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The Effectiveness of the Jayaraya Sidoarjo Club Training Program on the Strength and Explosive Power of Leg Muscles in Volleyball Athletes

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ABSTRACT

This study is based on the importance of these physical components in supporting the performance of volleyball game techniques such as smash, block, and serve. To evaluate the effectiveness of the training program implemented by the Jayaraya Volleyball Club of Sidoarjo Regency in increasing arm muscle strength, abdominal muscle endurance, and leg muscle explosive power in junior volleyball athletes. The study used a quasi-experimental approach with a one-group pretest-posttest design. The research sample consisted of 17 male junior athletes who participated in the training program for six weeks, with a frequency of twice a week. Measurements were carried out through push-up, sit-up, and vertical jump tests. The analysis showed a significant increase in the three physical components tested, with a significance value (2-tailed) <0.05 in all variables. The results of this study are that the Jayaraya Volleyball Club training program is effective in improving the main physical components that support athlete performance, and can be used as a reference for developing more optimal training programs in the future.

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INTRODUCTION

The definition of sport is that it is an integral part of daily human activities, contributing to the development of physical and mental health. The role of sport is to improve and shape the quality of human resources (Candrawati et al., 2018). Exercise is crucial and effective in reducing stress and maintaining health. Essentially, exercise is a planned and organized activity that can encourage physical, mental, and social growth and development, as well as train skills needed for daily life. Therefore, exercise should be practised daily, even at low intensity, to maintain optimal physical condition (Yoga et al., 2023).

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Sport is an integral part of human life, serving to improve physical and mental health. In the context of achievement, sport serves as a means of developing superior human resources, as stipulated in Law No. 11 of 2022 concerning Sports. One popular and competitive sport in Indonesia is volleyball. To achieve maximum performance in this sport, structured physical development is necessary, particularly in the components of muscle strength, endurance, and explosive power. It can be concluded that competitive sports are classified as sports that foster and develop individual interpersonal potential, implemented in a planned, structured, and tiered manner through competition to achieve maximum achievement (Ashfahani, 2020).

Volleyball is a sport that is widely enjoyed, particularly within Indonesian society. In Indonesia, the Indonesian Volleyball Association (PBVSI) has been established, an organization responsible for monitoring and overseeing the development of volleyball in the country. Anyone can play volleyball. Volleyball typically requires two teams of six players, a volleyball court, a net, and a ball. Volleyball was introduced by the Dutch in 1928 and has developed in various countries, including Indonesia, where it has become socially accepted. Volleyball is often played in various regional sports events and competitions, such as the National Sports Week (PON), National Sports Week (POPNAS), and National Sports Week (POMNAS)(Crystallography, 2016).

In essence, a crucial factor in achieving sporting success is a person's physical condition. Mastery of techniques and strategies plays a crucial role in the impact of achievement in this sport, which also depends on the needs of the sport. Physical condition, specifically related to basic skills, is important before and after training (Kadafi & Irsyada, 2021). Physical components include strength, speed, flexibility, endurance, and coordination. These physical conditions should be optimized to achieve optimal volleyball performance. Physical aspects are considered both general and specific character traits for achieving volleyball success (Kadafi & Irsyada, 2021).

It is said that physical condition not only supports technical ability but also facilitates strategic development. Effective strategies can only be implemented if players have good technical mastery and are physically fit. Conversely, good physical condition will positively impact a player's mental state, and conversely, a strong mental state will influence physical condition, technique, and strategy. The combination of technique, strategy, psychology, and physical conditioning is essential for achieving peak performance (Bahauddin & Sulistyarto, 2022). It is undeniable that physical condition is essential for athletes. Optimal physical condition, combined with other supporting factors, paves the way to peak performance. Technique and tactics can develop optimally if athletes are in good physical condition, which is achieved through an appropriate training program. However, various challenges often arise in implementing a structured training program that optimizes an athlete's physical condition (Priyoko & Januarto, 2022).

The Jayaraya Volleyball Club in Sidoarjo Regency is one of the clubs active in developing junior athletes and regularly participates in competitions at the district and provincial levels. This club has experienced coaches who develop and implement training

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programs aimed at improving athlete performance. However, to date, no scientific studies have systematically evaluated the effectiveness of the physical training program used at this club on the key physical aspects that support athlete performance. These factors are needed especially by volleyball athletes, optimizing physical conditions that require improvement to suit the athlete's needs, so they should be carried out routinely and appropriately through training programs (Priyoko & Januarto, 2022).

In the context of volleyball, various physical conditions are required, such as explosive leg muscle power, arm muscle power, and abdominal endurance. Leg muscle power is considered crucial in volleyball activities, for example, during smashes, blocks, and jump serves. The higher the leg muscle power, the easier it is to execute a smash and direct the ball accurately into an unguarded area. Explosive power directly influences a player's hitting power, throw distance, jump height, and speed (Rivan et al., 2023). In volleyball, being an attacker or defender is part of the game. Therefore, points can be earned by attacking or defending. A powerful and targeted smash is the attacker's primary weapon in volleyball. Most teams score points from a good spike. Blocking is performed by jumping as high as possible near the net in an attempt to block an opponent's attack (- & Adnan, 2019). Another crucial aspect of volleyball is passing, the initial technique for passing the ball to a teammate to set up an attack (Kuncoro, 2021). The ability of internal muscles to withstand maximum load is called strength, which is a crucial component of physical fitness. Maximum muscle strength can support the improvement of a person's abilities (Kuncoro, 2021). Arm muscle strength is defined as the ability of the arm muscles to develop maximum strength through optimized contractions to overcome loads and resistance. The muscles of the human body move according to their function and performance, just as the arm muscles play a crucial role in receiving the ball, blocking, and smashing. Explosive power in the leg muscles and arm muscles is said to be an essential physical component for volleyball athletes because they are used to perform the movements of serving, blocking, receiving the ball, and smashing. Explosive power is the result of a combination of strength and speed; therefore, explosive power ability can be seen using strength and speed (Kadafi & Irsyada, 2021). The explosive power of the leg muscles plays a role in reaching the highest point of the ball to smash, by having good explosive power of the leg muscles it will be possible to organize optimal attacks as well, the power of the leg muscles has several elements to improve the performance of athletes appropriately through muscles and connective tissue in explosive movements in almost all sports, this means that the greater the strength of the leg muscles to support or jump, the more stable it is when flying and the higher the jump results (Priyoko & Januarto, 2022).

In addition to these physical components, abdominal muscles play a crucial role in volleyball. Volleyball athletes frequently perform explosive movements such as smashes, passes, blocks, and jump serves, which require optimal body stability. One of the main factors contributing to athlete performance in this sport is core muscle strength, particularly the abdominal muscles. Abdominal muscles play a crucial role in maintaining body balance during jumps and landings, as well as increasing movement efficiency

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during smashes and passes. (Oktariana & Hardiyono, 2020) Shows that abdominal muscle strength contributes 16.4% to smash results in volleyball. This suggests that the better the endurance and strength of the abdominal muscles, the more effective an athlete will be in performing basic volleyball techniques with good stability. Strong abdominal muscles also help prevent injuries, especially to the lower back, which is often a problem for athletes who lack core stability. The training program implemented by the Jayaraya Club coaches includes developing arm muscle strength, abdominal muscle endurance, and leg muscle explosiveness, which are essential components of smashing, blocking, and serving techniques in volleyball. However, no research has specifically tested the effectiveness of this training program on the Club's male junior athletes. This creates a research gap: a lack of scientific evidence regarding the effect of specific training programs on improving athlete physical performance at the club level. The urgency of this research is also based on the need for coaches and athletes to provide scientific references in designing targeted training programs. This research will focus solely on the context of the Jayaraya Club in Sidoarjo Regency and is not intended to be generalized to other clubs. Therefore, the results of this study will provide direct practical contributions to coaches and club management in developing more effective training strategies.

Based on these considerations, this study aims to evaluate the effectiveness of the Jayaraya Club's Sidoarjo Regency training program on arm muscle strength, abdominal muscle endurance, and leg muscle explosiveness in junior volleyball athletes. This research is expected to serve as a scientific reference for coaches and athlete trainers in developing targeted, data-driven training programs. This background prompted the researcher to investigate the training program implemented by the Jayaraya Club in Sidoarjo Regency to determine its effectiveness. Therefore, based on this background, the researcher chose the title of the research, "The Effectiveness of the Jayaraya Club Training Program in Sidoarjo Regency on Arm Muscle Strength, Abdominal Muscle Endurance, and Leg Muscle Explosive Power of Volleyball Athletes."

METHODS

The type of research used in this study is a quasi-experimental study using a One-Group Pretest-Posttest Design, using only one group or even without a comparison group and sampling using a purposive sample method. The pretest and posttest design refers to research where there is no control group and subjects are not randomly assigned (Satria, 2019). In this research design, a group is given an initial test to find out before undergoing the test period, then monitoring is carried out during training to determine the effectiveness of the training program in supporting arm muscle strength, abdominal muscle endurance and leg muscle explosive power, and a posttest is carried out to compare with the results of the pretest scores. This study used a purposive sampling technique to select samples, namely by taking male junior volleyball athletes from the Jayaraya Club located at the Ronggojalu Sports Hall, Masangan Wetan, Sukodono

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District, Sidoarjo Regency, East Java. The research was carried out from November 2024 to April 2025. The sample used was 17 male junior volleyball athletes.

In the following study, two pretests and a posttest were conducted. Between the pretest and posttest, the athletes' training program was monitored to determine its effectiveness in improving arm muscle strength, abdominal muscle endurance, and leg muscle explosiveness.

RESULTS AND DISCUSSION

Result

The data obtained by the researchers in the following study are the results of physical condition tests before and after undergoing a physical training program from the Jayaraya Volleyball Club in Sidoarjo Regency.

The following study includes several stages of testing, namely a pretest and a posttest, consisting of three tests: push-ups, sit-ups, and vertical jumps. The data for the pre- and posttest results of the male athletes from the Jayaraya Volleyball Club in Sidoarjo Regency are explained below.

Sit-Up Test Data (30 seconds)

The results of the sit-up test on male junior athletes from the Jayaraya Club, Sidoarjo Regency, are shown in the following table:

Table 1.
Sit-Up Test Results

No	Nama	Pretest	Posttest
1.	AZ	29	31
2.	AR	29	32
3.	FA	33	35
4.	LO	35	38
5.	RE	28	30
6.	RG	32	35
7.	DI	29	33
8.	FI	32	34
9.	VI	32	34
10.	MA	30	32
11.	LE	28	29
12.	NA	24	25
13.	AK	27	30
14.	AM	30	32
15.	HA	33	35
16.	RA	25	27
17.	MH	28	29
Average		**29,65**	**31,82**

Push-Up Test Data

The results of the push-up test on male junior athletes from the Jayaraya Club are shown in the following table:

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Table 2.
Push-Up Test Results

No	Nama	Pretest	Posttest
1..	AZ	24	27
2.	AR	21	23
3.	FA	23	24
4.	LO	24	27
5.	RE	20	22
6.	RG	25	28
7.	DI	25	29
8.	FI	27	29
9.	VI	25	26
10.	MA	26	28
11.	LE	24	26
12.	NA	21	20
13.	AK	23	24
14.	AM	26	29
15.	HA	23	25
16.	RA	15	18
17.	MH	24	28
Rata - Rata		**23,29**	**25,47**

Explosive Power Test Data (Vertical Jump) (Cm)

Results of the vertical jump explosive power test on junior male athletes from the Jayaraya Volleyball Club, Sidoarjo Regency:

Table 3.
Hasil Tes *Vertical Jump*

No	Nama	Pretest	Waktu (s)	Posttest	Waktu (s)
1	AZ	275	0,7	280	0,7
2	AR	280	0,7	283	1,0
3	FA	290	0,7	295	1,0
4	LO	280	0,7	290	0,9
5	RE	283	0,7	288	0,8
6	RG	286	0,9	290	0,8
7	DI	265	0,6	270	0,7
8	FI	289	0,7	292	0,3
9	VI	275	0,8	280	0,6
10	MA	277	0,6	280	0,8
11	LE	275	0,7	288	0,8
12	NA	264	0,8	267	0,9
13	AK	263	0,7	263	0,7
14	AM	267	0,7	270	0,8
15	HA	285	0,6	290	0,8
16	RA	275	0,8	278	0,7
17	MH	265	0,4	265	0,7
Average		**276,12**		**280,5294**	

Normality Test

A normality test was conducted on each piece of research data obtained, namely, pretest and posttest data. The normality test was used to determine the normality of the data distribution. The research data normality test used the Shapiro-Wilk formula in SPSS version 25. Data were classified as normally distributed when the significance value exceeded 0.05. The following are the results of the normality test for each test item:

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Table 4.
Results of the Normality Test for the 30-Second Sit-Up Test

Shapiro-Wilkshapiro			
Sit Up	**N**	**Sig.**	**Distribusi**
Pretest	17	,816	Normal
Posstest	17	,943	Normal

Table 5.
Results of the Normality Test for the 30-Second Push-Up Test

Shapiro-Wilk			
Push Up	**N**	**Sig.**	**Distribusi**
Pretest	17	,019	Normal
Posttest	17	,092	Normal

Table 6.
Results of the Normality Test for the 30-second Vertical Jump Test

Shapiro-Wilk			
Vertical jump	**N**	**Sig.**	**Distribusi**
Pretest	17	,214	Normal
Posttest	17	,144	Normal

Referring to the table data, it appears that all the research data from the Jayaraya Sidoarjo Regency volleyball athletes' pretest and posttest tests have a significance value exceeding 0.05 at p>0.05. Therefore, it can be concluded that all variables in the study are normally distributed. Therefore, a paired sample t-test can be conducted.

Paired Sample T-test

This paired sample t-test is used to observe whether there are differences between two paired samples. A prerequisite for this test is that the data must be normally distributed. The paired sample t-test in the following study was used to answer the research question, "Is the Jayaraya Sidoarjo Volleyball Club training program effective in increasing arm muscle strength, abdominal muscle endurance, and leg muscle explosive power in volleyball athletes?" To address this question, a paired sample t-test was conducted on the pre- and post-test data for arm muscle strength, abdominal muscle endurance, and leg muscle explosive power. The basis for this test is as follows:

1) If the significance value (2-tailed) is <0.05, then there is no significant difference between the pre- and post-test results.
2) If the significance value (2-tailed) is >0.05, then there is no significant difference between the pre- and post-test results.

The following are the results of the paired sample T-test obtained from each test conducted:

Table 7.
Paired sample t-test for 30-second sit-ups

Paired Sample Test *Sit Up*		
	t	Sig. (2-tailed)
Pretest – Posttest	-11,093	,000

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Based on the data in the table, a significance value (2-tailed) of 0.000 <0.05 was obtained. It can be concluded that significant results were obtained between the pre- and posttests. This means that the physical training program of the Jayaraya Volleyball Club in Sidoarjo Regency affects the athletes' abdominal muscle strength.

Table 8.
Uji Paired sample T-test Push Up 30 detik

Sample Paired Test *Push Up*		
Pretest – Posttest	t	Sig. (2-tailed)
	-7,256	,000

Based on the data in the table, a significance value (2-tailed) of 0.000 <0.05 was obtained. Therefore, it can be concluded that the results obtained were significant between the pre- and posttests. This means that the physical training program of the Jayaraya Volleyball Club in Sidoarjo Regency affects the athletes' arm muscle strength.

Table 9.
Calculation of Explosive Power Using Physics Formulas

No	Nama	Pretest (W)	Posttest (W)	Selisih	Status
1	AK	484.24.00	477.22.00	-7.02	Turun
2	AM	523.47.00	442.57.00	-80.90	Turun
3	AR	414.27.00	291.65	-122.62	Turun
4	AZ	537.60	617.70	+80.10	Naik
5	DI	540.58.00	536.12.00	-4.46	Turun
6	FA	576.64	426.30.00	-150.34	Turun
7	FI	659.34.00	1425.45.00	+766.11	Naik
8	HA	576.33.00	506.33.00	-70.00	Turun
9	LE	516.54.00	613.09.00	+96.55	Naik
10	LO	536.82	497.97	-38.85	Turun
11	MA	588.31.00	518.49.00	-69.82	Turun
12	MH	745.76	443.13.00	-302.63	Turun
13	NA	423.36.00	394.31.00	-29.05	Turun
14	RA	490.00.00	629.58.00	+139.58	Naik
15	RE	501.93	448.47.00	-53.46	Turun
16	RG	462.00.00	594.53.00	+132.53	Naik
17	VI	548.80	796.25.00	+247.45	Naik
Average		**516.25.49**	**589.38.51**		

Referring to the contents of the table data, the participants who increased (Up) were 6 people (AZ, FI, LE, RA, RG, VI), and the participants who decreased (Down) were 11 people. The participants with the largest increase were: FI: +766.11 W, VI: +247.45 W. Participants with the largest decrease were: MH: –302.63 W, FA: –150.34 W.

Discussion

The following study aimed to observe the effects and effectiveness of the training program provided by the Jayaraya Volleyball Club in Sidoarjo Regency for junior volleyball athletes. The sit-up test results showed that all participants experienced improved performance after participating in the training program. This improvement reflects the development of abdominal muscle endurance across all participants. The consistent results indicate that the training provided sufficient stimulus to encourage physiological

adaptation, particularly in the core muscle groups. Furthermore, the uniformity of the training response indicates that the program was designed with appropriate load and volume, making it well-tolerated by all individuals. No decline in performance was observed from the pretest to the posttest, indicating that the program is highly effective and optimally structured for improving sit-up ability (Shi et al., 2024).

The push-up test results showed that all participants experienced improved performance after participating in the training program. The increase in scores from pretest to posttest was universal, with no decline in performance for any participant. This reflects the positive and consistent impact of the training program on the development of upper body muscle endurance and strength, particularly in the arms, chest, and shoulders.

The consistent improvement indicates that the training material was well-suited to the participants' physical condition. It also indicates that the training load, frequency, and intensity provided an effective adaptive stimulus to the trained muscles' capabilities. Variations in improvement between participants may reflect differences in initial fitness levels or individual physiological responses, but these are within reasonable limits.

With no declines in the push-up training program, it can be concluded that the push-up training program not only successfully improved the abilities of the majority of participants but was also considered effective overall. This provides a strong basis for demonstrating that the training program design was of good quality in terms of planning, implementation, and achieving training objectives (Malik & Ramakrishnan, 2021).

Although most participants showed an increase in jump height during the posttest compared to the pretest, this was not necessarily accompanied by an increase in power values based on basic physics calculations. An increase in jump height does indicate improvements in vertical motor skills, which generally indicates the success of the training program in improving functional physical performance. However, when considering movement speed, namely the time required to complete the jump, most participants experienced a slowdown. In physics power calculations, time plays a crucial role as the denominator in the formula. This means that the longer the time required, the more power values will decrease, even though the jump height increases.

This situation indicates that participants were able to jump higher, but not at optimal movement speed. In other words, explosive muscle power had not fully developed proportionally despite the increase in the final jump. This may be due to various factors, such as a training pattern that emphasizes strength over speed, fatigue levels during the posttest, or a lack of emphasis on explosive movement techniques. Therefore, overall, the training program can be considered quite effective in improving functional jump performance, but its effectiveness in developing explosive muscle power still needs to be evaluated and adjusted (Al-Jaber & Shandal, 2022).

The Jayaraya Volleyball Club's physical training program in Sidoarjo Regency supports athletes in improving their technique. The exercises typically strengthen the arm, leg, and abdominal muscles, and are performed twice a week, typically with or without weights. Explosive power and arm muscle strength are crucial physical components in volleyball, supporting technique, particularly the basic smash technique.

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A significant relationship exists between explosive power and arm muscle strength, indicating that explosive power in the leg and arm muscles correlates strongly with smashing ability (Rivan Syukur & Kastrena, 2019). Abdominal muscle strength also plays a role in smashing (Oktariana & Hardiyono, 2020).

The training program is tailored to the athlete's needs, and the impact and progress in physical performance can be felt. The training is also monitored to ensure consistent results. Muscle strength is a component that plays an important role in physical components that can maximize endurance when carrying out activities so that a person can minimize the possibility of injury when carrying out sports activities (Adhi et al., 2017).

CONCLUSION

Based on the results of a study examining the effectiveness of the Jayaraya Volleyball Club's training program in Sidoarjo Regency for junior volleyball athletes, it can be concluded that the program is highly effective in improving several aspects of the athletes' physical abilities. The program proved effective in increasing arm muscle strength, as demonstrated by improved performance on the push-up test for all participants without any decline in results. Furthermore, abdominal muscle endurance also experienced a uniform increase, as demonstrated by the consistent improvement in sit-up test results for all athletes. However, for leg muscle explosiveness, despite an increase in jump height, power calculations based on physics formulas showed inconsistent results due to a slowdown in movement time. This indicates that the training program is not fully effective in developing leg muscle explosiveness and requires evaluation and adjustments to improve movement speed in line with the increase in jump height.

Thus, overall, the Jayaraya Club's training program is considered effective in increasing arm muscle strength and abdominal muscle endurance. However, further development of leg muscle explosiveness is needed to achieve a more comprehensive and proportional improvement in athlete performance.

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