training. That is, the athletes with high levels of burnout may be more engaged in and benefit from mindfulness practice. Therefore, according to the results of this study, brief mindfulness training is more effective for the athletes with high levels of burnout, which also verifies the hypothesis of this study that brief mindfulness training can better help the athletes with high levels of burnout to improve their mood state.

4.4. Research limitations and prospects

This study has only selected high-level college athletes as the subjects, and the applicability of the results of this study for the elite athletes of the national team has not been verified. In the future, recruiting elite athletes as the subjects can be considered. “Non-judgment” and “acting perceptually” are two core elements of mindfulness, but the brief training in this study only significantly enhanced athletes' abilities to observe, describe, and not respond. Therefore, the mechanism of the effect of mindfulness on mood and burnout has not been fully revealed. In the future, comparative studies between long-term intervention and brief training can be added, or a control group regarding separately cultivating the abilities in terms of “non-judgment” and “acting perceptually” can be added. This study has only examined the moderating effect of burnout, but it has not taken into account other factors that affect the effectiveness of mindfulness training. In the future, attention can be paid to other boundary conditions that affect the effectiveness of mindfulness training, such as the type of sports, attention control ability, or representational ability, in order to gain a more detailed understanding of the effect mechanism of mindfulness training and promote the application of mindfulness training in the field of sports.

5. Conclusion

Through a randomized controlled trial, this study explores the effect of brief mindfulness training on athletes' moods and the moderating

effect of burnout between mindfulness training and athletes' moods. The results show that: (1) brief mindfulness training can improve athletes' mood and mitigate their levels of burnout; (2) the intervention effect of mindfulness on mood is moderated by the level of burnout.

CRediT authorship contribution statement

Fengbo Liu: Writing – review & editing, Writing – original draft, Conceptualization. **Qingyang Yu:** Writing – review & editing, Conceptualization. **Shichang Cai:** Data curation. **Zhantao Feng:** Data curation. **Ning Li:** Writing – original draft, Investigation.

Ethical statement

The study was approved by the Ethics Committee of Zhengzhou University of Light Industry. This study complies with the Declaration of Helsinki. All methods were performed in accordance with the relevant guidelines and regulations, and all participants completed an informed consent form before filling out the questionnaire. The participants were asked to sign an informed consent before the experiment, and were approved to provide informed consent on their own behalf.

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Declaration of competing interest

The authors have declared that no competing interests exist.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

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