https://doi.org/10.7251/SSH2401084M UDC: 796.42.012.1/.2:796.015
Original scientific paper *Originalni naučni rad*

The Influence of SCP-B-T (Standing Cable Pullover-Bench Press-Torso) Training on Spear-Throwing Ability on Prospective Spear-Throwing Athletes

Andi Atssam Mappanyukki[1], Sumaryanto[1], Erwin Setyo Kriswanto[1], Yudik Prasetyo[1], Nur Indah Atifah Anwar[1], Susanto[2]

[1]Sports Science Study Program, Faculty of Sports, Yogyakarta State University, Yogyakarta, Indonesia
[2]State Islamic University Sayyid Ali Rahmatullah Tulungagung, Tulungagung, Indonesia

Correspondence:
Andi Atssam Mappanyukki, Universitas Negeri Yogryakarta, Faculty of Sport and Health Science, Indonesia
andiatssam.2021@student.uny.ac.id

Abstract: *The rapid development of javelin throwing sport, it is necessary to improve the ability of athletes, this problem is a competitive demand. This study is to determine the effect of a specific training programme in this case is SCP-B-T training on improving the javelin throwing ability of prospective athletes. The sample in this study were prospective athletes at the South Sulawesi Sports Excellence High School specialising in javelin throwing, totalling 24 people. The research design used is true experiment, with purposive sampling technique. The experiment was given treatment for four weeks, consisting of two groups, namely the group given the SCP-B-T training programme and the control group. The SCP-B-T exercise programme treatment group used the Standing Cable Pullover-Bench Press-Torso tool, frequency 3 times per week, intensity 40-60%, reps 10-20, rest 60 seconds. To measure the level of improvement of the treatment given, we conducted a pre-test and post-test on both experimental groups. The study showed that the group given treatment in the form of the SCP-B-T training programme had a significant effect compared to the conventional training programme to improve the javelin throwing ability of prospective athletes. SCP-B-T training is very influential in improving the ability of prospective javelin throwing athletes.*

Keyword: *Experiment, Jevelin Throwing, SCP-B-T Training program*

INTRODUCTION

The sport of javelin throwing has been organised competitively since 1896 and has been part of the Olympic Games since 1908 for men and 1932 for women (IAAF, 2010). The development of javelin throwing sport is so rapid, so it demands an increase in the ability of athletes and becomes a competitive demand. It is a highly technical sport that involves precise sequential movements of lower and upper body segments. The javelin in this case is an aerodynamically designed device controlled by the laws of physics (Gorski, 1982). Javelin release is an important part of throwing technique (Hussain & Bari, 2012). The throwing angle is considered an important feature for travelling the maximum throwing distance, where the lower and upper body parts play an important role in javelin throwing (Krzyszkowski & Kipp, 2019). In the implementation of javelin throwing, there are several movements starting from the head, how to hold and carry the spear, body attitude when throwing a spear, how to throw a spear, and body attitude after throwing a spear. The sequence of movements is a unity of motion that must be trained in accordance with the throwing motion pattern. But so far there is no standardised training to improve javelin throwing, as stated by Guntoro, T.S. (2014) the conventional method is an approach that generally emphasises the use of weight training by trainers. This way of training contributes less to improving the performance of javelin throwing athletes.

To increase the success of javelin throwing, seen from the pattern of motion of the legs to the arms, the muscles that determine the motion of throwing javelins, especially the hip muscles to the arms still need to improve the form of training. One of the efforts to improve javelin throwing ability is physical exercise for athletes. Bafirman & Wahyuri (2018) say physical exercise and sports activities can provide changes in all body system functions. Changes that occur during training are called responses, while changes that occur due to regular and programmed training in accordance with the principles of training are called adaptations. The occurrence of changes in improving physiological abilities due to physical exercise is related to the use of energy by muscles, the form and method and principles of exercise carried out. Good physical condition will go hand in hand with good skills as well. In addition, to improve

the physical condition of an athlete, training with the circuit training method is needed (Susanto et al., 2021). Physical exercise can also be adjusted with a play approach so that it is not boring (Susanto et al., 2022).

Physical condition is a very important aspect in improving athlete achievement, physical development in factors that need to be resolved and improved without waiting for a better situation. Abou Elmagd, M (2016) explains that when athletes do not carry out regular physical exercise, they certainly cannot perform techniques optimally, to improve physical condition, programming must be done, that the training programme is part of training management that must be compiled and implemented properly and correctly. The basis for making an exercise programme should be based on the physiological and bimechanical aspects of the sport. Therefore, it is very important to make an exercise programme that is in accordance with the movement patterns of the sport to train the anatomy of the body that plays a role when performing these movements, so as to produce maximum ability. Increasing the ability of an athlete must be supported by a good physical component, this condition must be accompanied by structured training, this is in accordance with the opinion of McKinney, J., et al (2019) that an athlete can win the title when he has excellent physical condition in every training and competition.

In biomechanics of motion in javelin throwing sports, the implementation of javelin throwing techniques is a unity of motion from strength (strength), speed (speed), flexibility (flexibility), to produce a long throw influenced by the flexibility of the togok before releasing the javelin, and coordination of muscle work requires strength and speed (explosive power) of the arm in throwing the javelin. In the javelin throwing movement, the element of flexibility is very important because the movement of flexibility when starting the arm before releasing the javelin requires good flexibility so that the flexibility of the togok as a power plant to throw the javelin so that the explosive power of the arm is better. In javelin throwers, adaptation of static and dynamic shoulder flexibility will increase strength in the dominant physique (Edouard, P., et al 2013). The javelin throwing technique, the speed at which the thrower releases the javelin is by far the most important factor. To achieve a high throwing speed, the transfer of mechanical energy through the kinetic chain plays an important role.

Based on the author's interviews with several athletes and javelin throwing coaches, it was found that the problems experienced by athletes are the form of training that is not supported by facilities and infrastructure, related to physical training that does not understand the pattern of motion in accordance with the biomechanics of motion (Bacis, Special, Specific), there is no special training for javelin throwing numbers, the usual training given is training using external loads such as push ups, sit ups and others. In addition, the coach also complained about not understanding the types of muscles that play a role and the physiological function of training adaptations. This problem makes the athlete's performance decrease when competing, this is a factor inhibiting achievement, therefore it is necessary to offer a structured concept to support these achievements.

In addition, considering the nature and characteristics of javelin throwing, which is an explosive action and a series of continuous movements, the training provided should reasonably address these characteristics. Through the analysis of javelin thrower injuries in sports, this study uses biomechanical analysis methods to analyse the data changes in the final exertion stage and related reasons (Wang Wei a, Li Yalong b, 2021). Therefore, the compatibility of physical training with javelin throwing movements has an important role in improving physical fitness to the maximum. Based on this analysis, the author proposes a specific training programme based on the pattern of motion when throwing a javelin.

Problems arising from the observations of researchers, it was found that physical exercise that was not in accordance with the physical components of domonin did not have a good effect on improving javelin throwing ability. The need for weight training that trains muscles that play a role in anatomical physiology so that the results of the exercise have a significant effect. SCP-B-T training is a form of weight training that develops skeletal muscles well and has not been used by several coaches. The novelty of SCP-B-T training is a form of training that combines training (Bacis, Special, Specific) so as to increase the dominant biomotor components in the sport of javelin throwing.

METHODS

The research method used is True Experiment. As explained by Jack R. Fraenkel (2012) that an important element of the True Experiment is that subjects are randomly divided into several groups, where random assignment is a powerful technique for controlling the external influence of subject characteristics on the validity of the research. The random distribution of subjects was divided into two groups, the experimental group which was treated with the SCP-B-T exercise programme and the control group. The control group in this study as a comparison with the group

given treatment. The research design used in this study is The Randomised Pretest-Posttest Control Group Design. In this design, the effect will be seen between the group giving the treatment of the SCP-B-T training programme and the control group given treatment according to the conventional javelin throwing training programme. The division of groups is determined by random means through a lottery, in accordance with the research method used, namely True Experiment. The groups were given a pretest to measure the ability to throw a javelin, then given treatment to each group with a predetermined duration and form of treatment, ending with a posttest by measuring the javelin throwing ability again. The pre-test is given at the beginning before giving treatment to determine the initial state and changes that occur. The post-test is given at the end (after treatment) to evaluate changes in data during the pre-test as well as review the impact of the group given treatment or the control group given treatment according to the training programme provided. Changes that occur can be seen through the difference in O2 - O1 scores in each group, the difference obtained between O2 and O1 will explain the better effect due to the treatment given.

This research was conducted in Makassar City, with the population in this study being athletes at the South Sulawesi Sports Excellence High School specialising in javelin throwing, totalling 24 people. Participants in this study used a sampling approach, namely purposive sampling which is a sample selection based on criteria that are considered by researchers according to research needs. The criteria in this purposive sampling are: (1) Willing to be a sample, (2) Recorded as a student of the South Sulawesi Sports Excellence High School, (3) In good health, (4) Following the training programme properly. Based on these criteria, the number of samples in this study totalled 24 athletes.

RESEARCH INSTRUMENTS

In this study, data collection will be carried out using test and measurement techniques with research instruments in accordance with the reference. Specifically, the instruments used are (1) Microtoice or Anthropometer pipe to measure height. (2) Body weight using instruments: Body weight scales. (3) Strength using the instrument: Push Up. (4) Explosive Power using the instrument: Two hand medicine ball put test (5) Flexibility using the instrument: Forward flexion of trunk test (6) Javelin Throwing Ability using instrument: Javelin throwing ability test.

Treatment

The treatment was carried out after the athletes performed the SCP-B-T training programme with high intensity and had done the pretest. The treatment in this study was given to the SCP-B-T exercise programme treatment group using the Standing Cable Pullover-Bench Press-Torso tool, frequency 3 times per week, intensity 40-60%, reps 10-20, rest 60 seconds for the first group, with the number of meetings based on the significance of the treatment given. The control group was treated with a conventional javelin throwing training programme that did not specialise in the dominant body part when throwing the javelin.

Data Analysis Technique

The effectiveness test used was an experiment with a research design of one group pretest-postest design. Hypothesis testing using the Wilcoxon nonparametric test compares the results of the pretest and posttest of paired groups. The collected data were analysed using the SPSS version 20 application.

RESULTS

Presentation of data analysis results includes descriptive and inferential statistical analysis. Then a discussion of the results of the analysis and its relation to the theory underlying this research to provide interpretation of the results of data analysis. The Effect of SCP-B-T Training on Javelin Throwing Ability in Prospective Javelin Throwing Athletes. Empirical data obtained in the field in the form of SCP-B-T Training on Javelin Throwing Ability, first tabulated the data to facilitate further testing. Data analysis used in this research is analysis with inferential statistical techniques. Furthermore, testing the requirements of the analysis is carried out, namely testing the normality and homogeneity of the data, for hypothesis testing using the t-test to find the effect of SCP-B-T Training on the ability to throw javelins on prospective javelin throwing athletes with the requirement that the data must be normally distributed and homogeneous.

Descriptive data analysis is intended to get an overview of research data. Descriptive data is intended to be able to interpret and give meaning to the Effect of SCP-B-T Training on the Ability to Throw Javelin on Prospective Javelin Throwing Athletes the data is successively as in the following table.

Table 1. *Summary of the results of the analysis of the Effect of SCP-B-T Training on Javelin Throwing Ability in Prospective Javelin Throwing Athletes*

Variabel	N	Range	Minimum	Maximum	Sum	Mean	Std. Deviation
Javelin throwing pre test	20	14.50	19.00	33.50	483.24	24.1620	5.08484
Javelin throw post test	20	13.82	23.34	37.16	573.26	28.6630	4.70585

Based on table 1, the data results of the Effect of SCP-B-T Training on the Ability to Throw Javelins on Prospective Javelin Throwing Athletes are obtained as follows: 1) For Pre test data of javelin throwing given SCP-B-T training on prospective javelin throwing athletes obtained a value of N 20, range 14.50, minimum 19.00, maximum 33.50, Sum 483.24, mean 24.1620, Standard Deviation 5.08484. 2) For javelin throwing post test data given SCP-B-T training to prospective javelin throwing athletes obtained a value of N 20, range 13.82, minimum 23.34, maximum 37.16, Sum 573.26, mean 28.6630, Standard Deviation 4.70585.

One of the assumptions that must be met so that parametric statistics can be used is that the data follows a normal distribution if the test turns out that the data is normally distributed, it means that parametric statistical analysis has been fulfilled.To find out whether there is an effect of SCP-B-T training on javelin throwing ability in prospective javelin throwing athletes, testing is carried out with the Kolmogorov-Smirnov test. The results of the data normality test can be seen in the table.

Table 2. *Summary of the results of the normality test of the Effect of SCP-B-T Training on Javelin Throwing Ability in Prospective Javelin Throwing Athletes*

Variabel	N	Absolut	Positif	Negatif	KS-Z	Asymp.Sig (2 tailed)	Ket.
Javelin throwing pre test	20	0.250	0.250	-0.155	1.116	0.165	Normal
Javelin throw post test	20	0.141	0.141	-.0.129	0.631	0.820	Normal

Based on table 2, the variable Effect of SCP-B-T Training on Javelin Throwing Ability in Prospective Javelin Throwing Athletes above, it can be seen that the data normality test is as follows: 1) Pre test data for javelin throwing given SCP-B-T training on prospective javelin throwing athletes obtained a value of N 20, Absolute 0.250 Positive 0.250, Negative -0.155, KZ 1.116, asymp 0.165 (P> 0.005), with a perception equation asymp 0.165> 0.005 then the data on javelin throwing athletes given SCP-B-T training follows a normal distribution or normal distribution. 2) Javelin throwing post test data given SCP-B-T training on prospective javelin throwing athletes obtained the value of N 20, Absolute 0.141 Positive 0.141, Negative -0.129, KZ 0.631, asymp 0.820 (P> 0.005), with the perception equation asymp 0.820> 0.005 then the data on javelin throwing athletes given SCP-B-T training follows a normal distribution or normal distribution. For the sake of hypothesis testing, the average test between the research groups was carried out, namely the group that practised SCP-B-T training on javelin throwing ability in prospective javelin throwing athletes The statistical test technique used is the T test. A summary of the analysis results can be seen in the following table:

Table 3. *Summary of the results of the Effect of SCP-B-T Training on Javelin Throwing Ability in Prospective Javelin Throwing Athletes*

Variabel	N	Mean Value	Sig. Value
Javelin throwing pre test	20	24.1620	0.000
Post test javelin throw	20	28.6630	0.000
Difference	-	4.5010	-

Based on table 3 above, it can be seen that the effect of SCP-B-T training on the ability to throw javelins on prospective javelin throwing athletes as follows: 1) Data on athletes who were given SCP-B-T training on the ability to throw javelins on prospective javelin throwing athletes obtained the results of N 20, mean value 24.1620, value and sig value.0.000. 2) Data of athletes given SCP-B-T training on javelin throwing ability in prospective javelin throwing athletes obtained the results of N 20, mean value 28.6630, value and sig value.0.000. 3) From the data of athletes given SCP-B-T training on the ability to throw javelins at prospective javelin throwing athletes obtained the initial mean of 24.1620, the final mean of 28.6630 and obtained a difference of 4.5010.

DISCUSSION

Kinetic chains are segments influencing each other during movement (Seroyer et al., 2010). When one segment moves, it creates a chain of events that affects the movement of adjacent joints and segments. The more body segments that contribute to the total force output, the greater the velocity at release (Wilk et al., 2000). Throwing is the dynamic activity of an open-ended kinetic chain of segments acting from proximal (lower limb) to distal (upper limb) sequences (Oliver et al, 2018). The motion of each segment in the chain maintains energy transfer, but also increases energy (Wilk et al., 2000). Wilk and colleagues described a kinetic chain in overhead throws starting with 1) lower extremity, 2) pelvis, 3) spine, 4) shoulder girdle, 5) upper arm, 6) forearm, 7) hand; each segment starts as the adjacent proximal segment reaches its peak velocity (Seroyer et al., 2010).

The muscles of the lower extremities (quadriceps, hamstrings, internal and external rotators of the hip) coordinate together to provide a stable base for the trunk to rotate and flex during throwing (Seroyer et al., 2010). As the lower extremities generate most of the force during the throwing motion, dysfunction in the proximal segments can result in reduced energy transfer and shoulder and elbow (distal segment) weakness (Oliver et al., 2018). Success achieved from an efficient kinetic chain, requires strength, coordinated muscle activation with flexibility, and properly executed biomechanics (Meron & Saint-Phard 2017). According to Seroyer (2010), in support of Kibler and Chandler's previous findings, they found that a 20% decrease in kinetic chain energy delivered from the hip and torso to the arm would require a 34% increase in rotational velocity from the shoulder to achieve the same amount of force to the hand. Efficiency in the kinetic chain reduces the contribution of the shoulder joint, reducing stress and potentially reducing injury to the joint (Seroyer et al., 2010). Seroyer also stated that with greater knowledge of the kinetic chain and key parameters of the throwing motion can greatly improve technique, performance, rehabilitation and injury prevention. According to Weber et al. (2014) the energy generated during throwing should be safely released during deceleration and follow-through to reduce overuse injuries.

This study piloted the SCP-B-T training programme as a method to improve the javelin throwing ability of prospective athletes or novice athletes in throwing. Continuous training can also improve javelin throwing ability (Dumang, F., & Tengah, P. S. 2013). The throwing ability in this case is the javelin throwing technique from the prefix to the follow-through stage. When the prospective athlete is trained, a special training programme is given based on the dominant body organs when the prospective athlete throws. This is in line with what was revealed by Bompa O. Tudor, Buzzichelli A. Carlo. (2019), that the specificity includes: the dominant muscle group trained and the expected motion pattern. The exercises given must be related to the specific skills of a particular sport. This SCP-B-T exercise is a new training programme in the sport of javelin throwing. This study also compared the results of SCP-B-T training with conventional javelin throwing training. It was significantly found that SCP-B-T training was claimed to have more effect on improving javelin throwing ability than conventional javelin throwing training. Where throwing activity is a movement that provides energy to an object (Ambia, F et all., 2023).

In the initial stage of this study, the authors conducted a preliminary study by testing the training programme provided by the trainer at a high intensity. Once the SCP-B-T programme was deemed feasible, the author proceeded to administer the exercise programme to the actual sample. At the first meeting, the author introduced the sample to the programme and let the sample feel the physiological impact on their body after doing the SCP-B-T-based exercise programme. By the second week, the samples were getting used to the exercises and enjoying the exercise process. The SCP-B-T exercises belong to strength training. The author developed the training pattern to increase the strength of certain muscles so that when throwing, they have strength and speed. Strength training has been widely used as an exercise that is considered effective for increasing strength and muscle (Souza et al., 2014). Every week the author takes sample data to see the effect of the training programme that has been given. The increase in javelin throwing ability occurred in week three but the data showed that the increase was not significant. Therefore, the author continued until week four and found that the increase in the sample's javelin throw increased significantly. The results showed that of the two groups given treatment in the form of the SCP-B-T training programme and conventional training, it was found that SCP-B-T training had more influence on improving the javelin throwing ability of prospective athletes.

CONCLUSION

The SCP-B-T training programme has a significant effect compared to the conventional training programme to improve the javelin throwing ability of prospective athletes. This is in line with the research hypothesis based

on theories that support the principle of specificity of training programmes in related sports. Although the control group also showed an increase in the javelin throwing ability of the sample, when compared to the SCP-B-T training programme, it was found that the SCP-B-T training programme had a more significant effect on the javelin throwing ability of prospective athletes. The results showed the effect of the SCP-B-T training programme had a significant effect on javelin throwing ability, but this study still has several limitations such as, the number of samples that must be more and the duration of research time is too short. Therefore, future researchers are recommended to consider a larger and broader sample size, a longer duration of research and use different methods in order to reveal information that has not been revealed in this study.

Acknowledgments
We would like to thank the athletes at the South Sulawesi Sports Excellence High School specialising in javelin throwing.
Conflict of Interest
The authors declare no conflict of interest

REFERENCE

Abou Elmagd, M. (2016). Benefits, need and importance of daily exercise. Int. J. Phys. Educ. Sports Health, 3(5), 22-27.

Ambia, F., Zahara, Z., Ifwandi, I., & Rinaldy, A. (2023). Hubungan Power Otot Lengan Terhadap Kemampuan Lempar Lembing. *Jurnal Penjaskesrek*, *10*(2), 64-75.

Bafirman, B., & Wahyuri, A. S. (2018). *Pembentukan Kondisi Fisik* (Ed. 1). PT Rajagrafindo Persada.

Bompa O. Tudor, Buzzichelli A. Carlo. (2019). Theory And Methodology of Training. USA: Human Kinethic

Dumang, F., & Tengah, P. S. (2013). Meningkatkan Kemampuan Lempar Lembing Melalui Latihan Terus Menerus Pada Siswa Kelas V SDN hunduhon kec. Luwuk timur. *Tudolako Journal Sport Sciences and Physical Education*, *1*(1), 1-13.

Edouard, P., Damotte, A., Lance, G., Degache, F., & Calmels, P. (2013). Static and dynamic shoulder stabilizer adaptations in javelin throwers: A preliminary study. *Isokinetics and Exercise Science*, *21*(1), 47–55.

Gorski, J. P. (1982). Development of the soft-step javelin technique. *Coaching Clinic, 20*(3), 27-32.

Guntoro, T. S. (2014). The effect of training method and motor ability on javelin throw technique. *Asian Social Science*, *10*(5), 159–162.

Hussain, I. K. R. A. M., & Bari, M. A. (2012). Javelin throwing technique: A biomechanical study. Computer Engineering and Intelligent Systems, 3(1), 20-24

IAAF. (2010) Javelin throw. Retrieved from https://www.iaaf.org/disciplines/throws/javelin-throw.

Jack R.Fraenkel, N. E. W. (2012). *How to Design and Evaluate Research in Education*. (Michael Ryan, Ed.), *McGraw-Hill* (7th ed., Vol. 91). A venue of the America, New York: Beth Mejia

Krzyszkowski, J., & Kipp, K. (2019). Prediction of throwing distance in the men's javelin at the 2017 iaaf world championships. ISBS Proceedings Archive, 37(1), 344.

McKinney, J., Velghe, J., Fee, J., Isserow, S., & Drezner, J. A. (2019). Defining athletes and exercisers. doi:10.1016/j.amjcard.2018.11.001

Meron, A., & Saint-Phard, D. (2017). Track and field throwing sports: Injuries and prevention. *Current Sports Medicine Reports, 16*(6), 391–396.

Oliver, G. D., Washington, J. K., Barfield, J. W., Gascon, S. S., & Gilmer, G. (2018). Quantitative analysis of proximal and distal kinetic chain musculature during dynamic exercises. *Journal of Strength & Conditioning Research. 32*(6), 1545-1553.

Seroyer, S. T., Nho, S. J., Bach, B. R., Bush-Joseph, C., Nicholson, G. P., & Romeo, A. A. (2010). The kinetic chain in overhand pitching: Its potential role for performance enhancement and injury prevention. *Sports Health: A Multidisciplinary Approach, 2*(2), 135-146.

Susanto, S. et al. (2022). Traditional Sport-Based Physical Education Learning Model in Character Improvement and Critical Thinking of Elementary School Students. SPORTS SCIENCE AND HEALTH, 24(2), 165-172

Susanto, S., Siswantoyo, S., Prasetyo, Y., & Putranta, H. (2021). The effect of circuit training on physical fitness and archery accuracy in novice athletes. *Physical Activity Review*, *1*(9), 100-108.

Souza, E. O., Ugrinowitsch, C., Tricoli, V., Roschel, H., Lowery, R. P., Aihara, A. Y., Leão, A. R. S., & Wilson, J. M. (2014). Early adaptations to six weeks of non-periodized and periodized strength training regimens in recreational males. *Journal of Sports Science and Medicine*, *13*(3), 604–609.

Weber, A. E., Kontaxis, A., O'Brien, S. J., & Bedi, A. (2014). The biomechanics of throwing: Simplified and cogent. *Sports Medicine & Arthroscopy Review, 22*(2), 72-79.

Wei, W., & Yalong, L. (2021). Study on treatment and rehabilitation training of ligament injury of javelin throwers based on sports biomechanics. *Measurement: Journal of the International Measurement Confederation*, *171*(April 2020), 108757.

Wilk, K. E., Meister, K., Fleisig, G., & Andrews, J. R. (2000). Biomechanics of the overhead throwing motion. *Sports Medicine & Arthroscopy Review, 8*(2), 124-134.

Primljen: 30. mart 2024. / Received: March 30, 2024
Prihvaćen: 26. jun 2024. / Accepted: June 26, 2024