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ANALYSIS OF SURFACE ELECTROMYOGRAPHY OF THE QUADRICEPS MUSCLE DURING LUNGE MOVEMENTS IN THE SPORT OF FENCING WITH A HISTORY OF KNEE AND QUADRICEPS CORNER PAIN (Q-ANGLE)

Adhy Kurniawan[1*], Teguh Santosa[2], Nuruddin Priya Budi Santoso[3]

[1]Universitas Tunas Pembangunan Surakarta (UTP), Indonesia
[2]Universitas Tunas Pembangunan Surakarta (UTP), Indonesia
[3]Universitas Tunas Pembangunan Surakarta (UTP), Indonesia

*e-mail: adhykurniawan@gmai.com

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Abstract

Data collection techniques in this study were obtained using surface electromyography records. Treatment for 1 meeting. Data analysis used a Nonparametric Test in the form of a Two Independent Samples Test with the Mann Whitney U Test type. The research results obtained were 1) Differences in activation of the rectus femoris muscle for pain had a p-value of 0.034, 2) Differences in activation of the vastus medialis muscle for pain had a p-value of 0.289, 3) Differences in activation of the vastus lateralis muscle had a p-value of 0.034, 4) The difference in activation of the rectus femoris muscle to the q-angle has a p value of 0.077, 5) The difference in activation of the vastus medialis muscle to the q-angle has a p value of 1.000 and 6) The difference in activation of the vastus lateralis muscle to the q-angle has a p value of 0.289.

The conclusions of this study are as follows 1) There is a difference in activation of the rectus femoris muscle for fencers who experience pain, 2) There is no difference in activation of the vastus medialis muscle for fencers who experience pain, 3) There is a difference in activation of the vastus lateralis muscle for fencers who experience pain pain, 4) There was no difference in activation of the rectus femoris muscle against the q-angle, 5) There was no difference in activation of the vastus medialis muscle against the q-angle, and 6) There was no difference in activation of the vastus lateralis muscle against the q-angle.

Keywords: *Muscle Activation, Quadriceps Muscles, Lunge, Fencing*

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INTRODUCTION

Fencing is a sport game played by two players. Both fencers use swords to attack opponents and defend themselves (Tutorials Point (I) Pvt. Ltd., 2017). Fencing can be classified as an agility sport, because the entire body must be able to change direction quickly, balance of the limbs is also needed to change between attacking and defensive movements in a short time (Redondo et al., 2014).

According to data from the International Olympic Committee (IOC), fencing is one of the sports that has the highest risk of injury (Roi & Bianchedi, 2008). Harmer's research (2008) states that 92.8% of injuries to fencers are more likely to involve injuries to the lower limbs. Based on an epidemiological study conducted by Byung on professional South Korean fencing athletes, it was found that 47.2% of the total injuries recorded were injuries to the lower extremities, and knee injuries were injuries that often occurred (Park & Byung, 2017). The knee is a joint that is very prone to injury, especially in fencing which uses the knee joint as a support (Alekseyev et al., 2016). Knee pain is the main cause of decreased physical function in athletes (Huang et al., 2014).

Footwork is a combination of forward or backward foot movements that is used when carrying out attacks (lunges) or when maintaining distance from the enemy (C. Chen, 2014; Putra et al., 2017; Z.A et al., 2016). The lunge movement is one of various types of footwork and is a basic movement in fencing which aims to attack the opposing player. The lunge movement begins with a straight forward movement and uses the back foot as a push to create great power (Kurniawan & Husni, 2019).

The lunge movement is greatly influenced by lower limb muscle strength, body mass, leg length and flexibility. The lunge movement relies heavily on the strength of the quadriceps muscles to control the lunge movement to make it more efficient, so it will also affect the angle of the quadriceps. This also explains the relationship found between the knee and ankle joints where lunges tend to flex the quadriceps muscles, knee joints and quadriceps tendons. Meanwhile, at the posterior level of the foot through the soleus tendon and at the bottom of the foot through the flexor digitorum brevis (Lorca et al., 2020). As compensation for this, changes in the structure of the lower limbs will occur, especially in the knee joint which is the support when performing the lunge movement. Therefore, anthropometric measurements of the knee joint are very important.

The quadriceps angle (q - angle) is a clinically relevant diagnostic measurement for detecting various disorders of the knee joint. The Q-angle describes the overall alignment of the knee joint, when assessed correctly the Q-angle can indicate the biomechanical function of the lower extremities, especially the alignment of the knees, legs and pelvis. Q-angle assessment has an important role in sports medicine. Excessive pronation of the foot can have an effect on the q-angle if corrected can often reduce the adverse effects of an abnormal q-angle (Chevidikunnan et al., 2015).

The quadriceps angle (q-angle) is a very important parameter for examining knee joint mechanics and is of great interest to clinicians (Raveendranath et al., 2009). An increase in the quadriceps angle of more than 20% can result in injury to the knee joint (Kaya & Doral, 2012). The quadriceps angle is a clinical measure used to assess the alignment of the knee joint, the greater the quadriceps angle, the greater the knee joint injury (Emami et al., 2007).

When performing lunges, fencers use the strength and speed of the quadriceps muscle group, especially the rectus femoris and vastus lateralis muscles. Contraction of the rectus femoris muscle is very helpful when doing lunges, especially in fencing, football and badminton. Quadriceps muscle activation plays an important role during lunge movements, however anthropometric factors of the knee joint also influence the magnitude of this muscle activation (M. F. Ismail et al., 2017).

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The author has the idea to find out the extent of the contribution between the level of knee injury, the quadriceps angle (q-angle), and the activation of the quadriceps muscles when performing lunges in fencing so that we can draw implications from the research that will be carried out which we feel will be useful for the development of the sport. fencing. Based on the background above, the author is interested in conducting research entitled the contribution of knee injury level, quadriceps angle (q-angle) to quadriceps muscle activation.

METHODS

This research is a type of quantitative research that uses observational methods with descriptive analytics and uses a cross-sectional approach, where this research method aims to explore how and why a phenomenon occurs and then carry out analysis (Notoatmodjo, 2012).

According to Notoatmodjo (2012), the research design used was cross sectional, that is, the researcher only carried out observations and measurements of variables simultaneously (at the same time). This research will focus on determining the activation of the quadriceps muscles which include the rectus femoris, vastus lateralis and vastus medialis muscles when performing lunges in fencers.

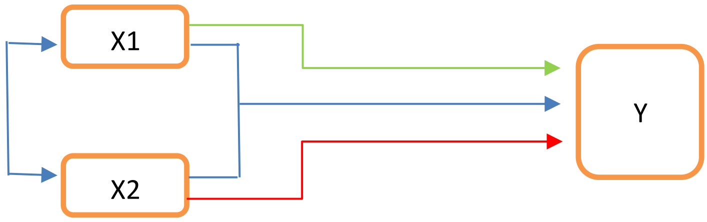

Figure 1. Multiple Model with Two Independent Variables

The population in this study were fencers at Tunas Pembangunan University, Surakarta. The total population is 40 people consisting of male and female athletes from Pracadet level aged 12 – 15 years, Cadets aged under 17 years, Junior aged 18 – 20 years, Senior aged over 20 years.

FINDINGS AND DISCUSSION

Findings

The research was conducted to determine muscle activation in the lower limb muscles, such as the rectus femoris, vastus lateralis, vastus medialis muscles during the lunge movement in Floret number fencers and Sabel number fencers at the UTP Solo fencing club. This research involved 7 respondents as research samples. This research looks at the lunge movement which consists of the movement from start to finish. Respondents were asked to spar with a friend of the selected number and then asked to do lunges 3 times and the average of the three was taken. The following is a description of the muscle activation data for each fencer athlete.

a. Rectus Femoris Muscle Activation

Data on activation of the rectus femoris muscle during the lunge position for 7 athletes divided into 4 athletes in the floret number and 3 athletes in the sable number which was done for a duration of 5 seconds. The following are the research results of the average activation of the rectus femoris muscle during lunges.

Table 1. Average Results of Rectus Femoris Muscle Activation

	Average Results of Rectus Femoris Muscle Activation			
	Lunge 1	*Lunge 2*	*Lunge 3*	Average
S1	40.00	55.00	50.00	48.33
S2	45.00	65.00	50.00	53.33
S3	51.00	45.00	60.00	52
F1	92.00	95.00	103.00	96.67
F2	89.00	111.00	74.00	91.33
F3	35.00	63.00	63.00	53.67

F4	96.00	112.00	80.00	96

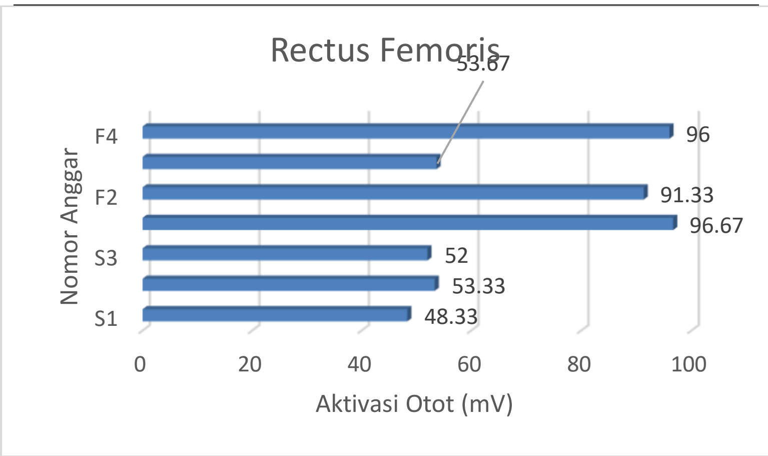

Figure 2. Rectus Femoris Muscle Activation Value

Based on the graph above, it can be seen that the lowest activation value for the rectus femoris muscle in the sable number when performing the lunge movement is 48.33mV and the highest activation value for the rectus femoris muscle in the sable number is 53.33 mV. Meanwhile, for the floret number, the lowest activation value was 53.67mV and the highest was 96.67mV.

b. Vastus Medialis Activation

Vastus Medialis muscle activation data during the lunge position for 7 athletes is divided into florets and sables which are performed for a duration of 5 seconds. The following are the research results of the average Vastus Medialis muscle activation during lunges.

Table 2. Average Results of Vastus Medialis Muscle Activation

Average Results of Vastus Medialis Muscle Activation				
	Lunge 1	*Lunge 2*	*Lunge 3*	Average
S1	65.00	97.00	99.00	87
S2	93.00	100.00	77.00	90
S3	50.00	65.00	50.00	55
F1	35.00	49.00	41.00	41.67
F2	41.00	42.00	38.00	40.33
F3	100.00	50.00	75.00	75
F4	50.00	152.00	63.00	88.33

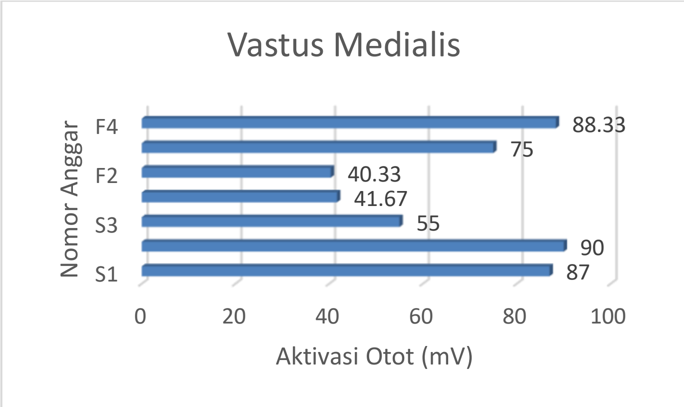

Figure 3. Vastus Medialis Muscle Activation Value

The graph above shows that the lowest vastus medialis muscle activation value in the sable number is 55mV, while the highest vastus medialis muscle activation value in the same number is 90 mV. The lowest activation value for the vastus medialis muscle in the floret branch was 40.38mV and the highest was 88.33mV.

c. Otot Vastus Lateralis Activation

Vastus Medialis muscle activation data during the lunge position for seven athletes was divided into floret and sable which were carried out for a duration of 5 seconds. The following are the research results of the average Vastus Medialis muscle activation during lunges.

Table 3. Average Results of Vastus Lateralis Muscle Activation

Average Results of Vastus Lateralis Muscle Activation				
	Lunge 1	*Lunge 2*	*Lunge 3*	Average
S1	50	50	75	58.33
S2	250	215	150	205
S3	50	15	25	30
F1	50	65	50	55
F2	55	65	85	68.33
F3	100	110	200	136.67
F4	150	100	500	250

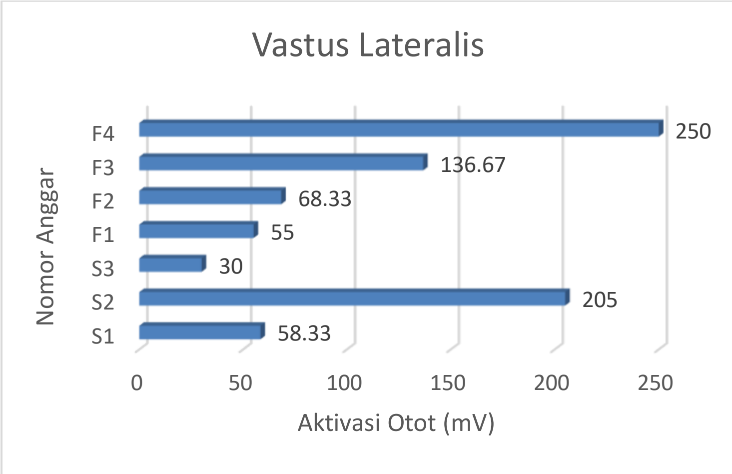

Figure 4. Vastus Lateralis Muscle Activation Value

The graph above shows that the lowest vastus lateralis muscle activation value in the sable number is 30 mV, while the highest vastus lateralis muscle activation value in the same number is 205 mV. The lowest activation value for the vastus lateralis muscle of the floret branch was 55 mV and the highest was 250 mV.

To test the hypothesis in this research, a Non-Parametric Test is used in the form of a Two Independent Sample Test, Mann Whitney U Test. The use of the Non Parametric Test is because in the prerequisite test, namely in the normality test of data variance there is data that is not normal even though in the homogeneity test all the data is homogeneous. The Mann Whitney U test in this study uses a significance value of <0.05. The following is an explanation of the results of the Mann Whitney U test as follows:

1) Hypothesis Testing Rectus Femoris Muscle Activation Against Pain

Table 4. Results of the Mann Whitney U Test for Rectus Femoris Muscle Activation

Muscle Activation	**N**	**Sum of Ranks**	***Mann Whitney U***	**Sig.**
Rectus Femoris Muscle				
- *Painful*	4	10,00	0,000	0,034
- *No Pain*	3	18,00		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on the activation of the rectus femoris muscle on pain, it was found that the conclusion of hypothesis testing from the activation of the rectus femoris muscle was that H0 was rejected at a significance level of 0.05 because the p value was 0.034<0.05.

2) Test the Vastus Medialis Muscle Activation Hypothesis on Pain

Table 5. Results of the Mann Whitney U Test Vastus Medialis Muscle Activation

Muscle Activation	N	Sum of Ranks	*Mann Whitney U*	Sig.
Vastus Medialis Muscle				
- *Painful*	4	19,00	3,000	0,289
- *No Pain*	3	9,00		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on vastus medialis muscle activation, it was found that the conclusion of hypothesis testing from deltoid muscle activation was that H0 was accepted at a significance level of 0.05 because the p value was 0.289> 0.05.

3) Test the Vastus Lateralis Muscle Activation Hypothesis on Pain

Table 6. Results of the Mann Whitney U Test for Vastus Lateralis Muscle Activation

Muscle Activation	N	Sum of Ranks	*Mann Whitney U*	Sig.
Vastus Lateralis Muscle				
- *Painful*	4	10,00	0,000	0,034
- *No Pain*	3	18,00		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on vastus lateralis muscle activation, it was found that the conclusion of hypothesis testing from vastus lateralis muscle activation was that H0 was rejected at a significance level of 0.05 because the p value was 0.034<0.05.

4) Hypothesis Test of Rectus Femoris Muscle Activation Against Q-Angle

Table 7. Results of the Mann Whitney U Test for Rectus Femoris Muscle Activation

Muscle Activation	N	Sum of Ranks	*Mann Whitney U*	Sig.
Rectus Femoris Muscle				
- *Abnormal*	4	11	1,000	0,077
- *Normal*	3	17		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on rectus femoris muscle activation against q-angle, it was found that the conclusion of hypothesis testing from rectus femoris muscle activation was that H0 was accepted at a significance level of 0.05 because the p value was 0.077 > 0.05.

5) Hypothesis Test of Vastus Medialis Muscle Activation Against Q-Angle

Table 8. Results of the Mann Whitney U Test for Vastus Medialis Muscle Activation

Muscle Activation	N	Sum of Ranks	*Mann Whitney U*	Sig.
Vastus Medialis Muscle				
- *Abnormal*	4	16	6,000	1,000
- *Normal*	3	12		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on vastus medialis muscle activation against q-angle, it was found that the conclusion of hypothesis testing from vastus medialis muscle activation was that H0 was accepted at a significance level of 0.05 because the p value was 1,000> 0.05.

6) Test Vastus Lateralis Muscle Activation Hypothesis against the Q-Angle

Table 9. Results of the Mann Whitney U Test Vastus Lateralis Muscle Activation

Muscle Activation	N	Sum of Ranks	*Mann Whitney U*	Sig.
Vastus Lateralis Muscle				
- *Abnormal*	4	13	3,000	0,289
- *Normal*	3	15		

Based on the results of hypothesis testing in the form of the Mann Whitney U Test on vastus lateralis muscle activation against q-angle, it was found that the conclusion of hypothesis testing from vastus lateralis muscle activation was that H0 was accepted at a significance level of 0.05 because the p value was 0.289> 0.05.

DISCUSSION

1. Differences in Rectus Femoris Muscle Activation in Fencing Athletes

Activation of the rectus femoris muscle when performing a lunge movement by 7 fencing athletes which was carried out for a duration of 5 seconds. The following are the average results of activation of the rectus femoris muscle from all athletes. From the results of hypothesis testing on rectus femoris muscle activation on pain in fencers, it was found that the conclusion was that H0 was rejected with a significance level of 0.05 because the p value was 0.034<0.05. So H0 is rejected, meaning there is a difference in muscle activation in the rectus femoris muscle between athletes who experience pain and those who do not experience pain. Reducing the hamstring, quadriceps and gastrocnemius will reduce thigh adduction movements in knee pain sufferers. The decrease in activation of the rectus femoris muscle is also caused because anatomically the rectus femoris muscle inserts towards the proximal part of the patella and through the patellar ligament towards the tibial tuberosity and is The main driving muscle is knee extension, so if the pain is located in the front of the knee then this will have a big effect on the rectus femoris muscle. Decreased activation in the painful rectus femoris muscle can also be caused by an imbalance in the work of the quadriceps muscle. Motor control deficits in patients with knee pain reverse the order of activation of the vastus medialis muscle with the vastus lateralis. Strengthening exercise patterns for the vastus medialis and lateralis muscles will not be able to reduce pain as long as the main driving muscles are not trained (Jairus Quesnele, 2011).

2. Differences in Vastus Medialis Muscle Activation in Fencing Athletes

Activation of the vastus medialis muscle during the lunge movement by 7 fencers which was carried out for a duration of 5 seconds. The following are the average results of vastus medialis muscle activation from all athletes. From the results of hypothesis testing on vastus medialis muscle activation on pain in fencers, it was found that the conclusion was that H0 was accepted with a significance level of 0.05 because the p value was 0.289> 0.05. So H0 is accepted, meaning there is no difference in muscle activation in the vastus medialis muscle between athletes who experience pain and those who do not experience pain. The vastus medialis muscle has an insertion on the patella and functions to pull the patella inward or medially so that if pain occurs in the knee area this muscle is not so affected. Weakness of the vastus medialis muscle due to pain will be helped by the presence of the popliteus muscle which helps this muscle (Jairus Quesnele, 2011).

3. Differences in Vastus Lateralis Muscle Activation in Fencing Athletes

Activation of the vastus lateralis muscle when performing a lunge movement by 7 fencers for a duration of 5 seconds. The following are the average results of vastus medialis muscle activation from all athletes. From the results of hypothesis testing on vastus lateralis muscle activation on pain in fencers, it was found that the conclusion was that H0 was rejected with a significance level of 0.05 because the p value was 0.034<0.05. So H0 is rejected, meaning there is a difference in muscle activation in the vastus medialis muscle between athletes who experience pain and those who do not experience pain. The vastus lateral muscle has an insertion on the tibial tuberosity so that if pain occurs in the knee area this muscle is affected. Apart from that, activation of the vastus lateralis muscle can also increase because the ITB (Illio Tibial Band), which is a hip stabilizer, shortens (Jairus Quesnele, 2011).

4. Differences in Quadriceps Muscle Activation to Quadriceps Angle

The results of the difference test for the three quadriceps muscles (rectus femoris, vastus medialis and vastus lateralis) on the quadriceps angle were 0.077, 1.00 and 0.289. This shows that there is no relationship between the activation of the three muscles and the quadriceps angle. This is in contrast to research which states that there is a relationship between the size of the Q-angle and the activation of the rectus femoris muscle. However, this research states that there is no significant relationship between Q-angle and Quadriceps muscle activation.

The absence of a relationship in this study may be due to the sample size being too small and the distribution being uneven. Apart from that, it is possible that shortening of the quadriceps muscles has not occurred so it does not affect the activation of the quadriceps muscles. The quadriceps angle is an angle formed by bones and is influenced by certain factors such as congenital abnormalities, muscle contractures, age, and so on. Even though it does not affect muscle activation, q-angle is very important as a predictor of knee injuries, especially PSPF (Fatahi, 2017; Tarawneh et al., 2016).

CONCLUSION

Based on research data regarding muscle activation in the quadriceps muscle when performing lunge movements in sable and floret fencers at the fencing unit at Tunas Pembangunan University, the following conclusions were obtained:

1. There is a difference in muscle activation in the rectus femoris muscle during lunges in sable and floret fencers regarding pain.
2. There is no difference in muscle activation in the vastus medialis muscle during lunges in sable and floret fencers regarding pain.
3. There is a difference in muscle activation in the vastus lateralis muscle during lunges in sable and floret fencers regarding pain.
4. There is no difference in muscle activation in the vastus medialis muscle when lunging in sable and floret fencers compared to the q-angle.
5. There is no difference in muscle activation in the vastus medialis muscle when lunging in sable and floret fencers compared to the q-angle.
6. There is no difference in muscle activation in the vastus medialis muscle when lunging in sable and floret fencers compared to the q-angle.

REFERENCES

Alekseyev, K., Stoly, Y., Chang, R., Lakdawala, M., Bijlani, T., & Cristian, A. (2016). Identification of the most frequent injuries in a variety of fencing competitors: A cross sectional study of fencing clubs in the Northeast tri-state region. *Physical Medicine and Rehabilitation Research*, *1*(3). https://doi.org/10.15761/pmrr.1000115

Chen, C. (2014). Footwork Teaching of College Badminton Elective Course. *Proceedings of the 3rd International Conference on Science and Social Research*, *1*(Icssr), 281–283. https://doi.org/10.2991/icssr-14.2014.69

Chevidikunnan, M. F., Al Saif, A., Pai, K. H., & Mathias, L. (2015). Comparing goniometric and radiographic measurement of Q angle of the knee. *Asian Biomedicine*, *9*(5), 631–636. https://doi.org/10.5372/1905-7415.0905.433

Emami, M. J., Ghahramani, M. H., Abdinejad, F., Namazi, H. 2007. Q-angle: An Invaluable Parameter for Evaluation of Anterior Knee Pain. Arch. Iran. Med, 10 (1).

Fatahi, A. (2017). Relationship Between Q Angle and Knee Injuries Prevalence in Elite Volleyball Players. *Advances in Surgical Sciences*, *5*(4), 45. https://doi.org/10.11648/j.ass.20170504.11

Huang, M. T., Lee, H. H., Lin, C. F., Tsai, Y. J., & Liao, J. C. (2014). How does knee pain affect trunk and knee motion during badminton forehand lunges? *Journal of Sports Sciences*, *32*(7), 690–700. https://doi.org/10.1080/02640414.2013.848998

Ismail, M. F., Mohd Hashim, A. H., & Morazuki, S. R. (2017). Muscle activity during lunge for fencers. *Man in India*, *97*(13), 153–158.

Jairus Quesnele, D. C. (2011). The assessment and treatment of muscular imbalance. The Janda approach. In Manual Therapy (Vol. 16, Nomor 5). https://doi.org/10.1016/ j.math.2011.03.001

Kurniawan, H. M., & Husni, A. (2019). Hubungan Antara Body Mass Index Dengan Q Angle : Studi Pada Mahasiswa Fakultas Kedokteran Universitas Diponegoro. *Diponegoro Medical Journal (Jurnal Kedokteran Diponegoro)*, *8*(1), 222–232.

Lorca, Á. S., Cid, F. M., Badilla, P. V., Franchini, E., & Valenzuela, T. H. (2020). Association between knee, ankle, and hip joint angles and contact time during the lunge and recoil phases among sabreurs. *Retos*, *83*, 523–527. https://doi.org/10.47197/retos.v38i38.74797

Notoatmodjo, S. 2012. Metode Penelitian Kesehatan. Jakarta: PT Rineka Cipta.

Park, K. J., & Byung, S. B. (2017). Injuries in elite Korean fencers: An epidemiological study. *British Journal of Sports Medicine*, *51*(4), 220–225. https://doi.org/10.1136/bjsports-2016-096754

Putra, A. K., Ramadi, Putu, N., & Wijayanti, N. (2017). The Effect of Footwork for Agility At Men Athlete of Persatuan Bulutangkis Mandiri Pekanbaru U-15. *Jurnal Online Mahasiswa*, *4*(1), 1–8.https://jom.unri.ac.id/index.php/JOMFKIP/article/view/14108/13667

Ravindranath, N.H, Parama, V.R. et al. 2009. Environmental Services, Vulnerability Reduction and Natural Resource conservation from NREGA Activities - Case Study of Chitra durga District Indian Institute of Science, Centre for Sustainable Technologies, Bengaluru.

Redondo, J. C., Alonso, C. J., Sedano, S., & De Benito, A. M. (2014). Effects of a 12-week strength training program on experimented fencers' movement time. *Journal of Strength and Conditioning Research*, *28*(12), 3375–3384. https://doi.org/10.1519/JSC.0000000000000581

Roi, G. S., & Bianchedi, D. (2008). The science of fencing: Implications for performance and injury prevention. *Sports Medicine*, *38*(6), 465–481. https://doi.org/10.2165/00007256-200838060-00003

Tarawneh, I., AL-Ajoulin, O., & Alkhawaldah, A. (2016). Normal Values of Quadriceps Angle and Its Correlation with Anthropometric Measures in a Group of Jordanians. *Journal of the Royal Medical Services*, *23*(2), 53–58. https://doi.org/10.12816/0027106

Z.A, A. R. D. M. H., Supriyadi, & I Nengah Sudjada. (2016). Pengaruh Latihan Agility Wheel Terhadap Kemampuan Footwork Siswa ekstrakurikuler Bulutangkis Sma N 4. *Jurnal Sport Science*, *6*(1), 52–62. http://journal2.um.ac.id/index.php/sport-science/article/view/5262