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Contributions of Repetitive Movements to Tennis Elbow Risk in Badminton Players

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Abstract

Regular practice of badminton players will lead to the formation of repetitive movement patterns as a significant factor causing outer elbow pain, commonly referred as tennis elbow. This study was aimed to identify the contribution of repetitive movements to tennis elbow risks in badminton players, to examine the relationship between repetitive movements and tennis elbow risks, and to investigate the differences of tennis elbow risk based on the repetitive movement status and the player status. The method used was the observational study with a correlational approach involving 122 players of student badminton organization, known as UKM, from four universities selected using the purposive and cluster sampling methods. The dependent variable of this study was the tennis elbow risk, while the independent variables were repetitive movements and the player status. The ordinal linear regression statistical test results obtained a p-value estimated parameter of p = 0.418 and a pseudo R-Square value of 11.4%. Spearman statistical test was obtained (p=0.020) with a value of r = -0.210. The Kruskal-Wallis H statistical test was obtained (p=0.040). The Mann-Whitney statistical test was also obtained (p=0.005). Repetitive movements contribute to the risk of tennis elbow in badminton players and affect the condition. In addition, there is a weak relationship between repetitive movements and tennis elbow. Repetitive movement status and player status affect the risk of tennis elbow in badminton players.

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INTRODUCTION

The prevalence of tennis elbow in the general population is 1-3% and 10% is in women (Kwapisz et al. 2018). The incidence rate of tennis elbow in the productive age of 20-65 years shows the highest risk at 40-50 years (Keijsers et al. 2019). In addition, the incidence of tennis elbow is also often found in badminton players, with a prevalence of 12.5% (Karahan et al. 2013).

Tennis elbow can occur due to repetitive movements or overuse activities on the forearm extensor muscles, causing degeneration of the extensor carpi radialis brevis (ECRB) and extensor digitorum communis. Repetitive movements of wrist extension, radial deviation, and forearm supination are causes of tennis elbow in tennis and badminton players (Buchanan BK, 2022; Kumar and Stanley, 2011).

Based on the status of badminton players, there are differences in the level of overuse injury where athletes have a higher risk. This can occur because an athlete training capacity is denser and most of the athlete time is spent in training for competition preparation (Senior Lecturer et al. 2009).

The problem with functional activity due to tennis elbow is pain with grip (DImitrios 2016). Therefore, the activities of badminton players usually disrupted by tennis elbow are gripping the racquet and hitting a backhand shot (Buchanan BK et al., 2022). Holding the racquet with repetitive movements can cause overuse of the forearm extensors, resulting in the tennis elbow. Pain caused by tennis elbow can reduce performance in badminton players (Sufitni 2004).

Designing the ratio of rest and exercise in repetitive movements to meet aerobic capacity needs during competition can be a preventive measure to reduce the risk of tennis elbow. In addition, as a control measure against tennis elbow, attention should be paid to changes in training, a more aggressive style of play, modification of the grip and forehand with an open position, and improving the physical abilities of players (Fu et al. 2021; Ibrahim Hamed Ibrahim Hassan and Mohammed A. Elgammal 2018).

It is not widely known what percentage of repetitive movements contribute to the tennis elbow risk, especially in badminton players. This is the premise of this study to see and identify the contribution of repetitive movement to the risk of tennis elbow in badminton players, the relationship between repetitive movement and the risk of tennis elbow in badminton players, differences in the risk of tennis elbow based on the status of repetitive movement in badminton players, and differences in the risk of tennis elbow based on the status of badminton players.

METHODS

This study used observational research with a correlational approach. This study was conducted to obtain data on factors or variables interrelated with other variables whose structure and nature are more complicated or complex. This study aimed to see and identify the contribution of repetitive movement to the risk of tennis elbow in badminton players, the relationship between repetitive movement and the risk of tennis elbow in badminton players, differences in the risk of tennis elbow based on the status of repetitive movement in badminton players, and differences in the risk of tennis elbow based on the status of badminton players.

Participants

This study used a purposive sampling method with a cluster sampling approach. The population in this study were members of badminton UKM consisting of 178 members. The sampling size after being processed using the OpenEpi platform resulted in a sample size of 122 divided into 4 clusters, namely 44 members of UKM badminton Universitas Muhammadiyah Surakarta, 38 members of UKM badminton Universitas Islam Indonesia, 20 members of UKM badminton Universitas Slamet Riyadi, and 20 members of UKM badminton Universitas Sebelas Maret.

Inclusion criteria and exclusion criteria determined the sample in this study. The inclusion criteria in this study were members and players, both athletes and non-athletes, in badminton UKM for more than six months with a vulnerable age of 17-23 years. Exclusion criteria in this study were players with a history of arm injuries for less than six months and unwilling to be research subjects.

Sampling Procedures

Sampling technique is a technique used to determine the research sample. The sampling technique used in this study was purposive sampling with a cluster sampling approach, included in the probability sampling type. The cluster sampling approach obtains a sample by dividing several regions or groups with similar characteristics (Gulo 2002).

Materials and Apparatus

This research used the pain-free grip strength test instrument, employing a hand grip dynamometer measuring instrument to detect the presence of lateral epicondylitis or tennis elbow by measuring the level of hand strength until pain arises (Wyn Lim 2013). This test is positive if there is pain in the lateral humeral epicondyle. In addition, the repetitive task assessment (ART) tool was used to assess common risk factors in repetitive movements contributing to upper limb disorder development (Great Britain 2010). The media used to measure the level of repetitive movements was the Assessment of Repetitive Tasks (ART), namely by taking videos to analyze direct assessments using the videos taken.

Procedures

A pain-free grip strength test was performed with the subject sitting in a chair, arm in 90° flexion, and holding a grip dynamometer. The test was carried out 3x/hand with a 1-minute rest period per session. The test is positive if there is pain in the lateral epicondyle of the humerus. This instrument used an ordinal scale with an interpretation of values > 36 very good, 31-36 good, 25-30 quite good, 19-24 moderate, and <19 poor for women, while an interpretation values for men were > 56 very good, 51 -56 good, 45-50 quite good, 39-44 moderate, and <39 poor (Wyn Lim 2013). The repetitive task instrument (ART) assessment tool used video media. The Assessment of Repetitive Tasks (ART) tool used an ordinal scale with an interpretation of a value of 0-11 as low risk, a value of 12-21 as moderate risk, and >22 as high risk (Great Britain 2010).

Ethical clearance was used to ensure that the research had met the principles of respecting human dignity, the principle of doing good, beneficial, and not harmful, and the principle of justice. Data collection was carried out based on the respondent consent through informed consent. This study has received approval from the Research Ethics Committee of Tk—II 04.05.01 Dr. Soedjono Hospital and an Ethical Feasibility Letter with No. 214/EC/II/2023.

Data Analysis

Data analysis and interpretation in this study used univariate, bivariate, and multivariate analyses. The univariate analysis involved mean, median, mode, variance, standard deviation, range, frequency, and N value. The bivariate analysis used the ordinal linear regression test, Spearman's test, and Mann Whitney test. At the same time, the multivariate analysis used the Kruskal-Wallis test.

RESULT

The study began with data collection on the characteristics of the research sample. Data were obtained through questionnaires, examination of pain-free grip strength tests directly with respondents, and analysis of repetitive movements through videos of respondents who had met the inclusion and exclusion criteria. The first evaluation before the intervention was conducted on a sample of respondents who had met the inclusion and exclusion criteria. The participation of respondents until the research was completed was 100% allocated successfully following the entire series of research processes. The data characteristics of this study are as follows:

Univariate Analysis

The data presentation used was descriptive statistics to describe the parameters of each variable. These parameters included the center value (mean, median, mode) and dispersion value (variance, standard deviation, range). Then, the total score was measured to add to the characteristics of the data.

Based on table 1, the pain-free grip strength test examination results were obtained. The average value was 27.9; the median value was 27.9, and the frequently appeared value was 16.9. The assessment of repetitive tasks (ART) tool examination gained an average value of 12.5, the median value of 9, and the frequently appeared value of 9.

Bivariate and Multivariate Analysis

The overall data were not generally distributed using the ordinal linear regression test to test for differences. Based on the ordinal linear regression statistical test results, the goodness of fit p-value on the person

Table 1. Univariate Analysis

Inspection	N	F	%	*Mean ± Std Deviation*	*Range*	*Median*	*Variance*	*Modus*
Gender	122							
Men	122	88	72.1					
Women	122	34	27.9					
Status	122							
Athlete	122	36	29.5					
Non-Athletes	122	86	70.5					
Pain Free Grip Strength Test	122			27.9 ± 8.11	38.30	27.9	65.7	16.9
Male	122			30.8 ± 7.18				
Good enough	122	2	2.2					
Medium	122	6	8.8					
Bad	122	79	86.9					
Female	122			20.3 ± 4.90				
Good enough	122	7	7.7					
Medium	122	10	11					
Bad	122	16	17.6					
ART TOOLS	122			12.5 ± 5.56	15.2	9	31	9
Low Risk	122	85	69.7					
Medium Risk	122	28	23					
High Risk	122	9	7.3					
VAS	122			0.22 ± 0.82	5	0	0.68	0
Mild Pain	122	119	97.6					
Moderate Pain	122	3	2.4					
Mill's Test	122							
Positive	122	15	12.3					
Negative	122	107	87.7					

Source: Primary Data, 2023

and deviance was (p=0.908), meaning that the research model fitted the empirical data or was feasible. In the Pseudo R-Square, the value was 11.4%, meaning that repetitive arm movements affected 11.4% of the risk of tennis elbow for badminton players. The test of parallel lines had a p-value (p = 0.908), meaning that the resulting model had the same parameters. In other words, these variables had indicators that could explain the cause and effect of the independent and dependent variables. The results of parameter estimates showed a p-value (p=0.418) so that H0 was accepted, meaning that there was no contribution of repetitive movements to the risk of tennis elbow for badminton players.

The results of Spearman's test obtained the results of the p-value (p = 0.020), meaning that p <0.05, so there was a relationship between repetitive movements and the risk of tennis elbow in badminton players. The coefficient correlation value was (r= 0.210), meaning that the higher the value of the assessment of repetitive tasks (ART) tool, the worse the risk of tennis elbow.

Based on the ordinal linear regression statistical test results, the goodness of fit p-value on the person and deviance was (p=0.908), meaning that the research model fitted the empirical data or was feasible. In the Pseudo R-Square, the value was 11.4%, meaning that repetitive arm movements affected 11.4% of the risk of tennis elbow for badminton players. The test of parallel lines had a p-value (p = 0.908), meaning that the resulting model had the same parameters. In other words, these variables had indicators that could explain the

Table 2. Bivariate and Multivariate Analysis

	R Square	*p-Value*	R	Conclusion
Test of Contribution of*Repetitive Movement* to*Tennis Elbow*				
Ordinal Linear Regression				
Goodness Of Fit				
Person		0.908		Model Fit
Deviance		0.908		Model Fit
Pseudo R-Square				
Cox and Snell	0.048			
Negelkerke	0.066			
Test Of Parallel Lines		0.908		Same Parameters
Parameter Estimates		0.418		H0 Accepted
Test the Relationship of*Repetitive Movement* to *Tennis Elbow*				
Spearman's		0.020	-0.210	H0 Rejected Weak Relationship
Differential Test of *Repetitive Movement* against *Tennis Elbow*				
Kruskal-Wallis H		0.040		H0 Rejected
Difference Test of PlayerStatus and *Tennis Elbow*				
Mann Whitney		0.004		H0 Rejected

Source: Primary Data, 2023

cause and effect of the independent and dependent variables. The results of parameter estimates showed a p-value (p=0.418) so that H0 was accepted, meaning that there was no contribution of repetitive movements to the risk of tennis elbow for badminton players.

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The Kruskal-Wallis H test results obtained a p-value (p=0.040), meaning that p<0.05, so there was a difference in the risk of tennis elbow based on repetitive movement status in badminton players. The Mann-Whitney test results obtained a p-value (p=0.004), meaning that p<0.05. It also gained a mean value of 4.82 in non-athletes and 4.47 in athletes, so there was a difference in the risk of tennis elbow based on the status of badminton players, with a higher risk in non-athletes.

DISCUSSION

A joint injury in badminton players is a tennis elbow (Zam and Pristianto, n.d.). Several factors, including poor playing techniques and repetitive movements, can cause tennis elbow. When badminton players perform poor playing techniques repetitively, it can increase the risk of tennis elbow. Repetitive movement means doing the same activity or movement on the arm for more than 1 hour/per day (Winston and Wolf, 2015).

Tennis elbow can occur due to repetitive movements. This is because the repetitive movement can cause micro-trauma to the extensor carpi radialis brevis muscle to partial rupture of the extensor carpi radialis brevis tennoperiosteal acute or chronic (Basak et al., 2018; Jindal et al., 2013; Muki Pratono, 2006). Another description of the process of tennis elbow is due to fibroblasts and vascular hyperplasia, also known as angiofibroblastic, which occurs in tendons damaged by repeated microtrauma (Cutts et al. 2020).

Based on the results of the ordinal linear regression statistical test, the result of p>0.05 was obtained, meaning that H0 was accepted so that there was no contribution of repetition movements to the risk of tennis elbow in badminton players. A Pseudo R-Square value of 11.4% was obtained, meaning that the arm repetitive movement factor had an 11.4% effect on tennis elbow in badminton players, and other factors had 88.6% influence. In line with the research of Karahan et al., (2013), the incidence of tennis elbow in badminton players is only 12.5%, meaning that tennis elbow is a minor injury to badminton players. However, functional activities in badminton players are entirely disrupted, such as when holding the racket and doing backhand movements, because these activities can activate the appearance of pain and reduce the player hitting performance (Buchanan BK, 2022).

Repetitive movement is a risk factor for tennis elbow in badminton players. The theory follows the research of Ahmad et al., (2013), stating that several factors cause tennis elbows, such as late backhand, duration of the training, frequency of play, racket size, racket weight, and repetitive movements performed for more than two hours.

Repetitive movements, especially wrist extension, commonly cause tennis elbow. The backhand movement is considered the most significant source of tennis elbow. This is because, for the needs of the stroke, the athlete must make extensions combined with radial deviation and contract the wrist continuously. If the movement is done repetitively, it will cause repetitive injury to the extensor carpi radialis brevis (ECRB) muscle which can reduce the function of the affected limb, namely the lateral epicondyle, so that it becomes the beginning of the appearance of tennis elbow (Vicens et al. 2017; Wolf 2015).

The results of Spearman's statistical test on p-correlation obtained a p-value (p = 0.020) with a value of (r = 0.210), meaning that there was a weak relationship between repetitive movement and the risk of tennis elbow, so that the higher the value of the assessment of repetitive tasks (ART) tool, the worse the risk of tennis elbow. The result of this research is also supported by the results of Haahr and Andersen (2003) research using a logistic regression test where the odds ratio (OR) of 3.7 was obtained so that the exp (b) value was 40.5, meaning that repetitive movement had an influence of 40.5% on tennis elbow.

The results of the Kruskal-wallis H statistical test obtained p <0.05, meaning that H0 was rejected so that there were differences in the risk of tennis elbow based on the status of repetitive movements in badminton players. The results of the Mann-whitney statistical test obtained p<0.05, meaning that H0 was rejected, so there was a difference in the tennis elbow risk based on badminton player status. Different results are found in previous research conducted by Senadheera et al., (2019), showing 13.33% of the incidence of tennis elbow in badminton players. However, the incidence was caused by the player lack of flexibility training, so there was no significant relationship with tennis elbow based on extrinsic factors, such as player status and length of playing time.

Based on the player status, the mean value was 4.82 in non-athletes and 4.47 in athletes, so the higher risk of developing tennis elbow was found in non-athletes. These results align with the opinion of Owens et al., (2015) in his research, stating that there is often an imbalance or untrained upper limb muscles in non-athletes or recreational players, so there is a high possibility of the risk of tennis elbow in non-athletes or recreational players.

Another opinion regarding the risk of injury based on player status is also explained by Syahmirdza Indra Lesmana (2020) in his book, stating that athletes are more at risk of repetitive injury. This can happen because athletes do strength and conditioning exercises to prepare for the match so that they can strengthen and activate the anti-gravity muscles. As a result, if athletes are lazy and no longer do routine training, the anti-gravity muscles do not work optimally anymore. Other tissues, such as ligaments, meniscus, and cartilage, need to re-adapt to load changes, increasing the risk of recurrent injuries in athletes.

This study had limitations, including that researchers had not carried out specific homogeneity of inclusion criteria in the form of different training duration for each UKM.

CONCLUSION

The results of the statistical test between repetitive movement and tennis elbow obtained the value of parameter estimates (p=0.418), meaning that there was no contribution of repetitive movement to the risk of tennis elbow in badminton players. The Pseudo R-Square value was 11.4%, meaning that repetitive movement on the arm affected 11.4% of tennis elbow in badminton players. The results of Spearman's statistical test obtained a p- correlation value (p = 0.020) with a value of (r = 0.210), meaning that there was a weak relationship between repetitive movement and the risk of tennis elbow so that the higher the value of the assessment of repetitive tasks (ART) tool, the worse the risk of tennis elbow. The results of the Kruskal-wallis H statistical test obtained a value of (p = 0.040), meaning that there were differences in the risk of tennis elbow based on the status of repetitive movement in badminton players. The statistical test results between the risk of tennis elbow based on the player status with the Mann-whitney statistical test obtained a value (p=0.005), meaning that there was a difference in the risk of tennis elbow based on the status of badminton players.

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REFERENCES

Ahmad, Z., N. Siddiqui, S. S. Malik, M. Abdus-Samee, G. Tytherleigh-Strong, N. Rushton, and N Rushton. 2013. "Lateral Epicondylitis A Review Of Pathology And Management." *Bone Joint Journal* 95-B(9):1158–64.

Basak, Tanusree, Tapas Kumar Pal, Mr Biswajit Saha, Shabnam Agarwal, and Tirthadeep Das. 2018. "Comparative Efficacy of Wrist Manipulation, Progressive Exercises and Both Treatments in Patients with Tennis Elbow." *International Journal of Health Sciences & Research (Www.Ijhsr.Org)* 8:87.

Buchanan BK, Varacallo M. 2022. *Tennis Elbow*. Treasure Island (FL): StatPearls.

Cutts, S., Shafat Gangoo, Nitin Modi, and Chandra Pasapula. 2020. "Tennis Elbow: A Clinical Review Article." *Journal of Orthopaedics* 17:203–7.

DImitrios, Stasinopoulos. 2016. "Lateral Elbow Tendinopathy: Evidence of Physiotherapy Management." *World Journal of Orthopedics* 7(8):463–66.

Fu, Yue, Yu Liu, Xiaoping Chen, Yongming Li, Bo Li, Xinxin Wang, Yang Shu, and Lei Shang. 2021. "Comparison of Energy Contributions and Workloads in Male and Female Badminton Players During Games Versus Repetitive Practices." *Frontiers in Physiology* 12.

Great Britain, Health and Safety Executive Staff. 2010. *Health and Safety Executive Assessment of Repetitive Tasks of the Upper Limbs (the ART Tool)*.

Gulo, W. 2002. *Metodelogi Penelitian*. viii. Jakarta: Gramedia Widiasarana Indonesia.

Haahr, J. P., and J. H. Andersen. 2003. "Physical and Psychosocial Risk Factors for Lateral Epicondylitis: A Population Based Case-Referent Study." *Occupational and Environmental Medicine* 60(5):322–29.

Ibrahim Hamed Ibrahim Hassan and Mohammed A. Elgammal. 2018. "Common Injuries in Racket Sports: A Mini Review." *Orthoplastic Surgery & Orthopedic Care International Journal* 1(4).

Jindal, Nipun, Yusuf Gaury, Ramesh C. Banshiwal, Ravinder Lamoria, and Vikas Bachhal. 2013. "Comparison of Short Term Results of Single Injection of Autologous Blood and Steroid Injection in Tennis Elbow: A Prospective Study." *Journal of Orthopaedic Surgery and Research* 8(1).

Karahan, Ali Yavuz, Usak Üniversitesi, Ercan Kaydok, Sinan Bagcaci, Selcuk Yesilyurt, and Burcin Olcucu. 2013. "Kienbock's Disease That Manifested in a Badminton Player: Case Report The Frequency of Estrogen Receptor 1

Polymophism in Patients with Fibromyalgia Syndrome and Its Relationship with Clinical Parameters View Project Kienbock's Disease That Manifested in a Badminton Player: Case Report." *International Journal of Sports Science* 2013(4):132–34.

Keijsers, Renée, Robert Jan de Vos, P. Paul F. M. Kuijer, Michel P. J. van den Bekerom, Henk Jan van der Woude, and Denise Eygendaal. 2019. "Tennis Elbow." *Shoulder and Elbow* 11(5):384–92.

Kwapisz, Adam, Sharad Prabhakar, Riccardo Compagnoni, Aleksandra Sibilska, and Pietro Randelli. 2018. "Platelet-Rich Plasma for Elbow Pathologies: A Descriptive Review of Current Literature." *Current Reviews in Musculoskeletal Medicine* 11(4):598–606.

Muki Pratono, Sugijanto. 2006. "Pengaruh Penambahan Transverse Friction Pada Intervensi Ultrasound Terhadap Pengurangan Nyeri Akibat Tennis Elbow Tipe II." *Jurnal Fisioterapi Indonusa* 6(2):113–29.

Owens, Brett D., Jonathan F. Dickens, and Brett D. Owens. 2015. "Tennis Elbow in Athletes: More than Just Tennis?" Pp. 7–15 in *Tennis Elbow: Clinical Management*. Springer US.

Senadheera, V. V, S. Mayooran, and J. K. Dissanayake. 2019. "Elbow, Wrist and Hand Tendinopathies in Badminton Players." *American Journal of Sports Science and Medicine* 7(1):16–19.

Senior Lecturer, MMed, Mohamad A. Shariff Hamid, Shariff A. H, and Ramlan A. A. 2009. *Musculoskeletal Injuries among Malaysian Badminton Players*. Vol. 50.

Shyam Kumar, David Stanley, Neil G Burke, and Hannann Mulett. 2011. "Current Thoughts on the Treatment of Tennis Elbow." *Annals of the Royal College of Surgeons of England* 93 (6):432–34.

Syahmirdza Indra Lesmana. 2020. *Fisioterapi Dan Cedera Olahraga* . Jakarta Timur: Rayyana Komunikasindo.

Vicens, Gemma, Roberto Seijas, Andrea Sallent, Andrea Dominguez, Oscar Ares, and Andrea Torrecilla. 2017. "Tennis Elbow Pathogenesis." *International Journal of Orthopaedics* 4(3):767–69.

Winston, Jonathan, and Jennifer Moriatis Wolf. 2015. "Tennis Elbow: Definition, Causes, Epidemiology." Pp. 1–6 in *Tennis Elbow: Clinical Management*. Springer US.

Wyn Lim, Edwin Choon. 2013. "Pain Free Grip Strength Test." *Journal of Physiotherapy* 59 (1):59.

Zam, Z., and M. D. Pristianto. n.d. "The Effectiveness of Mulligan Mobilization With Movement (MWM) in Lateral Epicondylitis Conditions: A Critical Review." *& Nasrullah Fisiomu* 2023(1):13–21.