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Analysis of Strength, Endurance, Flexibility Towards Speed of 100 Meter Bifins Diving Athletes of Shima Sport Club

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Abstract
This study aims to analyze the relationship between back strength (Back), leg strength (Leg), body pulling ability (Pull Up), cardiovascular endurance (12-minute Run), and flexibility (Sit & Reach) to Bifins performance in 10 diving athletes. Data were analyzed using the Shapiro-Wilk normality test and Pearson correlation. The results of the normality test showed that all variables were normally distributed ($p > 0.05$). Correlation analysis revealed a positive and significant relationship between the variables Leg ($r = 0.653$, $p = 0.040$), Pull Up ($r = 0.905$, $p < 0.001$), 12-minute Run ($r = 0.638$, $p = 0.047$), and Sit & Reach ($r = 0.873$, $p = 0.001$) with Bifins performance. While back strength (Back) did not show a significant correlation with Bifins ($r = -0.195$, $p = 0.588$). These results indicate that leg strength, pulling ability, endurance, and flexibility are important factors that affect the performance of diving athletes. This study provides a basis for developing training programs that focus on these aspects to improve the performance of diving athletes.

Keywords: strength, endurance, flexibility, speed, bifins, diving athletes

INTRODUCTION

Sports play an important role in human life. Even in the modern era, people cannot be separated from sports to improve their achievements and stay healthy.

Diving is a water sport that uses equipment such as fins, snorkels for pool numbers and OWF (Open Water Finsswimming), the use of *scuba equipment* for OBA (Underwater Orientation) numbers. The various pool numbers in diving are bifins, surface, apnea and intermediate, for open water numbers, namely OWF (Open Water Finsswimming) 1000 meters, 2000 meters, 3000 meters and OBA (Underwater Orientation), Diving is a measurable sport, namely a type of sport that can be observed directly and accurately through the distance traveled or the results (Fathannisa *et al.,* 2022) . To improve the performance of diving athletes to be better, a systematic training program needs to be provided, so that there is an increase in the time limit when competing in diving athletes.

Basically, important factors for achieving achievement in sports are physical condition, physical condition before and after the athlete's training process (Kadafi and Irsyada, 2021) , a coach must create a physical training program, physical training is very much needed for athletes, because it can support athlete performance during the championship. According to (Moghaddam, 2019) lack of physical training in athletes can affect athlete performance in achieving achievements. It can be concluded that the lack of strength, endurance, *flexibility,* coordination in diving athletes, training for physical conditions needs to be prepared and planned systematically and carefully so that physical conditions can improve functional abilities to be better for the body (Subarjah, 2013) .

Coordination is also needed in the pool number, namely *bifins,* because athletes need coordination between the arms and legs, so that it can make the coordination of the *bifins diving number* better and can maximize the movement of the arms and legs when competing. Long-distance *bifins pool diving numbers,* athletes need endurance, both muscle endurance and *VO2Max endurance,* for diving athletes who choose the 200 meter number or 400 meters *bifins*. Leg and arm muscle strength is very much needed for diving athletes who take part in the 50 meter pool event.

bifins to support the athlete's performance, require arm and leg muscle strength training (Rumpoko, 2013).

To build *the vitality of* the physical condition of diving athletes, consistent physical training is needed in preparing for a championship, physical condition is very necessary for the initial foundation, so that athletes can provide optimal performance. To optimize the physical condition of the athlete, the coach is required to have a physical training program, so that athletes have good physical condition components, in diving athletes this is necessary because in doing the 50-meter *apnea dive,* athletes need hip *flexibility and* leg *power* (Budiyana, Mulyana and Purnamasari, 2021) .

In addition to having pool numbers, there are also sea diving numbers, namely OWF *(Open Water Finsswimming)* and also OBA (Underwater Orientation), endurance is needed in these two numbers, because both have a long distance, namely 1500 meters for OWF *(Open Water Finsswimming)* and OBA (Underwater Orientation) 590 meters. Endurance plays an important role for athletes to be able to dive between the two numbers and the endurance needed can be maximized when competing (Umi, Sugeng and Herpandika, 2024) .

Bifins is one of the diving sport pool numbers, the movement of bifins diving is the same as freestyle in swimming, what distinguishes bifins from freestyle is the use of equipment in bifins diving, namely fins and snorkels, it should be noted that in order to have a good time limit from before, diving athletes must have good physical condition, so that athletes have strength, speed of arm muscles and leg muscles, coaches must provide physical training programs to diving athletes. There is a simultaneous contribution between the explosive power of the leg muscles and significant arm muscle strength to freestyle swimming.

Based on observations that have been made during training, the diving athletes of Club Shima Sport Jepara, totaling 10 athletes, consisting of 5 male athletes and 5 female athletes who lack good physical condition components, namely in terms of strength, endurance, flexibility towards the results of the 100-meter bifins speed, to provide an impact of improvement for the athletes of Club Shima Sport Jepara. Later, a physical training program will be given that can provide improvements for the athletes of Club Shima Sport Jepara in terms of poor physical condition, in order to change the physical condition of the diving athletes of Club Shima Sport Jepara to be better. After being given a physical training program, the diving athletes of Club Shima Sport Jepara will be given a measurement test before and after using the physical training program.

METHOD

This study uses a quantitative approach with a correlational method. Quantitative approaches usually use instruments to test theories and produce deductive conclusions from general to specific by processing data with numbers or additions (Sutja d., 2017). The research method used in this study is using a correlational approach. (Sutja d., 2017) put forward correlational research studies the relationship between two or more variables and samples through data processing. Based on the description above, it can be concluded that the quantitative approach with the correlational method is a type of research used to study a particular population or sample using data collection as a tool. The purpose of this approach is to find out how two or more variables relate to each other. This study used 10 athlete samples (5 male and 5 female).

RESULTS AND DISCUSSION

RESULTS

Table 1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Back	10	65.0	95.0	82,260	11.0815
Leg	10	69.5	98.9	87,620	8.7094
Pull	10	5	14	9.90	2,767
12 minute run	10	2308	2542	2420.40	86,395

Sit & Reach	10	24	46	32.00	6,532
Bifins	10	46	55	50.00	2,708
Valid N (Listwise)	10				

The results of the descriptive analysis show that the back value has an average of 82.260 with a standard deviation of 11.0815, a minimum value of 65.0 and a maximum value of 95.0. Leg has an average of 87.620 with a standard deviation of 8.7094, a minimum value of 69.5 and a maximum value of 98.9. Pull-up has an average value of 9.90 with a standard deviation of 2.767, a minimum value of 5 and a maximum value of 14. The 12-minute run shows an average of 2420.40, with a standard deviation of 86.395, a minimum value of 2308 and a maximum value of 2542. Sit and reach with an average value of 32.00, a standard deviation of 6.532, a minimum value of 24 and a maximum value of 46. Meanwhile, the speed of 100-meter swimming with bifins has an average of 50.00, a standard deviation of 2.708, a minimum value of 46 and a maximum value of 55. These data illustrate a fairly good level of physical fitness with variations in performance between participants.

Table 2 Tests of Normality

	Shapiro Wilk		
	Statistics	df	Sig.
Back	.911	10	.290
Leg	.919	10	.348
Pull	.956	10	.735
12 minute run	.903	10	.235
Sitnreach	.916	10	.328
Bifins	.929	10	.434

The results of the normality test using Shapiro-Wilk showed that all research variables, namely *Back* (p = 0.290), *Leg* (p = 0.348), *Pull* (p = 0.735), *12-minute run* (p = 0.235), *Sit & Reach* (p = 0.328), and *Bifins* (p = 0.434), had a significance value greater than 0.05. This indicates that the data on all these variables are normally distributed.

Table 3 Correlations

		Back	Leg	Pull	12 minute run	Sit & Reach	Bifins
Back	Pearson Correlation	1	-.330	-.212	-.647 *	-.154	-.195
	Sig. (2-tailed)		.352	.557	.043	.670	.588
	N	10	10	10	10	10	10
Leg	Pearson Correlation	-.330	1	.609	.506	.723 *	.653 *
	Sig. (2-tailed)	.352		.062	.135	.018	.040
	N	10	10	10	10	10	10
Pull	Pearson Correlation	-.212	.609	1	.492	.781 **	.905 **
	Sig. (2-tailed)	.557	.062		.148	.008	.000
	N	10	10	10	10	10	10
12 minute run	Pearson Correlation	-.647 *	.506	.492	1	.680 *	.638 *
	Sig. (2-tailed)	.043	.135	.148		.030	.047
	N	10	10	10	10	10	10
Sit & Reach	Pearson Correlation	-.154	.723 *	.781 **	.680 *	1	.873 **
	Sig. (2-tailed)	.670	.018	.008	.030		.001
	N	10	10	10	10	10	10
Bifins	Pearson Correlation	-.195	.653 *	.905 **	.638 *	.873 **	1
	Sig. (2-tailed)	.588	.040	.000	.047	.001	
	N	10	10	10	10	10	10

Pearson correlation analysis shows that the *Back variable* has an insignificant negative relationship to the *Bifins variable* (r = -0.195, p = 0.588), indicating that back muscle strength does not contribute significantly to the *Bifins variable*. In contrast, the *Leg variable* shows a significant positive correlation with *Bifins* (r = 0.653, p = 0.040), indicating a significant relationship between leg muscle strength and the ability measured by the *Bifins variable*. The *Pull Up variable* shows a very strong and significant positive correlation with *Bifins* (r = 0.905, p < 0.001), indicating that body pulling ability has a very large contribution to the variable. Furthermore, the *12-minute Run variable* also has a significant positive correlation with *Bifins* (r = 0.638, p = 0.047), indicating that cardiorespiratory endurance plays a significant role in this relationship. Finally, the *Sit & Reach variable* shows a very strong and significant positive correlation with *Bifins* (r = 0.873, p = 0.001), which indicates that flexibility also has an important influence on this variable.

DISCUSSION

The results of this study indicate a significant relationship between leg strength (Leg), body pulling ability (Pull Up), cardiovascular endurance (12-minute Run), and flexibility (Sit & Reach) with speed using Bifins in diving athletes. A very strong correlation in the Pull Up variable (r = 0.905, p < 0.001) and Sit & Reach (r = 0.873, p = 0.001) indicates that body pulling ability and flexibility are the main factors in increasing swimming speed with Bifins. In addition, leg strength (r = 0.653, p = 0.040) and cardiovascular endurance (r = 0.638, p = 0.047) also contribute significantly to this speed performance. In contrast, back strength did not show a significant effect, which may be related to the smaller role of back muscles in swimming movements using Bifins.

The elements of physical condition needed to support the achievement of diving achievements include leg length, leg muscle strength, and maximum oxygen volume (Rumpoko, 2014). The purpose of developing physical condition is to improve the technique of the chosen or trained sport, so the purpose of developing physical condition depends on the condition and skills of a person to improve the biomotor abilities needed to improve the achievements of the sport being pursued (Gusdi Wardiman et al., 2019). Prime physical condition will be the main foundation for athletes to achieve optimal performance (Syafrial et al, 2023). Achievement sports are closely related to the best performance movements carried out in practice using benchmarks or parameters (Cahyo B et al., 2024). In this context, diving athletes must have a systematic, sustainable, and appropriate physical training program according to the needs of the competition in order to be able to perform optimally (Ibnu, 2024). In the sport of finswimming, biomotor abilities including strength, endurance, speed, coordination, and flexibility are determining factors in athlete performance.

a. Arm Muscle Strength

Muscle strength greatly contributes to the performance of swimming and diving athletes, especially in breaststroke and 100-meter freestyle swimmers, which are greatly influenced by arm muscle strength. However, research related to freestyle shows a major role of arm muscle strength in swimming speed. According to research conducted by (Setiawan Y., 2022), the arm muscle strength of male athletes contributed 77.9% to freestyle swimming speed and 98.8% to the swimming speed of female athletes. Therefore, arm muscle strength greatly contributes to the freestyle arm pull in swimming, and bifins in diving.

b. Leg Muscle Strength

Muscle strength is a vital biomotor component in supporting speed in diving, especially in the bifins event. In the technique of swimming with bifins, the main movement comes from the legs which continue to move up and down like fish fins. Therefore, the strength of the leg and lower back muscles is the main source of power to produce a large thrust, which directly affects the speed of the swimmer in the water. The greater the strength of the leg muscles, the faster the athlete's bifins swimming time (Sobirin, 2019). This reinforces that developing muscle strength, especially the legs, is the main key to accelerating movement in the water. emphasized that strength not only supports movement but also increases acceleration efficiency at the start and when changing speed in the water (Syam et al., 2020).

c. Speed Endurance

Endurance is a person's ability to perform activities for a long time and continuously. Swimmers really need speed endurance, or speed endurance, especially in the 100-meter race, where anaerobic

and sprint endurance are needed to maintain high speed throughout the race. Although the 100-meter race is considered a sprint race, anaerobic endurance is still an important component of the competition. In swimming and diving, athletes really need a fairly high level of oxygen volume. This is because athletes are required to show their performance well and of course it is influenced by the level of oxygen volume they have (Lusianti, 2020). In 100-meter swimming, the athlete's body relies on the anaerobic energy system, namely ATP-PC system and glycolysis, to produce fast and efficient power. Proper training can increase the capacity of these systems, allowing athletes to maintain high speeds for longer without experiencing premature fatigue.

d. Flexibility

Flexibility is one of the important components in supporting speed in bifins diving. Flexible and efficient leg movements can increase forward thrust, reduce water resistance, and maintain a streamlined body position in swimming. In this context, the flexibility of the leg, hip, and lower back muscles greatly affects the athlete's performance (Ganeswara, 2018). Body flexibility and *joint proprioception* are two aspects that must be carefully determined in determining the identification of synchronized swimming and diving athlete talent (Yanuar et al., 2022). Flexibility allows swimmers to perform wider and stronger leg movements, and maintain an optimal body position in the water (Reichmuth et al., 2021)

The movement ability of bifins is the same as freestyle (*crawl*), so flexibility is also needed in bifins to help increase speed, coordination, agility, save energy, and help produce efficient movements (Kusumaningtyas et al., 2024). One of the biomotors that needs to be mastered by finswimming athletes is Speed. Speed is the ability to move from one place to another in the shortest possible time (Shanty et al., 2021). In the Finswimming sport, the Sprint Number in Bifins requires speed which must be followed by strong arm muscle strength and strong leg muscle strength. the faster the swimming speed of the bifins because the more explosive leg movements are able to produce higher acceleration (Alvionita et al., 2024).

Thus, the development of leg strength, body tensile strength, cardiovascular endurance, and flexibility are essential in increasing speed using *Bifins* in diving athletes. These findings can be a reference in designing more effective and specific training programs to support diving athletes' achievements.

Physical abilities such as upper body muscle strength and lower body flexibility are two important components that can affect the speed of the bifins in diving. One indicator of upper body strength is the ability to do a pull-up. This movement represents the strength of the upper back, arm, and shoulder muscles that play a role in maintaining a streamline position when swimming. The streamline position is very important to reduce water resistance and increase movement efficiency. Upper body muscle strength supports body stability in the water and maximizes propulsion when performing bifins movements. The better the upper body strength, the more stable and faster the body's movement in the water.

In addition, the flexibility of the lower body muscles also plays an important role, especially in the movement of the legs when performing a bifin kick. Sit and reach is a flexibility test that measures the flexibility of the hamstring, lower back, and calf muscles. Optimal bifin kick movement requires flexibility in these parts to produce a wide and efficient amplitude of movement. Lower body flexibility allows athletes to perform smoother and faster movements in the water, thereby increasing swimming speed. Tension or stiffness in these muscles can limit the range of motion and reduce movement efficiency.

Thus, pull-up ability and sit and reach results significantly contribute to bifins speed in diving athletes. Upper body strength supports stability and thrust strength, while lower body flexibility supports fluidity and leg movement efficiency. Both work synergistically to improve speed performance in the water.

CONCLUSION

This study shows that leg strength, body tensile strength, cardiovascular endurance, and flexibility have significant relationships with swimming speed using Bifins in diving athletes. Body tensile strength and flexibility have very strong correlations with Bifins speed performance, while leg strength and cardiovascular endurance also contribute significantly. In contrast, back strength has no significant effect on Bifins speed. From the results of this correlation, it can be concluded that pull-up

ability and body flexibility (sit and reach) are the two physical factors that have the most significant influence on bifins speed. These two factors can be used as the main reference in compiling a physical training program to improve the performance of diving athletes. Other variables such as cardio endurance (12-minute run) and leg strength are also important, although their influence is slightly lower. Therefore, the development of a training program is very important to improve the performance of diving athletes in swimming using Bifins.

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