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Providing of core stability exercise increase the core muscle strength of adult male Balinese vocational polytechnic volleyball athletes

Alifia Dwi Lestari^{1*}, Ari Wibawa², Anak Ayu Nyoman Trisna Narta Dewi²,
I Wayan Sugiritama³

ABSTRACT

Background: Central Management of Indonesian Volleyball Association admits that volleyball achievements have not been maximized, so they need to be improved. The core muscle have a role in each volleyball technique so that very important to increase core muscle strength which also impacts on the extremities, furthermore, the strength play a role to another biomotor and impact athlete's performance and achievement.

Aim: to prove that providing of core stability exercise increase the core muscle strength of male volleyball athletes aged 18-25 years old in the volleyball unit of student activities at Bali Vocational Polytechnic.

Method: an experimental study using a one group pre-test and post-test design with 22 total samples. Core muscle strength measured using one minute sit up test.

Results: Hypothesis test using paired sample T-test with p value= 0,000 ($p < 0.005$) statistically showed a significant increase in core muscle strength.

Conclusion: based on statistical tests, providing core stability exercise increase the core muscles strength of male volleyball athletes in the volleyball unit of student activities at Bali Vocational Polytechnic.

Keywords: core stability exercise, core muscle, volleyball, one minute sit up test

¹Bachelor of Physiotherapy and Physiotherapy Profession Study Program, Medical Faculty, Udayana University

²Department of Physiotherapy, Medical Faculty, Udayana University

³Departement of Histology, Medical Faculty, Udayana University

INTRODUCTION

Volleyball is one of the most popular sports and have many enthusiast in Indonesia. Volleyball has gained many achievements, but the Management Board of Indonesian Volleyball Association (PP PBVSI) admits that these achievements have not been maximized, so they need to be improved.¹

Volleyball athletes must have mastery basic techniques because it is important to produce optimal performance. Provision of these basic techniques is a factor that can determine the victory or defeat of volleyball matches.² In each volleyball technique, core muscles play an important role in the efficiency of movement, maintaining body position, maintaining flexibility and endurance strength when repeating performance, as well as supporting stabilization and strength to the arms and legs.³ Core muscles that work in volleyball techniques include external oblique, internal oblique, and transversus abdominis muscles in the abdominal regio,⁴ multifidus and erector spinae muscles in the back regio and pelvic floor muscles.⁵

It's very important to increase core muscles strength which also have an impact on the extremities, strength is the main determinant in achieving performance in sports while other biomotor such as speed, balance, accuracy and endurance are supporting that is formed in line

with the process of increasing strength.⁶ Core muscles also contributing about 50% of kinetic energy and the force for rapid arm movements such as bouncing and hitting the ball (smash), there is a pattern of muscle activation that starts from the contralateral oblique external muscle and continues to the arm.⁷ Core muscle strength affects the upper and lower extremities because if the muscle weakness then the risk factors for injury to athletes increase, for example shoulder injuries, low back pain, and hamstring injuries.⁸

Exercises that can increase core muscle strength are core stability exercises, but they also play an important role in stabilizing and transferring energy throughout the body. Increasing core muscle strength not only impacts athletes' performance but also minimizes the risk of injury.⁸

METHOD

This research is an experimental study using one group pre-test and post-test design. The research was conducted at the volleyball units of students activities at Bali Vocational Polytechnic on 9 October - 17 November 2019, with 22 total sampl. The sampling technique uses a purposive sampling technique that matches the inclusion and exclusion criteria. The procedure of this research before intervention is physiotherapy assessment to

*Correspondence to :
Alifia Dwi Lestari; Bachelor of Physiotherapy and Physiotherapy Profession Study Program, Medical Faculty, Udayana University;
alifiad60@gmail.com

record the identity and find out if there is a history of previous illnesses in the sample such as injury to bone and heart disease, if any, then included in the exclusion criteria. After that, a pre-test with measurement of core muscle strength uses one-minute sit-up test, then interventions core stability exercises, such as plank, superman, oblique plank and pelvic lift, are performed 3 times per week for 6 weeks. Each movement is held for 20 seconds, given an increase in time of 5 seconds for each of the four meetings, and carried out as many as 3 sets. After 6 weeks the core muscle strength was measured again and recorded as a post test result. The variables in this study are core stability training as an independent variable, core muscle strength as the dependent variable, core muscle strength based on pre-test results with below average categories (31-34 times), poor categories (25-30 times), and very poor categories (<25 times) is the category chosen as the inclusion criterion in this study. The control variables in this study are age and gender, the confounding variables in this study are nutrition and additional physical activity outside core stability exercise.

RESULT

1. Data Characteristic of Sample

Based on the presentation of [Table 1](#), it can be seen that a sample of 22 people in this research was dominated by 18-year-old of 16 samples (72.7%), while 19-year-old were only 6 samples (27.3%).

Characteristics of core muscle strength before

and after the intervention in [table I](#) show the results of pre-test with the poor category are the most numerous categories of 18 samples (81.8%), below average category of 4 samples (18.2%), while the very least category is the very poor category with a percentage of 0%.

Core muscle strength after intervention with the results of the post test in [table I](#) shows that the good category is the most frequent category, which is 9 samples (40.9%), the above average category is 8 samples (36.4%), the average category 5 samples (22.7%). Whereas the very good category is the least category with a percentage of 0%.

2. Normality Test Result

The results of the normality test using the Shapiro-Wilk test on the pre-test and post-test data respectively with $p = 0.215$ and $p = 0.434$ ($p > 0.05$) can be concluded that the data are normally distributed.

3. Homogeneity Test Result

Homogeneity test using Levene test in [Table 3](#) shows p value $0.829 > 0.05$ for pre test data, and p value $0.959 > 0.05$ for post test data, so that in homogeneity test, the data is homogeneous. Based on the results of the normality test and homogeneity test, the test used for hypothesis testing is the parametric statistical test.

After homogeneity testing, the data from the research results that have been obtained are then continued with paired different tests to determine differences in core muscle strength before and after exercise using Paired Sample T-test.

4. Different Tests of Core Muscle Strength Value Before and After Providing Core Stability Exercises

[Table 4](#) shows the differences in core muscle strength before and after giving exercise to all samples, the pre-test results showed a value of 28.82 ± 2.5 , after being given exercise core muscle strength increased to 41.45 ± 3.4 . [Table 4](#) also shows the p value = 0,000 ($p < 0.05$), so the hypothesis in this study was accepted and statistically can be interpreted that there is a significant difference between core muscle strength before and after core stability exercise in male volleyball athletes in the volleyball units of students activities at Bali Vocational Polytechnic.

DISCUSSION

Characteristic Sample

Characteristics of the sample in this research were active athletes of the volleyball units of students

Table 1. Characteristic Sample

Variable	Frequency (n)	Percentage (%)
Age		
18	16	72,7
19	6	27,3
Pre test		
Very poor	0	0
Poor	18	81,8
Below average	4	18,2
Post test		
Average	5	22,7
Above average	8	36,4
Good	9	40,9
Very good	0	0

Table 2. Normality Test Result

	Shapiro-Wilk		
	Statistic	N	p
Pre test	0,942	22	0,215
Post test	0,903	22	0,434

Table 3. Homogeneity Test Result

	<i>Levene Statistic</i>	N	p
<i>Pre test</i>	0,048	22	0,829
<i>Post test</i>	0,003	22	0,959

Table 4. Different Tests of Core Muscle Strength Value Before and After Providing Core Stability Exercises

Core Muscle Strength	N	<i>Mean±SD</i>	p
<i>Pre test</i>	22	28,82±2,5	0,000
<i>Post test</i>	22	41,45±3,4	

activities at Bali Vocational Polytechnic aged 18-19 years and samples were selected using purposive sampling with 22 total samples that were all male, this research dominated by 18-year-old of 16 samples (72.7%), while the 19-year-old was only 6 samples (27.3%). Bompas' research says the age to start practicing volleyball is 10-12 years old, the age to start specializing in volleyball is 15-16 years old and to achieve high performance at the age of 22-26 years old. The age of the athletes in the volleyball units of students activities at Bali Vocational Polytechnic are aged with mature specialization and an early phase to start achieving good performance, so that later at the age to achieve high performance in 22-26 years old, they will have better performance.⁹

Raharjo's research said the men aged 18 or over had twice the strength compared to female muscle strength. Young women until puberty have almost the same muscle strength as young men, after that middle age men (30-50 years) their muscle strength will increase significantly than women because after puberty, male muscle mass 50% greater than women. This happens because there is a relationship between increased muscle strength and muscle mass after puberty. Women's fitness is 15-25% lower than men after puberty. This happens because there are differences in body composition, lung capacity, body surface area, amount of hemoglobin, and so on.¹

Age and gender are among the factors that influence core muscle strength, which in the results of the analysis of the characteristics sample shows that this research has the same sample in the characteristics of age and gender, so that the characteristics of age and gender no longer affect the results of the research. The difference in results before and after the intervention is due to core stability exercises given in the study sample.

Characteristics of core muscle strength in 22

samples seen from the results before being given intervention (pre-test) showed that the very poor category percentage of 0%, poor category as many as 18 samples (81.8%), and for below average category were 4 samples (18.2%). One of the inclusion criteria in this study is the pre test results <35 for 1 minute, if the sample has a pre test result <25 then it is included in the very poor category, the pre test results are 25-30 including poor category, and the pre test results are 31- 34 included in below average category. This shows that all samples met the inclusion criteria seen from the pre-test scores.

Characteristics of core muscle strength based on the results after the intervention was given (post test) showed an average category of 5 samples (22.7%), a category above average of 8 samples (36.4%), a good category of 9 samples (40.9%), and for very good categories it has a percentage of 0%. This shows that all samples experienced an increase in pre-test to post-test results which in this study represented an increase in core muscle strength after administering core stability exercise

Difference Between Core Muscle Strength Value Before and After Giving Core Stability Exercise

The training given in this research was core stability exercise to increase the strength of the volleyball athletes' core muscles. Core stability training was also used in the Zulvikar's research by providing core stability training 3 times a week for 8 weeks resulting an increase balance in male students.⁹ Similar research conducted by Raharjo by giving a dose of exercise 3 times a week for 6 weeks could increase leg muscle strength in athletes volleyball.¹

Based on the research of Kharismawan et al., There was an increase in intra-abdominal pressure because the activated core muscles and resulted in increased stabilization of the trunk and can reduce loading on the spine. Increased intra-abdominal pressure due to activation of the core muscles occurs before the movements in the extremities so that the movement is more stable.¹⁰

These findings are supported by research Bagherian et al, which discusses the sequence of muscle activation during whole body movements and found that core muscles such as the transverse abdominis muscles, multifidus muscle, rectus abdominis muscle, and abdominal oblique muscle are consistently active before the limb muscles. This finding supports the theory that stability and control of movement begin from the core to the extremity (proximal-distal).¹¹

Research Hastuti, et al., States the activation of the core muscles is the beginning of postural reaction in the neuromuscular system. Postural

movements of the extremities and lower body segments such as the pelvic, hip and trunk will precede movements in the upper extremities.¹²

Another theory that is relevant to the relationship between core and extremities is the Law of Irradiation, which is defined as the ability of a muscle tension to recruit surrounding muscle tension, which occurs due to increased facilitation that changes the level of excitatory threshold in the anterior horn cell in the spinal cord. Facilitating stronger parts (core) can result in increased activation of motor units from the involved parts (extremities), thereby strengthening segment responses.¹³

Facilitating core muscles with core stability training so that the strength of the core muscles increases will play a role in other biomotor which affects the athlete's performance and achievement. Budianto's research states that good core muscle strength can maintain balance in the body when there external force. Muscle strength is directly related to the ability of muscles to resist gravity and other external loads that continuously affect body position.¹⁴ Kardha's et al., research proves that the determinants of running speed are very dependent on the strength of the muscles at work, speed cannot be developed without strength muscle.¹⁵ Other biomotor researched by Bempa stated that the greater the muscle strength, the greater the endurance produced.¹⁶

The very important thing in an exercise is the provision of regular and repetitive stress. Initially, core stability training creates stimulation which then causes the body's organs to compensate or adjust. Stimulation must be given repeatedly, systematically and pay attention to tolerance limits as long as the body's organs can adapt. Increased muscle strength begins with improvements in motor nervous system control such as aligning motor unit recruitment, decreasing autogenic golgi tendon organ inhibition, coactivation of antagonistic muscles and agonists and increasing the frequency of motor impulses towards motor unit. This improvement can also be associated with neural adaptation and coordination of neuromuscular learning with repetitive exercise.⁶

Core stability exercises that are done repeatedly will cause repetitive movements and muscle contractions in the spine, pelvic, and hip regions so that there is a combination of core, spine-pelvic-hip and nerve control functions, one of which functions to increase strength. Increasing the strength performance can also increase the ability of volleyball athletes in making both smash and service punches, jumps for smashes and blocks, and running to catch the ball.¹

This finding is supported by Purwocahyono's

research which proves that there is a significant relationship between good core muscle strength and ability to service and smash. Core muscles and arm muscles contribute 86.4% to the ability to service and smash volleyball athletes.¹⁶ These findings are in line with Yapici's research which proves that the effect of providing core stability training for 6 weeks increases accuracy and speed when volleyball athletes perform service and smash.¹⁷

Increasing core muscle strength is very important for volleyball athletes because it can improve motor skills, produce energy optimally, transfer and control force and movement from the body to the extremities so that athletes are able to apply strength more efficiently when performing performance such as service, smash, running, and jumping.¹⁸

RESEARCH LIMITATIONS

1. This research does not include data on the achievement of samples that have been successful or failed to be achieved so that the sample performance is seen increasing and decreasing. Future research are expected to include data that are consistent with the research objectives and are able to achieve the research objectives.
2. This research did not regulate additional nutrition and physical activity carried out by samples outside of the provision of core training that could affect the results of the research. Future research are expected to control this variable so that research results are more accurate.

CONCLUSION

Based on statistical tests, providing core stability exercise increase the core muscles strength of male volleyball athletes in the volleyball units of students activities at Bali Vocational Polytechnic.

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