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Comparison of Hip and Lumbopelvic Performance Between Chronic Low Back Pain Patients Suited for the Functional Optimization Approach and Healthy Controls

Bruna Pilz PT, PhD [a,b]; Rodrigo A. Vasconcelos PT, PhD [a,b], Paulo P. Teixeira PT, MS[1]; Wilson Mello MD[a]; Isadora O. Oliveira PT, MS [b,d], Juliana Ananias PT, BS [a], Michael Timko PT, MS [c], Débora B. Grossi PT, PhD [b]

a. Research and Study Center, Wilson Mello Institute, Campinas, São Paulo, Brazil

b. Rehabilitation and Functional Performance Postgraduate Program, School of Medicine, University of São Paulo, Ribeirão Preto, SP, Brazil

c. Department of Physical Therapy, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA.

d. Programa Locomotor, Hospital Israelita Albert Einstein, São Paulo, SP, Brazil

Correspondence

Bruna Pilz

Instituto Wilson Mello, Fisioterapia. Rua José Rocha Bonfim, 214, Condomínio Praça Capital, Ed. Chicago, 1° andar, Santa Genebra, CEP: 13080-650, Campinas, SP, Brazil.
Phone number: 55 19 996313310

E-mail: brunapilzm@yahoo.com.br

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ABSTRACT

Study Design. Cross-sectional study.

Objective. We explored the differences between chronic low back pain (CLBP) patients suited for the functional optimization approach and healthy controls in isometric hip-strength and lumbar-endurance tests and determined classificatory cutoff values for strength and endurance tests and ratios.

Summary of Background Data. To optimize the treatment effect for CLBP, some approaches have classified patients into homogeneous subgroups matched to specific treatments. We evaluated CLBP patients suited for the functional optimization approach, who seek care because they experience symptoms during activities with high physical demands, although they are relatively asymptomatic.

Methods. Three hundred and fifty subjects (healthy controls, 170; CLBP patients, 180) were stratified by age (18–40 and 41–65 years), sex, and physical activity level. The CLBP patients had an Oswestry Disability Index score < 20% and a Numeric Pain Rating Scale score < 3. The subjects underwent hip abductor, extensor, and flexor isometric strength tests; a deep abdominal function test; and lateral/frontal bridge and lumbar flexor/extensor endurance tests.

Results. Relative to the healthy controls, the CLBP patients showed significantly ($p > 0.05$) higher strength scores in the hip flexor and deep abdominal function tests but lower endurance in the lateral and frontal bridge and lumbar flexor and extensor tests. The cutoff values of the lumbar flexor test and the lumbar flexor/extensor, lateral bridge/lumbar flexor, frontal bridge/lumbar flexor, and hip extensor/flexor test ratios showed acceptable accuracy (AUC = 0.84, 0.82, 0.79, 0.75, and 0.73, respectively).

Conclusions. In lumbopelvic and hip-performance tests, CLBP patients suited for the functional optimization approach showed differences from healthy controls. These patients

could be discriminated from healthy controls on the basis of accurate cutoff values for strength and endurance tests and ratios, which should be considered in treatment decision-making when patients need to return to activities with higher physical demands.

Key words: chronic low back pain; endurance test; hip-strength test; functional performance; functional optimization approach; physical therapy; outcome measure; cut-off values; high-demand activity; accuracy.

Level of Evidence: 2

Introduction

The burden of low back pain (LBP) continues to increase, and the question of how to successfully manage chronic LBP (CLBP) in primary care remains unanswered.[1] In order to optimize the treatment effect for LBP, some approaches have attempted to classify patients into homogeneous subgroups matched to specific treatments by using different philosophies.[2,3,4,5,6,7]

The present study is dedicated to CLBP patients suited for the functional optimization approach—described by Alrwaily et al.[5]—who seek care because they experience symptoms during activities with high physical demands in their jobs, sports, or routine life, although they are relatively asymptomatic. These patients have a low intensity of pain, can perform daily activities without or with minimal limitations, and might not have flexibility or motor control deficits. There is a lack of studies on this specific population, which also needs attention.

Knowledge regarding the role of unilateral and bilateral strength imbalances in causing LBP episodes is critical for prescribing exercises for reducing the symptoms of this condition. However, it is not clear if the assessment and normalization of these variables are effective for preventing LBP episodes and rehabilitating these patients.[8]

Several studies have analyzed lumbar muscle fatigue assessment methods, but there are conflicting data regarding the validity and discrimination ability of the evaluated methods. The most commonly used method is the Biering-Sørensen test, which has demonstrated good accuracy[9,10] and—together with lumbar flexor and lateral and prone bridge tests—may also be used for evaluating endurance around the lumbar spine and identifying LBP patients.[11,12,13]

Some studies have also considered the assessment of hip muscles in the rehabilitation of LBP patients, because there is some evidence that patients with LBP commonly have weakness, especially in the gluteus medius and maximus.[14,15] Assessment of deep abdominal function using a Pressure Biofeedback Unit (PBU)[16] has also been considered for LBP patients; this test has acceptable clinimetric properties,[17,18] although some controversy exists regarding its efficacy in identifying CLBP patients.[19,20]

Analysis of test ratios might also be helpful for identifying patients with CLBP, and a major advantage of this approach is that the comparisons are normalized with subjects acting as their own standard.[11,21,22] However, the scarcity of data on these balance ratios hinder their use in a practical setting.

The current study aims to explore the differences in performance between CLBP patients suited for the functional optimization approach and healthy individuals in a set of isometric hip-strength and lumbar-endurance tests and determine the accurate cutoff values for strength and endurance tests and ratios which could help identify CLBP patients. These findings might help identify specific muscle deficits and provide guidance on the best treatment for patients.

MATERIALS AND METHODS

This is a cross-sectional study involving 350 subjects, who were recruited by convenience to undergo a combination of isometric strength and endurance tests. The subjects were divided into two main groups: healthy individuals (n = 170) and CLBP patients suited for the functional optimization approach (n = 180). They were also stratified by age (18–40 and 41–65 years), sex (male and female), and physical activity level (active or sedentary) determined using the International Physical Activity Questionnaire (IPAQ).[23] The recruitment and data collection processes were performed from June 2015 until September 2016. All participants provided written informed consent before the tests, and the University Human Ethics Committee (6037/2015) provided ethical approval for the study.

Healthy individuals were selected from the University community after assessment for eligibility, and CLBP patients were recruited while receiving treatment at a private physiotherapy clinic for musculoskeletal disorders. Patients between 18 and 65 years of age were eligible for this study. Healthy individuals were defined as asymptomatic subjects without a history of back pain for at least 1 year. CLBP patients suited for the functional optimization approach were included if they had a primary complaint of non-specific CLBP for at least 3 months, a Numeric Pain Rating Scale (NPRS) score of no more than 3 points at the moment of the test,[24] and an Oswestry Disability Index (ODI) score of no more than 20%.[25]

Individuals were excluded if they were pregnant; presented red flags (e.g., malignancy, infection, spine fracture, or cauda equina syndrome) [26,27]; had diagnosed radiculopathy or spinal stenosis, could not speak, read, or understand the language of the country; were professional athletes; or had a history of neurological disorders, other musculoskeletal diseases (hip, shoulder, ankle, and/or knee pain), or surgery (lumbar surgery). Women who were in their menstrual period were rescheduled to undergo the tests at a more appropriate stage of the menstrual cycle.[28]

Self-Reported Measures

Sex, age, and body mass index were recorded for all individuals involved in the study, and appropriate language versions of the questionnaires discussed below were provided only to CLBP patients.

NPRS. This is a point scale where the end points indicate the extremes of no pain (score, 0) and pain as bad as it can be (score, 10). The scores were recorded at the time of the test and the worst moment of pain in the past 2 weeks; additionally, the median pain score in the past 2 weeks was also recorded.[24,29,30]

ODI. The ODI includes ten 6-point scales, and the scores range from 0% to 100%, with higher scores representing worse function. The questionnaire items are related to the intensity of pain and functional ability for daily activities.[31,32]

Fear-Avoidance Beliefs Questionnaire for physical activity and work scale (FABQ-PA and FABQ-Work). This questionnaire assesses the beliefs and fears of individuals regarding how LBP affects their physical activities and work. The FABQ-PA and FABQ-W scores range from 0 to 24 points and 0 to 42 points, respectively, where higher scores represent more fear avoidance related to physical activities or work.[33,34]

STarT Back Screening Tool (SBST). This questionnaire consists of nine items, four of which are related to referred pain, dysfunction, and comorbidities and five to a psychosocial subscale concerning distress, catastrophization, kinesiophobia, anxiety, and depression. Patients are classified as being at a high, medium, or low risk of poor prognosis associated with psychosocial factors.[35,36]

IPAQ. The IPAQ short version was used to classify individuals in accordance with their physical activity levels. Participants who practiced any kind of physical activity for more than 150 min per week were considered physically active, and all others were considered sedentary.[23,37]

Outcome Measurements

The tests were performed as described by De Oliveira et al.,[38] and the combination of tests showed good intra- and inter-rater reliability (intraclass correlation coefficient > 0.80, with a 95% confidence interval [CI]) as well as acceptable values for standard error of measurement and minimal detectable change.[38] Four trained raters with over 3 years of experience in testing procedures participated in this study.

Three maximum voluntary isometric contraction tests were performed on each side of the hip using a hand-held dynamometer (HHD; Model 01165; Lafayette Instrument Co., Lafayette, IN), with 20 s for rest. Only the highest of the three measurements was considered for analysis. The tests were performed bilaterally for the hip abductors (Figure 1a), extensors (Figure 1b), and flexors (Figure 1c). The examiner gave verbal encouragement during measurement, asking the individual to push as hard as possible against the device.

The deep abdominal function test was performed using a PBU (Stabilizer®; Chattanooga Group Inc., Hixson, TN; Figure 1d). After three consecutive contractions, the mean of the two best values was considered for analysis.

Endurance tests of the lateral bridge (Figure 1e), frontal bridge (Figure 1f), lumbar flexors (Figure 1g), and lumbar extensors (Figure 1h) were attempted only once. Using a stopwatch, the measurements were manually recorded in seconds from the point at which the individuals assumed the correct position for each test until they could not maintain that position. The raters corrected the individuals regarding the movement to be performed, but the test ended if the subjects could not maintain the right position.

Statistical Analysis

All analyses were conducted with PASW Statistics 18.0 (SPSS Inc., Chicago, IL). Using the G*Power software (version 3.2.1.), [39] the required minimum sample size was calculated to be 256 on the basis of data from a pilot study, assuming a type-I error (α) of 5% ($P < 0.05$) and an effect size (Cohen's f2) of 0.04 to promote a test power ($1 - \beta$) of at least 95%.

The data were presented as mean, 95% CI, standard deviation, median, and quartile. Hip-strength data, measured in kilograms, was normalized to body mass using the following formula: (kgf hip strength / kg body weight) * 100.[40] Normal distribution of the data was verified by the Shapiro test and homogeneity by the Levene test. Intergroup comparison of performance was performed with the Mann–Whitney U test. For clinical analysis, effect size (Cohen's d) was calculated with values < 0.31, 0.31–0.70, and 0.70 indicating small, moderate, and good effect sizes, respectively.[41]

Receiver operating characteristic (ROC) curves were constructed to identify cutoff values for the tests and strength and endurance ratios that could significantly discriminate between CLBP patients and healthy individuals. For greater clinical applicability, this analysis was conducted independently of sex, physical activity level, and age. Additionally, the analysis considered the mean strength values of the right/left hip tests and mean endurance values of the right/left lateral bridge tests; for the ratios, it considered the mean ratios of the right and left hip tests and the right and left lateral bridge tests. The accuracy of each cutoff value was verified by the true positive (sensitivity) and negative (specificity) rates, area under the ROC curve (AUC), and CI of each test. The AUC was classified as follows: AUC = 0.9–1.0, excellent; 0.8–0.9, good; 0.7–0.8, fair; 0.6–0.7, poor; and ≤ 0.6, fail; AUC > 0.7 was considered acceptable.[42,43]

RESULTS

A total of 350 subjects underwent isometric hip-strength and endurance tests. The majority of the patients had a low risk of poor prognosis because of psychosocial factors (73%). The mean FABQ-PA, FABQ-W, ODI scores were 12 points, 7 points, and 14%, respectively (Table 1).

Individuals were stratified into 16 groups on the basis of physical condition (healthy or CLBP), age (young [18–40 years] or elderly [41–65 years]), sex (male or female), and physical activity level (active or sedentary) (Table 2).

The CLBP patients showed significantly higher hip flexor and deep abdominal function test values and significantly lower endurance test values (lateral and frontal bridge and lumbar flexors and extensors) than the healthy controls (Table 3).

The strength and endurance ratios of the lumbar flexor/extensor, lateral bridge/lumbar flexor, frontal bridge/lumbar flexor, and hip extensor/flexors, and lumbar flexor tests showed acceptable accuracy (AUC > 0.7) and could discriminate between healthy subjects and CLBP patients (Table 4).

DISCUSSION

In this study, we first attempted to explore the differences in performance between CLBP patients suited for the functional optimization approach and healthy individuals in a set of isometric hip-strength and lumbar-endurance tests. Our results demonstrated that these CLBP patients performed significantly better in the hip flexor and deep abdominal function tests but showed lower endurance in the lateral and frontal bridge and lumbar flexor and extensor tests, relative to the healthy controls, although only lumbar flexor test showed good effect size. We also determined the classificatory cutoff values for tests, strength and endurance ratios with acceptable accuracy (AUC > 0.7) for discriminating between CLBP patients and healthy individuals: lumbar flexors test (91.4 s; AUC = 0.84), lumbar flexors/extensors endurance ratio (0.95; AUC = 0.82), lateral bridge/lumbar flexors endurance ratio (0.57; AUC = 0.79), frontal bridge/lumbar flexors endurance ratio (0.79; AUC = 0.75), and hip extensors/flexors strength ratio (0.67; AUC = 0.73).

The ratios examined have sensitivities no higher than 71.1%, though all have specificities greater than 73%. This suggests that these ratios may be more useful to identify those patients who do not have low back pain symptoms. However, values equal to or higher than 70% are considered acceptable in the literature. [42,43]

Although some authors consider the hip joint to be a potential contributor to LBP,[44] and some studies have reported hip extensor and abductor weakness in LBP patients when compared with healthy individuals,[14,15] our results did not show a significant difference in performance between the two groups in the hip extensor and abductor tests. Our CLBP patients did show greater hip flexor strength than the healthy individuals, however the effect size was only moderate (0.57 for right and 0.55 for left hip flexor). There is a lack of patient inclusion criteria with regard to pain and disability and a lack of objective criteria for measuring strength; moreover, some relevant studies have focused primarily on athletes, who were not included in our study.[14,15] In a randomized controlled trial, adding hip-strengthening exercises to a lumbopelvic motor-control exercise program did not significantly improve the pain and disability outcomes in LBP patients.[45] There are few studies on hip flexor strength in LBP patients, and it is not known whether muscle-related spinal dysfunction is a cause or consequence of LBP. Future studies should evaluate hip performance in LBP patients and confirm its influence on prognosis regarding pain and function.

In the deep abdominal function test in this study, the LBP patients showed greater strength values than the healthy individuals. Although the PBU has shown good reliability in patients with nonspecific CLBP,[16] it is already known that it shows poor concurrent validity for measuring transverse abdominis muscle activity in patients with CLBP, as evident from its low diagnostic accuracy and the poor correlation of its results with superficial EMG findings, which is the gold standard.[19,20] This suggests that the PBU might not be a useful device for assessing deep abdominal muscle function.

There are some limitations to this study. The CLBP sample was recruited by convenience from a single private physical therapy clinic. Therefore, future studies should confirm these results across other practice settings. Additionally, the raters were not blinded to the grouping of individuals, and individual factors such as motivation, pain tolerance, fear, and kinesiophobia have been suggested to influence the results of endurance tests.[46]

However, we analyzed these psychosocial factors through a questionnaire survey, and the majority of the present CLBP patients were not at a risk of poor prognosis. Using the SBST, 73% of the present CLBP patients were determined to have a low risk of poor prognosis; 57% and 92% of the CLBP patients showed FABQ-PA and FABQ-W scores below the cutoff points for poor prognosis of kinesiophobia (14 points)[47] and work-related problems (29 points), respectively.[48] Moreover, our four raters were instructed to motivate all subjects in the same manner and were extensively trained in using the HHD, patient positioning, instruction, and voice commands (> 6 months and over 100 hours).

Therefore, all tests can be completed in 90 minutes [38], without expensive devices and can be performed in any busy clinic. Based on our findings, we can suggest that hip strength and deep abdominal function deficits do not influence CLBP patients' symptoms suited for a functional optimization approach, but endurance muscle groups could have an influence, especially the lumbar flexors. We hypothesize that endurance tests and ratio assessment can help detect performance deficits in those patients, set up rehabilitation goals, and help decision making on how physical therapists clear patients for certain high demand activities. These findings can guide the further extension of the exercise program, which should be based on already published electromyography studies [49,50,51,52], to help meet the high physical demands of patients within the context of their jobs, sports, or even daily activities.

Subsequent to this cross-sectional study—which is only the first step in the recommendation process for clinical tests—future studies should be performed to confirm the prognosis and specific treatment of individuals with hip-strength and/or lumbar-resistance deficits.

In conclusion, our results showed significant differences in lumbopelvic- and hip-performance tests between CLBP patients suited for the functional optimization approach and healthy controls. These results allowed us to identify CLBP patients on the basis of accurate cutoff values for strength and endurance tests and ratios. Although future studies are needed to confirm our findings, these values may be considered in treatment programs for allowing patients to return to activities with higher physical demands within the context of their jobs, sports, or even daily activity.

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Figure Legend:

Figure 1. Maximal isometric strength measurement for hip abductors (a), hip extensors (b), hip flexors (c), and hip lateral rotators (d). Positions for the deep abdominal function test (e), lateral bridge test (f), frontal bridge test (g), lumbar flexor endurance test (h), and lumbar extensor endurance test (i).

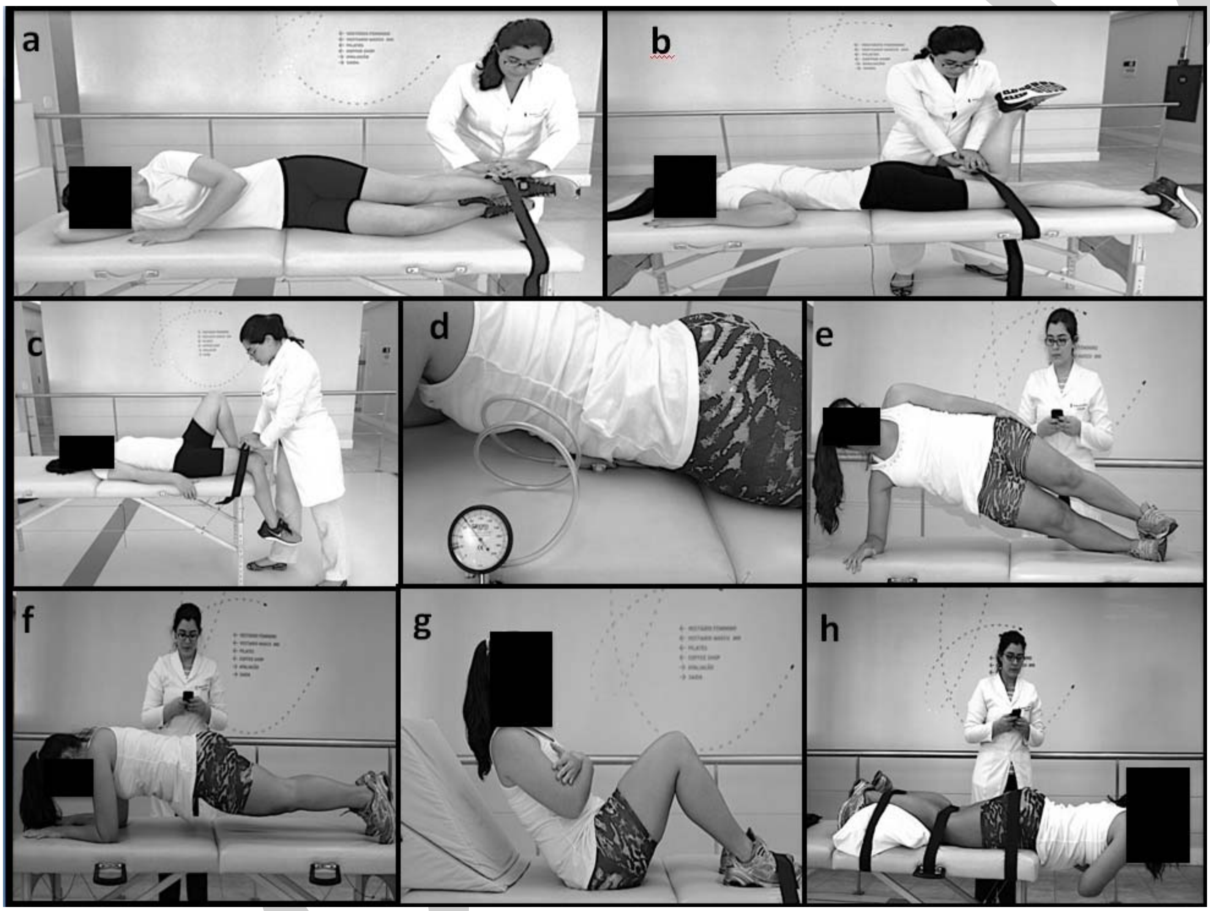

Table 1. Characteristics of healthy individuals (H) and chronic low back patients (CLBP)

Characteristics	H **(n = 170)**	CLBP **(n = 180)**
Age mean (SD) (years)	37 (14)	41 (10)
BMI mean (SD)	24.7 (3.3)	25.9 (3.7)
Gender [n (%)]		
Male	85 (50 %)	106 (59 %)
Female	85 (50 %)	74 (41 %)
NPRS – median (range) (0-10) NPRS - At the moment of the test	-----------------	3.0 (0.0 – 5.0) 1.0 (0.0 – 3.0)
NPRS - At the worst moment in 24hrs		6.0 (4.0-7.0)
SBST (classification) n (%) (Low/ Medium/ High risk of poor prognostic)	-----------------	Low risk 127 (73%) Medium risk 35 (20.1%) High risk 12 (6.9%)
FABQ-PA median (range) (0-24)	-----------------	12.0 (6.0-16.0)
FABQ-W median (range) (0-42)	-----------------	7.0 (2.0-15.0)
ODI median (range) (0-100%)	-----------------	14.0 (6.0-20.0)

BMI – Body Mass Index; NPRS – Numeric Pain Rating Scale; SBST-Brazil - STarT Back Screening Tool; FABQ-PA - Fear Avoidance Beliefs Questionnaire physical activity; FABQ-W Fear Avoidance Beliefs Questionnaire work scale; ODI - Oswestry Disability index.

Table 2. Sample stratification of two main groups: healthy individuals and chronic low back pain patients (CLBP).

	18 - 40 years				**41 – 65 years**			
	Male		**Female**		**Male**		**Female**	
	Physically active	**Sedentary**	**Physically active**	**Sedentary**	**Physically active**	**Sedentary**	**Physically active**	**Sedentary**
Healthy	**n=20**	**n=30**	**n=21**	**n=17**	**n=17**	**n=17**	**n=18**	**n=17**
CLBP patients	**n=17**	**n=38**	**n=17**	**n=18**	**n=17**	**n=33**	**n=17**	**n=18**

Table 3. Differences in performance between healthy individuals (H, n = 170) and chronic low back pain patients (CLBP, n = 180), regardless of age, gender or level of physical activity.

Variables	Group	Mean (SD)	CI 95%	Median (1st – 3rd quartile)	Effect Size	P
Right Hip Abductors	H	22.2 (6.0)	(21.3 -23.1)	20.9 (18.1 – 26)	0.15	0.13 [b]
	CLBP	23.1(6.9)	(22.1 – 24.1)	22.6 (18.5 – 27.3)		
Left Hip Abductors	H	21.1(5.8)	(20.3 -22.0)	20.2 (17.1 – 24.1)	0.22	0.02 [b]
	CLBP	22.5 (6.4)	(21.6 -23.4)	22.8 (17.6 – 27.1)		
Right Hip Extensors	H	30.3 (9.5)	(28.9 – 31.7)	29.5 (24 – 35.6)	0.06	0.51 [b]
	CLBP	30.9 (10.9)	(29.3 -32.5)	30.7 (23.6 – 37.6)		
Left Hip Extensors	H	29.9 (9.3)	(28.5 – 31.3)	29.6 (23.9 – 34.8)	0.07	0.56 [b]
	CLBP	29.3 (9.9)	(27.8 – 30.7)	28.6 (22.5 – 35.7)		
Right Hip Flexors	H	41.6 (14.3)	(39.5 – 43.8)	39.0 (32.2 – 48)	0.57	<0.001* [b]
	CLBP	49.9 (14.6)	(47.7 – 52.0)	49.8 (38.3 – 61.1)		
Left Hip Flexors	H	40.6 (13.9)	(38.5 – 42.7)	37.6 (31.2 – 48.6)	0.55	<0.001* [b]
	CLBP	48.3 (14.4)	(46.2 – 50.5)	48.0 (37.5 – 58)		
Right Hip External Rotators	H	17.5 (4.9)	(16.8 -18.3)	17.2 (14.5 – 19.8)	0.11	0.06 [b]
	CLBP	18.0 (4.6)	(17.4 – 18.7)	18.0 (15.2 – 20.2)		
Left Hip External Rotators	H	17.3 (5.0)	(16.5 – 18.0)	16.9 (13.9 – 19.4)	0.09	0.22 [b]
	CLBP	17.7 (4.5)	(17.0 -18.3)	17.4 (14.8 – 20.2)		
Deep abdominal function test (mmHg)	H	8.8 (5.2)	(8.1- 9.6)	7.0 (5.0 – 11.0)	0.39	<0.001* [b]
	CLBP	10.9 (5.2)	(10.1 -11.7)	10.0 (7.0 – 13.9)		
Right Lateral Bridge (sec)	H	70.3 (24.3)	(66.7 – 74.0)	69.4 (55.1 – 78.4)	0.28	0.004* [b]
	CLBP	62.2 (33.4)	(57.4 – 67.1)	59.9 (34.6 – 85.5)		
Left Lateral Bridge (sec)	H	70.1 (25.7)	(66.3 – 74.0)	67.5 (53.1 – 78.8)	0.17	0.03* [b]
	CLBP	64.9 (36.3)	(59.6 – 70.2)	59.6 (35.6 – 86.9)		
Frontal Bridge (sec)	H	91.6 (27)	(87.5 – 95.6)	89.5 (76.7 – 104.1)	0.32	<0.001* [b]
	CLBP	79.1 (47.8)	(72.2 -86.1)	68.8 (42.7 – 104.0)		
Lumbar flexors (sec)	H	193.8 (116.9)	(176.2 -211.3)	175.1 (108.0 – 230.9)	1.01	<0.001* [b]
	CLBP	92.3 (83.1)	(80.1 -104.4)	70.2 (48.0 – 116.1)		
Lumbar Extensors (sec)	H	140.0 (71.9)	(129.2-150.8)	116.0 (88.6 – 184.1)	0.41	0.005* [b]
	CLBP	114.4 (51.2)	(107.0 -121.9)	109.3 (77.9 – 146.9)		

Hip strength normalized by body weight (Kgf hip strength/Kg body weight)*100. SD- Standard deviation; SEC - Seconds; Effect Size (*d* of Cohen); [a] Independent t Test; [b] Mann Whitney U Test; * Significant Correlations at $p < 0.05$. P=p value.

Table 4. AUC, Cut-off values, sensitivity, specificity for test ratios and strength/endurance tests.

Test Ratios	**AUC**	**CI 95%**	**P**	**Cut-off Value**	**Sensitivity**	**Specificity**
Lumbar flexors/lumbar extensors (sec)	0.82	0.76-0.87	<0.001	0.95	71.10%	86.80%
Lateral bridge / lumbar flexors (sec)	0.79	0.74-0.84	<0.001	0.57	70.00%	82.90%
Frontal bridge/ lumbar flexors (sec)	0.75	0.69-0.80	<0.001	0.79	60.60%	80.30%
Hip extensors/ hip flexors	0.73	0.68 – 0.78	<0.001	0.67	67.80%	73%
Right/ left lateral bridge (sec)	0.6	0.54- 0.66	0.002	0.95	51.70%	81.60%
Hip abductors / hip extensors	0.58	0.52 – 0.64	<0.001	0.67	71.70%	42.80%
Frontal Bridge/lumbar extensors (sec)	0.56	0.50-0.62	0.053	0.72	56.70%	57.20%
Lateral Bridge / lumbar extensors (sec)	0.49	0.43-0.56	<0.001	0.51	54.40%	44.10%
Strength/endurance test						
Lumbar flexors (sec)	0.84	0.79-0.88	0	91.4	64%	96%
Hip Flexors	0.69	0.63 – 0.75	0	45	63%	72%
Lateral bridge (sec)	0.63	0.57-0.70	0	59.3	53%	68%
Hip abductors	0.58	0.52 – 0.64	0.01	22.6	52%	66%
Frontal bridge (sec)	0.56	0.49-0.62	0.07	77.5	58%	72%
Lumbar extensors (sec)	0.56	0.50-0.63	0.04	105.2	48%	60%
Hip extensors	0.51	0.45 – 0.57	0.75	30.3	50%	58%

AUC = Area Under the Receiver Operating Characteristic Curve; CI = Confidence Interval; P = p value.