ABDIMAS

Analysis of the Relationship Between Leg Muscle Strength and Flexibility and Headkick Results in Kickboxing Athletes in Kendal Regency

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Abstract

The purpose of this study was to determine: 1) To analyze and describe the relationship between leg muscle strength and headkick results in kickboxing athletes in Kendal Regency. 2) To analyze and describe the relationship between flexibility and headkick results in kickboxing athletes in Kendal Regency. 3) To analyze and describe the simultaneous relationship between leg muscle strength and flexibility and headkick results in kickboxing athletes in Kendal Regency. The author employed a quantitative approach, employing a correlational method. The study was conducted at the Rubelsalu Sports Complex, Taman Khayangan Housing Complex, Svargaloka A 1-2, Jalan Semarang – Campurejo, Kendal Regency, with nine athletes as subjects. Multiple regression analysis was used to analyze the data at a 5% significance level. The estimated r value for the hypothesis 1 test was 0.250 < r table (0.05) (7) (0.666), concluding that there was no significant correlation between kick height and wall squat time in Kendal Regency Kickboxing athletes. The calculated r value of 0.984 > r table (0.05) (7) (0.666) was displayed in the results of the hypothesis 2 test, concluding that there was a significant correlation between flexibility and kick height in Kendal Regency Kickboxing athletes, although there was a fairly strong positive correlation descriptively. The results of the hypothesis 3 test obtained a calculated F result of 115.807 with F table = 5.14, so that F count > F table (1158.807 > 5.14) concluded that there was a significant correlation between leg muscle strength and flexibility with headkick results in Kendal Regency Kickboxing athletes.

Keywords: correlation, kickboxing, leg muscles, flexibility, headkick

INTRODUCTION

Achievement sports are typically defined as activities conducted and managed professionally with the goal of achieving success in a particular sport. A person who studies and specifically participates in sports to achieve a specific goal is called an athlete (Noviansyah & Jannah, 2021) . One such sport is mahrtial arts. Martial arts is a sport that involves direct physical contact, where athletes face each other and compete face-to-face (Paypas et al., 2019) .

Kickboxing first entered Indonesia around 1980, but the official kickboxing organization was only formed and inaugurated in 2018 (Syah, 2020) . Kickboxing is a form of self-defense that can improve physical fitness and enhance performance. Because its movements require good physical condition and stamina, this martial art is very popular (Lystad, 2015) . Kickboxing is a martial art that combines techniques from boxing, karate, and taekwondo into one sport. (Anggara et al., 2024) .

An effective attacking technique in kickboxing is the headkick. Kicks are highly effective for attacking and disrupting an opponent's attack. They are easy to execute and can be combined with other types of attacks (Suryadin et al., 2021) . Kicking, particularly the headkick, requires two crucial physical components: leg muscle strength and flexibility to produce a good, high-quality kick (Rozikin & Hidayah, 2015) .

Leg muscle explosive power is the ability of muscles to overcome loads with high contraction speed (Akmal et al., 2021) . This ability is very necessary in sports that have elements of jumping/jumping, sprinting and kicking (Junior et al., 2023) . The leg muscle strength of athletes can

be developed and efforts to improve with various training variations (Aryatama et al., 2022) . Flexibility is the ability of a person's body to perform optimal joint movements supported by the elasticity of muscle tissue, tendons, and ligaments (Matin et al., 2018) . Hamstring muscle flexibility is closely related to the successful execution of high kicks, which allows athletes to perfect kicking techniques according to the desired target and reduce the possibility of injury (Junior et al., 2023) . To analyze and evaluate kick quality objectively, the use of motion analysis technology is very important, one of the motion analysis software that has been widely used in sports research is Kinovea. Kinovea has high validity and reliability in measuring angles and distances in biomechanical analysis (Id, CE, Padulle, JM, Puig-div1, A., Marcos-ruiz, D., Busquets, A., & Padulle, 2019) .

Looking at the facts on the ground, the sport of kickboxing has developed in Kendal Regency and produced potential athletes. This was proven at the Adonara Fighter Championship #series2 Open Tournament Kickboxing event in Brebes, where out of 10 athletes, 9 athletes from Kendal Regency managed to reach the final, demonstrating the potential and quality of kickboxing athletes in the region. However, only 2 athletes won 1st place and there has been no research that specifically analyzes the correlation between leg muscle strength and flexibility with the results of kickboxing athletes' headkicks in the region as far as the author has researched. In fact, understanding this relationship is important to create a more targeted and efficient training program that can improve athlete performance in competitions.

Based on this background, the researcher is interested in conducting a study on "Analysis of the Relationship between Leg Muscle Strength and Flexibility to Headkick Kick Results in Kickboxing Athletes in Kendal Regency." The results of this study are expected to provide scientific contributions in the development of kickboxing sports and become a reference in creating better training programs to improve headkick kick performance in athletes.

METHOD

This study uses a quantitative approach. According to (Creswell, 2014) , a quantitative approach is a research approach that uses numerical data to test objective theories by exploring the relationship between variables. This approach was chosen because the study aims to analyze the relationship between leg muscle strength and flexibility variables on headkick results that can be measured objectively and numerically. The type of research used is correlational research. (Fraenkel et al., 2014) explains that correlational research aims to determine whether or not there is a relationship between two or more variables, and how strong the relationship is.

This study will analyze the relationship between leg muscle strength (X_1) and flexibility (X_2) as independent variables with the results of headkick kicks (Y) as the dependent variable. This study involved kickboxing athletes from Kendal Regency from a total population of 9 athletes. The population is the entire area or group that includes research objects or subjects with special characteristics and properties that have been determined by the researcher as the focus of the study to produce research conclusions. (Sugiyono, 2019) . The population is the entire research subject that has certain characteristics (Arikunto, 2010) . Because the population in this study is relatively small, the entire population will be used as a research sample. Thus, the sample of this study is 9 kickboxing athletes from Kendal Regency. According to (Sugiyono, 2019) , if the population is less than 100, then the entire population should be used as a research sample.

RESULTS AND DISCUSSION

Research Results

This study involved nine athletes aged 13−21. Data collected included sit-and-reach test results to measure flexibility, wall squats to measure muscle endurance, and head kick analysis using Kinovea to measure kick height. The results of this study are described based on each variable: leg muscle strength, flexibility, and head kick results of the Kendal Regency Kickboxing athletes. The statistical results of the research data can be described as follows:

Leg Muscle Strength of Kickboxing Athletes in Kendal Regency

The description of the research data on the leg muscle strength of kickboxing athletes in Kendal Regency is shown in the following table:

Table 1. Description of Research Data for the Wall Squad of Kickboxing Athletes in Kendal Regency

Interval	Second	Frequency	Presentation
Excellent	> 102	0	0%
Good	102-76	1	11.1%
Average	75-58	5	55.6%
Fair	57-30	3	33.3%
Poor	< 30	0	0%
Amount		9	100%

Based on the research findings, if displayed in diagram form, the results are as shown in the image below:

Based on the research findings, if a diagram is made, the results will be as shown in the image below:
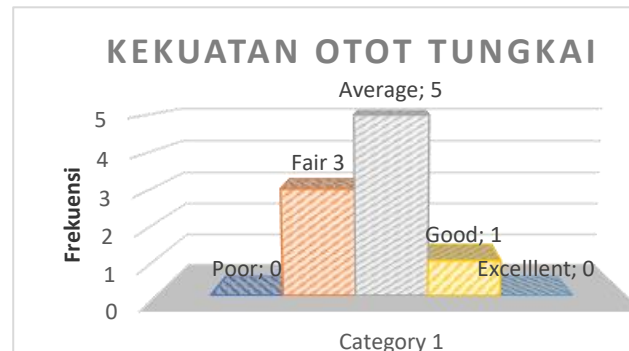

Figure 1. Description of Research Data on Leg Muscle Strength of Kickboxing Athletes in Kendal Regency

Flexibility of Kickboxing Athletes in Kendal Regency

The description of Flexibility data for Kickboxing athletes from Kendal Regency is shown in the following table:

Table 2. Description of Research Data on Flexibility in Kickboxing Athletes in Kendal Regency

Interval	Cm	Frequency	Presentation
Excellent	> 42.4	0	0%
Good	42.4-35.7	6	66.7%
Moderate	35.6-28.8	3	33.3%
Poor	28.7-18.6	0	0%
Amount		9	100%

Based on the research findings, if a diagram is made, the results will be as shown in the image below:
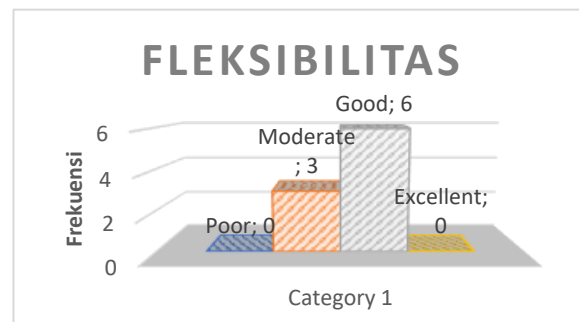

Figure 2. Flexibility Research Data in Kickboxing Athletes in Kendal Regency

Kick Height of Kickboxing Athletes in Kendal Regency

Description of Flexibility data for Kickboxing athletes in Kendal Regency based on the data in the following table:

Table 3. Description of Research Data on Kick Height in Kickboxing Athletes in Kendal Regency

Interval	Second	Frequency	Presentation
Excellent	> 150	0	0%
Good	150-145	4	44.4%
Average	144-140	3	33.3%
Fair	140-130	2	22.2%
Poor	<130	0	0%
Amount		9	100%

Based on the research findings, if a diagram is made, the results will be as shown in the image below:
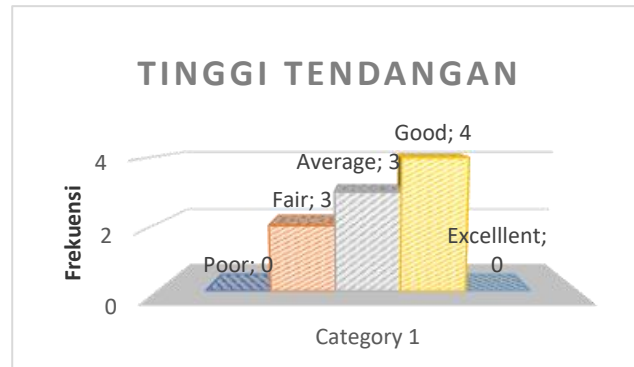

Figure 3. Research Data on Kick Height in Kickboxing Athletes in Kendal Regency

Data Analysis

Normality test

The normality test aims to confirm that the data distribution for each research variable conforms to a normal distribution. The Kolmogorov-Smirnov test is used to test the normality of the variables. A distribution is considered normal if $p > 0.05$, and abnormal if $p < 0.05$. The results of the normality test are presented in the following table:

Table 4. Normality Test

Variables	Z	p	Sig.	Information
Leg Muscle Strength	0.900	0.254	0.05	Normal
Flexibility	0.889	0.194	0.05	Normal
Kick Height	0.945	0.637	0.05	Normal

All data have a normal distribution according to the table above, and the significance value (p) for each variable is greater than 0.05. Therefore, the analysis can be continued with parametric statistical analysis.

Hypothesis Testing

Hypothesis Test 1

The research hypothesis testing was conducted after the data requirements were met. To analyze the relationship between variables X1 and Y, the *product- moment correlation analysis* developed by Karl Pearson was used. The findings from this correlation test can be explained as follows:

Table 5. Correlation Test of Hypothesis 1

Variables	df	r table	r count	Sign 5%
Correlation of leg muscle strength with headkick results	7	0.666	0.250	0.258

The results of *the product moment correlation test* described above provide results indicating that the calculated r is 0.250 < r table (0.05)(7) (0.666). In addition, the significance value of 0.258 > α (0.05). Thus, it can be concluded that in the research sample there is no significant correlation

between kick height and wall squad time.

Hypothesis Test 2

The Karl Person test on *product moment correlation* is used to determine the relationship between X2 and Y. The results of the correlation analysis are presented in the following table:

Table 6. Correlation Test of Hypothesis 2

Variables	df	r table	r count	Sign 5%
Correlation of flexibility with headkick results	7	0.666	0.984	0.001

Moment correlation test that has been conducted, the calculated r value is 0.984 > r table at the significance level (0.05) (7) (0.666). In addition, the significance value is 0.001 < α (0.05). These results indicate that flexibility has a significant relationship to kick height even though there is a fairly strong positive correlation descriptively.

Hypothesis Test 3

Based on simultaneous statistical testing, the relationship between variables X1 and X2 on Kickboxing athletes in Kendal Regency is shown in the following table:

Table 7. F Test Analysis ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	364,556	2	182,278	115,807	<,001b
	Residual	9,444	6	1,574		
	Total	374,000	8			
a. Dependent Variable: Kick Height						
b. Predictors: (Constant), Flexibility, Leg Muscle Strength						

Data in SPSS shows that leg muscle strength and flexibility significantly correlate with headkick results in Kendal Regency Kickboxing athletes. This is because the numerator (k) degree of freedom is 2, while the denominator is Nk-1=9-2-1=6, so the calculated F > F table (1158, 807 > 5.14).

Table 8. Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.987a	.975	.966	1.25459
a. Predictors: (Constant), Flexibility, Leg Muscle Strength				

Based on the Model Summary above, the R value of 0.987 indicates a very strong correlation between the independent variables (leg muscle strength and flexibility) and the dependent variable (headkick results). The R Square value of 0.975 indicates that 97.5% of the variability in headkick results can be explained by the variables of leg muscle strength and flexibility, while the remaining 2.5% is explained by other factors not examined.

Discussion

Kickboxing is a modern martial art that combines punching techniques from boxing with kicking techniques from traditional Asian martial arts. Kickboxing is a modern combat sport that requires athletes to reach high thresholds in several aspects of physical fitness (Slimani et al., 2017) . This sport is played by two participants who face each other in a ring with the aim of scoring points through accurate and effective punches and kicks against the opponent. The headkick is one of the most effective and spectacular techniques for scoring points or even ending a match. To successfully execute an accurate and powerful headkick, an athlete must have an effective combination of leg muscle strength and body flexibility.

Correlation of Leg Muscle Strength to Headkick Results in Kickboxing Athletes in Kendal Regency

The product moment correlation analysis conducted to test the relationship between leg muscle strength and headkick kick results in Kickboxing athletes in Kendal Regency produced a correlation coefficient (r count) of 0.250. When compared with the r table value (0.05)(7,) which is 0.666, the result obtained is 0.250 <0.666. This result indicates that the hypothesis stating that there is a

significant correlation between the two variables is rejected, so it can be concluded that leg muscle strength does not have a significant relationship with headkick kick ability in Kickboxing athletes in Kendal Regency.

According to previous research, leg muscle strength is related to the muscle's ability to generate maximum force in a short period of time. Leg muscle strength is the ability of a muscle group to overcome a load or resistance during a single maximal contraction. In the context of kickboxing, leg muscle strength involves the quadriceps, hamstrings, gluteus maximus, and gastrocnemius muscles, which work synergistically to produce an explosive kicking motion (Bompa & Buzzichelli, 2019) .

wall squat instrument used in this study may not have optimally measured the specific leg muscle strength components required for the headkick. Wall squats tend to measure isometric strength and leg muscle endurance in a static position, while the headkick requires explosive and dynamic strength involving high-speed ballistic movements. Furthermore, the wall squat places greater emphasis on quadriceps and gluteus muscle strength in the sagittal plane, while the headkick requires multi-planar strength involving trunk rotation, hip flexor flexibility, and kinetic chain coordination from the supporting leg to the kicking leg. Therefore, the insignificant correlation results may be explained by a mismatch between the measurement instrument and the actual movement demands of the headkick.

Correlation of Flexibility to Headkick Results in Kickboxing Athletes in Kendal Regency

The results of the correlation analysis of flexibility with the results of the headkick kick of the Kendal Regency Kickboxing athletes *product moment* above shows a calculated r value of 0.984 > r table (0.05) (7) (0.666). This means that there is a significant correlation between flexibility and the results of the headkick kick in the Kendal Regency Kickboxing athletes. In addition to the strength factor, performing a headkick kick requires optimal flexibility from the athlete. Flexibility is an important factor in a headkick kick because it determines the athlete's ability to reach the desired target height. Athletes with good flexibility will be able to lift their legs to the level of the opponent's head more easily and naturally.

To increase the success of a headkick in kickboxing, athletes must have optimal flexibility, especially in the hips, thighs, and calves. Good flexibility allows athletes to execute kicks with a wider range of motion, allowing them to reach higher targets more easily and efficiently.

Correlation Between Leg Muscles and Flexibility on Headkick Results in Kickboxing Athletes in Kendal Regency

Based on the statistical test results above, it can be concluded that there is a significant correlation between leg muscles and flexibility towards the results of headkick kicks in Kick Boxing athletes from Kendal Regency. This is because the degree of freedom of the numerator (k) is 2, while the degree of freedom of the denominator is Nk-1 = 9-2-1 = 6, so that the calculated F > from the F table (115,807 > 5.14).

Data analysis shows that leg muscle strength and flexibility are simultaneously positively correlated with headkick ability. When athletes face a competitive situation, the combination of these two physical factors is crucial. Athletes with good leg muscle strength will be able to deliver powerful kicks, while optimal flexibility allows them to accurately target the opponent's head.

An R-square value of 0.975 indicates that 97.5% of the variability in headkick results can be explained by leg muscle strength and flexibility. However, these results are not entirely attributable to these two factors. Other factors that can influence headkick success include technique, timing, coordination, and psychological factors such as confidence and concentration.

Kickboxing coaches must consider both aspects simultaneously if they want to improve their athletes' headkick performance. Athletes trained with a balanced program tend to feel more confident and more effective when performing kicks if they incorporate exercises that simultaneously improve leg strength and flexibility, such as plyometric training, dynamic stretching, or functional training. Additionally, exercises that improve coordination and balance, such as training on unstable surfaces or using a variety of movements, can also help athletes feel more stable and confident when executing headkicks in a real-life match situation.

CONCLUSION

Based on the research results and discussions presented above, the researcher concluded the

results which have been summarized as follows:

Based on hypothesis test 1, the calculated r value is 0.250 < r table (0.05) (7) is 0.666. In addition, the significance value is 0.258 > α (0.05). It is concluded that there is no significant correlation between kick height and wall squad time in Kick Boxing Athletes in Kendal Regency.

Based on the hypothesis test 2, the calculated r value was obtained at 0.984 > r table (0.05) (7) which is 0.666. In addition, the significance value was 0.001 < α (0.05). It was concluded that there was a significant correlation between flexibility and kick height in the research sample, although there was a fairly strong positive correlation descriptively.

Based on the hypothesis test 3, the calculated F result was 115.807 with F table = 5.14, so that calculated F > F table (1158, 807 > 5.14) it was concluded that there was a significant relationship between leg muscles and flexibility on the results of headkick kicks of Kick Boxing athletes from Kendal Regency.

REFERENCES

Akmal, Saripin, & Juita, A. (2021). the Contribution of Explosive Power Legs Muscle and 40 M Running Speed With Long Jump Results on Students At Sman 1 Kubu. *Physical Education, Health and Recreation Faculty of Teacher Training and Education Riau University*.

Anggara, ZA, Tomi, A., & Wahyudi, U. (2024). The Effect of Sports Massage on Push Kick Kick Speed in Kickboxing Athletes at Han Academy, Malang City. Kick can be explained as follows: which is tense and reduces stiffness. With more flexible muscles, athletes can. *Jurnal Pendidikan Bhineka Tunggal Ika, 2* (1).

Arikunto, S. (2010). *Research procedures: a practical approach* (Edition 4, Issue 3105196).

Aryatama, B., Putra, RT, & Mandalawati, TK (2022). Biomotor Abilities of Kick Boxing in State Senior High School Sports (Smanor) Lampung Province. *Wahana Didaktika: Journal of Educational Sciences, 20* (3), 431–445. https://doi.org/10.31851/wahanadidaktika.v20i3.10534

Bompa, T. O., & Buzzichelli, C. A. (2019). Peridization: Theory and Methodology of Training. In *Journal of Chemical Information and Modeling: Vol. 6th ed* (Issue 6).

Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (Fourth ed.). SAGE Publications.

Fraenkel, J.R., Wallen, N.E., & Hyun, H. (2014). *How to Design and Evaluate Research in Education* (Ninth edit). McGraw-Hill Education.

Id, C.E., Padulle, J.M., Puig-divı, A., Marcos-ruiz, D., Busquets, A., & Padulle, X. (2019). Validity and reliability of the Kinovea program in obtaining angles and distances using coordinates in 4 perspectives. *PLOS One, Icc,* 1–14. https://doi.org/10.5281/zenodo.2843847

Junior, AH, Dewi, AANTN, Putra, INA, & Widnyana, M. (2023). Hamstring Flexibility and Leg Muscle Explosive Power Are Related to C-Kick Ability in Udayana University's Psht Ukm Silat Athletes. *Indonesian Physiotherapy Scientific Journal, 11* (1), 36. https://doi.org/10.24843/mifi.2023.v11.i01.p07

Lystad, R. P. (2015). Injuries to Professional and Amateur Kickboxing Contestants: A 15-Year Retrospective Cohort Study. *Orthopedic Journal of Sports Medicine, 3* (11), 1–5. https://doi.org/10.1177/2325967115612416

Matin, AA, Nurudin, AA, & Maulana, F. (2018). The Relationship Between Leg Muscle Flexibility and Leg Muscle Strength to the Results of Sepak Sila in Extracurricular Sepak Takraw Games for Students at SMP Negeri 5, Sukabumi City in 2017/2018. *National Seminar on Physical Education,* 116–122.

Noviansyah, IA, & Jannah, M. (2021). THE RELATIONSHIP BETWEEN MENTAL TOUGHNESS AND SPORTS ANXIETY IN MARTIAL ARTS ATHLETES Ilham Andrian Noviansyah Miftakhul Jannah Abstract. *Journal of Psychological Research, 9* no *8* (https://ejournal.unesa.ac.id/index.php/character/issue/view/2418), 85–91. https://jurnalmahasiswa.unesa.ac.id/index.php/40/article/view/34412%0Ahttps://jurnalmahasiswa.unesa.ac.id/index.php/40/article/download/34412/30615

Paypas, AA, Kartika Dewi, R., & Brata, KC (2019). Implementation of TOPSIS in a Location-Based Recommendation System for Martial Arts Training Venues in Malang City. *Development of Information Technology and Computer Science, 3* (4), 3728–3732. http://j-ptiik.ub.ac.id

Rozikin, A., & Hidayah, T. (2015). The Relationship between Flexibility and Leg Muscle Strength and the Results of Eolgol Dollyo-Chagi Kicks in Taekwondo. *Journal of Sport Sciences and Fitness, 4* (1), 32–36.

Slimani, M., Chaabene, H., Miarka, B., Franchini, E., Chamari, K., & Cheour, F. (2017). Kickboxing review: Anthropometric, psychophysiological and activity profiles and injury epidemiology.

Biology of Sport, 34 (2), 185–196. https://doi.org/10.5114/biolsport.2017.65338

Sugiyono, P. (2019). Digital Book of Quantitative and Qualitative Research Methodology. In *Sustainability (Switzerland)* (Vol. 11, Issue 1).

Suryadin, T., Sahudi, U., & Kulyana, K. (2021). The Effect of Chair Kick Training on Front Kick Skills in Pencak Silat Extracurricular Activities at Bina Insan Mandiri Vocational School. *RESPECS Journal, 3* (2), 45–52. https://doi.org/10.31949/respecs.v3i2.1270

Syah, NCA (2020). ANALYSIS OF STRENGTH, WEAKNESS, OPPORTUNITY, AND THREATS, ACHIEVEMENT DEVELOPMENT OF KICKBOXING IN KBI LAMONGAN DISTRICT Nurudin Cholid Apreal Syah Himawan Wismanadi Abstract. *Journal of Sports Health, 08,* 15–22.