AOJ Emergency and Internal Medicine

Review Article

Open Access

A Narrative Review on Physiotherapy Management of Back Pain

Volume 1 Issue 2 – 2023

Yusuff Tunde Gbonjubola,[1] Harrison Toluwanimi Adetunji[2]

[1] Department of Physiotherapy, Abubakar Tafawa Balewa University Teaching Hospital
[2] Department of Physiotherapy, Sports Medicine Centre, Moshood Abiola National Stadium, Abuja

Correspondence: Yusuff Tunde Gbonjubola, Department of Physiotherapy, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi, Nigeria. Email gbonjubola4mercy@gmail.com

Received: November 21, 2023 **Published:** December 12, 2023

Citation: Gbonjubola YT. A Narrative Review on Physiotherapy Management of Back Pain. AOJ Emerg and Int Med. 2023;1(2):09–17.

Abstract

Low back pain (LBP) is a prevalent and multifaceted musculoskeletal condition impacting a vast population globally. It presents with a spectrum of symptoms and varied etiologies, leading to significant disability and healthcare burden. This paper explores the multifactorial nature of LBP, diagnostic procedures, prevention strategies, and management options. Diagnosis of LBP largely hinges on a thorough physical examination and selective use of diagnostic imaging when specific or severe conditions are suspected. Prevention strategies are categorized by primary, secondary, and tertiary interventions, focusing on education, physical exercise, and avoidance of non-beneficial supportive devices. Management encompasses a multidisciplinary approach including medical treatment, surgical intervention for selected cases, physiotherapy, and psychosocial support. The role of physiotherapy is highlighted in offering patient education, exercise therapy, manual therapy, and electrotherapy modalities, all tailored to individual needs. This integrative review underscores the necessity of a personalized and evidence-based approach to LBP to optimize outcomes and enhance quality of life for sufferers.

Keywords: low back pain, physiotherapy, myofascial syndrome, spondylolisthesis

Definition and General Overview of Back Pain

Pain refers to an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage.[1] Typically, Low back pain (LBP) is described as pain, muscle tension or stiffness that originates below the costal border and extends above the inferior gluteal fold, and may be accompanied with referred leg pain.[2,3] It is a debilitating musculoskeletal condition associated with disability and work absence. Which is responsible for elevated healthcare and economic costs globally.[4] During the second half of the twentieth century, low back pain became one of the most pressing issues for public health systems in the Western world , and it now appears to be spreading globally.[5] Most people will experience back pain at some point in their life.[6] Intervertebral discs, facet joints, sacroiliac joints, muscles, fascia, bones, nerves, and meninges are all local origins of LBP.[7] While Herniated discs, osteoarthritis, myofascial syndrome, spondylolisthesis, ankylosing spondylitis, rheumatoid arthritis, fibrosis, arachnoiditis, tumor, and infection are all causes of low back pain. The incidence of spinal disorders is high, especially those associated with poor posture, inappropriate body movements, and occupational factors that can injure the spine.[8]

Classification of Low Back Pain

Low back pain can be broadly classified into two. Namely: based on its specificity and the other based on time duration from its onset. Based on specificity, LBP is further classified into non-specific low back pain and specific low back pain. Non-specific low back pain (NSLBP) refers to pain as a result of no recognizable or serious pathology such as fracture, cancer, inflammatory diseases or nerve root compromise while specific low back pain refers to pain which is a result of a recognizable or serious cause of pathology.[9,10] Most LBP are non-specific as a definitive diagnosis is usually not met with current radiological investigations.[11] Based on low back pain time duration since onset is classified as acute, sub-acute and chronic. Acute low back pain is LBP which has lasted for less than 6 weeks, sub-acute low back pain is an episode between 6 and 12 weeks with chronic low back pain lasting over 12 weeks.[12] Studies indicate that, 85% of patients seen by physiotherapists are diagnosed with NSLBP with 10-40% of the cases established as chronic NSLB.[10,13]

Epidemiology and Global Burden of Low Back Pain

Low back pain (LBP) is a global burden; and the most common cause of disability in both developed and developing nation.[4],[5],[14] It is the most prevalent musculoskeletal problem in adults, affecting 70% of people in high-income countries at some point during their lives.[15] A review of the prevalence of low back pain in the adult population globally showed a point prevalence of 11.9±2.0% and a one-month prevalence of 23.2%±2.9% with the life time prevalence at 39.9%±4.3%.[16] Its prevalence ranges from 26% to 79 percent among adults in high-income nations, and from 16% to 59 percent among adults in Sub-Saharan Africa, where it is widely considered that the prevalence of LBP is lower, owing to a fewer number of research conducted on the continent.[5]

Low back pain is a major health problem with a higher prevalence in women and adults aged 40-80 years is expected that as the ages in the population increase over the decades, the number of people with low back pain would increase considerably.[16] A meta-analysis by Morris et al. 2018 indicated that the lifetime, annual and point prevalences of LBP among African populations was found to be higher than recently reported estimates for global LBP prevalence reported by.[4,17] According to Gilgil et al the life-time, 12-months and point prevalence of LBP in Turkey, a developing European country were 46.6%, 35.9%, and 20.1% respectively. The lifetime, annual and point prevalence of LBP was estimated to be higher among African adults compared to African children and adolescents.[4]

Some people believe that the existence of LBP in adolescence is a sign of or a precursor of a significant organic condition, while others believe it is a predictor of future low back pain in maturity.[17] A study conducted by[18] among adolescent secondary school students in Ibadan, Nigeria, indicated that the lifetime, twelve-month, one-month and point prevalence rates of adolescent low back pain were 58.0%, 43.8%, 25.6% and 14.7% respectively. Despite the fact that these figures are high, they are within the range of figures published by[19] for the prevalence of low back pain in school-aged children in industrialized countries (i.e., 7 to 70%).

The disability and morbidity associated with low back pain are a significant burden.[20] Patients with LBP frequently experience physical discomfort and functional limitations, which can lead to disability and a lower quality of life.[21] Annually, 149 million workdays are lost worldwide as a result of LBP, which causes a significant loss in production.[22] LBP is the third most common cause of surgical operations, the fifth most common cause of hospital admissions, and the second most common reason for people under 45 to visit a doctor after the common cold.[23] LBP is the most common cause of activity limitation and job absence in much of the world, putting a significant financial strain on individuals, families, communities, business, and governments.[24] LBP is the second most common cause of disability in US adults[25] and a common reason for lost work days.[26,27] The best estimates of the prevalence of chronic non-specific low back pain is approximately 23% with 11-12% of the population disabled by it and 26%-37% experiencing a relapse in work absence.[28] Patients with LBP frequently experience physical discomfort and functional limitations, which can lead to disability and a lower quality of life.[21] Between 1990 and 2015, the number of years lived with disability from low back pain increased by 54% globally, owing primarily to population growth and ageing, with the greatest increases occurring in low- and middle-income nations.[29] Low back pain is now the most common cause of disability globally.[30]

Low- and middle-income countries' gender-based prevalence and patterns of LBP may differ from those of high-income countries, and even between low-income regions.[3] A systematic review by Louw et al on the prevalence of low back pain in Africa in 2007, showed that men seem to report low back pain more often than women in Africa which was contrary to what was reported by Garcia et al, in a systematic review on the prevalence of low back pain in Latin America. This may reflect African culture, in which men frequently perform strenuous physical labor, as well as gender inequities, in which women may underreport their low back discomfort.[3]

Causes of Low Back Pain

Non-specific low back pain is, by definition, a symptom with an unknown origin (i.e., a condition for which the pathophysiology is currently unknown). Many elements, however, have been identified as potential causes of the pain or as having the ability to influence its progression and outcome.[6] Although clinical tests are unable to accurately identify the tissue source of most low back pain, several structures are innervated and have been shown to produce pain when stimulated.[3] Studies suggest that low back pain is thought to be caused by a variety of anatomical structures, including bones, intervertebral discs, joints, ligaments, muscles, neurological systems, and blood vessels.[31] Various structures in the spine may be the source of pain depending on their innervation, however clinical interpretation of anomalies cannot be made solely based on anatomical evidence.[32] Psychosocial dimensions become relevant in chronic pain and are important in explaining how people respond to back pain.[3] Low back pain can be linked to a specific cause in about 5–15 percent of cases, such as an osteoporotic fracture, tumor, or infection. The reason of low back pain in the remaining 85–95 percent of cases is unknown.[31]

Cross-sectional studies on large population samples have revealed a substantial link between low back pain and lumbar disc degeneration, as observed on clinical imaging; for example, the odds ratio (OR) for disc space narrowing and the presence of low back pain in men is 1·9 (95% CI 1·4–2·8)[33] and OR greater than 2 have been reported for disc degeneration (OR 2·18; 1·4–3·4) and for disc herniation (OR 2·07; 1·4–3·1).[34] Nonetheless, it was concluded from a systematic review with meta-analysis by Endean et al, that at the individual level, none of the lesions identified by MRI could be established as the cause of low back pain because such MRI anomalies are frequent in asymptomatic patients, they do not correspond to the onset of low back pain, and they do not predict the response to evidence-based therapy for non-specific low back pain.

Age, educational status, psychosocial factors, work satisfaction, mechanical factors, and obesity are all factors that have a role in the development of back pain.[16] One of the most significant factors in the development of low back pain is age, with most studies indicating that the peak incidence occurs in the third decade of life, with overall prevalence increasing until the age of 60 to 65. However, new information suggests that the prevalence of more severe kinds of back pain increases with age[14,35] while patients with a poor educational background have a higher prevalence of low back pain.[14] Indeed, lower educational levels have been associated with longer episode duration and worse outcomes.[35] Psychosocial factors such as stress, anxiety, depression, and certain types of pain behavior are associated with greater rates of low back pain.[14,36] Mechanical factors have long been thought to have a causal role in low back pain. However, findings from eight systematic reviews using the Bradford-Hill causation criteria have suggested that it was unlikely that occupational sitting, awkward postures, standing and walking, manual handling or assisting patients, pushing or pulling, bending and twisting, lifting, or carrying were independently causative of low back pain in the populations of workers studied.[37] A meta-analysis of cross-sectional and longitudinal studies carried out by[38] found that those who are overweight or obese have a higher risk of low back pain, with the highest associations for low back pain treatment and chronic low back pain. However, in a study on low back pain as seen in orthopedic clinics of a Nigerian teaching hospital Omoke et al,[20] reported that lifting heavy object and previous back injuries were the two top predisposing factors observed.[20]

Diagnosis of Low Back Pain

Peng stated that the prerequisite for successfully treating low back pain is to make an accurate pathological diagnosis. Diagnostic procedures can reveal its source in 90% of patients despite the inherent challenge in elucidating the specific etiology of chronic low back pain.

Low back pain can be diagnosed through the following procedures:

1. **Physical examination:** The goal of a physical examination is to narrow down possible causes of pain. A typical physical examination for low back pain includes some combination of the following steps:

- **Inspection and palpation:** Inspect for curvature of the spinal column anteriorly, posteriorly, and to the right or left. Palpate along the low back to locate any muscle spasms or tightness, areas of tenderness, or joint abnormalities.[39]

- **Neurologic examination:** The spinal cord and the nerve roots can contribute to or cause lumbar pain. The neurological examination consists of three elements: motor, sensory, and reflex. motor examination involves passive movement of hip, knee and big toe extension and flexion as well as ankle movement. Sensory examination includes testing the patient's reaction to light touch, a pin prick, or other senses in the lower trunk, buttock and legs. The patient's reflexes in the are also

checked to evaluate weakened reflexes and decreased muscle strength.[40]

- **Movement tests:** The patient may be asked to bend or twist in certain positions. These activities are done to look for positions that worsen or recreate pain, positions that relieve or alleviate the pain, and to see if certain movements are limited by discomfort.[40]

- **Straight leg raise test:** The straight leg raise (SLR) is a passive test. Each leg is tested individually with the normal leg being tested first. When performing the SLR test, the patient is positioned in supine without a pillow under his/her head, the hip medially rotated and adducted, and the knee extended. The clinician lifts the patient's lower limb by the posterior ankle while keeping the knee in a fully extended position. The clinician continues to lift the patient's lower limb by flexing at the hip until the patient complains of pain or tightness in the back or back of the leg. If symptoms are primarily back pain, it is most likely the result of a disc herniation.[41]

2. **Diagnostic imaging:** Diagnostic imaging is indicated for patients with low back pain only if they have severe progressive neurologic deficits or signs or symptoms that suggest a serious or specific underlying condition.[2] The following imaging scans can be used to diagnose low back pain

- **X-ray:** X-ray provides detail of the bone structures in the spine, and it is used to identify back pain resulting from instability (such as spondylolisthesis), tumors and fractures.[42]

- **CT scan/myelogram:** Computed tomography (CT) of the spine is a diagnostic imaging test used to help diagnose or discard spinal column damage in injured patients. It can reveal internal injuries and bleeding.[43] A myelogram uses a contrast dye and X-rays or computed tomography (CT) to look for problems in the spinal canal. Problems can develop in the spinal cord, nerve roots, and other tissues.[44]

- **MRI:** Magnetic resonance imaging (MRI) enables the visualization of all structures that could cause pain, but in patients with pain originating from nerve root compression, disc herniations or protrusions, these conditions could be invisible in images obtained with the conventional supine position.[42]

Prevention of Low Back Pain

Prevention is categorized into three types according to the National Center of Biotechnology Information (NCBI):

- Primary prevention is defined as specific practices for the prevention of disease or mental disorders in susceptible individuals or populations. These include health promotion, including mental health; protective procedures, such as communicable disease control; and monitoring and regulation of environmental pollutants. Primary prevention is to be distinguished from secondary prevention and tertiary prevention.[45]

- Secondary prevention is defined as the prevention of recurrences or exacerbations of a disease that already has been diagnosed. This also includes prevention of complications or after-effects of a drug or surgical procedure.[46]

- Tertiary prevention are measures aimed at providing appropriate supportive and rehabilitative services to minimize morbidity and maximize quality of life after a long-term disease or injury is present.[47]

Physical exercise is recommended to prevent consequences of low back pain, such as an absence of work and occurrence of further episodes. Physical exercise is especially useful in training back extensors and trunk flexors in conjunction with regular aerobic training. There is no specific recommendation of exercise frequency or intensity.[48] With regard to the back school programmes, a high intensity programmes are advised in patients with recurrent and lasting low back pain but not in preventing low back pain. The program consists of exercises and an educational skills programme. Education and information alone or based on the biomechanical model has only a small effect.

Carefully selected and presented information and education in combination with other interventions, in a treatment setting based on the bio-psychosocial model has a better effect in the prevention of back pain, preventing further episodes of back pain and work absence.

Information based on the bio-psychosocial model is focused on beliefs in low back pain and reducing work loss caused by low back pain. This attitude of giving information has a positive effect on back pain beliefs.[49] It is important to know that individually tailored programmes and intervention may have more results in comparison to group interventions.[48]

Lumbar supports, back belts and shoe insoles are not recommended in the prevention of low back pain. There is moderate evidence that lumbar supports are ineffective in preventing low-back pain when compared to no intervention or training, and there is mixed evidence about whether they are helpful supplements to other preventative interventions. It remains unclear whether lumbar supports are more effective than no or other interventions for treating low-back pain.[50] Lumbar supports and back belts have also been shown to have a negative effect on back pain beliefs and are therefore are not recommended in preventing low back pain. There is no proof for or against specific beds and chairs used for prevention. The long-term, chronic symptoms of LBP may be alleviated with medium support mattresses.[49] Preventing and avoiding LBP during early adolescence can prevent LBP progression, and thus, can decrease the associated morbidities.[51] Thus, young adults who experienced LBP at the age of 14 years had an increased incidence 25 years later compared with those who did not experience LBP at age 14 years.[52]

Management of Low Back Pain

As a result of extensive cost involved in managing musculoskeletal pain patients, the need for an early intervention as a means of secondary prevention has been pointed out.[53] The following are the various ways of managing LBP:

3. **Medical Management**

   Regardless of the pain's original etiology or ongoing mechanism, early intervention is key to facilitating the resolution of acute symptoms of back pain.[54,55] Initial treatments for back pain include advice to remain active, patient educational materials, the use of acetaminophen (AAP), and nonsteroidal anti-inflammatory drugs (NSAIDs). Patients who do not respond to the first-line medications at four weeks have additional nonpharmacologic and pharmacologic treatment options which include the use of skeletal muscle relaxant, tramadol, opioids and antidepressant.[56]

1. **Surgical Management**

   Surgery becomes mandatory in the management of chronic pain as a last choice as in cases of complete ligaments rupture, meniscal avulsion and crush injuries. Surgical management of non-specific back pain in the absence of a pathoanatomical diagnosis is bound to fail. As a result, spinal fusion may not be any better than nonsurgical treatment in these patients.[57] and imaging of the spine is unhelpful.[58] There is a range of techniques for spinal fusion, including anterior lumbar interbody fusions, posterior lumbar interbody fusions, 360° fusions (anterior and posterior approaches) and anterior disc arthroplasties.[59]

2. **Physiotherapy Management**

   Physiotherapists play a vital role at all stages of low back pain from acute to chronic presentations through the application of activity-based programs utilizing cognitive behavioral principles.[60] For acute pain, recommended management involves pain education, assurance, advice on resuming normal activity and discussion of options for pain management as needed. Management technique such as manual therapy should follow.[61]

Physiotherapy management include the following

- **Patient Education:** Most guidelines on Physiotherapy management of LBP suggest education and advice as a key intervention strategy.[62,63] The common message is that patients should be reassured that they do not have a serious disease, that they should stay as active as possible, progressively particularly relevant for patients with acute back pain who are at low risk of disability.[64]

- **Exercise therapy:** Exercise is used very extensively in the physiotherapy management of musculoskeletal pain. Physical exercise includes various interventions such as, resistance exercise, isometric exercises, mobility exercises and exercises to promote activation and re-education of key muscle groups.[65,66] Exercise can be very helpful in preventing and treating of LBP.[66]

In all exercise interventions, there is need for strategies to ensure adherence.[65] Delitto et al[67] suggest that clinicians should consider the following in the management of LBP:

a. Utilizing trunk coordination, strengthening, and endurance exercises to reduce low back pain and disability in patients with sub-acute and chronic low back pain.

b. Utilizing repeated movements, exercises, or procedures to encourage centralization to reduce symptoms in patients with acute low back pain with related (referred) lower extremity pain. Clinicians should consider using repeated exercises in a specific direction determined by treatment response to improve mobility and reduce symptoms in patients with acute, subacute, or chronic low back pain with mobility deficits.

c. Flexion exercises, combined with other interventions such as manual therapy, strengthening exercises, nerve mobilization procedures, and progressive walking, for reducing pain and disability in older patients with chronic low back pain with radiating pain.

d. Utilizing lower-quarter nerve mobilization procedures to reduce pain and disability in patients with subacute and chronic low back pain and radiating pain.

e. Moderate-to high-intensity exercise for patients with chronic low back pain without generalized pain

f. Incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain.[67]

1. **Manual Therapy:** Manual therapy including mobilization, manipulation and massage can be beneficial in reducing pain and improving function.[68] Massage has been found to be effective in the management of chronic low back pain but spinal manipulation has shown only small benefits.[69,70]

2. **Electrotherapy:** Electrotherapy modalities (also known as electrophysical agents) are methods of physical therapy that aim to reduce pain and improve function via increase in energy (Electrical, sound, thermal or light) into the body.[71] Examples include therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS), hot packs and interferential therapy.[72]

Conclusion

In conclusion, low back pain remains a complex, yet common ailment with significant implications for individuals and the healthcare system. Accurate diagnosis requires careful evaluation through history taking, physical examination, and judicious use of imaging. Preventative measures, though varied, indicate the effectiveness of education and exercise in mitigating the risk and recurrence of LBP. Treatment modalities should be selected on an individual basis, with non-invasive options being the first line of approach. Surgical interventions are reserved for specific pathologies and when conservative management fails. Comprehensive management, including physiotherapy and biopsychosocial approaches, aligns with current evidence in providing the best outcomes. Future research should continue to refine the understanding of LBP mechanisms and therapeutic interventions, promoting a shift towards personalized and preventive healthcare to alleviate the burden of low back pain.

Acknowledgement

None.

Conflicts of Interest

We have no conflict of interests to disclose and the manuscript has been read and approved by all named authors.

Funding

None.

References

1. Raja SN, Carr DB, Cohen M, et al. The revised International Association for the Study of Pain definition of pain: concepts, challenges, and compromises. *Pain*. 2020;161(9):1976–1982.
2. Chou R, Qaseem A, Owens DK, et al. Diagnostic imaging for low back pain: Advice for high-value health care from the American college of physicians. *Ann Intern Med*. 2011;154(3):181–189.
3. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *The Lancet*. 2018;391(10137):2356–2367.
4. Morris LD, Daniels KJ, Ganguli B, et al. An update on the prevalence of low back pain in Africa: a systematic review and meta-analyses. *BMC Musculoskelet Disord*. 2018;19(1):196.
5. Louw QA, Morris LD, Grimmer-Somers K. The prevalence of low back pain in Africa: a systematic review. *BMC Musculoskelet Disord*. 2007;8:105.

6. Balagué F, Mannion AF, Pellisé F, et al. Non-specific low back pain. *The Lancet*. 2012;379(9814):482–491.
7. Winkelstein BA, Weinstein JN, De Leo JA. The Role of Mechanical Deformation in Lumbar Radiculopathy: An In Vivo Model. *Spine*. 2002;27(1):27–33.
8. Verbeek JH, van der Weide WE, van Dijk FJ. Early occupational health management of patients with back pain: a randomized controlled trial. *Spine*. 2002;27(17):1844–1851.
9. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. *Lancet Lond Engl*. 2017;389(10070):736–747.
10. Saragiotto BT, Maher CG, Yamato TP, et al. Motor control exercise for chronic non-specific low-back pain. *Cochrane Database Syst Rev*. 2016;2016(1):CD012004.
11. Suzuki H, Kanchiku T, Imajo Y, et al. Diagnosis and Characters of Non-Specific Low Back Pain in Japan: The Yamaguchi Low Back Pain Study. *PloS One*. 2016;11(8):e0160454.
12. Violante FS, Mattioli S, Bonfiglioli R. Low-back pain. *Handb Clin Neurol*. 2015;131:397–410.
13. Östhols S, Boström C, Rasmussen-Barr E. Clinical assessment and patient-reported outcome measures in low-back pain - a survey among primary health care physiotherapists. *Disabil Rehabil*. 2019;41(20):2459–2467.
14. Hoy D, Brooks P, Blyth F, et al. The Epidemiology of low back pain. *Best Pract Res Clin Rheumatol*. 2010;24(6):769–81.
15. Mills SEE, Nicolson KP, Smith BH. Chronic pain: a review of its epidemiology and associated factors in population-based studies. *Br J Anaesth*. 2019;123(2):e273–83.
16. Manchikanti L, Singh V, Falco FJE, et al. Epidemiology of low back pain in adults. *Neuromodulation J Int Neuromodulation Soc*. 2014;17 Suppl 2:3–10.
17. Hestbaek L, Leboeuf-Yde C, Kyvik KO. Are lifestyle-factors in adolescence predictors for adult low back pain? A cross-sectional and prospective study of young twins. *BMC Musculoskelet Disord*. 2006;7:27.
18. Adegoke BOA, Odole AC, Adeyinka AA. Adolescent low back pain among secondary school students in Ibadan, Nigeria. *Afr Health Sci*. 2015;15(2):429–437.
19. Jeffries LJ, Milanese SF, Grimmer-Somers KA. Epidemiology of adolescent spinal pain: a systematic overview of the research literature. *Spine*. 2007;32(23):2630–2637.
20. Omoke NI, Amaraegbulam PI. Low back pain as seen in orthopedic clinics of a Nigerian Teaching Hospital. *Niger J Clin Pract*. 2016;19(2):212–217.
21. Horng YS, Hwang YH, Wu HC, et al. Predicting health-related quality of life in patients with low back pain. *Spine*. 2005;30(5):551–555.
22. Meucci RD, Fassa AG, Faria NMX. Prevalence of chronic low back pain: systematic review. *Rev Saude Publica*. 2015;49:1.
23. Patrick N, Emanski E, Knaub MA. Acute and chronic low back pain. *Med Clin North Am*. 2014;98(4):777–789.
24. Andersson GB. Epidemiological features of chronic low-back pain. *Lancet Lond Engl*. 1999;354(9178):581–585.
25. Centers for Disease Control and Prevention (CDC). Prevalence of disabilities and associated health conditions among adults--United States, 1999. *MMWR Morb Mortal Wkly Rep*. 2001;50(7):120–125.
26. Ja R, Wf S, E C, et al. Back pain exacerbations and lost productive time costs in United States workers. *Spine*. 2006;31(26).
27. Stewart WF, Ricci JA, Chee E, et al. Lost productive time and cost due to common pain conditions in the US workforce. *JAMA*. 2003;290(18):2443–2454.
28. Airaksinen O, Brox JI, Cedraschi C, et al. Chapter 4. European guidelines for the management of chronic nonspecific low back pain. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2006;15 Suppl 2:S192-300.
29. Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis*. 2014;73(6):968–974.
30. Global Burden of Disease Study 2019 (GBD 2019) Data Resources. GHDx . 2023.
31. Deyo RA, Weinstein JN. Low back pain. *N Engl J Med*. 2001;344(5):363–370.
32. Kapellen PJ, Beall DP. Imaging evaluation of low back pain: important imaging features associated with clinical symptoms. *Semin Roentgenol*. 2010;45(3):218–225.
33. de Schepper EIT, Damen J, van Meurs JBJ, et al. The association between lumbar disc degeneration and low back pain: the influence of age, gender, and individual radiographic features. *Spine*. 2010;35(5):531–536.
34. Cheung KMC, Karppinen J, Chan D, et al. Prevalence and pattern of lumbar magnetic resonance imaging changes in a population study of one thousand forty-three individuals. *Spine*. 2009;34(9):934–940.
35. Dionne CE, Korff MV, Koepsell TD, et al. Formal education and back pain: a review. *J Epidemiol Community Health*. 2001;55(7):455–468.
36. Linton SJ. A review of psychological risk factors in back and neck pain. *Spine*. 2000;25(9):1148–1156.
37. Roffey DM, Wai EK, Bishop P, et al. Causal assessment of occupational standing or walking and low back pain: results of a systematic review. *Spine J Off J North Am Spine Soc*. 2010;10(3):262–272.
38. Shiri R, Karppinen J, Leino-Arjas P, et al. The association between obesity and low back pain: a meta-analysis. *Am J Epidemiol*. 2010;171(2):135–154.
39. Schafer RC. Spinal and Physical Diagnosis.
40. Sandella BJ, Daetwyler CJ, Peitzman S, et al. Examination of Low Back Pain Technique. Medscape. 2022.
41. Magee DJ. Orthopedic physical assessment. St. Louis, Mo. : Saunders Elsevier; 2008; 1160p.

42. Weishaupt D, Schmid MR, Zanetti M, et al. Positional MR imaging of the lumbar spine: does it demonstrate nerve root compromise not visible at conventional MR imaging. *Radiology*. 2000;215(1):247–253.
43. Radiologyinfo. Computed Tomography (CT) - Spine. 2019.
44. Johns Hopkins medicine. Myelogram. 2021.
45. Primary Prevention - MeSH – NCBI. 2023.
46. Secondary Prevention - MeSH – NCBI. 2023.
47. Tertiary Prevention - MeSH – NCBI. 2023.
48. van Poppel MNM, Hooftman WE, Koes BW. An update of a systematic review of controlled clinical trials on the primary prevention of back pain at the workplace. *Occup Med Oxf Engl*. 2004;54(5):345–352.
49. Burton AK, Balagué F, Cardon G, et al. Chapter 2. European guidelines for prevention in low back pain : November 2004. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2006;15 Suppl 2(Suppl 2):S136-168.
50. van Duijvenbode ICD, Jellema P, van Poppel MNM, et al. Lumbar supports for prevention and treatment of low back pain. *Cochrane Database Syst Rev*. 2008;2008(2):CD001823.
51. Ganesan S, Acharya AS, Chauhan R, et al. Prevalence and Risk Factors for Low Back Pain in 1,355 Young Adults: A Cross-Sectional Study. *Asian Spine J*. 2017;11(4):610–617.
52. Harreby M, Neergaard K, Hesselsøe G, et al. Are radiologic changes in the thoracic and lumbar spine of adolescents risk factors for low back pain in adults? A 25-year prospective cohort study of 640 school children. *Spine*. 1995;20(21):2298–2302.
53. Nachemson A, Jonsson E. Neck and back pain : The scientific evidence of causes, diagnosis, and treatment. 2000.
54. Gatchel RJ, Polatin PB, Noe C, et al. Treatment- and cost-effectiveness of early intervention for acute low-back pain patients: a one-year prospective study. *J Occup Rehabil*. 2003;13(1):1–9.
55. Whitfill T, Haggard R, Bierner SM, et al. Early intervention options for acute low back pain patients: a randomized clinical trial with one-year follow-up outcomes. *J Occup Rehabil*. 2010;20(2):256–263.
56. Webster LR, Markman J. Medical management of chronic low back pain: efficacy and outcomes. *Neuromodulation J Int Neuromodulation Soc*. 2014;17 Suppl 2:18–23.
57. Dhillon KS. Spinal Fusion for Chronic Low Back Pain: A 'Magic Bullet' or Wishful Thinking? *Malays Orthop J*. 2016;10(1):61–68.
58. Maus T. Imaging the back pain patient. *Phys Med Rehabil Clin N Am*. 2010;21(4):725–766.
59. Atkinson L, Zacest A. Surgical management of low back pain. *Med J Aust*. 2016;204(8):299–300.
60. Nicholas MK, George SZ. Psychologically informed interventions for low back pain: an update for physical therapists. *Phys Ther*. 2011;91(5):765–776.
61. Lawrence DJ, Meeker W, Branson R, et al. Chiropractic management of low back pain and low back-related leg complaints: a literature synthesis. *J Manipulative Physiol Ther*. 2008;31(9):659–674.
62. Hill JC, Whitehurst DGT, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *Lancet Lond Engl*. 2011;378(9802):1560–1571.
63. National Institute for Health and Care Excellence . Low back pain and sciatica in over 16s: assessment and management. 2016.
64. Koes BW, van Tulder M, Lin CWC, et al. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2010;19(12):2075–2094.
65. Bergman S. Management of musculoskeletal pain. *Best Pract Res Clin Rheumatol*. 2007;21(1):153–166.
66. Stochkendahl MJ, Kjaer P, Hartvigsen J, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc*. 2018;27(1):60–75.
67. Delitto A, George SZ, Van Dillen L, et al. Low Back Pain. *J Orthop Sports Phys Ther*. 2012;42(4):A1–57.
68. Bishop MD, Torres-Cueco R, Gay CW, et al. What effect can manual therapy have on a patient's pain experience? *Pain Manag*. 2015;5(6):455–464.
69. Cherkin DC, Sherman KJ, Deyo RA, et al. A review of the evidence for the effectiveness, safety, and cost of acupuncture, massage therapy, and spinal manipulation for back pain. *Ann Intern Med*. 2003;138(11):898–906.
70. Kumar S, Beaton K, Hughes T. The effectiveness of massage therapy for the treatment of nonspecific low back pain: a systematic review of systematic reviews. *Int J Gen Med*. 2013;6:733–741.
71. Page MJ, Green S, Mrocki MA, et al. Electrotherapy modalities for rotator cuff disease. *Cochrane Database Syst Rev*. 2016;2016(6):CD012225.
72. Khadilkar A, Milne S, Brosseau L, et al. Transcutaneous electrical nerve stimulation (TENS) for chronic low-back pain. *Cochrane Database Syst Rev*. 2005;(3):CD003008.