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Skill Competency of Badminton Athletes: Basis for Training Design

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Abstract — This study aimed to determine the level of badminton skill competencies of athletes on strength and conditioning. Specifically, it sought to know the profile of the respondents like age, sex, number of years of playing badminton, number of relevant awards received and number of relevant trainings and seminars. The researcher used descriptive method to determine the objectives that seeks to attain and to help answer the queries and satisfy the curiosity of the researcher. The descriptive method was adopted since the research involved mainly description, analysis, and interpretation of the profile of the respondents concerning age and sex. Also, the extent of badminton skill competencies was determined in this study. The respondents of this study focus on badminton athletes from three (3) universities in Urdaneta City. Further, purposive sampling be used in the relation of respondents. Athletes' respondents undergone 2 to 3 years in training and seminar on Badminton. This study examined the perceptions of efficacy in badminton skill proficiency across the components among athletes. Cohorts exhibit strong beliefs in athletes' talents in speed, power, and muscular strength, has descriptive equivalent of highly competent for athletes. These findings align with research emphasizing the benefits of focused training interventions in badminton-specific abilities. To enhance on-court performance, agility, and endurance, tailored strength training regimens are recommended, emphasizing speed, power, and muscle strength. Additionally, the analysis revealed positive perceptions of athletes' skill competency with athletes consistently rating their proficiency highly competent across cardiovascular endurance, speed training, muscular strength, and flexibility. These results underscored the importance of focused conditioning training in improving performance across crucial aspects of badminton. Moreover, factors such as age, gender, years of athletic experience, accolades obtained, and attendance at relevant workshops and seminars were strongly correlated with athletes' strength and fitness levels. These findings emphasized the necessity of customized training plans tailored to individual traits for athletes. Addressing these disparities through tailored training approaches held promise for maximizing competitiveness and athletic performance in badminton.

Keywords — Strength, Speed, Power, Muscular Strength, Conditioning, Cardiovascular Endurance, Speed Training, Flexibility

I. Introduction

The history of sports is a compelling journey that intertwines with the fabric of human civilization, reflecting societal values, technological advancements, and global dynamics. From the ancient Olympic Games in Greece to the modern, digitized sports landscape, the evolution of

athletic competitions mirrors broader shifts in culture and human interaction. Early roots in ancient civilizations celebrated physical prowess as a symbol of strength and skill. The Industrial Revolution marked a pivotal moment, leading to the standardization of rules and the rise of organized leagues. In the mid-20th century, sports became a platform for social change, breaking racial barriers and championing inclusivity. The transitioned of the 21st century, globalization accelerated, turning events like the Fédération Internationale de Football Association (FIFA) World Cup and the Olympics into global phenomena. The latest trends in sports history research emphasized the impact of technology and digital media. Smith et al. (2021) explored the role of data analytics in player performance and injury prevention, highlighting the transformative influence of technology. Additionally, Jones and Brown (2022) discussed the growing significance of social media in shaping athletes' public personas and fan engagement. Understanding the history of sports is not merely a chronological exploration but a lens through which we can analyze the intricate interplay between sports and the ever-changing tapestry of human society.

Badminton becomes an Olympic sport in 1992. Increased participation worldwide due to this sport's inclusion in the Olympic Games. It is played by two or four players and has a similar temporal structure to other sports (squash, tennis, and volleyball), with repeating motions of short duration, fast speed, and technical skill on the court, but also significant tension. Research has also concentrated on the biomechanical characteristics of badminton. By examining the effects of footwork and racket techniques on performance, shed light on the significance of appropriate biomechanics in maximizing play (Johnson, 2022).

Moreover, speed, power, agility, flexibility, strength, and technical skill are all necessary for playing badminton (Gulati, 2021). In badminton, agility refers to the capacity to move to the oncoming shuttle with appropriate footwork. Numerous agility performance tests have been created based on the characteristics of several sports, including rugby, netball, and football, which emphasize change-of-direction speed and perceptual/decision making. In addition to all other skills, service is crucial to the outcome of the game.

Furthermore, the physical demands of badminton, a sport that combines elements of speed, agility, power, and precision, are quite high. In badminton, players' physical conditioning is just as important as their technical ability to succeed. Programs for improving strength and conditioning are essential for improving the physical qualities required for effective badminton performance (Sigit, 2021).

Additionally, the center of the court serves as the starting and finishing place for players' shifting and returning strategies. Steps, lunges, and other footwork maneuvers are used to catch the shuttlecock and quickly transition from an offensive to a defensive position during each attack and defense. This allows players to execute accurate shots that are high-quality (in terms of strength and intensity) and efficient (in terms of direction and distance). An effective method that raises a badminton player's likelihood of success is to immediately return to the center position after performing a shot and then execute another shot.

Numerous studies have examined badminton players' movements in recent years using kinesiological research techniques, and they have found that footwork is a crucial predictor of a badminton player's athletic performance and a basis for assessing their risk of injury. Studies in the literature have also shown that a greater proportion of badminton injuries affect the lower limbs than other areas of the body. The variability of a player's overall trend can therefore be understood by researchers through an appropriate examination of the quantitative data on agile reactions (of badminton players), and overtraining and an unnecessary training load can be avoided by using these data and concentrating on incidence statistics (Chiu, 2021).

In addition, a badminton court is divided into two halves, each of which is 6.7 meters long and 6.1 meters wide. In the forecourt, midcourt, and rear court, left and right are the three main directions of movement. The movements made in these six directions, which include the cross-step in the forecourt and back court and the lunge in the midcourt, affect how one responds to an opponent and how one executes footwork. Players of badminton who can finish their footwork more quickly have higher average and maximum acceleration (Chiu, 2021).

Likewise, Rapid direction shifts in badminton motions are essential for achieving tournament-winning performance. During lunges for net shots, players of various skill levels were observed in a research to see how their plantar pressure varied. The study's findings showed that skilled players distributed plantar pressure across the inner side of their feet, whereas average players distributed it across the outer side of their feet. They also showed that the difference in pressure distribution had an impact on how the lower limb joints moved in the players (Kuo KP et al. 2022).

Further, badminton players' athletic performance was impacted by lower limb joint loading. Studies have shown that improper footwork movements harm the condition of the lower limb joints and result in injuries. The body adjusts for improper footwork motions involving lunges by changing the angle of the lower limb joints' trunk inclination, which reduced the effectiveness of shots and leads to injuries (Rajšp, 2020).

Further, the same author mentioned that in order to increase muscular strength while appropriately and effectively lowering the link between injury risk and muscle-controlling neurons, neuromuscular theories and research findings have been widely implemented in many types of sports training in recent years. Therefore, improving one's footwork and movement is a crucial part of badminton training. The National Strength and Conditioning Association of the United States' agility t-test is a useful technique for assessing speed, explosive strength, and agility.

Moreover, the emphasis has switched in recent years from traditional training methods to simulation-based training methods that accurately track training outcomes through the processing of training results using quantitative approaches (such as data gathering). There aren't many scientific electronic gadgets designed specifically for sports that include testing and training capabilities yet. With regard to a player's movement features, advantages, and drawbacks,

scientific quantitative training methods allow for the precise and successful adaptation and enhancement of training programs for that player.

Researchers have recommended training that involves movements conducted with short (15–20 s) and very short (6–10 s) intervals in order to imitate the high intensity demands of badminton. To produce higher performance-related changes, training programs should additionally emphasize the sport-specific movement patterns. Additionally, it has been demonstrated that combining plyometric and resistance training improves high-intensity badminton performance in terms of measurements of upper and lower body power, speed, and agility (Lu, 2021).

Additionally, the sport of badminton is becoming more and more well-liked in the Philippines because it requires a special blend of agility, speed, power, and precision. Technical mastery is essential for success in badminton, but so is a solid base of physical fitness. Programs for improving strength and fitness are essential for developing the physical skills required for proficient badminton performance (Coffman, 2020).

In the Philippines, badminton has experienced substantial development in popularity thanks to an increase in both amateur and professional players. This increase is linked to the sport's rising popularity and accessibility (Department of Tourism - Philippines, 2019). Understanding how strength and conditioning might improve badminton skill competency in this setting is in line with the country's larger sports development objectives (Liu, 2020).

Besides, Filipino badminton players experience particular difficulties and advantages. As a result, it becomes crucial to optimize training methods. A significant pool of youthful talent presents opportunities, while scarce resources and access to cutting-edge training facilities present obstacles (Asian Badminton, 2019). These gaps can be filled with efficient strength and conditioning regimens designed for the Philippine environment.

Moreover, the field of strength and conditioning plays a crucial role in enhancing athletic performance across various sports, and badminton is no exception. Badminton is a sport that demands a unique combination of speed, agility, power, and endurance. As athletes continually seek to gain a competitive edge, understanding the specific requirements for strength and conditioning in badminton becomes imperative. Recent research has shed light on the importance of tailored training programs to address the sport's nuanced physical demands. Studies by Chang et al. (2020) emphasize the significance of agility and explosive power in badminton players, highlighting the need for targeted strength training regimens.

Additionally, the work of Tanaka and Swensen (2021) underscores the role of comprehensive conditioning in preventing injuries and sustaining peak performance in badminton athletes. These latest findings not only contribute to the evolving body of knowledge in sports science but also provide practical insights for coaches, trainers, and athletes in designing effective strength and conditioning programs tailored to the specific demands of badminton. The

intersection of science and sport in the context of badminton's physical demands is an area ripe for exploration, offering the potential to optimize training strategies and contribute to the overall advancement of athlete performance.

Further, children's healthy growth and development depend heavily on physical fitness, particularly strength and conditioning. Physical activity benefits children's physical, mental, and emotional health, according to UNICEF (UNICEF, 2021). It is crucial to comprehend how badminton strength and conditioning programs can enhance young athletes' physical fitness and ability level.

Moreover, this study investigates the crucial relationship between the design of strength and conditioning workouts and the development of badminton skill competency in the Philippines. With a focus on the distinctive setting of the Philippines, it intends to provide a full understanding of how personalized strength and conditioning regimens might enhance the performance of Filipino badminton players, thereby contributing in the expansion of the sport in the country. Further it aims to provide important insights into how training design in strength and conditioning can improve badminton skill competency, specifically tailored to the Philippine context. This is because badminton is becoming more popular in the Philippines and because the country is committed to the development of sports. This advances badminton generally in the nation and is consistent with the goals of sports development, youth empowerment, and physical fitness promotion as supported by the Philippine government and associated organizations.

Finally, the purpose of this study is to investigate the impact of a tailored strength and conditioning program on the performance of badminton athletes. Badminton is a sport that demands a unique combination of aerobic and anaerobic fitness, agility, strength, and explosive power. Recent research by Smith et al. (2022) emphasized the importance of sport-specific training in enhancing the overall performance of athletes. However, there is a gap in the literature regarding the specific needs of badminton players in terms of strength and conditioning.

This study aims to fill this gap by designing and implementing a comprehensive strength and conditioning training design specifically tailored to the demands of badminton. By incorporating the latest research findings on biomechanics and physiological aspects of badminton, such as those highlighted by Johnson and Brown (2023), the study seeks to optimize training protocols for improved on-court performance. The outcomes of this research will not only contribute valuable insights to the field of sports science but also provide practical recommendations for coaches, trainers, and athletes in developing effective training strategies. The findings of this research have the potential to inform evidence-based training protocols for badminton athletes, enhancing their competitive edge and potentially reducing the risk of injuries associated with inadequate conditioning.

Literature Review

A number of important ideas and principles form the foundation of the theoretical framework for training design in strength and conditioning to improve badminton skill proficiency. These theories offer a methodical framework for comprehending and putting into practice efficient training regimens in the context of badminton. To optimize training design for badminton players, the framework blends ideas from exercise physiology, sports science, and skill acquisition theory. The ideas to be used are the following: Adaptation Theory, SAID Principle (Specific Adaptations to Imposed Demands), and Dynamic Systems Theory. In this study, those above are explained through the ideas of the proponents of the said theories. The researcher has chosen these as much related to the fulfilment of the conduct of this study.

Adaptation Theory:

Adaptation is specific to the type of stress imposed on the body. In the context of badminton, this means that the physiological adaptations resulting from strength and conditioning exercises should align with the specific demands of the sport. For example, if a badminton player wants to enhance their power for smashes, their training should include exercises that closely mimic the explosive movements of a smash. For adaptation to occur, the body must be exposed to a level of stress greater than what it is accustomed to. This principle guides the progression of training intensity in a systematic manner. In badminton, athletes progressively increase the difficulty of their strength and conditioning exercises to continually challenge their physical capacities. Athletes' bodies adapt to the specific demands placed on them. In strength and conditioning for badminton, exercises are designed to elicit adaptations that enhance the athlete's ability to generate power, endurance, and agility specific to badminton movements.

SAID Principle (Specific Adaptations to Imposed Demands):

This principle emphasizes that the body will adapt specifically to the demands placed on it. Badminton athletes should engage in strength and conditioning exercises that closely mimic the movements and energy systems used during a match. The body's adaptations are specific to the type of stress or demand placed on it. In the context of badminton, this means that training should closely mimic the movements, energy systems, and skills required in the sport. The principle guides the selection of exercises and training modalities to ensure they align with the specific demands of badminton.

The SAID Principle operates at the cellular and systemic levels. Cells, tissues, and physiological systems adapt to the specific stressors encountered during training. In badminton, this could involve adaptations in muscle fibers, cardiovascular endurance, and neuromuscular coordination specific to the sport's requirements. The SAID Principle extends beyond physiological adaptations to include skill acquisition. In badminton, it implies that practicing specific skills, such as different types of shots, footwork patterns, and on-court strategies, is essential for developing competence in those areas.

Dynamic Systems Theory: Dynamic systems theory in sports science suggests that skill acquisition and performance are influenced by the interaction of multiple factors. In badminton, strength and conditioning programs aim to optimize these factors, such as strength, flexibility, and neuromuscular coordination, to improve overall skill competency (Newell, 1986).

DST recognizes that human movement, including the skills involved in badminton, is inherently complex. Movements emerge from the interaction of numerous components, including neural, muscular, and environmental factors. Systems, in this case, the coordination of movements in badminton, can self-organize. Rather than being centrally controlled, movement patterns emerge from the interactions of various elements. Players may adapt and adjust their techniques based on the context of play. Movements are nonlinear and can exhibit sudden, unpredictable changes. In badminton, this might be observed in the sudden shifts in direction, speed, or stroke choice based on the opponent's actions.

Statement of the Problem

This study aimed to determine the level of badminton skill competencies of athletes on strength and conditioning.

Specific, it sought to answer the following questions:

1. What is the profile of the respondents?
    a. Athletes
        i. Age
        ii. Sex
        iii. Number of Years of Playing Badminton
        iv. Number of Relevant Awards Received
        v. Number of Relevant Training and Seminars
2. What is the extent of skill competency of badminton athletes along the following;
    b. Speed;
    c. Power;
    d. Muscular Strength;
    e. Cardiovascular Endurance;
    f. Speed training; and

g. Flexibility?

3. Is there a significant difference in the skill competency of the athletes on their profile variables?

II. Methodology

This chapter presents the details of the process of this study. This includes the research design and methodology, the population and locale of the study, the data-gathering tool, the data gathering procedure, and the treatment of data. The description of the tools and resources to be used in gathering the information needed for this study is also presented and included in the content.

Research Design and Strategy

The researcher used descriptive method to determine the objectives that it sought to attain and to help answer the queries and satisfy the curiosity of the researcher. The descriptive method was adopted since the research involved mainly description, analysis, and interpretation of the profile of the respondents concerning age, sex, years in service as athletes, number of relevant awards received, and number of relevant training or seminars. Also, the extent level of badminton skill competencies will be determined in this study.

Population and Locale of the Study

The respondents of this study focus on badminton athletes from three (3) universities in Urdaneta City, Pangasinan.

Further, purposive sampling used in the relation of respondents. Athletes respondents shall had undergone 2 to 3 years in training and seminar on Badminton.

Data Gathering Tool

The researcher used survey questionnaires to answer the statements of the problem. The tabular questionnaire consists of two parts, first is the profile of the respondents. Second are indicators of the badminton skill competencies.

To institute valid and consistent data, the basis for this research study is a checklist questionnaire. This type of tool points out specific questions that are necessary in reaching the objectives of the study.

The researcher prepared the questioner- checklist which was reviewed and subject to content validation by five (5) experts in research namely one (1) expert in Language and Grammar two (2) from Human Kinetics Culture and Arts Department as subject experts in Urdaneta City University, one (1) from Schools Division of Urdaneta, and one (1) Senior High School teacher in

Urdaneta City National High School as content validator (Appendix D). In this instrument, four-point Likert scale was utilized as well as the overall weighted mean, employing the following scales with assigned descriptive interpretations.

The data gathering tool was pre-tested with twenty three (23 athletes) respondents using Cronbach's Coefficient Alpha in the SPSS trial version. The reliability is 0.96 or 96 percent indicating that the survey questionnaire was excellent based on the table of interpretation. The duly approved questionnaire was reproduced and subsequently used by the researcher to obtain data and information from the respondents.

The scale below was used for the data gathering for the Athletes;

Numerical Values	**WM Score Range**	**Descriptive Equivalent**	**Transmuted Rating**	**Interpretation**
4	3.50-4.00	Highly Agree (HA)	Highly Competent (HC)	The respondent-athletes skillfully demonstrated the expected competency needed for Badminton Athlete based from the Training Program.
3	2.50-3.49	Agree (A)	Competent (C)	The respondent-athletes demonstrated the expected competency needed for Badminton Athlete based from the Training Program.
2	1.50-2.49	Slightly Agree (SA)	Slightly Competent (SC)	The respondent-athletes seldom demonstrated the expected competency needed for Badminton Athlete based from the Training Program.
1	1.00-1.49	Note Agree (NA)	Not Competent (NC)	The respondent-athletes do not demonstrate the expected competency needed for Badminton Athlete based from the Training Program.

The validation of this research study establishing content validity in which there will be experts who understand our topic to read through our checklist questionnaire, and their assessment will help us determine whether the questions that effectively capture the topic under study.

Data Gathering Procedure

The researcher asked permission to the College Dean of the College of Teacher Education specifically in P.E Department of the different Universities to seek approval in the floating of survey questionnaires to the respondents. The researcher waited for the respondents' availability according to their work schedule since they may have different free time. The survey questionnaires were given individually to the identified respondents of the study to ensure a one hundred percent (100%) retrieval of the questionnaires.

III. Results and Discussion

T This chapter presents the results of the gathered responses on the skill competency of badminton athletes.

Profile of the Respondents

Table 1 below shows the frequency and distribution of the respondent-athlete profile variables.

Profile of the Athletes
n=23

Profile Variables	Variable Category	Frequency	Percentage
Age	18 and below	0	0
	19 -20	10	43.50
	21 and above	13	56.50
Sex	Male	14	60.9
	Female	9	39.10
Number of Years of Playing Badminton	2 years and below	9	39.1
	3-5 years	6	26.1
	6-9 years	4	17.4
	10 years and above	4	17.4
Number of Relevant Awards Received	1-2	10	43.50
	3-4	4	17.40
	5-6	3	13.00
	7 and above	6	26.10
Number of Relevant Trainings or Seminars	1-2	9	39.10
	3-4	9	39.10
	5-6	1	4.30
	7 and above	4	17.4

Age. Majority of athletes fall into the age range of 21 and above, comprising 56.5% of the total athletes. The next largest group is aged 19-20, constituting 43.5% of the athletes. Interestingly, there are no athletes below the age of 18. Analyzing the age distribution of athletes reveals a notable concentration of individuals aged 21 and above, comprising 56.5% of the total athlete population. The subsequent largest demographic consists of individuals aged 19-20, accounting for 43.5% of athletes. Remarkably, there are no athletes below the age of 18.

Extent of Skill Competency along Speed

Table 2 presents the weighted mean (WM) of skill competency of badminton players in terms of speed, as assessed by both coaches and athletes.

Speed	WM	DESCRIPTIVE EQUIVALENT	TRANSMUTED RATING
1. improved the overall quickness and agility significantly.	3.52	Highly Agree	Highly Competent
2. contribute capabilities in moving swiftly and reacting quickly in various activity.	3.51	Highly Agree	Highly Competent
3. specifically speed-focused drills positively impacted the ability to perform tasks that require quick responses and movements.	3.43	Highly Agree	Competent
4. influenced the performance in sports and physical activities positively.	3.53	Highly Agree	Highly Competent
5. improved speed which is valuable to the physical activities and overall well-being.	3.57	Highly Agree	Highly Competent
OVERALL WEIGHTED MEAN	3.51	Highly Agree	Highly Competent

The weighted mean for athletes' assessment of speed competency is 3.51, indicating that athletes, on average, perceive themselves as highly agree in terms of speed. Across the five statements assessing speed competency, athletes consistently rated their performance and improvement in speed as highly competent, with weighted means ranging from 3.43 to 3.57.

Extent of Skill Competency along Power

Table 3 presents that the weighted mean (WM) of skill competency ratings for badminton players in terms of power, as assessed by the athletes. The ratings are accompanied by descriptions of the competency level, with highly competent being the highest rating.

The athletes' ratings for each statement range from 3.43 to 3.69, with an overall weighted mean of 3.52, indicating that athletes perceive themselves as highly competent in terms of power. Athletes reported positive effects of power training on their overall strength, explosiveness, and performance in sports and physical activities requiring explosive movements.

Power		**WM**	**DESCRIPTIVE EQUIVALENT**	**TRANSMUTED RATING**
1. improved the overall strength and explosiveness significantly.		3.69	Highly Agree	Highly Competent
2. give more powerful and explosive in my movements.		3.43	Highly Agree	Competent
3. power-focused exercises positively impacted my ability to generate force and power in various physical activities.		3.47	Highly Agree	Competent
4. influenced the performance in sports and activities that require explosive movements positively.		3.52	Highly Agree	Highly Competent
5. affected the ability to execute explosive movements in sports events positively.		3.47	Highly Agree	Competent
OVERALL WEIGHTED MEAN		3.52	Highly Agree	Highly Competent

Overall, athletes perceive power training to be highly agree and highly competent in enhancing athletes' strength, explosiveness, and performance in sports requiring explosive movements. Several studies support the importance of power training for athletes, including badminton players. Power is essential for generating force quickly, executing explosive movements, and improving overall athletic performance. Research by Lee and Lee (2021) and Smith et al. (2021) has demonstrated the positive association between strength levels and power output in badminton strokes, highlighting the importance of strength development for maximizing racket head speed and shot velocity. Biomechanical analyses, including studies by Wang et al. (2024), have elucidated the biomechanical factors contributing to power generation in badminton, emphasizing the coordinated involvement of lower body musculature and core stability in executing powerful strokes. Furthermore, interventions focusing on strength training, as evidenced by research conducted by Zhang et al. (2024), have shown promising results in enhancing power production and stroke effectiveness among badminton players. While the existing literature provides valuable insights into the impact of strength components on power generation in badminton, further research is warranted to explore optimal training protocols and interdisciplinary approaches for maximizing power output and skill competency on the court.

Significant Difference in the Extent of Skill Competency of the Athletes Across their Profile Variables

Table 4 shows the significant difference of the profile of respondents, specifically for athletes in terms of their characteristics. The analysis includes various factors such as sex, years of experience, relevant awards received, and participation in relevant trainings and seminars. The interpretation and discussion of the findings for athletes and then review related literature pertaining to these factors in the context of athletic performance.

Profile of the Respondents	Strength		Conditioning	
ATHLETES	Stat	P-Value	Stat	P-Value
Age	74.089	0.000*	41.315	0.000*
Sex	16.701	0.003*	27.263	0.000*
Number of Years of Playing Badminton	38.378	0.000*	20.986	0.000*
Number of Relevant Awards Received	10.015	0.000*	7.890	0.001*
Number of Relevant Trainings and Seminars	14.295	0.000*	4.053	0.011*

*Sig.

Athletes:

The table also shows that there is a significant difference between the level of skill competency of the athletes in terms of strength and conditioning across their profile variables. This means that their skill competency may vary on their profile variables. Another study by Brown and Jones (2020) explored the impact of age on conditioning levels in a sample of elite athletes. The findings revealed a significant association between age and conditioning performance, with older athletes exhibiting lower conditioning levels compared to their younger counterparts. This study further supports the notion that older athletes may have distinct conditioning requirements.

IV. Conclusion

This chapter presents the conclusions derived from the badminton skill competencies of athletes and the recommendations on the problems specified in this study

Athletes consistently perceive the level of efficacy when it comes to badminton athletes' skill proficiency components. Results are in line with other research showing the beneficial effects of focused training interventions on athletes' performance in badminton-specific abilities. In order to improve on-court performance, agility, and endurance, studies highlight the significance of speed, power, and muscle strength. It may be suggested that in the future, training programs maintain their emphasis on customized strength training regimens created to address the requirements of badminton, which will ultimately lead to increased competitiveness and athletic performance. Based on the analysis of the respondent-athlete profile factors, several recommendations can be made to address the observed trends within the athlete population. Firstly, given the mature nature of the athlete population, efforts should be made to attract and nurture talent from younger age groups to ensure a sustainable pipeline of athletes for the future. This could involve implementing youth development programs and initiatives to engage with schools and communities to identify and support promising young athletes. Secondly, addressing the gender imbalance in the athlete population is essential to promote gender equality and inclusivity in sports. Strategies such as targeted recruitment efforts, mentorship programs for female athletes, and creating a supportive and inclusive sporting environment can help address this imbalance. Thirdly, while the athlete population demonstrates a uniformly high level of education with

bachelor's degrees as the highest educational attainment, opportunities for further educational and skill development should be provided to support athletes' personal and professional growth beyond their athletic careers. Fourthly, recognizing the mixed experience levels within the athlete population, tailored training and support programs should be developed to cater to the diverse needs of both seasoned veterans and newcomers to the sport. Finally, to enhance athlete development and performance, increasing engagement in training and seminars among the athlete population should be encouraged through incentives, accessible training opportunities, and partnerships with relevant organizations. Additionally, conducting comparisons with comparable athlete profiles from other sports teams or organizations could provide valuable insights and best practices to inform targeted interventions and initiatives aimed at furthering athlete development and success. Customized strength training programs should continue to be prioritized because coaches and athletes consistently perceive badminton athletes as having skill competence across strength components. Also, In order to improve agility, endurance, and on-court performance, it is imperative to keep speed, power, and muscle strength in mind. Consequently, in order to promote greater competition and improved athletic performance among players, future training programs should continue to place a strong emphasis on individualized strength training regimens catered to the specific requirements of badminton. The positive perceptions regarding badminton athletes' skill competency highlight the effectiveness of tailored training programs. To further enhance athletes' performance and overall well-being, it is recommended to continue emphasizing focused conditioning training across cardiovascular endurance, speed, muscular strength, and flexibility. Regular assessments and adjustments to training programs based on athletes' progress and feedback can ensure continued improvement and optimal performance on the court. Additionally, integrating recovery and injury prevention strategies into training routines can help maintain athletes' physical health and prolong their careers in the sport. The analysis's noteworthy correlations highlight the value of individualized training plans for badminton players and coaches alike. To improve their coaching techniques and adjust to the changing demands of athletes, coaches should place a high priority on continuing education. Optimizing performance outcomes requires specially designed training regimens that take into account the age, sex, experience, accolades, and participation in pertinent seminars of athletes.

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