



The Effect of Dumbbell Training and Rubber Weight Training on Badminton Smash Shots

Muhammad Ishak^{✉1*}, Hikmad Hakim², Syahrudin³

^{1,2,3}Universitas Negeri Makassar, Kota Makassar, Indonesia

Correspondence: E-mail: m.ishak@unm.ac.id

ABSTRACTS

This research aims to determine: the effect of dumbbell training and rubber weight training on the ability to hit smash in badminton at BKMF FIK UNM. The population of this study were all badminton players or members of BKMF FIK UNM with a total research sample of 20 players. The system is divided into groups. The data analysis technique used is the hypothesis testing analysis technique, so the analysis requirements are tested, namely the data normality test. The research results show that; (1) From the summary results of the table, the observation value = 9.032 > t_{table} = 1.729 at the 95% significance level ($\alpha = 0.05$). So H_0 is rejected and H_1 is accepted, meaning there is a difference between the initial test and the final test. So there is an influence of dumbbell training on smash shot ability in badminton at BKMF Badminton FIK UNM. (2). From the summary results of the table, the observation value = 8.128 > t_{table} = 1.729 at the 95% significance level ($\alpha = 0.05$). So H_0 is rejected and H_1 is accepted, meaning there is a difference between the initial test and the final test. The conclusion is that there is a significant influence of rubber weight training on smash shot ability in badminton at BKMF Badminton FIK UNM. (3). From the summary results of the table, the observation value = 3.368 > t_{table} = 2.101 at the 95% significance level ($\alpha = 0.05$). So H_0 is rejected and H_1 is accepted, meaning there is a difference in the form of training with rubber weight training. The conclusion is that there is a significant difference in the influence of dumbbell training and rubber weight training on smash shot ability in badminton at BKMF Badminton FIK UNM.

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INTRODUCTION

In principle, badminton games can be played both indoors and outdoors (Hakim et al., 2022). However, all official tournaments to date are practically carried out indoors (Nurcahya, 2016). This is because, indoors, the speed of the shuttlecock is relatively unaffected by the wind. In the game of badminton, there are tools used to hit (racquet) and objects that are hit (shuttlecock) (Hariandri et al., 2018). Badminton is a sport that uses tools called rackets and shuttlecocks, which are played by two people or four players (Remora & Firlando, 2020).

Badminton is a game that requires good physical abilities (Rubiyatno & Suganda, 2021), and good technical and mental abilities to compete (Hammado et al., 2020). This game aims to score points and prevent the opponent from scoring points (Yudhaprawira et al., 2022). Scoring points in badminton cannot be separated from the player's ability to master badminton playing techniques (Datukramat, Z. A., & Jusrianto, 2019). The ability to comprehend is greatly influenced by technical, physical, and mental mastery (Saputra et al., 2020).

To become a good and accomplished badminton player, you are required to master basic badminton techniques (Ardepa, 2020). Basic techniques are very important to make the game more interesting and fun (Dionika, 2021), basic techniques are the main basis that must be mastered, to avoid injury (Ibrohim et al., 2022), but if the basic techniques are correct and have been mastered then things like that are very minimal (Sari, 2020), basic techniques are the main key in a game and require good mastery so that the game becomes exciting and more enjoyable (Ishak et al., 2022). In playing badminton, you must master the basic techniques, namely the technique of holding the racket, the technique of the first blow or serve, blows over the head (overhead strokes), and underhand strokes (Maulana et al., 2020).

In general, these four techniques must be mastered well to play badminton correctly (Syahputri, 2021). After mastering these basic techniques, such as an appropriate grip on the racket, agile footsteps (Putra et al., 2020), receiving the shuttlecock well, and hitting the shuttlecock in a directed direction (Agustian, 2021). After that, the player must have hitting techniques, namely ways of hitting in badminton to fly the shuttlecock into the opponent's field of court (Krismon et al., 2022). Striking techniques include serves, lobs, drop drives, and smashes.

Smash is the main and most powerful technique for ending a long rally to get points and ending a game, so this technique must be owned and mastered (Wijayanto & Willyanto, 2022). The smash is a very powerful weapon for collecting points in a badminton match (Dewi et al., 2021). This was due to the fast and sharp nature of the ball's fall (Tri Ninglan, 2019).

However, what happened to students from the Department of Sports Coaching Education, Faculty of Sports and Health Sciences, Makassar State University, who programmed the Badminton Course, shows that not all students can hit well and strongly. Still doing a lot of smashes, sometimes aimless and weak. This is mainly due to the lack of muscle ability to

contract optimally, especially in the physical condition of arm muscle strength. So the ability to make a badminton smash is not correct in placing the shuttlecock on the court.

For this reason, it is necessary to analyze the physical conditions that are essential in supporting the increase in badminton smashes. If trained with physical condition training according to the correct training principles, the results of badminton smashes can produce accurate smashes. Therefore, it is necessary to improve badminton smashes by providing forms of training that focus on the strength of badminton smashes (Priambudi T., G. & Syaukani A., 2022).

A form of physical conditioning training that is aimed at supporting the formation of fast and strong smashes, in this case from many forms of training, including as research material, namely dumbbell training and rubber weight training. Dumbbell training is a variation of weight training that aims to increase the strength of the arm and shoulder muscles, especially the biceps muscles (Wahyudi et al., 2023). Exercise using a tool which is a dumbbell. Meanwhile, rubber weight training is a form of exercise that uses rubber as a training material, the aim of which is to develop arm muscle strength (Malla Avila, 2022). These two forms of training aim to build strength in the arm muscles to influence badminton smashes.

METHOD

Research design

The design or pattern used in this research is a subject design model, with the meaning of "Matched subject design", namely an experiment that uses two groups that have been equated, namely one or more variables whose influence on the experimental results is known, namely external variables or factors being experimented with. The purpose of data collection is to test and prove the truth or falsehood of hypotension. The research method used in this research is the experimental method.

The experimental method is a way to look for a cause-and-effect relationship (causal relationship) between two factors that are deliberately caused by researchers by implementing or reducing other disturbing factors. Experiments are always carried out to see the effects of a treatment.

Population and sample

Population is a generalized area consisting of objects/subjects that have certain quantities and characteristics determined by the researcher to be studied and then conclusions drawn. So population is not only people but also objects and other natural objects. Population is also not just the number of objects/subjects being studied but includes all the characteristics/traits possessed by the subject or object (Sugiyono, 2016). The population is all individuals who will be used as objects in a research study. The population in this study were members of the Badminton BKMF FIK UNM. There were 52 male athletes.

The sampling technique in this research is random sampling. Sample Random Sampling is where sample members are taken from a population randomly without paying attention to the strata in that population. Thus, the number of samples in this study was 20 male athletes at BKMF Badminton FIK UNM.

Data collection technique

The data that needs to be collected in this research includes; data on dumbbell weight training and caterpillar weight training as well as the ability to hit smashes in the game.

Data analysis technique

Data description and hypothesis testing in this research can be processed using descriptive and inferential methods using the bound sample t-test formula. Before the t-test analysis is used, a data normality test is first carried out, because the t test can only be used to test the difference in means of two samples taken from a normal population.

The formulas used in processing the data are as follows:

Test requirements are:

- a. The sample normality test uses the following formula:

$$\chi^2 = \sum \frac{(fo-fh)^2}{fh}$$

- b. The sample homogeneity test uses the following formula:

$$F = \frac{\text{Highest Variance}}{\text{Lowest Variance}}$$

Paired t-test (to see the effect of training), using the following formula:

$$t = \frac{Md}{\sqrt{\frac{\sum xd^2}{n(n-1)}}}$$

Unpaired t-test (to see the differences between the two forms of exercise), using the following formula:

$$t = \frac{\mu_1 - \mu_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} - 2r \left(\frac{s_1}{\sqrt{n_1}} \right) \left(\frac{s_2}{\sqrt{n_2}} \right)}}$$

RESULTS

Descriptive data results

A descriptive analysis of research data in the dumbbell training group and rubber weight training group on badminton smashes can be seen in **Table 1** below:

Table 1. Results of descriptive data for both groups

Variable	Dumbbell Training		Rubber Weight Training	
	Pretest	Posttest	Pretest	Posttest
N	10	10	10	10
Range	18.00	6.00	16.00	14.00

Minimum	35.00	52.00	36.00	42.00
Maximum	53.00	58.00	52.00	56.00
Sum	460.00	553.00	463.00	504.00
Mean	46.0000	55.300	46.3000	50.4000
Std. Deviation	4.89898	2.05751	4.57165	4.11501
Variance	24.00	4.233	20.900	16.933

Data normality test results

The results of the normality test carried out on the dumbbell training and rubber weight training groups on badminton smashes were obtained by calculating the results in Table 2 below:

Table 2. Data normality test results

Variable	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Dumbbell Training	0.159	10	0.200	0.971	10	0.901
Rubber Weight Training	0.188	10	0.200	0.904	10	0.240

Data homogeneity test results

The results of the homogeneity test carried out on the dumbbell training and rubber weight training groups on badminton smashes were obtained by calculating the results in Table 3 below:

Table 3. Data homogeneity test results

Pre-Test Group A & Group B	Levena Statistic	Sig.	α	Information
	0.569	0.460	0.05	Homogenous

First Hypothesis

The results of the t-test on the first hypothesis regarding the effect of dumbbell training on badminton smashes obtained the calculation results in Table 4 below:

Table 4. Results of the first hypothesis analysis

Hypothesis	T observasi	T Table	Information
There is an influence of dumbbell training on badminton smashes	9.032	1.729	Significance

Second Hypothesis

The results of the t-test on the second hypothesis regarding the effect of rubber weight training on badminton smashes obtained the calculation results in Table 5 below:

Table 5. Results of the second hypothesis analysis

Hypothesis	T observasi	T Table	Information
There is an influence of rubber weight training on badminton smashes	8.128	1.729	Significance

Third Hypothesis

The results of the t-test on the third hypothesis regarding the difference in the influence between dumbbell training and rubber weight training on badminton smashes were obtained by the calculation results in **Table 6** below:

Table 6. Results of differences in descriptive data between dumbbell training and rubber weight training

	Group	N	Mean	Std.Deviation	Std. Error Mean	
Kelompok	A	10	55.3000	2.05751	0.65064	
	B	10	50.4000	4.11501	1.30128	
Group A & Group B						
Equal variances assumed						
Equal variances not assumed						
Levene's Test for Equality of Variances	F			2.824		
	Sig.			0.110		
t-test for Equality of Means	T			3.368	3.368	
	Df			18	13.235	
	Sig. (2-tailed)			0.003	0.005	
	Mean Difference			4.90000	4.90000	
	Std. Error Difference			1.45488	1.45488	
	95% Confidence Interval of the Difference	Lower			1.84342	1.76260
		Upper			7.95658	8.03740

Table 7. Results of third hypothesis analysis

Hypothesis	T observes	T Table	Information
There is a difference in the influence between dumbbell training and rubber weight training on badminton smashes	3.368	2.101	Significance

DISCUSSION

There is an influence of dumbbell training on the ability to smash in badminton at BKMF Badminton FIK UNM.

The difference between before and after training shows that dumbbell training can increase arm muscle strength because dumbbell training can increase the strength of the muscles being trained. Muscle strength occurs because more motor units are active. This is in line with the opinion of Chozin (2009), who states that dumbbell training can increase muscle strength, speed, and explosive power because the muscle fibers experience adaptation and then the motor units increase. The more motor units that are active in the muscle fibers, the more the muscle fibers will adapt, namely by increasing muscle diameter which causes muscle hypertrophy so that muscle strength increases. The optimal training stimulus for building explosive muscle power is training with high intensity and fast repetitions. The impact that occurs as a result of this exercise is an increase in muscle strength so that the muscles experience hypertrophy.

After training for 12 meetings or 4 weeks, physiological changes will be obtained in the human body, namely the enlargement of muscle fibers (muscle hypertrophy), an increase in the number of capillaries in the muscles (muscle capillarization), an increase in the amount of connective tissue in the muscles, an increase in nutritional intake in the muscles, decreased lactic acid which may reduce the risk of fatigue during activity, and increased V_{O2max} . (Kahle, 2009).

Dumbbell training is a form of exercise that uses external weights. Because dumbbell training is progressive isotonic training which requires increasingly heavy weights. This form of dumbbell exercise is almost the same as swinging your arms when doing a badminton smash. Where when going for a badminton smash, a player must pull his arm back as far as possible, to create force when swinging his arm to hit the smash ball. This dumbbell exercise is also very helpful in increasing a badminton player's strength, especially arm muscle strength. Looking at the results achieved before and after carrying out the test, the average or mean value has increased, as well as the t observation value obtained is better compared to the t table value. Thus, there is a significant influence of dumbbell training on the smash ability in badminton for BKMF Badminton FIK UNM players.

There is an influence of rubber weight training on smash shot ability in badminton at BKMF Badminton FIK UNM.

Based on the results of the research and statistical analysis presented above, this section will then discuss the effect of rubber weight training on smash ability in badminton among BKMF FIK UNM players. Mulyana (1996) states that training using rubber resistance can also be interpreted as a movement in an exercise model by straightening the arm or increasing the angle between the bones at a joint. So rubber weight training on smashing ability in badminton, the muscles of the upper arm/lower arm really influence the performance of a badminton smash, because the power of the muscles really influences the smashing ability. Apart from that, the arm muscles also influence the badminton smash because the arm muscles help so that the smash can be executed perfectly or as expected. Strength and speed are also aspects of the abilities needed in badminton. So there is a significant relationship between rubber weight training and badminton smash ability. This shows that rubber weight training has a significant training effect on improving badminton smash ability. This can be seen in the increase in mean. Thus, rubber weight training is very significant for improving smashes in badminton.

There is a difference in the influence between dumbbell training or rubber weight training on smash shot ability in badminton at BKMF Badminton FIK UNM.

The characteristics of respondents in the research are based on players who are active in BKMF Badminton. Where the age of the respondents in this study was 20-23 years, totaling 20 people who were male. Soejono in Astriwi (2014) stated that aged 20 -30 years, in terms of bones, joints and muscles, they are ready to accept heavier loads. Muscle strength begins to

appear from birth to adulthood and continues to increase, especially from adolescence to puberty, because age is one of the factors that influence muscle strength. Muscle strength will increase until the age of 20 years, after that muscle strength will remain at the age of 20 - 30 years and gradually decrease.

The results of the research were obtained by looking at the average badminton smash ability of BKMF Badminton FIK UNM players who were given dumbbell training of 55.3000 and a standard deviation of 2.05751, as well as rubber weight training of 50.4000 and a standard deviation of 4.11501. This means that descriptively, the smash ability in badminton for BKMF Badminton FIK UNM players with dumbbell training is better and more consistent than with rubber weight training. Likewise, the t-test for Equality Means obtained a value of $t = 3.368$, $df = 18$, and $sig. (2\text{ tailed})$ or $p\text{-value} = 0.003/2 = 0.0015 < 0.05$. Or H_0 is rejected. Thus, the proposed hypothesis was tested by the data, so it was concluded that the smash ability in badminton for BKMF Badminton FIK UNM players who were given dumbbell training was better than rubber weight training.

Dumbbell training in practice shows the ability of the arm muscles to contract optimally to form a physical condition of strength and speed of the arm muscles that is more efficient in the execution movement. This can be proven by an increase in the final test by achieving a higher score. Compared to rubber weight training which emphasizes arm muscle strength contraction movements, the movement process is not optimal. Because some players who carry out rubber weight training movements are not able to maximize the pull they do.

This causes the muscle contractions in the arms to not be optimal in forming the physical strength to support the ability to smash in badminton. Thus, there is a significant difference in the influence between dumbbell training and rubber weight training on the smash ability in badminton for BKMF Badminton FIK UNM players. Dumbbell training is more effective for maximizing smashes than rubber weight training.

CONCLUSION

The results of data analysis for hypothesis testing can be concluded in this research as follows:

There is a significant influence of dumbbell training on smash ability in badminton at BKMF Badminton FIK UNM. There is a significant effect of rubber weight training on smash ability in badminton at BKMF Badminton FIK UNM. There is a significant difference in the influence between dumbbell training and rubber weight training on smash ability in badminton at BKMF Badminton FIK UNM. However, dumbbell training is more effective than rubber weight training.

REFERENCES

- Agustian, M. D. (2021). *Kontribusi Explosive Power Otot Lengan Dan Koordinasi Mata-Tangan Terhadap Kemampuan Forehand Clear Permainan Bulutangkis Pada Siswa Kelas XI SMA Negeri 1 Bangko Kabupaten Rokan Hilir* [Universitas Islam Riau]. <https://repository.uir.ac.id/7927/>
- Ardepa, Y. (2020). *Kontribusi Kkeuatan Otot Lengan Terhadap Hasil Servis Panjang Bulutangkis Mahasiswa Penjaskesrek Semester IV Universitas Islam Riau Pekanbaru* [Universitas Islam Riau]. <https://repository.uir.ac.id/14429/>
- Datukramat, Z. A., & Jusrianto, A. S. (2019). Hubungan Kelentukan Pergelangan Tangan terhadap Kemampuan Service Backhand dalam Permainan Bulutangkis pada Siswa Kelas VIII SMP N 1 Kota Sorong. *Jurnal Pendidikan Jasmani*, 53(9), 3. <https://unimuda.e-journal.id/unimudasportjurnal/article/view/424>
- Dewi, D. W. P., Widiastuti, & Samsudin. (2021). Badminton Smash Skill Training Model For High School Beginners Students. *Gladi: Jurnal Ilmu Keolahragaan*, 12(04), 237–247. <https://doi.org/https://doi.org/10.21009/GJK.124.03>
- Dionika, S. (2021). Variasi Latihan Untuk Meningkatkan Hasil Pukulah Forehand Bulutangkis Pada Atlet Pemula. *Khatulistiwa, Jurnal Pendidikan dan Pembelajaran*, 10(1), 1–8. <https://doi.org/http://dx.doi.org/10.26418/jppk.v10i1.44322>
- Hakim, H., Sahabuddin, Herman, H., Amahoru, N. M., & Fadillah, A. (2022). The Correlation Between Wrist Flexibility and Hand Reaction Speed with Short Serve Ability in Badminton Game. *Nusantara Journal Of Sport Science*, 1(2), 54–63. <https://journal.apskorisanjoss.org/index.php/njss/article/view/2>
- Hammado, N., Razak, A., Sahabuddin, & Hakim, H. (2020). Development of Lob Drive Model on Badminton Game in High School Students. *International Journal of Scientific Development and Research (IJS DR)*, 5(3), 327–331. <https://www.ijdsr.org/papers/IJS DR2003054.pdf>
- Hariandri, M., Ramadai, & Wijayanti, N. P. N. (2018). Power Contribution of Muscle Arm And Shoulder And Flexibility of The Wrist Smash Precision On Team Volley Ball Bintang Muda District Gunung Toar Regency of Kuantan Singingi. *Jurnal Online Mahasiswa, Fakultas Keguruan dan Ilmu Pendidikan*, 5(2), 1–15. <https://jom.unri.ac.id/index.php/JOMFKIP/article/view/20285>
- Ibrohim, Setiawan, A., & Agustin, N. M. (2022). Hubungan Kekuatan Otot Lengan Dan Koordinasi Mata-Tangan Dengan Ketepatan Servis Log Forehand Bulutangkis. *Jurnal Penjakora*, 9(1), 51–61.
- Ishak, M., Asmawi, M., Tangkudung, J., Dlis, F., & Sahabuddin. (2022). Smash Training Model in Badminton Game in College Students of the Faculty of Sports Science, Makassar State University. *International Journal of Science and Society*, 4(2), 209–221. <https://doi.org/10.54783/ijsoc.v4i2.463>
- Krismon, Wijayanti, N. P. N., & Syahriadi. (2022). The Correlation Of Wrist Flexibility And Arm Shoulder Muscle Power With Accuracy Results Of PB. Badminton PB Fortuna Pasir Pengaraian. *Jurnal Online Mahasiswa Fakultas Keguruan dan Ilmu Pendidikan Universitas Riau*, 9(1), 1–13. <https://jom.unri.ac.id/index.php/JOMFKIP/article/view/31907>
- Malla Avila, D. E. (2022). Pengaruh latihan menggunakan resitance band terhadap power tungkai dan ketepatan smash bulutangkis atlet PB Natura Prambanan [Universitas Negeri Yogyakarta]. In *Universitas Negeri Yogyakarta* (Nomor 8.5.2017). <https://eprints.uny.ac.id/73270/>
- Maulana, F., Nurudin, A. A., & Rasyid, A. A. (2020). Hubungan Fleksibilitas Pergelangan Tangan Dan Koordinasi Mata Tangan Terhadap Ketepatan Servis Pendek Bulutangkis. *Jurnal Master Penjas & Olahraga*, 1(2), 1–7. <https://doi.org/10.37742/jmpo.v1i2.14>

- Nurchahya, W. I. (2016). Kontribusi Antisipasi, Kecepatan Reaksi, Kelentukan Pergelangan Tangan, kekuatan Otot Tungkai, kekuatan Otot Lengan Dan Keseimbangan Terhadap Hasil Pukulan Backhand Net Clear Pada Atlet Bulutangkis Kota Kediri. *Artikel Skripsi, Fakultas Keguruan dan Ilmu Pendidikan UN PGRI Kediri*, 01(08), 1–13. http://simki.unpkediri.ac.id/mahasiswa/file_artikel/2016/11.1.01.09.1512.pdf
- Priambudi T., G., N., & Syaukani A., A. (2022). Perbedaan Pengaruh Latihan Handgrip & Dumbell Terhadap Peningkatan Kekuatan Genggaman Jari Pada Pemain Bulutangkis. *Jurnal Pendidikan Olahraga Kesehatan &Rekreasi*, 5(1), 23–34. <https://doi.org/10.29408/porkes.v5i1>
- Putra, P. P., Ruffi'i, R., & Cholid, A. (2020). Circuit training : training model to support the accuracy of backhand in badminton. *Journal Sport Area*, 5(1), 84–96. <http://journal.uir.ac.id/index.php/JSP>
- Remora, H., & Firlando, R. (2020). Evaluasi Program Pembinaan Prestasi Bulutangkis Di Klub Persatuan Bulutangkis Jaya Mandiri. *Gelanggang Olahraga: Jurnal Pendidikan Jasmani dan Olahraga*, 4(1), 86–93. <https://doi.org/https://doi.org/10.31539/jpjo.v4i1.1665>
- Rubiyatno, & Suganda, M. A. (2021). Pengembangan Model Latihan Taktik Dan Strategi Atlet Bulutangkis Pemula Pada Nomor Tunggal Kota Pontianak. *Musamus Journal of Physical Education and Sport (MJPES)*, Universitas Musamus Merauke, 04(01), 48–56. <https://doi.org/https://doi.org/10.35724/mjpes.v4i01.3943>
- Saputra, S. H., Kusuma, I. J., & Festiawan, R. (2020). Hubungan Tinggi Badan, Panjang Lengan Dan Daya Tahan Otot Lengan Dengan Keterampilan Bermain Bulutangkis. *Jurnal Pendidikan Olahraga*, 9(1), 93. <https://doi.org/10.31571/jpo.v9i1.1744>
- Sari, P. I. (2020). Pengaruh latihan beban dumbbell terhadap hasil servis pendek backhand bulutangkis pada kegiatan ekstrakurikuler SD Islam Khalifah Annizam Palembang [Universitas Sriwijaya]. <https://repository.unsri.ac.id/26000/>
- Syahputri, A. (2021). Kontribusi Power Otot Lengan Dan Koordinasi Mata-Tangan Terhadap Kemampuan Long Service Bulutangkis Pada Atlet Putra Usia 10-15 Tahun PB Bank Riau Kepri Pekanbaru [Universitas Islam Riau]. <https://repository.uir.ac.id/11623/>
- Tri Ninglan. (2019). Pengaruh Latihan Power Otot Lengan Dan Panjang Lengan Terhadap Hasil Ketepatan Pukulan Smash Forhand Dalam Permainan Tenis Meja Di Klub Silaberanti Palembang. In *Universitas Negeri Semarang. Studi, Program Olahraga, Pendidikan Semarang*, Universitas Negeri. <http://lib.unnes.ac.id/id/eprint/40248>
- Wahyudi, Kusuma, D. W. C. W., & Nurdin. (2023). Pengaruh Latihan Kombinasi Dumbbell High Swing dan Multiball Terhadap Ketepatan Pukulan Forehand Smash Pada Atlet Tenis Meja Club PTM Taruna Bajang Mataram Tahun 2023. *Sportify Journal*, 3(1), 1–9.
- Wijayanto, D. I., & Wiliyanto, S. (2022). Pengaruh Teknik Latihan dan Koordinasi Terhadap Ketepatan Jumping Smash Bulutangkis Di Klub Wonosobo. *Sport Science & Education Journal*, 3(2), 21–31. <https://ejurnal.teknokrat.ac.id/index.php/sport/article/view/1735>
- Yudhaprawira, A., Asmawi, M., & Dlis, F. (2022). Game-Based Badminton Smash Training Model for Beginner. *Proceedings of the 3rd International Scientific Meeting on Public Health and Sports (ISMOPHS 2021)*, 44(ismophs 2021), 28–31. <https://doi.org/10.2991/ahsr.k.220108.006>