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ORIGINAL ARTICLE

Association Between Gluteus Medius Strength and Gait Instability among University Students with BMI

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ABSTRACT

Background: Gluteus Medius muscle plays an important role in stabilizing the pelvis during gait. Individuals with obesity may experience weakness in gluteus Medius and gait instability. However, it is still unclear whether the musculature of a person with obesity can compensate for these changes.

Objective: To evaluate the comparison of gluteus medius strength and gait instability from university students with different BMI

Methodology: This cross-sectional study was conducted. The study was completed June 2022 to October 2022 according to the rules and regulations set by the ethical committee of University Of Lahore, Gujrat campus by selecting 385 patients who cleared the inclusion and exclusion criteria. Both male and female university students were included. In this study the strength of gluteus medius was checked by using with Manual Muscle Testing Grading System (MMT). The Grading Scale Range from 0 to 5, gait instability was checked from the Gait analysis Questionnaire.

Results: The results of current study shows that age of participants were 23.06±2.49, gender of participants were 1.30±0.46. BMI class * Manual Muscle Testing (Left) Cross tabulation shows that the normal (BMI Score >18.5 to 25) was 0 fair, 8 good and normal were 218, while Over Weight (BMI Score >25 to 30) were 2 fair, 11 good and 111 normal whereas Obese (BMI Score>30) got 3 fair, 15 Good and 17 Normal manual muscle testing scoring while (Right) side shows that normal (BMI Score >18.5 to 25) have 0 fair, 16 good and normal were 210, while Over Weight (BMI Score >25 to 30) have 3 fair, 21 good and 100 normal whereas Obese (BMI Score>30) got 6 fair, 9 Good and 20 Normal manual muscle testing scoring. Gait when walking through a narrow space have 373(10.2%), problems walking when getting on the lift 372(10.2%), problems walking when entering a revolving door was 374(10.2%), problem walking in crowded places 366(10.0%).

Practical Implication: Scientific evidence, muscle strength is inversely and independently associated with all-cause mortality. Some authors even recommend the use of an algorithm to remove the dependence on body size and to more appropriately compare the strength of the hip muscles across individuals since it cannot be concluded that the force is directly proportional to body weight.

Conclusion: There was significant correlation between BMI class and quadriceps strength. Participants with higher BMI shows less quadriceps strength than people with lesser BMI. Increased body mass, in absence of other obesity-related comorbidities, may have minimum impact on gait instability and in turn fall risk.

Keywords: Gluteus, Medius, Gait Instability, BMI, muscle testing

INTRODUCTION

The gluteus medius muscle is an essential pelvic stabilizer and contributes significantly to the transverse and frontal plane control of the pelvis. Hip abductor muscles are crucial in keeping the pelvis stable during locomotion, which enables the body to retain balance and movement in the lower limbs. The gluteus medius is the primary hip abductor muscle in this group of muscles, which also includes the gluteus minimums and tensor fascia latte.[1]

In vivo studies, it shown that the hip abductors require a force around 2.5 times the body weight to maintain the pelvis. Therefore, the combined strength of the abductor muscles must be larger than the person's body weight. When there is enough strength to support their body weight, an individual's stride pattern and joints operate normally. If weight overload or muscular deterioration occurs, an adaptation of the upper body will be started in an effort to bring the centre of gravity closer to the centre of hip rotation.[2]

For obese people, maintaining the strength of the gluteus musculature can be exceedingly difficult. Larger hip adduction with noticeable ankle eversion was seen during the terminal stance and per-balance phases of a three-dimensional gait examination of obese individuals.[3] These outcomes are consistent with those of patients lacking gluteal musculature, who exhibit a disordered gait pattern known as Trendelenburg gait as well as diminished abduction strength, a propensity for external rotation, and poor internal rotation of the lower limbs.[4] There is undoubtedly an imbalance, and this has a detrimental effect on the gait characteristics. These modifications cause the upper body's anteroposterior and mediolateral instability, which impairs function and increases the risk of injuries.[5-7]

When treating obese patients, it is crucial to evaluate their gluteus medius strength. Biomechanical changes in addition to musculoskeletal system problems like patellofemoral syndrome, hip arthrosis, lower back discomfort, and knee arthrosis are all linked to this muscle's weakness. [8]

METHODOLOGY

A cross-sectional study was conducted. The population of study was the orthopaedics patients in Gujrat region. The 385 sample using non probability convenient sampling method was done in the universities of Gujrat. This study was completed 2022 to October 2022 within 4 months after approval of synopsis from research ethical committee of University of Lahore, Gujrat campus. Both male and female active university students with in age group of 18-29 were included while those who suffer from Paresthesia or weakness or orthopedic disease of the lower limbs were excluded and also those who have heart disease or other diseases with restricted functional capacity or female with pregnancy were also excluded.[13-14]

RESULTS

The result of current study shows that age of participants were 23.06±2.49, gender of participants were 1.30±0.46 while the Mean±Std. Deviation of BMI was 25.76±3.31. BMI class * Manual Muscle Testing (Left) Cross tabulation shows that the normal (BMI Score >18.5 to 25) was 0 fair, 8 good and normal were 218, while Over Weight (BMI Score >25 to 30) were 2 fair, 11 good and 111 normal whereas Obese (BMI Score>30) got 3 fair, 15 Good and 17 Normal manual muscle testing scoring while * Manual Muscle Testing (Right) Cross tabulation shows that normal (BMI Score >18.5 to 25) have 0 fair, 16 good and normal were 210, while Over Weight (BMI Score >25 to 30) have 3 fair, 21 good and 100 normal whereas Obese (BMI Score>30) got 6 fair, 9 Good and 20 Normal manual muscle testing scoring. Gait instability frequency of participants where patients showing different response. Gait when walking throgh a narrow space have 373(10.2%), problems walking when getting on the lift 372(10.2%), problems walking

when entering a revolving door was 374(10.2%), problem walking in crowded places 366(10,0%), walking when there is sudden distraction in the environment were 364(10.0), problem walking when dealing with an obstacles in your way 358(9.8%), problem walking when you have to do two things at the same line were 367(10.0%), problem walking when crossing a zebra on green light were 356(9.7%), problem walking when getting on an escalator were 365(9.7%) and problem walking when you are walking in hurry under time pressure were 358(9.8%).

Table 1: Descriptive Statistics

	Age of Participants	Gender of Particiopnts	Body Mass Index (Kg/m^2)
Mean±Std. Deviation	23.06±2.49	1.30±0.46	25.76±3.31

Table 5.1 shows the descriptive analysis of mean and Std. Deviation of demographic data. Here we can see the age of participants were 23.06±2.49, gender of participants were 1.30±0.46 while the Mean±Std. Deviation BMI was 25.76±3.31.

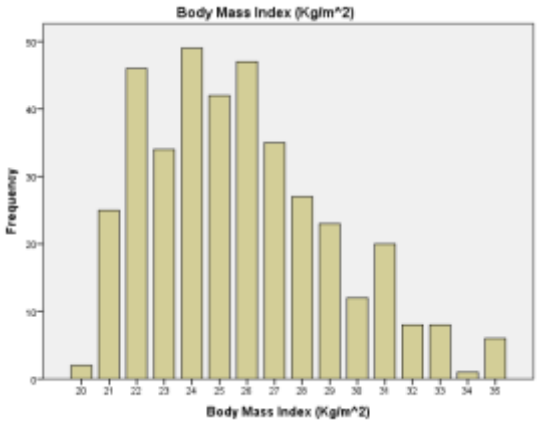

Figure 1: Body Mass Index (Kg/m^2)

Figure 1 showing frequency of Body Mass Index (Kg/m^2). The BMI range in bar chart lies between 20-35.

Table 2: BMI class * Manual Muscle Testing (Left) Crosstabulation

		Manual Muscle Testing (Left)			Total
		Fair	Good	Normal	
BMI class	Normal (BMI Score >18.5 to 25)	0	8	218	226
	Over Weight (BMI Score >25 to 30)	2	11	111	124
	Obese (BMI Score>30)	3	15	17	35

Table 2 showing BMI class * Manual Muscle Testing (Left) Cross tabulation. Normal (BMI Score >18.5 to 25) have 0 fair, 8 good and normal were 218, while Over Weight (BMI Score >25 to 30) have 2 fair, 11 good and 111 normal whereas Obese (BMI Score>30) got 3 fair, 15 Good and 17 Normal manual muscle testing scoring.

Table 3: Chi-Square Tests for BMI class * Manual Muscle Testing (Left)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	78.070[a]	4	.000
Likelihood Ratio	54.10	4	.000
Linear-by-Linear Association	57.215	1	.000

Table 3 shows Chi-Square Tests for BMI class * Manual Muscle Testing (Left). Pearson Chi-Square value is 78.070[a], Likelihood Ratio value is 54.10 whereas Linear-by-Linear Association value is 57.21

Table 4: BMI class * Manual Muscle Testing (Right) Cross tabulation

		Manual Muscle Testing (Right)			Total
		Fair	Good	Normal	
BMI class	Normal (BMI Score >18.5 to 25)	0	16	210	226
	Over Wight (BMI Score >25 to 30)	3	21	100	124
	Obese (BMI Score>30)	6	9	20	35

Table 4 showing BMI class * Manual Muscle Testing (Right) Cross tabulation. Normal (BMI Score >18.5 to 25) have 0 fair, 16 good and normal were 210, while Over Weight (BMI Score >25 to 30) have 3 fair, 21 good and 100 normal whereas Obese (BMI Score>30) got 6 fair, 9 Good and 20 Normal manual muscle testing scoring.

Table 5: Chi-Square Tests for BMI class * Manual Muscle Testing (Right)

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	55.795[a]	4	.000
Likelihood Ratio	41.309	4	.000
Linear-by-Linear Association	43.717	1	.000

Table 5 shows Chi-Square Tests for BMI class * Manual Muscle Testing (Right). Pearson Chi-Square value is 55.79[a], Likelihood Ratio value is 41.30 whereas Linear-by-Linear Association value is 43.71.

Table 6: Gait Instability Frequencies

		Responses		Percent of Cases
		N	Percent	
Gait Instability[a]	Have you notice problems with your gait when walking throgh a narrow space (passing through window)	373	10.2%	96.9%
	Have you noticed problems walking when getting on the lift	372	10.2%	96.6%
	Have you noticed problems walking when entering a revolving door	374	10.2%	97.1%
	Have you notice problem walking in crowded places	366	10.0%	95.1%
	Have you notice problem walking when there is sudden distraction in the enviroment	364	10.0%	94.5%
	Have you notice problem walking when dealing with an obstacles in your way	358	9.8%	93.0%
	Have you notice problem walking when you have to do two things at the same line	367	10.0%	95.3%
	Have you notice problem walking when crossing a zebra on green light	356	9.7%	92.5%
	Have you notice problem walking when getting on an escalator	365	10.0%	94.8%
	Have you notice problem walking when you are walking in hurry under time pressure	358	9.8%	93.0%

Table 6 shows gait instability frequency of participants where patients showing different response. Gait when walking throgh a narrow space have 373(10.2%), problems walking when getting on the lift 372(10.2%), problems walking when entering a revolving door was 374(10.2%), problem walking in crowded places 366(10,0%), walking when there is sudden distraction in the environment were 364(10.0), problem walking when dealing with an obstacles in your way 358(9.8%), problem walking when you have to do two things at the same line were 367(10.0%), problem walking when crossing a zebra on green light were 356(9.7%), problem walking when getting on an escalator were 365(9.7%) and problem walking when you are walking in hurry under time pressure were 358(9.8%)

DISCUSSION

The study were conducted according to the rules and regulations set by the ethical committee of University Of Lahore, Gujrat campus by selecting 385 patient who clear the inclusion and exclusion criteria. Both male and female university students were included whereas pregnancy, an orthopedic disease of the lower

limbs, paresthesia or weakness in the lower limbs, orthostatic or walking pain, heart disease, or other diseases with restricted functional capacity were excluded. The strength of gluteus medius were checked by using with Manual Muscle Testing Grading System (MMT). The Grading Scale Range from 0 to 5. The MMT for quadriceps can be performed in both sitting and side lying. Whereas the gait instability will be checked from the Gait analysis Questionnaire.

The results of current study shows that age of participants were 23.06±2.49, gender of participants were 1.30±0.46 while the Mean±Std. Deviation of BMI was 25.76±3.31. BMI class * Manual Muscle Testing (Left) Cross tabulation shows that the normal (BMI Score >18.5 to 25) was 0 fair, 8 good and normal were 218, while Over Weight (BMI Score >25 to 30) were 2 fair, 11 good and 111 normal whereas Obese (BMI Score>30) got 3 fair, 15 Good and 17 Normal manual muscle testing scoring while * Manual Muscle Testing (Right) Cross tabulation shows that normal (BMI Score >18.5 to 25) have 0 fair, 16 good and normal were 210, while Over Weight (BMI Score >25 to 30) have 3 fair, 21 good and 100 normal whereas Obese (BMI Score>30) got 6 fair, 9 Good and 20 Normal manual muscle testing scoring. Where the gait instability was also studied in the above results.

In this study we use manual muscle testing to access the strength of gluteus medius. Manual muscle testing is the most commonly used method for this purpose since it is easy and quick to perform, is free of charge, and does not require equipment. The determination of the force required by the abductor muscles to balance the body in a standing position depends on two variables: pelvic anatomy and body weight.[9]

Our study surrounds with different BMI participants, which include all normal, obese and overweight participants. In contrast to our study, some authors suggest that the antigravity muscles of obese individuals generate higher absolute forces. Increased muscle strength is described as a beneficial adaptation to obesity, with excess body weight acting as a chronic training stimulus for daily activities. Several studies have reported increased knee extension strength in obese individuals, with values varying from 10 to 30% higher than those of normal-weight individuals. However, gait analyses in obese individuals have shown a shorter stride length with a strategy involving quadriceps overloading and decreased hamstring activation. Due to gait changes, obesity can cause mechanical adaptations that favor the use of the strongest muscles and minimize the use of the weakest ones.[11]

Although obesity increases muscle mass in the short term in young individuals, lipid infiltration in skeletal muscle can reduce the incorporation of amino acids into muscle proteins over time, with a decrease in total muscle mass [10]. It is possible that the long-term effect of obesity on muscle tissue overlaps with this weight stimulus on antigravity muscles and culminates in muscle loss over time.[2]

Regarding muscle mass, the authors also reported that individuals with obesity required greater gluteal muscle strength for normal gait. This evidence is relevant since it suggests that individuals with obesity need stronger gluteal muscles, causing them to be more susceptible to fatigue. Thus, it was expected that overweight individuals have higher muscle strength to maintain balance while standing or walking. When strength was normalized to body weight, the group with obesity had relative weakness in the gluteus medius muscle ($p < 0.05$). It can be concluded that strength alone does not seem to be an adequate parameter for assessing the abductor musculature since more than half of the world's population is overweight and these strength values can be overestimated.[11]

The gluteal strength of individuals with obesity is a relevant factor since these two variables, obesity and weakness, are independently associated with musculoskeletal system changes. Moreover, according to new scientific evidence, muscle strength is inversely and independently associated with all-cause mortality. Some authors even recommend the use of an algorithm to remove the dependence on body size and to more appropriately compare the strength of the hip muscles across individuals since it cannot be concluded that the force is directly proportional to body weight. [12] Medical resources, diagnosis, and treatment must improve in developing countries. There are limited resources: access to medical and health resources; knowledge about disease; awareness, trainings, and awareness about health. Health literacy is mandatory for any disease and facilitates the patients access to resources, databases, and trainings about the disease in print and electronic (hybrid) format. 15-22

In current study, we have check the strength of gluteus medius of both limbs and compare this with BMI. There are no previous studies that check the BMI of both limbs.

CONCLUSION

There was a significant correlation between bmi class and quadriceps strength. Participants with higher Bmi shows less quadriceps strength than people with lesser Bmi. Increased body mass, in absence of other obesity-related comorbidities, may have minimum impact on gait instability and in turn fall risk.

Limitation(s)

- The study only includes university students.
- Middle age adults or geriatric population was not included.

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