COMPETITOR:
JURNAL PENDIDIKAN KEPELATIHAN OLAHRAGA
e-ISSN: 2657-0734 & p-ISSN: 2085-5389 || Volume 17, Number 3, 2025 || P.2780-2791

The Effect of Plank Exercise Variations on Arm Muscle Strength in Junior Male Floor Gymnastics Athletes of the FGI Medan in 2025

Ursulla Duti Oktria Simamora[1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]

[1,2,3] Universitas Negeri Medan, Sumatera Utara, Indonesia

simamoraursulla@gmail.com[1*], father@unimed.ac.id[2], indrasitepu@unimed.ac.id[3]

ABSTRACT

In floor gymnastics, strength is a key factor in performing movements correctly and achieving the desired results. To perform floor gymnastics movements such as handstands, handsprings and so on, strong arm muscles are needed to support the body. The stronger the gymnast's or athlete's arm muscles, the more flexibility they will have in their lower back, and the better their hand spring skills will be. In this floor gymnastics movement technique, the main problem lies in the strength of the arm, hand, shoulder, abdominal, thigh, and leg muscles, as well as the tightness of each body part. If arm muscle strength is not trained, technical ability in floor gymnastics will not achieve maximum results. This study aims to determine the effect of plank exercise variations on arm muscle strength in junior male floor gymnasts at FGI Medan in 2025. The research method used is a quantitative experimental method. The research design is a one-group pre-test and post-test design. The population in this study consists of 5 athletes. The sampling technique used is total sampling. The sample size used was 5 athletes. The results of the first hypothesis analysis obtained a t-value of 10.06 > t-table 2.132, thus Ha was accepted and Ho was rejected. It can be concluded that there is an effect of plank exercise variations on arm muscle strength in junior male floor gymnasts of the FGI in 2025.

ARTICLE HISTORY
Received: 2025/10/19
Accepted: 2025/10/23
Published: 2025/10/30

KEYWORDS
Exercise;
Plank Variations;
Arm Muscle Strength;
Floor;
Gymnastics.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Simamora, Ursulla Duti Oktria; Sinulingga, Albadi; Sitepu, Indra Darma. (2025). The Effect of Plank Exercise Variations on Arm Muscle Strength in Junior Male Floor Gymnastics Athletes of the FGI Medan in 2025. **Competitor: Jurnal Pendidikan Kepelatihan Olahraga**. 17 (3), p.2780-2791

INTRODUCTION

Sport is a physical activity carried out daily to maintain health and fitness, so that we always have physical and mental health. Good physical fitness will have an impact on improving athletic performance. This can be demonstrated by athletes who are in good physical condition, which also means they have good biomechanical and cardiovascular components. (Putra et al., 2022). According to Hardinoto et al. (2017), sport is an educational tool that utilises physical activities to achieve educational goals and has great potential in shaping individuals as they strive to build character.

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

Floor gymnastics is one of the branches of gymnastics. As the name suggests, this gymnastics is performed on the floor. Floor gymnastics exercises are generally performed on a mat or similar surface that provides comfort and safety during training. Floor gymnastics, often referred to as floor exercises, is also known by some as tumbling. This gymnastics is an exercise performed on a mat, where the movements include rolling, jumping, spinning in the air, and using the hands or feet to maintain balance, both when jumping forward and backwards. This type of gymnastics is often referred to as free exercise because it does not require special equipment when the gymnast performs the movements. When gymnasts use equipment such as balls, ribbons, or other objects, these are only used to improve the quality of the movements, flexibility, relaxation,

strength, skill, and balance. Floor gymnastics is performed on a 12x12 m area surrounded by a 1 m wide mat to maintain the gymnasts' balance. The series of gymnastic movements must begin with a variety of movements, including light, moderate, heavy and acrobatic movements, as well as elements of agility, balance, flexibility, and others. Male gymnasts have 70 seconds to perform, while female gymnasts perform to music for 90 seconds. Movements that require strength must be performed slowly, with static positions held for at least 2 seconds.

Various types of floor gymnastics movements include: forward roll, backward roll, tiger jump, handstand, headstand, handspring, back handspring, cartwheel, stand, round off, kip, neck kip, kayang, candle position, somersault, and others. A handstand is an upright position performed by resting on both hands, where the elbows must be straight and both feet must be close together and upright. When performing a handstand, it is best to do so on a hard surface, such as the floor or a mat, for safety and stability. Handstands require physical conditions such as strength, balance and flexibility.

In floor gymnastics, strength is the main factor required to produce precise movements and achieve the desired results. Strength is the force of muscle contraction achieved in a single maximum effort. Maximum effort is exerted by a muscle or group of muscles to overcome resistance. Strength is a very important element in sports activities because it is a driving force and prevents injury. In addition, strength plays an important role in other components of physical ability, such as power, agility and speed. Thus, strength is a major factor in achieving optimal performance.

Arm muscle strength is the ability of a group of arm muscles to handle loads and resistance in performing an activity. Strength is one of the many basic components in sports; most movements of the body are caused by the strength generated by muscle contraction. All sports activities require strength, as strength is one of the basic components in sports. Strength needs to be improved as a basic reference for forming other biomotor components. In sports activities, strength training is very useful for increasing muscle data in overcoming loads. In addition, arm muscle strength is a person's ability to use the maximum strength of the arm muscles to exert all their potential or strength in a short period (Firmansyah, 2022).

In floor gymnastics movements such as handstands, handsprings, cartwheels and so on, arm muscle strength is required to support the body. The stronger the gymnast's

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

or athlete's arm muscles, the more flexibility the athlete's lower back will have, and the better their hand spring skills will be. In this floor gymnastics movement technique, the main problem lies in the strength of the arm, hand, shoulder, abdominal, thigh, and leg muscles, as well as the tightness of each body part. If arm muscle strength is not trained, then technical ability in floor gymnastics will not achieve maximum results.

Based on the researcher's observations of floor gymnastics athletes at FGI Medan and an interview with coach Muhammad Iqbal on 25 October 2024 at the Prof. Drs. Jepta Hutabarat gymnastics building on Jl Stadion Teladan No.22, Teladan Barat, Kec. Medan Kota, North Sumatra. The researcher observed athletes practising basic floor gymnastics techniques such as handstands, handsprings, and cartwheels. When performing these movements, the athletes could not hold their body weight for long periods, and their hands trembled, so when attempting these movements, the athletes were unable to support their body weight for long periods of time, and their hands trembled, causing them to fall immediately when attempting handstands, handsprings, and cartwheels. As a result, when performing these movements, the results obtained were unsatisfactory or imperfect. This occurred because the athletes' hand strength was not sufficient to support their bodies, and they often fell, causing them to lose their balance. The physical training provided tends to be repetitive and lacks variety, so athletes often feel bored during physical sessions. In gymnastics, physical condition is very important for improving technical skills. Physical condition greatly supports an athlete's performance in competition, enabling them to perform optimally. Weak arm muscles will cause the hands to be unable to support the body, resulting in imperfect movements.

Based on the observations and interviews conducted, the researcher identified the existing problems and conducted initial data tests to measure arm muscle strength, with the athletes performing push-up tests. Based on the results of the initial data tests conducted, five athletes were classified as having insufficient strength.

This occurs due to the lack of arm muscle strength in athletes; therefore, researchers focused on efforts to increase athletes' arm muscles by providing a variety of plank exercises. It is hoped that with this variety of plank exercises, the arm muscle strength of junior male athletes at FGI Medan can increase significantly.

Based on the background described above, the researchers were interested in conducting a study entitled, 'The Effect of Plank Exercise Variations on Arm Muscle Strength in Junior Male Gymnasts at FGI Medan in 2025'.

METHODS

This study utilised a quantitative experimental approach with a one-group pre-test and post-test design. This design was chosen because it was appropriate for answering the research question regarding the effect of plank exercise variations on arm muscle strength. In this design, the research subjects first underwent a pre-test to determine their initial abilities, then were given treatment in the form of plank exercise variations

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

for several weeks, and finally underwent a post-test to see the improvement that occurred after the treatment.

The subjects in this study were five male junior floor gymnasts from FGI Medan in 2025. The sampling technique used was total sampling, as the entire population of five athletes met the criteria to be included in the study sample. This number was considered appropriate to represent the research population as a whole.

The research instrument used to measure arm muscle strength was the push-up test. This test aimed to assess the maximum ability of the arm muscles to support body weight. Each athlete performed push-ups for 60 seconds without a break, and the number of movements performed was counted as a score. The assessment norm referred to Moeslim's (2003) standard table, which classified the results into five categories, ranging from very good to very poor.

The research data were collected in two stages, namely a pre-test before the treatment and a post-test after the treatment was completed. The treatment given was a variation of plank exercises, which included dynamic planks, plank walkouts, plank tricep extensions, forward arm planks, and high plank shoulder taps. The exercises were carried out systematically and progressively in accordance with the principles of sports training to effectively increase arm muscle strength.

Data analysis techniques used descriptive and inferential statistical methods. The first step was to calculate the mean and standard deviation for the pre-test and post-test data. Next, a normality test was conducted using the Liliefors test to ensure normal data distribution, as well as a homogeneity test using the F test to ensure variance equality between data. Once the requirements were met, a t-test (paired sample t-test) was conducted to determine the significant difference between the pre-test and post-test results. The analysis results showed that the t-count value was greater than the t-table, so it can be concluded that there is a significant effect of plank exercise variation on increasing arm muscle strength.

Thus, the methods used in this study were systematically and thoroughly organised so that they could be replicated by other researchers. All procedures, instruments, and analysis techniques were clearly and sequentially explained, so that the results obtained could be scientifically accounted for.

RESULTS AND DISCUSSION

The subjects of this study were five male junior FIG floor gymnasts in 2025. The researcher used a quantitative experimental method in this study. The form of exercise used by the researcher was a plank exercise variation. The overall research process carried out by the researcher was divided into three stages. The first stage was a pre-test to determine the athletes' initial abilities. In the second stage, the athletes were given treatment in the form of plank variations during 18 sessions. The final stage was a post-test on the sample to determine the increase in arm muscle strength. The pre-test and post-test data were then processed using statistical tests.

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

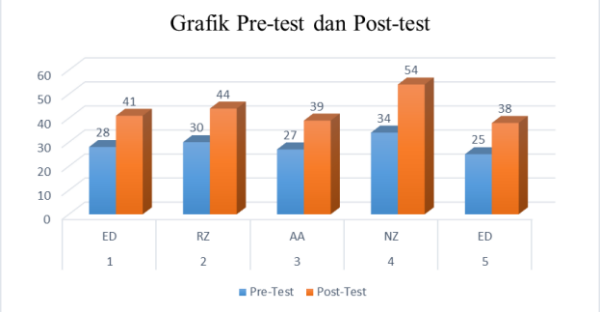

Figure 1.
Graph of Pre-Test & Post-Test Push-Up Arm Muscle Strength of Junior Men's Floor Gymnastics Athlete FIG Medan in 2025

Based on the graph above, the arm muscle strength of the 2025 FIG junior male gymnasts can be described. Data was obtained from 5 pre-test samples: Engku Daren 28, M. Rifaf 30, Alif Alfarizi 27, Nabil Zada 34 and Engku Daniel 25, and post-test scores: Engku Daren 41, M. Rifaf 44, Alif Alfarizi 39, Nabil Zada 54, and Engku Daniel 38. It can be concluded that there was an increase between the pre-test and post-test scores.

Table 1.
Analysis of Pre-Test and Post-Test Push-Up Data Description, Mean, Difference, Standard Deviation, Variance, Maximum and Minimum Values Against Arm Muscle Strength in Junior Men's Floor Gymnastics Athletes FGI Medan in 2025

Yes	Name	Pre-Test	Post-Test	B	B2
1.	ED	28	41	13	169
2.	RZ	30	44	14	196
3.	AA	27	39	12	144
4.	NZ	34	54	20	400
5.	ED	25	38	13	169
	Sum	**144**	**216**	**72**	**1.078**
	Average	**28,8**	**43,2**	**14,2**	
	Variance	**11,70**	**41,70**	**10,7**	
	Baku Junction	**3,42**	**6,45**	**3,27**	
	Maximum	**30**	**54**	**20**	
	Minimum	**25**	**38**	**12**	

The pre-test push-up results showed a range of 25–30 with an average of 28.8, variance of 11.70, standard deviation of 3.42, maximum value of 30, and minimum value of 25. Meanwhile, the post-test push-up results showed a range of 38–54 with an average of 43.2, variance of 41.70, standard deviation of 6.45, maximum value of 54, and minimum value of 38. Then, from the pre-test and post-test results, a difference value was obtained with a range of 12–20, an average difference value of 14.2, a variance of 3.27, and a standard deviation of 3.27.

Normality tests are used to determine whether research results are normal. Pre-test and post-test data from the study were used to test the normality of the distribution. The Liliefors test is the normality test formula used in this study. If the criteria are met at 0.05 Lcount < Ltable, then the data can be said to be normal.

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

Table 2.
Normality Test of Arm Muscle Strength Results

Data	Mean And Standard Deviation	Count	Table	α	Information
Pre-Test Push Arm Muscle Strength	$\bar{x}$ = 28.8 S = 3.42	0,193	0,337	0,05	Normal
Post-Test Push Arm Muscle Strength	$\bar{x}$= 43.2	0,250	0,337	0,05	Normal

From the results of the pre-test push-up calculations in the appendix, Lo = 0.192 was obtained. At the α = 0.05 level and Ltabel, 0.337 was obtained. So Lo = 0.192 < Ltabel = 0.337. It can be concluded that the sample comes from a normally distributed data distribution. From the results of the post-test push-up calculation in the appendix, Lo = 0.250 was obtained. At the α = 0.05 level, Ltabel = 0.337 was obtained. So Lo = 0.250 < Ltabel = 0.337. It can be concluded that the sample comes from a normally distributed data distribution.

The homogeneity test in this study aims to determine whether the research data are homogeneous or not. If the research data meet the criteria of Fcount < Ftable, then it is considered homogeneous. The homogeneity test formula used in this study is the F test.

Table 3.
Arm Muscle Strength Homogeneity Test

Data	Calculation	Ftable	α	DF (N-1)	Information
Pre-Test & Post-Test Push Arm Muscle Strength	3,56	6,39	0,05	4	Homogeneous

The results of the pre-test and post-test push-up F test are = 3.56 according to the calculations in the appendix. If Fcount < Ftable, then the data criteria are said to be homogeneous. Where Ftable is 6.39, Fcount < Ftable (3.56 < 6.39). Therefore, it can be said that the research data is homogeneous.

After conducting normality and homogeneity tests, the analysis continues with hypothesis testing. Hypothesis testing aims to prove the validity (answer the hypothesis) presented.

Table 4.
Arm Muscle Strength Hypothesis Test

Variable	Pre-test Arm Muscle Strength	Post-test Arm Muscle Strength	B	DK (N-1)	Stuttgart	Table
N	5			4	10,06	2,132
Sum	144	216	72			
Average	28,8	43,2	14,4			
SB	3,42	6,45	3,20			

Based on the results of the analysis requirements test, it is known that the data is normally distributed and comes from a homogeneous population, so that the data can be calculated using the t-test to test the proposed hypothesis. From the hypothesis calculation, a t-test value of 10.06 was obtained. The t-table value for a significance level

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

of 0.05 = n-1 = 5-1 = 4, so that t-table = 2.015. This means that t-count 10.06 > t-table 2.132, thus Ha is accepted and Ho is rejected. It can be concluded that there is a significant effect of plank exercise variation on arm muscle strength in handstand movements in junior male athletes of FIG Medan in 2025.

This study aims to determine the effect of plank exercise variations on arm muscle strength in male junior FGI athletes in 2025. The research process was carried out through several systematic stages, starting from the pre-test, the administration of treatment in the form of plank exercise variations, to the post-test and data analysis. The initial stage was the pre-test, which aimed to measure the athletes' initial arm muscle strength before the treatment was administered. The pre-test was conducted using a research instrument in the form of a push-up test. Each athlete performed the push-up test three times, and the results were recorded for analysis as initial data. After the pre-test, the athletes participated in a six-week training programme with a total of 18 sessions. Training was provided three times a week, with duration and intensity adjusted based on Bompa's training periodisation principles. During the training programme, the athletes were given treatment in the form of plank exercise variations. After the entire series of exercises was completed, a post-test was conducted using the same procedure as the pre-test. The results of the post-test became the final data to be compared with the initial data (pre-test) to determine the progress that occurred after the treatment was given. The final stage of the study was data processing and analysis. The data obtained from the pre-test and post-test results were analysed using statistical tests to determine whether there were significant differences between before and after the treatment. Based on the results of the data analysis, it was found that there was a significant increase in the arm muscle strength of the athletes after participating in a training programme with a variety of plank exercises for 6 weeks. Thus, it can be concluded that the variety of plank exercises applied in this study had a significant effect on arm muscle strength in handstand movements in junior male FIG athletes in Medan in 2025.

In (Dewi Irma Ristanti et al., 2019), 'gymnastics is a physical exercise that is specifically selected and designed, performed with full awareness and planning, arranged in an orderly manner for the purpose of improving physical fitness, honing skills and instilling inner and spiritual values'. Gymnastics can also be defined as a competitive sport in which individuals perform optional acrobatic routines that are largely judged on the use of special equipment. The aim is to demonstrate strength, balance and body control.

(Ratno et al., 2019) Revealed that planks are very good for the body because they not only train and tighten the abdomen, but also train the strength of the arm, shoulder and front thigh muscles. This exercise is very simple but provides many benefits. Planks are highly recommended because, in addition to training the core muscles of the body, they also protect the muscles from injury when lifting weights, especially in the arms. With maximum strength in these muscle areas, it will help improve performance in certain sports. The plank exercise is a type of isometric exercise, which is a static contraction exercise where muscle contraction works against resistance without any change in muscle length or joint movement. This plank exercise targets the deltoid, abdominal, quadriceps, and tibialis anterior muscles.

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

According to Priadana & Saifuddin (2023), plank exercises are a form of isometric exercise that involves almost all skeletal muscles. The goal is to maintain body position for a long time, thereby effectively increasing muscle strength and endurance.

The plank is a method for developing muscle strength, which is an important component in the achievement of most athletes. Increased plank activation patterns also result in increased activation levels in the extremities or limbs, thereby developing the ability to support or move the extremities. Muscle activation is used to move rotational forces around the spine. When core muscle activation occurs, there is a pattern that differs in intensity and timing from muscle activation, starting on the contralateral side, which creates the next rotational movement. Ultimately, muscle activation provides good strength endurance to the entire central mass, forming a cylinder that facilitates rotation, with the opposite side providing stabilisation through contraction of the core muscles. This exercise intensifies and stabilises the cooperative patterns between muscles. It also provides changing sensory input to the muscles, activating proprioceptive and neuroadaptive mechanisms (Lisnaini et al., 2022).

The training principle used in this study is progressive. In (Pralanate, 2023) explains that 'the progressive principle states that the training load given to athletes must be periodically and progressively increased'. The principle of overload is the application of training loads that increase day by day; in other words, the load given exceeds what can be done at that time. To achieve good training effects, the body's organs must be given loads that exceed the loads normally received in daily activities. The loads received are individual, but in principle, they are given loads close to submaximal to submaximal loads. The overload principle can improve overall performance. The overload principle, also known as the overload principle, is widely recommended by several experts, making it a fundamental principle of training. This principle explains that a person's progress is a direct result of the amount and quality of work achieved in training. From the beginning of training until the achievement of performance, the workload in training is gradually increased and adjusted to the physiological and psychological abilities of each individual.

Based on the results of the hypothesis test in this study, the t-value of 10.06 is greater than the t-table value of 2.132. Thus, Ha is accepted and Ho is rejected, so it can be concluded that there is a significant effect of plank exercise variation on arm muscle strength in handstand movements in junior male FIG gymnasts in 2025.

These results are in line with previous research by Wicaksono (2021) entitled 'The Effect of Plank and Push-up Exercise Variations on Arm Muscle Strength in Male Badminton Athletes at the Patunas Kuala Tungkal Club'. The data analysis results show that the hypothesis test obtained tcount > ttable in a sample size of 10 people. So it can be concluded that Ho is rejected and Ha is accepted, thus there is an effect of plank and push-up exercise variations on arm muscle strength in male badminton athletes at the Patunas Kuala Tungkal club.

Similarly, research conducted by P. Hafizh (2022) entitled 'The Effect of Plank Variation Training on Arm Muscle Strength and Badminton Smash Ability of PB Musagta Athletes'. There is consistency with this study. Therefore, it can be concluded that there

is an effect of plank variation training on arm muscle strength and badminton smash ability in Musagta athletes.

The research by Sejati et al. (2024) entitled 'The Effect of Tricep Dip and Plank Arm Reach Exercises on the Arm Muscle Strength of 13-15 Year Old Badminton Athletes at PB Narottama Grogol Kediri'. The results of the study show that (1) tricep dip exercises have an effect on arm muscle strength, (2) plank arm reach exercises have an effect on arm muscle strength, and (3) there is a difference in effect between tricep dip and plank arm reach exercises. It can be concluded that both exercises affect arm muscle strength.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that variations in plank exercises have a significant effect on increasing arm muscle strength in junior male floor gymnasts at FGI Medan in 2025. Statistical test results show that the t_{count} value of 10.06 is greater than the t_{table} value of 2.132, which means that there is a significant increase in arm muscle strength after being given the plank exercise variation treatment. Varied plank exercises are able to provide effective stimulation to the arm muscles, especially the triceps, biceps, and deltoids, thereby significantly increasing muscle strength.

Scientifically, this study contributes to the development of sports science, particularly in the field of physical conditioning training for floor gymnasts. The results of this study prove that plank exercise variations are not only effective for strengthening core muscles but also have a positive impact on upper extremity muscle strength. Thus, this study expands knowledge regarding the application of isometric and dynamic exercises such as planks in the context of specific strength training for gymnastics.

However, this study has limitations, namely the relatively small sample size (5 athletes) and the fact that it was conducted at only one club, so the results cannot be generalised widely to other populations of gymnasts. In addition, the duration of the training, which only lasted for six weeks, was also a limitation in observing the long-term effects of plank exercise variations on muscle strength.

Based on the results of this study, the researchers provided several suggestions and recommendations. First, gymnastics coaches are advised to incorporate plank exercise variations into their arm muscle strength training programmes, as they have been proven to effectively improve athletes' performance. Second, for future researchers, it is recommended to increase the number of samples, extend the duration of training, and combine plank exercises with other forms of exercise, such as push-up variations or resistance training, to obtain more comprehensive results. Third, further research can be conducted to examine the effect of plank exercise variations on other physical condition components, such as muscle endurance, balance, and core stability.

Thus, the results of this study are expected to serve as a scientific reference in the development of arm muscle strength training programmes for gymnasts and athletes in other sports that require upper extremity stability and strength in their movements.

REFERENCES

Alpen, J. (2017). Kontribusi Kekuatan Otot Lengan Terhadap Hasil Servis Bawah Bolavoli di SMP Negeri 2 Rambah Samo Kabupaten Rokan Hulu. https://doi.org/10.25299/sportarea.2017.vol2(1).592

Amansyah, A. (2019). Dasar Dasar Latihan Dalam Kepelatihan Olahraga. Jurnal Prestasi, 3(5), 42. https://doi.org/10.24114/jp.v3i5.13448

Anggraini. (2016). Pengaruh Latihan Handsatand Terhadap Peningkatan Keseimbangan Statis Pada Anak Laki-Laki Usia 8-9 Tahun Di SDN 2 Getas Blura Jawa Tengah. Skripsi, 1–5.

Asri, A., Suparman, S., & Haeril, H. (2021). Kekuatan Lengan dan Keseimbangan Terhadap Kemampuan Handstand Atlet Daradaeng Gymnastic Club. Gelora : Jurnal Pendidikan Olahraga Dan Kesehatan IKIP Mataram, 8(1), 1. https://doi.org/10.33394/gjpok.v8i1.4181

Dewi Irma Ristanti, Wawan Setiawan, & Donny Setiawan. (2019). Pengaruh Pembelajaran Menggunakan Media Hullahop Terhadap Peningkatan Hasil Belajar Senam Lantai Pada Siswa Kelas VIII Di SMP Negeri 1 Pakusari. Jurnal Kejaora (Kesehatan Jasmani Dan Olahraga), 4(1), 16–20. https://doi.org/10.36526/kejaora.v4i1.617

Dhimas, A., Ahmad, A., & Hidasari, F. P. (2021). Pengaruh Variasi Latihan Terhadap Akurasi Shooting Sepak Bola. Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK), 10(1), 1–9. https://doi.org/10.26418/jppk.v10i1.44398

Emral. (2017). Pengantar Teori dan Metodologi Pelatihan Fisik. Depok: Kencana.

Faot, D., Taek Bete, D. E., & Dairo Billi, L. (2023). Studi Tentang Proses Pembelajaran Olahraga Pra Remaja Dalam Cabang Olahraga Senam Artistik Pada Siswa-Siswi Kelas Viii a Smp Negeri Satap Oeusapi Soe. Jurnal of Sport & Science, 45(5), 44–50.

Firmansyah, F. (2022). Pengaruh Latihan Crocodile Push-Up dan T Push-Up Terhadap Kekuatan Otot Lengan dan Power Otot Lengan. Jurnal of Porkes, 5(1), 342–356. https://doi.org/10.29408/porkes.v5i1.5829

Hadi, F. S., Hariyanto, E., & Amiq, F. (2004). Pengaruh Latihan Ladder Drills Terhadap Peningkatan Kelincahan Siswa U-17 di Persatuan.

Hardianto, N., Syah, S., & Sitepu, I. D. (2017). Perbedaan Karakter Olahraga Kompetitif (Studi Komparatif Olahraga Individu Dan Olahraga Tim). Jurnal Prestasi, 1(2), 183–190. https://doi.org/10.24114/jp.v1i2.8058

Imran A. (2023). Hubungan Kekuatan Otot Lengan Dan Daya Tahan Otot Lengan Terhadap Akurai Tembakan Pada Anggota Unit Kegiatan Mahasiswa Panahan Universitas Hasanuddin. Accident Analysis and Prevention, 183(2), 153–164.

Jenifer. (2015). Plank Fitness. USA: Winds Press

Komariyah. (2013). Pengaturan Gizi Untuk Atlet Cabang Olahraga Senam Artistik Putri. Jurnal Kepelatihan Olahraga, 5(1), 35–43.

Lisnaini, . B., & Muhaimin, T. (2022). Pengaruh Plank Exercise Terhadap Diastasis Rektus Abdominis Atas Umbilikus Pada Ibu Post-Partum. Sains Olahraga : Jurnal Ilmiah Ilmu Keolahragaan, 5(1), 1. https://doi.org/10.24114/so.v5i1.20187

Mulyana, F. R. (2018). Hubungan Fleksibilitas Panggul Dan Power Otot Lengan Dengan

Keterampilan Stut Pada Senam Lantai. Journal of S.P.O.R.T, 2(1), 43–48.

Muzaffar, A., Adriani. S, F., & Ilham, I. (2023). Pengembangan Video Tutorial Senam Dasar. Score, 3(1), 01–07. https://doi.org/10.22437/sc.v3i1.24686

Nainggolan, F.A.A. & Sinulingga, A. (2021). Pengaruh Variasi Latihan Metode Drill Terhadap Jump Serve Pada Atlet Putra Klub Bola Voli Nusantara Deli Serdang Tahun 2021. Journal Physical Health Recreation, 2(1), 45–52. https://doi.org/10.55081/jphr.v2i1.518

P.Hafizh. (2022). Pengaruh Latihan Variasi Plank Terhadap Kekuatan Otot lengan Dan Kemampuan Smash Bulutangkis Atlet PB Musagta. Braz Dent J., 33(1), 1–12.

Pralanate, W. (2023). Pengaruh Latihan Kekuatan Otot Lengan Terhadap Kemampuan Smash Bola Voli Putra Gintes Aceh Tengah. Pendidikan, Studi Keguruan, Fakultas Ilmu, D A N Bina, Universitas Getsempena, Bangsa Aceh, Banda.

Priadana, B., & Saifuddin, H. (2023). Workshop Plank Exercise untuk Pembelajaran Kebugaran Jasmani bagi Guru PJOK Mi Se-Kecamatan Trowulan. Jurnal ABDINUS : Jurnal Pengabdian Nusantara, 7(2), 314–322. https://doi.org/10.29407/ja.v7i2.18414

Putra, I. M. A., Laksana, A., Yasa, I. P. M., & ... (2022). Hubungan Kelentukan Otot Pinggang dan Kekuatan Otot Tungkai terhadap Cut Back Selancar Klub Canggu Surf Community 2021. Jurnal Pendidikan ..., 2(3), 40–55.

Ramadhan, I. A., Priyono, B., & Purwono, E. P. (2013). Meningkatkan Hasil Belajar Handstand Dalam Pembelajaran Penjasorkes Melalui Media Audio Visual Pada Siswa Kelas Xi Smk N 1 Pringapus Tahun Ajaran 2012/2013. In Journal of Physical Education, Sport, Health and Recreation (Vol. 2, Issue 11).

Ratno, P., Hariadi, & Halimah, N. (2019). Perbedaan Pengaruh Latihan Plank Knee To Elbow, Mountain. Jurnal Ilmu Keolahragaan, 18(1), 54–62.

Rihatno, T., Rosana, S., Tobing, A. L., Jurnal, G., & Keolahragaan, I. (2019). Pengembangan Model Latihan Kekuatan Otot Lengan Pada Cabang Olahraga Softball. 10(01), 1–14.

Sejati, R., Muharram, N. A., & Junaidi, S. (2024). Pengaruh Latihan Tricep Dip dan Plank Arm Reach terhadap Kekuatan Otot Lengan Atlet Bulutangkis Usia 13-15 Tahun PB . Narottama Grogol Kediri. Sinkesjar, 639–649.

Sibarani, H. E. I. (2018). Seminar Nasional Seminar Nasional Pendidikan Olahraga. Prosiding, Seminar Nasional Pendidikan Olahraga, Universitas Negeri Medan, September, 442–447.

Siregar. (2021). Analisis Perbedaan Kontribusi Variasi Latihan Passing Bola Voli. Jurnal Olahraga Dan Kesehatan Indonesia, 1(2), 102–108. https://doi.org/10.55081/joki.v1i2.306

Siregar, I. (2015). Pengembangan Model Latihan Dribbling Bola Dengan Pendekatan Bermain. 11.

Sitepu, I. D., & Sandi, A. (2022). Pengembangan Alat Matras Multifungsi Untuk Membantu Teknik Roll Depan Dan Roll Belakang Senam Artistic Pada Atlet Junior .... Jurnal Ilmiah STOK Bina Guna ..., 10.

Sudharto, A., Pelana, R., & Lubis, J. (2020). Latihan Dribbling Dalam Permainan Sepak Bola. 11(02), 140–150.

Ursulla Duti Oktria Simamora [1A-E*], Albadi Sinulingga[2B-D], Indra Darma Sitepu[3B-D]
simamoraursulla@gmail.com[1*]

Sudjana. (2002). Metode Statistika. Bandung: Tarsito.

Sugiyono. (2015). Metodologi Penelitian Kuantitatif, Kualitatif dan R&D. Bandung: Alfabeta.

Suhairi, M., Effendi, A. R., & Rajidin, R. (2022). Pengembangan Model Pembelajaran Senam Lantai Berbasis Multimedia. Jurnal Penjaskesrek, 9(2), 25–33. https://doi.org/10.46244/penjaskesrek.v9i2.1912

Wicaksono, P. (2021). Pengaruh Variasi Latihan Plank Dan Push Up Terhadap Kekuatan Otot Lengan Pada Atlet Bulutangkis Putra Klub Patunas Kuala Tungkal. Program Studi Pendidikan Olahraga Dan Kesehatan, Fakultas Ilmu Keolahragaan. Universitas Jambi, 1(1), 1–84.