



OPEN ACCESS

EDITED BY

Naseer Abbas Khan,
South Ural State University, Russia

REVIEWED BY

Warhel Asim Mohammed,
University of Duhok, Iraq
Pierluigi Diotaiuti,
University of Cassino, Italy

*CORRESPONDENCE

Huilin Wang
✉ huilin.wang@ed.ac.uk

RECEIVED 04 February 2024

ACCEPTED 22 April 2024

PUBLISHED 01 May 2024

CITATION

Li Q, Li L, He Q and Wang H (2024) Exploring the role of mindfulness on obligatory exercise among young athletes: mediating roles of obsessive passion and cognitive state anxiety. *Front. Public Health* 12:1381983. doi: 10.3389/fpubh.2024.1381983

COPYRIGHT

© 2024 Li, Li, He and Wang. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Exploring the role of mindfulness on obligatory exercise among young athletes: mediating roles of obsessive passion and cognitive state anxiety

Qianyuan Li¹, Li Li¹, Qianqian He² and Huilin Wang^{3,4*}

¹School of Physical Education, Hunan University of Science and Technology, Xiangtan, China, ²Faculty of Economics, Chulalongkorn University, Bangkok, Thailand, ³School of Business, Hunan University of Science and Technology, Xiangtan, China, ⁴Moray House School of Education and Sport, The University of Edinburgh, Edinburgh, United Kingdom

Introduction: In the current trend toward youthfulness and age reduction in competitive sports, the issue of obligatory exercise among young athletes is becoming more severe. This not only affects their physical and mental health but also hampers their future prospects in the sports world. While delving into the impact of mindfulness on the issue of obligatory exercise among young athletes, it reveals the mediating role of obsessive passion and cognitive state anxiety.

Methods: This study is a cross-sectional research that employs convenience and snowball sampling methods. We selected 403 young athletes from several universities and high-level sports teams in the central-southern region of China as valid samples and used AMOS v.23 to construct a structural equation model to validate the hypotheses.

Results: The research findings indicate a significant positive correlation between obsessive passion, cognitive state anxiety, and obligatory exercise. Furthermore, obsessive passion and cognitive state anxiety mediate the relationship between mindfulness and obligatory exercise. This implies that young athletes can better regulate their emotional state during training, manage training loads sensibly, and avoid issues with obligatory exercise through mindfulness training.

Discussion: In conclusion, to enhance the cognitive levels of young athletes and reduce their obligatory exercise behaviors, national sports authorities and coaching teams should develop reasonable mindfulness training programs for athletes and encourage their participation in mindfulness training.

KEYWORDS

young athletes, mindfulness, obsessive passion, cognitive state anxiety, obligatory exercise

1 Introduction

Participating in high-intensity competitive sports can provide young athletes with positive physiological impacts and advanced athletic skills (1). However, the rigorous training intensity and the high-pressure competitive environment can also harm their behavioral health levels (2). In fact, away from the glamor of competition, one in every three to four athletes suffers from

overtraining syndrome (3). Alarming, this issue is more severe among young athletes, as their eagerness to reach the top ranks of professional athletes leads them to adopt a more aggressive attitude toward training, pushing themselves beyond their psychological and physiological limits (4).

Recent trends indicate a rising number of student athletes and an increase in sports specialization and competitiveness, which has further exacerbated the issue of overtraining among young athletes (5, 6). Studies highlight that the training load for student athletes now surpasses that of past Olympic champions (7), with nearly half of young athletes' sports injuries being attributable to obligatory exercise. Such practices not only risk their immediate health but also threaten to prematurely end their sports careers (8). Alarming, without early intervention, the rate of sports injuries related to obligatory exercise spikes threefold as athletes transition from high school to university (9), presenting a clear and urgent need for effective prevention and treatment strategies.

Mindfulness emerges as a vital tool in this context, offering a way to navigate the mental and physical challenges of competitive sports. Its importance lies in its ability to enhance athletes' awareness of their bodies, thoughts, and emotions, fostering a more balanced approach to training and competition. Despite the significance of this practice, research on the role of mindfulness in combating the issues related to obligatory exercise, particularly among young athletes, remains sparse. Existing studies have primarily focused on identifying the precursors of obligatory exercise, such as socio-cultural influences (10), body dissatisfaction (11), emotional regulation styles (12), perfectionism (13), and sports ideals (14), as well as on measuring the overtraining problem among young athletes (15). Although the academic community has conducted extensive empirical analysis on obligatory training at both the cognitive (16) and behavioral levels (17), there is a lack of research discussing the connection between cognitive and behavioral aspects.

Mindfulness encourages athletes to calmly observe their current training experience without judgment (18), enhancing their focus and sense of control over the activity, and helping them concentrate during training to avoid additional anxiety (19). It also promotes a continuum from self-regulation to self-exploration and ultimately to self-liberation (20), allowing athletes to face previous unpleasant training experiences with equanimity, strengthening willpower, and avoiding negative expectations in cognitive anxiety (21), which has a positive effect on athletes' sports-specific anxiety and competitive state anxiety (22–24). Furthermore, the potential mechanisms of self-regulation and behavioral flexibility in mindfulness training can shape athletes' abilities in self-regulation and emotional regulation, improving adaptability to the environment and better managing emotions such as anger and restlessness (25–27). Additionally, since obsessive passion is an external manifestation of internalized stress, the open and accepting attitude fostered by mindfulness can help student athletes approach training mistakes with a tolerant mindset, thereby reducing stress at its root (28). Therefore, mindfulness is considered an effective method for managing the internal stress of athletes. Young athletes who undergo mindfulness training are more likely to achieve a relaxed state, avoiding the stress and burnout associated with competitive sports (29, 30).

Cognitive state anxiety is defined as the negative prediction and cognitive concern about one's own sports abilities and status (31), reflecting to some extent the difficulty athletes face in coping with the

immense pressure of high-level sports competition. Compared to low-level athletes, cognitive state anxiety has a greater impact on high-level athletes (32, 33). Affected by cognitive state anxiety, athletes experiencing negative self-doubt may become distracted, leading to incorrect judgments in subsequent training or competitions and, consequently, to the adoption of incorrect approaches to activities (34). Additionally, persistent criticism from coaches and teammates can also cause young athletes to remain in a state of anxiety about their body shape and sports level for a long time, leading to symptoms of obligatory training (35, 36). Obsessive passion, originating from the dualistic model of passion (37), is an emotion where an individual has a strong inclination to pursue and is willing to devote a significant amount of time and energy to it (38). Moreover, obsessive passion is more like an uncontrollable impulse, compelling athletes to sacrifice their personal health and stubbornly persist in training tasks that may improve their sports performance abilities, even in the face of a clear risk of injury (39–42). Furthermore, when individuals frequently fall into anxiety and remain immersed in this negative state for a long period, it can provoke anger and accompany reckless and impulsive behaviors (43), and individuals with strong emotional impulsiveness are more likely to have high levels of anxiety internalization symptoms (44, 45).

Unlike previous studies, this study focuses on the problem of obligatory exercise among young athletes, considering the potential impact of cognitive aspects on behavioral aspects, and proposes mindfulness as an intervention to improve the problem of obligatory training among young athletes. Although mindfulness has potential benefits for young athletes' obsessive passion, cognitive state anxiety, and obligatory training, our understanding of how these factors are interconnected remains limited. The purpose of this study is to explore the potential mechanisms that form the relationships between these cognitive and behavioral factors and to determine strategies for improving the problem of obligatory exercise among athletes.

Based on the above, this study proposes the following hypotheses:

H1: Mindfulness has a negative and significant impact on cognitive state anxiety.

H2: Mindfulness has a negative and significant impact on obsessive passion.

H3: Cognitive state anxiety has a positive and significant impact on obsessive passion.

H4: Cognitive state anxiety has a positive and significant impact on obligatory exercise.

H5: Obsessive passion has a positive and significant impact on obligatory exercise.

H6: Cognitive state anxiety and obsessive passion mediate the relationship between mindfulness and obligatory exercise.

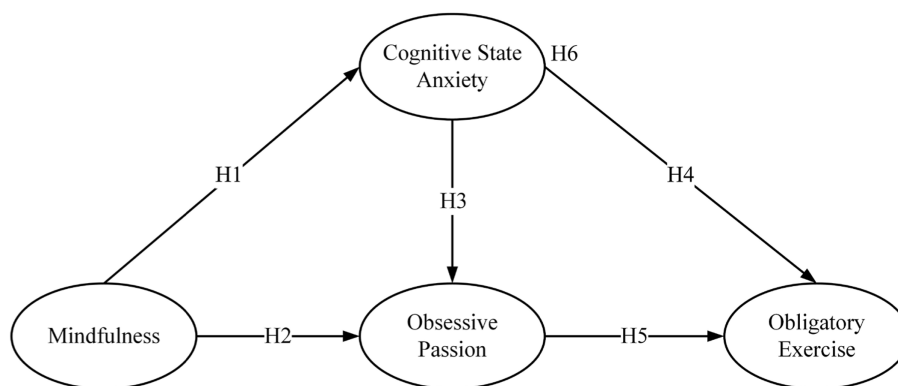


FIGURE 1 Hypothesis model.

All hypotheses are summarized in Figure 1.

Therefore, this study aims to: (1) understand the obligatory exercise issues among young Chinese athletes; (2) discuss the relationships between mindfulness, cognitive state anxiety, obsessive passion, and obligatory exercise in young athletes; and (3) provide recommendations for preventing and intervening in obsessive training behaviors for sports education institutions, including the National Sports Administration, universities, professional sports schools, and sports clubs.

2 Methodology

2.1 Participants and procedures

This study conducted a web-based questionnaire survey among high-level young athletes. To collect research data, the researchers employed convenience sampling and snowball sampling methods. After obtaining approval from local authorities, the researchers reached out to athletes from four universities, youth training centers, and high-level clubs in different provinces of central and southern China. Using social media platforms such as QQ and WeChat, the researchers inquired about their interest in participating in the study and sent the questionnaire tool link, inviting them to participate sincerely. All participants were informed of the survey’s purpose and volunteered before completing the questionnaire. Additionally, based on the snowball method, athletes who completed the questionnaire were encouraged to invite their friends and teammates to participate in the survey. Participants who completed the survey were then given training equipment as a token of appreciation. By the end of July, we had distributed 600 questionnaires and successfully collected responses from 482 athletes. After eliminating invalid questionnaires (due to data anomalies, missing information, blank responses, etc.), a total of 403 valid questionnaires were obtained, resulting in a valid response rate of 62.7%.

Table 1 presents the demographic characteristics of the 403 student athletes participating in this survey. Among the respondents, (1) the male-to-female ratio was approximately two to one; (2) 69% of the participants were under the age of 23; (3) athletes participating in badminton, soccer, basketball, and track and field accounted for half

TABLE 1 Demographic characteristics of participants.

Profiles	Survey (%)
Gender	
Male	260 (64.5%)
Female	143 (35.5%)
Age	
14–17	35 (8.7%)
18–20	97 (24.1%)
21–23	146 (36.2%)
>23	125 (31.0%)
Sports items	
Ball sports	195 (48.4%)
Track and field sports	70 (17.4%)
Other sports	138 (34.2%)
The number of sports competitions participated in the past year	
1–3	275 (68.2%)
4–6	59 (14.7%)
7–9	23 (5.7%)
≥10	46 (11.4%)

of the total; (4) in the past year, about 70% of athletes participated in sports competitions only 1–3 times. The reason for this relatively high number is attributed to the official lifting of COVID-19 prevention and control measures in China on January 8, 2023, allowing sports competitions to resume. Prior to that date, sports competitions could not be held normally, and athletes were unable to participate in them.

2.2 Instruments

The questionnaire comprised five sections. The first section requested respondents to provide their demographic information, including age, gender, the sports they were engaged in, the number of competitions participated in the past year, and the duration of training cessation due to sports injuries or illnesses in the past year.

The second section utilized five items from the scale developed by Feldman et al. (46) to collect relevant data on respondents' mindfulness levels. Sample items included "I try to pay attention to my thoughts without judging them." The third section employed four items from the scale developed by Lundqvist and Hassmén (47) to gather data on respondents' cognitive state anxiety. Sample items included "I worry about my performance when I am engaged in sports." The fourth section used four items from the scale developed by Vallerand et al. (37) to collect data on respondents' obsessive passion. Sample items included "There is a strong impulse to engage in this sport that I cannot resist." The fifth section utilized five items from the scale developed by Steffen and Brehm (48) to compile data on respondents' obligatory exercise. Sample items included "I feel guilty when I do not exercise." All four scales were measured using a Likert five-point scale, with response options ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The researchers adapted some items in the scales to better suit the habits and context of Chinese individuals, as well as to ensure the scale items were appropriate for our research context. Please refer to Table 2 for the content of the scales. A pilot test was conducted in advance to ensure its reliability (49). A total of 96 valid questionnaires were anticipated, and the results indicated that Cronbach's alpha coefficients were all above 0.8, confirming the researchers' modifications to the scales based on the context were justified.

2.3 Data analysis

In this study, AMOS v.23 was employed to construct a structural equation model (SEM) to examine how athletes, through mindfulness meditation, reduce cognitive state anxiety and obsessive passion, thereby improving their tendency toward obligatory exercise. The maximum likelihood (ML) estimation method was utilized to estimate the model parameters. A two-step modeling approach was employed to assess both the measurement and structural models. First, a comprehensive evaluation of the model's reliability and validity was conducted. Subsequently, fit indices and path coefficients of the hypothesis model were measured, and the presence of mediating effects was examined.

To mitigate potential common method variance (CMV) arising from self-reported behaviors, researchers followed the recommended approach outlined by Mossholder et al. (50). As part of this approach, a comparative analysis was conducted between model one and model two, focusing on variations in degrees of freedom and chi-square values. The results indicated that the chi-square value for model one was 3078.434, encompassing 135 degrees of freedom and yielding a p -value below 0.001. Similarly, for model two, the chi-square value was 252.106, accompanied by 129 degrees of freedom and a p -value below 0.001. These findings affirm the congruence of fit between model one and model two, suggesting that CMV is not a concern within the context of this study.

3 Results

3.1 Measurement model

The reliability and validity assessment of latent variables incorporated confirmatory factor analysis (CFA) using AMOS v.23.

Table 2 displays the factor loadings, Cronbach's α coefficients, composite reliability (CR), and average variance extracted (AVE) for each item on the scale. As shown in Table 2, all variables demonstrated Cronbach's α values exceeding 0.8, affirming robust internal consistency within the model structure as guided by Fornell and Larcker (51). Additionally, the AVE for each variable exceeded 0.6 (as noted in Table 2), surpassing the minimal acceptable threshold of 0.5. Furthermore, the CR of each latent variable surpassed 0.8, underscoring the model's robust convergent validity. The resilience of convergent validity across proposed models was well-established. Factor loadings from principal component factor analysis ranged from 0.751 to 0.908, reinforcing the measurement model's robust construct validity. Table 3 shows that the square root of the AVE is on the diagonals, while the off diagonals are Pearson's correlations of constructs. The square root of the AVE on the diagonals exceeds the inter-construct correlations, confirming discriminant validity.

3.2 Structural model

Following a comprehensive evaluation of the measurement model's reliability and validity, this study advanced to scrutinize the structural model using AMOS v.23, aimed at substantiating the formulated hypotheses. Using 5,000 bootstrap samples, the outcomes of CFA consistently aligned with established criteria ($\chi^2/df=2.755$, GFI=0.907, NFI=0.940, TLI=0.954, CFI=0.961, RMSEA=0.066), unequivocally indicating an optimal fit between the model and empirical data. Moreover, the interconnectedness of variables was corroborated by the Pearson correlation results outlined in Table 3. The standardized coefficients for variables within the structural equation model are visually depicted in Figure 2.

As illustrated in Figure 2, mindfulness exhibited a direct and negative correlation with cognitive state anxiety ($\beta=-0.378$, $p<0.001$) and a negative correlation with obsessive passion ($\beta=-0.150$, $p<0.01$), effectively substantiating H1 and H2, respectively. Additionally, cognitive state anxiety showed a direct and positive correlation with obsessive passion ($\beta=0.571$, $p<0.001$), robustly supporting H3. Similarly, cognitive state anxiety had a direct and positive association with obligatory exercise ($\beta=0.504$, $p<0.001$), affirming H4. Notably, obsessive passion was identified as having a direct and positive correlation with obligatory exercise ($\beta=0.290$, $p<0.001$), substantiating H5.

The evaluation of mediating effects, as depicted in Table 4, was conducted using bootstrap estimation with 5,000 resamples and 95% bias-corrected confidence intervals. The findings distinctively highlighted the indirect effect of mindfulness on obligatory exercise, mediated through cognitive state anxiety and obsessive passion. This mediation yielded a robust estimate of -0.297 (SE=0.041, CI=[-0.377 , -0.213], $p<0.001$), thus providing comprehensive support for H6.

4 Discussion

4.1 Theoretical contributions

This study makes several theoretical contributions to the analysis of athletes' obligatory exercise. Firstly, unlike existing research on athletes' obligatory exercise that focuses on athletes' body

TABLE 2 Reliability and validity.

Items	Loadings	C α	CR	AVE
Mindfulness (MI)		0.943	0.944	0.770
MI1: It is easy for me to concentrate on what I am doing	0.882			
MI2: I can accept things I cannot change	0.841			
MI3: I can usually describe how I feel at the moment in considerable detail	0.899			
MI4: I try to notice my thoughts without judging them	0.879			
MI5: I am able to pay close attention to one thing for a long period of time	0.886			
Cognitive State Anxiety (CS)		0.885	0.883	0.654
CS1: I am concerned about choking under pressure	0.751			
CS2: I am concerned about I am concerned that others	0.757			
CS3: I am concerned about will be disappointed with	0.878			
CS4: I am concerned about my performance	0.842			
Obsessive Passion (OP)		0.938	0.939	0.793
OP1: I cannot live without sports	0.897			
OP2: The urge to engage in sports is so strong. I cannot help myself from participating in this activity	0.892			
OP3: I have difficulty imagining my life without sports	0.908			
OP4: I am emotionally dependent on sports	0.864			
Obligatory Exercise (OE)		0.892	0.892	0.624
OE1: When I miss an exercise session, I feel concerned about my body possibly getting out of shape	0.767			
OE2: When I do not exercise, I feel guilty	0.813			
OE3: I frequently “push myself to the limits”	0.758			
OE4: I have had daydreams about exercising	0.818			
OE5: Sometimes I find that my mind wanders to thoughts about exercising	0.791			

TABLE 3 Pearson correlation.

Construct	MI	CS	OP	OE
MI	(0.877)			
CS	-0.354**	(0.809)		
OP	-0.349**	0.558**	(0.891)	
OE	-0.208**	0.616**	0.563**	(0.789)

The square root of the AVE is in diagonals; off diagonals are a Person's corrections of contracts. ** $p < 0.01$.

dissatisfaction (11) and socio-cultural factors (10), this study is pioneering in combining cognitive and behavioral aspects to explore the relationship between mindfulness and obligatory exercise among young athletes. The results reveal a significant negative correlation between mindfulness and cognitive state anxiety (see Figure 2), supporting the findings of Bühlmayer et al. (19). In our model, the impact of mindfulness on obligatory passion was the most pronounced, followed by cognitive state anxiety. These factors, cognitive state anxiety and obligatory passion, mediate the relationship between mindfulness and obligatory exercise, explaining 52% of the variance in obligatory exercise as depicted in Figure 2. This indicates that the prevalence of obligatory exercise issues among young athletes is intimately linked to how they manage anxiety and passion. Mindfulness training can potentially diminish the impacts of obligatory passion and cognitive state anxiety on their cognitive and judgment skills, thereby effectively reducing the occurrence of obligatory exercise issues. This insight provides a solid pathway and

theoretical foundation for further research into the relationship between mindfulness training and obligatory exercise issues among young athletes.

4.2 Practical implications

Considering the positive impact of mindfulness on reducing athletes' obsessive passion and cognitive state anxiety, as well as its indirect effect on alleviating obligatory exercise problems, the following recommendations are proposed: Firstly, at the national level, the National Sports Administration and its subordinate government departments should prioritize mental health in young athletes. Given their less mature mindset, athletes are more susceptible to cognitive distortions (4), making the incorporation of mindfulness training into daily plans crucial. Establishing a reasonable evaluation system and regularly inspecting the psychological conditions of athletes nationwide will provide a strong support system for their mental health. It is essential to collect and analyze data on the cognitive impact of mindfulness training methods on athletes, allowing for timely adjustments to ensure their effectiveness and applicability.

Secondly, at the level of athletes' surroundings, including their team psychologists, coaches and training partners, team sports psychologists play a crucial role. They must promptly understand the latest research on the impact of mindfulness on athletes, encourage active participation in mindfulness training, and meticulously observe and record the athletes' psychological states to maintain mental health. Coaches should identify athletes suffering from obligatory exercise

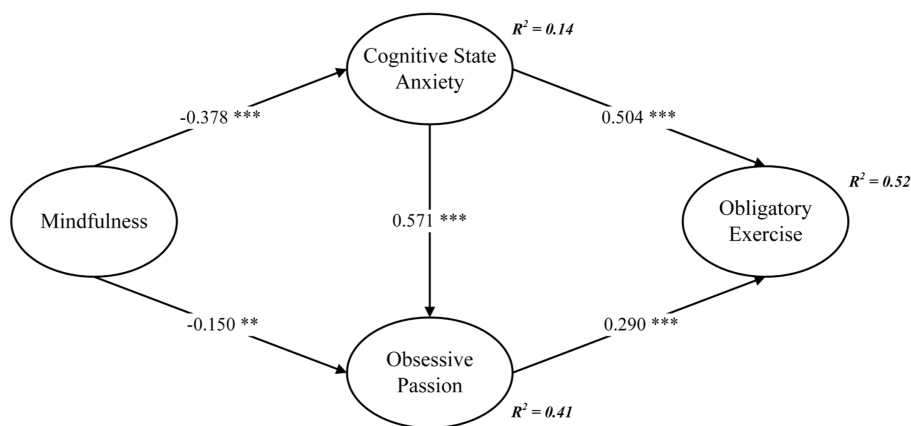


FIGURE 2
Structural path model. ** $p < 0.01$, *** $p < 0.001$.

TABLE 4 Standardized indirect effect.

	Point estimate	Product of coefficients		Bootstrapping		
		SE	Z	Bias-Corrected 95% CI		Two-Tailed Significance
				Lower	Upper	
MI → OE	-0.297	0.041	-7.244	-0.377	-0.213	0.000 (***)

*** $p < 0.001$.

issues and adjust training plans accordingly, in consultation with sports psychologists, while eliminating the unhealthy training atmosphere of “the more, the better.”

Finally, at the individual level, athletes should actively participate in mindfulness training and maintain good communication with coaches and teammates. When early symptoms such as anxiety and stress arise, athletes should provide honest feedback on their psychological issues (2) to prevent obligatory exercise problems. Early detection and treatment are crucial for realizing athletic potential.

For a long time, the focus has been on athletes’ performances, overlooking the negative impacts of long-term high-intensity training. Despite studies confirming that mindfulness training alleviates negative emotions like anxiety, tension, and fatigue (29) and positively impacts performance (52), its importance is often unrecognized by management organizations, coaches, and athletes themselves. Furthermore, influenced by personal self-esteem, many young athletes are reluctant to seek help for psychological issues such as training pressure and panic (53), leading to the loss of control over their training behavior. This study highlights the positive influence of cognitive improvements and encourages greater participation in mindfulness training. We recommend that young athletes in China try the Mindfulness-Acceptance-Insight-Commitment (MAIC) program, suited to the Chinese social context (54), to gain a comprehensive understanding of their training activities and reduce the occurrence of negative situations such as obligatory exercise.

4.3 Limitations

Firstly, the participants of our study were mainly drawn from universities and sports teams within the central and southern

regions of China. Recognizing the need for a more diverse and representative sample, future studies should aim to extend the geographical scope and include a wider range of sports disciplines. This expansion would not only enhance the representativeness of the sample but also improve the generalizability of the research findings across different contexts. Secondly, given the cross-sectional nature of our study, which lacks a temporal dimension, we acknowledge the limitation this presents in understanding the dynamic nature of mindfulness training effects. Future research could benefit from adopting a longitudinal approach, allowing for a detailed examination of how the relationships between variables evolve over time and the sustained impacts of mindfulness training on athletes’ behavior and psychological well-being. Thirdly, our research concentrated on young competitive athletes, leaving a gap in our understanding of mindfulness training’s relevance for non-competitive or recreational athletes. Future inquiries should explore the applicability of our findings to these groups, taking care to address potential biases in self-reporting by participants. Fourthly, our study was limited by its exclusive reliance on quantitative research methods. Incorporating qualitative insights on top of quantitative data could significantly enrich our understanding of how athletes personally perceive the impact of mindfulness on their training and psychological states. Therefore, future research should aim to integrate qualitative methodologies, such as interviews or focus groups, to capture the nuanced perspectives of athletes regarding mindfulness practices. This mixed-methods approach would offer a more holistic view of the mindfulness training effects, providing deeper insights into the athletes’ subjective experiences and the complex interplay between mindfulness, training habits, and mental well-being.

5 Conclusion

In accordance with the research objectives, this study identifies mindfulness, obsessive passion, and cognitive state anxiety as crucial factors influencing obligatory exercise behavior in young athletes. Specifically, mindfulness can indirectly improve the obligatory exercise issues of young athletes by reducing obsessive passion and cognitive state anxiety, acting as two mediating variables. Therefore, this study recommends that athlete management organizations and coaches prioritize monitoring the mental health levels of athletes and integrate mindfulness training into their daily routines. Simultaneously, young athletes should proactively respond to external assistance regarding their psychological well-being, attempting to utilize mindfulness to control negative training emotions, ultimately reducing the occurrence of obligatory exercise problems.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethics Committee of the School of Physical Education of Hunan University of Science and Technology (No. ECBPEHNUST 2022/0012). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

QL: Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. LL: Funding acquisition, Investigation, Resources, Writing – original

draft, Writing – review & editing. QH: Methodology, Validation, Writing – original draft, Writing – review & editing. HW: Conceptualization, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study was supported by the Hunan Provincial Social Science Achievement Review Committee (No. XSP2023JJZ001) and the Scientific Research Fund of Hu-nan University of Science and Technology (No. E52203).

Acknowledgments

The authors express their profound gratitude to all the participants who generously contributed their time and effort to this study. Their willingness to share their experiences and insights has been invaluable and has significantly enriched the research.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act.* (2013) 10:98. doi: 10.1186/1479-5868-10-98
- Neal TL, Diamond AB, Goldman S, Liedtka KD, Mathis K, Morse ED, et al. Interassociation recommendations for developing a plan to recognize and refer student-athletes with psychological concerns at the secondary school level: a consensus statement. *J Athl Train.* (2015) 50:231–49. doi: 10.4085/1062-6050-50.3.03
- Brink MS, Visscher C, Coutts AJ, Lemmink KAPM. Changes in perceived stress and recovery in overreached young elite soccer players. *Scand J Med Sci Sports.* (2012) 22:285–92. doi: 10.1111/j.1600-0838.2010.01237.x
- Nf M, Rj W, Ca W. Prevalence of nonfunctional overreaching/overtraining in Young English athletes. *Med Sci Sports Exerc.* (2011) 43:1287–94. doi: 10.1249/MSS.0b013e318207f87b
- Kliethermes SA, Marshall SW, LaBella CR, Watson AM, Brenner JS, Nagle KB, et al. Defining a research agenda for youth sport specialisation in the USA: the AMSSM youth early sport specialization summit. *Br J Sport Med.* (2021) 55:135–43. doi: 10.1136/bjsports-2020-102699
- Xanthopoulos MS, Benton T, Lewis J, Case JA, Master CL. Mental health in the Young athlete. *Curr Psychiatry Rep.* (2020) 22:63. doi: 10.1007/s11920-020-01185-w
- Winsley R, Matos N. Overtraining and elite Young athletes. *Med Sport Sci.* (2011) 56:97–105. doi: 10.1159/000320636
- Podlog L, Dimmock J, Miller J. A review of return to sport concerns following injury rehabilitation: practitioner strategies for enhancing recovery outcomes. *Phys Ther Sport.* (2011) 12:36–42. doi: 10.1016/j.ptsp.2010.07.005
- Roos KG, Marshall SW, Kerr ZY, Golightly YM, Kucera KL, Myers JB, et al. Epidemiology of overuse injuries in collegiate and high school athletics in the United States. *Am J Sports Med.* (2015) 43:1790–7. doi: 10.1177/0363546515580790
- Reynolds KA, Plateau CR, Haycraft E. Sociocultural influences on compulsive exercise in Young people: a systematic review. *Adolesc Res Rev.* (2023) 8:179–94. doi: 10.1007/s40894-022-00180-x
- Bell HS, Donovan CL, Ramme R. Is athletic really ideal? An examination of the mediating role of body dissatisfaction in predicting disordered eating and compulsive exercise. *Eat Behav.* (2016) 21:24–9. doi: 10.1016/j.eatbeh.2015.12.012
- Goodwin H, Haycraft E, Meyer C. Emotion regulation styles as longitudinal predictors of compulsive exercise: a twelve month prospective study. *J Adolesc.* (2014) 37:1399–404. doi: 10.1016/j.adolescence.2014.10.001
- Egan SJ, Bodill K, Watson HJ, Valentine E, Shu C, Hagger MS. Compulsive exercise as a mediator between clinical perfectionism and eating pathology. *Eat Behav.* (2017) 24:11–6. doi: 10.1016/j.eatbeh.2016.11.001
- Homan K. Athletic-ideal and thin-ideal internalization as prospective predictors of body dissatisfaction, dieting, and compulsive exercise. *Body Image.* (2010) 7:240–5. doi: 10.1016/j.bodyim.2010.02.004

15. Goodwin H, Haycraft E, Taranis L, Meyer C. Psychometric evaluation of the compulsive exercise test (CET) in an adolescent population: links with eating psychopathology. *Eur Eat Disord Rev.* (2011) 19:269–79. doi: 10.1002/erv.1109
16. Taranis L, Meyer C. Perfectionism and compulsive exercise among female exercisers: high personal standards or self-criticism? *Pers Individ Differ.* (2010) 49:3–7. doi: 10.1016/j.paid.2010.02.024
17. White C, Bickner E, Racine SE. Gender differences in compulsive exercise facets and their associations with eating disorder symptoms. *Eat Behav.* (2023) 49:101737. doi: 10.1016/j.eatbeh.2023.101737
18. Sauer S, Walach H, Schmidt S, Hinterberger T, Lynch S, Büssing A, et al. Assessment of mindfulness: review on state of the art. *Mindfulness.* (2013) 4:3–17. doi: 10.1007/s12671-012-0122-5
19. Bühlmeier L, Birrer D, Röthlin P, Faude O, Donath L. Effects of mindfulness practice on performance-relevant parameters and performance outcomes in sports: a Meta-analytical review. *Sports Med.* (2017) 47:2309–21. doi: 10.1007/s40279-017-0752-9
20. Ryan RM, Donald JN, Bradshaw EL. Mindfulness and motivation: a process view using self-determination theory. *Curr Dir Psychol Sci.* (2021) 30:300–6. doi: 10.1177/09637214211009511
21. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. *Assessment.* (2006) 13:27–45. doi: 10.1177/1073191105283504
22. Scott-Hamilton J, Schutte NS, Brown RF. Effects of a mindfulness intervention on sports-anxiety, pessimism, and flow in competitive cyclists. *Appl Psychol Health Well-Being.* (2016) 8:85–103. doi: 10.1111/aphw.12063
23. Evans S. Mindfulness-based cognitive therapy for generalized anxiety disorder In: SJ Eisendrath, editor. *Mindfulness-based cognitive therapy: Innovative applications.* Cham: Springerplus (2016). 145–54.
24. Tang Y, Liu Y, Jing L, Wang H, Yang J. Mindfulness and regulatory emotional self-efficacy of injured athletes returning to sports: the mediating role of competitive state anxiety and athlete burnout. *Int J Environ Res Public Health.* (2022) 19:11702. doi: 10.3390/ijerph191811702
25. Coffey KA, Hartman M, Fredrickson BL. Deconstructing mindfulness and constructing mental health: understanding mindfulness and its mechanisms of action. *Mindfulness.* (2010) 1:235–53. doi: 10.1007/s12671-010-0033-2
26. Tang Y, Jing L, Liu Y, Wang H. Association of mindfulness on state-trait anxiety in choking-susceptible athletes: mediating roles of resilience and perceived stress. *Front Psychol.* (2023) 14:1232929. doi: 10.3389/fpsyg.2023.1232929
27. Khan NA, Hassan S, Pravdina N, Akhtar M. Drivers of sustainability: technological and relational factors influencing young consumers' green buying intentions and green actual consumption behavior. *Young Consum.* (2023) 24:686–703. doi: 10.1108/YC-09-2022-1610
28. Petterson H, Olson BL. Effects of mindfulness-based interventions in high school and college athletes for reducing stress and injury, and improving quality of life %J journal of sport rehabilitation. *J Sport Rehabil.* (2017) 26:578–87. doi: 10.1123/jsr.2016-0047
29. Gustafsson H, Skoog T, Davis P, Kenttä G, Haberl P. Mindfulness and its relationship with perceived stress, affect, and burnout in elite junior athletes journal of clinical sport psychology. *J Clin Psychol.* (2015) 9:263–81. doi: 10.1123/jcsp.2014-0051
30. Khan AN, Mehmood K, Le J, Khan NA. Visionary leadership and leaders' burnout: a weekly diary analysis. *Asia Pac J Manag.* (2023). doi: 10.1007/s10490-023-09889-2
31. Prapavessis H, Grove R, Maddison R, Zillmann N. Self-handicapping tendencies, coping, and anxiety responses among athletes. *Psychol Sport Exerc.* (2003) 4:357–75. doi: 10.1016/S1469-0292(02)00020-1
32. Woodman TIM, Hardy LEW. The relative impact of cognitive anxiety and self-confidence upon sport performance: a meta-analysis. *J Sports Sci.* (2003) 21:443–57. doi: 10.1080/0264041031000101809
33. Ali A, Khan NA, Wang H, Wang N. Investigating the influence of social media on employee creativity: a perspective from social network ties. *Creat Res J.* (2024) 36:70–88. doi: 10.1080/10400419.2022.2102753
34. Gee CJ. How does sport psychology actually improve athletic performance? A framework to facilitate athletes' and coaches' understanding. *Behav Modif.* (2010) 34:386–402. doi: 10.1177/0145445510383525
35. Kovacsik R, Griffiths MD, Pontes HM, Soós I, de la Vega R, Ruiz-Barquín R, et al. The role of passion in exercise addiction, exercise volume, and exercise intensity in long-term exercisers. *Int J Ment Health Addict.* (2019) 17:1389–400. doi: 10.1007/s11469-018-9880-1
36. Khan AN, Khan NA, Mehmood K. Exploring the relationship between learner proactivity and social capital via online learner interaction: role of perceived peer support. *Behav Inform Technol.* (2023) 42:1818–32. doi: 10.1080/0144929X.2022.2099974
37. Vallerand RJ, Blanchard C, Mageau GA, Koestner R, Ratelle C, Léonard M, et al. Les passions de l'âme: On obsessive and harmonious passion. *J Pers Soc Psychol.* (2003) 85:756–67. doi: 10.1037/0022-3514.85.4.756
38. Gustafsson H, Hassmén P, Hassmén N. Are athletes burning out with passion? *Eur J Sport Sci.* (2011) 11:387–95. doi: 10.1080/17461391.2010.536573
39. Lalande D, Vallerand RJ, Lafrenière M-AK, Verner-Filion J, Laurent F-A, Forest J, et al. Obsessive passion: a compensatory response to unsatisfied needs. *J Pers.* (2017) 85:163–78. doi: 10.1111/jopy.12229
40. Paradis KF, Cooke LM, Martin LJ, Hall CR. Too much of a good thing? Examining the relationship between passion for exercise and exercise dependence. *Psychol Sport Exerc.* (2013) 14:493–500. doi: 10.1016/j.psychsport.2013.02.003
41. Khan NA, Bahadur W, Ramzan M, Pravdina N. Turning the tide: an impact of leader empowering behavior on employees' work-family conflict, spillover and turnover intention in tourism. *Leadersh Org Dev J.* (2024) 45:353–73. doi: 10.1108/LODJ-02-2023-0099
42. Zheng F, Khan NA, Khan MWA. Unethical leadership and employee extra-role behavior in information technology sector: a moderated mediation analysis [original research]. *Front Psychol.* (2021) 12:708016. doi: 10.3389/fpsyg.2021.708016
43. Kashdan TB, McKnight PE. The darker side of social anxiety: when aggressive impulsivity prevails over shy inhibition. *Curr Dir Psychol Sci.* (2010) 19:47–50. doi: 10.1177/09637211409359280
44. Terres-Barcala L, Albaladejo-Blázquez N, Aparicio-Ugarriza R, Ruiz-Robledillo N, Zaragoza-Martí A, Ferrer-Cascales R. Effects of impulsivity on competitive anxiety in female athletes: the mediating role of mindfulness trait. *Int J Environ Res Public Health.* (2022) 19:3223. doi: 10.3390/ijerph19063223
45. Khan NA, Bahadur W, Maialeh R, Pravdina N, Akhtar M. Turning the tide on turnover: the impact of empowering leadership on the work-family spillover of managers. *PLoS One.* (2023) 18:e0287674. doi: 10.1371/journal.pone.0287674
46. Feldman G, Hayes A, Kumar S, Greeson J, Laurenceau J-P. Mindfulness and emotion regulation: the development and initial validation of the cognitive and affective mindfulness scale-revised (CAMS-R). *J Psychopathol Behav Assess.* (2007) 29:177–90. doi: 10.1007/s10862-006-9035-8
47. Lundqvist C, Hassmén P. Competitive state anxiety Inventory-2 (CSAI-2): evaluating the Swedish version by confirmatory factor analyses. *J Sports Sci.* (2005) 23:727–36. doi: 10.1080/02640410400021484
48. Steffen JJ, Brehm BJ. The dimensions of obligatory exercise. *Eat Disord.* (1999) 7:219–26. doi: 10.1080/10640269908249287
49. Kimberlin CL, Winterstein AG. Validity and reliability of measurement instruments used in research. *Am J Health Syst Pharm.* (2008) 65:2276–84. doi: 10.2146/ajhp070364
50. Mossholder KW, Bennett N, Kemery ER, Wesolowski MA. Relationships between bases of power and work reactions: the mediational role of procedural justice. *J Manag.* (1998) 24:533–52. doi: 10.1177/014920639802400404
51. Fornell C, Larcker DE. Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res.* (1981) 18:39–50. doi: 10.1177/002224378101800104
52. Birrer D, Röthlin P, Morgan G. Mindfulness to enhance athletic performance: theoretical considerations and possible impact mechanisms. *Mindfulness.* (2012) 3:235–46. doi: 10.1007/s12671-012-0109-2
53. Diotaiuti P, Valente G, Mancone S, Grambone A, Chirico A. Metric goodness and measurement invariance of the Italian brief version of interpersonal reactivity index: a study with young adults. *Front Psychol.* (2021) 12:773363. doi: 10.3389/fpsyg.2021.773363
54. Su N, Si G, Zhang C-Q. Mindfulness and acceptance-based training for Chinese athletes: the mindfulness-acceptance-insight-commitment (MAIC) program. *J Sport Psychol Action.* (2019) 10:255–63. doi: 10.1080/21520704.2018.1557772