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THE EFFECT OF BODY MASS INDEX (BMI) AND AGE ON RANGE OF MOTION (ROM) OF ARTICULATIO TALOCRURALIS IN THE ELDERLY IN WIOI VILLAGE, REGENCY. SOUTHEAST MINAHASA

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KEYWORDS
Body Mass Index (BMI), Age, Range Of Motion (ROM), Articulatio Talocruralis

ABSTRACT

Background: The ROM value of a joint indicates the flexibility of that joint. An increase in BMI value is one of the factors that can cause ROM values to decrease and will affect muscle and joint strength. Several studies have linked increased BMI with decreased ROM where obese populations have limited ROM compared to non-obese populations. **Objective:** This study aims to determine the relationship between body mass index (BMI) and range of motion (ROM) of articulatio talocruralis in the elderly in Wioi Village, Regency. Southeast Minahasa. **Methods:** This study is an analytic observational study with a cross sectional approach. The instruments used in this study were digital scales and stature meters to measure BMI, and goniometers to measure ROM. The research sample was selected using simple random sampling technique. Data were tested using binary logistic regression analysis method. **Results:** Of the 51 respondents studied, binary logistic regression analysis showed an effect of BMI on Dorsiflexion ($p = 0.023$, $\beta = -0.197$) and Plantarflexion ($p = 0.014$, $\beta = -0.254$), but no effect of age on Dorsiflexion ($p = 0.635$, $\beta = -0.022$) and Plantarflexion ($p = 0.173$, $\beta = -0.069$). **Conclusion:** Body mass index (BMI) affects the range of motion (ROM) of articulatio talocruralis, but age does not affect the range of motion (ROM) of articulatio talocruralis in the elderly in Wioi Village, Regency. Southeast Minahasa.

INTRODUCTION

The times, especially in urban areas, have influenced people's lifestyles with increased technological advancements (Hendro Setyo Wahyudi & Sukmasari, 2018). The impact of this development, without realizing it, leads to a lack of physical activity in humans, potentially leading to health problems, such as obesity or increased body fat. (Wahyuni & Widiyawati, 2019).

Research by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, DC, shows that Indonesia is among the top ten countries with the highest obesity rates. (Minanton, Oktavia, & Rahagia, 2022). Basic Health Research (Riskesdas) 2018 data shows an increase in obesity rates in Indonesia, especially among adults, from 14.8% in 2013 to 21.8% in 2018. However, there is still insufficient attention to this health issue in Indonesia, despite its significant negative impact on future health, one of which is obesity.

Joint Scope of Motion (LGS) or Range of Motion (ROM) is the limitation of movement in a joint and indicates the flexibility of the joint. A high ROM value indicates a lower risk of injury. ROM at the articulatio talocruralis, which involves dorsiflexion and plantarflexion movements while walking, plays an important role. Several factors such as age, physical activity and obesity can affect the ROM in the joints (Rahardjo, Winarni, & Susanto, 2016).

Body Mass Index (BMI) is a relative measurement of human body mass, calculated by dividing body weight in kilograms by the square of height in meters. (Mandasari, 2017). BMI is used to evaluate health risks related to overweight and obesity. The National Institutes of Health recommends BMI, and an increase in BMI score may lead to a decrease in ROM (Akmal, Kusnanik, Pramono, & Jatmiko, 2022). According to the WHO, obesity is defined as a BMI equal to or above 30 for the general population, while for Asian populations, including Indonesia, the BMI limit for obesity is greater than or equal to 25.9,10 Decreased ROM due to increased body weight can result in impaired muscle and joint strength, complicating daily activities and walking.

Relevant research shows an association between increased BMI and decreased ROM. For example, a study by Mellyana Cahyadi on the relationship between obesity and ankle ROM in FK UM Palembang students found significant differences in ROM associated with BMI, especially in plantarflexion. (Mustikasari, 2018). A similar study by Muhammad Ma'ruf Agung on male students at SMA Xaverius 1 Palembang showed that students with BMI above normal limits had lower ROM, while students with BMI below normal limits tended to have higher ROM or hypermobility.

The increase in the number of obese individuals each year can affect joint health (Hutapea, 2022). Previous studies have shown that an increase in BMI is associated with a decrease in ROM at the hip joint and lumbar flexion, as well as ROM articulatio talocruralis in FK students with limited time for exercise. Age is also a factor that can affect BMI and ROM, because with increasing age, there is a decrease in muscle mass and body fat accumulation. The metabolic rate also drops, resulting in low caloric needs. (Effendi, 2020). However, research on changes in ROM of articulatio talocruralis in the elderly is still limited, encouraging researchers to further investigate the relationship between BMI and ROM in articulatio talocruralis in the elderly, both men and women.

RESEARCH METHODS

This research is a quantitative study with the type of analytic observational study and uses a cross-sectional approach. The population in this study were elderly aged <60 years in Wioi Village, Regency. Southeast Minahasa, have relatively stable health conditions, and are willing to participate in the study by signing informed consent. The number of samples was selected using simple random sampling technique so that each respondent had the same opportunity as a research subject. Body mass index data collection was carried out by measuring body weight and height using digital scales and stature meters, collecting ankle joint range of motion data using a goniometer. Data analysis was carried out using IBM SPSS Statistics 20 software. Data were tested using the binary logistic regression analysis method.

RESULTS AND DISCUSSION

Results

Table 1.
Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	51	100.0
	Missing Cases	0	.0
	Total	51	100.0
Unselected Cases		0	.0
Total		51	100.0

Based on Table 1, it can be obtained that the amount of data used in this study is 51 data for each variable.

Table 2.
Dorsiflexion Table Classification

Observed		Predicted		
		Dorsofleksi		Percentage Correct
		Abnormal	Normal	
Dorsofleksi	Abnormal	16	8	66.7
	Normal	5	22	81.5
Overall Percentage				74.5

Based on table 2, the information obtained for the presentation of prediction accuracy regarding Dorsiflexion as a whole is 74.5%, where the prediction value regarding abnormal is 66.7% and normal is 81.5%.

Table 3.
Plantarflexion Table Classification

Observed		Predicted		
		Plantarfleksi		Percentage Correct
		Abnormal	Normal	
Plantarfleksi	Abnormal	23	7	76.7
	Normal	8	13	61.9
Overall Percentage				70.6

Based on table 3, information for the overall prediction accuracy presentation regarding Plantarflexion is 70.6%, where the prediction value regarding abnormal is 76.7% and normal is 61.9%.

Table 4.
Model Fit Test

	Hasil	2 log likelihood	Keputusan
Dorsofleksi	Block Number = 0	70.524	Model Fit
	Block Number = 1	64.130	

Plantarfleksi	Block Number = 0	69.105	Model Fit
	Block Number = 1	55.444	

Based on table 4 on dorsiflexion, it is obtained that the block number = 0 results obtained a -2LL value of 70.524, while the block number = 1 results obtained a -2LL value of 64.130. Thus it can be decided that the value of -2LL remains and does not increase, so it can be said that the second regression model is better.

While in plantarflexion obtained in the block number = 0 results obtained a -2LL value of 69.105 while in the block number = 1 results obtained a -2LL value of 55.444. Thus it can be decided that the value of -2LL remains and does not increase, so it can be said that the second regression model is better.

Table 5.
Model Feasibility Test

	Chi-square	df	Sig.
Dorsofleksi	9.235	8	0.323
Plantarfleksi	10.906	8	0.207

By using a df of 8, the Chi Square table value of 15.51 is obtained, based on table 5, it can be seen that for dorsiflexion, the Chi Square value is 9.235, this value is < chi square table (15.51), while the Sig. value is 0.323. This value is greater than the research alpha (0.323> 0.05).

As for plantarflexion, the Chi Square value is 10.906, the value is < chi square table (15.51), while the Sig. value is 0.207. This value is greater than the research alpha (0.207> 0.05).

Based on the values obtained for dorsiflexion and plantarflexion, H0 is accepted and H1 is rejected, which means that there is no difference between the predicted classification and the observed classification. So it can be concluded that the model made is suitable for observational data, so this logistic regression model is suitable for use in the next stage (Akbar & Ridwan, 2019).

Table 6.
Overal Test or Simultaneous Test

Variabel	Chi-square	df	Sig.
Dorsofleksi	6.395	2	0.041
Plantarfleksi	13.661	2	0.001

By using DF 2, the Chi Square table value is 5.991, based on the results of table 6, it can be seen that for dorsiflexion, the calculated Chi Square value is 6.395, this value is greater than the Chi Square table while from Sig. of 0.041, this value is <0.05, which means that H0 is rejected and H1 is accepted.

As for plantarflexion, the calculated Chi Square value of 13.661 is greater than the Chi Square table while from Sig. of 0.001 the value is <0.05, which means that H0 is rejected and H1 is accepted.

Thus it can be concluded that there is a simultaneous influence of the independent variable on the dependent variable (ROM Dorsiflexion and Plantarflexion).

Table 7.
Dorsiflexion Partial Test

Variabel	Koefisien	Sig.
Usia	-0.022	0.635
IMT	-0.197	0.023
Constant	6.560	0.133

Based on the partial test results, presented in table 7, the following information is obtained:

1. The Age variable has a regression coefficient of -0.022, meaning that the age variable can reduce the value of dorsiflexion by 0.022. In addition, it also has a significance value of 0.635, this value is greater than 0.05. Based on this, it can be said that the age variable has no effect on the dorsiflexion variable. So that the first hypothesis, H1: the age variable has a partially significant effect on the dorsiflexion variable "rejected".
2. The IMT variable has a regression coefficient of -0.197, meaning that the IMT variable can reduce the value of dorsiflexion by 0.197. In addition, it also has a significance value of 0.023, this value is smaller than 0.05. Based on this, it can be said that the IMT variable affects the Dorsiflexion variable. So that the second hypothesis, H2: the imt variable has a significant effect partially on the dorsiflexion variable "accepted".

Table 8.
Plantarflexion Partial Test

Variabel	Koefisien	Sig.
Usia	0.069	0.173
IMT	-0.254	0.014
Constant	1.467	0.743

Based on the partial test results, presented in table 8, the following information is obtained:

1. The Age variable has a regression coefficient of 0.069, meaning that the age variable can increase the value of plantarflexion by 0.069. In addition, it also has a significance value of 0.173, this value is greater than 0.05. Based on this, it can be said that the age variable has no effect on the Plantarflexion variable. So that the first hypothesis, H1: the age variable has a partially significant effect on the plantarflexion variable "is rejected".

2. The IMT variable has a regression coefficient of -0.254, meaning that the IMT variable can reduce the value of plantarflexion by 0.254. In addition, it also has a significance value of 0.014, this value is smaller than 0.05. Based on this, it can be said that the IMT variable affects the Plantarflexion variable. So that the second hypothesis, H2: the imt variable has a significant effect partially on the plantarflexion variable "accepted".

Table 9.
Coefficient of Determination

Variabel	Nagelkerke R Square
Dorsofleksi	0.157
Plantarfleksi	0.317

Based on the results of the coefficient of determination test above, the Nagelkerke R Square value of the regression model is used to determine how much the ability of the independent variable (independent) to explain the dependent variable (dependent). From table 9 for dorsiflexion, it is known that the Nagelkerke R Square value is 0.157, this means that 15.7% of the variation in the dependent variable can be explained by variations in the independent variable. While the rest (100% - 15.7% = 84.3%) is influenced by other variables.

As for plantarflexion, the Nagelkerke R Square value is 0.317, this means that 31.7% of the variation in the dependent variable can be explained by variations in the independent variable. While the rest (100%-31.7% = 68.3%) is influenced by other variables.

Discussion

The results of this study showed that the BMI (Body Mass Index) of the research subjects in the elderly in Wioi village, Regency. Southeast Minahasa Regency, it was found that the elderly who had underweight BMI amounted to 3 people (5.9%), normal amounted to 12 people (23.5%), overweight amounted to 9 people (17.6%), type 1 obesity amounted to 20 people (39.2%), and type 2 obesity amounted to 7 people (13.7%). At the same time, measurement of ankle ROM revealed abnormalities, especially in plantarflexion movement, seen in a higher number of cases in obese elderly (Nadrati & Supriatna, 2021).

This study obtained the ROM (Range of Motion) value of articulatio talocruralis in the elderly in Wioi village, Regency. Southeast Minahasa Regency as measured by a goniometer. The ROM value of the ankle is obtained by directly measuring 2 movements, namely dorsiflexion and plantarflexion. Based on the results of the study on the ROM value of the ankle, it was found that the movement that experienced the most abnormalities in ROM value was plantarflexion, namely 22 in obese elderly and 8 in non-obese elderly, and dorsiflexion as many as 17 in obese elderly and 7 in non-obese elderly.

The results of this study indicate that there is an influence between BMI (Body Mass Index) values and ROM (Range of Motion) of the ankle joint in the elderly in Wioi village, Regency. Southeast Minahasa. By using the binary logistic regression analysis method, it was found that all movements in the BMI variable produced a significance value of less than 0.05, which indicated the influence of BMI on ROM. That is, when BMI increases, ankle ROM tends to decrease (Hendrawan, 2019). However, the movement test with the age variable resulted in a significance value of more than 0.05, indicating no effect of age on ROM.

Although age has no effect on ROM, this study is in line with previous research by Putri et al. (2022) and Asmara et al. (2023), who also found that an increase in BMI can lead to a decrease in ROM in other joints. Although similar results have been found in previous studies, differences in methodology, sample characteristics, as well as the joints measured may affect the intensity of the relationship found (Oktriani, Kusmaedi, Daniel Ray, & Setiawan, 2020).

According to this study, individuals with normal BMI will experience a decrease in ROM; however, this interpretation does not always occur and not all research subjects experience this phenomenon. Therefore, there are still few cases where individuals with normal BMI will experience normal ROM or experience hypermobility. The non-uniform distribution of fat implies that the degree of obstruction by excess fat will vary among different joint areas and body movements (Agung, Suciati, & Septadina, 2018). However, the limitation of movement in obese people can be attributed to the accumulation of body fat and the distribution pattern of obesity in the human body. When a person feels hunger and becomes fat, the pain spreads randomly to all parts of the body (Sudargo, Freitag, Kusmayanti, & Rosiyani, 2018). Excess fat around the joint segment will mechanically inhibit joint movement. Obesity in conjunction with other factors such as joint overload, changes in posture, and sedentary lifestyle can affect musculoskeletal development and result in ROM (Rahardjo et al., 2016).

Age is also one of the factors that can support an increase in BMI and the increase in BMI affects the decrease in ROM. As people age, their bodies gradually lose mass and become less flexible. The metabolic rate will also slow down, resulting in a reduced amount of calories needed for exercise (Novem, Laksono, & Kumaidah, 2017). The elderly experience tissue spasticity in the joint system and experience calcification. In general, connective tissue and bone degenerate, causing decreased elasticity and impaired flexibility. Furthermore, the connective tissue within the muscle fibers increases with changes in elasticity (Tamtomo, 2016). In the elderly there is erosion, degeneration, and calcification of the joint capsule and cartilage, a decrease in joint range of motion due to the joint losing its flexibility (Indrayana, Warijan, & Siswanto, 2020).

However, it should be recognized that this study has limitations, keeping in mind that the method used to determine the obesity category in this study was BMI, which has the disadvantage of not being able to determine obesity due to both lean mass and obesity. In addition, some respondents did not perform the dorsiflexion and plantarflexion movements correctly during the measurement, which could lead to bias. Although the researchers have worked hard to understand this by taking three ROM measurements and determining the highest ROM value, it is important to realize that response variation may affect the accuracy of the interpretation of the study findings.

This study also only examined the effect of body mass index on the range of motion of the foot, while other factors that affect range of motion, such as physical activity, were not calculated because obesity is usually associated with lower levels of physical activity in daily life (Muhammad Fakhri Wahyudi & Noordia, 2021). In addition, the sample size used in this survey was relatively small and does not accurately reflect the overall population of older people in Wioi Village. Therefore, statistical measures such as mean and standard deviation may be more representative if a larger sample size is used.

Thus, this study makes an important contribution to the understanding of BMI, age, and ROM of articulatio talocruralis in the elderly (Dewi, 2023). Further efforts in this study could include other factors that may affect ROM, such as physical activity, and further explore the clinical implications for the development of more effective interventions in the elderly population with high BMI.

The findings of this study indicate that there is an effect between the elderly population with a high BMI has a significant risk of limitation of range of motion (ROM) and motion ability in the ankle joint. The influence of decreased ROM, especially in dorsiflexion and plantarflexion movements, shows the importance of weight management in the elderly to maintain ankle joint function and mobility.

The clinical implications of these findings strongly emphasize that special attention should be given to the elderly with high BMI. Physiotherapists and medical personnel have a very important role to play in reducing the risk of movement limitation in this population. Effective and planned weight management strategies need to be implemented as an integral part of elderly care, with a focus on maintaining optimal ROM (Maliga, 2018). Everyday intervention measures, such as appropriate exercise programs and weight monitoring, can be an integral part of care planning for the elderly population with high BMI. This aims to maintain and improve their daily mobility, which in turn can have a positive impact on overall quality of life.

CONCLUSIONS

Body Mass Index (BMI) has a significant influence on Range of Motion (ROM) of articulatio talocruralis in the elderly in Wioi Village, Southeast Minahasa Regency. However, age does not show a direct influence on ROM, but is more likely to affect BMI. Therefore, it can be concluded that the influence of age on ROM is done through its influence on BMI, which then also affects ROM.

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