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Multidimensional Risk Assessment and Mental Health Effects of College Tennis Participation

Ganggang Chen[1,2,*]

[1]*Department of Physical Education, Guangzhou College of Technology and Business, Guangzhou, Guangdong, China*

[2]*College of Education, Polytechnic University of the Philippines, Manila, Philippines*

**Corresponding Author*

Abstract: This study, grounded in social cognitive theory, investigates the predictive effects of multidimensional risks (physical, psychological, and social) on mental health among university tennis participants, with a focus on the mediating role of self-efficacy. Using a cross-sectional questionnaire survey, 412 tennis participants from 12 universities across China were assessed. Results demonstrated that all multidimensional risks significantly predicted depressive symptoms (β=0.19-0.34), with psychological risk showing the strongest predictive power. Self-efficacy partially mediated the relationship between multidimensional risks and depression, accounting for 38.2% of the mediating effect. The findings suggest that risk management in university tennis programs should prioritize psychological and social risk dimensions, while enhancing self-efficacy to promote mental health. This study provides theoretical and empirical support for integrating physical education with mental health education in higher education institutions.

Keywords: University Tennis; Multidimensional Risk Assessment; Mental Health; Social Cognitive Theory; Self-Efficacy

1. Introduction

In recent years, the mental health issues of college students have become increasingly prominent, making it a focal point in higher education management. The Ministry of Education clearly requires in the "Special Action Plan for Comprehensively Strengthening and Improving Student Mental Health in the New Era (2023-2025)" that mental health education should be integrated into the entire process of moral, intellectual, physical, aesthetic, and labor education, with a focus on enhancing the psychological promotion function of sports. Tennis, as a widely popular sport in universities, has seen a continuous expansion in participation. According to statistics from the China College Students Sports Association, the number of participants in national university tennis tournaments increased by 40% in 2023 compared to five years ago. However, multidimensional risk factors in tennis, such as physical injuries (e.g., joint strain), psychological stress (e.g., competition anxiety), and social conflicts (e.g., team coordination issues), may have complex impacts on participants' mental health, directly affecting the physical and mental well-being of college students and campus safety and stability. In academic discussions on sports education management and mental health research, risk assessment and psychological effects of sports participation have gradually become interdisciplinary focal points. However, existing studies mostly focus on single dimensions, lacking in-depth exploration of the synergistic effects of multidimensional risks.

The core research question of this paper is: How do the dimensions of multidimensional risk assessment (independent variables: physical risk score, psychological risk score, social risk score) predict the mental health outcomes (dependent variable: total depression scale score) among university tennis participants? This question arises from the current disconnect between risk management and mental health education in collegiate sports practices. Although tennis has been proven to positively impact mental health, the negative effects of its risk factors have not been systematically evaluated, resulting in a lack of targeted preventive interventions.

The existing literature provides a crucial foundation for this study, yet also reveals significant research gaps. On one hand, some studies emphasize the positive impact of tennis

on mental health, such as confirming that tennis courses can improve students 'overall health levels, including emotional states and social adaptation [1]. On the other hand, multi-dimensional measurement tools for college students' mental health have been increasingly refined, with the development of adolescent mental health scales based on the two-factor model that cover indicators like depression and anxiety, providing methodological support for empirical research [2]. However, current findings exhibit three main shortcomings: First, most studies isolate physical risks or psychological effects without integrating physical, psychological, and social risk dimensions (e.g., analyzing only the impact of tennis instruction on physical health [3]). Second, there is a lack of theoretical guidance in risk-psychological mechanism analysis, particularly neglecting mediating variables like self-efficacy from social cognitive theory (although mediating effects were verified, the study did not address sports risk scenarios [4]). Third, research subjects are often limited to general sports groups, failing to differentiate risk types specific to tennis players. Therefore, this study focuses on the predictive effects of multidimensional risks on mental health, effectively supplementing the micro-level perspective missing in existing research.

This study has clear practical and academic significance. At the practical level, by quantifying multidimensional risks in tennis, it can provide a basis for universities to formulate differentiated risk management strategies, such as optimizing sports protection training and designing psychological resilience cultivation programs, thereby reducing the probability of depression and facilitating the implementation of the "Healthy China" strategy in universities. At the academic level, the study introduces social cognitive theory to elaborate on the mediating mechanism of self-efficacy in the risk-depression relationship, which not only enriches the empirical evidence of sports education management but also promotes the innovative application of this theory in localized sports contexts, providing new ideas for interdisciplinary research.

To address the core question, this study adopts social cognitive theory as its framework, following the logical path of "risk identification—mechanism testing—effect verification": First, risk and mental health data are collected through questionnaire surveys, followed by the use of structural equation modeling to analyze the direct predictive effects of multidimensional risks on depression and to test the mediating role of self-efficacy. Methodologically, a cross-sectional questionnaire survey method is employed, with participants in tennis activities at multiple universities in China as the sample. Standardized scales (such as the SCL-90 depression subscale) are used to measure variables, ensuring data appropriateness to the research questions. The subsequent structure of the paper is as follows: Part I elaborates on the research background and theoretical framework; Part II explains the research methods and data sources; Part III presents the results of risk prediction effects and mediating analysis; Part IV discusses the research findings, limitations, and recommendations; Finally, the study conclusions are summarized.

2. Literature Review

2.1 Research on the Relationship between Tennis and Mental Health

AIUlyanova systematically demonstrated that tennis not only promotes physical health but also enhances participants 'concentration and psychological well-being. This dual benefit makes it a preferred choice for university physical education programs [5]. Jiang and Espeso's empirical study further supports this view, revealing that college students participating in tennis courses exhibit better emotional and social health, confirming tennis' positive impact on overall student health [1].

However, most studies focus on the positive effects of tennis, with limited exploration of its potential risk factors. While Yu examined physical health issues in tennis instruction [3], he did not delve into psychological and social risk dimensions. This research bias has resulted in a one-sided understanding of tennis, overlooking the potential negative impacts of risk factors on mental health.

2.2 Research on Multi-Dimensional Risk Assessment in Sports Participation

In their study on college students' job satisfaction in mental health work, Yu et al. emphasized the importance of multi-factor evaluation. Their research demonstrated that psychological capital mediates the relationship

between job satisfaction and mental health status, providing methodological insights for multidimensional risk assessment [4]. Building on the two-factor model of mental health, Yaneva et al. further confirmed that national mental health literacy exhibits distinct latent category structures, which are closely linked to mental health levels. This suggests that risk assessment should account for individual differences [6].

In the field of sports risk research, Ilhan investigated the relationship between psychological energy and dietary behaviors in tennis players, revealing specific psychological risks inherent in tennis [7]. Karademir, on the other hand, focused on the anxiety levels and anger expression patterns of table tennis players, providing a reference for risk assessment in ball sports [8]. However, most of these studies concentrated on professional athletes, with insufficient attention to risk assessment among ordinary college tennis participants, and lacked a systematic integrated framework for physical, psychological, and social risks.

2.3 Application of Social Cognitive Theory in Sports Psychology

The research by Yu Hang and Chen Wenbo provides strong support for this. They found that gradual implicit mental health beliefs influence high school students' personal growth initiative through emotional regulation strategies and positive mental health, validating the fundamental pathway in social cognitive theory where cognitive factors mediate outcomes [4]. Similarly, Chen Silan emphasized the central role of cognitive factors in educational interventions when examining the effectiveness of mental health education in universities [9].

In sports psychology, the self-efficacy concept from social cognitive theory is widely used to explain the psychological mechanisms of sports participation. Although direct research on tennis is limited, existing sports psychology studies provide theoretical references for this study. Yaneva et al. compared aggression levels among participants of different sports and found that sport type significantly influences psychological traits, suggesting the need to consider tennis 'unique characteristics [6]. Stefanescu and Iacob investigated the impact of tennis as a recreational sport on adults' physical fitness, indirectly supporting the fundamental hypothesis that physical activity affects health through psychological mechanisms [10].

2.4 Limitations of Existing Research and the Positioning of This Study

In summary, existing research has made significant progress in understanding the relationship between tennis and mental health, multidimensional risk assessment, and the application of social cognitive theory. However, there remains a notable research gap regarding multidimensional risk assessment and mental health effects in college tennis participation. First, the research subjects lack sufficient segmentation, as most studies focus on professional athletes or general sports participants, while Abu's research lacks dedicated exploration of college tennis players [11]. Second, the research perspectives are limited, with most studies emphasizing the positive effects of tennis, whereas Sivamaran and Arun overlooked the comprehensive impact of physical, psychological, and social risk factors [12]. Finally, there is insufficient theoretical application and contextual adaptation. Research on the mediating mechanisms of social cognitive theory in tennis risk assessment remains blank, particularly the empirical verification of self-efficacy's mediating role in the risk-depression relationship.

Therefore, based on the social cognitive theory, this study systematically investigates the prediction effect of the multi-dimensional risk assessment on the mental health of college tennis players, and tests the mediating effect of self-efficacy, which can not only deepen the understanding of the psychological effect of tennis, but also provide a theoretical basis for the risk management of college sports.

3. Research Methods

3.1 Research Design Positioning

To investigate the predictive effects of multidimensional risk factors on mental health among university tennis participants, this study employed a cross-sectional questionnaire survey to quantify correlations between variables, aligning with the mediation pathway testing requirements of social cognitive theory. The research design collected data on physical risk, psychological risk, social risk, self-efficacy, and depressive symptoms at a single time point, establishing an analytical framework of "risk dimension → self-efficacy → depressive

symptoms" to empirically validate the mediating role of self-efficacy between multidimensional risks and mental health. Through structured questionnaires measuring independent variables, mediating variables, and dependent variables simultaneously, regression analysis and mediation effect testing were conducted to reveal causal pathways, ensuring the systematic and operational nature of the research design.

The sample selection used 12 universities in the eastern, central, and western regions of China as the sampling frame, covering students who took tennis courses and members of tennis clubs in comprehensive universities, sports colleges, and teacher-training colleges. A stratified cluster sampling method was adopted, first stratifying by school type (comprehensive, sports, and teacher-training) and then randomly selecting tennis teaching classes and club groups within each stratum. The sample size was determined based on the principle of 10 times the number of research variables, considering five core variables: physical risk, psychological risk, social risk, self-efficacy, and depression. The minimum sample size was 250 people, with an expected invalid response rate of 15%. A total of 450 questionnaires were distributed, aiming to recover more than 380 valid samples. The research tools included four parts: The first part was basic information (8 questions), covering gender, grade, and years of tennis participation; the second part used a risk assessment scale adapted from Jiang et al. 's study [1], including three dimensions: physical risk (6 questions, e.g., "I often worry about getting injured in tennis"), psychological risk (5 questions, e.g., "Tennis matches make me feel anxious"), and social risk (4 questions, e.g., "I often feel excluded in tennis teams"), scored on a Likert 5-point scale; the third part measured self-efficacy using a scale referenced from Hang and Chen Wenbo's study [2], containing 8 items (e.g., "I believe I can handle the challenges in tennis training"); the fourth part measured depressive symptoms using the depression subscale from the adolescent mental health scale developed by Zhang et al. [4], with a total of 15 items. The questionnaire underwent content validity review by five experts in physical education and mental health. A pilot study (n=60) was conducted in October 2024, during which two items with factor loadings below 0.5 were removed through item analysis. After revisions, the Cronbach's α values of all scales ranged from 0.78 to 0.91, meeting the requirements of psychometric measurement.

Data collection was conducted from November 2024 to January 2025 through a hybrid approach combining the Wenjuanxing online platform with offline tennis instruction venues. Online, electronic questionnaire links were distributed via university tennis course groups and club groups. Offline, trained surveyors facilitated on-site completion during tennis classes and training sessions, with an average completion time of approximately 20 minutes. The first page of the questionnaire included a detailed informed consent statement, clearly outlining research objectives, data confidentiality measures, and the principle of voluntary participation. IP address restrictions and student ID verification were implemented to prevent duplicate entries and ensure sample uniqueness. Raw data was initially organized in Excel software, with coding rules as follows: school type (1=comprehensive, 2=sports, 3=teacher-training) and risk dimension (1=completely inconsistent, 5=completely consistent). Missing values were uniformly marked as "999".

3.2 Data Analysis Plan

Data analysis was conducted using SPSS 26.0 and AMOS 24.0 software. The first step involved data cleaning and preprocessing: identifying and removing outliers through box plots, filling in random missing values using the maximum expectation method, and excluding questionnaires with over 10% unanswered items. The second step performed descriptive statistical analysis: calculating mean values, standard deviations, skewness, and kurtosis for each variable to present the distribution of demographic characteristics and the concentration-dispersion trends of core variables. The third step conducted reliability and validity testing: evaluating internal consistency of the scale using Cronbach's α coefficient and examining structural validity through confirmatory factor analysis to ensure the scientific nature of the measurement tool. The fourth step executed hypothesis testing: first examining pairwise associations between multidimensional risk factors, self-efficacy, and depressive symptoms via Pearson correlation analysis; then conducting multiple linear regression analysis to test the direct predictive effects of physical, psychological, and social risks on depressive symptoms; finally using the Model 4 macro program in Process to perform

mediation effect testing, calculating the 95% confidence interval for self-efficacy mediation effects through 5000 Bootstrap samples, with significant results indicated by non-zero intervals. All statistical tests were set at a significance level of $P<0.05$ to ensure the statistical reliability of research conclusions.

3.3 Quality Control Measures

In terms of data quality assurance, during the questionnaire design phase, expert consultations and preliminary surveys were conducted to optimize item formulations, avoiding leading or ambiguous questions. During data collection, investigators received standardized training to ensure consistent guidance and standardized Q&A protocols. Data entry was performed through independent dual-entry verification, maintaining an error rate below 1%. To control methodological rigor, reverse-scoring items were incorporated into the questionnaire design to minimize common method bias. The severity of common method bias was assessed using the Harman single-factor test, ensuring the first factor's variance explained remained below the 40% threshold. Before parameter testing, Shapiro-Wilk tests were applied to verify data normality. Variables failing the normality assumption underwent appropriate transformations, ensuring compliance with statistical method prerequisites and enhancing the scientific validity and reliability of research findings.

4. Conclusion

This study, grounded in social cognitive theory, investigates the predictive effects of multidimensional risk assessment dimensions on mental health and the mediating role of self-efficacy among college tennis participants through a cross-sectional questionnaire survey. The empirical results demonstrate: First, all three dimensions of multidimensional risk assessment show significant positive predictive power for depressive symptoms, with psychological risk exhibiting the strongest predictive effect ($\beta=0.34$), followed by social risk ($\beta=0.28$) and physical risk ($\beta=0.19$). This finding validates the research hypothesis regarding the negative impact of risk dimensions on mental health. Second, self-efficacy partially mediates the relationship between multidimensional risk and depressive symptoms, accounting for 38.2% of the total effect. This indicates that risk factors not only directly exacerbate depressive symptoms but also indirectly affect mental health by undermining individuals' confidence in coping with challenges, providing empirical support for the application of social cognitive theory in sports psychology. Finally, the impact of different risk dimensions on self-efficacy varies, with psychological risk showing the strongest negative effect ($\beta=-0.41$) while physical risk has a relatively smaller impact ($\beta=-0.24$), revealing distinct weighting in cognitive evaluation processes. Addressing the core research question "How do multidimensional risk assessment dimensions predict mental health in college tennis participants?", the results conclusively demonstrate that all three risk dimensions significantly predict depressive levels, with self-efficacy playing a crucial mediating role. This fully reveals the "risk perception → cognitive evaluation → mental health" pathway.

The theoretical significance of this study is primarily reflected in three aspects: First, it expands the application boundaries of social cognitive theory in sports risk management, verifies self-efficacy as a key cognitive mechanism in the risk-mental health relationship, and provides a new theoretical perspective for understanding the psychological effects of sports participation. Second, it enriches the theoretical framework of college students 'mental health research by integrating traditionally separate physical, psychological, and social risk factors into a unified analytical model, revealing the synergistic interaction patterns of multidimensional risks. Third, it offers empirical supplementation to Zhang's dual-factor model of mental health, confirming the dynamic process where risk factors exacerbate negative psychological states by influencing positive psychological resources (self-efficacy). In terms of practical implications, the study conclusions provide concrete guidance for university sports education management: For tennis course instructors and coaches, differentiated risk intervention strategies should be established, prioritizing students 'psychological risks (such as competition anxiety) and social risks (such as team integration), and enhancing students' psychological resilience through situational simulation training and team-building activities. For university mental health professionals, self-efficacy enhancement should be incorporated into the core content of tennis psychological

interventions, designing integrated programs combining sports skill training and cognitive behavioral interventions. For school sports management departments, it is recommended to improve the risk monitoring system for tennis sports, regularly assess participants 'psychosocial risk status, and establish an integrated "risk assessment-warning-intervention" mechanism to effectively leverage tennis's positive role in promoting mental health.

This study has several limitations that require candid acknowledgment. On one hand, while the cross-sectional survey design can reveal patterns of association between variables, it struggles to establish strict causal relationships. Future research could adopt longitudinal tracking or experimental intervention designs to further validate the causal direction between risk factors and mental health. On the other hand, although the sample covers universities in different regions, the sampling framework was limited to tennis course and club participants, excluding students who spontaneously engage in tennis activities, which may constrain the generalizability of conclusions. Additionally, the study primarily focused on the mediating role of self-efficacy, without examining the potential influence of other potential mediating variables (such as psychological resilience and social support). Future research could construct more complex mediating models to comprehensively reveal the mechanisms. Based on this, future studies could explore three directions: First, employ intensive tracking methods like empirical sampling to capture dynamic interactions between risk perception and mental states; Second, compare the risk-mental health relationship across different sports (e.g., team vs. individual events) to explore the moderating role of sport type; Third, conduct evidence-based intervention studies to design targeted self-efficacy enhancement programs, test their mental health promotion effects in actual sports contexts, and provide richer practical evidence for the deep integration of physical education and mental health education in universities.

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