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Original Research

Hip and Trunk Variables in University Students with and without Recurrent Low Back Pain

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Background

Low back pain (LBP) is a leading cause of disability. Recurrent low back pain (rLBP) is defined as two or more episodes of LBP in a 12-month period, each lasting more than 24 hours and separated by at least one pain-free month. Many studies have shown that hip and trunk variables have an influence on LBP. However, most of these are studies of participants with acute or chronic LBP rather than rLBP.

Purpose

To examine the difference between hip and trunk variables of university students with and without rLBP.

Study Design

Cross-Sectional

Methods

Participants with and without rLBP between 18 and 35 years of age not currently undergoing clinical orthopedic care were recruited for this cross-sectional study. Bilateral hip range of motion (ROM) and trunk ROM were measured with a goniometer or measuring tape (hip motions in all planes along with trunk flexion, extension, and lateral flexion). Strength of the hip extensors, abductors, and external rotators was measured using a handheld dynamometer, and a single-leg bridge endurance test was performed to assess differences and correlations between outcomes.

Results

Twenty-six subjects aged 18 to 35 years with rLBP (n=10) and without rLBP (n=16) participated. Statistically significant differences between the two groups were found for right and left hip flexion (p = 0.029 and 0.039, respectively), right hip adduction (p = 0.043), and right hip extension (p = 0.021). No significant differences were found between groups for strength, endurance, or other ROM measures.

Conclusion

The findings of this study show statistically significant although clinically non-meaningful differences in hip flexion, extension, and adduction ROM in the rLBP group compared to the control group. This lack of clinically meaningful difference may be relevant to testing procedures and treatment of patients or athletes with rLBP. This study also suggests that hip strength and endurance may not play a major role in the development or treatment of rLBP.

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Level of Evidence: 3

INTRODUCTION

Low back pain (LBP) is the leading cause of disability globally.[1] The annual prevalence of LBP is estimated to be around 38%.[2] Its prevalence in university students appears higher at 43%.[3] Similarly problematic is the recurrence of LBP in the university population.[4] Recurrent LBP (rLBP) is most consistently defined as two or more episodes of LBP in a 12-month period, each lasting more than 24 hours and separated by at least one pain-free month.[5] Between 25% and 69% of individuals in the general population who experience an acute bout of LBP are estimated to experience rLBP.[6-8] However, up to 77% of university students report recurrence.[9]

Hip and trunk variables appear to have an influence on LBP. Many authors have demonstrated a link between reduced lumbar range of motion (ROM) and LBP.[10] Authors have also suggested that decreased hip ROM, hip extensor strength, and hip endurance may be related to LBP.[11] However, participants in most of the prior studies report acute or chronic LBP rather than rLBP. Individuals with acute or chronic LBP are more likely to report pain at the time of testing than those with rLBP; therefore, they may demonstrate different hip or trunk kinematics and strength secondary to pain.

Although previous episodes of LBP and select psychosocial variables appear to increase the risk of LBP, evidence shows it is difficult to predict who will have a recurrence of LBP.[8,12,13] Occupational trunk flexion and rotation may contribute to a poor prognosis for individuals with rLBP.[13] Limited sagittal and frontal plane trunk ROM may also be risk factors for rLBP.[14] Moreover, hip ROM and strength as well as trunk endurance seem related to rLBP, albeit in a limited number of studies.[14,15] These variables have been studied in adolescents and adults, but not in the university population.

Some data suggest that motor control changes are related to rLBP. While prospective studies of motor control variables and rLBP are limited, one literature review concluded motor control exercises were superior to general exercise, manual therapy, or minimal intervention regarding pain and disability in the rehabilitation of those with rLBP.[16] However, multiple authors have demonstrated minimal or no difference between motor control exercises and a daily walking program in the treatment of rLBP, suggesting motor control exercises beyond a walking program may be unnecessary.[17,18]

Some data exist regarding collegiate athletes and rLBP, although the incidence appears lower than the non-athletic university population around 2%.[19] One study of 679 varsity collegiate athletes concluded that athletes who reported previous low back injury were at three times greater risk to experience another bout of LBP. Moreover, those with pain at the time of survey were six times more likely to sustain LBP than athletes without a history of LBP.[20] The authors suggested that rLBP may be due to congenital factors or a result of insufficient recovery time after the first LBP episode.

Figure 1. Hip Flexion Range of Motion Measurement

Given the prevalence of rLBP and the need for further study of its risk factors, the purpose of this study was to examine the difference between hip and trunk variables of university students with and without rLBP. Participants with rLBP were expected to demonstrate less hip and trunk ROM, hip strength, and hip endurance than those without rLBP.

METHODS

Participants with and without rLBP were recruited as a sample of convenience for this cross-sectional design study from a university population following Institutional Review Board approval (#4896). Participants between 18 and 35 years of age completed a written informed consent form and health questionnaire prior to testing and were excluded if they reported any of the following: severe spinal deformities; chronic disease affecting the musculoskeletal system; orthopedic surgery within the last six months; current pregnancy; or current spine, hip, or knee pain. Participants were assigned to the rLBP group if they reported two or more episodes of LBP in the previous year, each lasting more than 24 hours and separated by at least one pain-free month. Otherwise, the participants were assigned to the control group.

Participants completed a two-minute stationary bicycle warm-up between 30 and 60 rotations per minute.[21] During the warm-up, participants were educated on the testing procedures. After the warm-up, bilateral hip ROM and trunk ROM were measured with a standard goniometer on a standard plinth. Three trials of hip flexion (Figure 1), extension (Figure 2), abduction, adduction, external rotation, and internal rotation as well as trunk flexion, extension, and bilateral lateral flexion ROM were taken via goniometer and tape measure, respectively, and recorded in centimeters by a researcher blind to group assignment. These measurements have previously been found reliable.[22]

Next, strength of the hip extensors, abductors, and external rotators was measured using a handheld dynamometer (Lafayette Manual Muscle Tester, FEI, White Plains, NY). The peak force over three seconds was recorded. Par-

Figure 2. Hip Extension Range of Motion Measurement

ticipants completed three trials per leg, alternating legs, and allowing at least 30 seconds of rest between trials. Measurements were taken using a stabilization belt on a standard plinth by a researcher blind to group assignment. Hip extensor strength was measured with the participant in prone, the knee flexed to 90 degrees, and the stabilization strap and dynamometer positioned over the posterior distal femur. Hip abductor strength was measured with the participant in sidelying with the hip to be tested nearest the ceiling in 0 degrees of abduction using a pillow. The stabilization strap and dynamometer were placed over the lateral distal femur. Lastly, hip external rotator strength was measured in sitting with the hip in 90 degrees of flexion and neutral rotation. The stabilization belt and dynamometer were placed over the medial ankle. This method of strength testing has demonstrated high reliability in a previous study.[23]

The last measurement was a timed single-leg bridge, taken at least 90 seconds following strength measurements to allow adequate rest. This measure has demonstrated high reliability (ICC = 0.87-0.99) with a low standard error of measurement (SEM = 8.9 seconds).[24] Participants were positioned in hooklying with the knee to be measured flexed to 135 degrees and asked to hold a raised unilateral bridge until fatigue. One measurement on each leg recorded in seconds was taken by a researcher blind to group assignment with at least 90 seconds of rest between sides.

Data were analyzed using SPSS v28.0 (SPSS Inc, Chicaco, IL) via independent t-tests to determine significant group differences using an alpha level of 0.05. Descriptive statistics were calculated for all measures and demographic variables. The researcher performing data analysis was blind to group assignment.

RESULTS

Twenty-six participants' data were analyzed (mean age = 23 ± 2 years; mean height = 1.77 ± 0.10 meters; mean weight = 80.46 ± 14.07 kilograms). Descriptive statistics and results of independent t-tests for ROM measures are provided in Table 1. Those for strength and endurance measures are provided in Table 2. Statistically significant differences between groups were found for right hip flexion ROM (p = 0.029; 95% CI -11.88 to 6.66), left hip flexion ROM (p = 0.039; 95% CI -12.29 to 5.41), right hip adduction ROM (p = 0.043; 95% CI -4.32 to 0.15), and right hip extension (p = 0.021; 95% CI -1.31 to 7.50). No statistically significant difference was found between groups for the strength, endurance, or other ROM measures.

Participants with rLBP demonstrated less right and left hip flexion than participants without rLBP (2.61 and 3.44 degrees, respectively). Participants with rLBP also demonstrated 2.09 degrees less right hip adduction than those without rLBP. However, participants with rLBP demonstrated 3.1 degrees more right hip extension than those without rLBP. Each of those ROM differences were significantly different. Participants with rLBP demonstrated 0.64-2.58 pounds less hip strength than those without rLBP for all measures except left hip extension, however none of these were statistically significantly different. Single-leg bridge endurance was 2.7 seconds more on the right and 9.06 seconds less on the left among participants with rLBP than those without rLBP (also not significantly different).

DISCUSSION

The primary purpose of this study was to compare hip and trunk variables in university students with and without rLBP. The main finding was that participants reporting rLBP demonstrated significantly less hip flexion bilaterally, less right hip adduction, and more right hip extension than those without rLBP. However, these differences were between one and three degrees with overlapping confidence intervals, so the differences should be interpreted with caution. Even if the confidence intervals were smaller, one to three degrees among a sample this size is arguably not clinically significant.

Moreover, strength and endurance differences were not seen between groups. This finding may help explain why studies such as one by Cairns et al. demonstrated no additional benefit at a 12-month follow-up of adding specific spinal stabilization exercises to conventional physical therapy for patients with rLBP.[25] In a similar study, a general exercise program reduced disability in the short term to a greater extent than a stabilization-enhanced exercise approach in patients with rLBP.[26] However, several authors have demonstrated a benefit to trunk or hip strengthening and endurance for addressing rLBP. For example, trunk muscle endurance[14] and hip muscle strengthening[15,27] have both appeared to decrease the incidence or intensity of rLBP. Unilateral bridging, also called a Gluteal Endurance Measure (GEM), was the choice measure of endurance because of its high reliability and specificity to gluteal fatigue.[24] Future study may benefit from using an endurance measure that targets the erector spinae such as the Sorenson test to evaluate muscle endurance in those with rLBP.

In the current study, significantly less hip flexion ROM on either limb, less right hip adduction, and more right hip extension were seen in the participants with rLBP. Several prior authors have shown similar associations between hip motion and rLBP. For example, Jones et al. demonstrated

Table 1. Descriptive statistics and results of independent t-tests for ROM measures (hip ROM recorded in degrees; lumbar ROM recorded in centimeters)

	Mean ± SD for rLBP group (n = 10)	Mean ± SD for control group (n = 16)	p-value [95% CI]
Right hip flexion ROM	104.95 ± 14.73	107.56 ± 8.28	0.029* [-11.88, 6.66]
Left hip flexion ROM	103.52 ± 13.67	106.96 ± 8.29	0.039* [-12.29, 5.41]
Right hip extension ROM	16.22 ± 3.70	13.12 ± 6.06	0.021* [-1.31, 7.50]
Left hip extension ROM	16.53 ± 4.01	11.27 ± 4.43	0.421 [1.69, 8.82]
Right hip adduction ROM	10.95 ± 2.05	13.04 ± 3.01	0.043* [-4.32, 0.15]
Left hip adduction ROM	10.88 ± 2.71	12.06 ± 2.76	0.582 [-3.47, 1.09]
Right hip abduction ROM	25.19 ± 6.51	21.96 ± 6.19	0.792 [-2.02, 8.48]
Left hip abduction ROM	25.29 ± 6.63	20.67 ± 5.67	0.251 [-0.41, 9.65]
Right hip internal rotation ROM	37.96 ± 4.31	31.74 ± 5.22	0.212 [2.13, 10.28]
Left hip internal rotation ROM	37.06 ± 4.56	33.09 ± 7.06	0.102 [-1.22, 9.16]
Right hip external rotation ROM	35.10 ± 4.95	34.13 ± 5.35	0.951 [-3.36, 5.31]
Left hip external rotation ROM	36.56 ± 3.49	34.00 ± 5.93	0.115 [-1.73, 6.85]
Lumbar flexion ROM	5.40 ± 1.07	5.70 ± 1.25	0.631 [-1.28, 0.69]
Lumbar extension ROM	3.52 ± 1.31	3.13 ± 1.49	0.616 [-0.79, 1.58]
Right lateral lumbar flexion ROM	25.25 ± 2.70	22.18 ± 3.06	0.519 [0.64, 5.51]
Left lateral lumbar flexion ROM	24.99 ± 2.74	23.23 ± 3.33	0.166 [-0.84, 4.35]

CI = confidence interval; cm = centimeters; rLBP = recurrent low back pain; ROM = range of motion; SD = standard deviation; * = statistically significant difference at the $p < 0.05$ level

Table 2. Descriptive statistics and results of independent t-tests for strength (recorded in pounds) and endurance (recorded in seconds) measures

	Mean ± SD for rLBP group (n = 10)	Mean ± SD for control group (n = 16)	p-value for group differences [95% CI]
Right hip extensors	62.18 ± 18.93	62.82 ± 20.00	0.631 [-16.96, 15.67]
Left hip extensors	61.42 ± 18.15	60.53 ± 21.08	0.614 [-15.78, 17.55]
Right hip abductors	37.81 ± 8.26	39.93 ± 6.61	0.143 [-8.17, 3.93]
Left hip abductors	35.99 ± 7.01	38.45 ± 7.32	0.896 [-8.45, 3.54]
Right hip external rotators	29.69 ± 7.77	31.20 ± 8.00	0.646 [-8.10, 5.07]
Left hip external rotators	27.63 ± 9.14	30.21 ± 9.02	0.677 [-10.12, 4.97]
Right single-leg bridge endurance	56.70 ± 31.79	54.00 ± 35.22	0.995 [-25.56, 30.96]
Left single-leg bridge endurance (seconds)	49.50 ± 30.52	58.56 ± 39.81	0.484 [-39.51, 21.39]

CI = confidence interval; lbs = pounds; s = seconds; rLBP = recurrent low back pain; SD = standard deviation

that hip motion, including hip flexion, was a risk factor for rLBP or associated with its improvement.[14,28] Limited sagittal plane hip motion and hip motion asymmetry also appears correlated with chronic LBP by several authors.[27,29]

Lumbar motion as measured in the current study was not statistically associated with rLBP, although lumbar ROM has been linked to rLBP in prior studies. In one such study, symptomatic participants had significantly reduced lateral flexion of the spine and total lumbar sagittal plane mobility measured using a tape measure and the modified Schöber procedure when compared to asymptomatic participants.[14] In another study, lumbar sagittal mobility increased with improvements in rLBP.[28] Limited lumbar lordosis[30] and total lumbar sagittal ROM[31] are associated with LBP in other studies also; however, these were studies of general LBP rather than rLBP and used different ROM measurement methods, such as motion capture systems, spinal pantographs, and inclinometers.

The link between hip ROM, specifically hip flexion ROM, and LBP is intuitive and supported by multiple studies.[11] However, this study did not find ROM differences between those with and without rLBP that exceed typical measurement error. More studies of rLBP and its relationship to hip variables are needed to draw firm conclusions.

Limitations of this study include a small sample size and a specific population of university students. Also, previous treatment received by those with rLBP and the intensity and duration of their LBP was unknown. Lastly, participants self-reported their rLBP, introducing potential reporting bias.

CONCLUSION

Recurrent low back pain is a significant problem among the general and university populations. This study of university students demonstrated a statistically significant difference in bilateral hip flexion, right hip adduction, and right hip extension ROM between those with and without rLBP. These differences, although statistically significant, are clinically non-meaningful differences of 1-3 degrees. Strength and endurance measures were not significantly different in those with or without rLBP, which may indicate that they are not related to the presentation of rLBP.

CONFLICT OF INTEREST

There are no potential conflicts of interests, including financial arrangements, organizational affiliations, or other relationships that may constitute a conflict of interest regarding the submitted work.

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