Теорія та методика фізичного виховання
Physical Education Theory and Methodology
Teorìâ ta Metodika Fìzičnogo Vihovannâ

ISSN 1993-7989 (print)
ISSN 1993-7997 (online)
ISSN-L 1993-7989

ORIGINAL SCIENTIFIC ARTICLE

CHIMNEY JUMP AND STANDING LEG EXTENSION TRAINING INCREASES THE LOWER EXTREMITY POWER OF VOLLEYBALL ATHLETES

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Accepted for Publication: September 13, 2023
Published: October 30, 2023

DOI: 10.17309/tmfv.2023.5.07

Abstract

Background. The Covid-19 pandemic has caused various adaptations in the world of sports. One form of adaptation that is carried out is training at home or known as training from home (TFH).

Study purpose. This study aims to see the effectiveness of the chimney jump and standing leg extension exercises carried out by volleyball athletes during training at home or training from home (TFH).

Materials and methods. A total of 36 volleyball athletes with an age range of 19-20 years were selected by purposive sampling and divided into the chimney jump (KCJ) group, the standing leg extension (KSE) group, and the control group (KKL). This research is quantitative research with a quasi-experimental research design with one group pretest posttest design.

The three variables used as the dependent variable are agility, balance, and athlete's leg power which were measured before TFH and after the athlete carried out TFH for 3 months. The results of the exercise were analyzed descriptively and continued to be analyzed using the Independent Samples T-test and One-Way ANOVA.

Results. There was a significant difference in the results of the leg power posttest of the three groups (<.05) with KCJ having the highest average leg power (77.76 ± 9.38). Furthermore, KSE has the highest average in agility (56.83 ± 11.93) and balance (38.75 ± 3.02).

Conclusions. Based on the results of this study, it can be concluded that the chimney jump has a significant impact on increasing leg power. On the other hand, the standing leg extension has a positive impact on increasing agility and balance.

Keywords: chimney jump, standing leg extension, agility, balance, leg power.

Introduction

Volleyball is one of the most popular sports in the world (Briner & Kacmar, 1997). This sport is also a favorite sport in Indonesia (Maliki, 2017). Various training methods were developed rapidly to support the training to be more efficient (Munir & Muhammad, 2018). Various coaching programs have been implemented to maximize the athletes' best performance in volleyball (Oliinyk et al., 2021). There are variations of technical training models have also been studied to increase athlete motivation in training (Pranopik, 2017).

The physical component is an important factor in volleyball achievements (Prasetyo, 2020). Good physical condition can support athletes in performing techniques and tactics optimally to bring a positive impact on athlete achievement (Firmansyah, 2017). In basic passing techniques, the physical components of eye coordination, arm muscle strength, and balance are of key importance for an athlete (Ikadarny & Karim, 2020). Conversely, poor athlete performance is often caused by a decrease in the ability of the physical component (N. Saputra & Aziz, 2020). Furthermore, the achievements of a team are also determined by the physical condition of the players (Maizan & Umar, 2020).

The physical components that play an important role in volleyball are the explosive power of the arm muscles, leg muscles, agility, flexibility, and endurance (Guscahyati & Shin, 2019). Each physical component is closely related to the techniques and tactics used in volleyball. The role of the leg muscles is very important in defending or blocking (P. Saputra et al., 2016) and attacking or smashing (Pratomo & Iqbal, 2020). As a result, the training model to improve the leg muscle explosive power is the most frequently chosen by volleyball coaches in preparing physical training programs (Utamayasa, 2020).

Leg muscle is very important to train for volleyball athletes (Nasrulloh et al., 2021). The leg muscle is not only important to improve the athlete's performance, but also to prevent the occurrence of injuries that are often experienced by volleyball on the limbs such as ankle sprains (Briner & Kacmar, 1997) and Achilles tendon rupture (Al Ardha et al., 2020). These injuries can be avoided by training leg muscle strength which is important in performing various volleyball basic techniques related to vertical jump (da Cunha et al., 2020). Models of physical exercise can also be developed to support movements or techniques to overcome injuries involving the legs (Briner & Kacmar, 1997).

Various training models have also been developed to improve athletes' abilities (Maliki, 2017). The training model that can be used to increase the explosive power of the leg muscles is the drill box exercise (Widiantari & Indrawathi, 2018), plyometric exercises (P. Saputra et al., 2016), practice multiple box jumps (Utamayasa, 2020), skipping exercises (Hidayat et al., 2020), reactive jump over hurdles exercise (Nasri et al., 2017). As well as 1:3 interval ratio method exercises with skipping rope media (Hariyanto & Pramono, 2020). However, during covid-19 pandemic, it is necessary to modify the training model that can be applied independently at home (Irdiani, 2020).

The training model known as training from home (TFH), is carried out independently at home during the Covid-19 pandemic. Athletes use the facilities and infrastructure available in the home environment to practice. However, the training load and recovery model are important to maintain and improve athlete performance (Berriel et al., 2020). It is also necessary to consider the mental condition and anxiety of athletes when training during a pandemic (Herdyanto et al., 2020). Furthermore, the Chimney jump and Standing Leg Extension were selected as treatment in this study to increase agility, balance, and leg power in volleyball athletes.

Chimney Jump is a training model with a media agility ladder. The jump is done by bending both knees and assisted by the movement of the two arms swinging forward so that there is balance when making a forward jump, after that all leg muscles contract to jump forward as high as possible by lifting the thighs parallel to the horizontal line and landing both legs on the second box with followed by swinging both arms back so as to maintain balance when landing, after both feet land on the second box, immediately proceed with the same movement procedure to jump to the fourth box with a distance of one box to the end of the agility ladder toolbox. The series of chimney jump movements can be modified, and the level of difficulty can be adjusted. This is done to provide a challenge and make the exercise more interesting. This chimney jump training model is effective for increasing the ability of the leg muscles and agility of an athlete (Herdyanto et al., 2019).

Standing Leg Extension is a training model using additional equipment in the form of resistance bands or rubber weights attached to the ankles. The movement begins by lifting the leg that is given a load until the thigh and calf form a 90-degree angle. After that, just do the swing of the calf forward until it is straight with the thigh and then return to its original position. This is done repeatedly according to the prescribed dose. Single leg stands can help improve balance (Munawwarah & Rahmani, 2015). Similar exercises can also be used to improve mobility (Widayanto et al., 2017). Based on the background that has been presented, this study aims to determine the effectiveness of the Chimney Jump and Standing Leg Extension Exercise programs carried out independently at home (TFH) during the Covid-19 pandemic on agility, balance, and leg power in volleyball athletes.

This study aimed to analyze the result of the Chimney jump and Standing Leg Extension which were selected as treatment in this study to increase agility, balance, and leg power in volleyball athletes.

Materials and methods

Study participants

Based on the problems and research objectives that have been described previously, this type of research is a quasi-experiment with a one-group pretest-posttest research design. A total of 36 male volleyball athletes with an age range of 19-20 years were selected by purposive sampling method. All of the research samples were explained the research procedure and have agreed to participate by filling the informed concern. The group division was based on the z-score ranking of the pre-test scores which were then divided into three groups using the ordinal pairing technique, namely: the chimney jump (KCJ) group, the standing leg extension (KSE) group, and the control group (KKL). Treatment in the chimney jump (KCJ) group and the standing leg extension (KSE) group was carried out 4 days/week with a training duration of 20 minutes for 3 months of training from home (TFH). The research design was evaluated and approved by Universitas Negeri Surabaya Ethical Board Members No. B/12483/UN38/HK.01.01/2021.

Study organization

Agility in sports movements is needed for sudden changes in direction of motion. It requires movement speed and good balance. In this study, the ability of agility will be measured by a side-step test for 20 seconds. Records of automatic test results are visible on the monitor based on the number of athletes' steps through the right and left sensors.

Fig. 1. Agility Test Documentation

Balance is the ability to stay upright or keep control of body movements both while moving and still. In this study, balance was measured by a balance beam test. The athlete stands on one leg with his hands on his hips and eyes closed. The timing will be stopped when the pedestal foot shifts. This test will be carried out three times and the best time will be taken.

Fig. 2. Balance Beam Test Balance Test Equipment

Leg Power is a combination of two elements of physical condition, namely the strength of leg muscle contraction and the speed of movement of the leg muscles which are carried out simultaneously. In this study, leg power ability was measured by accu power or force plates with vertical jump movements. The test was carried out three times and the best leg power data was taken in Watt units.

Fig. 3. Limb Power Test Documentation with Accu Power

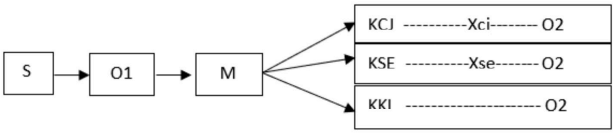

Fig. 4. Research design

Information:

S : Samples	KKL : Control Group
O1 : Pretest	O2 : Posttest
M : Matching Ordinal Pairing	X : Treatment
KCJ : Chimney Jump Group	Xcj : Chimney Jump Treatment
KSE : Standing Leg Group Extension	Xse : Standing Leg Treatment Extension

Statistical analysis

Data from the pre-test and post-test results were tested for normality with the Kolmogorov-Smirnov Test. If the results of the normality test show that the results of the data distribution are normal, then the data is continued with analysis using the one sample t-test to see differences in the results of the pre-test and post-test in each group (Figure 4). Furthermore, one-way ANOVA and post hoc tests were also carried out by comparing the results of the post test with all sample groups. All statistical tests were performed with SPSS 26 computer software.

Results

The results of the normality test using the Kolmogorov-Smirnov test showed that the data were normally distributed for each variable (α>0.05). The one sample t-test was conducted to compare the pre-test and post-test data in each group (Table 1).

The results of the one sample t-test analysis showed that there was a significant difference between the pre-test and post-test results in each group and variable (sig <0.05). However, in the control group, there was a decrease in leg power from the pre test results (68.89 ± 7.79) to (67.60 ± 6.75) on the post test results. One way ANOVA analysis was applied to see differences in pre-test and post-test results between sample groups (Table 2).

Based on the results of the one way ANOVA analysis applied, it can be seen that there is only one difference between the three sample groups, especially in the value of the leg power post-test. So that a post hoc analysis needs to be done to see the comparison of leg power post-test

Table 1. Results of the One Sample T-Test Analysis (Mean ± SD)

Group	Number of Samples (N)	Agility			Balance			Power Limbs		
		Pre-test	Post test	Sig	Pre-test	Post test	Sig	Pre-test	Post test	Sig
KCJ	12	35.33 ± 3.20	37.67 ± 3.77	0.00*	45.00 ± 10.88	54.33 ± 8.91	0.00*	68.07 ± 8.21	77.76 ± 9.38	0.00*
KSE	12	35.75 ± 4.09	38.75 ± 3.02	0.00*	46.58 ± 11.51	56.83 ± 11.93	0.00*	68.60 ± 6.65	76.15 ± 7.12	0.00*
KKL	12	35.75 ± 4.88	36.25 ± 4.53	0.00*	45.08 ± 15.90	46.41 ± 15.17	0.00*	68.89 ± 7.79	67.60 ± 6.75	0.00*

*sig. <0.05

Table 2. Analysis Results One Way Anova Test (Mean ± SD)

Group	Number of Samples (N)	Agility		Balance		Power Limbs	
		Pre-test	Post test	Pre-test	Post test	Pre-test	Post test
KCJ	12	35.33 ± 3.20	37.67 ± 3.77	45.00 ± 10.88	54.33 ± 8.91	68.07 ± 8.21	77.76 ± 9.38
KSE	12	35.75 ± 4.09	38.75 ± 3.02	46.58 ± 11.51	56.83 ± 11.93	68.60 ± 6.65	76.15 ± 7.12
KKL	12	35.75 ± 4.88	36.25 ± 4.53	45.08 ± 15.90	46.41 ± 15.17	68.89 ± 7.79	67.60 ± 6.75
Sig	36	0.96	0.289	0.945	0.109	0.964	0.07*

*sig <0.05

Table 3. Analysis Results of Post Hoc (Significant Value)

Group		Bonferroni	Tukey	Scheffe
		Sig	Sig	Sig
KCJ	KSE	1	0.869	0.881
	KKL	0.010*	0.009*	0.012*
KSE	KJC	1	0.869	0.881
	KKL	0.035*	0.031*	0.040*
KKL	KJC	0.010*	0.009*	0.012*
	KSE	0.035*	0.031*	0.040*

*sig. <0.05

values among the three sample groups. The post hoc analysis applied using Bonferroni, Tukey, and Scheffe showed the following results (Table 3).

There was a significant difference between the control group (KKL) and the other two groups (sig <0.05) based on the results of the post hoc analysis applied using Bonferroni, Tukey, and Scheffe. When compared with the average value, the control group (KKL) has the lowest leg power when compared to the chimney jump (KCJ) and standing leg extension (KSE) groups.

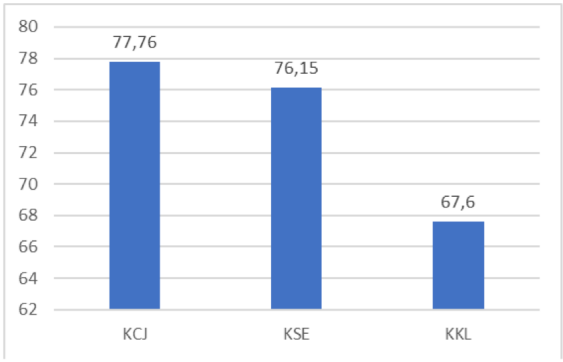

Fig. 5. Comparison of Limb Power Average of Each Group

Discussion

Based on the results of the data analysis that had been carried out, all groups experienced a significant increase in the results of the agility and balance post test. However, it should be noted that the increase in the balance score in the control group (KKL) was not as good as the increase in the chimney jump (KCJ) and standing leg extension (KSE) groups. However, the difference in the results of the post test balance score was not significant in one way ANOVA (sig. 0.109), but the average of KKL (46.41 ± 15.17) was the lowest when compared to KCJ (54.33 ± 8.91) and KSE which had the average value of the highest balance (56.83 ± 11.93).

Furthermore, on the results of the leg power post test, KCJ obtained the highest average score (77.76 ± 9.38) and the increase in leg power values was also followed by KSE (76.15 ± 7.12). However, KKL experienced a decrease in leg power in the post test (67.60 ± 6.75). The KKL power post test results decreased significantly when compared to the pre test results (68.89 ± 7.79). The one way ANOVA analysis also revealed that there was a significant difference (α <0.05) in the results of the leg power post test of the three groups, where KKL had the smallest average score compared to the other two groups.

Athletes who train using chimney jump and standing leg extension exercises experience improvements in agility, balance, and leg power. This provides another perspective on understanding strength training using heavy training loads and certain repetitions (Lacerda et al., 2021). The process of activating large muscles such as the Quadriceps is indeed easier to implement and train using weight training (Jakobsen et al., 2019). In contrast to weight training, chimney jump and standing leg extension exercises provide a movement experience that can be adjusted to the technique in volleyball. This is not only useful for training large muscles, but can also train the coordination of muscles, joints and tendons in performing movement techniques (Markowitz & Herr, 2016).

The chimney jump training model with an agility ladder helps improve the leg muscles and agility of an athlete through a variety of explosive movements (Herdyanto et al., 2019). In addition, the use of agility ladders in training programs can strengthen the athlete's leg muscles and agility (Hidayat, 2019). Various variations of the agility ladder exercise can also be combined with speed training for athletes (Fatchurrahman et al., 2019) as well as specific exercises related to skills in certain sports (Irfan & Umansyah, 2019). In volleyball, the chimney jump training model can be combined with blocking or smashing techniques through a variety of steps and movements.

The standing leg extension exercise model involves movements that include knee flexion, knee extension, knee medial rotation, knee lateral rotation, ankle plantarflexion, and ankle dorsiflexion (Belli et al., 2015). Standing leg

extension exercises with elastic band media can be combined with other exercise models according to the training program (Wu et al., 2018). In volleyball, the use of elastic bands can be combined with basic technical training movements such as receiving, passing, blocking, and also smashing. Movements that are also very influential in a volleyball match such as serving, receiving, and blocking can also be trained (Silva et al., 2014).

This study has several limitations, including the homogeneity of the selected sample, namely male volleyball athletes aged 19-20 years. This of course can be developed using various sample backgrounds to obtain broader data. Furthermore, the limitations experienced by researchers are the forms of treatment given. Chimney jump and standing leg extension exercises are additional training programs provided in addition to the routine training programs provided by the coach. So that several factors that affect aspects of measurement such as the training program provided by the trainer and the athlete's weight gain cannot be controlled and have the potential to affect the measurement results.

Conclusions

The chimney jumps and standing leg extension training models are effective for increasing agility, balance, and leg power in volleyball athletes. This is evidenced by the significant increase in post-test scores from the aspects of agility, balance, and leg power in the group that received the chimney jump and standing leg extension exercises. Furthermore, it was also found that there were significant differences in the results of the leg power post-test from the three groups. In general, the chimney jump group had the highest average score in the post-test of leg power, and the standing leg extension (KSE) group had the highest average score in the post-test of agility and balance.

Acknowledgment

All research costs were funded by the Universitas Negeri Surabaya, which is stated in the competitive research scheme for 2021 with decision letter number 635/UN38/HK/PP/2021.

Conflict of interests

The authors declare that there is no conflict of interest.

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ТРЕНУВАННЯ ЗІ СТРИБКІВ ІЗ МІСЦЯ НА КООРДИНАЦІЙНІЙ ДРАБИНІ ТА РОЗГИНАННЯ НІГ СТОЯЧИ ЗБІЛЬШУЄ ПОТУЖНІСТЬ НИЖНІХ КІНЦІВОК СПОРТСМЕНІВ-ВОЛЕЙБОЛІСТІВ

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 3 табл., 5 рис., 36 джерел.

Історія питання. Пандемія Covid-19 спричинила різноманітні адаптації у світі спорту. Однією з форм адаптації, яка здійснюється, є тренування вдома, також відоме як тренування з дому (TFH).

Мета дослідження. Метою цього дослідження є побачити ефективність вправ «стрибки з місця на координаційній драбині» та «розгинання ніг стоячи», які спортсмени-волейболісти виконують під час тренування вдома або тренування з дому (TFH).

Матеріали та методи. Загалом 36 волейболістів віком 19–20 років були відібрані шляхом цілеспрямованої вибірки та розділені на групу стрибків із місця на координаційній драбині (KCJ), групу розгинання ніг стоячи (KSE) та контрольну групу (KKL). Це дослідження є кількісним дослідженням із квазіекспериментальним планом дослідження за схемою попереднього та підсумкового тестування на одній групі.

Трьома змінними, які використовують як залежну змінну, є спритність, рівновага та потужність ніг спортсмена, які вимірювали до TFH та після того, як спортсмен проводив TFH протягом 3 місяців. Результати вправи аналізували описово та продовжували аналізувати з використанням t-критерію Стьюдента для незалежних вибірок та однофакторного дисперсійного аналізу.

Результати. Спостерігалася статистично значуща різниця в результатах підсумкового тестування потужності ніг у трьох групах (<0,05), причому група KCJ мала найвищу середню потужність ніг (77,76 ± 9,38). Крім того, група KSE має найвищий середній показник спритності (56,83 ± 11,93) і рівноваги (38,75 ± 3,02).

Висновки. На підставі результатів цього дослідження можна дійти висновку, що стрибок із місця на координаційній драбині значно впливає на збільшення потужності ніг. З другого боку, розгинання ніг стоячи позитивно впливає на підвищення спритності та рівноваги.

Ключові слова: стрибок із місця на координаційній драбині, розгинання ніг стоячи, спритність, рівновага, потужність ніг.

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Cite this article as: Al Ardha, M.A., Nurhasan, Ristanto, K.O., Putra, K.P., Wijayanto, A., & Bikalawan, S.S. (2023). Chimney Jump and Standing Leg Extension Training Increases the Lower Extremity Power of Volleyball Athletes. *Physical Education Theory and Methodology, 23*(5), 700-706. https://doi.org/10.17309/tmfv.2023.5.07

Received: 28.07.2023. Accepted: 13.09.2023. Published: 30.10.2023