



## RELATIONSHIP BETWEEN BODY MASS INDEX AND POSTURAL BALANCE AMONG STUDENTS OF THE MARTIAL ARTS CLUB MALIKUSSALEH UNIVERSITY

Melina Handayani<sup>1\*</sup>, Muhammad Sayuti<sup>2</sup>, Cut Sidrah Nadira<sup>3</sup>

<sup>1</sup>Undergraduate Program, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

<sup>2</sup>Department of Surgery, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

<sup>3</sup>Department of Physiology, Faculty of Medicine, Malikussaleh University, Lhokseumawe, Indonesia

\*Corresponding Author : Email : [melinlinh19@gmail.com](mailto:melinlinh19@gmail.com)

### ABSTRACT

**Background:** Relationship between body mass index and postural balance among students of the martial arts club malikussaleh university. Postural balance is an important component in martial arts. Every player's martial art needs fast and strong movements so that the body must be well controlled. Disturbances such as body mass index (BMI) that are not ideal can affect postural stability. The height and shortness or the weight and lightness of a person will affect the location of the center of gravity, that later will affect the balance. **Objective:** The purpose of this study is to find out the relationship between body mass index and postural balance among students of the Martial Arts Club Malikussaleh University. **Methods:** This study used a cross-sectional design conducted in March 2021 at the Bukit Indah Campus, Malikussaleh University. The sample of this study used total sampling with 49 respondents. Data was collected by measuring body weight, height, static balance with a standing stork test, and dynamic balance with a modified bass test of dynamic balance. **Results:** The results of this study obtained BMI with the highest proportion is normal category, with 31 people (63.3%), while the static balance is commonly found in the very good category with 11 people (22.4%), and dynamic balance is commonly found in the balanced category with 29 people (59.2 %). The chi-square analysis show there was a relationship between BMI with static balance ( $p = 0.019$ ) and dynamic balance ( $p = 0.012$ ). **Conclusion:** This study concludes that there is a relationship between BMI and postural balance among students of Martial Arts Club Malikussaleh University.

**Keywords:** *body mass index, static balance, dynamic balance.*

### INTRODUCTION

Postural balance is a major component in maintaining the posture of the human body to be able to be upright and maintain body position. There are two types of postural balance : static and dynamic. Static balance is a balanced form when the body is at rest and dynamic balance is a balanced form when the body is in motion<sup>1</sup>. Postural balance is a very important component in various sports activities. One of them is in the sport of self-defense. Martial sports players need to make fast and strong movements so that the body must be well controlled so as not to make mistakes. This makes postural balance a part that must be optimized for a martial arts player. Players who have good balance can make better movements because they can control every move they make and can minimize the risk of falling and injury<sup>2</sup>.

Balance that is not optimal is usually caused by weakness of extremity muscles, postural stability, and physiological disturbances of one of the senses (visual, vestibular, tactile, and proprioceptive), in addition to other factors such as body mass index (BMI) which is not ideal, also contributes effect from balance<sup>3</sup>. How to determine

whether or not a person's ideal BMI is to measure body composition using weight and height using the BMI formula. The World Health Organization (WHO) reports that in 2016 around 1.9 billion adults 18 years were categorized as overweight (overweight) and 600 million of them were obese. Overall of the world's adult population, about 13% are obese (11% men and 15% women), and about 39% (39% men and 40% women) are overweight<sup>4</sup>. If this continues, by 2030, it can be estimated that 38% of the world's adult population will be overweight, and another 20% will be obese<sup>5</sup>. Meanwhile, the prevalence of underweight globally has decreased. Based on weight trend data studied by the NCD Risk Factor Collaboration from 1975 to 2016, it was found that the prevalence of underweight in women decreased from 9.2% to 8.4%, and the prevalence of underweight in men decreased. from 14.8% to 12.4%<sup>6</sup>. In Indonesia, based on the Riset Kesehatan Dasar (Riskesdas) in 2018, the prevalence of obesity reached 21.8%, the prevalence of overweight was 13.6%, and the prevalence of underweight was 9.3%. Aceh Province has a prevalence of obesity as much as



24.4%, prevalence of overweight 13.9%, and prevalence of underweight 7.2%<sup>7</sup>.

One factor that influence changes in body mass index (BMI) is gender. Men have more muscle mass than women, with greater muscle mass burning more calories. Thus, it is easier for women to gain weight than men with the same calorie intake. The next factor is physical activity, physical activity describes body movements caused by muscle contractions that require energy expenditure. Body mass index is inversely proportional to physical activity, if physical activity increases, the results of body mass index will be more normal, on the contrary, if physical activity decreases, the results of body mass index will increase. Other factors such as age, genetics, and diet can also influence changes in BMI<sup>8</sup>.

Body mass index (BMI) that is not ideal can reduce the ability of postural control thereby increasing the risk of falls and injury. Postural instability not only increases the risk of falls and injury in older adults but also increases the risk of falls in young adults. Based on data on the prevalence trend of body weight among young adults in Indonesia 10.3% of young adults are underweight, 23.3% are overweight and 8% are obese<sup>9</sup>. The research results of Nascimento et al. show that the higher the body mass index in young adults, the greater the impact on balance which also indicates a high risk of falling when moving. This study was conducted on 25 adults, 10 of whom had an ideal BMI and 15 had a non-ideal BMI. The test results showed that young adults with a non-ideal BMI had a higher risk of falling than the group with an ideal BMI<sup>10</sup>.

Body mass index that is not ideal in martial arts players can also reduce postural stability thereby increasing the risk of falling and injury because self-defense is a sport full-body contact, where players earn points by making physical contact with the opponent's body, so it is more often associated with risk. greater sudden injury. Based on data collected by the National Sports Hospital in a sports competition in 2015 there were 87 participants were injured with an average injury rate of 6.3% and the highest injury rate was in contact sports, namely self-defense sports with a figure of 7, 1%. Based on Ruri Ardiyanti's research on contact sports athletes, the percentage of injuries to the BMI that is not ideal is 12.5% and the percentage of injuries to the ideal BMI is 6.5%.

From these data, it can be concluded that the non-ideal BMI has twice the percentage of injuries as the ideal BMI<sup>11</sup>.

Changes in Body Mass Index affect decreasing the ability of muscle tone which affects the balance of the human body. Decreased muscle strength and increased body mass in martial arts players can also cause balance problems<sup>12</sup>. One way to maintain postural stability is to maintain an ideal body posture and perform balance exercises<sup>13</sup>.

Based on the explanation that has been explained above, the researchers are interested in knowing "Relationship between body mass index and postural balance among student of the martial arts club malikussaleh university".

## **METHODS**

This research uses an analytic observational method with a cross-sectional design which was carried out at the Bukit Indah Campus, Malikussaleh University in March 2021.

The population in this study were students of the UKM Sports Martial Arts, Malikussaleh University. The sample in this study were students of the Malikussaleh University Self-Defense Sports UKM who were in Lhokseumawe when the research took place. The sample size in this study was 49 people determined by the total sampling technique.

The independent variable in this study was body mass index and the dependent variable was postural balance.

In this study, measurements were made on the variables to be studied. BMI is determined by measuring height using a microtoise and weight using a digital scale. Postural balance is divided into static and dynamic balance. Static balance was measured using the Standing Stork Test, and dynamic balance was measured using the Modified Bass Test of Dynamic Balance.

The data that has been collected will then be analyzed. Univariate data analysis was used to describe body mass index and postural balance.

Bivariate data analysis was used to test the hypothesis of the relationship between body mass index and postural balance in students of the Student Self-Defense Sports UKM at Malikussaleh University using the test Chi-Square, it was declared significant if the p-value < 0.05 with a 95% confidence interval.



**RESULTS**

Data distribution of respondents in this study related to BMI, static balance, and dynamic balance can be seen in the following table:

**Table 1.** Distribution of respondents

Variable	n	%
IMT :		
Underweight	6	12.2
Normal	31	63.3
Overweight	6	12.2
Obese I	4	8.2
Obese II	2	4.1
Static Balance :		
Very good	11	22.4
Good	10	20.4
Average	8	16.3
Less	10	20.4
Poor	10	20.4
Dynamic balance :		
Balanced	29	59.2
Unbalanced	20	40.8

Based on table 1, it is found that the distribution of the body mass index of respondents as a whole is more in the normal category, with 31 people (63.3%) and less in the obese II, with 2 people (4.1%). The overall distribution of static balance levels was more in the very good category with 11 people (22.4%) and less in the average category with 8 people (16.3%). The distribution of the level of the dynamic balance of respondents is more in the balanced category, with 29 people (59.2%).

The relationship between BMI and postural balance uses a statistical test in the form of an alternative test Chi-Square, which is a combination of cells because they do not meet the requirements to use Chi-Square. The results of combining cells in the form of ideal BMI (normal weight) and not ideal BMI (underweight, overweight, obese I, obese II). Static balance in either category is good, average, and less.

**Table 2.** Relationship between IMT and static balance

IMT category	Static Balance						P-Value		
	Good		Average		Less			Total	
	n	%	n	%	n	%			
Ideal	17	54.8	6	19.4	8	25.8	31	100	0.019
Non-Ideal	4	22.2	2	11.1	12	66.7	18	100	
Amount	21	42.9	8	16.3	20	40.8	49	100	

The results of the cell merging test in table 2 show that the p-value is 0.019 ( $\alpha = 0.05$ ), which means  $H_a$  accepted or there is a relationship between body mass index and static balance in students of the Martial art club, University of Malikussaleh.

**Table 3.** Relationship IMT and dynamic balance

IMT category	Dinamic Balance				P Value		
	Balanced		Unbalanced			Total	
	n	%	n	%			
Ideal	23	74.2	8	25.8	31	100	0.012
Not ideal	6	33.3	12	66.7	18	100	
Amount	29	59.2	20	40.8	49	100	

In table 3, we get a p-value of 0.012 ( $\alpha = 0.05$ ) which means  $H_a$  is accepted or there is a relationship between body mass index and dynamic balance in students of the Martial art club, University of Malikussaleh.

**DISCUSSION**

The results listed in table 1 show that the body mass index of members of the Malikussaleh University martial arts club is more in the normal weight category with 31 people (63.3%). Meanwhile, 18 other people have abnormal BMI, which indicates that there are still quite a lot of members of the Martial Arts Club Malikussaleh University with abnormal BMI.

The sample in this study were undergraduate students, where students generally had an age range of 18-25 years<sup>14</sup>. Those in the age range of 18 to 25 years enter the stage of emerging adulthood, which is one of the stages included in young adulthood<sup>15</sup>. Physically, individuals included in the young adult phase display a perfect profile in the sense that the growth and development of physiological aspects have reached the peak position. Most individuals in the group of young adults want to appear perfect and attractive in front of other individuals. In social life, body shape becomes the first self-representation seen. This causes people in this phase to want to have an ideal body. They begin to maintain their appearance by going on a diet and going to the fitness center to realize the desire to get an ideal body shape and meet the appearance standards of society<sup>16</sup>.

The number of normal BMI categories in martial arts players is caused because they have



high enough physical activity so that their body weight remains ideal because most of the calories that enter are burned to meet energy needs during activities. Body mass index is related to a person's nutritional status, where nutritional status can determine a player's performance in a match. A martial arts player with good nutritional status will be at a good level of physical condition ability so that he is in high performance a stable. Therefore, they are required to maintain their ideal body weight in every activity they participate in<sup>17</sup>.

The results of the research listed in table 1 also show that the description of static balance in the students of Martial Arts Club Malikussaleh University was found more in the very good category, with 11 people (22.4%) and less in the average category, with 8 people (16.3%). This is because the samples taken are students or groups of young adults, where for adults the location of the point of gravity will be closer to the fulcrum. This situation will affect the balance of the body, the lower the location of the center of gravity on the support plane, the more stable or stable the body position will be<sup>12</sup>.

Basically, an important component in getting an adequate balance is muscle strength. Good balance comes from good muscle strength<sup>18</sup>. A study conducted by Lee and Park (2013) found an increase in balance can be explained through tolerance to instability and an increase in resistance to muscle fatigue levels. The tolerance is obtained from the increase in muscle strength, especially the muscle strength of the lower limbs<sup>19</sup>.

Physical ability is a basic requirement in the performance of martial arts, physical ability is also considered an important part to display perfect technique and tactics. For this reason, the players are given physical training to improve their basic physical components<sup>20</sup>. Physical exercise can be in the form of sit-ups, back-ups, squat-jumps, push-ups, and running<sup>21</sup>. These movements include movements that focus on postural muscle strength. Regular physical exercise can increase muscle strength, thus muscles will work optimally to keep the body in balance. However, reduced exercise activity can increase the process of physical weakness. Decreased exercise activity will correlate to general physical status and to specific components of physical function including decreased muscle strength in the lower extremities as a component that maintains balance function.

This can make a difference in maintaining the static balance between individuals<sup>18</sup>.

The study results listed in table 1 show that the picture of dynamic balance in the students of Martial Arts Club Malikussaleh University was found more in the balanced category, 29 people (59.2%) and less in the unbalanced category, 20 people (40.8%).

In martial arts, players are not only trained to have good martial arts movements but are also taught how to improve basic physical fitness components such as strength, endurance, balance, agility, and flexibility. The optimal level of balance is needed when performing various movements, such as the movement of the stance (preparing position), lifting the legs, kicking movements, and others. Therefore, they are required to have a good postural balance in supporting the success of each movement<sup>22</sup>.

The dominant factor that affects the basic physical components of each martial arts player is programmed regular and measurable exercise. Regular training activities are the personal responsibility of each because they are considered to have understood the needs and physical demands that martial arts players must have<sup>23</sup>. Every sporting activity, including martial arts, always begins with a warm-up movement. The warm-up movement prepares the joints and muscles to move optimally and adapt to the increased intensity of the physical movement to be performed. In addition, there are also exercises to improve physical fitness. The more you practice, the better the physical component will be. This condition can gradually increase muscle strength besides that it can also train endurance. Muscle strength and endurance will affect balance performance. The better the strength and endurance, the better the control over balance<sup>18</sup>.

The results of statistical tests between body mass index and static balance in table 2 show p-value = 0.019, because p-value < 0.05 then  $H_a$  is accepted, namely there is a relationship between body mass index and static balance in students of Martial Arts Club Malikussaleh University. The results of the cross table show that the body mass index in the ideal category with static balance in the good category is 17 people (54.8%), moderate is six people (19.4%), less is eight people (25.8%). Body mass index in the category of not ideal with good





static balance amounted to 4 people (22.2%), being 2 people (11.1%), less than 12 people (66.7%).

Balance is a continuous process of joint and muscle adjustment that involves integration between different systems such as detecting, transmitting, and processing sensory and motor information in the central nervous system and adapting motor responses to determine body posture<sup>10</sup>. Many factors can affect postural balance, including age, BMI, physical activity, muscle strength, and LGS (scope of motion)<sup>24</sup>. From the age factor, the older a person is, the more disturbed the balance will be due to the process of cell degeneration, this occurs in the elderly while for young adults it is more associated with non-optimal daily activities that cause muscle strength is not optimal. In addition, the height and shortness or the weight and lightness of a person will determine the location of the center of gravity which affects balance. Being overweight and underweight will affect a person's level of balance and can pose a high risk of falling<sup>25</sup>.

Based on table 3, the results of statistical tests show p-value = 0.012, because p-value <0.05 then  $H_a$  is accepted, namely there is a relationship between body mass index and dynamic balance in students of Martial Arts Club Malikussaleh University. The results of the cross table show that the body mass index in the ideal category with dynamic balance in the balanced category is 23 people (74.2%), not balanced is 8 people (25.8%). Body mass index in the non-ideal category with dynamic balance in the balanced category amounted to 6 people (33.3%), unbalanced amounted to 12 people (66.7%).

Changes in body mass index affect decreasing the ability of muscle tone which also affects the balance of the human body. Decreased muscle strength and increased body mass in martial arts players can also cause balance problems. Research by Nascimento et al. shows that the less ideal the body mass index in young adults, the greater the impact on balance which also indicates a high risk of falling when moving. It was stated that the group of young adults with a non-ideal BMI had a higher risk of falling than the group with an ideal BMI<sup>10</sup>. Muscle strength is one of the factors that affect balance. A person with an ideal BMI category has better muscle strength than a person with a non-ideal BMI category because his body fat composition is relatively low and his muscle

composition is relatively high. This is what makes the ability to maintain postural balance is also better<sup>26</sup>.

A non-ideal body mass index is associated with functional limitations in muscle performance which allows for increased disability<sup>27</sup>. In obese individuals, low muscle strength is modulated by a systemic inflammatory state resulting from fat deposition in adipose tissue that stimulates muscle protein degradation, leading to muscle atrophy and decreased muscle protein synthesis. Low body weight is at risk for malnutrition. Weight loss due to fat and muscle mass depletion is the most obvious sign of malnutrition and can result in decreased muscle strength<sup>28</sup>. So it can be concluded that individuals with non-ideal BMI tend to experience a decrease in muscle strength. Weak muscle conditions will have an impact on a decrease in postural balance<sup>24</sup>.

A non-ideal body mass index can also modify how the limbs and the rest of the body create and react to forces. Excess adiposity can impair joint and muscle interactions that are important for functional capacity and postural balance<sup>24</sup>. An increase in fat can cause a shift in the gravity line (Line of Gravity) and changes in the body mass center (Center of mass), which can threaten the stability of the postural<sup>29</sup>. Likewise with underweight people. Underweight people usually have an unbalanced fat and muscle composition, resulting in a lower ability to resist the influence of external forces, making it more difficult to maintain balance<sup>30</sup>.

One way to maintain postural stability is to maintain an ideal body posture and do balance exercises. Balance exercise is good for improving one's balance and is an exercise program to improve balance, including strengthening balance control exercises, walking on different surfaces, and strengthening core muscles in general. Balance exercises can be used for young and old. Balance training can also improve the postural stability and performance of martial arts players<sup>13</sup>.

## CONCLUSION

The body mass index results in students of Martial Arts Club Malikussaleh University with the highest proportion in the normal weight category with a total of 31 people (63.3%) and the least in the obese II with a total of 2 people (4.1%).



The description of static balance commonly found in the very good category with 11 people (22.4%) and less in the moderate category with 8 people (16.3%).

The description of dynamic balance commonly found in the balance category with 29 people (59.2%) and less in the unbalance category with 20 people (40.8%).

This study concludes that there is a relationship between BMI and postural balance among students of Martial Arts Club Malikussaleh University.

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