



Physical Performance Indicators in Badminton

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Abstract. Performance indicators in sports are the selection and combination of variables that determine several aspects of performance. Where this indicator is an ideal profile that can be used to predict future behavior in sports activities such as badminton. The purpose of this study was to determine the relationship between physical factors and badminton sports achievement. The research method used is associative quantitative by testing the hypothesis. The sample of this research are athletes of PB Hafana, total 36 athlete. The research instruments used in this study were: bleep test to measure endurance, 40 m sprint to measure speed, shuttle run to measure agility, overhead medicine ball to measure arm muscle explosive power, vertical jump to measure leg muscle explosive power, push-up to measure arm muscle strength, and sit and reach to measure flexibility. The analysis technique used is descriptive analysis technique by making the physical norms used in badminton. The results showed that indicators of physical performance that need to be possessed in badminton are endurance, speed, arm muscle strength, arm muscle explosive power, agility and coordination. This is indicated by the existence of physical norms that have been compiled based on research results obtained by using the categories Very Good, Good, Fair, Less and Very Less. So, the conclusion is that physical condition can be an indicator of sports performance, especially in badminton. It is hoped that the trainer will pay attention to the physical condition of the athlete by providing an appropriate physical condition improvement training program.

Keywords: Badminton, Physical, Sports Performance Index.

1 Introduction

Performance indicators in sports can be defined as the selection and combination of variables that determine several aspects of performance [1]. These indicators are ideal profiles that can be used to predict future behavior in certain sports activities [2]. The development of systems to analyze performance for sports usually involves making decisions about which performance indicators to use. Performance indicators are a selection, or combination, of action variables that aim to determine some or all aspects of performance [3]. For performance indicators to be useful, they must be related to

the results to be achieved, namely sports achievements. For each selection of performance indicators by users of the analysis system, a corresponding action variable is required which must be entered during the operation of the system analysis. One of the performance indicators that is interesting to analyze is the physical component. Recent research on key performance indicators shows that the selection of key performance indicators is an important decision in developing a real-time performance analysis system [4]. Therefore, an optimal set of performance indicators is needed to provide players and coaches with sufficient information to support the coaching process, but performance indicators small enough so that the associated action variables can be reliably entered in real-time [2].

Recent research shows that the selection of key performance indicators is an important decision in the development of real-time performance analysis systems [4]. Real-time systems have specific requirements for the data to be entered and the performance indicators to be output within specified time limits [5]. For example, the system can be operated live during a game so that information can be provided to the coaches during the game. If the system involves a human operator, this real-time requirement must be achieved using trained and reliable observers. Of course, this can also be applied to badminton. Badminton is a competitive sport and one of the fastest racquet game sports. Badminton is a sport played by using a racket and hitting the shuttlecock over the net to the opponent's court and each player tries to win the rally by scoring winning points, but at the same time, preventing the opponent from scoring points [6]. By using a racket, this sport involves most of the body's muscles, uses energy obtained from aerobic and anaerobic processes, uses technology for physical training, creates the motor skills needed for rapid skill mastery [7], [8]. Badminton is an acyclic sport with the following characteristics: 1) movement speed; 2) speed of technique with minimal preparation; 3) speed of thought; 4) number of risky attacks [9]. Badminton makes it possible to diversify the impact on the human body, develop strength, endurance, coordination and speed of movement, increase joint mobility, increase various motor skills and volitional qualities [10], [11].

To be able to achieve a high achievement in badminton is the goal of an athlete or player. To achieve high performance, a badminton player must have good physical condition. Physical condition is the most important factor in achieving high achievement, athletes who have good conditions will be better prepared to face the training process and also competition [12]. Basically, there are several components of physical conditions which include strength, endurance, muscle explosive power, speed, flexibility, agility, coordination, balance and reaction speed [13]. There are several components of physical condition that must be developed, namely speed, strength, endurance, flexibility and muscle endurance [14]. Therefore, if a person has these physical components, that person's physical condition will be optimal in activities, especially in sports. Therefore, based on these problems, researchers are interested in conducting research on physical condition as an indicator of badminton performance. So the aim of this research is to find out what the physical performance indicators for badminton are in the form of preparing physical test norms for badminton athletes, namely: endurance, arm muscle strength, speed, agility, explosive power of arm and leg muscles, and flexibility.

2 Method

2.1 Study Design

The purpose of this study was to determine the indicators of physical performance in the badminton branch in the form of compiling the physical test norms for badminton athletes, namely: endurance, arm muscle strength, speed, agility, explosive power of the arm and leg muscles, and flexibility. The research method used is descriptive research method with survey techniques. The research started in March 2023 and finished until August 2023. Data collection was conducted in Jakarta.

2.2 Research Participants

The research population used in this study were PB badminton athletes. Hafana, numbering 60 athletes. Sampling was used using a purposive sampling technique with the criteria being that they took part in a city level championship and were in the age range of 10 – 16 years. So that the sample of this study amounted to 36 people with 27 sons and 9 daughters.

2.3 Data Collection and Instrumentation

The data collection technique used was a survey technique in which the athletes carried out several physical tests used in badminton, namely: endurance, arm muscle strength, speed, agility, explosive power of the arm and leg muscles, and flexibility. The instruments used to measure physical condition in the study were as follows: 1) Bleep test to measure endurance, 2) Push-ups to measure arm muscle strength, 3) Sprit 40 m to measure speed, 4) Shuttle run to measure agility, 5) overhead medicine ball to measure arm muscle explosive power, 6) vertical jump to measure leg muscle explosive power and 7) sit and reach to measure flexibility.

2.4 Statistical Analysis

The data analysis technique used in this research is a quantitative data analysis technique. Data analysis techniques are used to develop norms by determining physical test scale values. Preparation of physical test scales for badminton athletes using categorization with scale values. The scale values used in this research are: value 5 (very good), value 4 (good), value 3 (fair), value 2 (poor) and value 1 (very poor). From the existing benchmarks, a formula can then be created to categorize the physical test results of badminton athletes which can be seen in Table 1. The following is the Norm Classification Categorization Formula for the Badminton Physical Test.

Table 1. Norm Classification Categorization Formula for Badminton Physical Tests

Formula	Category	Score
$> M + (1.5SD)$	Very Good	5
$M + (0.5SD)$ S/D $M + (1.5SD)$	Good	4
$M - (0.5SD)$ S/D $M + (0.5SD)$	Enough	3
$M - (1.5SD)$ S/D $M - (0.5SD)$	Poor	2
$< M - (1.5SD)$	Very Poor	1

3 Result

The results of the research in the form of the formulation of the norms for the badminton physical test can be seen in table 2 – table 8. The results of the preparation of these norms were obtained based on the results of tests carried out by the badminton athletes who were the sample of the study, totaling 36 people. The following are the results of preparing badminton physical test norms:

Table 2. Endurance Norms

Boys	Girls	Score
> 48	> 42	5
42 - 47	35 - 41	4
38 - 41	31 - 35	3
33 - 37	27 - 30	2
< 32	< 26	1

Table 3. Speed Norms

Boys	Girls	Score
> 80	> 113	5
64 - 79	97 - 112	4
48 - 63	81 - 96	3
32 - 47	65 - 80	2
< 31	< 64	1

Table 4. Arm Muscle Strength Norms

Boys	Girls	Score
> 70	> 70	5
54 – 69	54 – 69	4
38 – 53	35 – 53	3
22 – 37	22 – 34	2
< 21	< 21	1

Table 5. Agility Norms

Boys	Girls	Score
> 13.80	> 12.16	1
11.43 - 13.79	10.30 - 12.15	2
9.05 - 11.42	9.62 - 10.89	3
6.68 - 9.04	8.33 - 9.61	4
< 6.67	< 8.32	5

Table 6. Arm Muscle Explosive Power Norms

Boys	Girls	Score
> 80	> 113	5
64 - 79	97 - 112	4
48 - 63	81 - 96	3
32 - 47	65 - 80	2
< 31	< 64	1

Table 7. Leg Muscle Explosive Power Norms

Boys	Girls	Score
> 73	> 50	5
58 - 72	39 - 49	4
43 - 57	31 - 38	3
29 - 42	23 - 30	2
< 28	< 23	1

Table 8. Flexibility Norms

Boys	Girls	Score
> 80	> 113	5
64 - 79	97 - 112	4
48 - 63	81 - 96	3
32 - 47	65 - 80	2
< 31	< 64	1

4 Discussions

Based on the results of research in the form of preparing physical test norms which can be seen in the research results above, it can be said that physical components can

be used as indicators of performance in badminton. Badminton is a fast-paced game that can be played by one person against one person (singles) or two people against two people (doubles) [15]. Therefore, badminton requires good physical components to be able to move quickly in various directions and be able to hit powerfully. Badminton is a sport where it is difficult to predict the movement of the ball given by the opponent [16]. The aim of badminton is to hit the shuttlecock as a hitting object, with the court used being rectangular and bounded by a net to demarcate the playing area between oneself and the opponent [17]. Good physical ability will encourage the achievement of movement skills in playing badminton. For example, in smashing which is the main weapon to kill opponents, which when doing so requires a high jump and hard and well-aimed punches. This requires strength and speed (power) of the muscles of the legs, arms, back and stomach [18].

The physical condition of the human body consists of 10 components, including: 1) Strength, 2) Endurance, 3) Muscle power, 4) Speed, 5) Flexibility, 6) Agility, 7) Coordination, 8) Balance, 9) Accuracy, 10) Reaction [19]. Therefore, physical condition is really needed in badminton and this physical condition can be used as an indicator of performance in badminton to see how badminton performance can be improved. The following are the physical conditions discussed in this study as performance indicators in the badminton branch:

4.1 Endurance

The results showed that endurance is one of the physical conditions that can be used as an indicator of performance in badminton. Cardiovascular endurance is the ability of a person's organs to fight fatigue that occurs when carrying out activities for a relatively longer time [20]. Cardiovascular endurance or cardiac fitness means the ability to provide oxygen to the muscles continuously for a long period of time when carrying out circulatory and respiratory system activities. Badminton is a sport that requires endurance because the series of activities carried out in one game shows its characteristics as a sport that has an anaerobic dominance. So that endurance becomes the most important component in the human physiology profile [21]. Badminton affects lung function in players, namely resulting in an increase in vital lung capacity and developing greater endurance in the respiratory muscles. By having good cardiovascular endurance, a badminton player can play badminton longer so that he does not get tired easily [22]. This is supported by research conducted by Nurul Faj'ri [23] which states that there is a relationship between badminton and vital lung capacity.

4.2 Speed

The results showed that speed is one of the physical conditions used as a performance indicator in badminton. Speed is the ability of a muscle or group of muscles to respond to stimuli in the shortest possible time [24]. While running speed can be interpreted as the speed of movement, namely the ability of a person to make a motion or a series of movements in the shortest possible time (moving the position of the body from one place to another quickly) [25]. Where one type of movement in playing bad-

minton is to make the necessary running movements when chasing or defending the shuttlecock so that it does not fall on its own playing field. By having good running speed, each player can move his body to the desired position quickly, so that he can play well [26]. Therefore, running speed is an important component in carrying out movement activities in the game of badminton. This is also supported by Utvi research [27] which shows that there is a significant relationship between running speed and badminton performance and has an effect of 12.171%.

4.3 Arm Muscle Strength

The research results show that one of the physical conditions that can also be an indicator of badminton performance is arm muscle strength. Strength is the ability to develop maximum strength with maximum contraction to overcome resistance or stress [28]. Strength is the driving force of every physical activity. In badminton, arm muscle strength is the driving force of the arm's follow-up movements which can make the shot on the shuttlecock stronger. This is supported by research conducted by Moh Andy Yusuf [29] which shows that there is a correlation between arm muscle strength and eye-hand coordination with smash hits. Other research also shows that there is an influence between arm muscle strength on smash accuracy in badminton and has a contribution of 33.7% [30].

4.4 Agility

The results showed that agility is also a physical condition that can be used as an indicator of performance in badminton. Agility is an element of movement ability that must be owned by an athlete because with agility athletes can change the direction and position of the body or its parts quickly and precisely. Agility is a person's ability to change direction quickly and precisely when moving without losing balance [31]. Agility is very important in the game of badminton because to make movements that are able to change the direction of body position quickly and precisely without losing balance and awareness of body position [32]. This is also supported by research conducted by Fakhur Rizal et al [33] which states that there is a positive and significant relationship between agility and badminton playing skills with a value of $r = 0.76\%$ and the contribution of agility to badminton playing skills is 57.75%.

4.5 Arm Muscle Power.

The results showed that one of the physical conditions that must be possessed by badminton players is the explosive power of the arm muscles. Power is the ability of a muscle that is used to work optimally in the shortest possible time which refers to strength and speed over time [34]. Arm muscle explosive power is a combination of maximum speed and maximum strength of the arm muscles. The explosive power of the arm muscles is shown by the movement of the body or object where the arm muscles must produce speed with high strength in order to be able to carry the body or object when moving the arm muscles to reach a distance [35]. The explosive power of

the arm muscles is needed in several movements such as throwing, swinging and pushing. Therefore, the explosive power of the arm muscles can be expressed as the ability of the arm muscles to carry out activities quickly and strongly to produce power [36], [37]. This result is supported by research which shows that there is a relationship between explosive power and smash results with a value of $r = 0.76$ and has a contribution of 57.67% [38].

4.6 Explosive Power of Leg Muscles.

Based on the research data above, it can be said that when playing badminton, players need to have explosive power in their leg muscles. Because the movements that players often make when playing badminton include jumping. The jumping movement made by a player is when the player carries out an attacking activity such as a smash [39]. This stroke needs to be mastered by badminton players to kill the opponent's game so that players will get numbers and possibly win the match. Explosive power is the ability of a muscle or group of muscles to overcome heavy load resistance with high strength and speed in one complete movement [40]. Explosive power is related to the maximum muscle contraction strength in a short duration of time [41]. Leg power is very decisive in making jumps, especially in doing smashes. With a high jump, the smash can be achieved at the highest point, making it easier to place the ball and the greater the success of the shot. Having great leg muscle power will also greatly affect peak performance [42]. These results are supported by research conducted by Debby Riski Alica and Afrizal S [43], which shows that the explosive power of the leg muscles contributes to the footwork ability of PB badminton athletes. Starka Hall Sangir Tengah Kerinci by 38.07%.

4.7 Flexibility.

Based on the research data above, it is shown that one of the physical conditions that must be possessed by badminton players is flexibility. Because flexibility shows the quality that allows a joint segment to move as much as possible according to the possible motion (breadth of the joint) so that it allows a muscle or group of muscles to contract in a shortened and elongated position to the fullest [44]. The quality of body flexibility is determined by the elasticity of the muscles, or connective tissue. Flexibility is essential and needed for all sports, to provide freedom of movement in the joints, increase muscle elasticity and help to prevent damage to existing muscles. These results are supported by several studies such as research conducted by Dedi Nofrizal [45], whose research results show that there is a contribution of arm muscle explosive power and flexibility to the accuracy of badminton smashes.

5 Conclusion

Based on the research results above, it can be concluded that physical components can be an indicator of performance in sports, especially badminton. The physical components that trainers must pay attention to in order to continue to improve are: en-

durance, speed, arm muscle strength, agility, explosive power of arm and leg muscles and flexibility. The physical test norms resulting from this research are not standard, because the norms can be adjusted to the level of championships being participated in or the amount of training carried out in one day will certainly influence the athlete's physical test results. However, this physical component can be a performance indicator to see improvements in the physical component in badminton. Suggestions for further research are to create more standard test norms by grouping athlete levels starting from age, level of championships participated in, number of training sessions participated in in 1 day, and so on. Apart from that, it is hoped that there will also be further research related to recording the results of test instruments which can be processed into training programs by utilizing technology which is currently increasingly developing.

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