The Effect of Arm Muscle Power Training and Hand Eye Coordination on the Accuracy of Table Tennis Smash Forehand on Athletes in the PTM Sukun Kudus Club

Frengki Setyo Prabowo[✉], Tri Rustiadi, Bambang Priyono

Universitas Negeri Semarang, Indonesia

Abstract
_____

The purpose of this study was to analyze the effect of arm muscle power exercise and hand eye coordination on the accuracy of table tennis forehand smash on athletes at PTM Sukun Kudus club. This type of research is quantitative research with experimental methods. The population used were all table tennis players at the PTM Sukun Kudus club, totaling 24 athletes. 8 male athletes and 16 female athletes at regional and national levels with a total sample of 24 athletes. The data analysis technique used is Two Way Anova. The results of the study stated that there was a significant effect between the dumbbell hight swing arm muscle power training method and push up exercises on the accuracy of the forehand smash on table tennis athletes at the PTM Sukun Kudus club. There is a significant effect between right and left hand eye coordination on the accuracy of the forehand smash on table tennis athletes at the PTM Sukun Kudus club.

[✉] Correspondence address:
Kampus Pascasarjana UNNES Jl. Kelud Utara 3, Gajahmungkur
Semarang
E-mail: frengkysetyo1@gmail.com

INTRODUCTION

Mastery of basic techniques is necessary in order to play well in a game. In this study, researchers are interested in researching achievement sports, table tennis is a sport that has quite a lot of enthusiasts in Indonesia. From its nature, this game develops and divides the type of game into 2 parts, namely the type of attacking game and the type of defensive game.

The types of attacking players are divided into 3, namely past attack players, top spin players, and smash players. Smash is a hit aimed at getting the target number right. One technique in the game of table tennis is the forehand smash. The most dominant and strongest hitting technique used in smashing is the forehand technique which is the most powerful technique, besides that the power used is more leverage than the backhand.

Based on initial observations of the PTM Sukun Kudus club athletes during the training process as well as in friendly matches, the researchers saw that there were several athletes who had several opportunities to turn off the ball or smash but did not do it optimally. The results of the forehand smash evaluation were as many as 18 people getting good scores with a total score between 18-21, then 9 people in the very good category (22-25), 5 people in the moderate category (14-17), and 4 people less (10 -13).

Based on the data above, it can be seen that there are still athletes who are in the poor category in the forehand smash evaluation test, namely 4 people and 5 people in the medium category. This shows that the accuracy of the athlete's forehand smash still needs to be improved so that the achievements achieved are maximized. Based on observations at several championships, the achievements of the PTM Sukun Club athletes are still far from expectations. This can be seen from the following matches. In the 2018 Central Java Province Kejurprov, he won 4 gold, 3 silver and 3 bronze medals, then in the 2018 Hartono Open Solo championship he won 1 gold, 3 silver, and 2 bronze. In the same year, at the ITB Open Championship, they won 3 silvers and 3

bronzes. Then in 2019, he participated in 2 championships, namely the IPB Open by bringing home 2 silver and 1 bronze, and the Open University Open championship getting 1 silver and 2 bronze. However, since the Covid-19 pandemic spread, governments in various countries including Indonesia have begun to enforce strict health protocols, such as regulations on social distancing and large-scale social restrictions, which will certainly disrupt sporting events.

Based on the statement above, it can be seen that the achievements of the table tennis athletes of the PTM Sukun Club have decreased in achievement from each of the championships that they participated in. At the 2018 Central Java Province Kejurprov, the PTM Sukun Club athletes were able to win 4 gold medals, 3 silver medals and 5 bronze medals while at the 2019 IPB Open championship in 2019 they were only able to win 2 silver medals and 1 bronze medal. This shows a decrease in the ability of players, one of which is in doing the accuracy of the forehand smash. One of the factors that can affect the accuracy of the forehand smash is arm muscle power training. Arm muscle power in table tennis is an important factor because the game of table tennis requires explosive motion to kill the game in order to get points or scores.

The table tennis game is influenced by the intensity of repeated training with models and even different training methods that can be done, namely by playing exercises, weight training, target training, and so on, from several training methods to improve the accuracy of the forehand smash in the table tennis game. Because at the time of hitting the ball the player must first see the direction the ball is coming from and then place the hitting position to then place the ball to the desired target. Physical abilities or conditions in sports include strength, speed, endurance, and flexibility as well as their parts to support the success of athletes (Syafruddin, 2012: 23). The trainer in providing training needs to strengthen and strengthen the athlete's mastery of a training material, namely arm muscle power training.

Eye-hand coordination is also one of the factors that can affect the accuracy of the

forehand smash. The importance of understanding the use of body parts in playing games can help in controlling every technique used, and can maximize every movement of a game. The table tennis game itself requires the coordination of body parts, as is the case with other sports games. One of the important body coordination in the game of table tennis is eye-hand coordination, because this coordination combines the stimuli transmitted by the eyes, one of which will be received by the hand and then the hand will make the desired movement. Especially for the table tennis branch, eye-hand coordination needs special attention where in the implementation of the table tennis training provided by the coach, the coach chooses to pay attention to mastery of skills. Therefore, athletes still need to be fostered and directed to be given physical condition exercises such as eye-hand coordination.

The objectives to be achieved in this research are as follows:

To analyze the effect of arm muscle power training on the accuracy of the table tennis forehand smash on athletes at the PTM Sukun Kudus club.

To analyze the effect of eye-hand coordination on the accuracy of the table tennis forehand smash on athletes at the PTM Sukun Kudus club.

Table Tennis Forehand Smash

According to Salim (2007: 48) the smash is a very fast forehand drive where the bet hits the ball with an upward hitting motion. Smash forehand is a shot that is shown to get the number right. In doing a smash, it is not only determined in the way and movement in doing it but also needs to be taken into account how to do the right ball placement. Kertamanah (2003:35), smash is also known as a ball-killing hit with the greatest attack power. There are two kinds of smashes, namely the forehand smash and the backhand smash, in doing the forehand smash it produces the most powerful attack which is always accompanied by a step forward while the sole of the foot is stomped on the floor. This blow often determines a victory or defeat in

a match. In female athletes, the forehand smash is more dominantly used to determine the final result when there is an opportunity to attack either from the left corner of the table.

Arm Muscle Power

According to Ismaryati (2006: 59) Power concerns the strength and speed of dynamic and explosive muscle contractions and involves the expenditure of maximum muscle strength in the fastest possible time. Widiastuti, (2015: 107) power or explosive is a series of work of several elements of muscle movement and produces explosive power if the power works simultaneously, then power has uses in a sport activity such as throwing, running, hitting and kicking. Meanwhile, Sukardiyanto (2011: 128) power is the product of speed and strength, in other words, the elements of power are strength and speed.

Based on the opinion above, it can be concluded that arm muscle power is the ability of a group of arm muscles to move maximum strength in a very fast and maximum time.

Hand Eye Coordination

According to Bompa (2000: 48) in Hartadi (2007: 19-20) states that eye-hand coordination will produce timing and accuracy. Timing is oriented to timeliness while accuracy is oriented to target accuracy. Timing will affect the impact of the ball with the bet so that it will produce an effective and efficient movement. While accuracy will determine the accuracy of the ball in the direction or target. The conclusion that can be drawn from this opinion is that coordination will establish continuity between timing and accuracy in a game.

METHODS

This type of research is quantitative research with all experimental methods which aims to compare two different treatments to research subjects with factorial design techniques. The research design was pre-experimental (Sugiyono, 2007:73). The design of this research is a two factor design. The

treatment is structured in such a way that each individual can be subject to two different factors, each factor consisting of several levels. (Dantes, 2012: 100).

This study used a population of all table tennis players at the PTM Sukun Kudus club, totaling 24 athletes. 8 male athletes and 16 female athletes at regional and national levels with a sample of 24 athletes divided into 4 groups.

The independent variable in this study consisted of two treatments, namely the manipulative variable, which was the training method for the arm muscle power training method, namely dumbbell high swing and push ups. The dumbbell high swing arm power exercise was measured using 5 kg dumbbells. The push up exercise to measure arm muscle power was carried out for 60 seconds. The dependent variable in this study is the accuracy of the forehand smash. The accuracy of the forehand smash was measured using the table tennis forehand drive test from Tomoliyus (2012: 11), which was to do a diagonal forehand drive rally for 30 seconds with two tries and the best was taken.

Attribute variables in this study are eye-hand coordination, namely: (1) right hand, and (2) left hand. The ability to exercise eye-hand coordination by throwing a forehand-like shot as measured by a modified test from Ismaryanti (2006). Practice using a tennis ball throw-and-catch test with a target. The use of eye-hand coordination exercises is a form of exercise in the game that is modified to resemble a target game.

The research instrument uses administrative instrument techniques, namely sports tests and measurements, arm length tests and exercise programs.

The data hypothesis test used for this research is by using two-way analysis of variance (Two Way Anova). Two-way analysis of variance (ANOVA) is a research data analysis technique with a factorial design with two factors. The conclusion of whether Ho is accepted or rejected is obtained by interpreting the significance value in the test of between subject effect table from the results of the analysis of variance through the SPSS 20.0 for windows program. The criteria used in drawing conclusions are if the probability of error is $p < 0.05$, then H0 is rejected, Hα is accepted.

RESULTS AND DISCUSSION

Classic Assumption Test

It can be seen in table 1 that the test results show a significant value of $0.916 > 0.05$, indicating that the standard residual data has a normal distribution. It can be explained in Figure 1 that the normality test curve is said to be normally distributed if the data or points in the figure below spread around the diagonal line and follow the direction of the diagonal line.
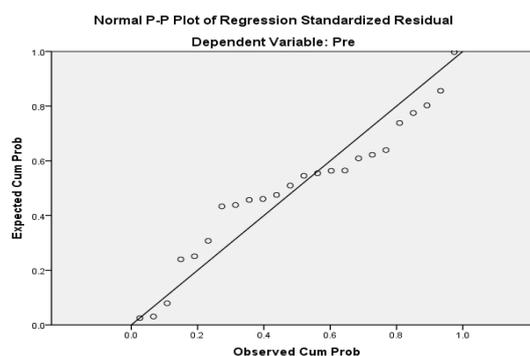

Figure 1. Normality Test Curve

Table 1. Results of Testing for Normality and Homogeneity

Group	Normality*	Homogeneity**
Practice Method Hand Eye Coordination	0,988	0,088

* Kolmogorov-Smirnov test
**Lavene Test

The homogeneity test aims to show that two or more sample groups come from a population that has the same variance. In the homogeneity test, the significant value is $0.088 > 0.05$ which shows the data variance between groups is homogeneous. Thus, testing using the

Two Way ANOVA test was assisted by using SPSS 19.

Hypothesis Testing

Table 2. Hypothesis Test Results
Tests of Between-Subjects Effects
Dependent Variable:Post

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2213.458[a]	3	737.819	5.170	.008
Intercept	299937.042	1	299937.042	2101.503	.000
Metode	1218.375	1	1218.375	8.537	.008
Koordinasi	925.042	1	925.042	6.481	.019
Metode * Koordinasi	70.042	1	70.042	.491	.492
Error	2854.500	20	142.725		
Total	305005.000	24			
Corrected Total	5067.958	23			

a. R Squared = ,437 (Adjusted R Squared = ,352)

Based on the test results, in the Corrected Model column, the Fcount value is 5.170 with a significant value of 0.008. With a sig value of 0.008 < 0.05, it shows that together the effect of the independent variables (exercise method and eye-hand coordination) and the interaction between training methods and eye-hand coordination are significant on the accuracy of the forehand smash.

Hypothesis 1

H_0 : There is no effect of the dumbbell hight swing and push-up arm muscle power training methods on the accuracy of the forehand smash in athletes at the PTM Sukun Kudus club.

$H\alpha$: There is an effect of the dumbbell hight swing and push-up arm muscle power training methods on the accuracy of the forehand smash in athletes at the PTM Sukun Kudus club.

The results of testing hypothesis 1 show a significant value of 0.008 <0.05. Based on these results, H0 is rejected and Hα is accepted, meaning that there is an effect of the dumbbell hight swing and push-up arm muscle power training methods on the accuracy of the forehand smash in athletes at the PTM Sukun Kudus club. The results of this calculation are then consulted with table F with dk in the numerator = 2 and dk in the denominator = 21,

and a significance level of 0.05 is obtained Ftable = 3.47 because F count > F table with a value of 8.537 > 3.47 and a significant value of 0.008 < 0 .05, then Hα which reads "there is an effect of the dumbbell high swing and push-up arm muscle power training method on the accuracy of the forehand smash on athletes at the PTM Sukun Kudus club" is accepted.

Hypothesis 2

H_0 : There is no effect of right and left hand eye coordination on the accuracy of the forehand smash on athletes at the PTM Sukun Kudus club.

$H\alpha$: There is an effect of right and left hand eye coordination on the accuracy of the forehand smash on athletes at the PTM Sukun Kudus club.

The results of testing hypothesis 1 show a significant value of 0.019 <0.05. Based on these results, H0 is rejected and Hα is accepted, meaning that there is an effect of right and left hand eye coordination on the accuracy of the forehand smash on athletes at the PTM Sukun Kudus club. The results of this calculation are then consulted with table F with dk in the numerator = 2 and dk in the denominator = 21, and a significance level of 0.05 is obtained Ftable = 3.47 because F count > F table with a value of 6.481 > 3.47 and a significant value of 0.019 < 0 .05, then Hα which reads "there is an

effect of right and left hand eye coordination on the accuracy of the forehand smash in athletes at the PTM Sukun Kudus club" is accepted.

Furthermore, the difference in the accuracy of the forehand smash based on the training method and eye-hand coordination can be explained based on the following table:

Table 3. Differences in Forehand Smash Results Based on Exercise Methods

Dependent Variable:Post

Metode	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Dumbell	104.667	3.449	97.473	111.861
Push Up	118.917	3.449	111.723	126.111

Based on the data in table 3, it is known that the average value of the forehand smash in the group using the Dumbell Hight Swing training method is 104.67 while the group using the Push Up method has a higher result of 118.91, or there is a difference of 14.24. . These results indicate that the Push Up method is more effective in increasing the accuracy of the forehand smash results compared to the Dumbbell Hight Swing method.

Table 4. Differences in Forehand Smash Results Based on Eye-Hand Coordination

Dependent Variable:Post

Coordination	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Right	118.000	3.449	110.806	125.194
Left	105.583	3.449	98.389	112.777

Based on the data in table 4, it is known that the average score for the forehand smash in the right-hand eye coordination group is 118.00 while the left-hand eye coordination group has a lower result of 105.583, or there is a difference of 12,417. These results indicate that the right-hand eye coordination group has more accuracy in the forehand smash results compared to the left-hand eye coordination group.

DISCUSSION

The Effect of Arm Muscle Power Training on the Accuracy of Smash Forehand

There is a significant effect between the arm muscle power training method which consists of the dumbbell hight swing and push up exercises on the accuracy of the forehand smash on the table tennis athletes at the PTM Sukun Kudus club which was obtained from the results of hypothesis testing I.

Exercise is an effort or activity to provide treatments (treatments) to help athletes so that in the end they can develop themselves and improve their talents, skills, physical conditions, knowledge, attitudes, emotional mastery and personality in the sports they are engaged in. Roestiyah (2001) revealed that the training method is a way of training in which athletes carry out training activities, so that athletes have higher dexterity and skills than what has been obtained. The training method in this study used the dumbbell hight swing and push up training methods that could affect the accuracy of the forehand smash. Arm muscle power training can affect the accuracy of the forehand smash in table tennis. The results of this study are in line with Putra's research (2015) which states that there is a positive and significant relationship between arm muscle power and table tennis playing skills. Hermansyah's research (2017) also shows that there is a relationship between arm muscle power and the accuracy of smash hits.

Arm muscle power in table tennis is an important factor because the game of table tennis requires explosive motion to kill the game in order to get points or scores. Two methods of arm muscle power training, namely dumbbell high swing and push up exercises, can have a positive impact where it is known that the push up exercise method has more potential than the dumbbell high swing exercise method. This can be seen from the training process where the load in the dumbbell hight swing training method ranges from a weight of 70% from 6 kg is 4 kg the maximum load of the athlete himself while the load in the push up exercise is greater as seen

from the body weight of the table tennis athlete in the club. PTM Sukun Kudus.

The Effect of Eye-Hand Coordination on the Accuracy of Smash Forehand

There is a significant effect between right and left hand eye coordination on the accuracy of the forehand smash on table tennis athletes at the PTM Sukun Kudus club which was obtained from the results of hypothesis II testing. This means that in the table tennis game eye-hand coordination is one of the success factors in doing the forehand smash in the table tennis game at the PTM Sukun Kudus club.

Eye-hand coordination has a relationship with the accuracy of the table tennis forehand smash. Eye-hand coordination referred to in this study is a person's ability to integrate movements, eyes and hands in performing the accuracy of the forehand smash. The results of this study are in line with research by Mahendra (2012) where eye-hand coordination makes a significant contribution to the forehand hitting ability of table tennis. Asri's research (2017) also states that athletes with high eye-hand coordination find it easier to learn table tennis forehand drive than athletes with low eye-hand coordination.

Sajoto (1988: 42) states that in carrying out precise movements requires controlling the movement of the limbs. Therefore coordination is needed in controlling a movement to be carried out. The table tennis game requires eye-hand coordination as well as other sports games because this coordination combines the stimuli transmitted by the eyes, one of which will be received by the hand and then the hand will make the desired movement. Especially for the table tennis branch, eye-hand coordination needs special attention where in the implementation of the table tennis training provided by the coach, the coach chooses to pay attention to mastery of skills. Therefore, athletes still need to be fostered and directed to be given physical condition exercises such as eye-hand coordination.

CONCLUSION

There is a significant effect between the dumbbell high swing arm muscle power training method and push up exercise on the accuracy of the forehand smash on table tennis athletes at the PTM Sukun Kudus club. Two methods of arm muscle power training, namely dumbbell high swing and push up exercises, can have a positive impact where it is known that the push up exercise method has more potential than the dumbbell high swing exercise method. There is a significant effect between right and left hand eye coordination on the accuracy of the forehand smash on table tennis athletes at the PTM Sukun Kudus club. In the table tennis game eye-hand coordination is one of the success factors in doing the forehand smash in the table tennis game at the PTM Sukun Kudus club.

REFERENCES

Hermansyah, R., Imanudin, I., Badruzaman. 2017. "Hubungan Power Otot Lengan Dan Koordinasi Dengan Kecepatan Dan Ketepatan Smash Dalam Cabang Olahraga Bulutangkis". Jurnal Terapan Ilmu Keolahragaan 2017 Vol. 02 No. 01 Halaman 44-50. Diakses pada tanggal 24 November 2018.

Ismaryati. 2008. Tes dan Pengukuran Olahraga. Surakarta: LPP UNS dan UNS Prees.

Kertamanah, Alex. 2003. Teknik dan Taktik Dasar Permainan Tenis Meja. Jakarta: PT. Raja Grafindo Persada.

Mahendra, Rudi I. Dkk. 2012. Kelentukan pergelangan tangan dan koordinasi tangan dalam pukulan forehand tenis meja. Fakultas Ilmu Keolahragaan, Universitas Negeri Semarang.

Salim, Agus. 2008. Buku Pintar Tenis Meja. Bandung : Nuansa.

Sugiyono. 2015. Metode Penelitian Pendidikan Kuantitatif, Kuantitatif dan R&D. Bandung: Alfabeta, cv.

Sukadiyanto. 2011. Pengantar Teori dan Metodelogi Melatih Fisik. Bandung: Lubuk agung.

Syafruddin. 2012. Ilmu Kepelatihan Olahraga. UNP Press Padang.

Widiastuti. 2011. Tes dan Pengukuran Olahraga. Jakarta: PT Bumi Timur Jaya.