Risk Factors for Low Back Pain in Recreational Distance Runners

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ABSTRACT

Background and Purpose: The purpose of this study was to examine differences between runners with and without low back pain (LBP) and a control group of non-runners in demographic, physical/running, and LBP variables. Impact from running can range from 1.5 to 6 times bodyweight. As a result, the low back is commonly injured during running. **Methods:** There were 102 runners included in the study. Runners were divided into 3 groups. **Findings:** Significant differences were found in the side bridge test, Biering-Sorensen test, and body mass index. Group differences were found in run days/week, rest days/week, years run, marathons run, km/week of running, and age. **Clinical Applications:** Competitive runners may possess a strong training motive leading to development of LBP. Runners may also possess better core strength and trunk muscle endurance compared to non-runners and still develop LBP. **Conclusion:** Runners with LBP demonstrated different characteristics than runners without LBP and non-runners.

Key Words: Biering-Sorensen, side bridge test, running, low back pain

BACKGROUND AND PURPOSE

Low back pain (LBP) ranks among the most common musculoskeletal injuries in the general population. In the United States, LBP affects over 74 million people per year,[1] and results in over $5 million in medical costs per year.[2] Lifetime incidence of LBP in the general population falls between 60% and 90%.[3-7] Impact forces from running can vary from 1.5 to 6 times a runner's bodyweight, particularly at heel strike.[8-12] As high loads are transferred to the lumbar spine on a repetitive basis, it is not surprising that LBP would occur in distance runners.[13] The low back was identified as one of the most common sites for injury in runners.[14,15] Ten percent of recreational distance runners experienced LBP during their first year of running,[15,16] similar to the general population of non-runners which demonstrated a one year incidence of LBP ranging between 6% and 15%.[17-20] Lewis identified recurrence rates of LBP in athletes including runners ranging from 41% to 85%.[1,2] The recurrence rate of episodes of LBP in runners was identified as high as 85% in one year.[1] This was much higher than the recurrence rates in the general population.[21,22]

Running injuries are more common in women than men.[23-26] Females with an increased BMI demonstrated a greater prevalence of LBP in the general population of non-runners.[27,28] In contrast, female athletes including runners with lower BMI were more susceptible to LBP.[23-26] The annual incidence of running-related injury ranges from 14% to 70%.[14,15,29-32]

Sixty percent of runners reported that they had an insidious onset of LBP.[33] Twenty-three percent of distance runners were unable to run because of their LBP.[2] Prior research identified that variables such as gender, age, height, weight, BMI, and years of running experience may be risk factors for development of LBP.[16,23-28,34,35]

Researchers were consistent in their findings that incidence of LBP increased over the age of 40.[7,17,35-41] Individuals in the general population over age 40 had a 67% greater risk of developing LBP.[36] Taunton et al reported in a survey study of 844 recreational runners that runners older than age 50, especially females, were more likely to develop running injuries including LBP.[14] Authors demonstrated that females in the general population were more likely to experience LBP.[7,42] The Nord-Trondelag Health Study (HUNT study) indicated greater prevalence of LBP with increasing values of obesity/BMI for both males and females. The association between LBP and obesity/BMI was slightly greater in females than in males.[28] Buist et al[43] reported in a 2010 study of 532 novice runners that elevated body weight/BMI in males was associated with increased risk of running injuries including LBP. Wong and Lee studied[44] 61 subjects, with 41 of them having LBP, and found that active lumbar flexion was limited in subjects with LBP. Authors have shown that lack of trunk muscle endurance and core strength is correlated with LBP.[23,45-50] The Biering-Sorensen test was previously validated to demonstrate the difference in trunk muscle endurance between subjects with and without LBP (Figure 1).[47] Impaired core stability has been shown to be related to LBP and lower extremity injury in athletes.[24] The side bridge test was established as an effective way to address core muscular endurance in one study (Figure 2).[51]

Previously researchers had suggested that runners with increased training volumes were at greater risk for running-related injuries including LBP.[14,48,49,52] Koplan et al found a linear relationship between increased weekly running distance and injury.[53] A review article by Fredericson and Misra concluded that weekly running distance of greater than 64 km was associated with a high chance of running injuries including LBP.[52] The purpose of this study was to determine if a difference exists between runners with and without LBP and a control group of non-runners in relation to demographic, physical/training, and LBP variables and running. These variables were chosen because previous research showed specific variables were linked to LBP and/or LBP and running.

METHODS

Following Nova Southeastern University IRB approval, a 10 subject pilot study was performed on runners with LBP. Subjects included males and females between the ages of 18 and 55. Subjects from running groups with and without LBP were running at least 20-30 km/week for at least 1 year. Subjects for the running group were required to have had a current episode of LBP for at least 2 weeks but not longer than 6 months that had impeded their running. Potential subjects were excluded if they had a history of known spinal spondyloarthrosis or stenosis, spinal malignancy, history of fracture of the lumbar spine, history of spinal infection or spinal fusion, cauda equine syndrome, referred pain from the gastrointestinal and genitourinary tracts, and inability to flex or extend the spine to perform the testing. Subjects were also excluded if they were currently receiving physical therapy for LBP that included stabilization exercises or were currently experiencing running-related injuries other than LBP. Subjects were recruited from a local running store and health club in the Rockford, IL area. All subjects were asked to sign an informed consent form that provided information about the required activities and their

Figure 1. Demonstration of the Biering-Sorensen test.

Figure 2. Demonstration of the side bridge test.

rights. The completed and signed forms were brought back by subjects to their data collection session. A total of 102 subjects—35 runners with LBP (16 males, 19 females), 33 runners without LBP (16 males, 17 females), and 34 non-running control group subjects (12 males, 22 females)—were included in this study.

Demographic data collected via a questionnaire asked for demographic data and physical/running variables. Lumbar active ROM measurements were taken using one BASELINE® bubble inclinometer (Fabrication Enterprises Inc. White Plains, NY). Lumbar flexion active ROM measurement involved inclinometer measurements taken at the S2 and T12-L1 spinal levels in an erect position and as the subject bent forward and reached towards the floor with knees straight. Total active lumbar extension ROM was determined by taking inclinometer measurements at the T12-L1 spinal level only in an erect position and as the subject bent backward as far as possible, without stabilizing the pelvis, while looking up at the ceiling and keeping the knees straight.[54] The Biering-Sorensen test is used to measure trunk extensor muscle endurance.[51] The test involves a subject lying prone on a plinth with his or her trunk from the waist up off the plinth and the legs secured to the plinth with straps or belts.[51]

FINDINGS

All data analysis was completed using PASW (IBM® SPSS® Statistics Gradpack 22 for Windows®/Mac®) statistics package. Outcomes variables were compared among the 3 groups using a one-way analysis of variance for each variable. Post-hoc analysis was performed using Tukey's test when significance was identified (Tables 1 and 2). Outcomes data for all ordinal data was compared using a Mann Whitney U test (Table 3). Outcomes data for all categorical data was compared using a Chi square or Fisher exact test as appropriate. The significance level was set a priori at the .05 level, using a 2-tailed test for all hypotheses. A significant difference was identified among the groups for BMI. Post-hoc analysis indicated that the control group demonstrated a higher mean BMI (24.9) compared to both running groups (22.5, 23.8). The analysis of variance revealed no significant difference among the control, runners with and without LBP groups for total lumbar flexion but marginal in active extension ROM. The control group demonstrated more total active lumbar extension ROM (40.4°) than both running groups (34.1, 37.2). The analysis of variance revealed a significant difference among the groups for the Biering-Sorensen test. Post-hoc analysis indicated that runners without LBP (52.3 sec) demonstrated significant greater endurance than the controls (40.1 sec). The results of the side bridge test were significantly different among all groups for both the right and left sides. Post-hoc analyses indicated that both running groups demonstrated significantly greater core strength than the control group. Two-tailed independent t-tests were performed on both running groups. A significant difference between running groups in years run ($p = .004$), marathons run ($p = .030$), rest days ($p = .035$), and running days/week ($p = .035$) was demonstrated by t tests. No significant difference was identified between running groups in races/yr. Chi square tests or Fisher exact tests (any cell <5) for categorical data between running groups failed to find any differences. A significant difference was identified among running groups for age ($p = .05$). For ordinal variables, a Mann Whitney U test was performed. This test did not reveal any significant differences between running groups. The Mann Whitney U test did identify a marginally significant difference between running groups in km/week of running ($p = .05$).

CLINICAL APPLICATIONS

Works by Taunton and Nadler et al indicated that runners with lower BMI were more likely to encounter LBP related to running.[15,26] Runners with LBP in the current study demonstrated a lower BMI compared to runners without LBP. However, the difference was not statistically significant. The current study demonstrated a significant difference in age among running subjects with LBP compared to running subjects without LBP. This may be because the runners with LBP group possessed more runners ≥40 years old. Taunton et al[14] and Roncarati et al[55] identified this increased incidence of LBP in runners over the age of 40 and 50, respectively.

Prior research has identified that female non-running subjects are more likely to demonstrate LBP.[38,56] The current study did not identify this difference in non-running subjects and runners with and without LBP. The mean total lumbar flexion value (range) for each group, 47.4 (27-70), 47.5 (19-70), and 45.4 (20-64), was less than the cutoff value suggested by Fritz et al[34] of 53° in non-running subjects. The mean total lumbar extension value (range) for each group, 40.4 (14-60), 37.2 (15-53), and 34.1 (13-55), exceeded the cutoff value suggested by Fritz et al[34] of 26° for non-running subjects.

The current study did show significant differences between the control group and both running groups for the right-side bridge test (32.9, 48.1, 48.3 sec) and for the left side bridge test (31.7, 45.4, 49.1 sec). The results of the side bridge tests were lower than reported by Leetun et al[57] (65 sec in subjects experiencing injury and 72 sec in subjects without injury) and Waldhelm[58] (82 sec on the right side and 77 sec on the left side for healthy male subjects). It is likely that the participation of the running groups in this challenging core activity had contributed to their superior core muscle stability and trunk endurance compared to the control group of non-runners.[24] A significant difference was found among the control group and runners without LBP for the Biering-Sorensen test (40.1, 52.3 sec). A previous study examined the Biering-Sorensen test in runners vs. non-

Table 1. Runner Characteristics and Differences between Groups of the Current Study[a]

Variable	Runners with LBP (n=35)	Runners without LBP (n=33)	Control (n=34)	F[c]	P
Height (cm)	171.5±7.9 (157-188)	172.7±9.4 (155-196)	169.0±10.2 (142-188)	1.42	.248
Weight (kg)	66.4±10.0 (50-85)	71.3±11.7 (49-95)	71.3 ±12.8 (47-102)	2.07	.132
Age (y)[b]					
18-19	0	3	2		
20-24	1	3	2		
25-29	6	4	9		
30-34	6	7	8		
35-39	2	6	6		
40-44	7	4	4		
45-49	6	3	1		
50-55	7	3	2		
BMI (kg/m^2)	22.5±2.5 (18-31)	23.8±2.5 (19-29)	24.9±3.8 (19-34)	5.35	.006*
Gender (# subjects)[b]					
Male	16	16	12		
Female	19	17	22		
TLF Active ROM	47.5±10.2 (19-70)	45.4±12.1 (20-64)	47.4±12.1 (27-70)	.343	.710
TLE Active ROM	34.1±10.1 (13-55)	37.2±10.1 (15-53)	40.4±12.0 (14-60)	2.90	.060
BST (sec)	45.9±19.6 (10-90)	52.3±20.3 (23-90)	40.1±14.0 (5-65)	3.84	.025*
Side Bridge Test-Right (sec)	48.3±20.4 (15-90)	48.1±19.0 (25-90)	32.9±17.6 (6-75)	7.29	.001*
Side Bridge Test-Left (sec)	45.4±20.2 (5-90)	49.1±19.0 (17-90)	31.7±15.8 (6-75)	8.00	.001*

[a]Values are mean ±SD (range). [b]Other values are counts. *Significant difference between groups (p<.05). [c]F = F value

Abbreviations: LBP, low back pain; BMI, body mass index; TLF, total lumbar flexion; ROM, range of motion; TLE, total lumbar extension; BST, Biering-Sorenson test

runners revealed average hold times of 66 seconds for runners and 48 seconds for non-runners. These values are similar to what was found in the current study. The results of the current study indicated that a control group of non-runners had less core muscle stability and trunk muscle endurance than runners with and without LBP. It was possible that the control group was composed of less fit subjects and possibly greater BMI which contributed to lower trunk endurance.

In the current study, runners with LBP were older, had been running for more years, and were running an average of more km/week than runners without LBP. Runners with LBP were also running more frequently and taking less rest days. It is possible that total lifetime running distances among runners with LBP may have been greater than runners without LBP. Gucciardi et al[59] defined mental toughness as "a capacity to produce consistently high levels of subjective or objective performance despite everyday challenges and stressors." Runners take pride in their ability to suffer. Maximizing race performance is about "overriding the brain's power to slow down."[60] Since runners with LBP were running more marathons and more miles/week, they may have been more competitive and possessed a stronger training motive than runners without LBP. While the results of the current study are descriptive in nature, they may help those involved in the prescription of exercise to understand the mental toughness of runners with LBP. The cross-sectional nature of the current study prevents knowing the long-term effect of those runners with LBP that continue to run long distances for long periods of time. The results of this study may lead to future longitudinal studies in runners. The difference identified between the control group and runners with and without LBP in terms of core stability and trunk muscle endurance warrants further investigation. It is important to understand what demographic and training variables resulted in superior core stability and trunk muscle endurance in runners compared to a control group of non-runners.

One limitation of the study was that not all runners with and without LBP were able to be tested at the same time of day. The researcher found out after all data collection was completed that some subjects,

Table 2. Running Characteristics and Differences between Groups[a]

Variable	Runners with LBP (n=35)	Runners without LBP (n=33)	Difference Between Running Groups	T[b]	P
Days of Running/wk	4.8±1.0 (3-7)	4.2±1.2 (3-7)	.6	-2.15	.035*
Rest Days	2.2±1.0 (0-4)	2.8±1.2 (0-4)	.6	2.15	.035*
Years Run	14.8±10.7 (1-36)	8.5±6.0 (1-20)	6.3	-2.99	.004*
Races/yr	9.4±8.3 (0-40)	7.8±8.7 (0-30)	1.6	.738	.463
Marathons	7.8±12.7 (0-60)	2.6±4.0 (0-15)	5.2	-2.23	.030*

[a]Values are mean ±SD (range). [b]t=t value. *Significant difference between groups (p<.05).

Abbreviations: LBP, low back pain; NLBP, non-low back pain

Table 3. Mann Whitney U test between LBP and NLBP Running Variables[a] for the Current Study

Variable	Runners with LBP (n=35) Median (Interquartile Range)	Runners without LBP (n=33) Median (Interquartile Range)	P
Average Pace/mi (min)	8-9 (7-10)	8-9 (7-10)	.236
Best 5k Time (min)	19-21 (17-25)	23-25 (19-27)	.072
Km/wk	48.3 (32.2-64.4)	35.4 (27.9-56.3)	.050*

*Significant difference between groups, (p<.05)

Abbreviation: LBP, low back pain

although very small in number, ran prior to the testing. This may have negatively affected the external validity of this study. Lack of stabilization of the pelvis may have allowed rotational movement in the pelvis from activation of the gluteal and hamstring muscles that increased lumbar extension active ROM measurement;[61] which may have been a source of error leading to lack of significance in total lumbar active ROM measurements among groups.

CONCLUSION

While this study was purely descriptive in nature, it raises questions regarding the difference in core muscle strength of running and non-running subjects. It also questions the importance of training motive in running and the potential psychological involvement in this form of exercise. The current study could be used for further study into LBP and BMI and its relationship to sports involving running.

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