Healthy lifestyle interventions in general practice: Part 15: Lifestyle and lower back pain

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Abstract

Lower back pain (LBP) is one of the most common medical problems in the adult population. LBP can be defined as pain, muscle tension or stiffness that is localised below the costal margin (inferior rib cage) and above the inferior gluteal folds and that can present either with or without leg pain (sciatica), and it can be classified as "specific" or "non-specific". LBP has a high lifetime prevalence and is associated with a substantial direct and indirect cost to the individual and society. In this review, the focus is on the identification of lifestyle risk factors and interventions that are associated with mainly non-specific chronic LBP. In addition to pharmacotherapy, the best treatment approach is exercise therapy (including physical reconditioning), psychosocial and behavioural intervention and therapeutic education. Other lifestyle changes include nutritional intervention and smoking cessation.

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Introduction and definition

Lower back pain (LBP) is one of the most common medical problems in the adult population and the family practitioner is frequently the first health professional to be consulted. There are many definitions but for the purposes of this review, LBP will be defined as pain, muscle tension or stiffness that is localised below the costal margin (inferior rib cage) and above the inferior gluteal folds, and that may present either with or without leg pain (sciatica).[1,2]

For the purposes of this review, LBP will be subclassified as either "specific" or "non-specific". "Specific" refers to LBP where the symptoms can be attributed to a very specific pathophysiological mechanism such as a herniated nucleus pulposus, infection, inflammation, osteoporosis, rheumatoid arthritis, fracture or tumour. It has been estimated that, in only a small percentage of LBP, a specific cause can be found.[1] Seventy to ninety per cent of patients therefore fall into the subgroup of NSLBP. NSLBP is defined as lacking a clear cause. In these patients, spinal abnormalities on X-rays or magnetic resonance imaging (MRI) are not strongly associated with pain, and many people without any symptoms also show these abnormalities.[3]

NSLBP is often further divided according to the duration of symptoms. Acute NSLBP is typically defined as symptoms less than six weeks, subacute NSLBP as between six and 12 weeks, and chronic NSLBP is defined as pain lasting for over 12 weeks.[2,4] In this review LBP refers to chronic NSLBP, unless stated otherwise.

Epidemiology

As mentioned, there is a considerable lack of consistency and standardisation in the definition and classification of LBP.[5] Therefore, it is often difficult to compare and interpret the results between epidemiological studies. However, data are very consistent in that the condition has both a high lifetime and point prevalence and annual incidence in the population.

Lifetime prevalence has been estimated at between 70% and 85%,[2,6,7] with a peak onset at age 30-40 years.[2] The annual incidence of a first-ever episode of LBP is between 6.3% and 15.4%, while the annual incidence of any episode ranges between 1.5% and 36%.[7] Furthermore, there is evidence that between two and five per cent of the population will seek medical attention annually because of LBP.[6] LBP is also the leading cause of limiting activity and is the second leading cause of absenteeism from work.[8] This condition therefore causes a very significant economic burden for individuals, families, communities, industry and governments.[7] Of further concern are recent data indicating that the prevalence of chronic LBP has more than doubled

in the 14-year period between 1992 and 2006 in adults over the age of 21 years.[9] There is also an increasing body of research showing that LBP is not only a common medical problem in the developed world, but it is also a major health problem in the low- and middle-income countries.[7]

However, there are little data on the epidemiology of LBP in Africa, and more particularly in South Africa. The point, annual and lifetime prevalence reported in studies from the African continent were reviewed in 2007.[10] The point prevalence was reported as 10-14% in children aged 10-19 years, and varied from 16-59% in the adult population. In adults, the annual prevalence was 40-74%, while the lifetime prevalence varied from 56-74%.[10] These data indicate that the prevalence of LBP in Africa is not much different from that reported in developed countries.

Economic burden

In a recently published study from the USA, claim records of more than 200 000 patients with one or more episode of LBP were examined. In this study, patients had significantly higher mean direct annual costs (in US dollar) of $7 211 compared with controls ($2 382 per annum; $p < 0.0001$). A systematic review of cost of illness studies in the United States and internationally was conducted in 2008.[11] Studies that measured not only direct (medical care) costs but also indirect (productivity, absenteeism) costs were included. The results of this review estimated that the direct annual cost of treating LBP in the USA ranged from $12.2 to $90.6 billion and the indirect costs were even higher, ranging from $7.4 to $28.2 billion.[11] Although estimates of the economic costs of LBP in different countries vary greatly depending on study methodology, it can nevertheless be concluded that by any standards, LBP presents a substantial economic burden on society.

Aetiology and risk factors

The aetiology of LBP is multifactorial. Non-specific cases have largely been attributed to a lumbar sprain/strain injury, but this is often a diagnosis by exclusion of the more specific causes. In a number of published reviews, the more specific causes have been classified into three main categories: mechanical, nonmechanical and referred/visceral (Table I).[2,12-14]

A number of general risk factors have been associated with NSLBP. These may be divided into factors related or unrelated to lifestyle (Table II).

General approach to diagnosis

A detailed discussion of the diagnostic approach to the patient with LBP is beyond the scope of this review. The general approach for the family practitioner, to diagnosis and management, has recently been reviewed.[2,5,15,18,19] The first step in the diagnosis and management is to obtain a focused history, and to perform a comprehensive clinical examination. A useful clinical approach is to focus on the identification of possible "red flags" that may indicate more serious underlying causes.[18-21] Serious specific causes include the cauda equine syndrome, fractures, malignancy and infections (Table III).[2]

Table I: The aetiology of lower back pain. Percentage of adult patients presenting to a primary care physician[12-14]

Category	Subcategory	Aetiology	%
Non-specific (70%)		Diagnosis by exclusion; often labelled as lumbar sprain/strain	70
Specific (30%)	Mechanical	Degenerative disc/facet	10
		Herniated disc	4
		Osteoporotic fracture (compression)	4
		Spinal stenosis	3
		Spondylolisthesis	2
		Traumatic fracture	<1
		Congenital disease (severe kyphosis, scoliosis, transitional vertebrae)	<1
		Other (spondylosis, internal disc disruption, instability)	<1
	Visceral/referred	Aortic aneurysm Pelvic organ disease (prostatitis, endometriosis, pelvic inflammatory disease) Gastrointestinal disease (pancreatitis, cholecystitis, peptic ulcer) Renal disease (nephrolithiasis, pyelonephritis)	2
	Other nonmechanical	Neoplasia Inflammatory arthritides Infections Other specific conditions (Scheuermann's disease, Paget's disease)	1

Table II: Risk factors associated with lower back pain[5,6,15]

Category	Factor
Lifestyle-related	Heavy physical work: prolonged periods of static work postures, heavy lifting, twisting, vibration[5,15]
	Physical inactivity[15,16]
	Increased high-risk physical activities (occupational and leisure time)[6,7,15]
	Obesity (body mass index greater than 30 kg/m^2)[6,15]
	Psychosocial factors: stress, depression, work-related factors such as dissatisfaction and monotonous work[5-7,15]
	Smoking[5,6,17]
	Drug abuse[5]
Not lifestyle-related	Increased age[5-7,15]
	Female gender[6,7]
	Low socioeconomic status and level of education[6,7]
	Low self-rated health status[6]
	Spinal anatomical factors, e.g. severe scoliosis, transitional vertebrae[5,6]
	Arthritis[15]
	Osteoporosis[15]
	Pregnancy[15]
	History of headache[5]

Psychosocial barriers to recovery from LBP are also important to recognise and are known as "yellow flags".[2,19,20] These include a variety of affective, behavioural, belief, social and work-related factors. Finally, it is important to understand perceptions about work that may lead to prolonged disability ("blue flags").[20]

Following the clinical assessment, appropriate special investigations may be required to exclude one of the specific or serious causes of LBP or referred pain from visceral disease. These may include blood tests and imaging studies such as plain X-ray films, MRI, computerised tomography (CT), ultrasound and diagnostic nuclear medicine scans. The routine use of special investigations for NSLBP is not recommended.[18,19] A detailed discussion of the indications for each possible special investigation is beyond the scope of this review. However, as mentioned, these investigations should be reserved for patients where the history or examination is suggestive of visceral pathology or one of the more serious underlying causes of LBP ("red flags").[18]

General approach to management

Once the patient has been fully assessed, management strategies for LBP can be initiated. If a diagnosis is made for specific LBP, then each condition requires management on its own merit. This could range from surgical intervention for serious emergencies such as aortic aneurysm or cauda equine syndrome, to referral to the appropriate specialist for management of malignancies or rheumatological conditions.

Table III: Findings on history and clinical examination ("red flags") that are suggestive of a serious underlying cause for lower back pain

	Infections[a]	Malignancy	Fractures	Cauda equina syndrome
Age > 70 years		X	X	
Minor trauma if age > 50 years		X	X	
Significant trauma			X	
History of a recent infection	X			
Penetrating wound near spine	X			
Night pain or pain at rest	X	X		
Unexplained weight loss	X	X		
History of cancer		X		
Progressive or disabling neurological symptoms/ signs (saddle anaesthesia, bilateral sciatica or leg weakness, urinary retention, faecal incontinence)				X
History of osteoporosis			X	
Chronic corticosteroid use			X	
Intravenous drug abuse	X			
Nonresponsive to conservative treatment after six weeks	X	X		
Immunocompromised	X			

[a]In the South African context, it is important to consider tuberculosis and human immunodeficiency virus infection

The management of NSLBP is difficult and demanding. A detailed discussion of all the possible management options for NSLBP is beyond the scope of this article, and this subject has recently been reviewed.[2,5,15,19,20,22,23] The management of LBP is generally best administered in a multidisciplinary team that includes the family practitioner. It is also important to note that no single treatment approach for chronic LBP is 100% successful.[5]

The management approach for NSLBP can be divided into pharmacological[24] and nonpharmacological treatment.[2] Detailed pharmacological management of LBP has recently been reviewed[24] and will not be discussed further here. For most patients, paracetamol and nonsteroidal anti-inflammatory drugs (NSAIDs) are first-line options for pain relief, while skeletal muscle relaxants and benzodiazepines can be used as adjunct medications. Tricyclic antidepressants may be an option in selected cases.[24] It should also be noted that, in general, acute LBP improves within a few weeks. The pain should be managed, and patients supported and encouraged to return to normal activity as soon as possible.

Nonpharmacological treatment modalities have also been studied extensively. There are numerous therapies and modalities and these have been used by a variety of health professionals. These treatment modalities may be divided into those that form part of a lifestyle intervention programme, and other treatment modalities (Table IV).

The type and duration of each of these nonpharmacological interventions will not be discussed further here and the reader referred to reviews.[2,5,15,19,20-22,23] It has been suggested that, in addition to pharmacotherapy, the best treatment approach for NSLBP includes the following:[5,19,21]

- Exercise (including physical reconditioning);
- Psychosocial and behavioural intervention;
- Therapeutic education.

These are therefore the main elements of a lifestyle intervention programme, and the remainder of this review will focus on the role of these in the prevention and management of LBP.

Table IV: Nonpharmacological treatment options for non-specific lower back pain

Category	Treatment
Lifestyle interventions	Exercise therapy
	Psychosocial intervention
	Therapeutic education
	Nutritional intervention
	Smoking cessation
	Other
Other	Heat or cold
	Acupuncture
	Massage
	Spinal manipulation
	Yoga
	Physical modalities (laser, ultrasound, electrotherapy)

Lifestyle interventions in prevention and management

There is good evidence that lifestyle interventions are an important element in the prevention and management of LBP and these will be discussed as follows: exercise and exercise therapy, psychosocial and behavioural intervention, therapeutic education and other lifestyle factor interventions (nutrition, smoking cessation).

Exercise in the prevention of lower back pain

The role of exercise in the prevention of LPB has been studied and the evidence has recently been reviewed.[4,25,26] The majority of these studies have been conducted in the workplace environment and there is considerable variation between studies with respect to the study populations, the frequency and duration of the exercise intervention programmes, and the type of exercise interventions. The results show that exercise interventions are widely used to prevent LBP in the workplace, but the evidence that these programmes reduce the incidence of LBP is inconsistent.[4] Therefore more studies are needed to confirm the benefits of exercise in the prevention of LBP.

Excess physical activity and lower back pain

It is important to recognise that excess physical activity may also increase the risk of LBP. In particular, repetitive higher-risk physical activity may produce cumulative stress on the spine and lead to the development of LBP.[6] Excess physical activity may be either occupational or leisure (sport) related. Occupational physical activities that may increase the risk of LBP are related to manual material handling such as heavy lifting, moving, carrying, bending or twisting.[6] Other potential factors are prolonged exposure to static positions, such as sitting, or low-frequency whole-body vibration.[6]

There is less evidence that specific sports are associated with an increased risk of chronic LBP.[6] No increased risk was reported in golf, cycling or athletic training, but in cross-country skiers and rowers the one-year prevalence of LBP was higher compared with controls.[6] However, there are limited data in this area and further investigation is required.

Exercise therapy

The role of exercise therapy in the management of acute and chronic NSLBP has also received considerable attention,[4,16,19,27-32] including Cochrane reviews.[33,34] As emphasised in previous articles in this series on lifestyle interventions, all patients should first be assessed to determine if absolute or relative contraindications are present before an exercise programme can be prescribed.[35] In particular, as LBP is more prevalent with increasing age, comprehensive medical assessment should include screening for underlying cardiorespiratory disease and other chronic condition.[36,37]

There is now consensus that during the acute phase of LBP, i.e. the first six weeks, patients will benefit from the advice to stay active. Bed rest is not recommended for more than two days.[4,19] However, specific back exercises are not recommended for patients during the acute phase.[4,33,38]

There is some evidence to suggest that a structured exercise programme should be introduced during the subacute stage in order to prevent the patient from progressing to a chronic stage of disability.[20,33]

The combined evidence from a large number of published randomised trials show that exercise therapy is effective at reducing pain and functional limitations in patients with chronic LBP.[4,19,28,33] There is also some evidence that exercise reduces recurrences.[34] Therefore, most international guidelines state that exercise therapy is recommended in the treatment of chronic LBP.[4,19,21,28,38]

The exercise prescription should incorporate a number of elements (Table V). However, there is currently no clear evidence that one particular type of exercise therapy is more effective than others.[4,38] It is conceivable that certain subgroups of patients will benefit more from a particular form of exercise therapy,[38] such as aquatic exercises for pregnancy-related LBP.[29] However, the general consensus is that the goals of an exercise programme are to improve strength, flexibility and general conditioning, as these may reduce the fear of movement and encourage full activity, including work.[20] An increase in exercise tolerance may also positively impact on a sense of wellness and self-efficacy.[20] However, most guidelines do not recommend a particular type of exercise programme, although some indicate that these should be of a high intensity.[19,38]

Table V: Exercise guidelines for the treatment of chronic low back pain with the relative importance (%) of each type of exercise modality in the management[27,29-32]

Types of exercise	Muscle strengthening (75%): - Strength and endurance training for the lower back and abdominal (trunk) muscles - Upper and lower limb progressive resistance strength exercises - Core stability (pelvic tilt, pelvic tilt progression, bridging) and hip and trunk stabilisation (hip abduction, hip extension) - Balance and proprioceptive exercises - Posture correction Flexibility training (13%): - Lower back flexibility training - General stretching and range of motion (upper and lower body stretches) Endurance exercise (aerobic exercises, 6%): - Endurance type activity (walking, swimming, cycling) Combined/multimodal exercise programmes (6%): - Combined strength, flexibility, and endurance exercises - Behavioural/supportive coping strategies - Work hardening - Ergonomic assessment and advice (home, work) Hydrotherapy (aqua therapy): - May include a number of water-based exercises - Particularly beneficial in pregnancy-related lower back pain Other exercise modalities: - McKenzie exercises, Williams exercises, callisthenics
Intensity of physical activity	Endurance-type activity (60-80% of symptom/sign limited maximal exercise test) General muscle strengthening (upper body, trunk, lower body) (moderate intensity, 70-90% one repetition maximum, 2-3 sets of 8-12 repetitions)
Frequency sessions	Endurance-type activity (most days of the week) General flexibility training and range of motion exercises (daily) General muscle strengthening (2-3 times/week)
Duration of sessions	Combining all exercise types (40-60 minutes per session)
Special considerations	Give attention to development of symptoms (pain): - Monitor pain during and after exercise sessions - Adjust exercise prescription according to symptoms - Conduct home and occupational ergonomic assessment and optimise ergonomics

In patients with chronic LBP, adherence to exercise programmes is generally poor, unless a therapist supervises these programmes.[4] There are data to suggest that supervised exercise training programmes (health professional) result in greater compliance compared with home-based exercise interventions. There is evidence that an exercise intervention programme is effective up to six months after treatment cessation.[28]

Psychosocial and behavioural intervention

In patients presenting with LBP, primary care practitioners will often notice a poor correlation between the radiological and clinical findings on the one hand and the degree of pain and disability on the other. The alert clinician will realise that simply viewing and treating patients from a purely biomedical perspective often result in clinical failure. This is supported by epidemiological and actuarial evidence. Therefore, it is essential to view the aetiology, progression and treatment of LBP not only from the traditional medical model, but also from a biopsychosocial perspective.[20] In the biopsychosocial model the physical, emotional, cognitive, behavioural, relational and social elements are viewed in a reciprocal relationship.[20]

The traditional view holds that the onset of pain is proportional to the severity of injury, and that psychosocial factors do not contribute. While the study methods and parameters assessed have varied, and the results are inconsistent, prospective studies have identified that certain psychosocial factors contribute to the onset of nociceptive experience.

These factors include the following:[39]

- Fear-avoidance beliefs (see below for further elaboration).
- Dissatisfaction in the workplace (including those with excessive workload, limited control and low income).
- Emotional distress at time of onset of pain.

In a busy general practice or clinic it is unlikely that clinicians will have time to do a formal assessment of patients at risk for developing persistent back pain. It is useful to be aware of these factors and to consider that these patients will require more intensive management.

The following are useful guidelines to identify an "at-risk" patient":[40]

- Maladaptive pain-coping behaviours and cognitions (catastrophising and fear-avoidance beliefs).
- Poor levels of general health and functional impairment.
- Psychiatric comorbidities.
- Tobacco use.
- Obesity.
- Unresolved legal issues or compensation relating to back pain.
- Low socio-economic or educational status.

The impact of psychological factors is most significant in the transition from acute to chronic and potentially disabling LBP. Of these, the most consistently described factor is fear avoidance.[41] If pain is appraised at its onset as benign and self-limiting, then the patient is less likely to experience fear and will maintain or quickly resume normal function, which will lead to rapid recovery.

On the other hand, fear avoidance involves catastrophising thoughts (exaggerated and dysfunctional negative cognition) and consequent avoidant behaviour. Thus, if pain is perceived as a severe or threatening condition, the individual will likely become fearful. That emotional state will inform and dictate the behavioural response to pain, including avoidance of movement or activities that are believed to exacerbate the injury or cause more pain. The avoidance of movement may lead to progressive deconditioning, reduced flexibility and strength, increased pain and the subsequent development of depression, disability and helplessness.[39] It is worth noting that the attitude and beliefs of the healthcare professional to pain exert some degree of influence on how patients will assess and interpret their pain experience, most especially if the doctor has his or her own unconscious fear-avoidance beliefs.[42]

Depression is also common in chronic LBP, and this increases significantly in those with the greatest pain severity and in which the medical cause is not obvious.[43] Depressive symptoms usually arise in response to ongoing pain (as opposed to acute pain in which depression does not occur), when it becomes apparent that the pain is not resolving. However, depression can occur before the onset of pain and some data suggest that depression may predispose individuals to developing LBP. The mechanism for this is not clear, but it is suggested that such an individual will already have a tendency to negative cognition and a diminished coping capacity.[44]

The primary care practitioner should have a high level of vigilance for patients who are at risk of progressing from acute to chronic pain. Offering reassurance and encouraging mobility are small but significant steps that can be employed, even in a busy practice. Doctors should be aware of their own beliefs about pain and acknowledge that these may influence how they relate to and advise their patients. It is suggested that for individuals with previous pain conditions or those with fear-avoidance patterns or depression, either onward referral to a psychologist is recommended, or additional sessions with the general practitioner should be scheduled, where these issues can be dealt with. In either case, using cognitive behavioural therapy is the psychological treatment of choice by which

dysfunctional belief patterns are challenged, and graded exposure is encouraged to behaviours and activities that are being avoided as a result of pain-associated fear.[45]

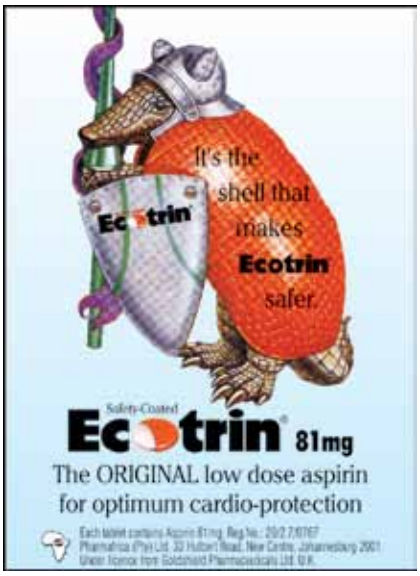
If depression is present along with chronic pain, it is important to take into account that simply treating patients with antidepressants will be unlikely to resolve the attendant problems. The problems that may occur with pain conditions include occupational disability, financial and relational stress, sexual difficulties and changes in societal and family roles. Given that, in mild to moderate depression, cognitive behavioural therapy is at least as effective as anti-depressants, and taking the above into account, patients in this category of dual diagnosis should be referred for psychotherapy.

Therapeutic education

There is an important role for therapeutic education, reassurance and self-care in the management of LBP.[20] The specific role of individual patient education has been reviewed in a Cochrane review of 24 studies.[46]

The main findings of this review were as follows:

- Patients who received their own individual patient education session, lasting for more than two hours, had better outcomes than patients who received the usual care.
- Shorter education sessions were not as effective.
- There was evidence from some studies that written information was just as effective as in-person education.
- Patient education was not as effective for patients with chronic, compared with acute or subacute, LBP.
- Patient education alone was not more effective than other therapeutic interventions.
- In a comparison of different education types, there were no clear guidelines on which type of education was most effective.



The purpose of providing educational material is to inform the patient about the natural history of back pain, reduce patient distress, promote compliance with evidence-based treatment recommendations, promote autonomy in the management of symptoms, and optimise functional outcome.[20] Furthermore, it has been shown that providing patients with accurate and meaningful information has a positive impact on return to work, pain, medication use, patient satisfaction with care, and overall improvement.[20] Specific self-care techniques include the application of heat or cold to control symptoms, stretching, all forms of walking and the use of relaxation techniques. Patient education is therefore an important part of the overall management of LBP and it is important that information and advice given to patients are individualised, specific and relevant.[15]

Other lifestyle interventions

Nutritional intervention also has a role in the prevention and management of LBP. This should focus on management of obesity and chronic degenerative or inflammatory arthritis. These interventions have already been reviewed in this series.[47-49] There is very limited evidence for the use of other nutritional (including herbal) supplements.[50] However, smoking cessation is an important lifestyle intervention for LBP,[17] and the importance of this intervention for other chronic diseases has also been previously reviewed in this series.[37]

References

1. Deyo RA, Rainville J, Kent DL. What can the history and physical examination tell us about low back pain? JAMA. 1992;268(6):760-765.
2. Duffy RL. Low back pain: an approach to diagnosis and management. Prim care. 2010;37(4):729-741, vi.
3. Van Tulder MW, Assendelft WJ, Koes BW, Bouter LM. Spinal radiographic findings and non-specific low back pain. A systematic review of observational studies. Spine 1997;22(4):427-434.
4. Van Middelkoop M, Rubinstein SM, Verhagen AP, et al. Exercise therapy for chronic non-specific low-back pain. Best Pract Res Clin Rheumatol. 2010;24(2):193-204.
5. Devereaux M. Low back pain. Med Clin North Am. 2009;93(2):477-501.
6. Rubin DI. Epidemiology and risk factors for spine pain. Neurol Clin. 2007;25(2):353-371.
7. Hoy D, Brooks P, Blyth F, Buchbinder R. The epidemiology of low back pain. Best Pract Res Clin Rheumatol. 2010;24(6):769-781.
8. Deyo RA, Tsui-Wu YJ. Descriptive epidemiology of low-back pain and its related medical care in the United States. Spine 1987;12(3):264-268.
9. Freburger JK, Holmes GM, Agans RP, et al. The rising prevalence of chronic low back pain. Arch Intern Med. 2009;169(3):251-258.
10. Louw QA, Morris LD, Grimmer-Somers K. The prevalence of low back pain in Africa: a systematic review. BMC Musculoskelet Disord. 2007;8:105.
11. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. Spine J. 2008;8(1):8-20.
12. Kinkade S. Evaluation and treatment of acute low back pain. Am Fam Physician. 2007;75(8):1181-1188.
13. Deyo RA, Weinstein JN. Low back pain. N Engl J Med. 2001;344(5):363-370.
14. Last AR, Hulbert K. Chronic low back pain: evaluation and management. Am Fam Physician. 2009;79(12):1067-1074.

15. Wilson JF. In the clinic. Low back pain. Ann Intern Med. 2008;148(9):ITC5-1-ITC5-16.
16. Verbunt JA, Smeets RJ, Wittink HM. Cause or effect? Deconditioning and chronic low back pain. Pain 2010;149(3):428-430.
17. Shiri R, Karppinen J, Leino-Arjas P, et al. The association between smoking and low back pain: a meta-analysis. Am J Med. 2010;123(1):87.e7-35.
18. Chou R, Qaseem A, Snow V, et al. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. Ann Intern Med. 2007;147(7):478-491.
19. Koes BW, Van Tulder M, Lin CW, et al. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. Eur Spine J. 2010;19(12):2075-2094.
20. Weiner SS, Nordin M. Prevention and management of chronic back pain. Best Pract Res Clin Rheumatol. 2010;24(2):267-279.
21. Dagenais S, Tricco AC, Haldeman S. Synthesis of recommendations for the assessment and management of low back pain from recent clinical practice guidelines. Spine J. 2010;10(6):514-529.
22. Haldeman S, Dagenais S. A supermarket approach to the evidence-informed management of chronic low back pain. Spine J. 2008;8(1):1-7.
23. Rubinstein SM, Van Middelkoop M, Kuijpers T, et al. A systematic review on the effectiveness of complementary and alternative medicine for chronic non-specific low-back pain. Eur Spine J. 2010;19(8):1213-1228.
24. Chou R. Pharmacological management of low back pain. Drugs 2010;70(4):387-402.
25. Bell JA, Burnett A. Exercise for the primary, secondary and tertiary prevention of low back pain in the workplace: a systematic review. J Occup Rehabil. 2009;19(1):8-24.
26. Bigos SJ, Holland J, Holland C, et al. High-quality controlled trials on preventing episodes of back problems: systematic literature review in working-age adults. Spine J. 2009;9(2):147-168.
27. Liddle SD, Baxter GD, Gracey JH. Exercise and chronic low back pain: what works? Pain 2004;107(1-2):176-190.
28. Smith C, Grimmer-Somers K. The treatment effect of exercise programmemes for chronic low back pain. J Eval Clin Pract. 2010;16(3):484-491.
29. Waller B, Lambeck J, Daly D. Therapeutic aquatic exercise in the treatment of low back pain: a systematic review. Clin Rehabil. 2009;23(1):3-14.
30. Standaert CJ, Weinstein SM, Rumpeltes J. Evidence-informed management of chronic low back pain with lumbar stabilization exercises. Spine J. 2008;8(1):114-20.
31. Mayer J, Mooney V, Dagenais S. Evidence-informed management of chronic low back pain with lumbar extensor strengthening exercises. Spine J. 2008;8(1):96-113.
32. Wai EK, Rodriguez S, Dagenais S, Hall H. Evidence-informed management of chronic low back pain with physical activity, smoking cessation, and weight loss. Spine J. 2008;8(1):195-202.
33. Hayden JA, Van Tulder MW, Malmivaara A, Koes BW. Exercise therapy for treatment of non-specific low back pain. Cochrane Database Syst Rev 2005(3):CD000335.
34. Choi BK, Verbeek JH, Tam WW, Jiang JY. Exercises for prevention of recurrences of low-back pain. Cochrane Database Syst Rev 2010(1):CD006555.
35. Derman EW, Patel DN, Nossel CJ, Schwellnus MP. Healthy lifestyle interventions in general practice. Part 1: An introduction to lifestyle and diseases of lifestyle. S Afr Fam Pract. 2008;50(4):5-7.
36. Derman EW, Whitesman S, Dreyer M, et al. Healthy lifestyle interventions in general practice. Part 2: Lifestyle and cardiovascular disease. S Afr Fam Pract. 2008;50(5):6-9.
37. Schwellnus MP, Patel DN, Nossel CJ, et al. Healthy lifestyle interventions in general practice. Part 3: Lifestyle and chronic respiratory disease. S Afr Fam Pract. 2008;50(6):6-12.
38. Buchbinder R, Pransky G, Hayden J. Recent advances in the evaluation and management of non-specific low back pain and related disorders. Best Pract Res Clin Rheumatol. 2010;24(2):147-153.
39. Moore JE. Chronic low back pain and psychosocial issues. Phys Med Rehabil Clin N Am. 2010;21(4):801-815.
40. Chou R, Shekelle P. Will this patient develop persistent disabling low back pain? JAMA. 2010;303(13):1295-1302.
41. Boersma K, Linton SJ. Psychological processes underlying the development of a chronic pain problem: a prospective study of the relationship between profiles of psychological variables in the fear-avoidance model and disability. Clin J Pain. 2006;22(2):160-166.
42. Coudeyre E, Rannou F, Tubach F, et al. General practitioners' fear-avoidance beliefs influence their management of patients with low back pain. Pain 2006;124(3):330-337.
43. Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: a literature review. Arch Intern Med. 2003;163(20):2433-2445.
44. Fishbain DA, Cutler R, Rosomoff HL, Rosomoff RS. Chronic pain-associated depression: antecedent or consequence of chronic pain? A review. Clin J Pain. 1997;13(2):116-137.
45. Hoffman BM, Papas RK, Chatkoff DK, Kerns RD. Meta-analysis of psychological interventions for chronic low back pain. Health Psychol. 2007;26(1):1-9.
46. Engers A, Jellema P, Wensing M, et al. Individual patient education for low back pain. Cochrane Database Syst Rev 2008(1):CD004057.
47. Schwellnus MP, Patel DN, Nossel CJ, et al. Healthy lifestyle interventions in general practice. Part 11: Lifestyle and arthritic conditions - rheumatoid arthritis. S Afr Fam Pract. 2010;52(3):176-83.
48. Schwellnus MP, Patel DN, Nossel CJ, et al. Healthy lifestyle interventions in general practice. Part 10: Lifestyle and arthritic conditions - osteoarthritis. S Afr Fam Pract. 2010;52(2):91-97.
49. Derman EW, Whitesman S, Dreyer M, et al. Healthy lifestyle interventions in general practice. Part 14: Lifestyle and obesity. S Afr Fam Pract. 2011;53(2):105-118.
50. Gagnier JJ. Evidence-informed management of chronic low back pain with herbal, vitamin, mineral, and homeopathic supplements. Spine J. 2008;8(1):70-79.