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Sprint running and repeated jumping in the sand and in water: Its influence on limb power in the game of sepaktakraw

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Abstract

Sepaktakraw is a traditional sport that continues to grow. The dominant biomotor component in this sport is leg power. The majority of techniques in this game are done by jumping. By having good power, the jump height can be maximized so that the potential for success in performing the technique is greater. This research aims to find out what kind of surface training is most effective for improving physical condition. There are several surfaces that have been popularly studied in recent years, namely sand and water. The research method used is quantitative research with a quasi-experimental design. The subjects in this research were 40 sepaktakraw athletes. The results of this research are that training in sand is more effective in increasing leg power. The average athlete's height is 168 cm, weight 60 kg, and age 17 years. Athletes were divided into 4 groups, namely the sprint training group in the sand, the repeated jump training group in the sand, the sprint training group in the water, and the repeated jump training group in the water.

Keywords: Sprint, jump, sand, water, power, sepaktakraw

Introduction

Science in sports continues to develop in line with the progress of human civilization. Stlet's abilities continue to develop starting from physical, strategic and mental techniques. Many parties continue to play a role in this research and development, one of which is from universities. Research like this should continue to be carried out to improve athletes' abilities so that they can support the achievements of Indonesian athletes on the world stage. In the physical aspect, studies have been carried out to improve the quality of athletes' performance. One of them in this research is trying to examine the role of the floor surface used during training, namely sand and water. Previously, several studies have been conducted that show sprinting is an exercise that can improve physical condition, especially jump height, (Hammami *et al.*, 2022) ^[5]. Apart from that, what also plays an effective role in increasing leg power is repeated jump training (Bashir *et al.*, 2022) ^[1]. By jumping repeatedly, you will certainly train the muscle system and nervous system in the body to improve its working mechanism. If this stress adaptation lasts for 6 to 8 weeks, it can be a positive thing for increasing power (Chen *et al.*, 2023) ^[3], (Utomo *et al.*, 2024) ^[14].

On the other hand, there is research that also examines the surface used for training, because it is considered that the training surface also needs to be developed. Athletes who have been actively training for a long time certainly need to be given more weight in their training. There are several ways to increase the training load, namely the load given to the body, the intensity of the training by increasing or reducing the training time and modifying the surface of the training area so that the body gets more resistance when doing the exercise. As an application, several researchers have found that modifying the training surface using sand can significantly improve physical condition (Pereira *et al.*, 2023) ^[8]. This can happen because the structure of the sand will change or move when pressure is applied (Ramirez-Campillo *et al.*, 2019) ^[9].

An athlete who steps foot into the sand will go down first, then when the athlete is about to push off, the body will go back into the sand so that the push off will lack power so that the effort made by the legs to produce power is pushed to be greater so that the jump can be done. In this case the legs will work harder to produce greater energy. If this mechanism takes place at a certain time, this will be good for the development of the muscle system and neuromuscular system as an action to increase physical abilities, especially power. Other developments were also carried out on a different training surface, namely water. Research shows that exercise done in water can improve physical performance in athletes (Salafi *et al.*, 2022) [11]. Water has certain advantages that are superior to others. For example, water can be obtained easily and is more flexible following the shape of the container that supports it. Water placed in a container will always remain flat so that the pressure or resistance on the legs will always remain stable during the training process.

Apart from that, water can balance the temperature of the skin because you can manipulate the water temperature. However, in this study the researchers used water of normal temperature. When exercising, body temperature will increase, when jumping in water, the legs will continue to do their work so that the temperature in the legs can be increased. Well, the role of water here is to stabilize the temperature of the legs so that fatigue can also be extended in duration. In this research, a collaborative study was carried out from several aspects above, namely combining sprint and repeated jump training in sand and water to increase power in sepaktakraw athletes. By combining several of these aspects, it is hoped that it can help athletes to increase their potential in playing sepaktakraw.

Methods

This research is classified as quantitative research with a quasi-experimental method. The design chosen was a matching only design using ordinal pairing as the division of research subjects into each group. The population in this study were all athletes from the Surabaya Sepaktakraw Academy club. The total number of athletes is 40 people. The first group was given sprint training on a sand surface, the second group was given treatment in the form of repeated jump training on a sand surface, the third group was given training in the form of sprinting in water, and the fourth group was given repeated jump training in water. The average athlete's height is 168 cm, weight 60 kg, and age 17 years. The facilities and infrastructure needed when carrying out training are a sandbox training area on a volleyball court, a water tank in a children's swimming pool with a final height of around 40-45 cm. This height is ideal for getting optimal output for the legs to produce energy. Other equipment used is chalk, jump DF, and stopwatch. The research instrument is a vertical jump test with a DF jump to measure the power performed by athletes. The research took place starting from the pre-test, namely measuring the athlete's initial abilities. This was then continued with treatment which was divided into four experimental groups for 6 weeks. Next, a post-test was carried out to see whether there were any changes after carrying out the treatment. Data analysis used multivariate tests and post-hoc tests with the help of SPSS 21.

Results

Based on tests carried out in SPSS 21, it was found that the sample came from a normal and homogeneous distribution. Furthermore, based on the multivariate t-test, there were

differences before and after the treatment was given, then carry out a post-hoc test to find out the sequence of exercises starting from the most effective for increasing the leg power of sepaktakraw players. The following is a table of data obtained from the results of the post-hoc test.

Table 1: Statistical test of hypothesis

Group		Mean difference	Sig (p)
Eksperiment I	Eksperiment II	-110,81	0,004
	Eksperiment III	90,23	0,006
	Eksperiment IV	83,33	0,006
Eksperiment II	Eksperiment I	110,81	0,004
	Eksperiment III	148,16	0,001
	Eksperiment IV	130,73	0,004
Eksperiment III	Eksperiment I	-90,23	0,006
	Eksperiment II	-148,16	0,001
	Eksperiment IV	-62,30	0,017
Eksperiment IV	Eksperiment I	-83,33	0,006
	Eksperiment II	-130,73	0,004
	Eksperiment III	62,30	0,017

Based on this table, it can be seen that the significance values are all more than 0.05, so that all the exercises in the experimental group are effective exercises for increasing power. However, it can be seen that there is a highest level of effectiveness for increasing leg muscle power. The most effective starting exercises start from repeated jump exercises in the sand, sprint exercises in the sand, repeated jump exercises in the water, and sprint exercises in the water.

Discussion

Repeated jump training in the sand is the best exercise to increase the leg power of sepaktakraw athletes. This is in line with the concept of plyometric training, namely the SSC (stretch shortening cycle) which occurs in this exercise is more powerful, (Sylvester *et al.*, 2024) [13]. The mechanism that occurs is that when the athlete's foot steps on the sand, the foot will enter the sand, this results in the pre-stretch process of the leg muscles taking place to a greater extent so that it has the potential to store greater energy. This is included in the action process carried out by the legs, then when the reaction process is carried out, namely flexing the muscles on the surface of the sand, the body will be pushed upwards more heavily because the sand will provide resistance. This process generates greater energy and the stressors obtained by the neuromuscular system are greater than exercises carried out on the floor (Giatsis *et al.*, 2022) [4]. Thus, as time goes by for 6 weeks, the muscles will continue to adapt so that the quality of power increases.

Sprint training in sand ranks second as an effective exercise for increasing the leg power of sepaktakraw players. Sprinting is running as fast as possible, in this research it was carried out in a sandy area, namely on a beach volleyball court. Before carrying out field practice, hoe the field first to avoid the hard texture of the sand. In this way, the sand will be more ready to use to get the best impact. Sprinting in sand is good to do, because it contains an active and constant movement mechanism with high intensity which can put excess pressure on the muscles and nervous system. With many repetitions of the spin movement, it will have an impact on the athlete's lower limbs resulting in changes in ability, especially in the athlete's leg power, (Sáez de Villarreal *et al.*, 2024) [10].

Furthermore, repeated jump exercises in water are the third best for increasing leg muscle power. Leap. The movement pattern for the repeated jump exercise is in accordance with the test carried out, namely vertical jump using jump df.

When doing this exercise the leg muscles are always working hard to jump as high as possible. Of course, this requires synergistic effort starting from the cardiovascular system, respiratory system, muscle system and nervous system (Höög & Andersson, 2021) ^[6]. Jumping in certain conditions will cause high coordination between the systems in the body. So this training process has an impact on leg muscle power. The next exercise that is effective for increasing leg power output is sprinting in water. Sprints performed in water have a different mechanism from those performed on the floor or ground. The system works by inhibiting the movement that occurs. With this resistance, the leg muscles will have a harder time carrying out their work. This is good for providing more stressor to the working muscles. The movements that occur will of course be slower when done in water, this is because water has a higher density than air, so the friction force between skin and water is greater than the friction force between skin and air (Salafi *et al.*, 2022) ^[11]. This is what causes training in water to feel harder than training on the floor.

There are different concepts between sprinting and repeated jumps, namely that in sprinting the movements are carried out in a direction that tends to be horizontal, while in repeated jumps the movements are carried out in a vertical direction. Thus of course the dominant muscles that work certainly have differences. Meanwhile, if studied from a biomechanical perspective, sprinting will experience a lower pre-stretch of the calf muscles than repeated jumps, this is because in repeated jump training the athlete jumps as high as possible and then goes astray after landing, the body weight when landing certainly increases because there is a gravitational force exerted on the body. In this way, the legs will support excess body weight, which causes greater pre-stretch (Scott *et al.*, 2022) ^[12]. Thus, repeated jump training has a greater impact on the neuromuscular system and produces better power generation.

The surface of the training ground also received an important focus in this research. The training surfaces used are sand and water. Sand media has a higher density than water (Bonavolontà *et al.*, 2021) ^[2]. However, the most important point why sand is more effective as a medium that can be used to train power is its working mechanism. There are different mechanisms between the two. In sand media there are 2 resistances, the first is that just after the athlete is about to jump, the feet will go back down a little and then they will rise, before actually taking off the feet will also be held by the sand around the feet. So there are 2 obstacles that occur in activities carried out on sand media. Meanwhile, in water media, only 1 resistance is provided, namely only the resistance provided by the water around the feet. This is because when an athlete sets foot in water, the foot will not sink deeper.

This research is in line with research conducted (Sáez de Villarreal *et al.*, 2024) ^[10], this research shows that sprinting and plyometrics on sandy media can improve athletes' physical condition. Apart from that, this research is also supported by research (Ozen *et al.*, 2019) ^[7] that plyometric training using sandy training areas can improve the overall performance of athletes. Research (Bashir *et al.*, 2022) ^[1] also shows similar results, namely that sprint training and jumping training can have a positive effect on athletes' functional movements.

Conclusion

Sprint and repeated jump training has a significant influence

on increasing the leg muscle power of sepaktakraw players at the Sepaktakraw Surabaya Academy (ASS) club. The highest level of effectiveness is to increase leg muscle power. Namely starting from repeated jump training in the sand, sprint training in the sand, repeated jump training in the water, and sprint training in the water. The four exercises examined in this research can be used as a reference for increasing the power of sepaktakraw athletes. It is best to carry out similar research with different media, and expand the research subject.

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