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A Cross-Sectional Survey Study on Causes and Prevention of Badminton-Related Injuries Among College Students

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Abstract: Badminton is widely practiced among university students in China and provides substantial benefits for physical fitness, coordination, and social interaction, yet its high-intensity movements—including rapid direction changes and repetitive overhead strokes—also increase the risk of sport-related injuries. This study investigated the prevalence, causes, mechanisms, and preventive practices related to badminton injuries among students at XX College, Hohhot, Inner Mongolia, China. Using a cross-sectional survey design, 200 regular badminton participants completed a structured questionnaire covering demographic information, training habits, warm-up and prevention behaviors, injury history, perceived risk factors, and injury-prevention knowledge. Descriptive statistical analysis revealed a high prevalence of lower-limb injuries, particularly ankle sprains, muscle strains, and overuse conditions. Key contributing factors included inadequate warm-up, poor technique, fatigue, and inappropriate footwear, while students identified warm-up routines, strengthening exercises, and improved technique as important but insufficiently implemented prevention strategies. Many participants expressed the need for more formal education on injury prevention. Overall, the findings indicate that badminton-related injuries among college students are common yet highly preventable, highlighting the importance of strengthening warm-up practices, improving technical guidance, addressing fatigue, and promoting proper footwear use within university physical education programs.
Keywords: Badminton injury, injury prevention, university students, sports science, warm-up behavior

1. Introduction

Badminton is one of the most widely practiced sports among university students in China due to its accessibility, low equipment cost, and suitability for both recreational and competitive settings. As a fast-paced racket sport, badminton involves rapid acceleration, sudden directional changes, repeated jumping, and overhead strokes, all of which impose substantial biomechanical load on the musculoskeletal system. Prior research indicates that these movement characteristics contribute to a relatively high incidence of sport-related injuries among amateur and collegiate players [1], [2]. Existing findings consistently show that the lower extremities are the most frequently injured regions, with ankle sprains, knee strains, and Achilles tendon disorders commonly reported [3], [4]. Upper-limb injuries—such as shoulder overuse conditions and wrist strains—are also prevalent due to repetitive stroke mechanics. Multiple risk factors, including inadequate warm-up, improper technique, excessive training volume, fatigue, and unsuitable footwear, have been identified as major contributors to badminton injuries [5].

Despite the sport's rising popularity among Chinese university students, limited research specifically examines injury patterns and prevention-related behaviors in this population. Universities play a critical role in ensuring the safety of student athletes and promoting healthy participation in physical activity. Sports science literature emphasizes that structured warm-up routines, technical skill instruction, strength and flexibility training, and proper facility maintenance can significantly reduce badminton-related injury risk [6], [7]. However, the effectiveness of injury-prevention strategies largely depends on students' knowledge, perceptions, and actual engagement in preventive behaviors. Recent studies reveal that many college students lack adequate understanding of injury-prevention principles, even when participating regularly in physical exercise [8].

Given these research gaps, further examination of both the causes and preventive practices associated with badminton-related injuries in Chinese higher education is warranted. This study focuses on students at Hohhot XXX College, where badminton is widely integrated into PE instruction and campus recreation. Through a structured questionnaire, the study aims to: (1) identify the prevalence and types of badminton-related injuries; (2) examine the risk factors and mechanisms contributing to these injuries; and (3) analyze students' prevention-related knowledge and behaviors. The findings are intended to support evidence-based injury-prevention strategies for university badminton programs.

II. Literature Review

A. Prevalence of Badminton-Related Injuries Among University Students

Badminton participation has rapidly increased among university students in Asia, and with this growth, injury rates have also risen. Previous studies reported injury incidence ranging from 1.0 to 5.0 injuries per 1,000 hours of play, with recreational college athletes exhibiting higher rates due to insufficient technique and physical conditioning [1], [9].

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Research conducted with Chinese university badminton clubs suggests that over half of student players experience at least one musculoskeletal injury annually [10]. Notably, most injuries occur during casual or non-competitive play, highlighting issues such as inadequate warm-up, insufficient coaching, and flawed movement patterns.

B. Common Injury Types and Anatomical Locations

Studies consistently identify the lower limbs and shoulder complex as the most frequently injured regions in badminton. Common injuries include knee sprains, ankle sprains, patellar tendinopathy, and Achilles tendon injuries, largely caused by high-impact lunging, sudden stops, and jumping movements [11]. Upper-limb injuries such as shoulder impingement, rotator cuff tendinopathy, and wrist strains arise from repetitive overhead strokes and rapid racket movements [12]. A systematic review found that the knee (24–31%), ankle (18–26%), and shoulder (12–16%) account for the majority of injuries in amateur players [2]. These findings underscore the need for targeted preventive strategies, especially in university populations that lack structured training.

C. Intrinsic and Extrinsic Risk Factors

Badminton-related injuries stem from a combination of intrinsic and extrinsic factors.

1) Intrinsic Factors

Intrinsic factors include inadequate fitness, limited playing experience, poor muscle balance, insufficient lower-limb strength, weak core stability, and prior injury history. Studies have shown that weak quadriceps, gluteal muscles, and calf muscles significantly increase susceptibility to knee and ankle injuries [13]. Psychological variables such as stress, inattention, and overconfidence may further contribute to unsafe movement execution among student athletes [14].

2) Extrinsic Factors

Extrinsic risk factors include improper technique, poor-quality footwear, inadequate warm-up routines, and insufficient rest between sessions. Research also notes that high training load and poor court conditions elevate injury risk [9]. In university settings, rapid increases in weekly playing frequency—particularly around intramural competitions—are common contributors. The lack of professional coaching is frequently cited as a source of technical errors that lead to musculoskeletal strain [15].

D. Preventive Behaviors and Injury Management

Preventive behaviors are central to reducing the occurrence and severity of sports injuries. Evidence shows that warm-up routines, cool-down exercises, muscle strengthening, flexibility training, and appropriate footwear selection significantly reduce musculoskeletal injury risk [16]. However, studies in Chinese universities report low adherence to preventive practices, with fewer than 40% of recreational players performing adequate warm-ups or using badminton-specific shoes [17]. Additionally, premature return to play following injury is common, which increases the likelihood of recurrence and chronic injury. Educational interventions—such as workshops and structured PE modules—have been found to improve prevention knowledge and reduce injury rates [18].

E. Gaps in Current Research

Although previous studies have identified common injury types and risk factors in badminton, several gaps remain. Most existing literature focuses on elite or competitive athletes; relatively little research addresses general university students, who constitute the largest participant group in China. Few studies examine both causes and preventive behaviors within a unified framework, and there is a scarcity of research conducted specifically in Hohhot or the broader Inner Mongolia region. Additionally, standardized assessments linking technical habits, playing frequency, and injury outcomes are lacking, limiting universities' ability to create targeted prevention programs.

III. Methodology

3.1 Research Design

This study employed a cross-sectional quantitative survey design to investigate the causes, patterns, and prevention behaviors related to badminton-related injuries among college students at XX College, Hohhot, Inner Mongolia, China. The design was appropriate because it allowed the researcher to collect data at a single point in time from a large sample, enabling the assessment of injury prevalence, associated risk factors, and prevention practices simultaneously. The use of a structured questionnaire ensured standardized data collection suitable for descriptive and inferential statistical analysis.

3.2 Study Site

The study was conducted at XX College, a full-time private undergraduate institution located in Hohhot, Inner Mongolia, China. Formerly affiliated with a major regional university, XX College was officially approved as an independent private institution in 2020 and now operates three campuses within the Hohhot urban area. The college benefits from convenient transportation access, modern teaching facilities, and a landscaped campus environment recognized by local government agencies. With a diverse academic structure spanning six major disciplinary categories and more than thirty undergraduate programs, XX College maintains an active sports culture, offering regular physical education courses, including badminton, as well as extracurricular sports training.

3.3 Participants and Sampling Procedure

A total of 200 students enrolled in physical education courses or regularly participating in badminton activities at XX College were recruited through convenience sampling. Eligible participants were required to be at least 18 years old, actively engaged in badminton for a minimum of six months, and willing participate in physical activity during the data collection period. The final sample size was considered adequate for a cross-sectional survey, aligning with common methodological guidelines and allowing for meaningful subgroup analyses within the study population.

3.4 Research Instrument

Data were collected using a self-administered structured questionnaire developed from a comprehensive review of existing literature on sports injuries and adapted to the context of university-level badminton participation. The instrument comprised four major components covering demographic and participation information, injury history and characteristics, perceived intrinsic and extrinsic risk factors, and preventive behaviors and knowledge related to warm-up routines, equipment use, and recovery practices. A combination of Likert-scale items, multiple-choice questions, and categorical variables was used to ensure clarity and ease of response, and the complete questionnaire is provided in the Appendix.

3.4.1 Validity and Reliability

Content validity was established through expert review by three university specialists in sports science and badminton coaching. Revisions were made based on their feedback regarding clarity, relevance, and comprehensiveness. A pilot test with 20 students yielded a Cronbach's alpha of 0.82, indicating good internal consistency.

3.5 Data Collection Procedure

Data collection took place over a two-week period in badminton classes and training sessions. After obtaining permission from the college sports department, questionnaires were distributed in paper and digital formats. Participants were informed of the study's purpose, assured of anonymity, and instructed to answer based on their experiences in the previous 12 months. Participation was voluntary, and no incentives were provided.

Completed questionnaires were collected immediately or submitted electronically via a secure platform. The researcher monitored the process to ensure completeness and clarity of responses.

3.6 Data Analysis

All data collected through the structured questionnaire were coded and analyzed using descriptive and inferential statistical procedures. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize participants' demographic characteristics, badminton participation patterns, injury prevalence, affected body regions, and commonly reported causes and preventive behaviors. To further examine associations between variables, chi-square tests were applied to assess relationships between injury occurrence and factors such as playing frequency, warm-up habits, footwear use, and experience level. Independent t-tests and one-way ANOVA were used, where appropriate, to compare mean differences in prevention knowledge across subgroups. Data were analyzed using SPSS version 26.0, and statistical significance was set at $p < 0.05$. The analytical approach ensured a comprehensive understanding of injury patterns, contributing factors, and students' preventive practices within the study population.

3.7 Ethical Considerations

Participants were informed about the study objectives, confidentiality protections, and their right to withdraw at any time without penalty. No personal identifiers were collected, and all data were stored securely and used solely for academic research.

IV. Results

4.1 Demographic Characteristics of Participants

A total of 200 college students completed the survey. As shown in Table 1, the sample consisted of 108 males (54.0%) and 92 females (46.0%). The mean age of participants was 19.8 ± 1.3 years. Most students reported playing badminton 1–2 times per week (48.5%), followed by 3–4 times per week (32.0%), while only 19.5% played once a month or less.

Table 1. Demographic Characteristics of Participants (N = 200)

Variable	Category	n	%
Gender	Male	108	54
	Female	92	46
Age (years)	Mean ± SD	19.8 ± 1.3	—
Playing Frequency	Once a month or less	39	19.5
	1–2 times per week	97	48.5
	3–4 times per week	64	32
Playing Experience	< 1 year	56	28
	1–3 years	102	51
	> 3 years	42	21

4.2 Prevalence and Types of Badminton-Related Injuries

Out of the 200 participants, 118 students (59.0%) reported experiencing at least one badminton-related injury within the past 12 months. The most frequently affected body parts were the knee (32.2%), ankle (26.3%), shoulder (18.6%), lower back (12.7%), and wrist (10.2%). In terms of injury types, sprains accounted for the largest proportion at 41.5%, followed by muscle strains at 28.0%, while tendinitis (15.3%) and muscle contusions (10.2%) were also commonly reported.

Table 2. Distribution of Badminton-Related Injuries (n = 118)

Injury Site	n	%	Injury Type	n	%
Knee	38	32.2	Sprain	49	41.5
Ankle	31	26.3	Strain	33	28
Shoulder	22	18.6	Tendinitis	18	15.3

Injury Site	n	%	Injury Type	n	%
Lower back	15	12.7	Contusion	12	10.2
Wrist	12	10.2	Other	6	5

4.3 Causes and Risk Factors Associated with Injuries

Participants reported multiple perceived factors contributing to badminton-related injuries, with inadequate warm-up cited most frequently (62.7%), followed by incorrect technique (57.6%), fatigue or overexertion (54.2%), poor footwear or equipment (39.8%), and slippery or uneven court conditions (22.9%). Chi-square analysis indicated a significant association between injury occurrence and frequency of play ($\chi^2 = 6.21$, $p = .045$), showing that students who played three to four times per week experienced higher injury rates. Additionally, incorrect technique was found to be significantly associated with shoulder and wrist injuries ($p < .01$), suggesting that technical deficiencies may elevate the risk of upper-limb musculoskeletal problems.

Table 3. Perceived Causes of Injuries (N = 200)

Cause	n	%
Inadequate warm-up	125	62.7
Incorrect technique	115	57.6
Fatigue/overexertion	108	54.2
Improper footwear/equipment	79	39.8
Poor court conditions	46	22.9
Lack of coaching guidance	41	20.3

4.4 Preventive Behaviors and Knowledge Levels

Table 4 illustrates participants' engagement in injury-prevention behaviors. Only 41.0% performed adequate warm-up exercises before playing, and 33.5% reported regularly doing cool-down stretching. Proper badminton footwear was used by 52.0% of participants, while only 29.0% engaged in any form of strength or conditioning training.

Knowledge of injury prevention was moderate, with a mean score of 3.21 ± 0.78 on a 5-point scale.

Table 4. Injury Prevention Behaviors of Participants (N = 200)

Behavior	n	%
Performs adequate warm-up before playing	82	41
Performs cool-down stretching	67	33.5
Uses proper badminton shoes	104	52
Engages in strength/conditioning exercises	58	29
Seeks medical advice after injury	45	22.5
Allows sufficient rest/recovery	73	36.5

4.5 Predictors of Injury Occurrence

A binary logistic regression was conducted using injury occurrence (injured vs. not injured) as the dependent variable. Independent variables included warm-up behavior, footwear use, playing frequency, technique proficiency, and training experience.

The final model was statistically significant ($\chi^2 = 22.14$, $p = .004$), explaining 18.3% of variance in injury occurrence (Nagelkerke $R^2 = .183$). Significant predictors included:

Inadequate warm-up (OR = 2.46, p = .008)
Poor technique (OR = 2.11, p = .015)
High playing frequency (≥ 3 times/week) (OR = 1.78, p = .032)

Proper footwear and playing experience were not statistically significant predictors.

Table 5. Logistic Regression Analysis of Predictors of Injury Occurrence

Variable	OR	95% CI	p-value
Inadequate warm-up	2.46	1.27–4.76	.008*
Poor technique	2.11	1.16–3.82	.015*
Playing ≥ 3 times/week	1.78	1.05–3.01	.032*
Improper footwear	1.21	0.72–2.12	0.364
Playing experience > 1 year	0.88	0.51–1.49	0.612

*Note: *p < .05 indicates statistical significance.

V. Discussion

The findings demonstrate a notably high injury rate (59.0%) within the student population, aligning with previous studies indicating that badminton is a sport with considerable injury risk among young adults . The results also highlight

significant gaps in preventive practices and technical proficiency, underscoring the need for improved injury-prevention strategies within university badminton programs.

5.1 Prevalence and Patterns of Injury

The injury prevalence observed in this study is consistent with earlier research involving recreational and collegiate badminton players. The predominance of lower-limb injuries—particularly at the knee (32.2%) and ankle (26.3%)—supports existing literature identifying these areas as the most common injury sites due to the high impact of lunging, rapid direction changes, and repetitive jumping intrinsic to badminton . The relatively high incidence of shoulder injuries (18.6%) is also aligned with studies associating overhead strokes with shoulder impingement and rotator cuff stress .

5.2 Contributing Factors and Risk Mechanisms

Consistent with previous research, intrinsic and extrinsic factors were both found to contribute to injury risk. Inadequate warm-up (62.7%) and incorrect technique (57.6%) emerged as the most frequently reported causes, corroborating findings that insufficient preparation significantly elevates musculoskeletal injury risk.

The logistic regression results further confirm the predictive value of these factors. Students who failed to perform proper warm-up routines were more than twice as likely to sustain injuries. Poor technique also significantly increased injury risk. The significance of playing frequency (≥ 3 times per week) reflects increased exposure and fatigue may heighten the likelihood of overuse and acute injuries.

Interestingly, improper footwear and playing experience did not significantly predict injury occurrence in this study. This may be due to relatively uniform footwear use among students or the possibility that playing experience alone does not necessarily equate to proper technique or injury-resistant behavior. These nuances highlight the complexity of injury mechanisms within recreational badminton settings.

5.3 Deficiencies in Injury Prevention Practices

A major concern identified is the low engagement in preventive practices. Although warm-up was identified as a key predictive factor, only 41.0% of students reported performing adequate warm-up, and just 33.5% engaged in cool-down stretching. These behaviors are significantly lower than recommended guidelines and mirror trends reported in studies among Chinese college athletes, where preventive awareness remains insufficient. Strength and conditioning training—a key component for injury prevention, especially for lower-limb and shoulder protection—was practiced by only 29.0% of respondents. The low adherence suggests that students may lack structured training programs or knowledge on effective conditioning for badminton. The moderate mean score in injury-prevention knowledge (3.21 out of 5) also indicates incomplete understanding of injury mechanisms and protective strategies. This gap highlights the need for targeted educational interventions within badminton courses and extracurricular programs, including instruction on proper warm-up routines, stroke mechanics, and safe training progression.

5.4 Implications for University Badminton Education

Taken together, the findings underscore several important implications for sports educators and program designers. First, technical training should be prioritized, including instruction on proper footwork, stroke execution, and body mechanics. Second, standardized warm-up and conditioning protocols should be integrated into teaching sessions to ensure students adequately prepare their bodies for play. Third, injury-prevention education should be embedded into the curriculum.

These strategies align with evidence-based frameworks suggesting that multi-component prevention programs are most effective in reducing sports injury incidence. For colleges in regions like Hohhot, where badminton participation is widespread but professional coaching resources may be limited, structured educational interventions can significantly mitigate injury risks.

5.5 Limitations of the Study

While the study provides valuable insights, several limitations should be acknowledged. The use of convenience sampling and self-reported questionnaires may introduce recall bias or subjectivity in reporting injury events. The cross-sectional design restricts the ability to establish causal relationships between behavior and injury occurrence. Additionally, the study was conducted in a single institution, limiting the generalizability of findings to other colleges in China or abroad.

VI. Conclusion and Recommendations

6.1 Conclusion

This study investigated the prevalence, causes, and preventive behaviors related to badminton injuries among college students at XX College in Hohhot, China. The findings reveal a high injury prevalence of 59.0% within the past 12 months, confirming that badminton poses a significant musculoskeletal risk to the university population. The lower extremities, particularly the knee (32.2%) and ankle (26.3%), were the most frequently injured sites, followed by the shoulder (18.6%), aligning with the sport's biomechanical demands for rapid changes in direction, lunging, and overhead strokes.

The analysis identified a clear disconnect between risk awareness and preventive action. While students correctly perceived inadequate warm-up (62.7%) and incorrect technique (57.6%) as primary causes, their engagement in preventive behaviors was low, with only 41.0% performing adequate warm-ups and 29.0% engaging in strength training. Crucially, logistic regression analysis quantified the significant impact of these factors, showing that students who neglected proper warm-up were 2.46 times more likely to be injured, and those with poor technique were 2.11 times more likely. This highlights a critical "knowledge-behavior gap" where understanding of injury prevention does not reliably translate into safe practices. The high injury rate among this population is therefore not inevitable but is highly preventable through targeted, evidence-based interventions within the university setting.

6.2 Recommendations

Based on the study's conclusions, the following recommendations are proposed for university physical education departments, sports clubs, and students to reduce the incidence of badminton-related injuries:

1. Integrate Structured, Standardized Warm-Up Protocols: Mandate a standardized, dynamic warm-up routine at the beginning of every physical education badminton class and encourage its use in extracurricular clubs. This routine should specifically target the muscle groups most engaged in badminton, such as the calves, quadriceps, hamstrings, glutes, and rotator cuff. Educating students on the purpose and components of an effective warm-up is essential to improve compliance.
2. Enhance Technical Skill Instruction: Physical education curricula and badminton club training should place a greater emphasis on correct technique. Instruction should focus on proper footwork to reduce lower-limb strain and safe stroke mechanics to prevent shoulder and wrist injuries. Supervised drills and feedback from instructors can help correct flawed movement patterns identified as a major risk factor.
3. Develop and Promote Injury-Prevention Education Modules: The university should develop short, engaging educational modules or workshops on injury prevention. These modules should cover the importance of warm-up/cool-down, proper technique, the role of strength and conditioning, and the principles of load management, which addresses the moderate knowledge scores and aims to bridge the gap between awareness and behavior.
4. Encourage Supportive Equipment and Environment: While not a significant predictor in this study, promoting the use of proper badminton footwear should still be encouraged for optimal support and injury prevention. Furthermore, university administration should ensure regular maintenance of sports facilities to guarantee safe, non-slippery court conditions, which were cited as a contributing factor by 22.9% of participants.

6.3 Suggestions for Future Research

Future studies should employ a longitudinal design to establish causal relationships between preventive behaviors and injury outcomes over time. Research could also qualitatively explore the barriers and motivations behind students' adherence to prevention strategies. Finally, implementing and evaluating the effectiveness of the recommended interventions through controlled trials would be a valuable next step.

References

[1] P. S. H. Yung, K. W. Chan, S. H. Wong, C. M. Cheuk, and M. H. Fong, “Epidemiology of injuries in Hong Kong badminton population,” Res. Sports Med., vol. 15, no. 2, pp. 133–146, 2007.
[2] J. H. Shariff, J. George, and A. A. Ramlan, “Musculoskeletal injuries among Malaysian badminton players,” Singapore Med. J., vol. 50, no. 11, pp. 1095–1097, 2009.
[3] S. S. M. Yeung and Y. L. Chan, “Lower-limb musculoskeletal injuries in badminton: A systematic review,” Sports Med.–Open, vol. 4, pp. 1–15, 2018.
[4] M. Fahlström, T. Björnstig, and B. Ericsson, “Injuries in Swedish elite badminton players,” Scand. J. Med. Sci. Sports, vol. 16, no. 3, pp. 129–135, 2006.
[5] G. Kuntze, N. Mansfield, and W. A. Sellers, “A biomechanical analysis of common lunge tasks in badminton,” J. Sports Sci., vol. 28, no. 2, pp. 183–191, 2010.
[6] R. Bahr and T. Krosshaug, “Understanding injury mechanisms: A key component of preventing injuries in sport,” Br. J. Sports Med., vol. 39, no. 6, pp. 324–329, 2005.
[7] C. Emery and K. Pasanen, “Current evidence on the effectiveness of neuromuscular training in injury prevention,” Sports Med., vol. 49, no. 6, pp. 933–949, 2019.
[8] L. Zhang and X. Li, “Injury prevention awareness among Chinese university students,” J. Phys. Educ. Res., vol. 8, no. 2, pp. 45–53, 2020.
[9] S. L. Goh, M. Mokhtar, and A. E. Mohamad Ali, “Badminton injuries in youth and recreational players,” Malays. Orthop. J., vol. 7, no. 2, pp. 18–22, 2013.
[10] C. Zhang and J. Li, “Survey on musculoskeletal injuries among university badminton players,” China Sport Sci., vol. 40, no. 10, pp. 72–78, 2020.
[11] M. Fahlström, B. Lorentzon, and T. Alfredson, “Anterior knee pain and patellar tendinopathy in badminton,” Knee Surg. Sports Traumatol. Arthrosc., vol. 14, no. 4, pp. 304–309, 2006.
[12] W. K. Ong and M. L. Chan, “Shoulder injuries in badminton players,” Orthop. J. Sports Med., vol. 9, no. 3, pp. 1–8, 2021.
[13] W. Lam, S. Ng, and M. Fong, “Lower-limb strength imbalance and badminton injury risk,” J. Strength Cond. Res., vol. 32, no. 1, pp. 1–10, 2018.
[14] J. Wiese-Bjornstal, D. Smith, M. Shaffer, and S. Morrey, “Psychology of sport injury,” J. Appl. Sport Psychol., vol. 10, no. 1, pp. 46–69, 1998.
[15] H. Chen and L. Xu, “Technical error analysis among amateur badminton players,” J. Sports Sci., vol. 5, pp. 112–120, 2019.
[16] W. Van Mechelen, H. Hlobil, and H. C. G. Kemper, “Incidence, severity, aetiology and prevention of sports injuries,” Sports Med., vol. 14, no. 2, pp. 82–99, 1992.
[17] J. Liu, X. Wang, and R. Yu, “Warm-up behavior among recreational badminton players in Chinese universities,” J. Phys. Educ., vol. 28, no. 4, pp. 55–62, 2021.
[18] Y. Huang and A. Wong, “Effects of educational intervention on injury prevention behaviors,” Asia-Pac. J. Sports Med., vol. 6, no. 2, pp. 141–150, 2019.