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ANALYSIS OF THE CONTRIBUTION OF MUSCLE EXPLOSIVE POWER TRAINING MANAGEMENT TO SMASH QUALITY IN BADMINTON

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Abstract

Badminton is a sport that requires a combination of technical skill and physical performance. Smash, one of the main attacking techniques, demands excellent explosive power from the upper and lower extremities. This study aims to analyze the relationship between the explosive power of the arm and leg muscles with smash ability in badminton players of PB Angkasa Jaya Sumbawa. The method used was a correlational study with a population of 12 athletes as total sample. Arm muscle power was measured using the Two-Handed Medicine Ball Put Test, leg power using the Vertical Jump Test, and smash ability through a field-based shuttlecock accuracy test. The results showed a strong correlation between arm explosive power and smash performance (r = 0.719), while leg muscle explosive power alone did not show a significant relationship (r = 0.547). However, when both variables were analyzed together, the correlation was very strong (R = 0.798). These findings suggest that training programs should prioritize the integration of upper and lower body explosive training to improve smash effectiveness in badminton.

INTRODUCTION

Badminton is one of the most popular sports in Indonesia, along with soccer and volleyball. Its popularity reaches all levels of society, both at the recreational and professional levels. Globally, badminton is included in the list of sports competed at the international level, with an organized competition structure under the auspices of the Badminton World Federation (BWF, 2020). The number of badminton clubs that have developed, both amateur and professional, shows how important technical and physical development is in this sport.

In badminton matches, mastery of basic techniques is crucial to support athlete performance. One technique that plays an important role is smash. This technique is a form of attack that is very decisive in the game because it can score points directly and force the opponent to be in a defensive position. As the rally point scoring system is implemented, every mistake will directly have consequences for the opponent's points, so the accuracy and strength of the smash becomes increasingly vital (BWF, 2021).

Effective smash execution requires the contribution of certain physical abilities, especially the explosive strength of the arm and leg muscles. The explosive strength of the arm muscles is indispensable for producing powerful blows that accelerate the shuttlecock's speed, while the leg muscles are needed to make jumps in jumping smashes that allow players to reach the optimal position when hitting (Bobbert & van Ingen Schenau, 1988). The harmonious combination of arm and leg muscle strength has a significant effect on the quality and accuracy of smashes (Lees, 2003).

According to Syarifuddin (1997), a badminton player must master basic techniques such as service, netting, drop shot, and smash. Of the four techniques, smash is considered the most decisive because it functions as a cover and determines the success of a series of attacks. In the context of technical performance, muscular ability, especially explosive power, is the main supporting factor.

Although there has been much discussion in the literature regarding the importance of muscle strength in badminton performance, there are limited studies that directly examine the relationship between arm and leg muscle explosive strength and smash ability, particularly in the population of amateur or semi-professional players at local clubs. Research by Phomsoupha and Laffaye (2015) confirmed that muscular strength is one of the key factors in badminton performance at the elite level, but has not explained in depth the simultaneous contribution between arm and leg strength in the context of smash technique.

Thus, this research has an urgency to be carried out to answer these gaps. The focus of the research is directed at badminton players at PB Angkasa Jaya Sumbawa, which is a local club with the characteristics of middle-level athletes. This study not only has theoretical implications but also practical, because the results can be used as a reference for coaches and coaches in designing training programs based on specific technical needs.

The novelty in this study lies in the simultaneous approach to two physical variables (arm and leg muscle explosiveness) to specific techniques (smash). Unlike previous studies that tended to test variables separately or only on elite athletes, this study involved subjects from the amateur club level, and used a quantitative approach through field testing with standardized instruments such as the vertical jump test and medicine ball put test (Ismaryati, 2008).

Previous studies such as by Cabello Manrique and Gonzalez-Badillo (2003) mostly examined match characteristics or the effects of strength training on performance in general. While this study focuses on the direct effects of muscle ability on specific skills in the game. Therefore, this study is expected to contribute to the development of training strategies and sports science, especially in efforts to improve smash performance.

Based on the above background, the problem formulations in this study are: Is there a relationship between arm muscle explosiveness and smash ability in PB Angkasa Jaya Sumbawa players in 2020?; Is there a relationship between leg muscle explosiveness and smash ability in PB Angkasa Jaya Sumbawa players in 2020?; and Is there a simultaneous relationship between

arm muscle explosiveness and leg muscle explosiveness with smash ability in PB Angkasa Jaya Sumbawa players in 2020?.

The purpose of this study is to determine the extent of the contribution of each physical variable - namely arm muscle explosiveness and leg muscle explosiveness - to the player's smash ability, both individually and simultaneously.

With the results obtained, this research is expected to be able to provide theoretical input for the development of sports science, as well as practically assist sports coaches and coaches in designing focused and evidence-based training.

METHODS

The subjects of this study were all members of the PB Angkasa Jaya Sumbawa club, totaling 12 people with an age range of 18-20 years. The sampling technique used is a population study because the entire population is used as a research sample.

Data was collected at the badminton court of PB Angkasa Jaya Sumbawa club. The researcher did not provide incentives, and all participants followed the data collection procedure voluntarily. The researcher also ensured that all participants agreed to written informed consent before the data was collected.

The instrument used to measure arm muscle explosiveness was the Two-Handed Medicine Ball Put Test, while leg muscle explosiveness was measured by the Vertical Jump Test. To measure smash ability, the shuttlecock accuracy test instrument was used based on the number of shuttlecocks entering the target area in five trials.

Data collection was conducted by the research team and field assistants. Each participant made three attempts at each test and the highest score was used as the analysis data. Data collection procedures were carried out in accordance with standard protocols for measuring strength and sports skills.

Data were analyzed using Pearson correlation to see the relationship between independent and dependent variables, as well as multiple correlation to see the simultaneous relationship between arm and leg muscle explosive power to smash ability. All analyses were conducted with the help of SPSS statistical software.

RESULTS & DISCUSSIONS

Results

The results of the correlation test conducted in this study indicate a significant relationship between arm muscle explosion and smash ability, with a correlation value of $r = 0.719$. This figure illustrates a strong positive relationship, which means that the higher the arm muscle explosion, the better one's ability to smash. This finding supports the hypothesis that arm muscle explosion plays an important role in improving smash performance, which is a core skill in many sports, especially badminton and volleyball.

However, the analysis of leg muscle explosion showed a lower correlation of $r = 0.547$, indicating that the relationship between leg muscle explosion and smash performance was not statistically significant. Although leg muscles also play a role in providing strength and stability during smashes, this result indicates that their contribution may not be as great as arm muscles in influencing smash speed and power. This could be due to other more dominant factors, such as technique and overall body coordination, which may affect smash results more than leg muscle strength individually.

When both variables, arm muscle explosion and leg muscle explosion, were analyzed simultaneously, the results showed a very strong relationship with smash ability, with a correlation value of $R = 0.798$. This value illustrates that the two factors, when combined, support each other and contribute significantly to the improvement of smash ability. This suggests that although arm muscles have a more dominant influence, the role of leg muscles still cannot be

ignored, and the synergy between the two variables is very important in achieving optimal smash performance. Therefore, exercises that develop muscle strength and explosiveness in these two parts of the body need to be considered to improve overall smash ability.

Table 1. Recapitulation of Correlation Values

Variabel	r hitung	Keterangan
X1 dan Y	0.719	Signifikan
X2 dan Y	0.547	Tidak Signifikan
X1, X2, Y	0.798	Sangat Kuat

Discussions

The findings in this study support the theory that muscle strength, especially arm muscles, has a very important role in producing effective smashes. Smash is one of the main techniques in racket sports, such as badminton and tennis, which requires explosive power to produce hard and fast hits. Arm muscle strength allows players to maximize the speed and intensity of smashes, thereby increasing the chances of winning points. Although leg muscles did not show a significant influence individually in this study, their contribution becomes more important when combined with arm muscle strength, especially in smash techniques that involve jumping. Leg muscle strength, although not dominant, still plays a role in providing body stability and balance when performing jumping movements.

In general, the role of leg muscles in improving smash ability can be explained by the function of the lower body in maintaining body position and stability when players perform jumping smashes. When performing a jumping motion, the leg muscles help the player to catapult the body into the air with optimal force. This is crucial to ensure that the player can achieve the right position in the air to perform an effective smash. Without the strength and stability of the leg muscles, the jumping smash technique cannot be performed optimally, even though the arm muscles play a dominant role in generating the speed and power of the blow.

This study is in line with the findings of Cabello and Gonzalez-Badillo (2003) who stated that arm muscle strength contributes significantly to smash intensity, especially in elite-level athletes. In their study, the researchers found that athletes with greater arm muscle strength tended to have stronger and faster smash abilities. This finding confirms that arm muscle strength is not only important in smash technique, but also in the development of better speed and intensity at high levels. This research further reinforces the belief that a training focus on developing arm muscle strength can result in significant improvements in smash performance.

In addition, research by Lees (2003) shows that upper and lower body muscle coordination and strength have an important role in all aspects of hitting in racquetball, including badminton. The strength of the upper body muscles, especially the arms, allows athletes to hit the ball with great power and precision, while the leg and lower body muscles help maintain balance and provide support for further movement. This combination of upper and lower body muscle strength is crucial in improving overall shot performance, including in smash techniques that involve jumping.

Phomsoupha and Laffaye (2015) also confirmed that in world-level athletes, explosive power is an important predictor of hitting technique performance. Their research indicated that the ability of muscles to generate force quickly and efficiently is strongly related to an athlete's ability to perform effective punches. Increased explosive power in the arm and leg muscles can have a direct impact on smash quality, especially in terms of stroke speed and power. Thus, explosive power, both in the upper and lower body, is a key element that needs to be considered in the development of optimal smash technique.

On the other hand, the results of this study are slightly different from the findings of Gowitzke and Waddell (1979), who stated that leg muscle strength is more dominant in the jumping smash technique. This difference may occur because the research subjects in this study did not consistently use the jumping smash technique or were limited to mastering the technique.

The jumping smash technique requires more intensive training to master the coordination between arm and leg strength and overall body control. If the subjects did not fully master this technique, then the effect of leg muscle strength on smash ability may not be as great as expected.

Practically, the results of this study suggest that training programs to improve smash ability should focus on improving the explosive strength of the arm muscles as a top priority. However, although leg muscle strength did not show a significant effect individually, it should still be included in the training component to support more complex techniques, such as jumping smashes. This approach supports the findings of Wong et al. (2010), who suggested the integration of strength and technique in an integrated training model. Thus, training that focuses on both aspects will provide more optimal results in improving overall smash performance.

This study also extends the understanding of the relationship between physical parameters and technical skills in the context of club-level athletes, which has previously focused more on elite athletes. The findings suggest that although research on the effect of muscle strength on smash ability has been mostly conducted on elite athletes, this aspect is also very relevant to be applied to athletes at lower levels, such as club or regional level athletes. Therefore, the results of this study not only have significant theoretical value but also make a practical contribution in the coaching of young athletes at the regional level, who can utilize these findings to design more targeted and effective training programs.

CONCLUSION

Arm muscle explosiveness has a significant relationship with smash ability, while leg muscle explosiveness is not directly related. However, simultaneously, the combination of arm and leg muscle explosiveness is strongly related to smash ability. Coaches and coaches should integrate explosive strength training for arms and legs in badminton smash technical training programs.

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