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Effect of plyometric depth jump exercise toward vertical jump changes of volleyball players UKM, Hasanuddin University

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Abstract. In volleyball game, vertical jump is an important component in doing spikes and blocks. One of the exercise that can be used to improve the vertical jump is plyometric depth jump exercise. This study aims to determine the effect of plyometric depth jump exercise toward changes in vertical jumps of volleyball player UKM Bola Voli. This study was a quasi-experimental research with time series design approach. The sample sizes were 20 students and plyometric exercise was given 12 times (1 month). The sample inclusion criteria were men on aged 18-25 who are willing to become respondent and sign informed consent. The data collected was vertical jump value of volley ball player UKM. The results showed that there was an effect of plyometric depth jump exercise with the intensity of 4 set of 12 repetitions and 5 sets of 12 repetitions with significance value of 0.017 and 0.000 ($p < 0.05$). This study showed an increase in vertical jump value in volley ball players UKM, Hasanuddin University.

1. Introduction

The physical activity (PA) is well-known for the good health which helps in reduce risks of chronic disease and improved life quality [1,2,3]. Physical activity is defined as “any bodily movement produced by the skeletal muscle those results in energy expenditure” and classified in different ways including intensity, duration, type, frequency and context [4]. The inactive physical activity also correlated with risk of heart disease, cancers, diabetes, hypertension, obesity, osteoporosis and mental health disorders [5,6].

Most important technical capability in volleyball is the ability to attack (spike/ smash) and block which using both of these techniques can be score about 80% in the game [7]. Ciccarone et al. (2008) stated ability of block, spike and jumping services is influenced by the height that the volleyball can be achieve [8]. The vertical jump capabilities improvement are required for the proper training program. The physiotherapist as one of health professions associated with sports as well as having competence in handling and preventing injuries in sport also contribute to improve performance by suggesting appropriate exercise to improve athletes achievement.

The plyometric exercise is alternative that can be used to improve the vertical jump ability as well as muscle power. This exercise aimed to improve the muscle for achieving maximum strength within the shortest possible time. Plyometric exercise was mainly used by martial artist, sprinters and high jumpers to improve performances has gain the popularity and used by the athletes in all types of sport [9]. The depth jump technique that uses explosive movement to develop explosive power to increase



muscle strength and speed up attack ability. This study aims to determine the effect of plyometric depth jump exercise toward changes in vertical jumps of volleyball player UKM.

2. Methodology

The study was used quasi-experimental design with time series experimental design approach. The study was conducted at PKM field Hasanuddin University on 9th February and 19th February 2017. The study population was all members of Hasanuddin University volleyball players who were active. The study samples were 20 samples obtained based on met inclusion criteria such as willing involved in this study, male and aged between 18 years old and 25 years old.

The data was collected through primary data in questionnaire. The body mass index (BMI) value by taking weight and height data. The vertical jump data were obtained by direct measurement using vertical jump test performed before and after treatment. The vertical jump samples were measured after plyometric depth jump for 3 times per week as post test data which each week, intensity exercise was increased. In first week, plyometric depth jump exercise with intensity of 2 sets of 8 reps, 2nd week was given plyometric depth jump exercise with intensity of 3 sets of 12 reps. 3rd weeks was given plyometric depth jump exercise with intensity of 4 sets of 12 reps and 4th weeks was given plyometric depth jump exercise with the intensity of 5 sets of 12 reps.

The data was analysed by using SSS program. The collected data was tested in normality using the Shapiro- Wilk test. The paired T-test was performed to determine the effect of plyometric depth jump exercise on the vertical jump of UKM volleyball players of Hasanudin University. The result was presented in form of tables and narratives.

3. Result and Discussion

3.1. Result

Table 1 shows that 16 respondents (80%) were aged between 18 years old and 20 years old and 4 respondents (20%) were aged between 21 years old and 23 years old. There were 3 respondents (15%) were underweight and only 1 respondent (5%) were overweight. Meanwhile, most of respondents had normal BMI with total of 16 respondents (80%).

Table 1. Respondent characteristics.

Characteristics	Treatment group (Depth jump)	
	N	%
Age (years old)		
18-20	16	80
21-23	4	20
Total	20	100
BMI		
Underweight (17.0-18.5)	3	15
Normal (18.5-24.9)	16	80
Overweight (25.0-29.9)	1	5
Obesity (30.0-34.9)	0	0
Total	20	100

In additions, the pre-test mean and standard deviation were 48.07 and 9.18. The minimum and maximum of pre-test were 30 and 69. The post-test 1 had mean and standard deviation were 48.42 and 8.54. Minimum and maximum of post-test 1 were 31 and 71.5. Meanwhile, post-test 2 had mean and standard deviation were 49.57 and 9.60. Post-test 2 had minimum and maximum of 31.5 and 70. The mean and standard deviation of post-test 3 were 50.67 and 9.10. The minimum and maximum of post-

test 3 were 32 and 71.5. In additions, post-test 4 had mean and standard deviation of 52.97 and 8.95. Besides, post-test 4 had minimum and maximum of 34 and 73.

Table 2. Distribution of mean, minimum. maximum and standard deviation (SD) in UKM volleyball players of Hasanuddin University before and after given plyometric depth jump exercise.

	Mean	Minimum	Maximum	Standard deviation
Pre test	48.07	30	69	9.18
Post-test 1, intensity of 2 sets/ 8 reps	48.42	31	71.5	8.54
Post-test 2, intensity of 3 sets/12 reps	49.57	31.5	70	9.60
Post-test 3, intensity of 4 sets/12 reps	50.65	32	71.5	9.10
Post-test 4, intensity of 5 sets/12 reps	52.97	34	73	8.95

In additions, shapiro-wilk test for pre-test and post-test 1 were 0.663 and 0.082. Meanwhile, Shapiro-Wilk test for post-test 2,3 and 4 were 0.286, 0.474 and 0.930.

Table 3. Normal test.

	Shapiro-Wilk
Pretest	0.663
Post-test 1, intensity of 2 sets/ 8 reps	0.082
Post-test 2, intensity of 3 sets/12 reps	0.286
Post-test 3, intensity of 4 sets/12 reps	0.474
Post-test 4, intensity of 5 sets/12 reps	0.930

The paired T-test after being plyometric depth jump exercise with the intensity of 2 sets with 8 reps had obtained $p = 0.741$. After being given plyometric depth jump exercise, the intensity of 3 sets with 12 reps was obtained $p = 0.085$. Meanwhile, plyometric depth jump exercise with intensity of 4 sets with 12 repetitions was obtained $p = 0.017$ and intensity of 5 sets with 12 repetitions was obtained $p = 0.000$.

Table 4. Influence of plyometric depth jump exercise toward vertical jump changes

	Differences	p-value
Intensity 2 sets/8 reps Pretest	0.35	0.741
Post-test 1		
Intensity 3 sets/12 reps Pretest	1.50	0.085
Post-test 2		
Intensity 4 sets/12 reps Pretest	2.58	0.017
Post-test 3		

Post-test 3		
Intensity 5sets/12 reps		
Pretest	4.90	0.000
Post-test 4		

3.2. Discussion

In this study, average of respondents age was between 18 years old and 20 years old with total of 16 respondents and 4 respondents aged between 21 years old and 23 years old was good age that students starting to participate in physical activity. Furthermore, highest number of respondents was in normal category of BMI with total of 16 respondent (80%). A person with overweight will have less in jump high since gravitational jump will aggravate the movement and body mass was provided additional force that provides burden during jumping motion [10]. The accumulation of excessive fat may also aggravate the performance since additional loads was needed instead of extra force.

In this study, plyometric depth jump exercise with intensity of 2 sets with 8 repetition and intensity of 3 sets with 12 repetition had no effect on the vertical jump changes. Meanwhile, plyometric depth jump exercise with intensity of 4 sets with 12 repetition had significant influence compared with plyometric depth jump exercise on intensity of 5 sets with 12 repetitions. Sari (2008) had stated that plyometric depth jump exercises could increase vertical jump [11]. Higher exercise intensity and longer exercise duration had increased the effective in vertical jump. In additions, exercise at high intensity for shorter period also resulted in greater effect than exercise with moderate intensity over longer period.

In additions, workloads in exercise are gradually increased and adjusted to individual physiological and psychological capabilities. The gradually incremental training is must to achieve the desired outcome. The neuromuscular system functions and reactions, neuromuscular coordination and psychological capacities to cope with stress on increased athlete exercise might have taken time and athlete performance required training and adjustment for long duration. Hence, the training load should be sustained if too progressively overloaded.

The neurophysiology basis of plyometric exercises is related to the proprioceptors present in the body including the muscle spindle, Golgi tendon organ (GTO) and mechanoreceptors located in the joint and ligament capsules. This receptor stimulation leads to facilitate, inhabitation and modulate the agonist and antagonist muscles. Once the muscle spindle is stretched, there was an increase in the afferent nerve stimulation. The signal transmitted strength to the spinal cord of the spindle muscle depended on the strain rate applied. The faster the stretch leads stronger neurologic signal transmitted from the muscle spindle and increased the muscle contraction.

Another mechanism plays an important role in the plyometric-shorten stretch is GTO. The GTO acted as protective reflex that prevents over contraction or excessive tension in the muscles. Thus, GTO helps with modulation power during plyometric exercises. The goal of plyometric exercise is to increase excitation of neurological receptors to increase the reactive of neuromuscular system, while reducing the GTO. Plyometric explosive exercise had improved neural efficiency by enhancing neuromuscular coordination. Therefore, plyometric exercises improved neuromuscular performance by increasing the speed set based on the muscle action. Hence, this mechanism resulted in increment of neurological systems which enable neuromuscular coordination becoming more automated.

4. Conclusion

In conclusion, there was an effect of plyometric depth jump exercise with the intensity of 4 set of 12 repetitions and 5 sets of 12 repetitions with significance value of 0.017 and 0.000 ($p < 0.05$). This study showed an increase in vertical jump value in volley ball players UKM, Hasanuddin University.

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