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Original Research Article

The correlation between the angle of calcaneal eversion and gastrocnemius extensibility with nonspecific low back pain in obese women

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ABSTRACT

Background: Individuals with obesity will experience an increase in the angle of calcaneal eversion which has an impact on increasing the workload of the muscles to maintain joint stability, so that tension occurs in the gastrocnemius muscle which affects its extensibility ability. Increasing the angle of calcaneal eversion will cause changes in lumbopelvic alignment so that it can cause low back pain. The aim of the study was to determine the correlation between the angle of calcaneal eversion and gastrocnemius extensibility with nonspecific low back pain in obese women.
Methods: This research was a cross sectional analytic study with simple random sampling technique. The number of samples are 78 women aged 36-55 years old. The variables measured were functional pain reduction score in nonspecific low back pain with modified Oswestry disability questionnaire, the angle of calcaneal eversion and gastrocnemius extensibility with goniometer.
Results: Our study showed that there was no significant correlation between the angle of calcaneal eversion and gastrocnemius extensibility. However, there was a significant correlation between gastrocnemius extensibility and low back pain at the level of 0.033. In addition, there was a significant correlation between the angle of calcaneal eversion and low back pain at the level of 0,000.
Conclusions: There was a significant correlation between the angle of calcaneal eversion and gastrocnemius extensibility with low back pain. However, the angle of calcaneal eversion is not directly related to gastrocnemius extensibility.

Keywords: The angle of calcaneal eversion, Gastrocnemius extensibility, Low back pain

INTRODUCTION

Currently, the number of obese people is increasing. Obesity is defined as an excessive increase in fat tissue in muscle and skeletal tissue.[1] Based on the classification of Body mass index (BMI), according to the Asia Pacific criteria, a person is categorized as obese if they have a BMI score ≥25. Obesity is more experienced by women.[2]

Increased BMI is associated with musculoskeletal problems, especially in the waist and lower extremities. According to Porto et al, individuals with obesity tend to experience a shift in the center of mass (COM) to the anterior. Excess body weight causes the weakness of abdominal muscle tone, so that a person's center of gravity (COG) will be pushed forward and cause lumbar lordosis to increase which then causes fatigue in the paravertebral muscles, this is a risk of LBP.

Body weight also affects the compression pressure on the spine in the lumbar region when doing movements. Based on this, it is possible that there is a relationship that people

who are obesity can have an effect on the freedom of movement in the lumbar spine which affects the problems of LBP.[3]

Anterior shift also increases the amount of ankle torsion required to stabilize the body in an upright position. This can cause biomechanical changes to the ankle. One of them is hyper-pronation of the subtalar joint. Based on the results of research by Masaun et al that there is an increase in the angle of calcaneal eversion in obese women. With this weight transfer, the foot will compensate by pronation of the calcaneus to reduce the impact of body weight and maintain foot stability. In the weight bearing position, the eversion of the calcaneus is accompanied by a plantarflexion movement which is driven by the gastrocnemius muscle which inserts in the posterior part of the calcaneus.

The calcaneus accommodates the impact of excessive heel strike and tensile forces from the gastrocnemius muscle. With weight gain, there is an increase in muscle load to maintain joint stability so that the tension in the gastrocnemius muscle will increase and more sarcomere shortens. This muscle tension will affect the ability of the muscle to stretch or lengthen which is often called extensibility.[4]

The existence of a relationship between obesity and low back pain and the effect of obesity on calcaneus eversion and gastrocnemius extensibility makes researchers want to know whether there is a relationship between these things. Based on the explanation above, researchers are interested in conducting a study entitled the relationship between the angle of calcaneal eversion and gastrocnemius extensibility with nonspecific low back pain in obese women.

METHODS

The design of this study was an analytical observational cross-sectional study that analyzed the correlation between the angle of calcaneal eversion and gastrocnemius extensibility with nonspecific low back pain in women aged 36-55 years old. Sampling technique in this study uses simple random sampling. Inclusion criteria were women aged 36-55 years old, have a BMI≥25, not pregnant, good general condition, cooperative and understand verbal command, and willing to volunteer as a research subject from the beginning of the study until the end by signing an informed consent willing as a sample. Exclusion criteria were having deformities in the ankle joints due to rheumatoid arthritis, gouty arthritis, other genetic diseases. The total number of respondents were 78. This research was conducted on Mangesta Village, Penebel district, Tabanan, Bali and it was conducted on 20th November 2020. The results were analyzed using the Spearman correlation test. Statistical analyses were performed using SPSS version 16.0. All of the p values that less than 0.05 were considered to indicate statistical significance.

Modified Oswestry low back pain disability questionnaire

One measurement of functional pain is the modified Oswestry low back pain disability questionnaire. The development of the modified Oswestry low back pain disability questionnaire was initiated by John O'Brien in 1976. The index was designed as a measure for assessment and outcome.[5]

The sample was asked to express the degree of pain experienced using the modified Oswestry low back pain disability questionnaire for the Indonesian people. There are 10 question sections, each of which discusses pain intensity, personal needs (washing, dressing, etc.), lifting weights, walking, sitting, standing, sleeping, social life, traveling and office/household work.[5]

From each question, there are six choices of answer statements with a total score of 5. If the first answer statement is chosen, the value is 0 while if the fifth answer statement is chosen, the value is 5. If more than one answer statement is chosen, choose the one whose value is the tallest. If all questions have been answered, the value is calculated as follows: if 16 (total score) out of 50 (total possible score) ×100% = 32% (Hiagian et al, 2013). The classification of modified Oswestry low back pain disability questionnaire is completely disability (81%-100%), cripple (61%-80%), severe disability (41%-60%) and moderate disability (21%-40%).[5]

The angle of calcaneal eversion

The angle of calcaneal eversion was measured using a goniometer. The appropriate examination for this condition is knowing the position of the subtalar joint neutral (STJN). STJN position can be measured by measuring calcaneus eversion ROM with no weight-bearing.

The procedures are: the subject was positioned to sleep on his stomach with the lower part of the calf on the edge of the bed, calipers or sliding calipers were used to find the midpoint of the calf and calcaneus then draw the midline to the posterior 1/3 of the calf.

The angle of calcaneal eversion was measured using a goniometer, the axis of the goniometer being placed between the malleolus in the frontal plane. One goniometer arm is placed above the midline of the posterior calf and the other goniometer arm is moved according to the midpoint of the calcaneus.[4]

Gastrocnemius extensibility

Gastrocnemius extensibility measurement is seen from gastrocnemius muscle tightness measurement through Range of motion (ROM) measurement of ankle dorsiflexion with knee extension position. The procedure is as follows: (a) The subject was positioned prone and a marker was used to mark the fibular head, lateral

malleolus, base of the metatarsal tuberosity V and metatarsal head V; (b) The goniometer arm is placed along the axis of the fibula with reference to the dots on the fibular head and lateral malleolus; (c) Move the goniometer arm then place it parallel to the lateral side of the foot with reference to the dot on the base and head of the V metatarsal; (d) The axis of the goniometer is fixed on the lateral side of the foot. The zero position of dorsiflexion is at an angle of 90º between the long axis of the fibula and the lateral side of the foot; (e) Then the measurement can be started until the subject is able to perform maximum dorsiflexion.

RESULTS

Table 1 shows that the number of respondents were 78, with all of the subjects were women. Majority of the subjects with obesity 1 (51.3%) and had severe disability in modified Oswestry disability index (41.0%).

Table 2 shows the correlation between gastrocnemius extensibility and the modified Oswestry disability index. The results indicate that there was a moderate negative correlation between the gastrocnemius extensibility and the modified Oswestry disability index.

Table 3 shows that the correlation between the angle of calcaneal eversion and the modified Oswestry disability index. The results show that there was a strong positive correlation between the angle of calcaneal eversion and the modified Oswestry disability index.

Table 4 shows the correlation between the angle of calcaneal eversion and the gastrocnemius extensibility. The results of spearman's coefficient showed that there was no correlation between the angle of calcaneal eversion and the gastrocnemius extensibility with the sig value (2-tailed) 0.609.

Table 1: Characteristic of the respondents.

Characteristics	Number of respondents	Mean ± SD	Percentage (%)
Age	78	44.63±6.517	100
Body mass index		29.78±3.046	
Obesity 1	40		51.3
Obesity 2	38		48.7
The angle of calcaneal eversion	78	19.54±2.822	100
Gastrocnemius extensibility	78	7.05±2.203	100
Modified Oswestry disability index		65.74±16.47	
Completely disability	18		23.1
Cripple	25		32.1
Moderate disability	3		3.8
Severed disability	32		41.0

Table 2: The correlation between gastrocnemius extensibility and modified Oswestry disability index.

Spearman's rho		Gastrocnemius extensibility	Modified Oswestry disability index
Gastrocnemius extensibility	Correlation coefficient	1.000	-0.337
	Sig (2-tailed)	0.0	0.033
	N	78	78
Modified Oswestry disability index	Correlation coefficient	-0.337	1.000
	Sig (2-tailed)	0.033	0.0
	N	78	78

Table 3: The correlation between the angle of calcaneal eversion and modified Oswestry disability index.

Spearman's rho		The angle of calcaneal eversion	Modified Oswestry disability index
The angle of calcaneal eversion	Correlation coefficient	1.000	0.642
	Sig (2-tailed)	0.0	0.000
	N	78	78
Modified Oswestry disability index	Correlation coefficient	0.642	1.000
	Sig (2-tailed)	0.000	0.0
	N	78	78

Table 4: The correlation between the angle of calcaneal eversion and gastrocnemius extensibility.

Spearman's rho		The angle of calcaneal eversion	Gastrocnemius extensibility
The angle of calcaneal eversion	Correlation coefficient	1.000	-0.059
	Sig (2-tailed)	0.0	0.609
	N	78	78
Gastrocnemius extensibility	Correlation coefficient	-0.059	1.000
	Sig (2-tailed)	0.609	0.0
	N	78	78

DISCUSSION

The results showed that the number of respondents in this study was 78 people with a mean age (44.63±6.517). The BMI category of respondents showed almost the same number of 40 people (51.3%) for the obesity category I and 38 people (48.7%) for the obesity category II.

For the modified Oswestry disability index, respondents in the completely disability category were 18 subjects (23.1%), the Cripple category were 25 subjects (32.1%), the moderate disability category was 3 subjects (3.8%), and the severe disability category was 32 subjects (41.0%). This shows that the modified Oswestry disability index value in respondents with the dominant obesity category has severe disability. Obese women who have low back pain are more likely to have disabilities compared to non-obese women who have low back pain.[6] Obesity increases the mechanical load on the lumbar disc so that the cog shifts anteriorly. These changes have an impact on increasing back pain and even knee pain which can limit mobility.[7] In addition, biomechanical changes in the lower extremities also contribute to the increased incidence of mechanical low back pain. Foot overpronation is one of the factors that most often affects this condition. Foot overpronation is a condition where the medial arch is reduced or absent and is associated with decreased ankle dorsiflexion such as calcaneal eversion.

In this study, the results of the calcaneus eversion angle were obtained with a mean (19.54±2.822). Calcaneal eversion reflects the occurrence of deformities in the sole of the foot which can affect the reduced flexibility of the surrounding soft tissues, especially the abnormal position of the Achilles tendon which can affect stiffness in the calf muscle such as the gastrocnemius which can be assessed by reduced ankle dorsiflexion.[8] In this study, the gastrocnemius extensibility value was also obtained with a mean (7.05±2.203), which describes the ability of the gastrocnemius muscle to stretch actively or passively in ankle dorsiflexion.

Based on Table 3, the Spearman's rho test results show that there is a positive correlation with the sig value (2-tailed) 0.000. These results indicate that there is a strong positive correlation between the angle of calcaneal eversion and the modified Oswestry disability index. The eversion of the calcaneus that occurs excessively is one of the deformities in the sole of the foot that causes overpronation. In obese individuals, the occurrence of eversion of the calcaneus in which excess body weight is forced on the medial side of the foot and forces the longitudinal arch to collapse. Excessive pronation can cause cumulative stress on the skeletal system and can cause foot and ankle pain which of course affects proximal joints such as the knee and even causes low back pain.[9,10]

There is an interdependent mechanism between calcaneal eversion and pelvic anteversion whereby excessive subtalar pronation and calcaneal eversion result in internal rotation of the hip joint and induce posterior pelvic motion. This occurs as the body's effort to maintain balance through forward body movements and can be done with pelvic anteversion. As a result, lateral tilt and pelvic anteversion cause lumbar hyper-lordosis which can provoke mechanical low back pain.[11-13,16]

Based on Table 2, through the Spearman's rho test, the results showed that there was a negative correlation with the sig value (2-tailed) 0.033. These results indicate that there is a moderate negative correlation between the gastrocnemius extensibility and the modified Oswestry disability index. The reduction of gastrocnemius extensibility can be assessed by reduced ankle dorsiflexion when the knee is extended. Decreased ankle dorsiflexion range of motion is one of the factors that cause mechanical low back pain.[8] This is also in line with several previous studies which confirmed the correlation between complaints of chronic low back pain and calf muscle tightness, especially the gastrocnemius muscle.[8,14,15] The gastrocnemius muscle contributes to knee flexion movements and tension in this muscle will indirectly affect the hamstring muscles so that it can limit forward bending which can cause back pain because of its influence on the lumbar pelvic rhythm.[10]

Based on Table 4, through the spearman's rho test, the results show that there is no correlation between the angle of calcaneal eversion and gastrocnemius extensibility with the sig value (2-tailed) 0.609. These results show that there is no strong positive correlation between the angle calcaneal eversion and gastrocnemius extensibility. This is because changes in the position of the subtalar, talocrural and midtalar joints do not significantly affect the dorsiflexion of the ankle as a whole. Stretching with the subtalar joint in the supine position may obtain more ROM at the talocrural joint than those stretching with the subtalar joint in the prone position, but the overall increase in

dorsiflexion is no different. At the time of weight bearing and no weight bearing positions, the strain received by the gastrocnemius muscle was not significantly different in both supine and pronation positions. This causes the angle of eversion of the calcaneus and the extensibility of the gastrocnemius muscle to not significantly affect each other.[17]

Limitation

The limitation of this study was it did not control physical activity or daily activities which are factors that can trigger the low back pain.

CONCLUSION

This study shows that there was a significant relationship between the angle of calcaneal eversion with nonspecific low back pain and gastrocnemius extensibility with nonspecific low back pain. However, the angle of calcaneal eversion is not directly related to gastrocnemius extensibility in obese women.

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