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The Relationship of Obesity with Range Of Motion (ROM) On The Ankle

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ABSTRACT

Introduction. Obesity is weight gain beyond the limits of physical and skeletal needs due to excessive accumulation of body fat that may increase risk factors for musculoskeletal disorders. A musculoskeletal disorder that can occur is a limited range of motion of a joint. This study aimed to identify the relationship between obesity and ankle range of motion (ROM). **Methods.** This study was conducted using an analytical observational study with an overall sample of 311 students who met the inclusion criteria. The sample for this study was students' class of the Muhammadiyah Palembang's School of Medicine from 2018 to 2020 and was extracted using the total extraction method. The population of this study is Palembang students. **Results.** The study found that 238 students (76.5%) were not obese and 65 students (20.9%) were obese. Among obese college students, 51 college students (69.9%) had normal dorsiflexion ROM and 22 college students (30.1%) had abnormal dorsiflexion ROM. Obese students had normal plantarflexion ROM in her 20 students (27.4%) and students with abnormal plantarflexion ROM in her 53 students (72.6%). 195 students (81.9%) had normal dorsiflexion ROM and 43 students (49.7%) had abnormal dorsiflexion ROM. 185 students (77.7%) had normal plantarflexion ROM and 53 students (22.3%) had abnormal plantarflexion ROM. **Conclusion.** Suggesting an association between obesity and the Range of Motion (ROM) in the ankle joint.

1. Introduction

Obesity is a chronic, multi-factorial disease and is also called a chronic inflammatory disease characterized by an increase in total body fat.[1] *Range of motion* (ROM) is the range of joint motion or the distance of joint movement that can be done to full.[2] Obesity is a risk factor for cardiovascular, systemic, and musculoskeletal diseases. Obesity is often associated with changes in foot structure and function such as impaired foot posture, decreased muscle strength, and range of motion (ROM) as well as gait changes.[3]

The prevalence of obesity in the world such as in Western Europe is 13.9%, in Latin America by 18.1%, and in Mexico by 10.5%. The prevalence of obesity is around 62% in the world in developing countries.[4] China also saw an increase in the prevalence of obesity in males from 2.88% to 11.8%, and in females from 4.55% to 11%.[5] As many as 12.3% of students in the United States are obese with an increase of about 1 kg per year at the age of 18-29 years.[6] Asia, Africa, and South America have a prevalence of obesity aged 16-30 years in students in various universities at 22%. The male prevalence was 24.7% and the female prevalence was 19.3%.[6] Indonesia has an increasing prevalence of obesity every year. The prevalence of obesity in adults was 15.4%, the prevalence of obesity in adults in 2013 was 14.8% increased to 21.8% in 2018.[7] The prevalence of obesity in Central Java is 7.62%. The prevalence of female obesity is 8.61% while male obesity is 6.4%.[7]

In general, obese people have low physical activity habits and sit a lot so that muscle strength also decreases and this increases the risk of getting low ROM values.[2] A person who is obese can increase the weight load received by muscles such as the *gastrocnemius* and *soleus* muscles. Increased weight will increase the load of *the gastrocnemius* and *soleus* muscles so that *tightness* occurs. This can cause interference with plantar flexion movement because the *gastrocnemius* and *soleus* muscles play a role in plantar flexion movement. The increased load on the muscles can interfere with the ability of the muscles to contract or relax.[8]

Previous studies showed a significant relationship between obesity and low ROM values in pelvic flexi, pelvic adduction, and lumbar flexi.[2] ROM plantarflexion in someone who is obese also has a smaller value when compared to someone who has normal weight.[9] However, no studies have been

conducted to determine the relationship between obesity and ROM in college students' ankles. This is the reason for the research on the relationship between obesity and ROM in the ankle.

2. Methods

The type of research used in this study is observational analytical research using a quantitative approach. The research design in this study was *cross-sectional*. The sample in this study were Students of the Faculty of Medicine, University of Muhammadiyah Palembang class of 2018-2020. The independent variable in this study was obesity. The variable tied to this study was the *Range of Motion* (ROM) of the ankle joint. The statistical test used in this study is the *Chi-square test.*

3. Results

This study shows that the majority of students have normal weight or are not obese as many as 238 people (76.5%, Table 1). More students have *a dorsiflexion Range of Motion* (ROM) value within normal limits as many as 246 people (79.1%, Table 2). Based on Table 3, as many as 205 people (65.9%) have plantarflexion *Range of Motion* (ROM) values within normal limits. Students who were not obese and had a *dorsiflexion Range of Motion* (ROM) value within normal limits were 195 people (81.9%, Table 4). In the table of the relationship between obesity and *the Range of Motion* (ROM) dorsiflexion, a statistical test was carried out, namely *the Chi-square* test, which obtained a *p-value* of <0.05. This shows a significant relationship between obesity and *Range of Motion* (ROM) dorsiflexion of the ankle joint. Based on Table 5, students who were not obese and had a *plantarflexion Range of Motion* (ROM) value within normal limits were 185 people (77.7%). In the table of the relationship between obesity and the *Range of Motion* (ROM) plantarflexion, a statistical test was carried out, namely *the Chi-square* test, which obtained a *p-value* of <0.05. This shows a significant relationship between obesity and the *Range of Motion* (ROM) plantarflexion of the ankle joint.

Table 1. Results of obesity distribution

Obese	n	%
No obesity	238	76,5
Obese	73	23,4

Table 2. Dorsiflexion *Range of Motion* (ROM) distribution results

Dorsiflexion ROM	n	%
Normal	246	79,1
Abnormal	65	20,9

Table 3. *Plantarflexion* Range of Motion (ROM) distribution results

ROM Plantarflexes	n	%
Normal	205	65,9
Abnormal	106	34,1

Table 4. Relationship of obesity with *Range of Motion* (ROM) Ankle joint dorsiflexion

Obese	Range Of Motion (ROM) Dorsoflexi			P Value
	Normal n(%)	Abnormal n(%)	Sum n(%)	
Obese	51 (69,9)	22 (30,1)	73 (100)	
No obesity	195 (81,9)	43 (49,7)	175 (100)	0,027
Total	246 (79,1)	65 (20,9)	311 (100)	

Table 5. Relationship of obesity with *Range Of Motion* (ROM) plantarflexion of the ankle joint

Obese	Range Of Motion (ROM) Plantarflexes			P Value
	Normal n(%)	Abnormal n(%)	Sum n(%)	
Obese	20 (27,4)	53 (72,6)	136 (100)	
No obesity	185 (77,7)	53 (22,3)	175 (100)	0,000
Total	205 (79,1)	106 (20,9)	311 (100)	

4. Discussion

The results of this study showed that the body mass index of the study subjects, namely students of the Faculty of Medicine, University of Muhammadiyah Palembang, there were 238 students (76.5%) who had a body mass index within normal limits or were not obese. A total of 73 students (23.4%) had a body mass index above the normal limit or were obese. The results of this study found that 246 students (79.1%) had normal dorsiflexion *Range of motion* (ROM) scores. A total of 65 students (20.9%) had abnormal dorsiflexion *Range of motion* (ROM) scores. In plantarflexion movement, 205 students (65.9%) had normal plantarflexion *Range of motion* (ROM) scores. A total of 106 students (34.1%) had abnormal plantarflexion *Range of motion* (ROM) scores. The results of this study showed a significant relationship between obesity and the *Range of motion* (ROM) of the ankle joint (articulatio talocruralis).

The results of this study are in line with previous research conducted by Jeong (2018) showing changes in the *value of Range of motion* (ROM) of the elbow, pelvis, knee, and ankle joints in people who have an obese body mass index.[9] Research conducted by Zhao (2017) shows the results of an influence between weight loss and an increase in ROM values. This explains the relationship or influence of body mass index with the *Range of motion* (ROM) value.[10] The anterior and posterior parts of the leg have more soft tissue and contain more subcutaneous fat. This causes an increase in body weight will affect the posterior area of the leg so that the abnormal joint range of motion occurs.[9]

The results of this study are also following research conducted by Unver (2021), where this study shows a relationship between plantarflexion and obesity. This study shows a decrease in ROM values (abnormal) in someone who is obese. An increase in body weight can cause a higher volume of adipose tissue in the *gastrocnemius* muscle resulting in stiffness in the ankle joint which can reduce ROM values (abnormal). Ankle joint stiffness can occur due to fat infiltration in the muscles of the lower extremities as a form of compensation for the instability of posture in someone who is obese, and also the accumulation of fat in the *gastrocnemius* muscles which can cause reduced joint flexibility.[3]

Research conducted by Capodaglio (2021) also showed a decrease in plantarflexion ROM values in obese subjects. This can happen because obese individuals have less physical activity, and also the accumulation of excessive fat tissue in the posterior part of the legs, namely musculus gastrocnemius, soleus, plantaris, and others so that joint motion becomes abnormal.[11]

Research conducted by Szymanska (2017) shows a relationship between body mass index that is more than normal or obese with a decrease in dorsiflexion *Range of motion* (ROM) values in children. This study explains that someone who is obese has a decrease in dorsiflexion ROM values and on average has a normal arch of the sole of the foot.[12] Research conducted by Zhao (2017) explains the effect between weight loss and increased ROM scores. The value of dorsiflexion ROM will increase if a person experiences weight loss. This indicates that if someone is obese, there will be an abnormal or limited range of motion in the joints. Weight loss can be a solution to overcome the occurrence of a joint limited range of motion.[10] Research conducted by Merta (2018) found that there was an effect of increasing BMI on dorsiflexion ROM values. This occurs due to an increased weight load on the tibial muscles that interfere with the muscle for extension. Increased BMI can also increase the weight load on the *gastrocnemius* and *soleus* muscles which can affect joint border motion, namely reduced dorsiflexion ROM values.[8]

This study is not in accordance with the results of research conducted by Salsabila (2020), namely this study shows no significant correlation between body mass index and *Range of motion* (ROM) in the ankle joint (articulatio talocruralis) in both dorsiflexion and plantarflexion movements.[13] This is also supported by the results of research conducted by Park (2010) explaining that in people who are obese, there is a buildup of fat tissue that occurs unequally in all limbs. Some parts of the body such as the stomach, buttocks, and thighs tend to accumulate more easily so it is easier to be obese. This explains that the accumulation of unequal fat tissue in each limb has differences also in the occurrence of joint motion limitations. Limbs that tend to accumulate fat tissue more easily will affect the movement of the joints around the limbs.[14] Joint limitation of motion can also be found in cases of ankle injury. This is in accordance with research conducted by Jodi (2019), namely, there is a relationship between injuries to the ankle joint with the occurrence of limited joint motion. Injury to the ankle joint can cause motion pain and decreased motion function of the ankle joint. Conditions such as arch posture, advanced age, *plantar fasciitis*, and ankle joint injuries can cause limited joint range *of motion* (ROM) abnormal.[15]

5. Conclusion

From the results of the study conducted more students who are not obese compared to those who are obese. In the *Range of Motion* (ROM) measurement, it was found that the results of dorsiflexion ROM measurements of students had normal ROM values than students who had abnormal ROM. In plantarflexion**,** ROM **was** also obtained **for** students who **had** normal ROM values more than abnormal ROM values. The results of this study show that there is a relationship between obesity and *Ankle Range of motion* (ROM)**.**

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