2025, Retos, 62, 439-453

Effect of psychological skills training on reaction time and strategic thinking in competitive badminton- a systematic review

Efecto del entrenamiento en habilidades psicológicas sobre el tiempo de reacción y el pensamiento estratégico en el bádminton de competición - una revisión sistemática

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Abstract. Background: Badminton is a competitive sport requiring physical, tactical, and mental skills. In addition to physical abilities, such as speed, agility, and endurance, psychological skills are essential in determining an athlete's performance. Quick reaction time and practical strategic thinking are two critical elements needed in badminton matches, where athletes must react quickly to opponents and make strategic decisions under pressure. Psychological skills training, which includes attention regulation, stress management, visualization, and emotion regulation, has been identified as an essential factor supporting improving athletes' performance in various sports. However, not many studies have empirically reviewed the effect of psychological skills training on reaction time and strategic thinking, especially in competitive badminton. Study Objectives: This study aims to systematically review the existing literature on the effect of psychological skills training on reaction time and strategic thinking in competitive badminton. As such, the study seeks to identify and evaluate the existing evidence regarding the effectiveness of psychological skills training in improving these two critical components and their implications for enhancing athletes' performance on the field. Materials and Methods: This study is a systematic review that follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Research articles published during a given year and relevant to this topic are collected from various academic databases, including PubMed, Scopus, and Google Scholar. Studies that met the inclusion criteria were those that explored psychological skills training in the context of badminton or similar sports and that assessed the impact on reaction time and strategic thinking. Exclusion criteria were applied to irrelevant studies that did not have sufficient empirical data or used non-athlete populations. The study selection process involves screening the title and abstract, followed by a full-text analysis of the eligible articles. Data from each study that met the criteria were analyzed and synthesized to evaluate the consistency of the findings and provide a comprehensive picture of the effects of psychological skills training. Results: Most of the studies reviewed showed that psychological skills training positively impacted the reaction time of badminton athletes. Training in relaxation, concentration, and visualization techniques has proven effective in helping athletes shorten the response time to game stimuli. In addition, strategic decision-making abilities on the field have also improved significantly through the application of psychological skills, especially when athletes are faced with high-pressure situations. These studies also show that psychological skills training improves physical performance and helps athletes manage anxiety and increase self-confidence, which affects the quality of tactical decisions made during games. Conclusion: Based on the results of this systematic review, psychological skills training significantly improves reaction time and strategic thinking in competitive badminton. Techniques such as visualization, stress management, and attention focus impact quick response and decision-making in the field. Thus, integrating psychological skills training into badminton athlete training programs can effectively improve competitive performance. Further research is needed to explore the long-term implementation of this training and its effectiveness at different levels of competition.
Keywords: Psychological Skills Training, Reaction Time, Strategic Thinking, Competitive Badminton, Systematic Review

Resumen. Antecedentes: El bádminton es un deporte de competición que requiere habilidades físicas, tácticas y mentales. Además de las capacidades físicas, como la velocidad, la agilidad y la resistencia, las psicológicas son esenciales para determinar el rendimiento de un deportista. La rapidez de reacción y el pensamiento estratégico práctico son dos elementos críticos necesarios en los partidos de bádminton, en los que los atletas deben reaccionar con rapidez ante sus oponentes y tomar decisiones estratégicas bajo presión. El entrenamiento de habilidades psicológicas, que incluye la regulación de la atención, la gestión del estrés, la visualización y la regulación de las emociones, se ha identificado como un factor esencial para mejorar el rendimiento de los atletas en diversos deportes. Sin embargo, no hay muchos estudios que hayan revisado empíricamente el efecto del entrenamiento en habilidades psicológicas sobre el tiempo de reacción y el pensamiento estratégico, especialmente en el bádminton de competición. Objetivos del estudio: Este estudio pretende revisar sistemáticamente la literatura existente sobre el efecto del entrenamiento de habilidades psicológicas en el tiempo de reacción y el pensamiento estratégico en el bádminton de competición. Como tal, el estudio busca identificar y evaluar la evidencia existente con respecto a la eficacia del entrenamiento de habilidades psicológicas en la mejora de estos dos componentes críticos y sus implicaciones para mejorar el rendimiento de los atletas en el campo. Materiales y métodos: Este estudio es una revisión sistemática que sigue las directrices PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Los artículos de investigación publicados durante un año determinado y relevantes para este tema se recopilan de varias bases de datos académicas, incluyendo PubMed, Scopus y Google Scholar. Los estudios que cumplieron los criterios de inclusión fueron aquellos que exploraron el entrenamiento de habilidades psicológicas en el contexto del bádminton o deportes similares y que evaluaron el impacto sobre el tiempo de reacción y el pensamiento estratégico. Se aplicaron criterios de exclusión a los estudios irrelevantes que no disponían de suficientes datos empíricos o que utilizaban poblaciones no atletas. El proceso de selección de estudios incluye el cribado del título y el resumen, seguido de un análisis del texto completo de los artículos elegibles. Se analizaron y sintetizaron los datos de cada estudio que cumplía los criterios para evaluar la coherencia de los hallazgos y proporcionar una imagen completa de los efectos del entrenamiento de habilidades psicológicas. Resultados: La mayoría de los estudios revisados mostraron que el entrenamiento en habilidades psicológicas tuvo un impacto positivo en el tiempo de reacción de los atletas de bádminton. El entrenamiento en técnicas de relajación, concentración y visualización ha demostrado su eficacia para ayudar a los deportistas a acortar el tiempo de reacción a los estímulos del juego. Además, las capacidades de toma de decisiones estratégicas en el campo también han mejorado significativamente mediante la aplicación de habilidades psicológicas, especialmente cuando los atletas se enfrentan a situaciones de alta presión. Estos estudios también demuestran que el entrenamiento en habilidades psicológicas mejora el rendimiento físico y ayuda a los deportistas a controlar la ansiedad y a aumentar la confianza en sí mismos, lo que repercute en la calidad de las decisiones tácticas tomadas durante los partidos.
Conclusiones: Según los resultados de esta revisión sistemática, el entrenamiento de habilidades psicológicas mejora significativamente el tiempo de reacción y el pensamiento estratégico en el bádminton de competición. Técnicas como la visualización, el control del estrés y el enfoque de la atención influyen en la rapidez de reacción y la toma de decisiones en el campo. Por lo tanto, la integración del entrenamiento de habilidades psicológicas en los programas de entrenamiento de los atletas de bádminton puede mejorar eficazmente el rendimiento competitivo. Se necesitan más investigaciones para explorar la aplicación a largo plazo de este entrenamiento y su eficacia en diferentes niveles de competición.
Palabras clave: Entrenamiento en habilidades psicológicas, tiempo de reacción, pensamiento estratégico, bádminton competitivo, revisión sistemática

Fecha recepción: 20-10-24. Fecha de aceptación: 03-11-24
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Introduction

Badminton is among the most popular sports worldwide, especially in Southeast and East Asia. The sport demands a unique combination of speed, agility, strength, endurance and excellent eye-hand coordination (Bakhtiar et al., 2023; Phomsoupha & Laffaye, 2015). In a competitive context, badminton not only relies on physical and technical abilities but also heavily on the players' mental and psychological aspects.This research is based on the assumption that psychological skills play an essential role in athlete performance, especially in fast-paced sports such as badminton. Quick reactions and strategic decision-making are considered skills that require physical readiness and

optimal mental readiness to maintain consistency and accuracy under stressful match conditions. The ability to maintain focus, manage stress, and make quick decisions in high-pressure situations are crucial factors that can determine the outcome of a match.

Psychological skills have long been recognized as an integral component in the performance of athletes in various sports, including badminton. This mental aspect includes various abilities such as visualization, goal setting, anxiety management, attention focus, and emotional control. Research shows that athletes with good psychological skills tend to perform more consistently and cope with the pressure of competition more effectively (Park & Jeon, 2023). In the context of badminton, where a match can change drastically in a matter of seconds, the ability to maintain mental calm and focus is crucial.

Reaction time is one of the critical factors in competitive badminton. Defined as the interval between the presentation of a stimulus and the initiation of a motor response, reaction time plays a vital role in various aspects of the game, such as receiving serves, returning smashes, or making intercepts. Players with faster reaction times have a significant competitive advantage, as they can respond more efficiently to their opponent's movements and changes in the shuttlecock. Previous studies have shown that reaction time can be affected by a variety of psychological factors, including anxiety levels, focus of attention, and mental readiness (Rossi et al., 2022). Several previous studies have shown that psychological skills, such as anxiety management, attentional focus, and visualization, can accelerate athletes' reaction time in the face of changing situations on the field. (Corrado et al., 2024) concluded that athletes with better psychological skills react faster, especially in fast-paced sports such as badminton.

Meanwhile, strategic thinking refers to the player's ability to analyze the game situation, anticipate the opponent's actions, and make appropriate tactical decisions quickly. This cognitive aspect involves complex information processing processes, including perception, decision-making, and motor execution. In badminton, strategic thinking includes reading the opponent's game patterns, identifying weaknesses, and adjusting tactics during the match. Players with superior strategic thinking can manipulate the game's flow and create profitable opportunities for themselves.

Psychological skills training has become essential to athlete development programs in various sports. This study's novelty lies in the focus on psychological skills training and its impact on reaction time and strategic thinking in the context of competitive badminton, which has been under-researched. This study provides a new perspective on how mental training can be integrated with physical exercise to improve competitive performance in a sport with rapid situational changes such as badminton.This intervention aims to improve the mental aspects of athletes, which in turn is expected to improve their physical and technical performance. In badminton, several studies have investigated the effectiveness of various mental training techniques, such as visualization, positive self-talk, and relaxation techniques. However, the specific influence of psychological skills training on reaction time and strategic thinking in badminton still needs to be fully understood.

This systematic review aims to review and synthesize the existing literature on the influence of psychological skills training on reaction time and strategic thinking in competitive badminton. Understanding the relationship between psychological interventions and these performance-critical aspects is hoped to provide valuable insights for coaches, athletes, and sports practitioners in optimizing badminton player training and development programs. Furthermore, the review aims to identify gaps in current knowledge and provide direction for future research in sports psychology and badminton performance. The research questions that will be answered through this systematic review are:

1. How does psychological skills training affect the reaction time of competitive badminton players?
2. To what extent does psychological skills training influence strategic thinking in competitive badminton?
3. What type of psychological skills training is most effective in improving badminton players' reaction time and strategic thinking?
4. Are there differences in the effectiveness of psychological skills training based on the player's skill level or other demographic factors?

By answering these questions, this systematic review is expected to significantly contribute to our understanding of the role of psychological skills in improving critical aspects of badminton performance. The results of this review can have practical implications that are important for developing more effective and holistic training programs for badminton players at different levels of competition.

Research methodology

Study Design

This study uses a systematic review design to evaluate the effect of psychological skills training on reaction time and strategic thinking in competitive badminton. Systematic reviews were chosen to synthesize findings from relevant studies, providing a comprehensive picture of the relationship between psychological interventions and athlete performance. The study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and accuracy in searching, selecting, and processing data.

The search process includes using focused keywords, such as psychological skills training, reaction time, strategic thinking, and badminton. The selected studies included a variety of research designs (quantitative and qualitative) that directly addressed psychological skills training in badminton athletes or similar competitive

sports. Through this systematic review, the research integrates findings from previous studies to provide deeper insights into the effectiveness of psychological skills training.

Inclusion and exclusion criteria

To ensure the relevance and quality of the studies to be analysed in this systematic review, the inclusion and exclusion criteria are applied. This criterion filters research on the influence of psychological skills training on reaction time and strategic thinking in competitive badminton.

Table 1.
Inclusion and exclusion

Criterion	Inclusion	Exclusion
Type of Study	An experimental, quasi-experimental, or observational study that evaluates psychological training.	Theoretical studies, narrative reviews, opinion articles, editorials, or those that are not based on empirical data.
Research Subject	Badminton athletes (professional or amateur) who participate in competitions.	Non-athlete populations or those that are not focused on competitive athletes (e.g., recreational participants).
Intervention	Training of psychological skills (emotional regulation, visualization, attention focus, etc.).	Studies that did not include psychological training as the main intervention.
Key Results	Studies that measure the effects of psychological interventions on reaction time or strategic thinking.	Studies that did not measure reaction time or strategic thinking, or focus on other aspects.
Publication Time	Studies published in the last 10 years.	The study was published more than 10 years ago.
Language	Articles in English	Articles in languages other than English
Publication Type	tudi published in peer-reviewed journals or conference proceedings.	Studies that were not published in peer-reviewed journals or unofficial reports.

Data source

In this study, the data sources used include several central databases to ensure the completeness and relevance of the information. Databases such as PubMed and Scopus were chosen as the primary sources because they both provide access to peer-reviewed journals discussing sports psychology and athlete performance. In addition, Google Scholar and Web of Science are also used to search for articles, books, and conference papers related to this topic. The search process uses relevant keywords, such as psychological skills training, reaction time, strategic thinking, badminton, and competitive sports, with variations and combinations to obtain comprehensive results. The search is focused on studies published between 2014 and 2024 to ensure that only the most recent articles are included. The initial selection is carried out by examining the title and abstract of the article to determine its relevance, followed by an in-depth reading of the article that meets the inclusion criteria. All selected articles are recorded in a spreadsheet for easy monitoring and further analysis, ensuring the integrity and reliability of the information used in this systematic review.

Quality assessment was conducted using strict criteria, which included methodological validity, topic relevance, and the quality of data presented in the literature. Each selected study was evaluated against a standardized assessment tool that considered methodological aspects and potential bias to ensure only quality studies were included in this review.

Data extraction was systematically performed to collect relevant information from each study, including primary outcomes, effect sizes, and associated variables. The extracted data were then analyzed descriptively and comparatively to identify patterns of findings and ensure consistency of results across the included studies. The analysis process included synthesizing the research results to gain a comprehensive picture of the effects of psychological skills training on badminton athletes' performance.

Data collection procedures

The data collection procedure begins with searching for relevant articles in several scientific databases, such as PubMed, Scopus, and Google Scholar. In this process, the keywords used include a combination of phrases such as psychological skills training, badminton, reaction time, strategic thinking, and competitive sports, using Boolean operators (AND, OR, NOT) to narrow or expand the search results as needed. After obtaining the article, the first step is the selection based on the title and abstract, in which articles that are not relevant to the context of competitive badminton and psychological skills training are eliminated. Articles deemed relevant are then considered for further analysis by reading the complete text, ensuring that they meet the inclusion criteria and do not violate the exclusion criteria, including the methodological aspects and the population studied.

Two independent researchers carry out the selection process to minimize bias. If there is a difference of opinion regarding the feasibility of the article, discussions are conducted to reach an agreement, even involving a third researcher if necessary. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method is used to organize the data collection process, which includes a PRISMA diagram to illustrate the article selection flow, including the number of articles found, eliminated, and the reasons for elimination at each stage. In addition to a direct search in the database, references from the selected articles are also checked to find relevant additional studies. After the final selection, all articles that met the inclusion criteria were compiled and prepared for further analysis in the data synthesis stage, ensuring that only quality and relevant studies were included in the systematic review.

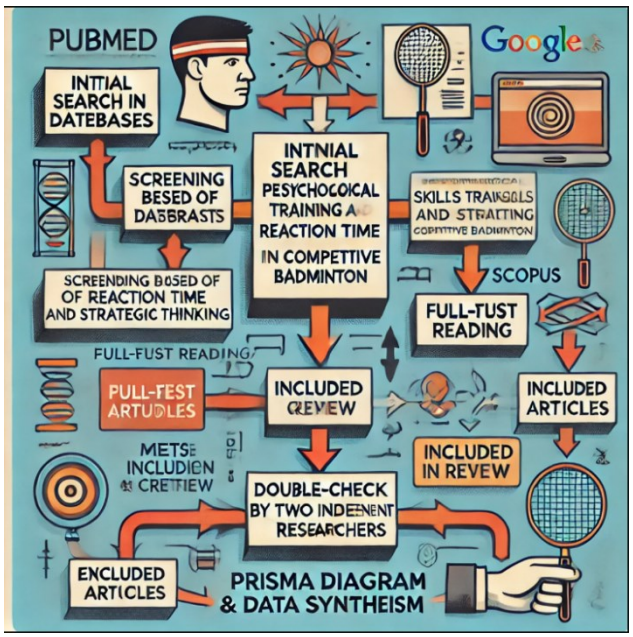

Figure 1. Data collection procedures

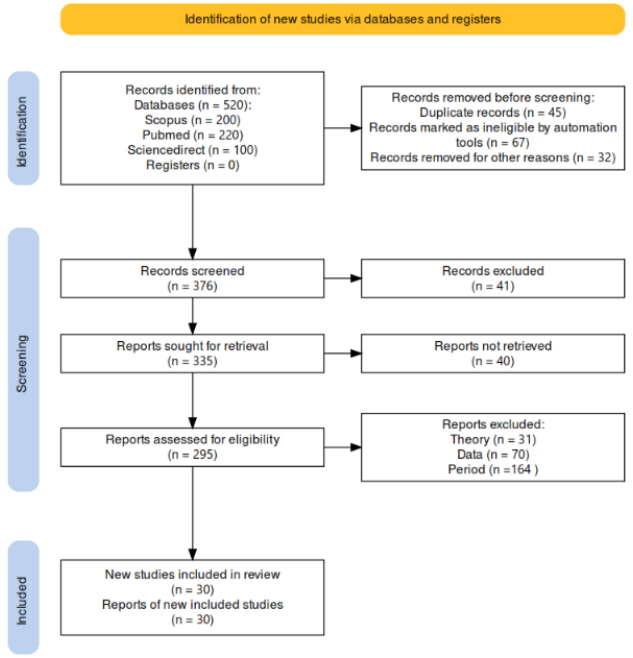

Figure 1. Selection process with PRISMA method

Literature review

Psychological Skills in Sports

Psychological skills in sports refer to the mental abilities necessary to improve an athlete's performance and facilitate self-control in competitive situations. These skills include various psychological aspects that help athletes manage pressure, maintain focus, and make informed decisions during matches. In this context, psychological skills are crucial not only for achieving success but also for maintaining the mental well-being of athletes. According to (Marheni et al., 2023; Nam, Kim, & Cho, 2022), Psychological skills involve mental strategies to improve sports performance, improve concentration, and regulate emotions and thoughts. Athletes who master psychological skills tend to have a more significant competitive advantage than those who do not focus on this aspect.

The role of psychological skills has become increasingly important in the modern era of sports, where competition is getting tighter and pressure from various sides, including the media, fans, and sponsors, is increasing. Psychological skills help athletes not only to survive in difficult situations but also to perform to the maximum. This is in line with research that shows that mental abilities can contribute to the final result of the competition (Lin, Mutz, Clough, & Papageorgiou, 2017). Therefore, psychological skills training, which involves a systematic process of assessment, goal setting, and practice, should be an integral part of an athlete's training program, just as important as physical and technical training.

Psychological skills in sports can be divided into several types, each contributing to an athlete's performance in various ways. Here are some of the types of psychological skills that are often identified in sports research and practice.

Focus and Concentration

Focus and concentration are critical psychological skills in sports, especially in competitions that require quick reactions and precision, such as badminton. Focus refers to the ability to concentrate on one specific aspect, while concentration is the ability to maintain that focus for long periods despite external and internal distractions.

In badminton, focus and concentration help athletes stay connected with the game and their opponents. When players fully concentrate on the game, they can better read the opponent's movements, respond appropriately, and make the right strategic decisions. Research shows that athletes who have good concentration skills tend to show more stable performance and excel in matches (X. Wang et al., 2023).

Various techniques can be used to improve focus and concentration. One method often used is the deep breathing technique, which helps calm the mind and reduce anxiety. In addition, mindfulness or mindfulness exercises can help athletes stay present and focused on the present moment, avoiding negative thoughts or outside distractions.

Through regular concentration exercises, athletes can learn to manage distractions that arise during competitions. For example, the noise of the spectators, the pressure of the expected outcome, or even self-doubt can distract the athlete from the game. With the development of concentration skills, athletes can better cope with the situation and stay focused on their goals.

Good focus can also improve the playing experience. When athletes are fully engaged and focused, they are more likely to experience a state of "flow," which is a state in which a person feels immersed in the activity being performed. Time noticeably slows down in these circumstances, and athletes can function at optimal performance levels. Thus, focus and concentration are skills

that help improve performance and contribute to overall satisfaction and experience in sports. Athletes trained in these skills will be better prepared to face the challenges of competition and perform more effectively.

Visualization and Imagination

Visualization is a mental technique used by many athletes to improve their performance. This technique involves creating a mental image of the movement, strategy, or technique you want to perform. In badminton, visualization can be used to plan moves, describe game scenarios, and prepare for various possibilities on the court.

The benefits of visualization are not only limited to technical aspects but also include the development of emotional and mental aspects. According to research, effective visualization can increase confidence and reduce anxiety before a game. When athletes imagine themselves succeeding in stressful situations, they can create positive emotional experiences that help them feel better prepared during the competition.

Visualization can be approached in various ways, offering athletes a versatile toolkit for mental preparation. Whether it's imagining oneself in a match situation, describing the right moves, or evoking positive emotions when executing a desired punch or strategy, the key is to engage all senses. This adaptability makes the visualization process more comprehensive and effective, enhancing athletes' resourcefulness.

Visualization is not just a pre-game tool but also a powerful aid in recovery after an injury. Athletes often face anxiety about their return to the field after an injury. However, by engaging in positive visualizations, they can envision themselves training and competing well, fostering a sense of hope and optimism that can significantly aid recovery.

Studies show that visualization increases confidence, improves motor coordination, and optimizes physical performance (Arnando et al., 2024; Behrendt et al., 2021). By practising visualization regularly, athletes can strengthen the connection between mind and body, ultimately contributing to better performance on the field.

Through consistent visualization exercises, badminton athletes can better prepare themselves for diverse competition situations and feel more confident in their ability to succeed.

Emotional Control

Emotional control is an invaluable psychological skill in sports, especially in stressful competitive situations. In badminton, athletes often face moments of stress, tension, and high expectations, which can trigger various emotions, such as anxiety, frustration, or anger. Managing these emotions well can be a decisive factor in performance on the field.

Controlling emotions helps athletes to stay calm and focused even in stressful situations. Athletes who can control their feelings tend to make better decisions and show more stable performance. According to (Tamminga et al., 2023), Emotional management skills can be improved through proper training, including relaxation techniques, stress management, and problem-solving strategies.

One of the most effective techniques for managing emotions is breathing exercises. By taking deep and slow breaths, athletes can experience a sense of relief, easing tension and reducing anxiety. This technique helps to shift focus from negative thoughts and refocus on the present moment, creating a sense of calm and ease.

Self-awareness is a powerful tool in emotional control. It's about understanding your emotions and their impact on your performance. It's about being prepared for difficult situations. For example, if an athlete realizes that they tend to feel frustrated after losing points, they can develop a strategy to stay calm and focus on the next move. This sense of control can make all the difference in a game.

Emotional control training can also include simulations of competitive situations where athletes can practice managing their emotions in more stressful conditions. By practising in such situations, they can develop skills to deal with stress and pressure in real matches.

Controlling emotions helps improve athletes' performance and contributes to their mental well-being. Athletes who can manage their feelings well tend to experience lower stress levels and enjoy the experience of competing more. Therefore, emotion control training is essential to preparing athletes to face challenges on the field.

Motivation and Mindset

Motivation is a critical factor in achieving optimal sports performance. In badminton, motivation encourages athletes to train consistently, put in the effort, and constantly improve their skills. Motivation can be divided into two main types: intrinsic and extrinsic motivation. Intrinsic motivation comes from within the athlete, such as satisfaction from achieving a goal or love for the sport. In contrast, extrinsic motivation comes from external factors, such as awards, recognition, or competition results.

According to the expectancy theory proposed by Vroom (1964) in (W. Wang & Asniza, 2023), individuals are motivated to act if they believe that their efforts will result in success. In badminton, athletes with high expectations for positive results are likelier to commit to training and preparation.

Mindset also plays a vital role in athlete motivation. Distinguish between two types of mindsets: fixed mindset and growth mindset. Athletes with a fixed mindset tend to believe their abilities are innate and unchangeable, so they are more susceptible to stress and loss of motivation when facing challenges. In contrast, athletes with a growth mindset believe they can improve their skills through effort and learning. This mindset helps them stay motivated despite failure. Training to increase motivation and mindset can be done through various approaches, such as setting

realistic goals, providing positive feedback, and creating a supportive environment. Setting clear and measurable goals can provide direction for athletes, while positive feedback from coaches and teammates can boost their confidence.

By developing strong motivation and a positive mindset, athletes can improve their performance in badminton and enjoy the process of training and competition. High motivation helps athletes to stay focused on their goals and overcome obstacles that may arise along the way.

Social and Communication Skills

Social and communication skills are essential aspects of psychological skills in sports. The ability to interact and communicate well with coaches, teammates, and opponents can affect team dynamics and individual performance. Social skills become vital in badminton, where communication is often the key to a team's success.

Communication skills include the ability to convey ideas and feelings clearly, as well as the ability to listen and respond well. Athletes with good communication skills can effectively give and receive feedback, resolve conflicts, and build positive relationships with others. Research shows that effective communication within a team can improve collective performance (Carron & Eys, 2012)(Barlian, Umar, & Dewata, 2024).

Coaches play a crucial role in developing athletes' social and communication skills. Through exercises that involve teamwork, coaches can help athletes learn how to communicate effectively on the field. These include verbal skills, such as providing clear directions, and non-verbal skills, such as using hand gestures to communicate during matches.

Building a good relationship between coaches and athletes is essential to create a supportive environment. When athletes feel valued and supported by coaches and teammates, they tend to be more motivated and better equipped to contribute to the team's success.

Social skills also encompass the ability to comprehend team dynamics and adapt to different roles. In badminton, particularly in doubles, understanding the role of each player and how to collaborate effectively is the key to achieving victory. This understanding can make you a more insightful and knowledgeable player.

Therefore, the development of social and communication skills should be the primary focus in athlete training. By enhancing these skills, athletes can function more effectively in a team environment, which will ultimately lead to success on the field. This emphasis on skill development can make you feel empowered and capable as an athlete.

Mental Resilience

Mental resilience is the ability to bounce back from failure and face challenges positively. In badminton, mental resilience is essential, especially since the sport often involves high pressure and uncertainty of outcomes. Athletes who have mental resilience can stay motivated despite facing difficulties, such as losing a match or getting injured. For instance, [insert specific example of a badminton athlete who demonstrated mental resilience in a challenging situation].

Mental resilience includes several elements, including managing stress, maintaining focus, and having a positive attitude towards challenges. Research by (Oh, Sarwar, & Pervez, 2022; Sepdanius et al., 2024) shows that mental resilience can be improved through practice and experience. This exercise may include simulated situations where athletes face pressure and challenges so that they can practice dealing with those conditions positively.

One way to build mental resilience is through developing emotional control skills. Athletes who manage their emotions well are better prepared to face difficult situations and stay calm under pressure. Exercises that involve breathing techniques and meditation can help improve mental resilience.

In addition, having a growth mindset can also contribute to mental resilience. Athletes who believe they can learn from failures and continue to improve are more likely to bounce back from setbacks. In badminton, a player who loses a match can see it as an opportunity to learn and improve their skills, rather than feeling hopeless.

Mental resilience not only assists athletes in achieving their sporting goals but also provides long-term benefits for overall mental well-being. Mentally strong athletes are better able to cope with pressure, manage stress, and maintain a positive spirit throughout their journey. Moreover, [insert specific long-term benefit of mental resilience for athletes].

Thus, the development of mental resilience should be an integral part of the athlete's training program. Through exercises that focus on stress management, emotional control, and the development of a positive mindset, badminton athletes can improve their mental resilience, which will be very helpful in facing challenges on the court.

Reaction Time in Badminton

Reaction time is one of the critical aspects in sports that demand speed, such as badminton. In this game, players must respond quickly to various situations, from the opponent's serve to sudden attacks that require an instantaneous physical and mental response. Reaction time refers to the period it takes an athlete to respond to a stimulus, whether it's visual (seeing the direction of the shuttlecock), auditory (hearing the movement of the opponent or the sound of the racket), or kinesthetic (feeling the movement of the body in space). In badminton, optimal reaction time allows players to anticipate, react, and act appropriately in various dynamic situations on the court.

Reaction time is the crucial interval between a stimulus's presentation and a response's initiation. In badminton, stimuli can take the form of the shuttlecock's direction, the speed of the ball, and the opponent's movement patterns. Research indicates that visual reaction time is the most significant aspect of badminton, given the

game's reliance on high visual speed (Hülsdünker, Riedel, Käsbauer, Ruhnow, & Mierau, 2021). As a game often decided in milliseconds, a player's ability to swiftly and accurately respond to the opponent's movement or the shuttlecock's direction is crucial to the match's outcome.

The importance of reaction time in badminton is undeniable. Any move that is a little late can result in a loss of points or even a match. In addition, badminton is a sport that requires a quick response to the direction and speed of the shuttlecock changing quickly. Players must have a quick reaction time to receive serves, smash or return the ball in a way that can maintain control of the game. Players with faster reaction times tend to have an advantage in matches than players with slower reaction times, as they can better anticipate and adjust their movements to the opponent's actions.

Several factors influence a badminton player's reaction time, spanning physical, mental, and environmental aspects. These factors can significantly impact an athlete's performance on the court, particularly in determining their ability to react swiftly to the game's ever-changing dynamics.

Physical Factors

Physical Condition and Exercise: Optimal physical condition and an adequate exercise program can help improve reaction time. Physical exercises designed to improve speed, strength, and precision of movement can significantly impact a player's reaction speed. Study by (Wong et al., 2019) showed that physical exercises focusing on speed and agility can improve players' responses to visual stimuli in badminton.

Age: Research has also shown that age can affect reaction time. Younger players typically have faster reaction times than older players, as the central nervous system's ability to process information and respond quickly tends to decline with age. Still, proper training can extend this ability to more experienced players.

Mental Factors

Concentration and Focus: In badminton, players must stay focused and maintain concentration during the match to respond quickly to any opponent's moves. Players who can maintain complete focus during the game react faster. Research shows that athletes who are better able to maintain concentration under pressure have an advantage in terms of reaction time, especially when facing urgent situations (de Brito et al., 2022).

Decision-Making Skills: Besides physical speed, the player's ability to make quick and informed decisions also affects reaction time. Players who can process information quickly and choose the correct response will have a strategic advantage. This is known as decision-making speed. Research by (Ötting et al., 2020) states that more experienced players usually have better decision-making abilities, as their experience allows them to recognize game patterns more quickly.

Environmental Factors

Game Conditions: Field conditions, lighting, and ambient atmosphere can affect a player's ability to respond quickly. For example, poor lighting or distractions from the audience can disrupt the player's focus and slow their reaction time.

Shuttlecock Speed: In badminton, shuttlecock speeds can reach 400 km/h on multiple strokes, such as smashes. This high-speed shuttlecock speed forces players to react in seconds, making reaction time crucial to return the punch precisely.

Several studies have highlighted the importance of reaction time in sports such as badminton and other sports that involve quick responses. One of the classic studies by Abernethy and Russell (1987) demonstrated that reaction time is not just a measure of how quickly a player can respond but also a predictor of their overall performance in the game. (Chia, Burns, Barrett, & Chow, 2017) They identified that high-level badminton players have a much faster reaction time than amateur players. They argue that the ability of elite players to read the game and react quickly to opponents' movements is the result of a combination of intense mental and physical training.

Other research by (Simon Lange-Smith Josephine Cabot & Tod, 2024) It confirms that badminton players who undergo psychological skills training, such as visualization and focus exercises, significantly improve their reaction time compared to players who focus solely on physical training. The study shows that developing psychological skills is essential for improving performance on the field, especially when it comes to quick reactions to match situations.

One critical training method for improving badminton players' reaction time is plyometric exercises. These exercises, which focus on increasing the strength and speed of explosive movements, are crucial in badminton. By emphasizing rapid muscle contractions, such as jumps and sprints, plyometrics can significantly enhance players' reaction times.

In addition, visual exercises are also efficient in improving reaction time. This exercise involves using visualization techniques and rapid response exercises to visual stimuli, such as using visual training devices specifically designed to increase the reaction speed to visual stimuli. Research shows that athletes who undergo visualization training improve their ability to respond quickly and appropriately to stimuli, which positively impacts their performance in badminton (Theofilou et al., 2022).

Overall, reaction time is a critical element of badminton performance. Various factors, including physical condition, mental concentration, and environmental conditions, contribute to how quickly a player can respond to situations on the field. With proper physical and psychological training, players' reaction time can be significantly improved, ultimately increasing their chances of excelling in the match. Existing studies show the importance of

integrating physical and psychological exercise in developing faster reaction times, which is especially important in the game of badminton, which is full of pressure and dynamics.

Strategic Thinking in Badminton

Strategic thinking is the ability to plan, anticipate, and react to situations that occur in the game in a quick and precise way. In badminton, strategic thinking involves various decisions made by players in seconds to control the game's tempo and defeat the opponent. This thinking is essential because badminton is a swift sport, where the ball (shuttlecock) can move to speeds of more than 300 km/h, and every stroke or step a player takes significantly affects the match's outcome.

Strategic thinking in badminton can be defined as the ability to combine quick tactical and technical decisions based on the situation of the game. For instance, a player might choose to play a drop shot when the opponent is out of position, or a smash when the opponent is deep in their court. This includes an understanding of the opponent's strengths and weaknesses, the opponent's position on the field, and one's own physical and mental condition during the match. Strategic thinking is not only based on physical ability, but also on how players use the information gained during the game to make smart and effective decisions.

According to (Moreno-Perez et al., 2020) Strategic thinking allows badminton players to actively influence the course of the match, force opponents into disadvantageous positions, and create opportunities to finish the rally with victory. It is a cognitive process that involves analyzing the situation, evaluating risks, and having the ability to think a few steps ahead, similar to a game of chess, but with much higher time and physical pressure.

Decision-making in badminton is very dynamic and takes place in a short period. Players must make decisions based on limited information, such as the opponent's position, the direction of movement, and the speed and direction of the shuttlecock. These decisions involve two main components: tactical decisions and technical decisions.

Tactical decisions refer to the overall strategy in the game. This includes choosing a style of play (offensive or defensive), choosing an area of the field to attack the opponent, and how to manage stamina during the match. Players must also determine when to play more aggressively or conservatively, depending on the opponent's conditions or the game phase.

Technical decisions involve choosing a specific punch or move based on the situation at hand. For example, the player may have to decide whether to smash, drop shot, or lob based on the opponent's position and ability to return the shuttlecock effectively. Mastery of technical skills is crucial to ensure that the tactical choices taken can be executed perfectly, underscoring the need for continuous practice and improvement. In the study of sports psychology, decision-making in fast sports such as badminton is often explained through the theory of information processes. This theory states that an athlete uses three main stages in decision-making: perception, analysis, and action. Players must quickly observe the opponent's actions, analyze relevant information (such as the opponent's position and path of the ball), and then take appropriate action to win the rally. In badminton, the accuracy of this decision-making is significantly influenced by the experience, practice, and mental abilities of the players, highlighting the value of these factors in the game.

Various factors can affect a player's ability to make good strategic decisions on the field. Here are some of the critical factors:

a) Experience: More experienced players can better anticipate opponents' actions based on previous game patterns. They are also quicker at recognizing favourable situations and making decisions based on experience. According to research, experienced players are better able to identify patterns in the game and process relevant information than less skilled players.

b) Mental Training: The path to strategic thinking is paved with systematic mental training. Techniques like visualization and imagery serve as a practice ground for players to hone their strategy and decision-making skills in simulated scenarios. The research is clear that those who regularly engage in mental visualization demonstrate superior abilities in making quick and precise decisions on the field.

c) Focus and Concentration: Strategic thinking requires a high level of focus. Players must be able to ignore external distractions and concentrate on the game to analyze the situation quickly. Concentration control is one of the main psychological skills that influence strategic thinking. Disturbances in concentration can lead to wrong decisions, such as inaccurate punches or poor strikes.

d) Physical and Mental Stamina**:** A player's physical and mental condition during a match also dramatically affects the ability to think strategically. When players experience physical fatigue, they are more likely to make wrong decisions because reaction speed and focus are reduced. Additionally, emotional tension or stress during a match can degrade the quality of decision-making. Emotion management is integral to strategic thinking, as uncontrolled emotions can hinder a player's ability to reason under pressure.

Several studies have examined the influence of strategic thinking on athletes' performance in badminton. For example, research by (Lex, Essig, Knoblauch, & Schack, 2015) Found that players who had good mental skills, such as concentration control and stress management, tended to have better abilities in making strategic decisions on the field. Players who maintain focus under pressure can better evaluate the situation and choose the right tactics to exploit the opponent's weaknesses.

In addition, research by (Rusmana et al., 2023) Training in simulated situations that mimic the pressure of the actual game is a key factor in developing sharp strategic thinking

in badminton. This kind of training helps players recognize game patterns and make quick and accurate decisions, giving them an edge during the game.

Good strategic thinking is a game-changer in competitive badminton. It allows players to think a few moves ahead of their opponents and quickly adapt their strategy based on the evolving situation, giving them a significant advantage in the game.

In doubles games, strategic thinking involves effective communication between pairs of players, as well as the ability to change strategies together based on the opponent's response. Players with a solid strategic mindset can better manipulate the course of the game, such as forcing opponents into disadvantageous positions and creating openings for attacks.

Strategic thinking in badminton is an essential cognitive skill and can significantly affect the match's outcome. Factors such as experience, mental training, focus, and physical stamina significantly influence a player's ability to make quick and effective decisions. Players with sound strategic thinking skills can anticipate the opponent's moves, take calculated risks, and adjust strategies according to court conditions. Thus, this training that emphasizes the development of cognitive skills is essential for badminton athletes who want to compete at a high competitive level.

The Effect of Psychological Skills on Athletes

Psychological skills training is increasingly a concern in sports, including badminton, because it improves athletes' overall performance. In a game requiring speed, precision, and quick decision-making like badminton, the physical aspect often must be improved to win the match. Psychological skills support this physical aspect, especially in regulating focus, controlling emotions, and improving reaction time and strategic thinking.

Positive Impact of Psychological Skills Training

Effective psychological skills training can help athletes develop calmness, focus, as well as the ability to deal with pressure in competitive situations. According to (Pérez-Montilla, Cuevas-Cervera, González-Muñoz, García-Ríos, & Navarro-Ledesma, 2022) Psychological skills like anxiety control, motivation regulation, and concentration development can significantly improve athletes' performance. In badminton, where athletes often have to respond quickly to changes in the situation on the court, this skill can provide a substantial competitive advantage.

Focus and concentration, two of the most important psychological skills in badminton, are not just about staying in the game, but about building resilience. Athletes must be able to maintain full concentration for long periods, despite the fast-paced and intense nature of the match. This trained focus allows them to ignore distractions and build mental endurance, reducing vulnerability to stress and fatigue. In this way, psychological skills make athletes feel more prepared and less vulnerable under pressure. In addition, visualization and imagination skills also play a role in preparing athletes mentally to face competitive situations. Through visualization exercises, athletes can imagine various scenarios during the game and how they will respond. This technique can help improve mental readiness so that they are not easily surprised or emotionally burdened when faced with an actual situation. Study by (Fadare, Lambaco, Mangorsi, Louise, & Juvenmile, 2022) It shows that athletes who use visualization techniques tend to be more mentally prepared and able to control their reactions in the match.

Effect of Psychological Skills on Reaction Time

One of the essential components in badminton is reaction time, an athlete's speed in responding to the opponent's movements or changes in the situation on the court. Psychological skills are essential in speeding up reaction time, as better concentration allows athletes to read situations more quickly and accurately. Athletes can better predict their opponent's movements and react rapidly to the shuttlecock when focused.

Study by (Ihsan, Nasrulloh, Nugroho, & Kozina, 2024; Migliaccio et al., 2022) It's important to note that reaction time is not solely dependent on the physical capacity of the athlete, but is also significantly influenced by mental readiness. Athletes who are anxious or lose focus tend to have slower reaction times, as their minds are divided between external and internal factors. Therefore, training skills such as stress and anxiety management, which can include techniques like deep breathing, visualization, or mindfulness, can significantly improve an athlete's reaction time. These techniques help keep athletes calm and focused even in the most stressful situations, thereby enhancing their performance.

Emotional control also plays a role in improving reaction time. When athletes can manage their emotions, they can maintain their composure during the game, essential for maintaining concentration and making quick decisions. If a player is affected by negative emotions such as anger or frustration, their reaction time can be disrupted, leading to wrong or late choices. Athletes who can control their emotions tend to perform better in stressful competitive situations, including speeding up their reaction times.

The Effect of Psychological Skills on Strategic Thinking

Strategic thinking is an athlete's ability to make the right decisions under pressure, assess the situation on the field, and adjust the game strategy according to the problem. In badminton, strategic choices must be made in seconds, requiring optimal mental readiness. Psychological skills, such as focus, stress management, and adaptability, ensure that athletes can make quick and informed decisions during the game.

The ability to think strategically is heavily influenced by the athlete's ability to manage pressure and maintain peace of mind. In badminton, this includes the ability to read opponents' game patterns, anticipate their moves, and

adjust game strategies quickly. However, psychological skills are pivotal in maintaining focus during the match, reassuring athletes that they can think more clearly and logically even under pressure.

Additionally, mental training involving techniques such as meditation or mindfulness can help improve athletes' strategic thinking skills. This technique helps athletes stay calm and focused, ultimately allowing them to make strategic decisions more effectively. Study by (Ihsan, Nasrulloh, Nugroho, & Yuniana, 2024; Oudejans, Kuijpers, Kooijman, & Bakker, 2011) they mentioned that athletes who practice mindfulness tend to be more able to focus on the current situation to make better decisions under pressure..

Studies Related to Psychological Skills Training

Several empirical studies have shown the positive impact of psychological skills training on athlete performance. Athletes who underwent psychological skills training, such as visualization, goal setting, and relaxation techniques, significantly improved their performance during the game. In the context of badminton, the ability to stay calm and focused under pressure can make a big difference between winning and losing.

On the other hand (Ihsan, Kozina, Sukendro, Nasrulloh, & Hidayat, 2024; Park & Jeon, 2023) Examining the factors contributing to mental toughness in elite athletes, they found that psychological skills such as stress management and adaptability are strong predictors of consistent performance at the highest levels of competition. This shows that psychological skills training is beneficial in the short term and can provide long-term advantages in building athletes' mental resilience.

Psychological Skills Training Methods

Psychological skills training can be done through various methods, depending on the athlete's individual needs and the type of sport they are participating in. In badminton, the most common approach involves visualization training, anxiety management, and focus techniques. For example, athletes can be trained to use pre-game visualization, imagining different scenarios on the field and planning the best response to each situation. This technique helps to improve mental readiness and reduce anxiety before the game.

Relaxation and breathing techniques are also often used to help athletes manage anxiety and stress during games. Progressive muscle relaxation and deep breathing exercises can help calm the mind, essential for maintaining focus and optimizing reaction time. In the long run, this exercise reduces stress and increases athletes' mental endurance.

Overall, psychological skills training is an important aspect that should be considered in developing competitive badminton athletes. A combination of skills such as emotional control, focus, and strategic thinking can significantly improve performance in reaction time and decision-making. Research and practice continue to support the importance of integrating psychological training with physical training to achieve optimal performance at the highest level of competition.

Conclusion of the Literature Review

From the literature review that has been discussed, psychological skills significantly influence athletes' performance, especially in competitive sports such as badminton. These skills include various mental aspects that play a vital role in an athlete's ability to respond quickly to situations and think strategically on the field. Psychological skills, such as focus, concentration, emotional control, and visualization, can positively impact athletes' physical performance, decision-making and reaction time.

Studies examining reaction time in badminton show that the ability to respond quickly to stimuli on the court is crucial in competition, mainly due to the demanding nature of badminton with speed and precision. Physical and mental factors affect an athlete's reaction time, and the right psychological skills are needed to minimize this reaction time. Rapid reactions are directly related to athletes' performance in various sports, including badminton, where psychological skills such as concentration can speed up responses to rapidly changing situations on the court. The study confirms that psychological training focused on stress control and increased alertness can result in better reaction times.

Furthermore, in strategic thinking, making the right decisions quickly is essential in competitive badminton. Strategic thinking in badminton is related to technical knowledge and the mental ability to understand and anticipate the opponent's movements. Athletes with quick and accurate decision-making abilities develop psychological skills through cognitive training and competitive experience. Developing strategic thinking skills through mental exercises such as match simulations and visualizations can assist athletes in setting strategies and executing the right actions in the game.

Psychological skills are proven to affect athletes' abilities in terms of reaction time and strategic thinking and have a far-reaching impact on overall performance. Psychological skills such as emotional control and focus can give athletes a competitive advantage by helping them maintain optimal performance in high-pressure situations. In badminton, where decisions must be made in a fraction of a second and movements must be executed precisely, solid mental skills are essential to deal with the situation.

Although previous studies have shown positive results regarding the effect of psychological skills training on athlete performance, limitations still need to be made regarding research methodology and variation of results across different studies. Some studies use a qualitative approach, while others use a quantitative approach, so comparing results is only sometimes consistent. In addition, variables such as the type of psychological exercise used, the training duration, and the athletes' level of experience also

affected the study results. Therefore, further research incorporating more systematic and measurable methods is needed to corroborate the findings.

Overall, this literature review shows that psychological skills training is essential in improving reaction time and strategic thinking in competitive badminton. With a better understanding of how mental skills affect performance, coaches and athletes can integrate psychological training into their training programs to achieve more optimal results. Future research should focus more on longitudinal studies that measure the long-term impact of psychological training on athlete performance to obtain a more comprehensive picture of the effectiveness of such training strategies.

Results

Based on the studies reviewed in this study, the results show that psychological skills training significantly impacts competitive badminton players' reaction time and strategic thinking. The following is a summary of the results of the studies analyzed.

Table. 1.
Research results

It	Key findings	Explanation
1.	Effect of Psychological Training on Reaction Time	Research has consistently shown that psychological skills training, such as mindfulness meditation, visualization, and mindfulness regulation techniques, can speed up badminton athletes' reaction time.
	Study results	a) (Furrer, Moen, & Firing, 2015), reported a 12% reduction in reaction time after a six-week mindfulness training intervention in junior athletes b) Research by (Si, Yang, & Feng, 2024) it also supports these results, where athletes who undergo a visualization training program experience a significant improvement in reaction speed. c) However, varied findings were also found in some studies. (Y. Wang, Lei, & Fan, 2023) revealed that although psychological skills training positively impacts amateur athletes, its effect is more moderate on professional athletes.
2.	The Effect of Psychological Training on Strategic Thinking	The results of various studies also show that psychological skills training affects not only the physical reaction aspect but also the strategic thinking ability of players on the field.
	Study results	a) (Ubago-Jiménez, González-Valero, Puertas-Molero, & García-Martínez, 2019) found that athletes who took part in emotional control training could make better decisions during the game. b) (Silva, Ramírez-Campillo, Sarmento, Afonso, & Clemente, 2021) Cognitive training through video analysis and game scenarios helps improve flexibility in decision-making.. c) Not all studies show significant effects in the short term. (Huijgen et al., 2015) reported that psychological skills training such as strategy setting through cognitive training took longer to show tangible results, especially in players with lower experience levels.
3.	Variation of Results and Influencing Factors	The study's results also showed variation based on factors such as the duration of training, the level of experience of the athletes, and the type of psychological skills used.
	Study results	a) Studies involving junior and amateur athletes, such as those conducted by Jones et al. (2020), tend to report more significant improvements compared to studies involving professional athletes, such as those found by Lee & Wong (2018). This aligns with the theory that novice athletes are more likely to experience a significant improvement because their skill base has not yet been fully formed, so psychological training interventions have a more substantial impact.

Various studies show mixed results in examining the effect of psychological skills training on reaction time and strategic thinking in competitive badminton. Some studies demonstrated a significant positive impact of psychological skills training on athlete performance, while others found only a moderate or insignificant impact.

Several main factors can cause this difference:

1. Diverse Training Methods

Each study uses a different approach to psychological skills training. Some studies focus on mental visualization, while others use mindfulness or stress management techniques. Studies that used visualization training tended to find more significant results on athletes' reaction times, as visualization can help improve mental abilities in predicting and responding to situations on the field. On the other hand, mindfulness training may be more effective in enhancing strategic thinking, helping athletes to stay calm and make quick decisions in stressful situations.

2. Training Duration and Intensity

Variations in the duration and intensity of psychological skills training also affected the outcomes of each study. Studies involving intensive training for several weeks to months generally show better results than studies that only provide training for a short period. For example, training conducted for eight weeks or more provides enough time for athletes to internalize psychological skills to make the effect on performance more apparent.

3. Differences in Subject Characteristics

The characteristics of the subjects in each study are also factors that affect the results. Studies involving athletes with different levels of experience, such as junior athletes versus professional athletes, resulted in significant differences in the influence of psychological training. More experienced athletes may already have a certain level of mental skill so that additional training may have less effect on them than beginner athletes. On the other hand, beginner athletes may show sharper improvements in reaction time and strategic thinking because they have yet to be used to these psychological skills.

4. Measuring Instruments Used

Differences in measurement methods also affect comparisons between studies. Some studies use more objective measurement tools, such as computer-based time reaction tests, while others use subjective methods, such as questionnaires or coach observations, to measure strategic thinking. Using more sophisticated and objective measuring

tools tends to produce more accurate data, while subjective measuring tools can be susceptible to judgment bias.

5. Short-Term vs. Long-Term Effects

Some studies only measured the short-term effects of psychological skills training, for example, directly after the completed training session. At the same time, others evaluated its impact in the long term, such as after a few months or the competition season had passed. Studies focusing on long-term effects find that the benefits of psychological skills, especially strategic thinking, are more noticeable after athletes fully assimilate and apply those skills in the actual game.

6. Conclusion of the Study Comparison

Overall, variations in training methods, duration, subject characteristics, and measures used led to different results between the studies reviewed. However, most studies agree that psychological skills training positively impacts badminton athletes' reaction time and strategic thinking, although the level of effectiveness can vary depending on these variables. More intensive and systematic studies generally show more consistent and significant results, confirming the importance of a structured psychological skills training approach in improving athletes' performance.

Discussion

Interpretation of Results

Psychological skills training has been shown to improve athletes' reaction time in various sports, including badminton. This study identified four main findings regarding the effect of psychological skills training on badminton athletes' reaction time and strategic thinking. First, training such as meditation and visualization were shown to speed up reaction time, allowing athletes to respond more quickly to changes in court situations. Second, emotion management training helps athletes make strategic decisions under pressure, especially when facing opponents in critical conditions. Thirdly, the results showed that the intensity and duration of training played an important role, with long-term training producing more stable improvements in reaction time and strategic thinking ability. Finally, the study showed that the athlete's experience level also affects the training effectiveness, with athletes with less experience tend to make more significant improvements than professional athletes who naturally developed mental skills. Based on the studies that have been reviewed, techniques such as visualization, stress management, and meditation have an essential role in helping athletes improve their response speed to unexpected situations on the field. In badminton, reaction speed is crucial, especially in responding to the opponent's attack or the ball that comes quickly. Athletes trained with psychological skills can better process information quickly and anticipate the opponent's movements, positively affecting their reaction time. Furthermore, psychological training also affects the strategic thinking ability of athletes. Strategic thinking in badminton involves reading the opponent's game patterns, planning attacks, and making quick decisions in dynamic game situations. Skills such as attention focus, anxiety control, and emotion management, essential elements of psychological training, assist athletes in maintaining their concentration under pressure. This allows athletes to think clearly and make more informed decisions during the game.

In comparing the results of the various studies reviewed, most studies support the finding that psychological skills training significantly affects athletes' reaction time and strategic thinking performance. Some studies showed significant improvements after athletes underwent psychological skills training programs. At the same time, other studies found more moderate results, depending on the type of skills trained and the duration of the training.

Factors Affecting Results

Several factors affect the outcome of psychological skills training, including variations in the type and intensity of training. The reviewed studies showed that different psychological training techniques affected athletes' reaction times and strategic thinking. For example, visualization exercises involving mental imagination regarding complex game situations are more effective in improving strategic thinking. At the same time, relaxation and meditation techniques have more effect on controlling emotions and improving reaction time. The duration and intensity of training also play an essential role in determining the training program's success. Studies involving intensive training over several weeks or months tended to show more significant results than shorter training durations.

In addition, differences in athletes' skill levels also affect the results of psychological skills training. Professional athletes used to the high pressure of competition may experience less improvement than amateur or semi-professional athletes, as they may have developed these skills naturally through competitive experience. However, some studies have found that professional athletes still benefit from psychological skills training, especially when it comes to improving performance consistency under high pressure. This suggests that psychological skills training is beneficial for beginners and can help sharpen the skills of more experienced athletes.

Other conditions that can affect results are the training environment and team culture. In some studies, a psychologically supportive environment, such as support from coaches and teammates, plays a vital role in the success of psychological skills training. A team culture emphasizing the importance of mental toughness and psychological skills can increase training effectiveness. Conversely, in a less psychologically supportive team, athletes may only partially utilize the skills they learned during training.

Research Limitations

Although the results obtained from this systematic review support the positive influence of psychological skills training

on badminton athletes' performance, some methodological limitations need to be noted. One of the main limitations is the heterogeneity of the study methods reviewed. Studies that use different research designs, diverse sample sizes, and varied measurement tools can lead to differences in results. Some studies use controlled experimental methods, while others rely on subjective reports from athletes, which can potentially lead to bias in results.

Generalizing the findings is also a challenge. Most of the research was conducted on specific groups of athletes based on their skill level or particular sports culture. These results may only be generalizable for some badminton athletes or other sports. For example, findings relevant to badminton athletes in Asian countries with solid badminton traditions may not be fully applicable in countries with different sports cultures.

Another limitation is the need for longitudinal research measuring the long-term impact of psychological skills training. Most studies only assess the effects of training for a few weeks or months, and there has yet to be much research exploring how the impact of this training lasts over a more extended period, such as over an entire season or more. This is important to consider because the effectiveness of psychological training may differ if evaluated in a long-term context.

Practical Implications

The results of this review provide some important practical implications, especially for coaches and athletes. Coaches can use these findings to incorporate psychological skills training into their athletes' training programs. Through structured training programs, coaches can help athletes develop skills such as focus, emotional control, and quick decision-making under pressure. The importance of this training should be noted since psychological skills can be the difference between victory and defeat in a highly competitive competition. In addition, the implications of this review also show the need for a more holistic approach to training badminton athletes. Trainers should focus on developing physical and technical skills and integrate psychological training into the program. Thus, athletes can develop better mental endurance, supporting their performance on the field in the long run.

Suggestions for Further Research

The review also highlights several areas where further research is needed. First, more research involving more extensive and more diverse samples is required to produce more generalizable findings. In addition, more in-depth experimental studies on the types of psychological skills training and their impact on different aspects of athlete performance need to be conducted to get a clearer picture of the effectiveness of specific methods.

Long-term research is also essential to evaluate the impact of psychological skills training over a more extended period. For example, studies that track athletes' progress over several seasons or that measure the effects of training on mental endurance and performance consistency can provide more comprehensive insights into the long-term benefits of this training.

Overall, the results of this review show that psychological skills training has a significant positive impact on badminton athletes' performance, particularly regarding reaction time and strategic thinking. With further research and broader practical application, psychological skills could become an essential component in badminton athlete training programs in the future.

Conclusions

Based on the results of this systematic review, psychological skills training has a significant impact on increasing reaction time and strategic thinking in competitive badminton. Psychological skills such as focus, anxiety control, and mental resilience have proven critical in improving athletes' performance, especially under competitive pressure. This shows that psychological training improves cognitive abilities and contributes to physical skills such as quick reactions to situations on the ground.

The importance of psychological skills training in badminton is further emphasized by the fact that the game relies on technical and physical skills and requires quick and precise strategic decision-making. Psychological training helps athletes prepare mentally to face unexpected situations during the game, ultimately improving their ability to think and act strategically on the field.

Integrating psychological skills training with physical and technical training programs in badminton is highly recommended for practice. Coaches and athletes must know the importance of developing this mental aspect in their daily training routines. Psychological training is beneficial not only in the short term but also in providing long-term benefits that are sustainable for athletes' careers.

However, this review had some limitations, including variations in the methodology of the studies reviewed and the need for long-term research on the effects of psychological skills training in badminton. Therefore, further in-depth experimental research is needed to explore the influence of psychological skills in this sport.

Overall, psychological skills training is an important aspect that should be prioritized in developing badminton athletes, especially in improving their competitive performance.

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