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The effect of variability knee tuck jump training and box jump training on the explosive capabilities of legs muscles

El efecto de la variabilidad del entrenamiento con salto con flexión de rodillas y del entrenamiento con salto al cajón sobre las capacidades explosivas de los músculos de las piernas

*Riand Resmana, *Mardepi Saputra, *Ardo Okilanda, *Iit Selviani, *M. Fakhrur Rozi, *Yogi Arnaldo Putra, **Mottakin Ahmed, ***Singha Tulyakul

*Universitas Negeri Padang (Indonesia), **Government College Silwani (India), ***Thaksin University (Thailand)

Abstract. The problem in this research is the low jumping ability of male volleyball athletes which effect on the decreased performance. The aim of this research is to know the effect of knee tuck training and box jump training on the explosive capability of the legs muscles of volleyball athletes. The type of the research is quasi-experiment with the research population is all male volleyball athletes at SMK 1 Solok Selatan which totally 24 athletes aged 17 years. The technique of sampling which is used is total sampling with a sample is 24 athlete. The instrument in this research is to use Vertical Jump to measure the explosive power of leg muscles. Before giving a treatment, an initial test (pte-test) is carried out to see the explosive power of leg muscles. The testees used as a samples are drawn into two groups. The group 1 is given the Knee Tuck Jump training treatment and the group 2 is given Box Jump Training treatment. This treatment is given 16 times (8 weeks), then the final test will be given. The data analysis technique which is used to test the hypothesis is t analysis at the significance level of 5%. Based on the data analysis in this study, 1) the Knee Tuck Jump get an average increase of (7.703) and was marked by getting t_{count} (10.631)> t_{table}(1.796). It means that the application of Knee Tuck Jump can increase the explosive power capability of leg muscles, 2) the Box Jump training get an average increase (2.456) and was marked by getting t_{count} (9.240)> t_{table} (1.769), it means that the application of the Box Jump training can increase the explosive power of leg muscles, 3) there was an influence training. Where in Knee Tuck Jump is getting the average increase is (7.703) while the box jump training is (2.456) and is indicated by getting t_{count} (2.05)>t_{table} (1.796). It means that the application of Knee Tuck Jump training and Box jump training could increase the explosive power capability of the leg muscles, where the Knee Tuck Jump training shows better results in increasing the explosive power of the leg muscles. Coaches apply knee tuck jump training at the right age level to achieve maximum results according to the athlete's training capacity.
Keywords: Explosive Capability of Leg Muscle, Knee Tuck Jump, Box Jump.

Resumen. Resumen. El problema de esta investigación es la baja capacidad de salto de los atletas masculinos de voleibol, que afecta a la disminución del rendimiento. El objetivo de esta investigación es conocer el efecto del entrenamiento de flexión de rodillas y el entrenamiento de salto al cajón en la capacidad explosiva de los músculos de las piernas de los atletas de voleibol. El tipo de investigación es cuasi-experimental con la población de investigación compuesta por todos los atletas masculinos de voleibol en SMK 1 Solok Selatan, que en total son 24 atletas de 17 años. La técnica de muestreo que se utiliza es un muestreo total con una muestra de 24 atletas. El instrumento en esta investigación es utilizar el salto vertical para medir la potencia explosiva de los músculos de las piernas. Antes de administrar un tratamiento, se lleva a cabo una prueba inicial (pte-test) para ver la potencia explosiva de los músculos de las piernas. Los sujetos de prueba utilizados como muestra se dividen en dos grupos. El grupo 1 recibe el tratamiento de entrenamiento de salto con flexión de rodillas y el grupo 2 recibe el tratamiento de entrenamiento de salto al cajón. Este tratamiento se administra 16 veces (8 semanas), luego se realizará la prueba final. La técnica de análisis de datos que se utiliza para probar la hipótesis es el análisis t con un nivel de significancia del 5%. Con base en el análisis de datos en este estudio, 1) el salto con las rodillas encogidas obtiene un aumento promedio de (7,703) y se marcó al obtener un recuento t (10,631)> tabla t (1,796). Esto significa que la aplicación del salto con las rodillas encogidas puede aumentar la capacidad de potencia explosiva de los músculos de las piernas, 2) el entrenamiento de salto al cajón obtiene un aumento promedio (2,456) y se marcó al obtener un recuento t (9,240)> tabla t (1,769), lo que significa que la aplicación del entrenamiento de salto al cajón puede aumentar la potencia explosiva de los músculos de las piernas, 3) hubo un entrenamiento de influencia. Donde en el salto con las rodillas encogidas se obtiene el aumento promedio es (7,703) mientras que el entrenamiento de salto al cajón es (2,456) y se indica al obtener un recuento t (2,05)> tabla t (1,796). Esto significa que la aplicación del entrenamiento de salto con las rodillas flexionadas y del entrenamiento de salto al cajón podría aumentar la capacidad de potencia explosiva de los músculos de las piernas, donde el entrenamiento de salto con las rodillas flexionadas muestra mejores resultados en el aumento de la potencia explosiva de los músculos de las piernas. Los entrenadores aplican el entrenamiento de salto con las rodillas flexionadas en el nivel de edad adecuado para lograr los máximos resultados de acuerdo con la capacidad de entrenamiento del atleta.
Palabras clave: Capacidad explosiva del músculo de la pierna, Salto con las rodillas flexionadas, Salto al cajón.

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Riand Resmana
riandresmana@fik.unp.ac.id

Introduction

Sports in one of the effort to increase someone capability into the better things as an individual, group and social (Aziz et al., 2023). physical activities give positive effect on the body endurance. one of the that is often played is volleyball. Volleyball is a game played in teams by 6 people in each team (Ratimiasih.Y;Hudah, 2021). To create a strong volleyball club, it needs to be supported by components of physical condition, technical and tactical abilities as well as those related to psychological problems (Afanasieiva et al., 2019; Jabbar, 2023). Excellent physical condition will support athletes in having good movement techniques in competitions. To improve excellent physical condition , the quality of physical training program is very important or crucial, because no matter how large the

biological potential (Heredity and talent) owned by volleyball athletes, without being supported by a good quality training program and correct training, then maximum performance is difficult to achieve (Liskustyawati et al., 2024; Susila, 2021).

The development of quality human resources is the main focus in the effort to get the ideals of the Indonesian independence movement, which emphasize in the fair society, prosperous and prosperity (Syafruddin & Asri, 2022). The quality of human resources is not determined by intellectual aspect, but also physical aspect including level of health and physical fitness (Mamurov et al., 2020). In this context sport is being one of the effective ways to increase the level of health and physical fitness (Ardian et al., 2024; Riyanto, 2020). Sport coaching aimed to create healthy, and have good quality human (Bissett et al., 2020). One of the Branch of sport which has a good quality is volleyball (Trecroci et al., 2021). In Volleyball game the explosive capability of leg muscle is important to do movements such a jump, smash, and block (Suadmaji et al., 2020; Syafriandi & Donie, 2020). This ability can be improve by various exercises, including Knee Tuck Jump training and Box Jump training.

Knee Tuck Jump is a training including jumping movements while bending the knees toward the chest (Halimah et al., 2023; Marpaung & Sari, 2022). meanwhile Box Jump is exercise including jumping on the box or a higher platform (Maćkała et al., 2021) . Box jump trining effect is streghtening leg muscles, this is reaction process that happened by adapting the training to the physiological system when doing heavier jumping weights, so that the muscle fibers will contract very strongly (hidayat fahrul, 2023). These two training can help increase the power and explosive capability of the leg muscles, which is very necessary in playing football. In this context, the aims of the study is to investigate the effect of variability in the Knee Tuck Jump training and Box Jump training on the explosive capability of volleyball athletes' leg muscles. By knowing the effect of these two training, it is hoped that it can contribute to the development of effective training methods to improve the physical abilities of volleyball athletes, especially in terms of leg muscle explosive capability. According to athlete achievement of SMK 1 Solok selatan, solok selatan regency, that the author got information from the physical education teacher as coach and observer, as well as the author's observations when the volleyball athletes from this school go in the last match with athlete. The author found that the defeat experienced by athletes of SMKN1 Solok Selatan is caused by their capability in jumping was unable to support basic techniques likes: smash, jump serve and block. So, from the many weaknesses, the most prominent is the ability of jump. The condition of jumping ability is considered a fundamental factor in sports performance that requires high demands of power and speed (Vilela & Caniuqueo-Vargas, 2021).

Materials And Methods

The research method used in this research is Quasi Experiment method (quasi-experiment) with a pretest and posttest research design. Participants in this research will be randomly divided into two group. First experimental group will undergo Knee Tuck Jump training and the second group will undergo Box Jump training with different training variations. The populations of the study is 24 man athlete who had problem with leg muscle explosive capability. Sampling in this research using total sampling techniques which all members of the population were sampled totaling 24 athlete aged 17 years. The variable that will be tested in this research are the variable of the Knee Tuck Jump and Box Jump training as independent variables, while the explosive capability of leg muscles is the dependent variable. The research instrument used was the leg muscle explosive power test before and after training intervention (Garcia et al., 2013). Research procedures include group determination, pretest measurement, interventions with exercises, and posttest measurements. This research design was carried out using a Two Group Pre-Test-Post- Test Design.

Data analysis done is using appropriate statistical test, such as t-test, to identify the effect of training variability on the explosive power capacity of the leg muscles. By using this experimental method, it is hoped that we can know more specific the influence and the variability of Knee Tuck Jump training and Box Jump training on the explosive capability of volleyball athletes legs muscles, so that it can contribute to the development of more effective training program in improving the physical abilities of volleyball athletes. Data result the normality test for the distribution of initial test data (pretest) and final test data (posttest) for Knee Tuck Jump and Box Jump in group II was analyzed using the Lilliefors statistical test with a significance level used as a basic for rejecting or accepting decision about the data distribution is normal or not.

Result

According to the calculation of normality test both of the group research can be found that L count (LH) got was smaller than the L table (Lt) at the reveal level a=0.05. So it can be conclude that all data group in this study were taken from a normally distributed population. Then t-test data statistical analysis.

Table 1.
Data Normality Test

Group	N	L_h	L_t	Information
Knee Tuck Jump	12	0,0318	0,2420	Normal
Exercise	12	0,1186	0,2420	Normal
Box Jump Training	12	0,0381	0,2420	Normal
	12	0,0227	0,2420	Normal

According to the table above, summary of homogeneity test result between the initial test data (pre test) from the knee tuck jump and the box jump training groups got: F count < F table, so it can be conclude that the sample comes from homogeneous population. Based on the measurement result of Knee Tuck Jump training group, the result of the

first hypothesis testing were; the initial test value : mean 108.799 kg.m/sec, standard deviation 7.20, lowest leg muscle explosion capability 98.5 kg.m/sec and the best leg muscle explosion capability was 121.41kg.m/sec. Final test score: mean 116.503kg.m/sec, standard deviation 7.794, lowest leg muscle explosion capability 102.78kh.m/sec and the highest leg muscle explosion capability 125.45 kg.m/sec. Based on the result of pre test and post test data calculation using the t test statistical approach, the knee tuck jump training group had a significance effect on increasing the explosion capability of the leg muscles of volleyball athletes at SMKN 1 Solok Selatan Regency. Tcount is 10.631 while ttable=1.796 with a significance level of a : 0.05 and n =12, so tcount>ttable (10.631>1.796). The result of data processing show that the mean pre teat result is 108.799kh.m/sec and the mean post test is 116.503 kg.m/sec where the range of the mean pre test and post test for the Knee Tuck jump training is 7.703kg.m/sec.

The measurements of the Box Jump training group and the result of the second hypothesis can be seen that : mean 109.084, standard deviation 7.459, lowest muscle explosion capability 99.39kg.m/sec and highest muscle explosive capability 121.04kg.m/sec. Final rest score mean: 111.540, standard deviation 7.201, lowest muscle explosion 101.44kg.m/sec and highest muscle explosive capability is 123.25kg.m/sec. Based on the result of pre test and post test data calculation using the t test statistical approach, the box Jump training group had a significance effect on increasing the explosion capability and muscle fitness abilities of volleyball athletes at SMKN 1 Solok selatan Region. T count is 9.240 while ttable is 1796 with significance level of a=0.05 and n=12, so tcaount>ttable (9.240>1796). The result of data processing show that the average pre test result is 109,084kg.m/sec and the average of post test result is 111,540 kg.m/sec. Where the average of pre test and post test range for box jump training is 2,456kg.m/sec. The increase in muscle explosion capability from knee tuck jump and box jump training can be seen in figure 1 below:

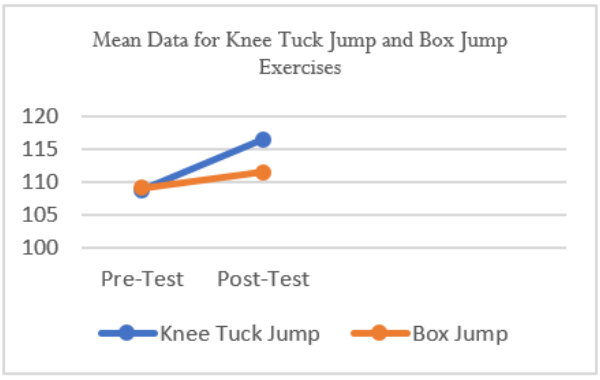

Figure 1. The data of Knee Tuck Jump and Box jump before and after given a treatments

Discussion

Hypothesis testing in this research uses the t test and consists of 3 hypotheses. The first hypothesis shows that Knee Tuck Jump training has a big effect on increasing the explosive capability of leg muscles with tcount > ttable 10.631 > 1.796 with a significance level of $\alpha = 0.05$. The results of data processing show that the Knee Tuck Jump group mean pretest was 108.799 and the mean post test was 116.503, meaning that there was an increase of 7.703 kg/m/second in the explosive power of the leg muscles. This can explain that during the Knee Tuck Jump training, 16 meetings showed significant improvement. In other words, the proposed research hypothesis has been significantly tested and the hypothesis is accepted. Training is systematic process in preparing athletes for high level performance, the process is carried out repeatedly with increasing loads (Nugroho & Yuliandra, 2021; Pamungkas et al., 2023) .in principle, training is providing physical pressure or stress regularly, systematically, continuously, in such a way that it can improve physical ability to do work. Knee Tuck Jump training is a form of Plyometrics exercise whose implementation is a form of jumping exercise by lifting both knees to the chest simultaneously (Anwar et al., 2020; Wasak, 2017). this exercise also focuses on movements in the leg muscles, where the movements are almost the same as measuring the explosive power capacity of the leg muscles. So that the movements in training predominantly stimulate the same muscles used in the Vertical Jump test (Arianda et al., 2021; Pişirici et al., 2020).

The results of testing the second hypothesis showed that Box Jump training had a significance effect on increasing the explosive power of the leg muscles of volleyball athletes at SMK Negeri 1 Solok Selatan Regency with tcount 9.240 > ttable of 1.796 with significance level of = 0.05. This means that the proposed research hypothesis is accepted.The second hypothesis was accepted in this research because the Box Jump training carried out could increase the explosive power of the leg muscles, progressive load increase is one of the principles of training, where the training load must always be increased according to the athlete's abilities (Mukhopadhyay, 2022). The higher the athlete's level of ability, the heavier and more intensive the training load given, or in other words the heavier the training given." It can be seen more clearly the work of the leg muscles when jumping onto the box by using both feet as support and swinging both hands simultaneously when landing. Jumping immediately onto an obstacle requires leg muscle strength, the stronger the leg muscles, the faster you can push your feet up. Meanwhile, leg muscle explosive power is dened as the ability to combine strength with speed which is realized in the form of the muscle's ability to handle loads with high contraction speed (Akbar et al., 2023; Hidayat et al., 2023); for example when a volleyball player performs a smash, jump serve and also when performing block. Therefore, the explosive capability of leg muscles is one of the elements of physical condition that volleyball players must have.

The results of testing the third hypothesis show that there is an effect of training using the Knee Tuck Jump exercise and Box Jump exercise on increasing the explosive power ability of the leg muscles of volleyball athletes with t count > t table (2.05 > 1.796) with a significance level of 0.00 = 0.05. It means that there is a difference between the results of Knee Tuck Jump training and Box Jump training, where Knee Tuck Jump training is more effective in increasing the explosive power of the leg muscles of volleyball athletes at SMK Negeri 1 Solok Selatan Regency. Based on the magnitude of the influence of each independent variable on the dependent variable, the variables Knee Tuck Jump training and Box Jump training both have an effect on increasing the explosive power ability of the leg muscles of volleyball athletes at SMK Negeri 1 Solok selatan Regency. This can be seen from the average increase in leg muscle explosive capability through initial and final test data. Both forms of exercise can increase the explosive capability of the leg muscles, however, according to the researchers and according to data and reality in the field, training using the Knee Tuck Jump training is more effective than the Box Jump training in increasing the explosive capability of the leg muscles, where To increase the explosive capability of the leg muscles by using the Knee Tuck Jump training, athletes are required to make movements quickly and the Knee Tuck Jump training movement is easier to do so that athletes are more enthusiastic about doing it. Meanwhile, in the Box Jump training, players often experience hesitation in the movement, so that The movement rhythm is less fast than in the Knee Tuck Jump training. However, carrying out training to increase the explosive power of the leg muscles cannot be separated from the role of the testee himself, meaning that the testee is required to be serious and disciplined in carrying out the training program so that the training objectives can be achieved well.

If we look at the explosive power ability of the leg muscles of the Volleyball athletes at SMK Negeri 1 Solok selatan Regency out of 24 people, after being given Knee Tuck Jump and Box Jump training, there are still some people who still have low leg muscle explosive power ability. This is of course caused by many factors, including the implementation of the exercises given not being practiced correctly, the time for practicing the exercises not being too long. Apart from that, there are other factors that influence the explosive capability of the leg muscles, namely the seriousness and correctness of the movements in carrying out the exercise. Furthermore, a person's muscle explosive power capacity is largely determined by the type of muscle fibers, muscle length, muscle strength, muscle temperature, gender, fatigue, inter muscular coordination, intramuscular coordination, muscle reaction to nerve stimulation, and joint angles (Hariyanto et al., 2022) . Therefore, it is clear that the explosive capability of leg muscles has many factors that effect it, so it is not only determined by the exercises carried out but is influenced by the condition of the muscles, the type of muscle and several elements of physical condition that need to be improved, such as strength, speed, coordination of movements.

As explained in the previous section, Knee Tuck Jump exercises and Box Jump exercises are forms of Plyometrics training (Darussalam.A.M, Yunus.M, 2023; Novita et al., 2022). Plyometrics is a special exercise that trains muscles to produce maximum strength more quickly (Galay et al., 2020). Plyometrics is an isotonic pattern, namely the muscle shortens towards the center of the sarcomere preceded by a lengthening pull. So in sports activities the contraction is manifested in explosive work (throwing, jumping). Plyometric contractions emerged and were taken from the characteristics of sports that have elements of strength and speed. Plyometrics is a training method for developing explosive abilities (Nggana et al., 2022). The results of this study allow us to draw the conclusion that students' strength, power, and speed are greatly increased when they get two distinct types of plyometric training for six weeks (Huang et al., 2023). These Plyometrics exercises are very useful for playing soccer and volleyball when jumping to smash and block opponents' attacks (Prianto et al., 2024).

Conclusion

The Knee Tuck Jump exercise has a significance influence on increasing the explosive power capability of the leg muscles, it means that if the Knee Tuck Jump training is applied according to the program given, it will increase the explosive capability of the leg muscles. Box Jump training has a significance influence on increasing the explosive capability of the leg muscles, meaning that if the Box Jump training is applied according to the program given, it will increase the explosive capability of the leg muscles. The Knee Tuck Jump exercise has a greater effect compared to the Box Jump exercise.

Suggestion

Coaches are expected to be able to choose and use appropriate training methods in an effort to increase the explosive muscle power of volleyball athletes. Players, to improve their ability to play volleyball effeffectively, should carry out training in accordance with the directions and guidelines from the coach and must have a competitive spirit. Researchers are further advised to look for other training methods that can increase the explosive power capacity and capability of short muscles.

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Datos de los/as autores/as y traductor/a:

Riand Resmana	riandresmana@fik.unp.ac.id	Autor/a – Traductor/a
Mardepi Saputra	mardepi@fik.unp.ac.id	Autor/a
Ardo Okilanda	ardo.oku@fik.unp.ac.id	Autor/a
Yogi Arnaldo	yogi.ap@fik.unp.ac.id	Autor/a
Iit Selviani	iitselviani@fik.unp.ac.id	Autor/a
M.Fakrur Rozi	Fakhrur.rozi@fik.unp.ac.id	Autor/a
Mottakin Ahmed	mottakin460@gmail.com	Autor/a
Singha Tulyakul	singha@tsu.ac.th	Autor/a