Published in final edited form as:

Pain Pract. 2011 ; 11(1): 42–47. doi:10.1111/j.1533-2500.2010.00391.x.

Differences in Comorbidities on Low Back Pain and Low Back Related Leg Pain

Adam Goode, PT, DPT¹, Chad Cook, PT, PhD^{1,2}, Christopher Brown, MD¹, Robert Isaacs, MD², Matthew Roman, PT³, and William Richardson, MD²

¹ Department of Community and Family Medicine, Duke University

² Department of Surgery, Duke University

³ Department of Physical and Occupational Therapy, Duke University

Abstract

Objective—Investigate the influence of external factors such as depression and BMI among subjects with primary severe low back pain (LBP) and low back pain related leg pain (LBLP).

Background—The report of disability in patients with LBP may be significantly influenced by confounding and moderating variables. No similar studies have examined the influence of these factors on LBLP.

Methods—This study included 1448 consecutive subjects referred to a tertiary spine clinic. Unconditional binary logistic regression was used to determine the influence of comorbidities on the relationship between self reported back and leg pain. A change in estimate formula was used to quantify this relationship.

Results—Among those subjects with primary low back pain the unadjusted odds ratio was 8.58 (95% CI 4.87, 15.10) and when adjusting for BMI, depression and smoking was 5.94 (95% CI 3.04, 11.60) resulting in a 36.7% change due to confounding by these comorbidities. Among those with primary low back related leg pain the unadjusted odds ratio was 4.49 (95% CI 2.78, 7.27) and when adjusting for BMI and depression was 4.60 (95% CI 2.58, 8.19) resulting in a 1.7% change due to confounding by these comorbidities.

Conclusion—The disability statuses of the patients with primary LBP in this study were more significantly affected by comorbidities of BMI, depression and smoking than patients with report of LBLP. However, these comorbidities contribute little to the relationship of primary low back related leg pain and Oswestry scores ≥ 40 .

Keywords

Low Back Pain; Moderators; Low Back Related Leg Pain

A number of low back specific outcomes measures exist that are designed as proxy measures of disability and/or pain. One of the most commonly used is the Oswestry Disability index (ODI),¹ which is a 10 item scale that examines findings associated with activities of daily living, such as standing, walking, lifting, sitting, lying down, dressing and personal care that might be disrupted by low back pain.² The ODI has been used to evaluate

Corresponding Author: Adam Goode, PT, DPT, Assistant Professor, Duke University Doctor of Physical Therapy, Durham, North Carolina, USA, 919-681-6154, Adam.goode@duke.edu, Fax: 919 668 1957.

***Funding Disclosures:** Supported by the NIH Loan Repayment Award, National Institute of Arthritis and Musculoskeletal and Skin Diseases (1 L30 AR057661-01).

pre and post surgical outcomes and is considered a benchmark for determination of treatment effectiveness.³

A number of external factors, outside of the physical manifestation of low back pain (LBP), can contribute to disability status and successful adjustment of the patient. The ODI has been used previously to document disability changes when external factors such as psychological/psychosocial factors are present concomitantly with LBP.⁴ External factors may be qualitative (e.g., sex, race) or quantitative (e.g., age, BMI strata). Moderating variables affect the direction and/or strength of the relation between an independent variable or main exposure (such as a primary low back pain) and a dependent variable (the outcome measure such as ODI).⁵ To qualify as a moderating variable the covariate must: 1) precede the treatment temporally, 2) be independent of the exposure (is not affected by the exposure), and 3) must influence the outcome when stratified by selected values.⁶ Frequently investigated external moderating variables associated with low back pain include coping,⁷ self efficacy,⁸ fear avoidance behaviors,^{8–10} catastrophizing,^{8, 11} body mass index (BMI),¹² and depression.^{6, 13} Findings have shown that a large percentage of the disability in patients with low back pain is derived from external moderating variables such as depression and self efficacy.^{8, 14} What has been less investigated is the role of the external moderating variables on the disability associated with low back related leg pain (LBP).

Especially in non-experimental studies, external factors may also confound the relationship between the primary exposure and the outcome. To qualify as a confounder the covariate must 1) be directly associated with the main exposure, 2) be directly associated with the primary outcome, and 3) may not be influenced by the primary exposure.¹⁵ Confounders may mix with the primary exposure or outcome and bias the true relationship of interest. Confounders and moderators may be present together in the model. If confounders are not controlled in the model then the bias would be present across strata of the moderator. Given the complexity of the relationship between physical and psychosocial variables with low back pain, external variables should be assessed as both moderators and confounders.

Although only recently delineated, LBP is one of the most predictive elements associated with positive reports of change after lumbar surgery.^{16, 17} For patients with stenosis and LBP, it does appear that patients that exhibit the most severe nerve root compression and corresponding leg symptoms are most likely to achieve success with decompression surgery specifically conditions that are associated with unilateral leg pain.¹⁸ We hypothesize that one of the reasons may be the unequal contribution of variables on the disability status of patients with primary LBP and patients with primary LBP. Consequently, the purpose of this study was to investigate the role of selected comorbidities on the disability status of patients classified with these conditions.

Methods

Study Design, Setting, and Participants

The study was performed in a division for adult spine disorders within a department of surgery of Duke University, a tertiary institution in the United States. Data were prospectively collected by two orthopedic physicians, who performed all clinical examination methods, including observational, patient history, and imaging assessments and supervised capture of all non-physical data. Both physicians were board certified orthopedic surgeons, one with 22 years of orthopedic surgical experience and the other with 4 years of orthopedic surgical experience.

Study participants (N=1448) included patients seen at an adult spine surgery clinic between the years of 2005 to 2009 who were 14 years of age and older. A previous study using the

same patient population has recently been described.¹⁹ Patients were included in the study if a diagnosis associated with low back pain (e.g., stenosis, herniated disc, compression fracture, scoliosis, etc) was made during their initial visit and confirmed by various forms of imaging. The majority (90%) had symptoms greater than 6 months. The study was approved by the ethics and institutional review board of Duke University Medical Center.

Standardized Clinical Examination

All patients received a standardized clinical examination that consisted of self report, observational, physical examination, and imaging assessment. A standardized clinical examination was implemented in 2005 to improve outcome reporting and data capture at the institution. Intake data included questions associated with comorbidities such as concurrent diagnosis of depression, osteoarthritis (OA), rheumatoid arthritis (RA), anemia, smoking status, alcohol consumption, and previous or current history of cancer. The standard patient history included demographics capture and questions on the location, constancy, characteristics, and severity of pain in general and by location. In addition questions regarding provocative movements (e.g., walking, sitting, or standing), alleviating movements (e.g., walking, sitting, rest, or standing), exercise frequency and participation, and previous treatment were captured. All patients completed the SF12 (split by PCS and MCS), which is weighted and summed to provide an interpretable measure of quality of life,²⁰ and the 10 item Oswestry Disability Index.¹

Variables

The primary outcomes for this study were scores on the ODI dichotomized at $\geq 40\%$ as described by Fairbanks et al.² as an optimal cutpoint. The primary exposures were patient's report of back pain and leg pain. Back and leg pain were dichotomized into a "severe" group and "none to moderate" group based upon ROC cut points, area under curve for leg pain group 0.71 and 0.76 for back pain, to optimize the greatest correctly classified subjects. Covariates for this analysis included basic demographics, pain level and external moderating variables such as previous or current history of cancer, anemia, osteoarthritis, rheumatoid arthritis, BMI, concurrent diagnosis of depression (self report), alcohol consumption was dichotomized as daily (at least 1 drink/day) or frequent use (3–5 drinks/week) to social use (1–2 drinks/week), rarely use (less than 1 drink/month), or occasional use (1–4 drinks/month) of alcohol, smoking was categorized as currently smoking, quit but previously smoked, or never smoked, workers compensation benefits status and educational level categorized as high school or less, some college or college graduate.

Statistical Analysis

Effect measure modification was assessed with a Breslow-Day test, with a p-value of ≤ 0.15 , between covariates and the main exposures. All covariates that were not potential effect measure modifiers were assessed as potential confounders defined as a significant univariate association with both the primary exposure and outcome at a p-value of ≤ 0.05 . A strict p-value was used based upon previous studies that have identified several of these covariates as potential confounders of the relationship between function and LBP. The strength of association between the significant potential confounder and main exposure/outcome was also taken into account.

Unconditional binary logistic regression was used for all model building processes. A stepwise backward deletion was used to determine the most parsimonious model controlling for confounders of the relationship between ODI scores and LBP and/or LBLP. Likelihood ratio tests (LRT) between the full model with all potential confounders and interaction terms and reduced models were used with a p-value of ≤ 0.15 to remain in the model. A validity precision trade off was also used to determine the retention of covariates for the final model.

with precision of the point estimate given greatest weight. Crude odds ratios were compared to adjusted odds ratios with a change in estimate formula, as the absolute value of the adjusted beta coefficient subtracted by the adjusted beta coefficient, to quantify the amount of confounding by covariates in the final model.

Results

Table 1 presents the basic demographics of the study population. The mean age was 55 and ranged from 14–88 years old. A large proportion were white (85%), 44% were college graduates and the majority (60%) were females. A small proportion (7.5%) was receiving workers compensation benefits. There were a large number of subjects with a BMI of 30 or greater (30.9%). Sixty-seven percent reported severe low back pain and 43.3% reported severe leg pain. The average SF12 PCS score was high at 47.0 and ranged between 15.6 and 70.4 while the mean Oswestry Disability Index score was 21.2 (42.4% disability) ranging between 0 and 48.

Covariates including anemia, cancer, depression, BMI, OA, RA, smoking, alcohol consumption, compensation status, age, race, education level and gender were assessed for effect measure modification and confounding for both back pain and leg pain. Among these, educational level demonstrated a significant Breslow Day test ($p=0.08$) for LBP and LBLP ($p=0.04$). Depression, BMI and smoking demonstrated a significant ($p<0.05$) association with both ODI scores and self reported LBP. Depression and BMI demonstrated a significant ($p<0.05$) association with LBLP.

The full model to examine the relationship between ODI scores and LBP or LBLP consisted of potential confounders and the interaction between educational level and LBP or LBLP. The interaction term was not significant to the back pain model (LRT $p=0.23$) or the leg pain model (LRT $p=0.63$). Depression, BMI and smoking status were significant to the model for LBP while only depression and BMI were significant for the LBLP.

The crude odds ratio among those with severe LBP and LBLP was 8.93 (95% CI 6.66, 11.98), indicating that the odds of a patient with severe LBP and LBLP to have a score of ≥ 40 on the Oswestry were 8.93 times the odds of a patient with no to moderate LBP and LBLP. Following adjustment for depression and BMI this point estimate changed to 7.35 (95% CI 5.10, 10.60), resulting in a change in estimate by 19.4%. Among those subjects that reported severe primary LBP greater than LBLP the crude odds ratio was 8.58 (95% CI 4.87, 15.10). Following adjustment for depression, BMI and smoking this association dropped to 5.94 (95% CI 3.04, 11.60). The confounding by these covariates resulted in a change in estimate of 36.7%. Among those subjects with reported primary LBLP greater than LBP the association was 4.49 (95% CI 2.78, 7.27). Following adjustment for depression and BMI this association became 4.60 (95% CI 2.58, 8.19) resulting in a change of estimate of 1.7% (Table 2).

Discussion

Our study found that comorbidities appear to influence a primary report of LBP greater than a primary report of LBLP. To our knowledge, this is a unique finding that has not been previously explored within the literature. In particular, we found that the disability score of primary LBP is influenced more greatly by BMI, depression, and smoking than primary LBLP is affected. This finding has a number of important potential implications; most notably the possibility that a physically-oriented treatment approach such as those employed during conservative care and surgery may yield different outcomes based on the inability or attenuated ability to address these external factors. We found that educational status

modified the relationship between LBP or LBLP and ODI scores. This indicates that the association between our main exposure and outcome differed significantly across strata of educational status. However, the interaction term did not provide important information to the fit of the model and these estimates were imprecise even with our modest sample size. Further studies with larger sample sizes should assess educational status as an effect measure modifier and potential interaction in regression.

This is certainly not the first study to suggest that LBP is significantly influenced by these comorbidities. As was previously mentioned, psychosocial factors such as coping,⁷ self efficacy,⁸ fear avoidance behaviors,^{8–10} catastrophizing,^{8, 11} body mass index (BMI),¹² and depression.^{6, 13, 21} have been associated with LBP. Smoking²¹ and body mass index¹² have also been identified and smoking is a predictor of poor post-surgical outcomes²¹ for LBP. What appears novel about our study is that other publications have not divided LBP into reports of primary LBP and primary LBLP. Our preliminary findings suggest the two groups may have different underlying dimensions.

It is plausible that there are no previous studies that have examined the differences between the two groups because there are challenges in defining each as a distinct diagnosis. There is notable variability in the definition of LBLP and recommendations for detection and treatment of LBLP among guidelines for the care of LBP.²² The variability may be stimulated by the overlap in clinical findings of both conditions. In our study, there were a number of subjects who reported both moderate to severe LBP and LBLP. To measure the influence of this overlap we examined the two samples discretely, when the sample was merged and when the two groups were extracted to form mutually exclusive populations. Both methods yielded similar findings.

Despite the well known recognition of these comorbidities, only marginal overall improvements have been reported in studies that attempt direct psychosocial interventions for LBP in primary care.²³ Whether this failure to demonstrate significant change reflects our lack of knowledge on the full dimensions of LBP or our failure to provide optimal care is unknown. What is known is that treatment decision making such as surgery must take into account that external non-physical factors may impact outcome.²¹ A number of studies have supported the use of surgery for patients with significant LBLP,^{16, 17, 24} whereas support for general use of fusion or other back surgeries for patients with LBP or a mixed low back and leg pain group is less robust.

Lastly, one issue that this study also exposes is that outcomes measures that may be designed for a specific body part region, such as the ODI, may in fact be influenced by findings well outside of the physical elements of LBP. The ODI does not have directions that specify to the patient that they are to report their disabilities with singular respect to pain associated with the low back. In fact, the ODI states “This questionnaire has been designed to give us information as to how your pain has affected your ability to manage in everyday life”. With nondescript directions such as this, it is likely that other outcomes measures capture findings well outside their projected domain. This may be why we see the strength of the association between primary low back pain and ODI scores are nearly twice that of the primary low back related leg pain group.

Limitations

There are a number of limitations to this study. This study only reflects cross sectional data and does not include change scores, which may yield different findings. Our study only captured a small number of potential moderators and confounders and evidence exists that others such as fear avoidance, coping, and self efficacy may have an even higher moderating effect than the variables selected in our study. Chance exists that other variables may

influence report of LBLP more than the variables used in our study. There is a risk of the spectrum effect in this study as the majority of patients reported chronic LBP. Consequently, similar findings in a different population are unknown.

Conclusion

The disability statuses of the patients with LBP in this study were more significantly affected by comorbidities than patients with report of LBLP. This suggests the possibility that the disability status of LBLP is more rooted in the physicality of the disorder, whereas LBP may involve non-physical elements that influence patient report. Future studies should investigate disability change scores and initiate this study in a different population of less chronic reports of LBP and LBLP.

Acknowledgments

The primary author would like to acknowledge the Foundation for Physical Therapy for their financial contributions during his PhD training in Epidemiology at the UNC Gillings School of Global Public Health.

References

1. Bombardier C. Outcome assessments in the evaluation of treatment of spinal disorders: summary and general recommendations. *Spine (Phila Pa 1976)*. 2000; 25:3100–3103. [PubMed: 11124724]
2. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. *Physiotherapy*. 1980; 66:271–273. [PubMed: 6450426]
3. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. *Best Pract Res Clin Rheumatol*. 2005; 19:593–607. [PubMed: 15949778]
4. Taylor SJ, Taylor AE, Foy MA, Fogg AJ. Responsiveness of common outcome measures for patients with low back pain. *Spine (Phila Pa 1976)*. 1999; 24:1805–1812. [PubMed: 10488511]
5. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*. 1986; 51:1173–1182. [PubMed: 3806354]
6. Kraemer HC, Wilson GT, Fairburn CG, Agras WS. Mediators and moderators of treatment effects in randomized clinical trials. *Arch Gen Psychiatry*. 2002; 59:877–883. [PubMed: 12365874]
7. Spinhoven P, Ter Kuile M, Kole-Snijders AM, Hutten Mansfeld M, Den Ouden DJ, Vlaeyen JW. Catastrophizing and internal pain control as mediators of outcome in the multidisciplinary treatment of chronic low back pain. *Eur J Pain*. 2004; 8:211–219. [PubMed: 15109971]
8. Woby SR, Roach NK, Urmston M, Watson PJ. The relation between cognitive factors and levels of pain and disability in chronic low back pain patients presenting for physiotherapy. *Eur J Pain*. 2007; 11:869–877. [PubMed: 17360202]
9. Peters ML, Vlaeyen JW, Weber WE. The joint contribution of physical pathology, pain-related fear and catastrophizing to chronic back pain disability. *Pain*. 2005; 113:45–50. [PubMed: 15621363]
10. Vlaeyen JW, Kole-Snijders AM, Boeren RG, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. *Pain*. 1995; 62:363–372. [PubMed: 8657437]
11. Jensen MP, Turner JA, Romano JM, Karoly P. Coping with chronic pain: a critical review of the literature. *Pain*. 1991; 47:249–283. [PubMed: 1784498]
12. Mirtz TA, Greene L. Is obesity a risk factor for low back pain? An example of using the evidence to answer a clinical question. *Chiropr Osteopat*. 2005; 13:2. [PubMed: 15967048]
13. Koleck M, Mazaux JM, Rascle N, Bruchon-Schweitzer M. Psycho-social factors and coping strategies as predictors of chronic evolution and quality of life in patients with low back pain: a prospective study. *Eur J Pain*. 2006; 10:1–11. [PubMed: 16291293]
14. Woby SR, Urmston M, Watson PJ. Self-efficacy mediates the relation between pain-related fear and outcome in chronic low back pain patients. *Eur J Pain*. 2007; 11:711–718. [PubMed: 17218132]

15. Rothman, K.; Greenland, S. *Modern Epidemiology*. 2. Philadelphia, PA: Lippincott Williams & Wilkins; 1998.
16. Patrick DL, Deyo RA, Atlas SJ, Singer DE, Chapin A, Keller RB. Assessing health-related quality of life in patients with sciatica. *Spine (Phila Pa 1976)*. 1995; 20:1899–1908. discussion 1909. [PubMed: 8560339]
17. Weinstein JN, Lurie JD, Tosteson TD, et al. Surgical versus nonsurgical treatment for lumbar degenerative spondylolisthesis. *N Engl J Med*. 2007; 356:2257–2270. [PubMed: 17538085]
18. Katz JN, Harris MB. Clinical practice. Lumbar spinal stenosis. *N Engl J Med*. 2008; 358:818–825. [PubMed: 18287604]
19. Roman M, Brown C, Richardson W, Isaacs R, Howes C, Cook C. The Development of a Clinical Decision Making Algorithm for Detection of Osteoporotic Vertebral Compression Fracture or Wedge Deformity. *J Man Manip Ther*. 2010; 18 In Press.
20. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. *Qual Life Res*. 2001; 10:405–413. discussion 415–420. [PubMed: 11763203]
21. DeBerard MS, LaCaille RA, Spielmans G, Colledge A, Parlin MA. Outcomes and presurgery correlates of lumbar discectomy in Utah Workers' Compensation patients. *Spine J*. 2009; 9:193–203. [PubMed: 18440278]
22. Haswell K, Gilmour J, Moore B. Clinical decision rules for identification of low back pain patients with neurologic involvement in primary care. *Spine (Phila Pa 1976)*. 2008; 33:68–73. [PubMed: 18165751]
23. van der Windt D, Hay E, Jellema P, Main C. Psychosocial interventions for low back pain in primary care: lessons learned from recent trials. *Spine (Phila Pa 1976)*. 2008; 33:81–89. [PubMed: 18165752]
24. Atlas SJ, Keller RB, Wu YA, Deyo RA, Singer DE. Long-term outcomes of surgical and nonsurgical management of sciatica secondary to a lumbar disc herniation: 10 year results from the maine lumbar spine study. *Spine*. 2005; 30:927–935. [PubMed: 15834338]

Table 1

Basic Demographics of Primary Low Back and Primary Leg Pain Sample (n=1448)

Variable	N (%) or Mean (range)
Age	55 (14, 88)
Race	
White	1,185 (85%)
Black	142 (10%)
Other	64 (5%)
Education Level	
High school or less	366 (30%)
Some College	327 (26%)
College Graduate	549 (44%)
Gender	
Female	861 (60%)
Male	587 (40%)
Workers Compensation	84 (7.5%)
BMI	
BMI >=30	411 (31%)
BMI < 30	920 (69%)
SF12 PCS	47.0 (15.6, 70.4)
Oswestry	21.2 (0, 48) or 42.4% disability
Back Pain	
None to Moderate	659 (57%)
Severe	506 (43%)
Leg Pain	
None to Moderate	421 (33%)
Severe	849 (67%)

Table 2
Logistic Regression Model Beta Coefficients and Odds Ratios for severe back pain and severe leg pain.

Variable	Crude Model OR (95% CI)	Crude Beta (95% CI)	Adjusted Model OR (95% CI)	Adjusted Model Beta (95% CI)	Change in Estimate *
Severe Back and Leg Pain	8.93 (6.66, 11.98)	2.19 (1.90, 2.48)	7.35 (5.10, 10.60)	2.00 (1.63, 2.36)	19.4%
Primary Complaint Low Back Pain	8.58 (4.87, 15.10)	2.15 (1.58, 2.71)	5.94 (3.04, 11.60)	1.78 (1.11, 2.45)	36.7%
Primary Complaint Low Back Related Leg Pain	4.49 (2.78, 7.27)	1.52 (1.02, 1.98)	4.60 (2.58, 8.19)	1.49 (0.89, 2.08)	1.7%

* based upon the absolute value of the unrounded adjusted beta coefficient minus the crude beta coefficient.