World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Correlation *between Body Mass Indexs* (BMI), Leg flexibility and dynamic balance in adolescent judo athletes in Surabaya

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World Journal of Advanced Research and Reviews, 2025, 25(02), 2761-2764

Publication history: Received on 18 January 2025; revised on 24 February 2025; accepted on 27 February 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.25.2.0650

Abstract

Background: Judo is a combat sport that requires a combination of strength, flexibility, and balance. Dynamic balance is crucial for maintaining stability during movement, while leg flexibility enhances an athlete's ability to execute various techniques effectively. Both physical attributes are essential for judo athletes to optimize performance, prevent injuries, and maintain control during matches, and they are often associated with Body Mass Index (BMI) or an athlete's body composition.

Objective: To examine the correlation between Body Mass Index (BMI), leg flexibility, and dynamic balance in adolescent judo athletes in Surabaya.

Methods: This study used an analytical cross-sectional research design to analyze relationships. BMI measurements were conducted by measuring height and weight, leg flexibility was assessed using the Sit and Reach Test, and dynamic balance was evaluated using the Star Excursion Balance Test (SEBT). Data analysis was performed using IBM SPSS 25.0, with normality tests conducted using the Shapiro-Wilk test and correlation analysis using Pearson's test.

Results: The correlation between BMI and leg flexibility, analyzed using Pearson's correlation test, showed a p-value of 0.313 ($p>0.05$), while the correlation between BMI and dynamic balance yielded a p-value of 0.217 ($p>0.05$).

Conclusion: No significant relationship was found between BMI, leg flexibility, and dynamic balance.

Keywords: Sit and Reach Test; Star Excursion Balance Test; Height; Weight

1. Introduction

Judo is one of the most popular martial arts and was officially included in the Summer Olympic Games in 1964 (Tokyo) for men and in 1992 (Barcelona) for women. Judo's activity profile requires athletes to perform repeated high-intensity efforts in both standing and groundwork positions, interspersed with periods of lower intensity and/or rest (Prieske et al., 2020). Judo is a combat sport that demands a combination of strength, flexibility, and balance. Dynamic balance is essential for maintaining stability during movement, while leg flexibility enhances an athlete's ability to execute various techniques effectively (Kilic et al., 2022). Flexibility, defined as the ability of muscles and joints to move through their full range of motion, is a key component of athletic performance, particularly in combat sports such as judo (Behm et al., 2021). Meanwhile, dynamic balance, which refers to the ability to maintain stability while moving, also plays a crucial role in executing complex techniques and effectively confronting opponents (Mocanu et al., 2022). These two physical attributes are critical for judo athletes to optimize performance, prevent injuries, and maintain control during matches (Prieske et al., 2020). Body Mass Index (BMI), as a measure of body composition, has been linked to physical attributes

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such as flexibility and balance in previous studies (Sari et al., 2022). However, the relationship between BMI, leg flexibility, and dynamic balance, particularly in judo athletes, remains under-researched. Understanding this relationship can provide guidance in designing training programs to enhance performance and reduce injury risks. This study aims to analyze the relationship between BMI, leg flexibility, and dynamic balance in judo athletes. The research findings emphasize the importance of maintaining an optimal BMI to improve flexibility, dynamic balance, and overall performance.

2. Methods

This study used an analytical cross-sectional design to analyze the relationship between Body Mass Index (BMI), leg flexibility, and dynamic balance. The research sample consisted of 47 judo athletes from the KONI Surabaya branch, aged 11-18 years. Samples were selected using purposive sampling, considering inclusion and exclusion criteria. The inclusion criteria were: judo athletes aged 11-18 years, no lower limb injuries, willingness to participate in the study, and signing informed consent. The exclusion criteria included athletes with chronic ankle instability (CAI), as evidenced by joint instability.

BMI was measured by assessing height and weight, leg flexibility was measured using the Sit and Reach Test, and dynamic balance was evaluated using the Star Excursion Balance Test (SEBT). The collected data were tested for normality using the Shapiro-Wilk test. The relationships between variables were analyzed using Pearson's correlation test with a significance level of $p<0.05$.

3. Results

The study found that the total number of research subjects was 45 judo athletes, with the distribution based on age categorized into two groups: 11-14 years (20 athletes, 44.44%) and 15-18 years (25 athletes, 55.56%). Based on BMI distribution, 19 athletes (42.22%) had normal BMI, 11 athletes (24.44%) were underweight, and 15 athletes (33.33%) were overweight. The distribution of leg flexibility among judo athletes, based on the Sit and Reach Test results, showed that 37 subjects had good flexibility (82%), while 8 subjects had poor flexibility (18%).

The Shapiro-Wilk normality test results showed that the significance values for Body Mass Index (BMI) were $p=0.67$ ($p>0.05$), Sit and Reach Test (SRT) was $p=0.37$ ($p>0.05$), and Star Excursion Balance Test (SEBT) was $p=0.12$ ($p>0.05$). Since all three indices had p-values greater than 0.05, the data were concluded to be normally distributed.

Table 1 Descriptive Data of Research Sample

Data Umum	N	Minimum	Maximum	Mean ±SD
Usia	45	11	18	14,81±0,68
IMT	45	14,5	38,40	22,04±5,20
SRT	45	20	50	34,04±7,43
SEBT	45	40	90	75,16±10,79

Table 2 Normality Test using Shapiro-Wilk Test

Data	Statistic	df	Sig.
IMT	0,96	47	0.67
SRT	0,97	47	0.37
SEBT	0,97	47	0.12

After conducting a correlation test using Pearson's test between Body Mass Index (BMI) and lower limb flexibility, measured by the Sit and Reach Test (SRT), a result of 0.313 was obtained. This Pearson correlation result indicates a weak positive relationship between BMI and lower limb flexibility. A positive relationship means that as BMI increases, lower limb flexibility tends to increase as well, although this relationship is not strong. However, since the correlation

value is only 0.313, the relationship is quite weak and inconsistent. This means that changes in BMI do not necessarily lead to significant changes in lower limb flexibility.

The correlation test using Pearson's test between Body Mass Index (BMI) and dynamic balance, measured by the Star Excursion Balance Test (SEBT), yielded a result of 0.217. This result indicates a weak positive correlation. This means that as BMI increases, there is a slight tendency for dynamic balance to increase as well. However, this relationship is not strong enough to indicate a significant association.

Table 3 Pearson Correlation Test between Body Mass Index (BMI) and Sit and Reach Test (SRT)

Correlations			
	IMT	**SRT**	
IMT	Pearson Correlation	1	0,313
	N	45	45
SRT	Pearson Correlation	0.313	1
	N	45	45

Table 4 Pearson Correlation Test between Body Mass Index (BMI) and Star Excursion Balance Test (SEBT)

Correlations			
	IMT	**SEBT**	
IMT	Pearson Correlation	1	0.217
	N	45	45
SEBT	Pearson Correlation	0,217	1
	N	45	45

4. Discussion

4.1. Relationship between BMI and Leg Flexibility

Pearson's correlation test results showed a weak positive correlation (r = 0.313) between BMI and leg flexibility. This indicates that an increase in BMI tends to be followed by an increase in leg flexibility, although the relationship is not strong. This finding is consistent with previous research indicating that body composition, including BMI, can influence flexibility (Castro-Piñero et al., 2010). However, the weak relationship suggests that other factors may play a more dominant role in affecting the leg flexibility of judo athletes.

4.2. Relationship between BMI and Dynamic Balance

Pearson's correlation test between BMI and dynamic balance (Star Excursion Balance Test/SEBT) produced a correlation value of 0.217, indicating a very weak positive relationship. This means that an increase in BMI is only slightly correlated with an increase in dynamic balance. These findings align with research by Wadawadigi & Annigeri (2021), which also reported a very weak correlation between BMI and dynamic balance. This suggests that BMI is not the primary factor determining dynamic balance in judo athletes. Factors such as muscle strength, coordination, and technique may play a more significant role.

5. Conclusion

This study indicates that there is no significant correlation between Body Mass Index (BMI) and leg flexibility or dynamic balance. The lack of correlation may be due to other dominant factors influencing leg flexibility and dynamic balance in judo athletes, including muscle strength, coordination, and technique. Therefore, further research involving additional factors is needed to better understand the correlation between BMI, leg flexibility, and dynamic balance.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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