EFFECTS OF MINDFULNESS TRAINING ON RUMINATION DISPOSITION, REPETITIVE THINKING, AND REGULATORY ANXIETY AMONG CHINESE UNIVERSITY TENNIS PLAYERS IN JIANGXI PROVINCE, CHINA

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UNIVERSITI SAINS MALAYSIA

2025

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Thesis submitted in fulfilment of the requirements
for the degree of
Master of Science

March 2025

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my supervisors, Associate Professor Dr Garry Kuan Pei Ern and Associate Professor Dr Liying Yao, for their invaluable guidance and unwavering support throughout this research endeavour. I am profoundly grateful for their mentorship, which extended beyond academic matters to encompass personal encouragement, facilitating my progress both in my studies and in life. Their expertise and insightful feedback have been instrumental in shaping my understanding of the subject matter and enabling significant advancements in my knowledge. Furthermore, I extend my sincere appreciation to Associate Professor Kueh Yee Cheng for her generous assistance with the data analysis central to this thesis. Her meticulous review of the manuscript and insightful comments have been invaluable in refining the quality and rigour of this work.

I am also indebted to Dr Zhutang Liu, my roommate, for his academic guidance and unwavering support. His insights have been profoundly beneficial to my academic development, and I am grateful for his care and consideration in all aspects of my life. I wish to acknowledge the contributions of the staff and colleagues within the Exercise and Sport Science programme, School of Health Sciences, Universiti Sains Malaysia for their assistance and support throughout this project.

Finally, I wish to express my profound gratitude to my family for providing me with a nurturing and supportive environment that has enabled me to pursue my academic aspirations and further my personal development. Their unwavering belief in my abilities has been a constant source of motivation and inspiration.

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LIST OF ABBREVIATIONS

SCR	Sport competitive Rumination
RTQ	Repetitive Thinking Questionnaire
MRS	Mistake Rumination Scale
MCRQ	Metacognitions about Self-Critical Rumination Questionnaire
ANOVA	Analysis of Variance
CFA	Confirmatory factor analysis
RMSEA	Root means square error of approximation
SEM	Structural Equation Modelling
SRMR	Standardized root means square residual
TLI	Tucker and Lewis index
CR	Composite reliability
CFI	Comparative Fit Index
ATPE	Assessing Test Anxiety in Physical Education

LIST OF APPENDICES

KESAN LATIHAN KESEDARAN TERHADAP KECENDERUNGAN RUMINASI, PEMIKIRAN BERULANG DAN KEBIMBANGAN KAWAL SELIA DALAM KALANGAN PEMAIN TENIS UNIVERSITI DI WILAYAH JIANGXI, CHINA

ABSTRAK

Kajian ini bertujuan untuk menyiasat impak latihan kesedaran (LK) terhadap kecenderungan ruminasi (KR), pemikiran berulang (PB), kebimbangan kawal selia (KS), dan prestasi sukan (PS) dalam kalangan pemain tenis universiti China di Wilayah Jiangxi. Memandangkan peningkatan penggunaan LK dalam sukan untuk peningkatan prestasi, penyelidikan ini bertujuan untuk menilai keberkesanannya dalam populasi khusus ini. Kajian dua fasa telah dijalankan. Dalam Kajian 1, 460 peserta dari empat universiti di Bandar Ganzhou melengkapkan soal selidik dalam talian yang menilai KR, PB, dan KS. Selepas kesimpulan fasa pengumpulan data, analisis seterusnya telah dijalankan. Kajian 2 melibatkan percubaan terkawal rawak (PTR) di mana peserta dari Kajian 1 telah diagihkan secara rawak sama ada kepada kumpulan eksperimen (n = 30) yang menerima intervensi LK atau kumpulan kawalan (n = 30) yang mengekalkan rutin biasa mereka. Sesi LK berlangsung selama 40 minit, dengan dua sesi seminggu, berjumlah 12 sesi. Data mengenai KR, PB, KS, dan PS dikumpulkan melalui soal selidik pada asas, pertengahan intervensi (minggu 3), dan pasca-intervensi (minggu 6). ANOVA bercampur digunakan untuk menganalisis data, memeriksa kesan masa, kesan kumpulan, dan kesan interaksi masa-dengan-kumpulan. Penemuan mendedahkan inter-hubungan yang signifikan antara KR, PB dan KS. Kumpulan eksperimen menunjukkan pengurangan yang signifikan dalam KR, PB dan KS berbanding dengan kumpulan kawalan. Kumpulan

eksperimen juga menunjukkan peningkatan yang signifikan dalam PS. Keputusan mencadangkan bahawa LK adalah intervensi yang berkesan untuk mengurangkan faktor psikologi negatif dan meningkatkan PS dalam kalangan pemain tenis universiti China. Pengurangan dalam KR, PB dan KS sejajar dengan penyelidikan terdahulu yang menyoroti manfaat LK dalam menguruskan corak pemikiran negatif dan menggalakkan peraturan emosi. Peningkatan yang diperhatikan dalam PS mungkin disebabkan oleh peningkatan fokus, pengurangan kebimbangan, dan peningkatan daya tahan mental yang terhasil daripada LK. Kajian ini memberikan bukti untuk keberkesanan LK dalam meningkatkan kesejahteraan psikologi dan PS dalam kalangan pemain tenis universiti China. Penemuan ini menyokong integrasi LK ke dalam program latihan sukan untuk meningkatkan daya tahan mental atlet dan mengoptimumkan prestasi. Penyelidikan masa depan harus meneroka kesan jangka panjang LK dan menyiasat kebolehgunaannya kepada sukan dan populasi lain.

Kata Kunci: latihan kesedaran minda, pemikiran meleret, pemikiran berulang, kebimbangan kawal selia, pemain tenis universiti, pelajar Cina.

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ABSTRACT

The present study aims to investigate the impact of mindfulness training (MT) on the rumination disposition (RD), repetitive thinking (RT), and regulatory anxiety (RA) among Chinese university tennis players in Jiangxi Province, China. Given the increasing adoption of MT in sports for performance enhancement, this research aims to evaluate its effectiveness in this specific population. A two-phase study was conducted. In Study 1, 460 participants from four universities in Ganzhou City completed an online questionnaire assessing RD, RT, and RA. Following the conclusion of the data collection phase, the subsequent analysis were conducted. Study 2 involved a randomised controlled trial (RCT) where participants from Study 1 were randomly assigned to either an experimental group (n = 30) receiving MT intervention or a control group (n = 30) maintaining their regular routines. MT sessions lasted 40 minutes, with twice session a week, totalling 12 sessions. Data on RD, RT, RA, and SP were collected via questionnaires at baseline, mid-intervention (week 3), and post-intervention (week 6). Mixed ANOVA was used to analyse the data, examining time effects, group effects, and time-by-group interaction effects. The findings revealed significant inter-relationships between RD, RT and RA. The experimental group showed a significant reduction in RD, RT and RA compared to the control group. The experimental group also demonstrated significant improvements in SP. The results suggested that MT is an effective intervention for

mitigating negative psychological factors and enhancing SP among Chinese university tennis players. The reduction in RD, RT and RA aligns with previous research highlighting the benefits of MT in managing negative thought patterns and promoting emotional regulation. The observed improvements in SP may be attributed to enhanced focus, reduced anxiety, and improved mental resilience resulting from MT. This study provides evidence for the effectiveness of MT in improving psychological well-being and SP among Chinese university tennis players. These findings support the integration of MT into sports training programs to enhance athletes' mental resilience and optimize performance. Future research should explore the long-term effects of MT and investigate its applicability to other sports and populations.

Keywords: mindfulness training, rumination, repetitive thinking, regulatory anxiety, university tennis players, Chinese.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Tennis, a competitive net sport originating in France during the 12th and 13th centuries, has since flourished, particularly in the United States. Ranking as the second most popular sport worldwide, its premier events are the Grand Slam tournaments: the Australian Open and US Open (played on tough courts), Wimbledon (played on grass), and the French Open (played on clay). These tournaments have significantly contributed to the sport's global development and popularisation.

Each year, thousands of tennis players from around the world compete on the professional tennis circuit (International Tennis Federation [ITF], 2020). However, their pursuit of success comes with challenges, as highlighted in the latest ITF Pro Circuit Review (ITF, 2017). A striking disparity in earnings exists on the professional tennis tour. In 2013, the top 1% of players earned 60% of the prize money on the men's tour and 51% on the women's tour, while only 1.8% of male players and 3.1% of female players turned a profit (ITF, 2017). Due to the high costs associated with competing, most professional players face varying levels of debt and are at risk of ending their careers prematurely.

While research has explored the lifestyle challenges of professional athletes in other sports (Battochio et al., 2016; Gordin, 2016; Moore, 2016; Shrom et al., 2023), the understanding of the specific challenges faced by tennis players on the professional tour, beyond financial difficulties, remains limited. Little is known about how these challenges may impact players' mental health and well-being.

Although some studies have examined players' transitions into professional tennis (Gowling, 2019; Jensen, 2012; Shrom et al., 2023), research on lifestyle challenges in this context is minimal and would benefit from more diverse samples, including players of different sexes and nationalities (Shrom et al., 2023).

In recent years, tennis has experienced a surge in popularity within China. According to the 2019 ITF Global Tennis Report, China boasts a tennis-playing population of nearly 20 million, second only to the United States (ITF, 2019). This growth is mirrored within Chinese universities, where students, possessing relatively more discretionary time and strong learning capabilities compared to other demographics, have actively embraced the sport.

Athletes find it challenging to play at their typical level, though, because of a number of variables that can impact the game, such as climate, venue, psychological issues, and environmental conditions (Song et al., 2024; Xuemeng, 2023). Despite the absence of direct physical contact during a tennis match, opponents can be subjected to different degrees of psychological pressure based on the trajectory of the ball and different match conditions in real time (Song et al., 2024; Xuemeng, 2023). The players' many psychological shifts throughout the game directly impact how the tennis match turns out (Song et al., 2024; Xuemeng, 2023). Athletes' success in tennis is greatly influenced by psychological factors, as evidenced by the legendary former tennis player Jimmy Connors' statement that psychological aspects account for 95% of an athlete's performance. It is feasible to guarantee that sportsmen do not worry about psychological aspects and play well in tennis matches by examining the psychological aspects that influence them and suggesting suitable tactics and countermeasures (Song et al., 2024).

Currently, the university-level tennis training programs in China tend to prioritize technical skills, tactical awareness, and physical conditioning, often overlooking the cultivation of essential mental skills. Birrer and Morgan (2010) argue that athletes should acquire key psychological attributes, including motivational, attentional, and coping skills. Mindfulness training, an intervention integrating Buddhist contemplative traditions with Western psychological principles, aims to foster concentration and meditative abilities. It emphasizes cultivating a present-moment awareness with an open, non-judgmental attitude, thereby mitigating automatic reactions (Kabat-Zinn, 2003).

Although athletes may perceive themselves as psychologically robust, many experience emotional volatility following setbacks in competitions or in the face of defeat (Birrer & Morgan, 2010). Pre-competition anxiety, negative emotions, and fear of failure, coupled with external pressures, can directly or indirectly compromise athletic performance (Birrer & Morgan, 2010). Strengthening mindfulness training to mitigate the adverse effects of rumination, such as reducing negative affect, has the potential to enhance the sporting performance of Chinese tennis players (Birrer et al., 2012). However, it is important to acknowledge that mindfulness does not directly influence athletic performance (Gardner, 2009); rather, it indirectly improves performance through mechanisms such as rumination reduction (Röthlin et al., 2016).

Rumination, as defined by Watkins (2008), is a maladaptive cognitive process characterised by repetitive thinking, often dwelling on negative emotions, problems, or concerns. This pattern involves repeatedly replaying, analysing, or contemplating issues rather than engaging in constructive problem-solving. Such excessive and repetitive thinking can contribute to anxiety, depression, and a heightened negative

perception of difficulties, as individuals struggle to disengage from intrusive thoughts. Therapeutic interventions, such as cognitive-behavioural therapy (CBT), are frequently employed to modify this detrimental thinking style. Research suggests that a persistent tendency towards rumination can negatively impact emotions and emotion-related cognition in the short term (Nolen-Hoeksema et al., 2008). Furthermore, rumination can impede effective problem-solving by fostering pessimism and abstract thinking, thereby hindering the comprehension and management of specific details related to challenges (Donaldson & Lam, 2004). Therefore, the existing body of research highlights the predominantly negative effects of rumination on athletes, making it a salient area for investigation to explore methods for mitigating its detrimental consequences.

Sporting performance encompasses the demonstration of skills, abilities, and performance levels within the context of athletic activities (Farrow et al., 2013; Phillips et al., 2010). This includes technical proficiency, physical fitness, competitive outcomes, and various qualities exhibited by athletes during training and competition (Phillips et al., 2010). It represents a comprehensive evaluation of an individual's athletic ability and overall attributes (Baker & Farrow, 2015). As such, improving sporting performance is considered a primary objective in sports and sports psychology.

1.2 Problem Statement and Study rationale

Currently, within universities, coaches understand the importance of psychological training, such as attentional training; however, few studies have examined its effects (Laine et al., 2017). There is a prevalent emphasis on physical and technical training while neglecting psychological training. Therefore, enhancing

training at the psychological level, for instance, by strengthening attentional training to improve reflection abilities and sports performance among Chinese university tennis enthusiasts, could further elevate their skills. Currently, within universities, coaches understand the importance of psychological training such as attentional training, yet few apply it in practice (Laine et al., 2017). There is a prevalent emphasis on physical and technical training while neglecting psychological training. Therefore, enhancing training at the psychological level, for instance, by strengthening attentional training to improve reflection abilities and sports performance among Chinese university tennis enthusiasts, could further elevate their skills.

In high-level competitions today, the technical differences between players are minimal, making the psychological aspect of the game even more crucial. Athletes with strong mental resilience and the ability to remain calm under pressure often gain a competitive edge (Williamon, 2004). As a result, psychological training in sports is receiving increasing attention (Williamon, 2004). Athletes possessing various psychological skills can enhance their performance across different situations (Osborne et al., 2014).

Mental training is essential in tennis, as players often struggle with their mindset due to both internal and external factors, such as repeated errors or missed match points. Difficulty in managing emotions in these moments can negatively impact match outcomes. Therefore, players with stronger mental resilience have a competitive advantage over their opponents. Emphasizing psychological training can enhance athletes' performance (Birrer & Morgan, 2010). Attention, as a key psychological ability, plays a crucial role in the process of reflection (Birrer et al., 2012) and is considered an essential component of this cognitive function (Josefsson

et al., 2017). Reflection, in turn, can influence various psychological skills relevant to sports through its own mechanisms (Andraszewicz et al., 2015). Therefore, it is imperative to examine how mindfulness can enhance the rumination abilities of Chinese university tennis players.

Therefore, the purpose of this study was to investigate the effects of using mindfulness training as a psychological tool to intervene on rumination disposition, repetitive thinking, and regulatory anxiety, which may be able to improve the mental health and psychological quality of Chinese tennis players, as well as their ability to regulate their emotions and thus optimising their psychological performance. This study will bridge the gaps in the previous research, promote the integration of sport psychology, and provide a new direction for practice and further research.

1.3 Significance of the study

Tennis is gaining popularity worldwide (Liu, 2023) and experiencing rapid growth in China (Xu et al., 2017). In recent years, the impressive performances of Chinese players on the international stage and their rising world rankings have contributed significantly to the sport's development in the country. However, compared to technical and tactical training, the psychological aspect is often overlooked (Febrianty et al., 2021). This issue is also prevalent in Chinese universities, despite the crucial role of psychological training in tennis (Abdul Rahim, 2022). In tennis, numerous internal and external factors can influence the outcome of a match, such as crowd hostility, personal mistakes, or even an umpire’s misjudgement. Successfully managing these challenges requires players to have strong psychological resilience and the ability to cope under pressure. When

competitors possess similar technical skills, the player with greater mental strength often gains the advantage (Abdul Rahim, 2022).

University tennis players are a key factor in the development of tennis in a country, and the lack of relevant mental training can be a limiting factor for them. According to Deyo et al. (2009) mindfulness training can reduce the negative effects of rumination and other such negative factors, and it can also enhance an individual's psychological well-being (Allen et al., 2021). This study intends to use mindfulness training as a psychological tool to intervene on rumination disposition, repetitive thinking, and regulatory anxiety to compensate for this deficiency, repetitive thinking, and regulatory anxiety. According to Lyubomirsky et al. (2003), factors such as rumination affect attention and executive power; this may result in a decline in concentration levels, potentially impacting the performance outcome.

In the context of China, there is a paucity of studies employing mindfulness training as an intervention tool, yet there is a preponderance of students exhibiting rumination, repetitive thinking, and regulatory anxiety problems. This underscores the potential for mindfulness training to address these gaps in the field. Consequently, it can be employed as a pioneering approach to address the lacunae in this domain, which is pivotal to more effectively integrating psychological principles into sports. The efficacy of mindfulness training as an intervention for these factors would not only serve to increase the popularity of psychological tools such as mindfulness training in sports training but also have a certain effect on other areas to reduce the impact of negative emotions and enhance mental ability.

1.4 Research Questions

1. Is there any relationship between rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players?
2. Is there any significant time effect of mindfulness training intervention on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players?
3. Is there any significant group effect of mindfulness training intervention on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players?
4. Is there any significant interaction effect (group*time) of mindfulness training intervention on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players?

1.5 Study Objectives

1.5.1 General objective

The objective of this study is to examine the influence of a mindfulness training programme on the rumination disposition, repetitive thinking, and regulatory anxiety levels among Chinese university tennis players in Jiangxi province, China.

1.5.2 Specific objectives

1. To investigate the inter-relationship between rumination disposition, repetitive thinking and regulatory anxiety among Chinese university tennis players?

2. To investigate the time effects (within group) of mindfulness training on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players.
3. To investigate the group effect of mindfulness training on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players?
4. To investigate the interaction effect of mindfulness training on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players (within-between groups).

1.6 Research Hypotheses

1. There are significant inter-relationships between rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players.
2. There is a significant time effect of mindfulness training on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players.
3. There is a significant group effect of mindfulness training on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players.
4. There is a significant interaction effect of mindfulness on rumination disposition, repetitive thinking, and regulatory anxiety among Chinese university tennis players (within-between groups).

1.7 Operational definition

Structural equation modeling (SEM)	Structural Equation Modelling (SEM) is a statistically based multivariate analysis method designed to test theoretical hypotheses by constructing networks of causal paths between variables. It integrates explicit variables (directly observable data) and latent variables (abstract concepts that need to be indirectly measured) and analyses their complex relationships, such as direct, mediated or moderated effects (Hair Jr et al., 2021). SEM consists of two components: a measurement model (which describes how the latent variables are measured by the explicit variables, e.g., in a validated factor analysis) and a structural model (which defines causal paths among the latent variables). Its strength lies in its ability to deal with complex multivariate relationships that are difficult to address in traditional regression analyses, while separating measurement error, improving model accuracy, and assessing the fitness between theory and data through fit indices (e.g., TLI, CFI, RMSEA, and SRMR) (Hair et al., 2021).
Repetitive thinking	A mental process in which an individual repeatedly and uncontrollably falls into the same negative thinking pattern, usually in the form of a persistent preoccupation with negative experiences, emotions, or problems and 'circular thinking' (Nolen-Hoeksema, 1991).

Regulatory anxiety	The term refers to a state of anxiety triggered by ineffective strategies or insufficient resources in an individual's emotion regulation process. This state of anxiety manifests itself as a high level of concern about failing to manage emotions or excessive self-monitoring, often accompanied by physiological arousal (e.g., rapid heart rate) and cognitive rigidity (Gross, 2015).
Rumination disposition	Refers to a trait that is stable and habitually present in individuals who repeatedly think about negative emotions or experiences, usually focusing on the causes, consequences and feelings of the negative content (Nolen-Hoeksema, 1991).
Mindfulness training	Refers to a cross-cultural psychological intervention technique that integrates Eastern meditation practices (such as Buddhist Internal Perspective) with modern cognitive-behavioral sciences to cultivate individuals' non-judgmental awareness of their present experiences. Its core goal is to enhance attentional regulation through systematic practice, helping individuals move from an ‘automated response mode’ to a ‘conscious response mode,’ ultimately improving emotional regulation and cognitive flexibility (Kabat-Zinn, 2003).

1.8 Conceptual Framework

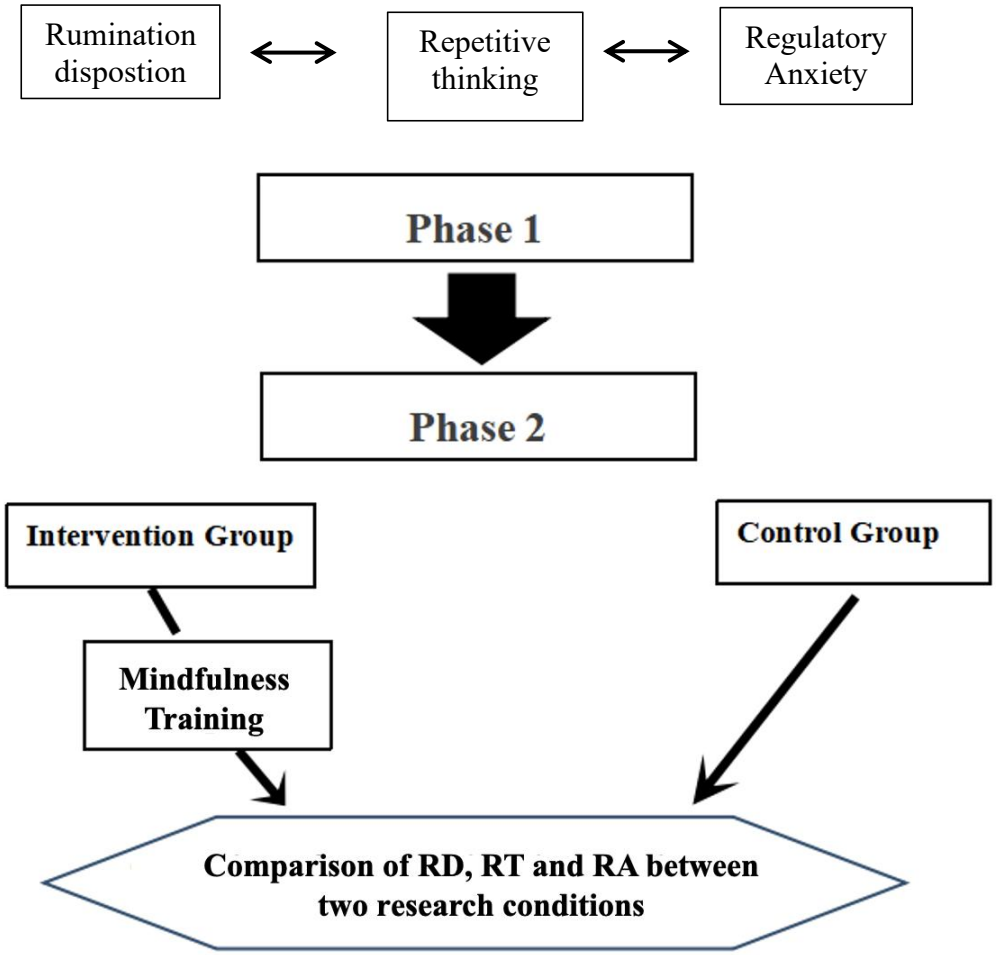

Figure 1.1: Conceptual Framework of the study

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In order to construct the theoretical framework and empirical basis of this study, it is necessary to integrate academic results from multiple sources to reveal the research dynamics of the field through systematic literature search and critical analysis. In the process of constructing the interdisciplinary theoretical foundation, the researcher employs a multidimensional search strategy, focusing on core databases such as Web of Science, Scopus, PubMed, CNKI and open academic platforms (e.g., ResearchGate), whilst simultaneously incorporating grey literature to mitigate publication bias. With regard to the search technique, Boolean logic operators ("AND"/"OR") were applied to optimise the combination of compound subject terms, including but not limited to: mindfulness training, rumination, sport performance, analysis, empirical studies of interventions, CFA, SEM, and mixed factorial ANOVA.

Thorough critical search of the original literature was performed, and the research team systematically identified the theoretical associations between variables and the reliability characteristics of measurement tools. Ultimately, they formed a structured knowledge system through classification and organisation, which provides theoretical support for the formulation of hypotheses and multi-method validation of subsequent studies.

2.2 Literature Search Strategy

In this study, a systematic search strategy was adopted in order to integrate multimodal search syntax for the purpose of cross-library search of heterogeneous literature resources, with a view to constructing a multidimensional theoretical analysis framework. Based on the intersectional perspective of sport and sport psychology, the search scope covered mindfulness training, rumination, sport performance, analysis, etc. With regard to database selection, priority was given to Scopus, PubMed, and other citation indexing databases in order to ensure the quality of the literature, whilst CNKI was combined to achieve full coverage of Chinese literature. The search design was based on the nesting strategy of Boolean logic operators, and methodological keywords (CFA, SEM) were embedded in order to screen methodologically rigorous empirical studies.

Through iterative searching and citation tracing, a literature map was formed that combines theoretical depth and methodological innovation, providing a basis for the subsequent operational definition of variables and construction of hypothesis testing models.

2.3 Theoretical Basis of Mindfulness Training

Mindfulness training, rooted in ancient contemplative practices, has gained substantial attention in contemporary psychological literature as a powerful tool for enhancing mental well-being (Baer, 2003). At its core, mindfulness is defined as the process of maintaining a moment-by-moment awareness of our thoughts, feelings, bodily sensations, and the surrounding environment (Kabat-Zinn, 2003). The various methodologies associated with mindfulness training, such as Mindfulness-Based

Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT), incorporate both meditative and non-meditative techniques to cultivate this awareness (Kabat-Zinn, 2003). These methodologies often involve practices such as mindful breathing, body scans, and mindful walking, which encourage individuals to engage with their thoughts and emotions without judgment, promoting greater self-awareness and emotional regulation (Dimidjian & Segal, 2015).

The psychological effects of mindfulness training on athletes have been well documented in the literature. Numerous studies have shown that mindfulness can lead to improved mental health outcomes, including reductions in anxiety and depressive symptoms (Mitchell et al., 2019; Roberts et al., 2020; Roberts & Montgomery, 2016). For instance, athletes who engage in mindfulness training often report enhanced overall well-being, increased resilience to stress, and improved coping strategies in competitive environments (Greeson & Brantley, 2009). Furthermore, a systematic review underscores the effectiveness of mindfulness in not only reducing mental health issues but also in fostering positive mental states, thereby enabling athletes to perform at their peak under pressure (Corbally et al., 2020).

The mechanisms through which mindfulness exerts its influence on mental health are multifaceted (Forte et al., 2023). One primary mechanism is the enhancement of focus and concentration, which is vital in competitive sports (Forte et al., 2023). By training the mind to stay present, athletes can mitigate distractions that may otherwise interfere with performance (Sappington & Longshore, 2015). Research indicates that mindfulness practice leads to increased activation in brain regions associated with self-regulation and focus, such as the prefrontal cortex (Zeidan, 2015). Additionally, mindfulness can effectively reduce anxiety by

promoting a non-judgmental acceptance of internal experiences, thereby decreasing the likelihood of rumination and negative thinking patterns that can hinder athletic performance (Keng, 2016).

Furthermore, the neurobiological underpinnings of mindfulness suggest its role in altering physiological responses to stress (Forte et al., 2023). Mindfulness training has been found to decrease levels of cortisol, a hormone associated with stress, in athletes, leading to an overall sense of calm and improved emotional stability (Gagrani et al., 2018). The practice allows individuals to develop a more adaptive response to anxiety-provoking situations, enabling them to harness nervous energy into focused performance rather than being overwhelmed by anxious thoughts. Consequently, incorporating mindfulness training within the athletic framework not only cultivates mental resilience but also enhances overall sporting performance (Gagrani et al., 2018).

In summary, the theoretical basis of mindfulness training is underpinned by a rich tapestry of methodologies and psychological effects that highlight its relevance in enhancing athlete performance and mental health. Through the cultivation of present-moment awareness, athletes can experience decreased anxiety, improved focus, and greater emotional regulation (Forte et al., 2023; Gagrani et al., 2018). The neurobiological changes resulting from mindfulness practice further reinforce its effectiveness as a mental training strategy in the realm of sports (Zeidan, 2015). As such, continued exploration and integration of mindfulness training can play a pivotal role in optimising the psychological well-being and performance of athletes across various sporting disciplines.

2.3.1 Mindfulness Training and Its Psychological Effects

Mindfulness training (MT) is a contemporary approach that has gained substantial traction within both psychological and sporting contexts. Its methodologies primarily revolve around cultivating an awareness of the present moment through various practices, such as meditation, breathing exercises, and body scans (Kabat-Zinn, 2003). These practices encourage individuals to observe their thoughts and feelings non-judgmentally, facilitating an enhanced understanding of their internal experiences (Gagrani et al., 2018). An increasing body of research evidences the effectiveness of MT in addressing psychological issues, thereby highlighting its potential therapeutic applications (Gagrani et al., 2018; Nery et al., 2019; Wang et al., 2023). For athletes, who frequently encounter performance-related anxiety, the incorporation of mindfulness is particularly pertinent, as it aligns with their need for mental resilience in high-stakes environments (Sappington & Longshore, 2015).

The psychological effects of mindfulness training have been well-documented, specifically in relation to mental health improvements among athletes. Numerous studies indicate that MT can lead to significant reductions in anxiety levels, depression, and stress while simultaneously promoting overall well-being (Greeson & Brantley, 2009; Sappington & Longshore, 2015). For instance, a study by Creswell (2017) highlighted that athletes who participated in mindfulness interventions exhibited lower anxiety and higher levels of satisfaction with their performance. Moreover, mindfulness training fosters resilience, enabling athletes to recover more effectively from setbacks and maintain focus during competitions (Bishop et al., 2004; Quaglia et al., 2015). The emphasis on self-awareness built

through MT equips athletes to navigate the psychological demands of sport more adeptly, thus improving both mental health and performance outcomes (Quaglia et al., 2015).

A critical aspect of the impact of mindfulness on athletes is its role in enhancing attentional focus, a vital component for successful performance (Birrer et al., 2012; Quaglia et al., 2015). According to mindfulness control theory, MT facilitates a remarkable improvement in athletes' ability to switch their attentional focus effectively (Röthlin, Horvath, et al., 2016). Research by Tang et al. (2015) has demonstrated a 14.3% increase in alpha wave power, indicating enhanced neural efficiency associated with attentional processes. This improvement is attributed to the augmentation of connectivity within the prefrontal-amygdala neural circuitry, which plays a crucial role in regulating emotional responses and cognitive functioning (Tang et al., 2015). As a result, athletes can inhibit automated thought patterns related to rumination and other forms of repetitive thinking that often detract from performance (Tang et al., 2015).

The applicability of mindfulness training in sports contexts has been further elucidated through empirical studies demonstrating its effectiveness in enhancing athletic performance while mitigating negative psychological factors. Miller et al. (2017) conducted a comprehensive analysis revealing that athletes who engaged in MT not only experienced improved performance metrics but also reported significant reductions in stress and anxiety levels. These findings reinforce the notion that MT serves as a valuable tool in the athlete's mental training repertoire, supporting greater consistency in performance. Consequently, the integration of MT into sports training regimes has emerged as a promising strategy to enhance athletes' psychological resilience, especially under competitive pressure.

In summary, mindfulness training presents a compelling framework for addressing the psychological challenges faced by athletes. With its structured methodologies and demonstrated benefits, MT facilitates improved mental health, enhanced attentional focus, and the ability to manage anxiety effectively. Furthermore, the theoretical underpinnings of mindfulness control theory provide insight into the neural mechanisms that underpin these benefits, offering a scientific basis for its application in sports contexts. As the dialogue surrounding the mental aspects of athletic performance evolves, the continued exploration of mindfulness training is essential for optimising athlete well-being and success.

2.3.2 Mindfulness Control Theory Perspective on Mindfulness Training Mechanisms

The neurophysiological changes associated with mindfulness training further elucidate its mechanisms in inhibiting repetitive thought patterns, especially rumination and automatic responses that can detract from optimal performance (Tang et al., 2015; Zeidan, 2015). The prefrontal cortex, which is heavily involved in executive functions such as attention regulation and decision-making, becomes more engaged through mindfulness practices. In turn, this engagement serves to modulate the activity of the amygdala, a brain region central to processing emotions and stress responses (Tang et al., 2015). By enhancing this neural connectivity, mindfulness training enables athletes to disrupt detrimental thought patterns and maintain a clearer focus on their tasks, thereby alleviating the impact of regulatory anxiety that may arise prior to or during competitions (Osborne et al., 2014).

The applicability of mindfulness training in sports contexts extends beyond just cognitive enhancement; it also plays a crucial role in promoting psychological

resilience among athletes. Miller et al. (2017) demonstrate that MT is effective in not only mitigating stress but also enhancing performance by fostering a more adaptive mindset. Their study highlights how athletes engaging in mindfulness practices report decreased levels of stress and anxiety, which are often prevalent in competitive settings. This reduction in negative psychological factors is particularly important, as mental strain can impede an athlete's ability to perform at their best. Furthermore, the benefits of MT are not confined to high-pressure situations; they also contribute to long-term mental well-being, allowing athletes to recover more rapidly from setbacks and cope more effectively with the inherent challenges of competitive sport (Birrer et al., 2012).

The integration of mindfulness training into athletic routines thus emerges as a valuable strategy for enhancing both mental and physical performance. Through the refinement of attentional focus and emotional regulation, mindfulness practices equip athletes with the tools to navigate the complexities of competition more effectively (Birrer et al., 2012). This is particularly relevant in individual sports, where the psychological component often determines success or failure. The findings by Miller et al. (2017) provide a compelling case for the systematic implementation of MT within sports training frameworks, underscoring its potential to foster not only superior athletic performance but also holistic athlete development.

In summary, the Mindfulness Control Theory perspective offers a robust framework for understanding how mindfulness training facilitates cognitive and emotional enhancements in athletes. By cultivating attentional flexibility and improving emotional regulation through neurophysiological changes, MT proves to be an invaluable resource for athletes seeking to optimise their performance. The applicability of MT within the sports context, as supported by empirical evidence,

reinforces the notion that a mindful approach can lead to more resilient, focused, and successful athletes, highlighting the importance of mental training in achieving peak performance in competitive environments.

2.4 Rumination and Repetitive Thinking in Sports

The Rumination and repetitive thinking are psychological phenomena that have implications for the performance and well-being of athletes. Rumination is commonly defined as the tendency to continuously think about the same thoughts, which are often negative, leading to a cycle of distress and anxiety (Nolen-Hoeksema et al., 2008). In contrast, repetitive thinking encompasses a broader category of thought processes that can be either maladaptive, such as dwelling on mistakes or failures, or adaptive, such as reflecting on performance to promote learning and growth (Martin & Tesser, 2006). In the context of sports, excessive rumination is particularly concerning, as it can lead to decreased focus, impaired decision-making, and ultimately hinder performance outcomes (Martin & Tesser, 2006). Therefore, understanding the implications of these cognitive patterns is essential for developing effective mental training strategies for athletes.

Research has consistently demonstrated a correlation between rumination and athletic performance. Athletes who engage in high levels of rumination may find themselves trapped in a cycle of negative thinking, which can lead to increased anxiety and decreased confidence (Park et al., 2020). For example, a study by Kröhler and Berti (2019) indicated that athletes who reported higher levels of rumination also exhibited lower performance levels, as their ability to concentrate on the task at hand diminished. The pressure of competitive environments often amplifies this tendency, causing athletes to focus on past mistakes or potential

failures, thereby detracting from their present performance (Kröhler & Berti, 2019). Consequently, rumination can create a mental barrier that prevents athletes from achieving their peak performance (Roy et al., 2016; Tahtinen et al., 2019).

To mitigate the negative effects of rumination and improve performance, various strategies have been identified and implemented within athletic contexts. One commonly employed approach is mindfulness training, which has been shown to help athletes cultivate present-moment awareness and reduce the impact of repetitive negative thoughts (Keng et al., 2016). Research by Josefsson et al. (2019) highlighted the benefits of mindfulness in sports, showcasing how athletes who engaged in mindfulness practices reported reduced rumination, improved focus, and greater emotional regulation during competitions. Additionally, cognitive-behavioural techniques, such as cognitive restructuring, encourage athletes to challenge and reframe negative thought patterns, allowing them to replace rumination with more constructive forms of thinking (Rogowska & Tataruch, 2024). These strategies, when incorporated into training regimens, can significantly enhance an athlete's ability to manage their cognitive processes effectively (Rogowska & Tataruch, 2024).

Another effective strategy for reducing rumination is the practice of goal setting, which helps athletes maintain focus on their objectives rather than on past failures or anxieties regarding future performance (Locke & Latham, 2013). By establishing specific, measurable goals, athletes can channel their energy into positive, forward-focused thoughts that promote motivation and confidence (Locke & Latham, 2013). Furthermore, engaging in self-compassion exercises allows athletes to cultivate a more forgiving and understanding mindset toward themselves, which can diminish the tendency to ruminate over mistakes (Rude et al., 2007).

These techniques not only enhance mental resilience but also foster an environment conducive to optimal performance by reducing the cognitive clutter associated with rumination (Rude et al., 2007).

In short, rumination and repetitive thinking represent significant psychological challenges for athletes that can adversely affect performance (Rude et al., 2007). The negative correlation between rumination and athletic success underscores the need for effective interventions aimed at addressing these cognitive patterns. Strategies such as mindfulness training, cognitive-behavioural techniques, and goal setting have demonstrated efficacy in reducing rumination and promoting improved focus and performance (Roy et al., 2016; Rude et al., 2007). As the field of sports psychology continues to evolve, the integration of these strategies into standard training protocols will be invaluable in supporting athletes in achieving both their mental and performance-related goals.

2.5 Regulatory Anxiety in Competitive Sports

Regulatory anxiety is a prevalent concern for high-performance athletes, impacting both their mental well-being and competitive efficacy (Osborne et al., 2014; Park et al., 2020). It is characterised by feelings of apprehension and nervousness that arise in anticipation of competitions, often resulting in heightened physiological arousal and emotional distress (Park et al., 2020). For many athletes, this anxiety manifests as a fear of negative evaluation, concerns over performance outcomes, or the pressure to succeed based on external expectations (Coreia et al., 2017; Correia & Rosado, 2018). Understanding the nature of regulatory anxiety in this context is crucial, as it plays a significant role in determining athletic

performance, influencing concentration, decision-making, and overall psychological resilience during competitions (Coreia et al., 2017; Correia & Rosado, 2018).

Several factors contribute to the development and exacerbation of regulatory anxiety within competitive sports environments. Firstly, the innate pressure associated with competition can be a significant source of anxiety, particularly when expectations from coaches, teammates, and fans are high (Hanin, 2021). This pressure can lead athletes to internalise their fears, causing them to focus excessively on potential outcomes rather than the process of performance itself (Hanin, 2021). Additionally, prior experiences of failure or underperformance can create a heightened fear of repeating past mistakes, further intensifying anxiety levels (Spielberger, 2021). Furthermore, individual personality traits, such as perfectionism or high levels of trait anxiety, can predispose athletes to experience greater regulatory anxiety in competitive situations, as these traits often amplify their responses to stressors (Correia & Rosado, 2018; Spielberger, 2021).

To effectively manage regulatory anxiety, athletes can utilise a variety of techniques designed to enhance their mental resilience and performance readiness before and during competitions (Correia & Rosado, 2018). One foundational approach is cognitive-behavioural strategies, which involve identifying and restructuring negative thought patterns that contribute to anxiety (Cox, 2024; Cox et al., 2016). Techniques such as cognitive restructuring allow athletes to replace irrational fears with more rational and constructive thoughts, thereby reducing the psychological burden they may carry into competitive performances (Cox, 2024; Cox et al., 2016). In addition to cognitive strategies, mindfulness training has gained traction as an effective method for managing anxiety (Cox, 2024; Cox et al., 2016). By promoting present-moment awareness and non-judgmental acceptance of