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Original Research Article

IS THERE PRESENCE OF GLUTEAL MUSCLE WEAKNESS IN INDIVIDUALS WITH CHRONIC LOW BACK PAIN AS COMPARED TO HEALTHY INDIVIDUALS?

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ABSTRACT

Background: Low back pain has been recently regarded as the largest cause of disability in humans. The hip musculature plays an important role in transferring the forces up towards the spine from the lower extremities in upright positions. A study suggested that gluteus medius weakness and tenderness is a common presentation in chronic non-specific low back pain individuals.

Design: Cross-sectional observational study.

Setting: OPD based patients visiting various clinics in Pune, India.

Participants: 2 groups – group 1 consisted of 50 individuals with chronic non-specific low back pain (LBP), group 2 had 50 age and sex matched healthy unaffected individuals as controls.

Methodology: After a detailed history, the gluteus maximus and gluteus medius strength was assessed with proper positioning and stabilization of subjects and their maximum isometric strength was recorded. Trendelenburg test and tensor fascia lata (TFL) tightness was also assessed.

Main outcome measures: gluteal muscle strength was assessed using the hand held dynamometer (microFET-3). TFL tightness was assessed using Obers test. Trendelenburg test was used as a functional test for gluteus medius.

Results: Using the Mann Whitney U test, a significant difference ($p<0.05$)in the strength for gluteus maximus as well as gluteus medius was found which indicated that there was reduced strength in the affected group as compared to the healthy unaffected controls. Gluteus medius was found to be a strong predictor for prevalence of LBP in an individual.

Conclusion: There is presence of gluteal muscle weakness in chronic non-specific LBP individuals as compared to unaffected healthy controls. Gluteus medius weakness proved to be a more significant predictor as compared to gluteus maximus for development or occurrence of LBP.

KEY WORDS: Low Back Pain, Gluteus Medius, Hip Abductor, Gluteus Maximus.

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INTRODUCTION

Low back pain (LBP) has been recently considered the single largest cause of disability for mankind [1]. The hip muscles play an important role in transferring forces to the spine in upright position. The gluteus maximus is a powerful hip extensor and lateral rotator while the gluteus medius is a fan shaped muscle which stabilizes the femur and pelvis during weight bearing specially the stance phase of the gait cycle [2]. Thus any imbalance in the gluteal muscles may lead to the development of LBP.

Hip dysfunctions like weakness of hip musculature have been found to be moderately correlated with low back and various lower extremity pathologies [2]. In chronic LBP subjects, the hip-spine interaction is disturbed. Reduced endurance and increased fatigability of the gluteus Maximus and gluteus medius have been noted in individuals with LBP [2, 3]. Gluteus maximus muscle fatigability was found significant in chronic LBP patients thus leading to deconditioning of the hip extensor muscle because of less use of the muscle leading and pain avoidance theory [3]. Gluteus medius weakness along with tenderness occurs commonly in chronic LBP was found in a study conducted by Nicholas Cooper. They thus concluded that the gluteus medius muscle is weaker in individuals with chronic non-specific low back pain as compared to non-affected individuals [1]. A study that was conducted by Simon and Travell described myofascial pain from gluteus medius muscle as a component in patients with LBP. The study stated that trigger points from gluteus medius muscle referred pain to the sacrum and buttock region [4]. Amir and colleagues showed that subjects with chronic LBP with and without iliotibial band (ITB) tightness showed lower hip abductor strength as compared to those without LBP [5]. All of these studies show that hip extensors and abductors muscle imbalances are present in chronic LBP subjects.

With a view to treat this disability and rid humans from its symptoms various interventions of exercise therapy as well as electrotherapy have been formulated, studied upon and are in practice by all physiotherapists throughout. Despite various intensive studies there has been no optimal fixed exercise protocol that has been devised, that can effectively target LBP. Currently there are several exercise programs, electrotherapy programs and a combination of both which cater towards tackling the varied symptomatic presentations of LBP patients. Exercise therapy concerned with LBP mostly focuses on the abdominal and lumbar muscle strengthening or directional preference exercises [1].

This study was conducted to assess the strength of the main hip musculatures-gluteus Maximus and gluteus medius in chronic LBP and compare it with the gluteal muscle strength of healthy controls without LBP with the help of a hand held dynamometer. It was performed to check the existence, significance and the degree of muscular imbalance if present in chronic LBP in comparison to healthy controls without LBP. The hand held dynamometer was used in order to establish a more quantitative result for the strength differences between the two groups.

METHODOLOGY

Two groups of subjects were recruited. One group consisted of 50 individuals with complaints of low back pain. The second group consisted of 50 non-affected individuals. Of the 50 affected subjects, 16 of them had unilateral affection and 34 of them had bilateral affection.

Inclusion criteria for LBP individuals: pain should be non-specific and anywhere from between the inferior margin of the rib cage up to the gluteal fold for more than 3 months.

Subjects with a defined etiology, including radiculopathy, neurogenic claudication, fracture, primary or secondary spinal tumours, or other specific pathology, were excluded.

A cross sectional study was conducted where in 50 LBP individuals fitting the inclusion criteria were recruited and assessed. After recruiting 50 LBP subjects, age and sex matched healthy un-affected individuals were recruited and assessed. Personal history was taken for each subject. Those who presented with no to having current LBP and no to having a history of more than 3 months of LBP were included. Approval from the ethical committee board was obtained to carry forward the study. Consent was taken from every individual participating in the research. LBP pain was evaluated based on the

numerical rating scale (NRS) and the pain duration was noted (in months). A detailed history about LBP occurrence, recurrence and causes was obtained from the subjects.

Strength of gluteus Maximus and gluteus medius muscles was tested by hand held dynamometer (micro FET-3). Positions and stabilization for strength testing were established with the help of various articles [8, 9] and the FET-3 manual. Best of 3 readings was considered for statistical purpose. For gluteus maximus the subject was taken in prone. The dynamometer was placed 1 inch above the mid-thigh region below the gluteal folds. The knee was flexed to 90° to eliminate the hamstrings. Stabilization belt was used along the pelvis and a second belt was used to stabilize the microFET-3 machine onto its position. A pillow was placed below the thigh to maintain the hip in mid-range between extensions so as to record the maximum force production of the muscle Subject was asked to perform maximum isometric contraction 3 times. The force was recorded in Kgs. Best of the 3 readings was considered for statistical purposes.

For gluteus medius the subject was taken in side lying. Pillow was placed between the two legs. Pelvis was stabilized using a stabilization belt and dynamometer was stabilized and placed 1 to 2 inches above the lateral joint line. Subject was asked to perform abduction and apply maximum force to the dynamometer probe.

The subjects were also assessed for TFL tightness by Obers test. The patient was made to lie towards the edge of the bed on 1 side such that the test leg was on the upper side. Patient was made to flex the lower leg while the examiner standing behind the patient , passively extends and slightly abducts the test leg and leaves it at the edge of the bed. TFL tightness was noted as present if the test leg remained abducted in the air. It was marked absent if the test leg fell into adduction below the bed level [11].

Subjects were palpated for tenderness along the paraspinous muscles, the gluteal muscles, the greater trochanter, the TFL.

For Trendelenburg sign assessment the examiner stood behind the subject and palpated the ASIS of the subject. The subject was asked to perform single leg stance, the test was considered positive if the non-stance leg was unable to maintain the pelvis elevated or in neutral. The Trendelenburg test was performed to evaluate the functional capacity of the gluteus medius muscle [10].

Data analysis: The chronic LBP subjects were divided into affected and unaffected sides based on the location of their symptoms. Subjects, who complained of bilateral affection, were considered as both sides affected. Out of the 50 LBP subjects, sixteen complained of unilateral affection and thirty-four were bilaterally affected. The strength assessed for each subject was normalized by dividing each strength value with individual's BMI. The median absolute statistic was used for presence of outliers in the data set. Within the LBP group, the Shapiro-Wilk test was significant which indicated that the data collected was not normally distributed for both gluteus maximus and gluteus medius muscle. Hence Wilcoxon signed rank test was used to analyse the strength differences within the LBP group between the affected and unaffected side of the unilaterally affected subjects. For analysis between the two groups of LBP (n=50) and unaffected healthy subjects (n=50) the Mann Whitney U test was used. A logistic regression was performed to analyse age, BMI, gluteus maximus and gluteus medius variables and their contribution in the likelihood in development of low back pain. Chi-square test was used in the analysis of prevalence of Trendelenburg sign and TFL tightness in both the groups.

RESULTS

From the data collected, fifty subjects presented with chronic non-specific LBP of which 16 were unilaterally affected and 34 were bilaterally affected. The second group had fifty controls without low back pain. Therefore we divided our 100 subjects into two groups- affected group and control group, considering the number of limbs affected based on unilateral and bilateral symptoms of the subjects(n=84) and compared it to the healthy subjects limbs(n=100) for statistical purposes.

On performing the test for equality of means for age and BMI between the two groups, both

age as well as the BMI showed p>0.005 suggesting that there was no significant differences between the age(p=0.778) and BMI(p=0.094) of the two groups. Hence both groups had similar subjects as far as age and BMI parameters were concerned.

From among the 16 unilaterally affected subjects, the Wilcoxon signed rank test was found to be significant indicating that there was no significant statistical difference in the strength of the gluteus maximus (p=0.146) and gluteus medius (p=0.131) muscles between the affected side(n=16) and the unaffected side(n=16).

When the affected group(n=84) and the control group(n=100) was compared using the Mann Whitney U test, a significant difference (p<0.05)in the strength for both, gluteus maximus as well as gluteus medius was found which indicated that there was reduced strength in the affected group as compared to the healthy unaffected controls.

A logistic regression analysis was conducted to predict the likelihood of developing low back pain in a given group of population using variables like age, BMI, strength of gluteus maximus and gluteus medius as predictors. A test of the full model against a constant only model was statistically significant for BMI, strength of gluteus maximus and gluteus medius, suggesting that these three predictors of the four predictors as a set were able to predict the likelihood of developing LBP. The prediction success without using the above predictors showed a 54% chance that a subject in a given population is prone to LBP development or has developed LBP. After adding the predictors, the overall prediction percentage raised up to 75%. Age was not a significant predictor. Exp (B) value indicates that when the strength of gluteus medius reduces by 1 unit (1 Kg) there is 1.32 times more likely of the individual to develop low back pain. Similarly strength of gluteus maximus reduces by 1 unit (1Kg) it puts an individual 1.08 times at risk of developing LBP.

Trendelenburg sign and tensor fascia lata (TFL) tightness was not found to be significantly affected in affected as well as control group. For Trendelenburg test, only 17 out of 84 and 11 out of 100 subjects positive for Trendelenburg sign for the respective group. 14 out of 84 and 10 out of 100 subjects showed the presence of TFL tightness in the respective group.

Table 1: Shows the average age and the average BMI of the samples recruited for this study along with the std. deviation.

	Group affection	N	Mean	Std. Deviation
AGE	affected	84	32.2	11.169
	control	100	32.67	11.219
BMI	affected	84	24.53	3.403
	control	100	23.7	3.221

Fig. 1: Gluteus maximus strength differences between the affected and the control group.

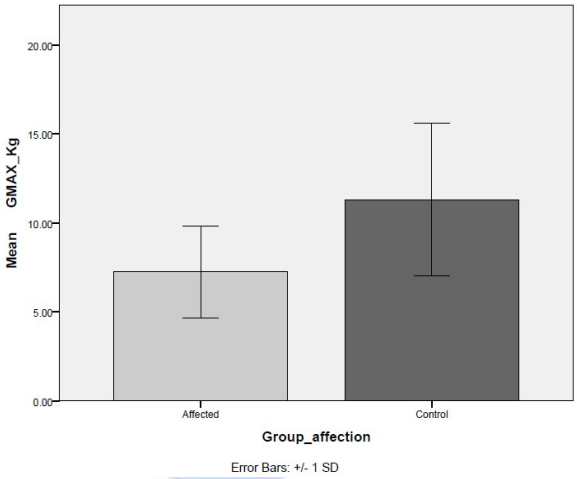
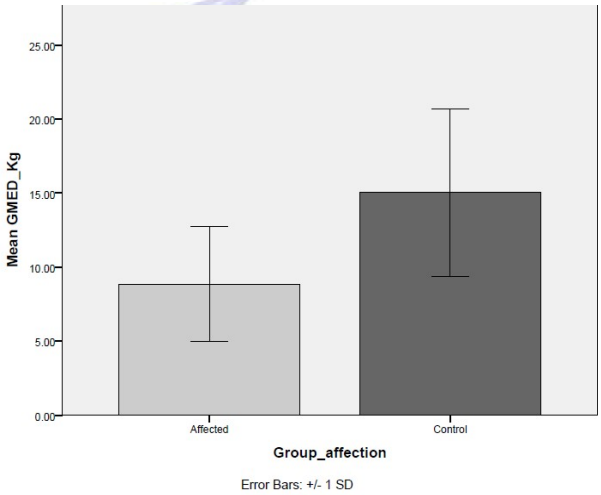


Fig. 2: Strength differences of the gluteus medius muscle between affected group and control group.



DISCUSSION

The most striking result of this study was that in the unilaterally affected subjects of the LBP group, there was no significant difference noticed in the strength of the gluteus maximus and gluteus medius muscle when analysed between the affected and the unaffected limb of the said group. In chronic LBP, the subjects tend to avoid utilizing their backs and apply less pressure on

the affected side due to anxiety and pain. The muscles go into guarding thus leading to atrophy, deconditioning and reduced strength [3].

So there could be a generalized weakness of both muscles of both sides resulting in no significant difference in their strengths on comparison within each subject. Studies conducted by Nadler SF, noted a percentage difference between side-to-side hip extensor strength in females [6]. But there was no percentage difference found in the strength of right and left hip abductors for females as well as for males with chronic low back pain. Similarly, no difference was seen in right and left hip extensors for males [6]. Another study on athletes had stated that females maybe more prone to injuries due their anatomy, gait differences and performance style [7]. Our study included more female subjects (31) as compared to males (19), but the results obtained did not show any difference in either muscles in males and females. Athletes without LBP were found to show normal differences in the side-to-side strength difference of both the hip muscles noting the effect of lateral dominance [7].

When the data of the muscle strengths of chronic LBP were compared with healthy unaffected subjects, there was a significant difference in the strength of the gluteus maximus as well the gluteus medius muscle between the two groups. Gluteus medius muscle was found to be a higher predictor for identification of LBP subjects. There are several studies that have reported the involvement of weak hip extensor muscle in chronic low back pain cases. A study has observed that there is faster fatigability rate of the back extensor like the paraspinous and the gluteus maximus since the two muscles are interlinked via the thoracolumbar fascia which helps in force transmission from the back to the lower limbs [3]. This study observed that isolated hip extensor strengthening results in weakness of the left hip abductor in particular in female athletes thus putting them at a risk of developing low back pain. It was concluded in the same study that core strengthening program alone did not reduce the occurrence of developing LBP in females athletes hence considering need for hip abductor strengthening in their treatment protocol could help in decreasing the incidence of LBP [6].

A preliminary study was conducted by one of the studies that concentrated on gluteus medius strengthening for 3 weeks in non- specific LBP subjects. The result showed 48% reduction in pain in these subjects but this was not recorded statistically significant [6]. But, it is still not clear whether gluteus medius weakness is a cause of LBP or a consequence of LBP. Therefore chronicity of the condition as well as "pain interference" could be the possible reasons for reduced muscle voluntary contraction thus reducing their strength [5].

Since very few subjects from the sample collected showed TFL tightness, it should be noted that TFL tightness is not clinically very significant in subjects with chronic LBP. A few articles have conducted studies to assess the presence of ITB/TFL tightness in subjects with gluteus medius weakness, but the result did not support the theory that was assumed by the authors [5].

Thus, adding hip abductor strengthening program in the rehabilitation protocol for chronic LBP patients may help in reducing their symptoms of pain and improve their quality of life. Early assessment of the gluteal muscle strength may prove to be a good tool to predict the future possibility of the subject to develop LBP thus helping therapists to work on prevention of the condition. The results obtained from this study can help therapists in their clinical settings to tackle chronic LBP in a better way, allowing them to sub-divide the LBP subjects into those with presence of gluteal muscle weakness and enhancing their treatment protocol. This study has a few limitations like the physical activity and the occupation of the subjects were not taken into consideration. It may also be possible that the control group was healthier as compared to the affected group, thus stronger. The population collected in this study maybe clinically different from those seen in other regions. Further studies need to be conducted to see if such results persist in different population groups.

Further studies should be conducted to see if isolated strengthening of gluteus medius or a ddition of gluteus medius strengthening in the LBP treatment protocol results in reduction in pain and disability arising due to LBP.

CONCLUSION

There is presence of gluteal muscle weakness in individuals with chronic low back pain as compared to healthy unaffected individuals. Gluteus medius muscle has been found to be a more significant predictor for LBP as compared to gluteus maximus. Further studies should be conducted to further support the presence of gluteal muscle weakness in chronic non-specific LBP.

ABBREVIATIONS

LBP- Low Back Pain

TFL- Tensor Fascia Lata

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Conflicts of interest: None

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