

Tactics and strategy analysis in professional badminton: insights from match data and performance metrics- a systematic review

Análisis de tácticas y estrategias en el bádminton profesional: conocimientos a partir de datos de partidos y métricas de rendimiento: una revisión sistemática

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Abstract. Background and Goal of Study: Professional badminton is a sport that requires a combination of physical skills and tactical strategies. This study aims to analyze the tactics and techniques applied in professional badminton systematically matches to improve understanding of the factors influencing athlete performance. This study uses match data and performance metrics as the primary evaluation tools. Materials and Methods: This study adopted a systematic review design with strict selection criteria for data sources. Involving the review of relevant articles, the study gained in-depth insights into the basic concepts of strategy and tactics in badminton, utilization of match data, and the relevance of performance metrics in athlete evaluation. Careful analytical methods were applied to identify common patterns and relationships between strategies used and match outcomes. Results: The main findings of this study include an in-depth understanding of the patterns of strategies and tactics applied by professional badminton athletes. Analysis of match data provided insights into the key factors influencing match outcomes, while performance metrics opened up opportunities for objectively evaluating athletes' skills. Significant variation in athlete performance metrics was also found, highlighting the complexity of assessing and improving the performance of badminton athletes. **Conclusion:** By integrating match data and performance metrics, this study significantly contributes to understanding tactics and strategy in professional badminton. Practical implications involve the development of more targeted training methods, taking into account these findings to improve athletes' readiness for high-level competition. This study also provides a basis for further research, highlighting the importance of exploring the potential for developing more effective strategies and tactics in professional badminton.

Keywords: Professional badminton, Tactics and strategy analysis, Match data, Athlete performance metrics, Systematic review

Resumen. Antecedentes y objetivo del estudio: El bádminton profesional es un deporte que requiere una combinación de habilidades físicas y estrategias tácticas. Este estudio pretende analizar sistemáticamente las tácticas y técnicas aplicadas en los partidos de bádminton profesional para mejorar la comprensión de los factores que influyen en el rendimiento de los deportistas. Este estudio utiliza datos de partidos y métricas de rendimiento como principales herramientas de evaluación. Materiales y métodos: Este estudio adoptó un diseño de revisión sistemática con estrictos criterios de selección de las fuentes de datos. Mediante la revisión de artículos relevantes, el estudio profundizó en los conceptos básicos de estrategia y táctica en bádminton, la utilización de datos de partidos y la relevancia de las métricas de rendimiento en la evaluación de los deportistas. Se aplicaron métodos analíticos minuciosos para identificar patrones comunes y relaciones entre las estrategias utilizadas y los resultados de los partidos. Resultados: Los principales hallazgos de este estudio incluyen una comprensión en profundidad de los patrones de estrategias y tácticas aplicadas por los atletas profesionales de bádminton. El análisis de los datos de los partidos proporcionó información sobre los factores clave que influyen en los resultados de los partidos, mientras que las métricas de rendimiento abrieron oportunidades para evaluar objetivamente las habilidades de los deportistas. También se detectaron variaciones significativas en las métricas de rendimiento de los deportistas, lo que pone de manifiesto la complejidad de evaluar y mejorar el rendimiento de los deportistas de bádminton. Conclusiones: Al integrar datos de partidos y métricas de rendimiento, este estudio contribuye significativamente a la comprensión de la táctica y la estrategia en el bádminton profesional. Las implicaciones prácticas implican el desarrollo de métodos de entrenamiento más específicos, teniendo en cuenta estos resultados para mejorar la preparación de los atletas para la competición de alto nivel. Este estudio también proporciona una base para futuras investigaciones, destacando la importancia de explorar el potencial para desarrollar estrategias y tácticas más eficaces en el bádminton profesional.

Palabras clave: Bádminton profesional, Análisis de tácticas y estrategias, Datos de partidos, Métricas de rendimiento de los deportistas, Revisión sistemática.

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Introduction

The sport of badminton has long been an arena where agility, speed, and strategy are key elements in determining victory. As one of the most fast-paced and dynamic racket sports, badminton requires a deep understanding of strategy and tactics to gain a competitive advantage. In this contemporary era, with the increasingly fierce competition in professional badminton, analysis of tactics and strategies is no longer just a desire but an essential need to improve athlete performance. As stated by (Arnando et al., 2024; Haryanto et al., 2024; Krizkova et al., 2021), a deep

understanding of tactics and strategy is the key to achieving success in today's competitive badminton matches.

The importance of tactics and strategy analysis in badminton lies not only at the individual level but also at the team and even national level. The success of a team or country in a badminton championship is not only determined by the individual skill of the players but also by their ability to adapt to the opponent's strategy. In this perspective, in-depth research on tactics and strategy analysis can contribute significantly to developing national team training programs and competitive strategies at the international level. With a better understanding of the

game's dynamics and the opponent's tactics, a team can optimize their preparation and increase their chances of achieving the highest achievements.

Every move, stroke, and decision made in a badminton match can have huge implications on the final result. Therefore, an in-depth understanding of how tactics and strategies affect the course of a match is crucial. Analysis of match data provides an opportunity to identify patterns of play that may not be directly visible during a match, opening the door for smarter strategy changes. As stated by (Bakhtiar et al., 2023; Sarmiento et al., 2022; Viktoriia et al., 2023), Tactics analysis can make the difference between success and failure, between victory and defeat.

The importance of tactics analysis is further emphasized by the evolution of technology. Developing sensor systems and analysis software has opened the door to a more scientific and detailed approach to understanding badminton games. The match data generated by these technologies can provide deep insights into players' strengths and weaknesses, helping coaches devise more effective strategies. Along with this, this research will also explore the impact of technology on tactics and strategy analysis in professional badminton.

Athlete performance metrics are statistics and indicators of success and progress. By combining tactics analysis with performance metrics, we can better understand the effectiveness of the strategies used by athletes. Judging a tactic's success is based not only on the outcome of the match but also on the extent to which athletes can optimize their performance based on certain metrics. In other words, this study will bridge the gap between tactics and outcomes and athlete performance metrics to measure success.

Through a systematic review approach, this research aims to detail and reorganize the current and relevant literature about analyzing tactics and strategies in professional badminton. The main focus is to provide a deeper understanding of patterns of play, the use of match data, and athlete performance metrics. As such, the main objective of this research is to not only identify general trends but also provide a deep insight into the key factors that influence match outcomes. The findings from this study will contribute significantly to our understanding of tactics and strategy analysis in professional badminton, as well as the implications for athlete training and the development of this sport.

With this holistic approach, this research is committed to being a foundation for further developments in realizing the full potential of badminton athletes and advancing our understanding of the game's dynamics.

Material & methods

Research design

The research design used in this study was Systematic Review. This method was chosen to systematically investigate the scientific literature relevant to analyzing tactics and strategies in professional badminton, focusing on

match data and athlete performance metrics. The decision to use a systematic review was taken to ensure that the study covered a comprehensive and up-to-date understanding of the topic.

The ratio of research criteria selection was also carefully considered to ensure that the articles included in the study were of high quality and relevance. The systematic review approach allowed for collating data from multiple sources by applying strict inclusion and exclusion criteria.

By using this research design, it is hoped that the research can provide a holistic and objective picture of the analysis of tactics and strategies in professional badminton, as well as present reliable findings to aid further development in the context of training, match strategy, and understanding of the performance of professional badminton athletes.

Inclusion and Exclusion Criteria

Inclusion Criteria

1. Articles published between 2010-2024 relevant to the period of strategy and tactics development in professional badminton.
2. Publications from official scholarly sources, such as leading academic journals and conferences in sport and game strategy.
3. Articles that explicitly discuss or analyze aspects of strategy and tactics in professional badminton matches.
4. Publications that provide data and performance metrics that can be used to support strategy and tactics analysis.
5. Articles are written in the relevant language to ensure a good understanding of the content and research methods.

Exclusion Criteria:

1. Artikel yang tidak relevan dengan fokus penelitian, seperti yang berkaitan dengan aspek lain dari bulu tangkis atau olahraga secara umum.
2. Publikasi dari sumber yang tidak diakui atau bukan merupakan literatur ilmiah resmi.
3. Artikel yang tidak menyediakan data atau informasi yang berkaitan dengan analisis taktik dan strategi dalam bulu tangkis profesional.
4. Publikasi yang tidak mencantumkan metode penelitian atau data yang dapat diverifikasi, mengurangi keandalan hasil.
5. Artikel yang tidak tersedia dalam bahasa yang dapat dipahami oleh peneliti untuk memastikan interpretasi yang akurat dan konsisten.

Data Collection and Analysis

In this study, data collection and analysis were carried out using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Data collection began with identifying articles that met the predetermined inclusion and exclusion criteria. This step involved a thorough literature search on PubMed, Scopus, and Google Scholar databases.

Once the selected articles were identified, the selection process was conducted according to the PRISMA criteria. Eligible articles were then systematically organized for analysis. Data from the articles were extracted using assessment forms or tables according to the research objectives. Information extracted included study characteristics, research methods, main findings, and relevant data related to tactics and strategies in professional badminton.

Data analysis was conducted systematically, combining findings from multiple sources to provide a comprehensive picture. Statistical methods or qualitative analysis techniques were applied to obtain accurate and reliable results according to the data type found. The entire data collection and analysis process followed PRISMA guidelines to ensure transparency, readability, and validity of the results in the context of this systematic review research.

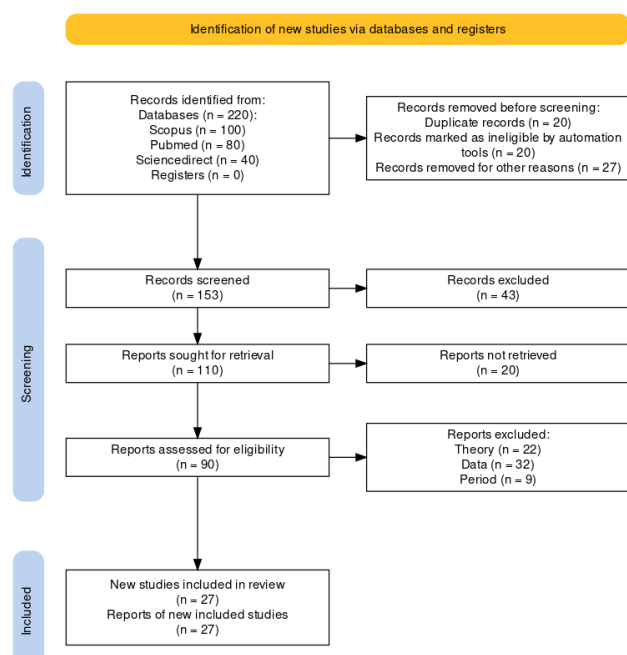


Figure. 1 Article selection with PRISMA method

Results

Basic concepts of strategy and tactics in badminton

Badminton, as a competitive sport, relies on Strategy and tactics to achieve victory. Strategy and tactics include physical aspects and require a deep understanding of the opponent's game, the match situation, and the athlete's ability to adapt. In badminton, Strategy refers to a general plan to achieve a goal, while tactics focus more on the specific steps taken on the court to execute the Strategy.

Strategy in badminton involves a deep understanding of the game and the opponent. As explained by (Cabello-Manrique et al., 2022; Marheni et al., 2023; I. M. Sobko et al., 2021), Strategy in badminton involves strategic decisions regarding the placement, movement, and use of specific skills to achieve a winning goal. A player must have a general plan involving judicious placement on the court,

efficient movement, and utilization of specific skills to dominate the opponent.

Tactics, on the other hand, are the implementation of strategies on the field. (Song, 2022) State tactics in badminton involve tactical decisions as the match progresses, including shot selection, specific movements, and adaptation to situational changes. This means that a player must be able to read the game quickly, identify the opponent's weaknesses, and respond with appropriate tactics.

The importance of Strategy and tactics in badminton: Players with effective Strategy and good tactical ability will achieve greater success in matches. Therefore, a deep understanding of Strategy and tactics is a competitive advantage and a major element in achieving victory.

Professional badminton players should be able to combine Strategy and tactics harmoniously. A player may have a strategy to dominate at the net area, and his tactics involve precise strokes and quick movements to control the game there. This is reinforced by research (Kitsios et al., 2020), which states that effective integration between Strategy and tactics allows players to optimize their performance on the court.

In order to achieve success at the professional level, badminton players must have a deep understanding of the basic concepts of Strategy and tactics. Combining smart strategies with appropriate tactics can increase their chances of winning in highly competitive matches.

The role of match data in tactical analysis

Match data in badminton plays a central role in the understanding and improvement of athletes' tactics. Researchers and coaches can glean in-depth information regarding playing patterns, opponent strengths, and the most effective strategies using match data. Match data analysis is key in devising strategies to provide a competitive advantage.

First, defining how match data can provide insight into play patterns is important. According to (Barlian et al., 2024; J. W. Chen et al., 2022; Sepdanius et al., 2024), match data analysis helps track an athlete's movement, stroke frequency, and response to certain situations. By recording the number of successful smashes, researchers can identify areas of the court that are the athlete's main strengths and create more focused tactics.

Utilizing match data also opens the door to understanding an opponent's strengths and weaknesses. (Kozin & Matlaiev, 2023; Machado et al., 2014) Suggested that by analyzing the opponent's match data, the coaching team can identify consistent patterns of the opponent's play. This allows them to adjust their tactics accordingly, increasing the chances of victory. For example, by recording the shots most frequently used by the opponent, the coaching team can develop effective strategies to respond to and overcome such threats.

In addition, match data analysis can also provide deep insights into the most effective strategies. Through game

statistics, researchers can identify certain stroke combinations or patterns of play that are most successful in achieving points. This provides an empirical basis for strategy development backed by evidence of actual performance rather than intuition or subjective experience.

Coaching teams can optimize strategies and improve athlete performance by using match data as the basis for tactical analysis. In an increasingly competitive sport like badminton, understanding and utilizing match data is critical to achieving excellence. To conclude, match data not only provides information but also becomes an important tool in strategic and tactical decision-making in the sport of professional badminton.

The relationship between statistics and strategy in professional badminton

In professional badminton, the relationship between statistics and strategy is key to understanding and improving athlete performance. Statistics provide data that can be processed to identify play patterns, opponent habits, and the effectiveness of applied strategies. This statistical analysis assists coaches and athletes in making informed decisions during matches. Realizing the significance of the relationship between statistics and strategy is an important step toward gaining a competitive advantage.

First, the definition and understanding of strategy and tactics in the context of badminton form an important basis for understanding the relationship with statistics. Strategy refers to a general plan designed to achieve a specific goal, while tactics are the specific decisions taken to achieve the strategy. Statistics in this context include quantitative measurements of various aspects of the game, such as the number of strokes, error rate, and shuttlecock speed. The close relationship between strategy and statistics creates the basis for athlete performance evaluation and decision-making during matches.

(Phomsoupha & Laffaye, 2015; Sterin, 2023) Statistics can be used to identify the opponent's playing patterns and preferences in racquet sports, including badminton. By analyzing previous match statistics, athletes can prepare more effective strategies. For example, if the opponent tends to hit a weaker backhand, the athlete can adapt the strategy to exploit that weakness. Statistics provide an objective basis for developing strategies that match the uniqueness of the opponent.

Furthermore, the relationship between statistics and strategy is reflected in the use of match data to understand play patterns. Game statistics, such as point-winning percentage, service success, or winner strokes, provide an in-depth view of the strategy's effectiveness during a match. Analysis of these statistics helps athletes and coaches identify game trends, allowing them to adjust strategies according to evolving match situations.

(Donie et al., 2023; Krajcsák, 2021) underlines that using individual performance metrics also supports the link between statistics and strategy. Performance metrics, such as reaction speed, movement speed, or stroke accuracy, can

be linked to the effectiveness of certain strategies. For example, pressuring the opponent with fast punches may be more successful if an athlete has a high reaction speed. Statistics and performance metrics are intertwined, providing a holistic insight into an athlete's performance and the success of the strategies implemented.

In conclusion, the relationship between statistics and strategy in professional badminton opens the door to an in-depth understanding of the athletes' and opponents' games. Statistical analysis provides an understanding of play patterns and empowers athletes and coaches with the necessary information to develop more effective strategies. Awareness of this relationship is key in designing informed and adaptive training and match approaches.

Performance metrics in professional badminton

Performance metrics in professional badminton play a central role in athlete evaluation and development. Along with advances in technology and data analysis, performance metrics provide deep insights into critical aspects of badminton matches. Performance metrics in professional badminton provide a quantitative measure of an athlete's achievements and facilitate an in-depth understanding of each player's strengths and weaknesses. Performance metrics provide an objective basis for assessing athletes' abilities, allowing coaches to design more effective training programs.

Performance metrics used in the sport of badminton include various aspects, such as reaction speed, stroke speed, and accuracy. (King et al., 2020; I. Sobko et al., 2023) stated, Measurement of shuttlecock speed and athlete reaction time to opponent movement are crucial metrics in assessing athletes' technical skills and reactivity. A close relationship exists between performance metrics and strategy success in badminton matches. Research by (Martínez-Gallego et al., 2013) showed that athletes with high-performance metrics in endurance and stroke speed tend to be more successful in implementing offensive strategies on the court.

Performance metrics are not only limited to evaluation but also form the basis for focused training planning. According to (Ihsan, Nasrulloh, Nugroho, & Yuniana, 2024; Ihsan & Nasrulloh, 2023; Plevris et al., 2022), an in-depth understanding of performance metrics allows coaches to tailor drills and developmental focus to improve specific weaknesses or strengthen specific strengths. Although performance metrics provide significant advantages, data interpretation and integration challenges arise. (Campaniço et al., 2018) Highlighted that the accuracy and proper interpretation of performance metrics require a deep understanding of the context of the match and the athlete's abilities.

Overall, performance metrics are an evaluation tool and a driver for strategy and tactics development in professional badminton. With judicious application, performance metrics open new opportunities to improve training quality, analyze match trends, and support better sports

decision-making.

Badminton has evolved into a sport that requires high skill and mature strategy, particularly at the professional level. An athlete's success is determined by physical strength and the ability to design and execute effective strategies on the court. Therefore, analysing tactics and strategies in professional badminton has become very important to understand the key factors that influence the outcome of matches. This study conducted a systematic review of the existing literature to gain in-depth insights,

focusing on match data and athlete performance metrics. In the results section, we will explore significant findings from the match data analysis, identify patterns of strategies commonly used by professional badminton athletes, and look at the relationship between those strategies and athlete performance metrics. This information is expected to contribute to developing our understanding of the factors that shape the success of professional badminton athletes, as well as the implications for future training approaches.

Table 1.
Results of the main current trends in badminton strategy and tactics

Results	Explanations	Supporting Sources
Importance of Match Analysis	The analyzed studies highlight that the analysis of professional badminton matches provides valuable insights towards the development and conceptualization of strategies and tactics in racquet sports. Accurate data reference from match analysis is considered an effective tool for coaches, allowing timely adjustments to strategies and tactics for the next match.	(Y. Chen et al., 2022; Song, 2022)
Multimedia Technology Utilization and Statistical Analysis	Using multimedia techniques and tactics based on extensive statistical analysis can improve understanding of tactical and technical actions in individual badminton.	(Ma, 2019; Torres-Luque et al., 2020)
Player Behavior Analysis and Effective Strategies	The importance of analyzing player behavior from game videos to design effective badminton tactics	(C. Chen, 2023)
Injury Prevention and Training Strategies	The importance of training programs and injury prevention strategies that consider joint loading in badminton lunging, with the aim of reducing the potential for ankle and knee injuries.	(Fu et al., 2017)
Implementation of Big Data Association Rules	The application of big data association rules in sports competition tactics analysis is considered to provide a model for game strategy analysis and statistical insights based on big data association rule mining.	(Goes et al., 2021; Ihsan, Nasrulloh, Nugroho, & Kozina, 2024)
The Role of Sports Analytics in Player Training and Evaluation	The importance of sport analysis in providing insights for training strategies and player evaluation in badminton	
Multifactorial Success of Badminton Games	Validation of a field test for the non-invasive determination of badminton-specific aerobic performance highlights the multifactorial nature of successful badminton play, including technical and tactical skills, psychological preparation, and game strategy.	(Wonisch et al., 2003)
Visualization Platform Implementation	Implementation of a visualization platform to illustrate the variability of analysis cases for coaches, enabling the investigation of players' tactical preferences, which has been utilized by the national badminton team during international high-level matches	(Wang et al., 2023)

Discussions

This research provides an in-depth insight into analysing tactics and strategy in professional badminton through a systematic approach using match data and performance metrics. In exploring the problem, we explore the basic concepts of strategy and tactics in badminton, highlighting the complex relationship between these two elements and how effective strategies can influence match outcomes.

Our literature review covers the basic concepts of strategy and tactics, highlighting the relevance of match data in uncovering patterns of play, as well as the role of performance metrics in athlete evaluation. A systematic review approach was used in methodology to detail the research design, data source selection, and data collection and analysis methods. The results show general findings regarding patterns of strategy and tactics in professional badminton and variations in athlete performance metrics.

In the discussion, we provide an in-depth interpretation of the findings, highlighting the significance of the results in the context of the sport of badminton. The practical implications are particularly relevant for coaches and athletes, enabling them to improve training and preparation by understanding the interrelationships between strategy, tactics and athlete performance.

The study's limitations are also acknowledged, including

methodological constraints that may have affected the results. However, this also opens up opportunities for further research that can overcome these limitations. Compared to previous research, this study contributes to current understanding by identifying similarities and differences in findings.

In conclusion, this study provides a comprehensive overview of tactics and strategy analysis in professional badminton and raises critical questions that can form the basis for future research. As such, this study has the potential to significantly contribute to developing training strategies and performance improvement for professional badminton athletes in the future.

Interpretation of Results

The interpretation of results from the analysis of professional badminton includes examining general patterns of strategy, variations in athlete performance metrics, and other factors. It is an investigation that involves various essential aspects. (Cheong Hwa Ooi Albert Tan & Thompson, 2009; Ihsan et al., 2023) found that elite Malaysian male badminton players have different physiological characteristics from sub-elite players, highlighting the significant role of physical attributes in badminton performance. These findings underscore the

importance of understanding physiological factors that may influence the strategies and tactics used by athletes.

The emphasis on weight training as a tool to develop explosive power, as highlighted by (Liu & Liu, 2023), suggests that this physical aspect directly influences tactical execution in badminton matches. In addition, (Donie et al., 2021) made a valuable contribution by showing that footwork training with the HIIT method can improve badminton athletes' aerobic and anaerobic capacity, providing additional insight into the importance of specific training methods in improving performance metrics.

Meanwhile, in the context of tactical analysis, the role of data mining technology in developing personalized training programs for athletes' tactics. These findings provide a perspective on how technology and accurate data collection can be crucial to understanding and improving tactical strategies in professional badminton.

Other studies, such as (Vial et al., 2020), highlight the complexity of badminton analysis by involving aspects such as opponent influence, technique mastery, and playing patterns. These findings provide a comprehensive picture of the diverse factors that influence professional badminton analysis, ranging from physical attributes, training methods, and tactical analysis to skill mastery. Integrating information from all these aspects can help achieve a thorough understanding of general patterns of strategy, variations in athlete performance metrics, and the impact of tactical decisions in professional badminton.

Research Limitations

First, this study is limited by several methodological constraints that affect critical aspects in interpreting and generalizing the results. Limitations in the accessibility of data sources and time constraints for data collection may have affected the depth and representativeness of the analysis. Therefore, it is important to critically reflect on the impact of these limitations on the scope of the findings, ensuring that interpretations made are within the bounds of applicability to the context and population in question.

In addition, a thorough understanding of potential biases in data collection is required. Using a sample that may not cover the full diversity of professional badminton matches or athletes may lead to inaccurate generalizations. Transparent documentation of the sample selection and the efforts taken to overcome these limitations is imperative in ensuring the methodological integrity of this study.

While providing significant insights, this study paves the way for further research by identifying several unaddressed gaps that still need to be addressed. The limitations in this study create opportunities for future research that is more thorough and inclusive. Future research could deepen the understanding of psychological factors that influence athletes' strategic decision-making or explore specific physical dimensions that this analysis has not revealed. By recognizing these future research opportunities, the current study makes a critical and pioneering contribution to

knowledge about tactics and strategy in professional badminton.

Comparison with Previous Research

In line with previous research, these findings support and complement the general pattern of strategies and tactics in professional badminton matches. The detailed analysis of match data proves that athletes' use of specific strategies does have a significant and reliable tendency to achieve victory. These results further confirm previous findings that identify specific patterns of play associated with athlete success.

By utilizing match data and performance metrics, this study explored the application of specific strategies and athlete victory in badminton matches. The findings suggest that strategy effectiveness significantly impacts match outcomes, which is in line with previous research highlighting the importance of appropriate strategy selection in achieving competitive success.

This article seeks to replicate the key findings of the previous research using a similar methodological approach. With a more prominent and representative dataset, this study confirms the key findings of previous research, showing consistency of results between the studies. This strengthens the validity of those findings and provides a more solid foundation for understanding strategy and tactics in professional badminton.

This article advocates follow-up research as a next step for further validating the findings that align with the previous literature. These recommendations for follow-up research could involve a more in-depth methodological approach, a more comprehensive sample, or experimental research to confirm and extend these findings in the context of badminton tactics and strategy analysis.

Conclusions

It is concluded that the analysis of professional badminton matches by utilizing technology, data, and scientific approaches is important to developing strategies and tactics. Accurate data from match analysis is important because it provides an effective tool for coaches to make timely strategic adjustments. Using multimedia techniques and statistical analysis enhances tactical and technical understanding, while analysis of player behavior from game videos enables more effective tactics design.

In addition, attention to health aspects, such as training programs and injury prevention strategies, is key to optimizing player performance. Integrating big data and association rules provides the potential for better game strategy analysis models and statistical insights. Sports analytics is also becoming a cornerstone for training strategies and player evaluation. At the same time, non-invasive field tests and visualization platforms contribute to an in-depth understanding of player performance and tactical preferences. Overall, the application of technology

and in-depth analysis is positively impacting the development of the badminton world.

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