Available online at : http://journal.unj.ac.id/unj/index.php/gjik
Gladi : Jurnal Ilmu Keolahragaan, 14 (01) 2023, 16-27
Permalink/DOI: https://doi.org/10.21009/GJIK.141.02

THE EFFECT OF HAND GRIP STRENGTH, WRIST FLEXIBILITY, AND HAND-EYE COORDINATION ON FOREHAND DRIVE SKILLS

Nur Septian Maulana[1*], Hernawan[1], Taufik Rihatno[1]

Pendidikan Olahraga, Pascasarjana Universitas Negeri Jakarta,
Komplek Universitas Negeri Jakarta Gedung M. Hatta Jl. Rawamangun Muka, Jakarta Timur, Indonesia 13220

Coresponding email : nsmaulana92@gmail.com

(Submission Track: Received: 07-08-2021, Final Revision: 25-12-2021, Available Online: 31-03-2023)

ABSTRACT This research to cognize the effect of hand grip strength, wrist flexibility, and hand-eye coordination on forehand drive skills in badminton extracurricular students in senior high schools in Jatiasih. The research method used was a survey method by using test and measurement techniques. The data was analyzed with path analysis. The population was determined in extracurricular badminton students in senior high schools in Jatiasih as many as 60 students. Sampling technique used total sampling so that sample numbered 60 people. Instrument hand grip strength test, flexibility test, hand eye coordination test, and forehand drive test in badminton. The instrument was compiled by researchers and consulted with Sports Test and Measurement expert. The result showed that (1) there was a direct effect of X_1 on X_3. (2) There was a direct effect of X_2 on X_3. (3) There was a direct effect of X_3 on Y. (4) There was a direct effect of X_2 on Y. (5) There was a direct effect of X_3 on Y. (6) There was an indirect effect of X_1 on Y through X_3. (7) There was an indirect effect of X_2 on Ythrough (X_3).
Keywords: Hand Grip Strength, Flexibility, Coordination, Forehand Drive

INTRODUCTION

Badminton is one of the most popular sports in Indonesia. It is evident from various circles in Indonesia that they can play this sport whether that is just a hobby or a target of achievement. It is undeniable that the name of Indonesia is fragrant, among others, through the badminton sport, so it is appropriate if badminton is studied in an educational environment whether formal or informal, or non-formal.

In a formal environment, badminton is learned as a sportq lesson with a relatively short and limited time. To solve the above problems, physical education teachers of Health and Recreation are required to develop their creativity so that badminton techniques are mastered by students without neglecting their practice so that learning objectives are achieved and their knowledge can be learned in the community in the future. There may not be many obstacles in carrying out badminton games both the game facilities and infrastructure, considering badminton is a sport that can be done indoors or outdoors.

Badminton is a racket sport played by two people for single and two pairs for opposite doubles. Similar to tennis, badminton aims to hit a game ball ("cock" or "shuttlecock") over the net to fall on the opponent's predetermined field of playing and try to prevent the opponent for doing the same. This game requires techniques to run according to existing rules (Datukramat et al., 2019).

Badminton games possess several techniques that must be mastered by an athlete to be able to perform well while playing. In badminton games, there is one stroke technique, namely the forehand stroke made by someone who leads to the opponent's field area. A good forehand drive can also be a deadly blow for the opponent playing. Forehand stroke is to hit a ball with the palm holding the bet/racket facing forward (Anggraini, 2018).

The most wide stroke used in badminton games is the forehand. Carrying out the forehand drive with a racket is the same as hitting the ball with your palm. Forehand stroke is harder than backhand stroke, other than that half of all badminton strokes are forehand.

According to PBSI (2001) basic techniques of badminton are described as follows: 1) grip; 2) footwork; 3) stand and position; 4) service; 5) service return; 6) underhand; 7) overhead; 8) smash; 9) drop shot; 10) netting; 11)

smash return; 12) backhand overhead; 13) drive; 14) stroke and 15) basics of physical exercise (Suhendra, 2018).

Handgrip strength is the effort of a group of muscles in gripping or clenching the racket when performing a slice serve (Maulidin, 2017). Handgrip strength requires a combination of action from several muscles of the hand and forearm also this action is crucial for daily activity. Handgrip muscle strength really needs to be trained to increase its strength, especially in sports that use handgrip muscle strength, such as badminton, table tennis, and court tennis (Irwan et al., 2018).

Handgrip strength is one of the unexpected thingd in the world of grip on the fingers, it really helps to support fluency in performing forehand drive skills in badminton, and the reason is that performing forehand drive skills requires a strong grip on the grip of the racket as a tool to be played in badminton.

In doing this forehand stroke is strongly supported by elements of physical condition. One of the elements of physical condition that supports when doing forehand stroke is flexibility. Flexibility is needed when hitting the ball because a ball that is hit from the side is arduous if someone does not have flexibility. With good flexibility, a person is able to make perfect forehand strokes (Fajrial et al., 2020). This ability is needed by all players because badminton uses a lot of hands (Barakat et al., 2018). Flexibility is the ability to perform a movement in joint space (Robi et al., 2016). Wrist flexibility is a wide range of motion in the wrist joint and has elastic muscles (Ishak & Sahabuddin, 2018).

Flexibility is really helpful in the skill of doing smash stroke in badminton. Flexible people are people who have a wide range in their joints and have elastic muscles, usually a limited range of motion in their joints.

Coordination is one of the physical condition elements that is related to movements. Coordination is a complex skill because it is also related to speed, strength, endurance, and flexibility. Coordination as a harmonious relationship of mutual influence between muscle groups during work aimed at various levels of skills (Nasri et al., 2019). Coordination is basically a person’s ability to combine several movements into one effective and efficient movement pattern (Wibowo, R. A., 2016). Hand-eye coordination is one of the main components of the body

where the eyes and hands are very important roles, the hands are to hold the racket and the eyes are to see game series that will be carried out, both are mutually sustainable when the eyes see the cock then the hands indirectly respond to hit immediately.

Extracurricular is a learning activity organized outside of lesson hours that is tailored to the needs of knowledge, development, guidance, and habituation of students to have support. Extracurricular aim to develop and explore the interests and talents of student's competencies, improve student's abilities in cognitive, affective, and psychomotor aspects, as well as foster students to excel (Nugraha, 2016). Each student who takes badminton extracurricular must master the techniques in the badminton sport itself. Among the basic techniques in badminton, one of them is forehand drive skills.

In general, a basic technique is a factor which cannot be considered trivial because it is one of the keys that master badminton games itself and all sports must be able to master their respective basic techniques and cannot be separated from optimal training to achieve achievement, mastery of techniques in sports, one of them is badminton.

The reason of authors focused on forehand drive research is that during friendly matching or trial matches, seeing poor mastery of forehand drive as evidenced by the presence of an inappropriate forehand drive in the back right corner of the opponent's field namely the direction of a ball is not right and often hits the net until the shuttlecock does not cross the net and it benefits the opponent (R. R Kusuma, 2018).

It is not actually effective for students to reach an achievement if they have not mastered the techniques in badminton yet. This makes the authors attempt to take steps to be able to develop or take points from one of the basics badminton techniques.

As the previous researches showed that no one had researched the same as the authors are doing now nevertheless there are many supporting references for this research materials. Thus, the authors make materials for research as concrete evidence of the basic techniques of badminton, namely the effect of handgrip strength, wrist flexibility, and hand-eye coordination on forehand drive skills.

Based on this issue, the authors are interested to research and discuss about the direct and indirect effects of the effect of handgrip strength, wrist flexibility, and hand-eye coordination on forehand drive skills in badminton extracurricular students in senior high schools in Jatiasih sub district.

METHODS

The research method used was a survey method, with a test technique while the analysis technique used a path analysis approach. Path analysis is an extension of multiple linear regression analysis or path analysis is the use of regression analysis to estimate causality between variables (causal models) that have been determined based on theory previously.

The research involved three exogenous variables whose influence on endogenous variables will be inspected, namely forehand drive skills (Y) in badminton. While the free variables included handgrip strength (X_1), wrist flexibility (X_2), hand-eye coordination (X_3). This research aimed to find out how much the effect of handgrip strength, wrist flexibility, and hand-eye coordination on forehand drive skills in badminton extracurricular students in senior high schools in Jatiasih sub-district. This research was conducted at the Serena Badminton Gymnasium, RT 004/RW 004 Jatisari, Jatiasih District, Bekasi City. The study time was carried out from January to July 2021.

Population targets on this research were all of the badminton extracurricular students in senior high schools in Jatiasih sub-district. The population was determined by students who took badminton extracurricular which have been recorded by the coaches and the school. The reachable population was 60 extracurricular participants.

The sampling technique used was total sampling. A sampling technique where all participants have the same opportunity to be sampled, according to their proportions, many small populations (Setyorini & Syahlani, 2019). The total of the population was 60 badminton extracurricular students at senior high schools in Jatiasih sub-district.

To obtain the data needed in this research, an instrument was needed as a collection of the instruments and the researchers used instruments according to the variables are: (1) handgrip strength test (2) wrist flexibility test, (3) hand-eye coordination test and the last (4) forehand drive skills test that all of those

were compiled by the researchers and consulted with Sports Test and Measurement expert.

Data analysis techniques were conducted through two analysis stages, namely descriptive and inferential data analysis. Descriptive analysis was used in terms of data presentation, central measure, and deployment measure. Data presentation used distribution and histogram lists. Inferential data analysis is carried out to test hypotheses using path analysis to calculate the direct and indirect of an independent on the pendent variable is reflected in the path coefficient.

RESULTS AND DISCUSSION

Results

Table 1.

Descriptive analysis

Descriptive Statistics

	N	in	Max	Mean	Std. Dev
X1	60	16	50	33.17	8.288
X2	60	80	150	110.15	20.017
X3	60	5	19	13.50	3.056
Y	60	7	18	12.38	2.464
Valid N (listwise)	60				

The data used in this research amounted to 60 samples. Based on table 1 was obtained handgrip strength variable (X_1) had the lowest value was 16 kg and the highest value was 50 kg. The average of handgrip strength variable was 33,17 kg with a standard deviation was 8,288 kg. In the wrist flexibility variable (X_2) had the lowest value was 80˚ and the highest value was 150˚. The average of wrist flexibility variable was 110, 15˚with a standard deviation was 20,017˚. In the hand-eye coordination (X_3) had the lowest value was 5 and the highest value was 19. The average of hand-eye coordination was 13,50 with a standard deviation was 3,056. In forehand drive (Y) had the lowest value was 7 times and the highest value was 18 times. The average of forehand drive variable was 12,38 with a standard deviation was 2,464.

Direct Effect

The direct effect of the handgrip strength (X_1), the wrist flexibility (X_2) on the hand-eye coordination (X_3) and the hand-eye coordination (X_3) on the forehand drive (Y) or more simply presented as follows:

$DE_{x_3x_1}$ X1⟶ X3; $P_{x_3x_1}$= 0,107

$DE_{x_3x_2}$ X2⟶ X3; $P_{x_3x_2}$= 0,038

DE_{yx_1} X1⟶ Y; P_{yx_1}= 0,071

DE_{yx_2} X2⟶ Y; P_{yx_2}= - 0,047

$Deyx_3$ $X3 \longrightarrow Y$; pyx_3= 0,358

The direct effect was given by the handgrip strength variable (X_1) on the hand-eye coordination (X_3) was 0,107. Afterwards, the direct effect was given by the wrist flexibility variable (X_2) on the hand-eye coordination variable (X_3) was 0,038. Then, the direct effect was given by the handgrip strength variable (X_1) on the forehand drive variable (Y) was 0,071. Subsequently, the direct effect was given by the wrist flexibility variable (X_2) on the forehand drive variable (Y) was -0,047. And the last, the direct effect given by the hand-eye coordination variable (X_3) on the forehand drive variable (Y) was 0,358. Based on the results of the above calculations can be concluded that the greatest direct effect was given to the effect of the hand-eye coordination variable (X_3) on the forehand drive variable (Y).

Indirect effect

The indirect effect is from the handgrip strength (X_1) on the forehand drive (X_2) through the hand-eye coordination (X_3) and from the wrist flexibility (X_2) on the forehand drive (Y) through the hand-eye coordination or more simply as follows:

$Ieyx_3x_1 : X_1 \longrightarrow X_3 \longrightarrow Y$; $Px_3x_1 . Pyx_3$ = (0,107).(0,358)= 0,038

$Ieyx_3x_2 : X_2 \longrightarrow X_3 \longrightarrow Y$; $Px_3x_2 . Pyx_3$ = (0,038).(0,358)= 0,014

The indirect effect was given by the handgrip strength variable (X_1) on the forehand drive variable (Y) through the hand-eye coordination variable (X_3) was 0,038 while the indirect effect was given by the wrist flexibility variable (X_2) on the forehand drive variable (Y) through the hand-eye coordination (X_3) was 0,014. Based on the results of the above calculations can be concluded that the greatest indirect effect was given to the handgrip strength variable (X_1) on the forehand drive variable through the hand-eye coordination variable (X_3).

Total Effect

Total effect is the calculations of DE and IE (DE+IE) as follows:

TE_{11} = $DEyx_1$ + $IEyx_3x_1$ (0,071) + (0,038) = 0,109

TE_{12} = $Deyx_2$ + $IEyx_3x_2$ (-0,047) + (0,014) = -0,033

TE_{21} = $Deyx_3$ = 0,358

The total effect was given by the handgrip strength variable (X_1) on forehand drive variable was 0,109. Meanwhile, the total effect was given by the wrist flexibility (X_2) on the forehand drive (Y) was -0,033. And the last, total

effect given by the hand-eye coordination variable (X_3) on the forehand drive variable (Y) 0,358. Based on the results of the above calculations can be concluded that the greatest total effect was given to the hand-eye coordination variable (X_3) on the forehand drive variable (Y).

Discussions

The result showed that there was the direct effect of the handgrip strength on the hand-eye coordination.

On the handgrip strength variable (X_1) with a significant level of 95% (α =0,05). The significance number was 0,022 < 0,05. On the basis of this comparison, H_0 was rejected or there was the direct effect of the handgrip strength on the hand-eye coordination in badminton extracurricular students. It can be explained that the better the handgrip strength the better the hand-eye coordination, and conversely, the lower the handgrip strength the lower the hand-eye coordination.

The result showed that there was the direct effect of the wrist flexibility on the hand-eye coordination.

On the wrist flexibility variable (X_2) with a significant level of 95% (α =0,05). The significance number (P value) was 0,048 < 0,05. On the basis of this comparison, H_0 was rejected or there was the direct effect of the wrist flexibility on the hand-eye coordination in badminton extracurricular students. It can be explained that the better the wrist flexibility the better the hand-eye coordination, and conversely, the lower the wrist flexibility the lower the hand-eye coordination.

The result showed that there was the direct effect of the hand grip strength on the forehand drive skills.

On the hand grip strength variable (X_1) with a significant level of 95% (α =0,05). The significance number (P value) was 0,034 < 0,05. The basis of the comparison, H_0 was rejected or there was the direct effect of the handgrip strength on the forehand drive skills in badminton extracurricular students. It can be explained that the better the handgrip strength the better the forehand drive skills, and conversely, the lower the handgrip strength the lower the forehand drive skills.

The result showed that there was the direct of the wrist flexibility on the forehand drive skills.

On the wrist flexibility variable (X_2) with a significant level of 95% (α =0,05). The significance number (P value) was 0,001 < 0,05. The basis of this

comparison, H_0 was rejected or there was the direct effect of the wrist flexibility on the forehand drive skills in badminton extracurricular students. It can be explained that the better the wrist flexibility the better the forehand drive skills, and conversely, the lower the wrist flexibility the lower the forehand drive skills.

The result showed that there was the direct effect of the hand-eye coordination on the forehand drive skills.

On the hand-eye coordination (X_3) with a significant level of 95% (α =0,05). The significance number (P value) was 0,000 < 0,05. The basis of this comparison, H_0 was rejected or there was the direct effect of the hand-eye coordination on the forehand drive skills in badminton extracurricular students. It can be explained that the better the hand-eye coordination the better the forehand drive skills, and conversely, the lower the hand-eye coordination the lower the forehand drive skills.

The result showed that there was the indirect effect of the handgrip strength on the forehand drive skills through the hand-eye coordination.

The calculation of Sobel test was obtained that one-tailed probability value was 0,399 > 0,05. It can be concluded that there was the indirect effect of the handgrip strength variable (X_1) on the forehand drive skills through the hand-eye coordination in badminton extracurricular students. It can be explained the better the handgrip strength the better the forehand drive skills, and conversely, the lower the handgrip strength the lower the forehand drive skills.

The result showed that there was the indirect effect of the wrist flexibility on the forehand drive skills through the hand-eye coordination.

The calculation of Sobel test was obtained that one-tailed probability value was 0,462 > 0,05 so it can be concluded that there was the indirect effect of the wrist flexibility variable (X_2) on the forehand drive skills in badminton extracurricular students. It can be explained that the better the wrist flexibility and the hand-eye coordination the better the forehand drive skills, and conversely, the lower the wrist flexibility and the hand-eye coordination the lower the forehand drive skills.

CONCLUSION

Based on research findings data with independent variables consisting of the hand grip strength (X_1), the wrist

flexibility (X_2), and the hand-eye coordination (X_3) on the dependent variable of the forehand drive skills (Y). Based on the hypothesis results and research discussions, the following conclusion can be drawn:

1. There was a positive effect between the direct effect of the handgrip strength (X_1) on the hand-eye coordination (X_3) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
2. There was a positive effect between the wrist flexibility (X_2) on the hand-eye coordination (X_3) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
3. There was a positive effect between the handgrip strength (X_1) on the forehand drive skills (Y) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
4. There was a positive effect between the wrist flexibility (X_2) on the forehand drive skills (Y) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
5. There was a positive effect between the hand-eye coordination (X_3) on the forehand drive skills (Y) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
6. There was an indirect effect of the handgrip strength (X_1) on the forehand drive skills (Y) through the hand-eye coordination (X_3) in badminton extracurricular students in senior high schools in Jatiasih sub-district.
7. There was an indirect effect of the wrist flexibility (X_2) on the forehand drive skills (Y) through the hand-eye coordination in badminton extracurricular students in senior high schools in Jatiasih sub-district.

REFERENCES

Angraini, D., & Fardi, A. (2020). *Pengaruh Latihan Highes Rally Forehand Dan Latihan Feeding Forehand Terhadap Kemampuan Forehand Drive Tenis Lapangan Atlet Kota Pariaman Tenis Club*. *2*, 434–445.

Arisman. (2016). Kontribusi Koordinasi Mata-Tangan Dan Fleksibilitas Terhadap Ketepatan Pukulan Forehand Drive Pada Klub Ptl (Pelatihan Tenis Lapangan) Padang. *Jurnal Ilmu Kependidikan*, *14*(September), 1–161.

Asri, N. (2020). *Pengaruh Latihan Forehand Ke Dinding Terhadap Hasil Forehand Drive Tenis Meja Siswa Smp Negeri 1 Tanjung Batu*. *3*(1), 30–39.

Barakat, N., Maulana, F., & Bachtiar. (2018). *Hubungan Antara Kekuatan Otot Lengan Dan Fleksibilitas Pergelangan Tangan*

Terhadap Ketepatan Servis Long Forehand Di Ekstrakurikuler Bulutangkis Sma Negeri 1 Kota Sukabumi Tahun 2018. *4*(1), 16–19.

Bintara, D. S., Yuliawan, D., & Firdaus, M. (2021). *Kontribusi Kekuatan Otot Lengan , Fleksibiliti Bahu Terhadap Pukulan Lob Backhand Bulutangkis Contribution Of Arm Strength , Shoulder Flexibility And Eye*. *3*(1), 1–11.

Datukramat, Z. A., As, J., & Fathurrahman. (2019). Hubungan Kelentukan Pergelangan Tangan Dan Koordinasi Mata Tangan Terhadap Kemampuan Service Backhand Dalam Permainan Bulutangkis Pada Siswa Kelas Viii Smp N 1 Kota Sorong. *Journal Of Chemical Information And Modeling*, *53*(9), 1689–1699. Https://Doi.Org/10.1017/Cbo9781107415324.004

Fajrial, J., Abdurrahman, & Sykuriad, A. (2020). *Korelasi Flexibilitas Togok Dengan Kemampuan Forehand Clear Dalam Permainan Bulutangkis Pada Mahasiswa Prodi Penjaskesrek Fkip Unsyiah*. *7*(1), 15–27.

Hasyim, A. H. (2020). *Hubungan Kelentukan Pergelangan Tangan Dan Kelincahan Terhadap Kemampuan Menggiring Bola Dalam Permainan Bola Basket Mahasiswa Penjaskesrek Stkip Ypup Makassar*. 143–151.

Irwan, L. M., Candra, D. W., & Muliyani, S. E. (2018). *Hubungan Antara Daya Ledak Otot Lengan Dan Kekuatan Genggaman Tangan Dengan Kemampuan Smash Dalam Permainan Bulutangkis Pada Club Pb Bintang Generasi Kota Raja Tahun 2018*. *5*(September), 71–74.

Ishak, M., & Sahabuddin, S. (2018). *Hubungan Antara Daya Ledak Tungkai, Kelentukan Pergelangan Tangan Dan Koordinasi Mata Tangan Terhadap Kemampuan Lay-Up Shoot Pada Mahasiswa Fik Unm*. *1*(2), 94. Https://Doi.Org/10.26858/Sportive.V1i2.6395

Kurniawan, R., Rangkuti, Y. A., & Ulfah, N. R. (2020). *Hubungan Antara Fleksibilitas Pergelangan Tangan, Koordinasi Mata-Tangan, Dan Motivasi Latihan Dengan Ketepatan Pukulan Forehand Tenis Meja*. *2*, 951–965.

Kusuma, R. R. (2018). Hubungan Kekuatan Lengan, Koordinasi Mata Tangan, Dan Fleksibilitas Terhadap Keterampilan Forehand Drive. *Juara : Jurnal Olahraga*, *3*(2). Http://Jurnal.Upmk.Ac.Id/Index.Php/Juara

Maulidin. (2017). Hubungan Power Otot Lengan Dan Kekuatan Genggaman Dengan Hasil Servis Slice Pada Permainan Tenis Lapangan Pada Mahasiswa Fpok Ikip Mataram Tahun 2017. ی, ی(ی), ی.

Nasri1, Y. Y., Sepdanius, E., & Haris, F. (2019). Hubungan Daya Ledak Otot Lengan Dan Koordinasi Matatangan Terhadap Kemampuan Servis Panjang Pemain Bulutangkis Sma Negeri 1 Lengayang Kabupaten Pesisir Selatan. *Jurnal Stamina*, *2*, 187–195.

Nugraha, F. S. (2016). *Hubungan Antara Power Otot Lengan Atas, Kekuatan Otot Tungkai, Koordinasi Mata Tangan Terhadap Kemampuan Free Throw Pada Peserta Ekstra Kurikuler Bola Basket Di Sman 1 Papar Kabupaten Kediri*. *4*, 1–27.

Purwitasari, D. I., Wibowo, N. A., & Muninggar, J. (2020). Identifikasi Dampak Jenis Olahraga Terhadap Kekuatan Genggaman Tangan (Studi Kasus Pada Mahasiswa Jurusan Pendidikan Olahraga Uksw). *Jurnal Sains Dan Edukasi*

Sains, *3*(1), 1–7. Https://Doi.Org/10.24246/Juses.V3i1p1-7

Robi, M., Abdurrahman, & Amiruddin. (2016). *Hubungan Fleksibilitas Bahu Dan Pergelangan Tangan Dengan Lob Dalam Permainan Bulutangkis Pada Siswa Smp Negeri 1 Peukan Bada Aceh Besar Tahun 2015*. *147*(March), 11–40.

Setyorini, D., & Syahlani, A. (2019). Analisis Jalur (Path Analysis) Pengaruh Kondisi Sosial Ekonomi Dan Motivasi Belajar Terhadap Prestasi Belajar Mahasiswa. *Fakultas Teknologi Informasi Program Studi Sistem Informasi*, *16*(02), 177–193. Https://Doi.Org/10.36406/Jam.V16i02.241

Suhendra, D. I. (2018). Pengaruh Latihan Menggunakan Karet Terhadap Peningkatan Fleksibilitas Pergelangan Tangan Pada Pemain Bulutangkis. *Journal Of Chemical Information And Modeling*, *53*(9), 1689–1699.

Wibowo, R. A., & A. (2016). Perbedaan Pengaruh Model Pembelajaran Dan Koordinasi Mata-Tangan Terhadap Hasil Belajar Keterampilan Smash Bulutangkis Pada Pemain Putra Umur 10-13 Tahun Klub Bulutangkis Purnama Kadipiro Surakarta Tahun 2014. *Jurnal Ilmiah Spirit*, *16*(1), 30–39.