



Evidence base and future research directions in the management of low back pain

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Author contributions: Abbott A contributed solely to this editorial.

Conflict-of-interest statement: The author has no conflict of interests.

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Received: September 18, 2015
Peer-review started: September 22, 2015
First decision: October 30, 2015
Revised: November 17, 2015
Accepted: December 18, 2015
Article in press: December 21, 2015
Published online: March 18, 2016

Abstract

Low back pain (LBP) is a prevalent and costly condition. Awareness of valid and reliable patient history taking,

physical examination and clinical testing is important for diagnostic accuracy. Stratified care which targets treatment to patient subgroups based on key characteristics is reliant upon accurate diagnostics. Models of stratified care that can potentially improve treatment effects include prognostic risk profiling for persistent LBP, likely response to specific treatment based on clinical prediction models or suspected underlying causal mechanisms. The focus of this editorial is to highlight current research status and future directions for LBP diagnostics and stratified care.

Key words: Low back pain; Diagnostics; Prognostics; Stratification; Treatment

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Core tip: Knowledge of the current research status and future directions for low back pain diagnostics and stratified care is essential to help engage clinicians in evidence based practice and to potentially improve patient management.

Abbott A. Evidence base and future research directions in the management of low back pain. *World J Orthop* 2016; 7(3): 156-161 Available from: URL: <http://www.wjgnet.com/2218-5836/full/v7/i3/156.htm> DOI: <http://dx.doi.org/10.5312/wjo.v7.i3.156>

INTRODUCTION

Low back pain (LBP) is a prevalent and burdensome problem for individuals and society worldwide^[1,2]. LBP is often defined in terms of its localization, duration, severity, frequency, and interference on activities of daily living^[3]. Most episodes of LBP are self-limiting but approximately 20% develop chronic symptoms^[1]. The etiology of LBP is often classified as specific or non-

specific, based upon if a pathoanatomical cause can be identified through objective diagnostic assessment and confirmed by medical imaging^[4]. The prevalence of LBP caused by specific pathology of serious nature such as malignancy, spinal fracture, infection, or cauda equine syndrome requiring secondary or tertiary health care has been reported to range between < 1%-4% in the primary health care setting^[5,6]. Furthermore, nerve root problems associated with radiculopathy or spinal stenosis are thought to explain approximately 5%-15% of cases^[7,8]. Medical imaging studies have highlighted that approximately 50% of younger adults and 90% of older adults have degenerative findings and large variations in lumbar spine morphology^[9]. This is however evident in both symptomatic and asymptomatic individuals which renders diagnosis of specific LBP prone to false-positive results. The choice of treatment merely based on benign anatomic impairment or individual clinical assessment techniques with low diagnostic accuracy is controversial and may result in suboptimal outcomes^[10]. Treatment focused on patient specific and modifiable pain mechanisms assessed with accurate diagnostics has the potential to improve patient outcomes. Therefore, research in these topics is of utmost importance.

EVIDENCE BASE FOR THE ASSESSMENT OF LBP AND FUTURE RESEARCH DIRECTIONS

Guidelines published nationally and internationally recommend diagnostic triage (non-specific LBP, radicular syndrome, serious pathology), screening for serious pathology using red flags, screening of psychosocial risk factors, physical examination for neurologic screening, and the avoidance of routine imaging for non-specific LBP^[11].

Valid and reliable assessment procedures are required to accurately understand the clinical presentation of pain. Recent Cochrane diagnostic test accuracy reviews have reported that the many red flags reported in clinical guidelines display low individual diagnostic accuracy^[5,6]. However, a combination of red flags such as significant trauma, older age, corticosteroid use and the presence of contusion improve the diagnostic accuracy of vertebral fractures^[5]. For the identification of spinal cancer, a history of cancer was the only useful red flag meaningfully increasing the likelihood of cancer^[6]. Raison *et al*^[12] reported that bowel and bladder dysfunction and saddle sensory disturbance where significant red flags but only marginally raise clinical suspicion of spinal cord or cauda equina compression.

A systematic review of literature by Shultz *et al*^[13] displayed how history items such as age > 50, lower extremity pain or numbness, symptoms relieved with sitting/bending over and symptoms exacerbated with standing/walking suggests lumbar spinal stenosis in patients with LBP and non-specific lower extremity symptoms. Furthermore, a limited amount of literature for the diagnosis of nerve root compression/radiculopathy

suggests that, dermatomal distribution/radiation was the history component with the largest diagnostic odds ratio followed by history of nerve injury, more pain on coughing, sneezing or straining, leg pain, subjective muscle weakness, subjective sensory loss, and disturbed urinary passage^[13]. Regarding the diagnosis of lumbar disc herniation, a limited amount of literature suggests previous non-spinal surgery, education level and progressive sciatic pain to be significant history components^[13]. Kasai *et al*^[14] reported symptoms exacerbated by specific movements such as standing up and rolling over and the timing of symptoms such as morning pain could assist clinicians in diagnosing structural lumbar segmental instability. When no anatomical abnormality is suggested in the patient's history, patients with pain or aggravating/easing factors disproportionate to injury, along with psychosocial symptoms were very likely to be diagnosed with central sensitization. Similarly, patients with localized or intermittent pain were more likely to be diagnosed with nociceptive LBP^[13]. The future research direction for the value of patient history will focus on clustering items to improve diagnostic accuracy.

The physical examination aims to confirm or rule out serious pathological condition or neurological compromise and classify body function impairments and activity limitations. Systematic literature reviews suggest that neurological examination including muscle weakness, muscle wasting, impaired reflexes and sensory deficits display poor pooled diagnostic accuracy values with low individual sensitivity and moderate specificity for surgically and radiologically confirmed disc herniation and the identification of affected segmental level^[15,16]. Mechanical diagnostic tests such as forward flexion, hyper-extension test, and slump test have slightly better diagnostic accuracy and combining positive test results increased the specificity of physical tests^[15]. The straight leg raising (SLR) test has high sensitivity and widely varying specificity while the crossed SLR showed high specificity with low sensitivity^[15].

A systematic review by Hancock *et al*^[17] reported that high intensity zone, endplate changes and disc degeneration assessed on magnetic resonance imaging are informative for the disc being the source of LBP. The only clinical feature found to increase the likelihood of the disc as the source of pain was the centralization phenomena. Manual tests of the sacroiliac joint when use in combination were informative but none of the tests for facet joint pain were found to be informative to distinguish the source of LBP. A systematic review by Alqarni *et al*^[18] showed that high specificity and moderate to high sensitivity for lumbar spinous process palpation test for the diagnostic test for lumbar spondylolisthesis. Another systematic review by Alqarni *et al*^[19] showed the passive lumbar extension test may be useful in orthopaedic clinical practice to diagnose structural lumbar segmental instability.

Studies investigating the reliability of mechanical LBP provocation test show varying results and methodological qualities. Low reliability is often reported in palpation-based assessment but improves to moderate reliability

when based on symptom response^[20]. Furthermore, timed muscle endurance tests and symptom response with repeated movements have high reliability^[20]. The reliability of the SLR procedures are considered good in most studies^[21]. Carlsson and Rasmussen-Barr^[22] in a systematic review of reliability of functional and active movement control tests to identify movement dysfunction in LBP showed that prone knee bend and one leg stance have moderate and good reliability across studies with low risk of bias.

Future research directions recommended in the literature focus on the clustering of diagnostic tests to improve the diagnostic accuracy for identifying specific diagnostic subgroups. This research direction is closely aligned with the process of clinical decision making^[23].

EVIDENCE BASE FOR PRIMARY HEALTH CARE INTERVENTIONS FOR LBP AND FUTURE RESEARCH DIRECTIONS

Therapeutic recommendations from guidelines published nationally and internationally discourage the use of bed rest and therapeutic ultrasound as well as the solitary use of electrotherapy^[11]. Early and gradual return to normal functioning and activities, the time-contingent use of paracetamol progressing to non-steroidal anti-inflammatories, and the assessment of psychosocial risk factors for chronicity are recommended^[11] based on a low number of randomized controlled trials (RCTs) with overall low methodological quality showing significant analgesic and/or functional effects^[24-27]. As LBP persists, the guidelines recommend therapies such as supervised exercise, manual therapy, acupuncture, cognitive behavioral therapy and multidisciplinary treatments^[11] based on a low number of RCTs with overall low-moderate methodological quality showing significant analgesic and/or functional effects^[24-27].

Research investigating the effectiveness of conservative interventions for LBP have often reported small to moderate effect sizes in the short term with no longer-term effect on LBP trajectories for patients^[24-27]. These studies may however be confounded due to heterogeneous pooling of patients and treatment modalities where average treatment effect masks patient's responding with large effect or little or no effect^[28]. This has led to an increased research focus on stratified care which targets treatment to patient subgroups based on key characteristics such as their prognostic risk profile for persistent LBP, likely response to specific treatment based on clinical prediction models (CPRs) or suspected underlying causal mechanisms^[29].

The STarT Back approach stratifies patients based on a multi-domain prognostic model to determine patients at low, medium and high risk of persistent back pain. Patients at medium and high risk are referred for more extensive treatment while those at low risk can be reassured and offered minimal treatment. The model performed well in a validation study and impact analysis

and is current undergoing broader external validation^[29].

Another option is to take aspects of the patient history, physical examination and clinical test findings to match the patient to treatment based on the prediction of responsiveness to a specific treatment. Currently 13 CPRs for LBP have been developed from clustering of diagnostic clinical tests^[30]. Most of these CPR for LBP are in their initial development phase with only 1 tool for identifying lumbar spinal stenosis and 2 tools for identifying inflammatory back pain having undergone validation and no studies have yet undergone impact analysis^[30]. Furthermore 30 prognostic LBP CPRs have been developed with 3 having undergone validation including the Cassandra rule for predicting long-term significant functional limitations and the five-item and two-item Flynn manipulation CPRs for predicting a favorable functional prognosis in patients being treated with lumbopelvic manipulation^[31].

Targeted treatment can also be based on underlying mechanisms of the patient's LBP. For example, mechanism-based classifications of pain aim to define if underlying nociceptive, neuropathic, central sensitization, autonomic/motor, or affective neurophysiological mechanisms are driving the LBP^[4]. Other classifications include the Pathoanatomic Based Classification approach and the Mechanical Diagnosis and Treatment approach. These models have nonetheless been criticized for aspects of poor validity and reliability, not covering all dimensions of the biopsychosocial nature of LBP and not adequately being tested in RCTs^[29,32]. The Classification based Cognitive Functional Therapy approach integrates pathoanatomical, neurophysiological, psychosocial, physical and lifestyle domains. It has been validated in a RCT but has not undergone impact analysis or broader external validation^[33]. The approach requires effective communication, education of body relaxation strategies, the normalization of functional movement patterns and discouragement of pain behaviors and utilization of mindfulness and motivational principles^[29].

Fersum *et al*^[32] reported in their systematic review and meta-analysis that a statistical significant difference exists in favor of the classification-based intervention for reductions in LBP and disability in the short and long-term with moderate effect size reported in the short term. However, only 7.4% of published RCT studies had performed sub-classification beyond applying general inclusion and exclusion criteria and matched interventions^[32]. Fairbank *et al*^[34] suggested that future efforts in developing classification systems should focus on one that helps to direct both surgical and nonsurgical treatments.

EVIDENCE BASE FOR SECONDARY/ TERTIARY HEALTH CARE INTERVENTIONS FOR LBP AND FUTURE RESEARCH DIRECTIONS

While primary health care is the first step in the mana-

gement of LBP, in the case of persistent pain despite primary health care intervention and in the presence of a clear pathoanatomic pain mechanism, secondary health care in the form of surgical intervention may be indicated. With regards to isthmic spondylolisthesis, one study with a high risk of bias has indicated that surgery leads to better improvement in pain and overall clinical outcome compared to conservative treatment, while the different surgical techniques show conflicting results^[35]. Regarding degenerative spondylolisthesis, fusion results in better clinical outcomes than decompression, but there is a lack of evidence regarding if instrumented or non-instrumented fusion is optimal and there is a need for comparisons with conservative treatment^[36]. For spinal stenosis, there are heterogeneous studies of low methodological quality suggesting that surgery result in better leg pain and disability outcomes compared conservative treatment^[37]. Considering that the prevalence of lumbar spinal stenosis with neurogenic claudication is expected to rise with an aging population, large high-quality trials comparing surgery and conservative treatment are warranted^[37].

A recent systematic review and meta-analysis suggests that there is strong evidence that lumbar fusion surgery is not more effective than conservative treatment in reducing disability because of chronic LBP^[38]. In a review of systematic reviews and RCTs, Jacobs *et al*^[36] reported that for discogenic LBP, surgery is no more effective than high-intensity conservative interventions for improvements in pain scores or function. Similarly disc replacement results in equal success rates as surgical fusion does^[36]. With regards to disc herniation with radiculopathy, surgery leads to short-term benefits for leg pain and to a lesser extent for LBP. Despite this, no short-term and long term effects have been observed for functional outcomes measures. Furthermore, the different surgical techniques show no differences in outcomes. There is currently a lack of high quality RCTs comparing conservative or surgical treatment for disc herniation with or without sciatica^[36].

There are differing views about how a patient should prepare for and afterwards undergo rehabilitation for lumbar spinal surgery. The evidence base is evolving as are the differing opinions. In the past, surgeons have commonly restricted the amount of active rehabilitation after surgery in the belief that it may prevent complications during healing. Usual care has therefore often consisted of limited advice to stay active postoperatively and has sometimes included brief general exercise programs. It has however become more apparent the importance to optimizing pre- and post-operative care in aid to improve patient outcomes.

A recent systematic review and meta-analysis by Oosterhuis *et al*^[39] summarized 22 clinical trials investigating the effectiveness of rehabilitation after first-time lumbar discectomy surgery. The results suggest that exercise programs conducted four to six weeks post-operatively result in less pain and disability with small to medium effect sizes compared to usual care.

Furthermore, rapid reduction in pain and disability occurred in high intensity exercise programs compared to low intensity programs. Supervised or home exercise programs did not show significant differences for pain relief or disability. There were no indications that re-operation rate increased as a result of active rehabilitation programs after first-time lumbar disc surgery^[39]. The study's active rehabilitation programs consisted of exercise therapy, strength and mobility training, physiotherapy and multidisciplinary programs. More specifically, these included back schools, ergonomics education, motor control modification, resumption of activities of daily living including work and physical activity and enhancement of pain coping strategies delivered by individual sessions, group training or education or a combination of these. The quality of evidence was concluded to be low as more than half of the studies had high risk of bias and heterogeneity in rehabilitation programs warranting the need for more research with methodological rigor and the stratification of rehabilitation content^[39]. Findings from a recently published RCTs from Ozkara *et al*^[40] support the conclusion drawn by Oosterhuis *et al*^[39]. Furthermore in a RCT conducted by Louw *et al*^[41], preoperative neuroscience education for lumbar radiculopathy resulted in significantly better patient-rated preparation for lumbar discectomy surgery, fulfillment of postoperative expectations as well as less health care utilization compared to usual preoperative education provided by surgeons and staff.

Another systematic review and meta-analysis has investigated the effectiveness of rehabilitation after spinal stenosis surgery from 3 existing RCTs^[42]. The study's active rehabilitation programs focused on functional outcomes and used group or therapist-led exercise or educational materials encouraging activity starting between 6 and 12 wk after surgery. The review highlighted that active rehabilitation is more effective than usual care for improving functional status and LBP both in the short and long-term. Furthermore long term improvements were seen for the reduction of leg pain. The review as a whole concluded that despite the studies having low risk of bias, the small number of relevant studies rendered the quality of evidence as very low. Additional research including stratification of rehabilitation content is warranted^[42].

With regards to rehabilitation after lumbar spinal fusion, several RCT's have highlighted that the integration of active rehabilitation and cognitive behavioral programs improve patient functional and pain outcomes significantly more than usual care^[43-45]. Nielsen *et al*^[46] conducted an RCT taking a structured pre-habilitation and early rehabilitation program compared to standard care. The structured pre-habilitation and early rehabilitation program consisted of muscle strengthening exercise for the back and abdomen as well as cardiovascular conditioning, analgesics and a nutritional program. The integrated program of pre-habilitation and early rehabilitation improved the outcome and shortened

the hospital stay, without more complications, pain or dissatisfaction. Only one existing study has reported prospective outcomes of a structured rehabilitation program after total disc replacement (TDR). Canbulat *et al*^[47] reported good outcomes with regards to early pain relief and return to activities when combining careful patient selection, surgical technique, and a structured rehabilitation program. Furthermore, a large retrospective study has highlighted that 4 or more sessions of clinic-based physiotherapy produces better functional disability, pain and quality of life outcomes compared with self-mediated rehabilitation after TDR^[48]. In conclusion, more research is need using a stratified biopsychosocial approach to pre-habilitation and rehabilitation of patients undergoing lumbar spine surgery.

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P- Reviewer: Tangtrakulwanich B, Yao DF

S- Editor: Ji FF L- Editor: A E- Editor: Li D





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