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CONTRIBUTION OF COORDINATION, BALANCE, FLEXIBILITY, ARM MUSCLE STRENGTH TO THE '*KIZAMI-GYAKU ZUKI*' PUNCH: ANALYSIS OF FEMALE KARATE ATHLETES

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Abstract:
The purpose of this research is to analyze the contribution of coordination, balance, flexibility, arm muscle strength to the *kizami-gyaku zuki* punch of female athletes. The background to this research is from observations of the qualifying round at the 2023 National Sports Week (PON), on average female athletes earn points from punches. This research is an analytical survey to test the contribution of the independent variables. The sample was 50 female athletes with characteristics namely age 19.8±1.2 years, training experience 8.3±0.6 years, weight 50±1.5 kg, height 160.4±1.5 cm. The tests carried out included coordination using the *Hand-Wall Toss Test*, balance using the *Modified Bass Test of Dynamic Balance*, flexibility using the *sit and reach test*, arm muscle strength using *push up* for 1 minute, *kizami-gyaku zuki* punches using a punching bag during 30 seconds. The results of this research show that coordination, flexibility, and arm muscle strength have an effect on *kizami-gyaku zuki* punches. However, balance has no effect on the *kizami-gyaku zuki* punches. Adjusted R Square results, the contribution from coordination (r = 0.341) or 34.1%, balance (r = 0.235) or 23.5%, flexibility (r = 0.490) or 49%, arm muscle strength (r = 0.465) or 46.5%, contribution overall against *kizami-gyaku zuki* punch (r = 0.674) or 67.4%. The conclusion is that it is important for trainers, athletes, and sports karate academics to focus on these four physical components so that the kumite abilities of female athletes can be improved. However, it is important to train in other physical components, such as

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endurance, technique and tactics and mental. Future research is expected to add variables or update the types of tests used in this research.

Keywords: *kizami-gyaku zuki*; kumite; karate

1. Introduction

Punching is one of the basic techniques in learning self-defense apart from kicking techniques, parrying techniques, or throwing techniques (Yulfadinata et al., 2022); (Prabowo et al., 2022). If a punch hits the opponent's fighter on target, the fighter who hits it will get a point. A combat sport that uses fighters to hit opponents, one of which is karate. The punches in karate are called *kizami* and *gyaku zuki* (Herrera-Valenzuela & Valdés-Badilla, 2016). A karateka in the *zenkutsu dachi* position, *kizami* is a punch with the front hand then *gyaku zuki* is a reverse punch or back hand (Ghanem et al., 2022).

These two punches are always done when the athlete is at a beginner level or is practicing karate for the first time. In karate matches, these two punches are always used to attack the opponent because the practicality of this technique does not require long preparation, long distance, does not require great strength, and when attacking by hitting you can still focus on the enemy (Wąsik et al., 2019); (Ribas et al., 2020); (Ianchuk, 2021); (Doder et al., 2023). However, the points earned are not higher than the kicking technique. In fact, the *kizami* and *gyaku zuki* techniques remain the mainstay for an athlete when performing kumite. Many factors influence the success of karate athletes in performing *kizami* and *gyaku zuki* punches, namely physical biomotor components, anthropometry such as arm length, height and weight (Przybylski et al., 2021); (Ojeda-Aravena et al., 2021); (Krkeljas & Kovac, 2021); (Pavlović et al., 2022); (Prabowo et al., 2023). Then there are physiological factors, namely changes in athletes before and after training and mental factors such as doubt, lack of confidence and anxiety (Lestari et al., 2020); (Abiş et al., 2021); (Vveinhardt & Kaspare, 2022); (Hikmah et al., 2023); (Wangi et al., 2023). However, the physical component is the dominant factor in an athlete's success in performing all karate techniques through a long training process, in this case success in performing the *kizami* and *gyaku zuki* punches.

The physical components that influence strikes in karate are complex and interconnected. Based on the results of previous research, the physical components that influence and are interconnected are the reaction between eye-hand coordination (Haqiyah et al., 2023). The results of other research explain that there is a strong relationship between reaction training and coordination in the *gyaku zuki* punch test (Riyadi et al., 2019). Then other physical component factors are flexibility, arm muscle strength, while anthropometric factors are influenced by arm length. From the results of this research using the Kinovea test, flexibility influences punch speed, but strength does not affect punch speed (Purwanto, 2022). Meanwhile, arm muscle strength influences the speed of the *gyaku zuki* punch using the push up test and doing *gyaku zuki* during 10 seconds (Lamusu & Lamusu, 2023). The next result is that the arm muscle strength and

arm length of student karate athletes influence the speed of *gyaku zuki* punches using a punching bag during 30 seconds (Ruskin & Liputo, 2021).

From previous research evidence, it is important for further research to investigate the physical component factors that can influence a karate athlete's blows, namely *kizami* and *gyaku zuki* by adding several other variables. Based on observations of qualifying round matches at the 2023 National Sports Week (PON) in Indonesia, the score results show that karate athletes earn points from punching techniques with an average percentage of 55% for male athletes and 80% for female athletes, while the remainder comes from kicks. Then from other observations, an average of 77% of female karate athletes did not use kicking techniques during the qualifying rounds. So, the aim of this research is to analyze the contribution of physical components to the *kizami* and *gyaku zuki* punches specifically for female athletes. The uniqueness of this research is that it adds other variables such as *kizami* punch and physical components, namely balance (Greco, 2020). Previous research shows that balance has a positive relationship with the performance of karate athletes (Pal et al., 2021); (Oktavian et al., 2022). It is hoped that the publication of the results of this research will provide academic information for coaches, athletes and academics in the field of karate.

2. Material and Methods

2.1 Research Design

This research is an analytical research from a survey in the form of a regression test and tests how much influence the independent variable contributes to the dependent variable. The independent variables of this research are coordination, balance, flexibility and arm muscle strength, the dependent variable is the *kizami-gyaku zuki* punch. The research population was female karate athletes in the city of Yogyakarta, while the sampling technique used purposive sampling, meaning the sample had criteria. The criteria for female karate athletes involved in this research are 1) athletes who are still active, 2) currently undergoing a competition training program, 3) possess a minimum black belt AND 1, 4) are specialists in the kumite category. So, the sample involved was 50 female athletes with characteristics (mean ± S.D) age 19.8 ± 1.2 years, training experience 8.3 ± 0.6 years, weight 50 ± 1.5 kg, height 160.4 ± 1.5 cm.

2.2 Data Collection

Data collection for this research was carried out one day through five tests. The physical component of coordination uses the *Hand-Wall Toss Test*, balance uses the *Modified Bass Test of Dynamic Balance*, flexibility uses the *sit and reach test*, arm muscle strength uses 1 minute *push up*. Meanwhile, testing the *kizame-gyaku zuki* punch, athletes are asked to hit the *kizame-gyaku zuki* on a bag and do it during 30 seconds. The test procedure is carried out twice, then the value obtained for analysis is the best test value. This test involved several professional karate coaches and expert academics from sports science who specialize in karate sports.

2.3 Data Analysis

The data analysis used in this research is by testing the coefficient value and the value of the Adjusted R Square. However, before a regression analysis was carried out, a normality test was carried out as a requirement in the regression test. Analysis of this research data uses SPSS version 26.

3. Results

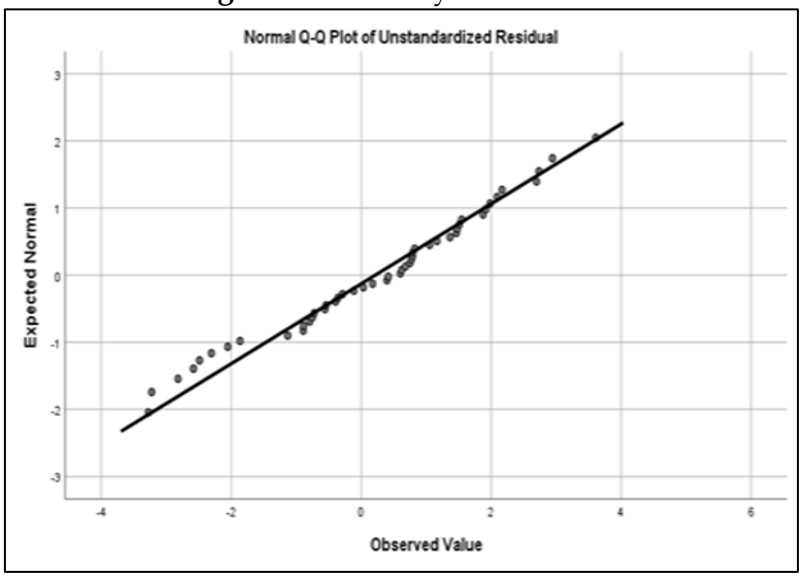
After the data is collected, the first step is descriptive analysis. The following are the results of a series of tests that have been carried out in Table 1.

Table 1: Descriptive Analysis Results

Variable	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Coordination	50	12	16	28	24,18	3,243	10,518
Balance	50	35	65	100	84,8	10,25	105,061
Flexibility	50	7	16	23	19,1	2,082	4,337
Arm muscle strength	50	17	27	44	33,64	3,805	14,48
Kizami-gyaku zuki	50	14	20	34	28,24	3,612	13,043

From these results it can be seen that in the Hand-Wall Toss Test coordination test, the highest score was obtained 28 times and the lowest score was 16 times. Modified Bass Test of Dynamic Balance test, the highest score obtained was 100 and the lowest score was 65. Sit and reach flexibility test, the highest score obtained was 23 cm and the lowest score was 16 cm. Arm muscle strength test with push-ups for 1 minute, the highest score obtained was 44 times and the lowest score was 27 times. The *kizami-gyaku zuki* test lasted 30 seconds, the highest score was 34 times and the lowest score was 20 times. The second step with the normality test as a requirement before carrying out the regression test, the results of the normality test can be seen in Figure 1.

Figure 1: Normality Test Results



This normality test uses residual values because previous testing data was not normal. From the image results, the point is close to a straight line. Apart from that, the normality test of the Kolmogorov-Smirnov results was sig 0.200, then the Shapiro-Wilk results were sig 0.405. So, it can be said that the test results of this research are normally distributed.

After the research data is confirmed to be normal, the third step is a regression test to measure the influence of the independent variable on the dependent variable. The results of the regression test are proven in Table 2.

Table 2: Results of the Influence of the Independent Variable on the Dependent Variable

Coefficients[a]							
	Unstandardized Coefficients		**Standardized Coefficients Beta**	**t**	**Sig.**	**Collinearity Statistics**	
	B	**Std. Error**				**Tolerance**	**VIF**
(Constant)	4,798	3,297		1,455	0,153		
Coordination	0,312	0,103	0,280	3,019	0,004	0,771	1,297
Balance	0,034	0,034	0,098	1,002	0,322	0,701	1,426
Flexibility	0,596	0,191	0,343	3,112	0,003	0,546	1,831
Arm muscle strength	0,333	0,096	0,351	3,469	0,001	0,651	1,537
[a]Dependent Variable: Kizami - Gyaku zuki							

Based on the results from Table 2, the significance value between coordination and *kizami-gyaku zuki* is 0.004 or (p<0.005) meaning that there is a relationship between coordination and *kizami-gyaku zuki*. The significance value between balance and *kizami - gyaku zuki* is 0.322 or (p<0.005) meaning that there is no relationship between balance and *kizami - gyaku zuki*. The significance value between flexibility and *kizami-gyaku zuki* is 0.003 or (p<0.005) meaning that there is a relationship between flexibility and *kizami-gyaku zuki*. The significance value between arm muscle strength and *kizami-gyaku zuki* is 0.001 or (p<0.005) meaning that there is a relationship between arm muscle strength and *kizami-gyaku zuki.*

Then, the fourth step is to test the coefficient of determination value of each independent variable against the dependent variable (*kizami-gyaku zuki*), below are the results in Table 3.

Table 3: Adjusted R Square Results

Model Summary				
Variable	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
Coordination	0,596	0,355	0,341	2,931
Balance	0,500	0,250	0,235	3,160
Flexibility	0,708	0,501	0,490	2,578
Arm muscle strength	0,690	0,475	0,465	2,643
Coordination, balance, flexibility, arm muscle strength	0,837	0,701	0,674	2,062

From these results, it can be seen that the contribution of coordination to the *kizami-gyaku zuki* punch is 0.341 or 34.1%. The balance contribution to the *kizami-gyaku zuki* punch is 0.235 or 23.5%. The contribution of flexibility to the *kizami-gyaku zuki* punch is 0.490 or 49%. The contribution of arm muscle strength to the *kizami-gyaku zuki* punch is 0.465 or 46.5%. The overall contribution, namely coordination, balance, flexibility, arm muscle strength to the *kizami-gyaku zuki* punch is 0.674 or 67.4%.

4. Discussion

The punching technique is one of the techniques that a karate athlete must master. A good punch is a punch that results in points in the match. An athlete can be said to have won if the points collected are more than those of his opponent. Therefore, karate athletes are required to attack more and of course these attacks must produce points (Alinaghipour et al., 2020); (Seyedi et al., 2021). More attacks may not necessarily result in points. However, many attacks can certainly make it difficult for the enemy to defend so that it is possible for these attacks to hit the opponent and result in points (Yulfadinata et al., 2022). From the results of this research, coordination, flexibility and arm muscle strength influence the *kizami-gyaku zuki* punch through a 30 second test. Then the results of his contribution are still below 50%, meaning there is still a physical component that influences the *kizami-gyaku zuki* punch. The contribution of coordination, flexibility, arm muscle strength has also been studied in several other sports such as badminton, volleyball and cricket (Akbari et al., 2018); (Suparman et al., 2021); (Karim & Ikadarny, 2021); (Wigradianti et al., 2021).

The results of this research explain that there is a direct and indirect influence between coordination, flexibility, arm muscle strength on sports technique. Meanwhile, the contribution given to each technique is an average of 30% in cricket and the greatest contribution to coordination, flexibility and arm muscle strength comes from volleyball.

From the results of this research, it is clear that coordination, flexibility and arm muscle strength also contribute to the technical ability of each type of sport. In karate matches, especially kumite, there are many unexpected movements and fast reactions are required ((Yudhistira & Tomoliyus, 2020); (Danardono et al., 2023)). This is because during kumite the movements will always be dynamic and the athlete must be ready when the opponent's defense is opened even slightly. So the contribution of physical components such as good coordination between hands (punches) and steps or moving will be very useful for attacking or dodging more quickly (Chindarkar et al., 2021); (Karadağ et al., 2021).

The contribution to flexibility will be very useful when an athlete attacks and is then repelled by an opponent, so with good flexibility the athlete can look for an opening to attack him again as quickly as possible. If the opponent who is hit falls, then the contribution of arm muscle strength will be very influential because the blow delivered will definitely produce power (Ioannides et al., 2020); (Narita Devi et al., 2022); (Pinto & Matos, 2023). Of course, this is a huge advantage for karate athletes who hit. But keep in

mind, the contribution of each physical component is still below 50%, while the overall contribution is 67.4%, meaning there are still contributions from other physical components that influence the ability of *kizami-gyaki zuki* punches, such as excellent physical fitness, strong endurance, then the body anthropometric factors of female karate athletes (Ojeda-Aravena et al., 2021); (Nakayama et al., 2022); Prabowo et al., 2022; (Aziz et al., 2023); (Hardinata et al., 2023).

Meanwhile, the contribution to balance only shows a result of 23.5% and regression testing also shows that there is no influence on the *kizami-gyaku zuki* punch. Until now, the contribution of balance to technical ability in combat sport punches has not yet been found, but there are studies that explain that balance can influence lower limbs strength, of course it can influence stances (*dachi*) or kicks in karate (Oktavian et al., 2022); (Ölmez & Akcan, 2023).

The limitation of this research is the lack of variables tested in this research. Then two types of tests to test balance and *kizami-gyaku zuki* punch were deemed not optimal. Because the results of his contribution to the *kizami-gyaku zuki* punch are very different from the contribution of coordination, flexibility and arm muscle strength. However, with the results and publication of this research, it can be a good guide for trainers in training coordination, balance, flexibility and muscle strength so that karate athletes have good quality *kizami-gyaku zuki* punch techniques. Apart from that, adding variations in endurance training will result in an increase in the quantity of *kizami-gyaku zuki* punches, because there is no draw in kumite.

5. Conclusion

Coordination, balance, flexibility and arm muscle strength contribute to the *kizami-gyaku zuki* punch for female karate athletes. From the results of this research, coordination, flexibility and arm muscle strength influence the *kizami-gyaku zuki* punch, only balance does not affect the *kizami-gyaku zuki* punch. Then the results of the Adjusted R Square test, coordination contributed (r = 0.341) or 34.1%, balance contributed (r = 0.235) or 23.5%, flexibility contributed (r = 0.490) or 49%, arm muscle strength contributed (r = 0.465) or 46.5%, then the four physical components as a whole contribute to the *kizami-gyaku zuki* punch (r = 0.674) or 67.4%. So, it is important for coaches, athletes and karate academics to pay attention to these four physical components so that female athletes' kumite abilities can be improved. However, it is important to train other physical components, such as endurance, technique and tactics and mental. Future research is expected to add variables or update the tests previously used in this research so that the results obtained can be accurate.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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