

## Analysis of the main physical condition factors in petanque Análisis de los principales factores de condición física en la petanque

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**Abstract.** Physical condition is a crucial factor in enhancing athlete performance. Athletes with good physical condition have a greater chance of reaching peak performance. This research aims to analyze the dominant physical condition factors of petanque athletes in Central Java. The research utilized tests and measurements on a sample of 58 athletes and employed confirmatory analysis techniques. The results indicate that seven factors influence petanque skills. Body height has a correlation value of 1.352 with a significance value of 0.000. Arm length has a correlation value of -0.641 with a significance value of 0.015. Palm length has a correlation value of -0.573 with a significance value of 0.002. Arm muscle strength has a correlation value of 0.041 with a significance value of 0.000. Hand-eye coordination has a correlation value of 3.017 with a significance value of 0.000. Grip strength has a correlation value of -0.233 with a significance value of 0.008. Static balance has a correlation value of 0.359 with a significance value of 0.000. However, two factors do not significantly influence the playing skills of petanque athletes in Central Java: trunk flexibility, which has a correlation value of -0.15 with a significance value of 0.159, and endurance, with a correlation value of 0.085 and a significance value of 0.359. In conclusion, the main physical condition factors in petanque include body height, arm length, palm length, arm muscle strength, hand-eye coordination, grip strength, and static balance. The novelty of this research lies in its potential use by coaches as a reference for providing appropriate training to improve the physical condition of petanque athletes. This study is limited to petanque athletes in Central Java.

**Keywords:** athletes, petanque, physical condition.

**Resumen.** La condición física es un factor crucial para mejorar el rendimiento de los atletas. Los atletas con una buena condición física tienen mayores posibilidades de alcanzar el máximo rendimiento. Esta investigación tiene como objetivo analizar los factores dominantes de la condición física de los atletas de petanca en Java Central. La investigación utilizó pruebas y mediciones en una muestra de 58 atletas y empleó técnicas de análisis confirmatorio. Los resultados indican que siete factores influyen en las habilidades de petanca. La altura corporal tiene un valor de correlación de 1,352 con un valor de significancia de 0,000. La longitud del brazo tiene un valor de correlación de -0,641 con un valor de significancia de 0,015. La longitud de la palma tiene un valor de correlación de -0,573 con un valor de significancia de 0,002. La fuerza muscular del brazo tiene un valor de correlación de 0,041 con un valor de significancia de 0,000. La coordinación mano-ojo tiene un valor de correlación de 3,017 con un valor de significancia de 0,000. La fuerza de agarre tiene un valor de correlación de -0,233 con un valor de significancia de 0,008. El equilibrio estático tiene un valor de correlación de 0,359 con un valor de significancia de 0,000. Sin embargo, dos factores no influyen significativamente en las habilidades de juego de los atletas de petanca en Java Central: la flexibilidad del tronco, que tiene un valor de correlación de -0,15 con un valor de significancia de 0,159, y la resistencia, con un valor de correlación de 0,085 y un valor de significancia de 0,359. En conclusión, los principales factores de condición física en la petanca incluyen la altura del cuerpo, la longitud del brazo, la longitud de la palma, la fuerza muscular del brazo, la coordinación mano-ojo, la fuerza de agarre y el equilibrio estático. La novedad de esta investigación radica en su posible uso por parte de los entrenadores como referencia para proporcionar un entrenamiento adecuado para mejorar la condición física de los atletas de petanca. Este estudio se limita a los atletas de petanca en Java Central.

**Palabras clave:** Atletas, petanca, condición física.

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### Introduction

Peak success in sports activities is the primary goal that should be achieved by all athletes, both individuals and groups (Nasution, Nasrulloh, and Pambagyo, 2023). The preservation of a culture of performance petanque sport must be preserved because it has a large enough chance of achieving peak performance (Pratama et al., 2019). Petanque is one of the sports that compete 13 numbers on PON (Indonesia National Sports Games) 2024 in the province of Aceh and North Sumatra. This sport has basic techniques of shooting and pointing playing it (Pelana et al., 2021; A. G. Permadi & Lubis, 2022; Rizqanada et al., 2022). This sport also requires a high level of concentration (Sitohang et al., 2023; Suwanto et al., 2018). A good level

of focus will affect the coordination ability of the athlete (Irawan et al., 2019; Widodo and Hafidz, 2018a).

Physical activity is considered one of the main strategies to combat physical disorders associated with weakness in the human body (Angulo et al., 2020). Physical condition is one of the important components in the process of improving the performance of an athlete (Nadzalan, Mohd Latif, et al., 2021). Increased physical condition factors require proper training load and adapted to the physical condition of the athlete (Nadzalan, Shafiee, et al., 2021). A good exercise program has a positive impact on health (Le and Charry, 2024). Good and proper physical exercise can improve muscle ability and coordination of movements (Kalmaganbetova, 2024). According to research interviews with five internationally and nationally licensed petanque trainers, the problem with physical conditioning is the lack

of a dominant reference for enhancing technique in the sport. The key anthropometric factors that are believed to improve an athlete's performance are height, weight, and arm length.

Physical factors that are believed to enhance athletic performance include endurance, arm muscle strength, overall arm strength, hand coordination, muscle development in the hands, and arm structure. Endurance, in particular, has crucial implications for improving athlete performance (Maunder et al., 2021). Men and women have differences in maximum oxygen intake (VO<sub>2</sub>max) (Besson et al., 2022; Thomas et al., 2023). Good endurance skills are very beneficial to athletes. Endurance skills can support athlete performance, accelerate recovery in the event of an injury, and prevent disease (Chaillou et al., 2022; de Almeida et al., 2022; Górna & Domaszewska, 2022). Endurance can be a potential therapeutic strategy to prevent reduced muscle mitochondrial content and physical performance induced by hypoandrogenism (Takahashi, Kitaoka, and Hatta, 2022).

Based on the above description, endurance is a crucial factor for enhancing athletic performance, preventing infections, and facilitating rapid recovery from injuries. Many sports injuries require surgery and prolonged immobilization, leading to significant muscle atrophy and a loss of maximum strength and range of motion (Rasheed et al., 2021). Flexibility is one of the standard components of physical fitness, it is reinforced by the results of research that flexibility can have a positive effect on muscle strength, muscle power, muscular hypertrophy, and reduce the risk of injury (Bougezzi et al., 2023). Muscle flexibility also has effects on myofascial release that can cause muscle tension (Sulowska-Daszyk & Skiba, 2022). In fact, the flexibility capability of a male athlete is worse than that of a female (İnal et al., 2022).

Based on the description, the flexibility factor becomes essential for the trainer to know the level of his ability to end the performance of the movement and minimize the injury. Strength training in athletes on macrocycles is essential for long-term player development, injury prevention, and performance (Kraemer & Nitka, 2022). The World Health Organization (WHO) recommends doing strength training at least twice a week, and is likely to do regular strength training every week (Muhu and Tilga, 2023).

Strength training is vital in the development and maintenance of musculoskeletal health (Vasudevan & Ford, 2022). Strength training can be used to rehabilitate post-injury muscles to recover and improve (Vivekanantha et al., 2023). The bullet power or arm muscle power has a very significant relationship with the accuracy of a shot or shot of an athlete (Abdalkarim, 2023; Fayogi, 2022). The flexibility of the swing movement into the arm can affect the power produced by such a swing (Zhang et al., 2022).

In petanque, arm power is essential for executing the shooting technique. Athletes with strong arm power can more easily perform shooting techniques at distances of 8,

9, and 10 meters. Hand coordination is a crucial physical factor that significantly impacts concentration when determining the direction of a movement (Permadi and Nurhidayat, 2021). Eye-hand coordination can help athletes in reaching high-level potential (Phon-Amnuaisuk and Au, 2015). Hand coordination has a contribution to improving the accuracy of movement in the athlete (Haryanto and Amra, 2020a). Petanque have the characteristics of precision sports. It can be seen from the way this sport is played that requires a level of accuracy to perform pointing movements and shooting movements. However, the analysis of physical condition factors in petanque remains unclear, necessitating further research.

Based on previous research, the primary physical condition factors in the sport of petanque remain unclear. To address this gap, researchers will conduct experimental actions aimed at identifying and analyzing these factors through a study titled "Analysis of the Main Physical Condition Factors in Petanque".

## Material and methods

### Type of research

This type of research is correlational research with quantitative research approaches and confirmatory analysis designs. Characteristics of research using quantitative approaches are the testing of theory or hypothesis using standard instruments (Maksum, 2012).

### Population and Samples

The purpose of population existence is to determine the size of the sample member taken from the population member and to limit the extent of the generalization area, the population consists of many things not just people (Mukhtazar, 2020). The population in this study is a petanque athlete of Jawa Tengah province with a total 79.

The sample is part of the number and characteristics that a population possesses (Sugiyono, 2011). The purpose of the sample determination is to study the characteristics of a population because it does not allow researchers to conduct surveys in the population due to large numbers of populations, time constraints, costs, and other obstacles (Hidayat, 2015).

Nonprobability sampling is a sample-taking technique that does not allow every member of the population to be selected as a sample, and purposive sampling is a technique that takes a specific sample with a certain consideration (Sugiyono, 2011). In determining the sample of the study, the researchers considered the selection of samples on the condition that they were 1) male, 2) training age of more than 12 months, and 3) resident or trained in Central Java. The total sample used in the study was 58 athletes.

### Research Instrument

A research instrument is a tool used by a researcher to collect data, measure phenomena, and analyze data that corresponds to the problem faced by the subject or sample

(Kurniawan, 2021). The instruments to measuring body height used stadiometer (Putri Purwoto et al., 2024), arm length used Measuring Tape (Putri Purwoto et al., 2024), palm length used Measuring Tape (Putri Purwoto et al., 2024), arm muscle strength used Back and Leg Dynamometer (Abi et al., 2022; Akbar Harmono et al., 2024; Wahyono et al., 2024), trunk flexibility used Sit And Reach (Peireira et al., 2024), grip strength used Hand Grip Dynamometer (Pedro et al., 2023), static balance used Stork Balance Stand Test (Sunanto et al., 2024), eye-hand coordination used Throw And Catch Test (Sunanto et al., 2024), and endurance used Multistage Fitness Test (Jatmiko et al., 2024).

### Data Analysis Techniques

Analysis techniques are also called data processing and interpretation. The purpose of performing quantitative data analysis is to understand what is behind all the data, group it, summarize it into one unit, and make it easier to understand (Siyoto & Sodik, 2015).

Table 1.  
Frequency Description

	Body Height (cm)	Length of Arms (cm)	Palm Length (cm)	Arm Muscle Strength (kg)	Eye-Hand Coordina- tion (time)	Grip Strength (kg)	Trunk Flexibility (cm)	Static Balance (min)	Endurance (mL/kg/min)
N	58	58	58	58	58	58	58	58	58
Mean	170.795	74.74	17.05	37.17	17.88	43.34	19.32	41.62	38.46
Median	171.25	76.00	17.00	38.00	18.00	43.00	19.30	42.00	39.20
Std. Deviation	6.6507	5.145	1.905	5.245	1.546	4.411	2.228	4.916	3.198
Minimum	153.3	66	14	25	14	34	15	30	32
Maximum	181.0	85	21	45	20	53	24	51	44
Sum	9906.1	4335	989	2156	1037	2514	1121	2414	2231

Based on the results of the descriptive analysis of anthropometric and physical factors, Central Java athletes have varying values. Athlete's height factor varies between 153,3cm - 181cm with a mean of 170,795 cm. The arm length factor ranges between 66-85 with a mean of 74,74. The palm length ranges from 14-21 with a mean of 17,05. The arm muscle strength factor from 25-45 with a mean of 37,17. The hand grip strength factor of 34-53 with a mean of 43,34. The trunk flexibility factor has a value between 15-24 with a mean of 19,32. The static balance factor of 30-51 with a mean of 41,62. The endurance factor has a value between 32-44 with a mean value of 38,46. The endurance factor has a value between 32-44 with a mean value of 38,46. The pétanque skills variable ranges of 13-30 with a mean of 20,43.

### Prerequisite Test

The prerequisite test is carried out with the help of the Amos 22 program to test the compatibility assumption of the model proposed to obtain a suitable model. The model compatibility assumption tests performed include data normality tests, outlier evaluation, goodness of fit tests, and hypothesis testing.

### Normality Test

The normality of data is identified with univariate and multivariate results against the data used. The result is as

The data analysis technique in this study is a confirmatory analysis technique. The prerequisite test is performed with the help of the Amos 22 program SEM application to test the compatibility assumption of the model submitted to obtain a suitable model. (Goodness of Fit). Factor analysis is used to explain the relationship between several independent changes between one and the other to determine the dominant factor.

## Results

### Data Analysis

The data collection process was carried out on a total of 58 athletes. Data descriptions are used to reveal research variables related to mean, median, standard deviation, and frequency tables as well as histogram graphs. The analysis of the data description in this study is described as follows: Height, length of arms, palm length, arm muscle strength, eye-hand coordination, grip strength, trunk flexibility, static balance, endurance.

presented in the following table:

Table 2.  
Normality Data

Variable	min	max	skew	c.r.	kurtosis	c.r.
X9	29,000	67,000	-0,308	-0,959	-0,935	-1,454
X8	26,000	69,000	-0,073	-0,228	-0,569	-0,884
X7	31,000	73,000	-0,023	-0,072	-0,692	-1,075
X6	29,000	73,000	0,181	0,562	-0,611	-0,95
X5	25,000	64,000	-0,151	-0,471	-0,693	-1,078
X4	27,000	65,000	-0,398	-1,238	-0,724	-1,125
X3	31,000	72,000	0,446	1,385	-0,473	-0,735
X2	33,000	70,000	0,03	0,093	-1,169	-1,817
X1	24,000	65,000	-0,464	-1,443	-0,374	-0,581
Y	32,000	73,000	0,251	0,781	-0,54	-0,84
Multivariate					0,124	0,030

Based on Table 2. the results of the normality test of the data in this study are univariate for the values in C.r skewness, all factors indicate that the value is below the absolute value  $\pm 2,58$  i.e. X1, X2, X3, X4, X5, X6, X7, X8, X9, and Y. So in the study, it can be said that the data are normally distributed univariate.

The value shown in the bottom right corner of Table 2. indicates that the information in this research is normally distributable multivariate because the value of 0.030 is smaller than the absolute value of 2.58. Based on the results of the analysis obtained all factors have normal values based on both univariate and multivariate tests.

### Outlier Evaluation

Tests on multivariate outliers were carried out using bus distance criteria at a rate of  $p < 0,001$ . When the d-squared bus is greater than the chi-square value at the free degree level  $p < 0,001$ . Then the data suggests multivariate outliers. From the results of computing on Amos 22 the largest d-squared bus distance is 19,591. And in this study based on the value of the chi-square at free degrees 9 (the number of variables) at the level  $p < 0,001$  is 27,877. Then it can be concluded that the data in this study does not indicate a multivariate outlier, because all the data has a diameter of  $< 27,877$ .

#### Criteria Test (Goodness of Fit)

The result of the Amos 22 calculation produces a parameter number that will be compared to the cut-off value of the goodness of fit. Table 3.

Criteria Analysis (Goodness of Fit)

Goodness-of-fit Indices	Cut-Off Value	Value	Description
Chi-Square ( $\chi^2$ )	$< 43,773$	29,329	Fit
Probability (p)	$\geq 0,05$	0,500	Fit
CMIN/DF	$\leq 2,0$	0,978	Fit
RMSEA	$\leq 0,08$	0,000	Fit
GFI	$\geq 0,9$	0,920	Fit
AGFI	$\geq 0,9$	0,854	Marjinal
TLI	$\geq 0,9$	1,004	Fit
CFI	$\geq 0,9$	1,000	Fit

Based on the overall measurement of goodness of fit the table explains that the recursive model proposed in the study is acceptable.

#### Hypothesis Testing

The test of the hypothesis was done using the help of the AMOS 22 program. This analysis is seen from the magnitude significance of the regression weight model can be seen in the following table:

Table 4.

Analysis Hypothesis Dominant Factor Playing Skills Petanque

		Estimate	Probability	Significance
Y	<--- X1	1,352	***	Significant
Y	<--- X2	-0,641	0,015	Significant
Y	<--- X3	-0,573	0,002	Significant
Y	<--- X4	0,401	***	Significant
Y	<--- X5	0,317	***	Significant
Y	<--- X6	-0,233	0,008	Significant
Y	<--- X7	-0,15	0,159	Insignificant
Y	<--- X8	0,359	***	Significant
Y	<--- X9	0,085	0,395	Insignificant

Based on the results of factor analysis in Table 4. the influence of each variable X on the variable Y is as follows:

- The influence of height on petanque playing skills is significant.
- The impact of arm's length on petanque playing skills is significant.
- The effect of palm length on petanque playing skills is significant.
- The effect of hand muscle strength on petanque playing skills is significant.
- The impact of hand coordination on petanque playing skills is significant.
- The influence of hand grip on petanque playing skills is significant.

g) The influence of trunk flexibility on petanque playing skills of insignificant.

h) The effect of static balance on petanque playing skills is significant.

i) The impact of endurance on petanque playing skills is insignificant.

#### Discussion

Based on the analysis of factors obtained 7 factors have a significant influence on the playing skills of petanque athlete Central Java among others body height, length of the hand, palm length, muscle strength of the arm, hand-eye coordination, hand grip strength, and the static balance. Whereas 2 factors do not significantly influence the skills of Central Java athletes among others trunk flexibility and endurance. This is probably because if petanque in its movements predominantly uses the hand to throw the ball so that it hits the target, so that body height, length of the hand, palm length, muscle strength of the arm, hand-eye coordination, hand grip strength, and the static balance are indeed really supports the accuracy of the ball hitting the target.

Based on the results of the analysis it is known that the skill of playing petanque is influenced by several factors of physical condition (Hidayah et al., 2024; Nurhasan et al., 2024). The petanque sport has two techniques: pointing and shooting. Height and length of arms affect pointing and shooting throwing because the higher the athlete's posture, the view towards the target becomes wider and if the Athlete has long arms then the distance between the pitch of the ball and the target becomes closer (Kristanto, 2020).

Static balance is the ability of a person to maintain his or her body position while standing or sitting (Isyani & Primayanti, 2019). Athletes must keep their bodies in balance so that they don't fall or get their legs out of the specified circle. Static balance in petanque is of course necessary for the body in the game of petanque, because when throwing the ball the feet do not change places (Nurhasan et al., 2024).

Hand-eye coordination has contributed to increasing the accuracy of movements so that they can hit the target (Haryanto & Amra, 2020b). Petanque is a sport that requires high accuracy. It can be seen from the way this sport is played that requires a level of accuracy to perform pointing movements and shooting movements (Isyani & Primayanti, 2019).

With good arms muscle strength, so make the right movements to reach the target. Arm muscle strength is also required by a petanque athlete to throw the boule to a target that has been specified. Throwing the boule must use the strength of the arm muscles so that the throwing to curious (Ashari & Apriani 2023). In petanque, the power arm is required to throw the ball on the shooting technique. Athletes with a good power arm will find it easier to do the throwing technique shooting at a distance of 8 and 9 meters (Widodo & Hafidz, 2018b).

The main physical condition factors in petanque include

body height, arm length, palm length, arm muscle strength, eye-hand coordination, grip strength, and static balance. Body height helps petanque athletes see the ball far away so they can estimate how hard to throw. If petanque athletes have long arms, this supports accuracy in reaching the target. The length of the palm supports petanque athletes to be able to hold almost all parts of the ball so that when the hand moves they don't worry about the ball coming loose (Kristanto, 2020). With arm muscle strength, it will support the movements carried out thereby increasing the accuracy of the ball reaching the target (Ashari & Apriani 2023). Eye-hand coordination is needed to predict the accuracy of hitting a target (Phon-Amnuaisuk & Au, 2015). Static balance is needed to support foot movements in petanque because in petanque there are no footsteps, so good static balance is needed (Isyani & Primayanti, 2019). Meanwhile, trunk flexibility and endurance are not main physical condition factors because they do not support petanque movements.

This research reveals that the primary physical factors influencing petanque athletes are height, hand length, arm muscle strength, hand-eye coordination, hand grip strength, and static balance.

## Conclusion

In conclusion, seven factors influence petanque skills: body height, arm length, palm length, arm muscle strength, hand-eye coordination, grip strength, and static balance. Conversely, trunk flexibility and endurance do not significantly affect the playing skills of petanque athletes in Central Java. Based on the analysis of these predominant physical condition factors, coaches should remain attentive when planning training programs and use these findings as a benchmark for effective exercises to enhance petanque skills. Athletes should strive to maintain their optimal physical condition.

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## References

- Abdalkarim, E. K. (2023). Explosive power of the arms and its relationship with speed of the arm angle, the angle of ball's flight and the accuracy of spiking skill of volleyball players. April.
- Abi, P. D., Widyah, K. N., Nurhasan, Hari, S., Zainal, A. M., & Putri, P. S. (2022). Enhancing Strength, Leg Muscle Explosive Power, And Muscle Hypertrophy Using Hurdle-Box Jump Plyometric. *Physical Education Theory and Methodology*, 22(1), 113–120. <https://doi.org/10.17309/TMFV.2022.1.16>
- Akbar Harmono, B., Setijono, H., Wiriawan, O., Wahyono, M., Nuryadi, A., Putri Purwoto, S., & Pranoto, A. (2024). Increased Leg Muscle Strength and Power After 6 Weeks of Trapping Exercise in Male College Students. *Sport TK*, 13. <https://revistas.um.es/sporttk>
- Angulo, J., El Assar, M., Álvarez-Bustos, A., & Rodríguez-Mañas, L. (2020). Physical activity and exercise: Strategies to manage frailty. *Redox Biology*, 35(March), 101513. <https://doi.org/10.1016/j.redox.2020.101513>
- Ashari, A. T., & Apriani, L. (2023). Hubungan Tinggi Badan Dan Kekuatan Otot Lengan Terhadap Ketepatan Hasil Shoting Pada Ukm Petanque Uir. *Journal of SPORT (Sport, Physical Education, Organization, Recreation, and Training)*, 7(1), 22–31. <https://doi.org/10.37058/sport.v7i1.6514>
- Besson, T., Macchi, R., Rossi, J., Morio, C. Y. M., Kunimasa, Y., Nicol, C., Vercruyssen, F., & Millet, G. Y. (2022). Sex Differences in Endurance Running. *Sports Medicine*, 52(6), 1235–1257. <https://doi.org/10.1007/s40279-022-01651-w>
- Bouguezzi, R., Sammoud, S., Markov, A., Negra, Y., & Chaabene, H. (2023). Why Flexibility Deserves to Be Further Considered as a Standard Component of Physical Fitness: A Narrative Review of Existing Insights from Static Stretching Study Interventions. *Youth*, 3(1), 146–156. <https://doi.org/10.3390/youth3010010>
- Chaillou, T., Treigyte, V., Mosely, S., Brazaitis, M., Venckunas, T., & Cheng, A. J. (2022). Functional Impact of Post-exercise Cooling and Heating on Recovery and Training Adaptations: Application to Resistance, Endurance, and Sprint Exercise. *Sports Medicine - Open*, 8(1). <https://doi.org/10.1186/s40798-022-00428-9>
- de Almeida, F. O., Santana, V., Corcos, D. M., Ugrinowitsch, C., & Silva-Batista, C. (2022). Effects of Endurance Training on Motor Signs of Parkinson's Disease: A Systematic Review and Meta-Analysis. *Sports Medicine*, 52(8), 1789–1815. <https://doi.org/10.1007/s40279-022-01650-x>
- Fayogi, N. 'Urizka. (2022). Study of the Correlation between Arm Muscle Power, Arm Length, Hand-Eye Coordination, and Concentration on Gate-In Results in Woodball. *International Journal of Multidisciplinary Research and Analysis*, 05(03), 606–615. <https://doi.org/10.47191/ijmra/v5-i3-04>
- Górna, S., & Domaszewska, K. (2022). The Effect of Endurance Training on Serum BDNF Levels in the Chronic Post-Stroke Phase: Current Evidence and Qualitative Systematic Review. *Journal of Clinical Medicine*, 11(12). <https://doi.org/10.3390/jcm11123556>
- Haryanto, J., & Amra, F. (2020a). The relationship of concentration and eye-hand coordination with accuracy of backhand backspin serve in table tennis. *International Journal of Technology, Innovation and Humanities*, 1(1), 51–56. <https://doi.org/10.29210/881701>
- Haryanto, J., & Amra, F. (2020b). The relationship of concentration and eye-hand coordination with accuracy of backhand backspin serve in table tennis. *International Journal of Technology, Innovation and Humanities*, 1(1), 51–56. <https://doi.org/10.29210/881701>
- Hidayah, T., Saghita Pratama, R., Rahayu, S., Budiono, I., Nadzalan, A., Hafidz, A., Purwoto, S. P., & Nurrachmad, L. (2024). Do Petanque Athletes in Jawa Tengah Need Android-Based Applications for Training Program Implementation? *Retos*, 53, 69–77. <https://recyt.fecyt.es/index.php/retos/index>
- Hidayat, A. A. (2015). *Metode Penelitian Kesehatan Paradigma Kuantitatif* (Aulia, Ed.). Health Books Publishing.

- İnal, Ö., Keklicek, H., Karahan, M., & Uluçam, E. (2022). Postural stability and flexibility responses of yoga training in women: Are improvements similar in both sexes? *Health Care for Women International*. <https://doi.org/10.1080/07399332.2022.2061971>
- Irawan, F. A., Permana, D. F. W., Akromawati, H. R., & Yangtian, H. (2019). Biomechanical Analysis of Concentration and Coordination on The Accuracy in Petanque Shooting. *Journal of Physical Education, Sport, Health and Recreations*, 8(2), 96–100.
- Isyani, & Primayanti, I. (2019). Efektivitas Latihan Core Stability terhadap Kemampuan Shooting Dalam Permainan Petanque. *Pendidikan Olahraga Dan Kesehatan IKIP Mataram*, 6(2), 76–80.
- Jatmiko, T., Kusnanik, N. W., Nurhasan, N., Muhammad, H. N., & Purwoto, S. P. (2024). Increase of VO 2 max After 8 Weeks Tuja Shuttle Run Exercise for Athletes in the 14-17 Year Age Group. In *Retos* (Vol. 55). <https://recyt.fecyt.es/index.php/retos/index>
- Kalmaganbetova, A. (2024). *Developing coordination with the author's "Sport in Square" technique Desarrollar la coordinación con la técnica del autor "Deporte en cuadrado."* 2041, 501–508.
- Kraemer, W. J., & Nitka, M. (2022). Importance of an In-Season Strength Training Program: A Reminder to Sport Coaches. *Strength & Conditioning Journal, Publish Ah*. <https://doi.org/10.1519/SSC.0000000000000739>
- Kristanto, N. (2020). Kontribusi Konsentrasi, Tinggi Badan, Pnjang Lengan, dan Persepsi Kinestetik Terhadap Hasil Pointing Atlet Petanque Jawa Timur. *Jurnal Universitas Negeri Surabaya*, 3(1), 1–5.
- Kurniawan, H. (2021). *Pengantar Praktis Penyusunan Instrumen Penelitian*. Deepublish.
- Le, P., & Charry-m, S. (2024). *Efecto de un programa de ejercicio físico con enfoque sanológico en población universitaria Effect of a physical exercise program with a sanológico focus on university population.* 2041, 267–274.
- Maksum, A. (2012). *Metode Penelitian Dalam Olahraga [Research Methods In Sports]*. Unesa University Press.
- Maunder, E., Seiler, S., Mildenhall, M. J., Kilding, A. E., & Plews, D. J. (2021). The Importance of 'Durability' in the Physiological Profiling of Endurance Athletes. *Sports Medicine*, 51(8), 1619–1628. <https://doi.org/10.1007/s40279-021-01459-0>
- Muhu, A., & Tilga, H. (2023). Strength Training Habits and Awareness of Its Recommendations among 18–63-Year-Old Adults. *Sustainability*, 15(6), 5087. <https://doi.org/10.3390/su15065087>
- Mukhthazar. (2020). *Prosedur Penelitian Pendidikan*. Absolute Media.
- Nadzalan, A. M., Mohd Latif, A. A., Hamdan, A. S., Yen Lee, E. L., Tan, K., Mohamad Jahizi, A. A., & Pratama, R. S. (2021). Comparison of Muscle Activation between Traditional, Clap and Power Push up among Trained Men. *Journal of Physics: Conference Series*, 1874(1). <https://doi.org/10.1088/1742-6596/1874/1/012015>
- <https://doi.org/10.15294/jsce.v3i1.31910>
- Putri Purwoto, S., Pranoto, A., Hidayatullah, F., Anwar, K., Handayani, H. Y., Widodo, H. M., Hamdhan Utama, F., Himawan, A., Arifin, M. Z., Utami, T. S., & Purwoto, S. P. (2024). Neuromuscular taping reduced pain intensity after the eccentric activity in senior high school students. *Sport TK*, 13(2). <https://revistas.um.es/sportk>
- Rasheed, A., Abduljawad, R., Mabrouk, S., Jdaitawi, M., & Abdulmonem, M. (2021). Physical fitness training program Nadzalan, A. M., Shafiee, M. S., Mohamad, M. H., Tan, K., Rahman, R. I. A., Mohamad, N. I., & Pratama, R. S. (2021). The Effects of Loadings during Forward Lunge on Force Output in Dominant and Non-Dominant Leg. *Journal of Physics: Conference Series*, 1874(1). <https://doi.org/10.1088/1742-6596/1874/1/012001>
- Nasution, F. A., Nasrulloh, A., & Pambagyo, D. (2023). Evaluation of petanque achievement development for the special region of Yogyakarta. *International Journal of Physical Education, Sports and Health*, 10(1), 176–187. <https://doi.org/10.22271/kheljournal.2023.v10.i1c.2770>
- Nurhasan, Arif, M., Ardha, A., Ristanto, K. O., Yang, C. B., Wijayanto, A., Warta, S., Pradana, K. C., Rhesa, N. S., Putra, P., Firmansyah, A., Sawa Bikalawan, S., Rizki, A. Z., & Utomo, R. S. (2024). Kinematic Movement Differences Between Petanque Pointing and Shooting Technique in Children. *Retos*, 52, 52–61. <https://recyt.fecyt.es/index.php/retos/index>
- Pedro, Ka. P. P., Oliveira, I. M. de, & Carral, J. M. C. (2023). Influence of Age and Sex on Grip Strength Levels Applying a Protocol with Different Elbow Angles. *Retos*, 47, 853–858.
- Pelana, R., Setiarnawijaya, Y., Anggraini, D., Sukiri, S., Safitri, I., & Antoni, R. (2021). Pointing Skills Training Model For Petanque Athletes. *Kinestetik: Jurnal Ilmiah Pendidikan Jasmani*, 5(1), 1–8. <https://doi.org/10.33369/jk.v5i1.13488>
- Pereira, M. V. do N., Paes, P. P., Costa, M. S. F., Freitas, I. L. T., Feitosa, R. C., Morena, J. M. D. de la, Santos, W. R., & Santos, W. R. (2024). Cross Sectional Analysis of Muscular Strength and Flexibility During the Menstrual Cycle in Women Engaged in Strength Training. *Retos*, 55, 704–709.
- Permadi, A. G., & Lubis, M. R. (2022). Penggunaan Video Feedback (VFB) Untuk Meningkatkan Kemampuan Shooting Petanque. *Empiricism Journal*, 3(1), 25–31. <https://doi.org/10.36312/ej.v3i1.722>
- Permadi, R., & Nurhidayat. (2021). Contribution Hand-Eye Coordination And Balance To Petanque Shooting Ability In Sports Education Students At Muhammadiyah University Of Surakarta. *International Journal of Educational Research & Social Sciences*, 2(4), 773–780. <https://doi.org/https://doi.org/10.51601/ijersc.v2i4.134>
- Phon-Amnuaisuk, S., & Au, T. W. (2015). Computational Intelligence in Information Systems: Proceedings of the Fourth INNS Symposia Series on Computational Intelligence in Information Systems (INNS-CIIS 2014). *Advances in Intelligent Systems and Computing*, 331, 201–202. <https://doi.org/10.1007/978-3-319-13153-5>
- Pratama, R. S., Hidayah, T., & Haryono, S. (2019). Konservasi Budaya Berprestasi Melalui Olahraga Petanque Pada Siswa Sekolah Dasar Se Kabupaten Purbalingga. *Journal of Sport Coaching and Physical Education*, 3(1), 30–35.
- using electronic simulation games to foster psychological health among university students during COVID-19 pandemic. *International Journal of Human Movement and Sports Sciences*, 9(3), 421–427. <https://doi.org/10.13189/saj.2021.090305>
- Rizqanada, A., Prasetyo, Y., Hutami, D. T., & Darma, G. P. (2022). Evaluation of the coaching program for petanque in Kediri District. *International Journal of Physical Education, Sports and Health*, 9(3), 103–114.

<https://doi.org/10.22271/kheljournal.2022.v9.i3b.2520>

Sitohang, I. S., Pelana, R., & Nuraini, S. (2023). THE EFFECT OF ANTHROPOMETRY, EYE - HAND COORDINATION AND CONCENTRATION ON PETANQUE POINTING SKILLS. *Jurnal Ilmu Keolahragaanlahragaan*, 14(01), 94–103. <https://doi.org/https://doi.org/10.21009/GJIK.141.08>

Siyoto, S., & Sodik, M. A. (2015). *Dasar Metodologi Penelitian* (Ayup, Ed.). Literasi Medis Publishing.

Sugiyono. (2011). *Metode Penelitian Kuantitatif, Kualitatif dan R & D*. Alfabeta.

Sulowska-Daszyk, I., & Skiba, A. (2022). The influence of self-myofascial release on muscle flexibility in long-distance runners. *International Journal of Environmental Research and Public Health*, 19(1). <https://doi.org/10.3390/ijerph19010457>

Sunanto, Himawan, A., Purwoto, S. P., Machmudah, & Handayani, Y. H. (2024). Basic motor movements of elementary school students following their experience with online learning during the COVID-19 pandemic period. *Sport TK*, 13, 17. <https://revistas.um.es/sportk>

Suwanto, W., Kristiyanto, A., & Doewes, M. (2018). Learning of Petanque Sport to Improve Concentration and Achievement of Students in Central Java. *The Infussion of 21st Century Skills on Elementary Education*, 508–513.

Takahashi, K., Kitaoka, Y., & Hatta, H. (2022). Effects of endurance training on metabolic enzyme activity and transporter protein levels in the skeletal muscles of orchietomized mice. *The Journal of Physiological Sciences*, 72(1), 14. <https://doi.org/10.1186/s12576-022-00839-z>

Thomas, H. J., Marsh, C. E., Lester, L., Maslen, B. A., Naylor, L. H., & Green, D. J. (2023). Sex differences in cardiovascular risk factor responses to resistance and endurance training in younger subjects. *American Journal of Physiology-Heart and Circulatory Physiology*, 324(1), H67–H78. <https://doi.org/10.1152/ajpheart.00482.2022>

Vasudevan, A., & Ford, E. (2022). Motivational Factors and Barriers Towards Initiating and Maintaining Strength Training in Women: a Systematic Review and Meta-synthesis. *Prevention Science*, 23(4), 674–695. <https://doi.org/10.1007/s11121-021-01328-2>

Vivekanantha, P., Diao, D., Cohen, D., Murphy, B., & de SA, D. (2023). Strength-based rehabilitation on clinical outcomes in patients post-partial meniscectomy: a systematic review and meta-analysis. *American Journal of Physical Medicine & Rehabilitation, Publish Ah*. <https://doi.org/10.1097/PHM.0000000000002198>

Wahyono, M., Setijono, H., Wiriawan, O., Harmono, B. A., Nuryadi, A., Pranoto, A., Purwoto, S. P., Kholis, M. N., Zawawi, M. A., & Puspodari, P. (2024). The effect of ladder drill exercises on some physical abilities in male junior high school students. *SPORT TK*, 13, 1–8. <https://revistas.um.es/sportk>

Widodo, W., & Hafidz, A. (2018a). Kontribusi Panjang Lengan, Koordinasi Mata Tangan, dan Konsentrasi Terhadap Ketepatan Shooting Pada Olahraga Petanque. *Prestasi Olahraga*, 3(1), 1–6.

Widodo, W., & Hafidz, A. (2018b). Kontribusi Panjang Lengan, Koordinasi Mata Tangan, dan Konsentrasi Terhadap Ketepatan Shooting Pada Olahraga Petanque. *Prestasi Olahraga*, 3(1), 1–6.

Zhang, Y., Wang, Y., Han, J., Sun, G., & Xie, Y. (2022). Effects of hydrofoil motion parameters and swing arm parameters on power extraction of a flexible hydrofoil in swing arm mode. *Ocean Engineering*, 245, 110543. <https://doi.org/10.1016/j.oceaneng.2022.110543>

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