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How to prevent low back pain

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This chapter summarizes the European Guidelines for Prevention in Low Back Pain, which consider the evidence in respect of the general population, workers and children. There is limited scope for preventing the incidence (first-time onset) of back pain and, overall, there is limited robust evidence for numerous aspects of prevention in back pain. Nevertheless, there is evidence suggesting that prevention of various consequences of back pain is feasible. However, for those interventions where there is acceptable evidence, the effect sizes are rather modest. The most promising approaches seem to involve physical activity/exercise and appropriate (biopsychosocial) education, at least for adults. Owing to its multidimensional nature, no single intervention is likely to be effective at preventing the overall problem of back pain, although there is likely to be benefit from getting all the players onside. However, innovative studies are required to better understand the mechanisms and delivery of prevention in low back pain.

Key words: back pain; guidelines; prevention.

Prevention of low back pain is an attractive notion but is it a realistic goal and, if so, how can it be achieved? To answer these questions requires an understanding of the epidemiology of low back pain as well as a synthesis of the scientific evidence on (purported) preventive interventions. This has recently been undertaken within the framework of Cost Action B13 'Low back pain: guidelines for its management', issued by the European Commission, Research Directorate-General, Department of Policy, Co-ordination and Strategy. Under this initiative, a working group was established to develop guidelines for prevention—European Guidelines for Prevention in Low Back Pain. The full guidelines, of which this chapter is essentially a summary, are available at: www.backpaineurope.org.

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BASIC EPIDEMIOLOGY

The lifetime prevalence of non-specific (common) low back pain is estimated at 60–70% in industrialized countries (1-year prevalence 15–45%, adult incidence 5% per year). The prevalence rate during school age approaches that seen in adults[1,2]; it increases from childhood to adolescence[3] and peaks between ages 35 and 55.[4] Symptoms, pathology and radiological appearances are poorly correlated. Pain cannot be attributed to pathology or neurological encroachment in about 85% of people. Recent research has suggested a role for a genetic influence on liability to back pain.[5,6]

Acute low back pain is usually considered to be self-limiting but 2–7% of people develop chronic pain. Whereas the vast majority of episodes of back pain are associated with return to work in a timely fashion[7], recurrent and chronic back pain is widely acknowledged to account for a substantial proportion of total workers' absenteeism. About half the days lost from work are accounted for by the 85% of people away from work for short periods (<7 days); the other half is accounted for by the 15% who are off work for >1 month. This is reflected in the social costs of back pain, where some 80% of the health care and social costs are for the 10% with chronic pain and disability.[8]

These statistics, however, tend to be based on the clinically convenient classification of acute and chronic, which does not fully reflect the pattern of back pain among the population. Recent evidence shows that back pain manifests as an untidy pattern of symptomatic periods interspersed with less troublesome periods[9–11], although for some the symptoms (and associated disability) can become persistent. Around two-thirds of people are likely to experience relapses of pain over 12 months, and around one-third are likely to have relapses of work absence.[12] These issues present interpretative difficulties when considering the matter of prevention, where back pain and its consequences tend to occur in an episodic manner.[11]

Importantly, back pain should be seen as an issue for all ages and all sectors of society. Furthermore, it is important to distinguish between the presence of symptoms, care seeking, work loss and disability; these have different prevalence rates and are influenced by a varying balance of biological, psychological and social factors.[8,13]

The issue of 'risk' for the development of low back pain is clearly highly relevant to the concept of prevention, but the subject is poorly understood and inconsistently documented. The most powerful risk indicator for a new episode of back pain is a previous history.[12] Beyond that, the most frequently reported risk indicators are heavy physical work, frequent bending, twisting, lifting, pulling and pushing, repetitive work, static postures and vibrations.[4] Psychosocial risk indicators include distress, depression, beliefs, job dissatisfaction and mental stress at work.[4,14,15] However, there is limited evidence for these (purported) risk factors and those that are well documented frequently have small effect sizes; logically this will compromise the magnitude of preventive interventions.

OUTCOMES AND INTERVENTIONS

The guidelines working group spent considerable time debating the focus of the guideline and attempting to produce a working definition of 'prevention'. Taking account of the epidemiology of back pain, the working group concluded that prevention of the first onset of common low back pain is, to all intents and purposes, likely to be impracticable. It was considered that, overall, non-specific low back pain is important not so much for its

existence as for its consequences. Therefore, the consequences of common low back pain are a primary concern for prevention. They include broad issues such as recurrence (including severity and disability), work loss, care seeking, health-related quality of life and compensation. Thus, the conceptual focus was prevention of future aspects of low back pain, as opposed to manifestations of the current spell. Several aspects of the back pain phenomenon were generally excluded, such as prevention of structural changes and 'degeneration', along with interventions aimed at modification of (purported) risk factors, unless there is concomitant specific influence on back pain outcomes. However, in recognition of widespread interest in back pain among school children, and the possibility of prevention of consequences later in life, consideration of potentially modifiable risk factors for back pain in this population was considered.

A vast number of 'interventions' might 'prevent' (some aspect of) common low back pain (LBP), and not all possible interventions are included in the guideline because they are idiosyncratic, non-generalizable or untested (although that is not to say they will not be shown to be effective at some future date). Some interventions involve an active element and some will concern avoidance, whereas others involve less direct approaches, such as addressing inappropriate beliefs[16] or interfacing with social reorganization.[17] Individual interventions might not be universally applicable; rather they will be variously suited to the general population, workers and school-aged children. Although some 'clinical' interventions might have a preventive effect on some outcomes, therapy is not generally considered prevention, yet preventive interventions cannot (and should not) exclude people with existing back symptoms. The same basic interventions will apply equally to the different groups, but their nature and location of delivery will differ. It is possible that the evidence will overlap, and might not necessarily come to identical conclusions.

EVIDENCE

The guideline is evidence based and evidence linked, relying on systematic searches of the scientific literature up to the end of 2003. In the first instance, systematic reviews (and existing guidelines) were sought, supplemented by individual scientific studies where systematic reviews and evidence-based guidelines were not available. The evidence was reviewed and discussed by the entire working group, as were the resultant recommendations; the process is best summarized as systematic searching of the published scientific literature with mixed quantitative/qualitative evaluation of the evidence to produce best-synthesis recommendations.

The strength of the recommendations was based on a four-level rating system:

Level A: generally consistent findings provided by (a systematic review of) multiple randomized controlled trials (RCT).
Level B: generally consistent findings provided by (a systematic review of) multiple weaker scientific studies.
Level C: one RCT/weaker scientific study, or inconsistent findings provided by (a systematic review of) multiple weaker scientific studies.
Level D: no RCTs or no weaker scientific studies.

The following sections outline the primary evidence, followed by the recommendation for each intervention. Additional sections representing the discussion of

the evidence and formulation of the recommendations, including additional literature considered, can be found in the full guideline at www.backpaineurope.org.

EVIDENCE AND RECOMMENDATIONS

General population (P)

P1: physical exercise

Evidence. Two systematic reviews[18,19] and one primary care guideline[20] were found on exercise for prevention in the general population. All the authors' main conclusions were that physical exercise has a positive effect in the prevention of back pain, further episodes and work absence. Effect sizes were reported to be small to moderate. One systematic review found for pregnant women[21] concluded that water gymnastics has a preventive effect on future back pain.

Recommendation. Physical exercise is recommended to prevent absence due to back pain and the occurrence or duration of further back pain episodes (level A). The effect size is moderate. There is insufficient evidence to recommend for or against any specific kind of exercise, or the frequency/intensity of training (level B). Water gymnastics could be recommended to reduce (short-term) back pain and extended work loss during and following pregnancy (level C).

P2: information/education/training (back schools)

Evidence: information and education. One systematic review[22] found inconsistent results on the effect of information for prevention in back pain. More recently, a controlled trial of a public health multimedia campaign found improved beliefs about back pain, a reduction in days off work and reduced use of the health care system.[23]

Recommendation: information and education. Information and education about back pain, if based on biopsychosocial principles, should be considered for the general population; it improves back beliefs and can have a positive influence on health and vocational outcomes, although the effect size might be relatively small (level C). Information and education focused principally on a biomedical or biomechanical model cannot be recommended (level C).

Evidence: back schools/training. A recent Cochrane review[24] defined back school as a group intervention, conducted or supervised by a paramedical therapist or a medical specialist, which consisted of both an education/skills programme and exercises. The authors found that there was: (1) conflicting evidence on the effectiveness of back schools on further work loss; (2) limited evidence that back schools show no differences in long term recurrence rates of LBP episodes. The authors concluded that back schools might be effective for patients with recurrent and chronic pain, with the most promising interventions being those with a high intensity (3–5-weeks stay in specialized centres). The effect sizes of these interventions were judged small.

Recommendation: back schools/training. Back schools based on a biomechanical approach with emphasis on teaching lifting techniques are not recommended (level A).

High-intensity back schools, which comprise both an educational/skills programme and exercises, can be recommended for patients with recurrent and persistent pain (level B). The effect sizes of these interventions might be relatively small.

P3: lumbar supports/back belts

Evidence. Two systematic reviews[18,19] and one primary care guideline[20] evaluated five RCTs and two non-randomized trials on lumbar supports/back belts for prevention of back pain or back problems. All concluded that lumbar support or back belts are no more beneficial than either no intervention or other preventive interventions, and that they might even be detrimental. The combination of back belts with back school is no better or worse than back school alone.

Recommendation. Lumbar supports/back belts are not recommended for prevention in LBP among the general population (level A).

P4: furniture

Evidence: mattresses. No systematic reviews on the use of mattresses for the prevention of back pain were found. Twelve published studies were found, which reported interventions aiming at reducing back pain by using different mattresses. The design of the studies, their methodological quality and the results do not allow any conclusions with respect to prevention in back pain, although one RCT suggests that patients might have less pain with a medium-firm rather than hard mattress.[25]

Recommendation: mattresses. There is insufficient robust evidence to recommend for or against any specific mattresses for prevention in back pain (level C), although existing persistent symptoms might reduce with a medium-firm rather than a hard mattress (level C).

Evidence: chairs. No acceptable evidence for any preventive aspects of chairs was found; the three studies retrieved had inappropriate methodology.

Recommendation: chairs. There is insufficient evidence to recommend for or against any specific chairs for prevention in LBP (level D).

P5: shoe insoles/correction of leg length discrepancies

Evidence. No systematic reviews on the use of shoe insoles, shock-absorbing heel inserts or orthoses for the prevention of back pain were found. Seven clinical trials reported interventions aiming to reduce back pain by use of different insoles: only two of those reported a beneficial effect from orthoses.[26,27] No acceptable study concerning prevention of LBP by correction of leg length discrepancy was identified.

Recommendation. The use of shoe insoles or orthoses is not recommended for prevention of back problems (level A). There is insufficient evidence to recommend for or against correction of leg length inequality for prevention in LBP (level D).

P6: manipulation

Evidence. No acceptable studies reporting on the value of regular manipulative treatment for prevention of LBP were found.

Recommendation. No evidence was found to support recommending regular manipulative treatment for the prevention in LBP (level D).

Workers (W)

W1: physical exercise/physical activity

Evidence. Six reviews concluded that there is some evidence of positive effect of exercise[18,19,22,28–30], and one review[31] concluded that there was contradictory evidence that various general exercise/physical fitness programmes reduce future LBP and work loss, and that any effect size was modest. The authors of the most recent review[30] concluded that there was limited evidence of effect of exercise on sick leave and new episodes of LBP but no evidence of effect of exercise on level of pain. Recently, the conclusion of positive effects of physical exercise in the prevention of recurrence of sick leave due to LBP was confirmed indirectly by a meta-analysis.[32] However, the effect on workers receiving a disability allowance is seemingly small and not significant.[32]

Recommendation. Physical exercise can be recommended in the prevention of LBP (level A). Furthermore, physical exercise might be recommended in the prevention of recurrence of LBP (level A) and in the prevention of recurrence of sick leave due to LBP (level C).

W2: information/advice/instruction

Evidence. Six reviews[18,19,22,29–31] concluded that there is no effect of information, advice and instruction for preventing sick leave, episodes or costs. One review concluded that there are strong effects on recipients' knowledge of 'correct' back posture and movements, and on knowledge of back school contents, yet the interventions had only small effects on health outcome variables and no effects on clinical variables.[33] One review concluded that there was a modest relationship between training of employees and a decrease in the occurrence of back pain or duration of sick leave associated with back pain.[28] Two reviews[18,30] noted a single, non-randomized trial that suggested that workplace delivery of information targeting fear avoidance behaviour by promoting coping could shift beliefs and reduce sick leave.[34] The most recent and comprehensive review concluded that there was limited evidence of no effect on episodes of LBP and no evidence of effect on both pain and sick leave.[30] There is contradictory evidence for the effects of educational interventions in the prevention of recurrence of sick leave due to LBP.[35–37] The educational interventions involved in those studies have a common theme; they promote the 'important to stay active' message, but there is also substantial variation in the content of the interventions.

Recommendation. Traditional information/advice/instruction on biomechanics, lifting techniques, optimal postures, etc. is not recommended for prevention in LBP (level A). There is insufficient evidence to recommend for or against psychosocial information delivered at the worksite (level C) but information oriented towards promoting activity

and improving coping can promote a positive shift in beliefs (level C). Although the evidence is not sufficiently consistent to recommend education in the prevention of recurrence of sick leave due to LBP (level C), incorporating the messages from the accompanying clinical guidelines into workplace information/advice is encouraged.

W3: back belts/lumbar supports

Evidence. Three reviews concluded that there was strong evidence that lumbar support is not effective for prevention in LBP.[18,29,31] One review concluded that there is moderate evidence that lumbar supports do not prevent LBP[38], another concluded that there is no evidence of effect of back belt for prevention in LBP30 and two reviews concluded that there is insufficient evidence of the efficacy of lumbar supports.[19,22] Whereas one study suggested that the use of back belts was associated with some reduction in risk of low back injury among female home attendants[39], inspection of the findings revealed the preventive effect was far from significant when controlling for confounders.

Recommendation. Back belts/lumbar supports are not recommended for prevention in LBP (level A).

W4: shoe inserts, shoe orthoses, shoe insoles, flooring and mats

Evidence. Two RCTs[40,41] reporting no preventive effects on lower back injury and back problems concluded that there is evidence of no effect of shoe inserts/orthoses in the prevention of workers' LBP. There is no scientific evidence of a preventive effect of shoe insoles, flooring or mats, because no studies relevant to prevention outcomes in LBP were found.

Recommendation. Shoe inserts/orthoses are not recommended for prevention in LBP (level A). There is insufficient evidence to recommend for or against shoe insoles, soft shoes, soft flooring or antifatigue floor mats (level D).

W5: physical ergonomics

Evidence. One review found a general lack of success from mechanical exposure interventions[42], and another offered a negative conclusion about the role of ergonomic interventions.[18] Three subsequent good-quality studies[43–45] reported that physical ergonomics interventions might reduce the prevalence and severity of LBP. Two further good-quality studies did not report an improvement following changes intended to reduce exposure to physical risk factors.[46,47] Physical ergonomic interventions that include an organizational dimension, actively involving the workers and leading to substantial changes in exposure to the risk factors, might (in principle) be the most effective. However, there is only limited supportive evidence from one systematic review.[42] In respect of reducing (reported) back injuries and occupational or compensable LBP, several studies[43,48–51] report physical ergonomics interventions to be successful, although these studies are generally of low quality. The only RCT[45] did not find lower injury rates in the intervention groups.

Recommendation. There is insufficient consistent evidence to recommended physical ergonomics interventions alone for reduction of the prevalence and severity of LBP

(level C). There is insufficient consistent evidence to recommended physical ergonomics interventions alone for reduction of (reported) back injuries, occupational or compensable low back pain (level C). There is some evidence that, to be successful, a physical ergonomics programme would need an organizational dimension and involvement of the workers (level B). There is insufficient evidence to specify precisely the useful content of such interventions (level C), and the size of any effect might be modest.

W6: organizational ergonomics

Evidence. There is inconsistent evidence that work organization interventions are successful for reduction of LBP. This conclusion is based on two studies, one positive with a low methodological quality[52] and one negative with moderately high methodological quality.[53]

Recommendation. There is insufficient consistent evidence to recommend stand-alone work organizational interventions for prevention in LBP (level C), although such interventions could, in principle, enhance the effectiveness of physical ergonomics programmes.

W7: multidimensional interventions

Evidence. There is evidence from two systematic reviews[30,54] that multidimensional interventions (some of which included an ergonomics component) have a positive effect for prevention in LBP. The most recent review concluded that comprehensive multidisciplinary and multimodal treatment interventions can have a positive effect for some, but not all, LBP outcomes.[30]

Recommendation. Whereas multidimensional interventions at the workplace might be recommended to reduce some aspects of LBP, it is not possible to recommend which dimensions and in what balance (level A). The size of any effect might be modest.

W8: modified work for return to work after sick leave due to LBP

Evidence. Studies on the effects on return to work of modified work have been evaluated in three reviews.[55–57] There is moderate evidence of positive effects of modified work to promote return to work (shorter return-to-work time) after sick leave from regular work due to LBP.

Recommendation. Temporary modified work (which might include ergonomic work-place adaptations) can be recommended, when needed, to facilitate earlier return to work for workers sick listed due to LBP (level B).

Notwithstanding the evidence on physical and organizational ergonomics to specifically influence outcomes, the working group endorsed the pragmatic view that 'Work should be comfortable when we are well, and accommodating when we are ill'[58], and recognized that ergonomics has a role in formulating modified work to facilitate early return to work.[59]

School age (S)

There is limited evidence linking childhood back pain with adult symptoms[60], but no evidence was found to indicate that modifying childhood back pain would influence its occurrence in adults. Studies evaluating the effects of interventions to prevent LBP or its consequences in school children are still sparse, with only school-based interventions satisfying the criteria for the guideline.

S1: school-based interventions

Evidence. Only five school-based intervention studies on back pain or its consequences could be located. The intervention programmes comprised a variable number of hours of education in back care principles. In a controlled trial, an independent health check 4 years after programme application tended to favour the intervention pupils, who required less medical treatment for LBP.[61] A controlled before–after trial showed a positive short-term effect of back education on back pain prevalence, which was sustained at 9-month follow-up.[62] Similarly, another controlled trial, involving a small sample of children, reported a positive effect on back pain.[63] By contrast, the educational intervention in another study did not have an effect on back pain after 1 year of intervention.[64] During the 3-year period analyzed in an uncontrolled intervention study, there was an overall reduction in prevalence of LBP yet recollection of participation in the prevention programme was associated with increased self-reported LBP, although with significantly decreased utilization of medical care.[65]

While it can be concluded that the results of the intervention studies are promising, differences between the interventions and the limitations of the studies dictate a need for cautious interpretation and do not encourage the recommendation of back care education for prevention of LBP in school children. Moreover, follow-up into adulthood is missing and there is insufficient information to be able to specify precisely what might be the important/effective components of such interventions.

Recommendation. There is insufficient evidence to recommend for or against a generalized educational intervention for the prevention of LBP or its consequences in school children (level C).

S2: modifiable risk factors

No studies were found that evaluated the effects on back pain or its consequences in school children from modification of risk factors. Nevertheless, the available information on modifiable risk factors was synthesized to inform future research, accepting that risk factor modification without concomitant influence on outcomes cannot be considered prevention.

A number of potentially modifiable risk factors/risk indicators were located in the literature. Some have a theoretical causal link with LBP but others are better described as risk indicators. They fell into four groups: lifestyle factors (overweight/obesity, smoking, alcohol intake, eating habits, working, sports participation, physical inactivity and sedentary activities), physical factors (physical fitness, mobility and flexibility, muscular strength), school-related factors (school bags and school furniture) and psychosocial factors. The association between these purported risk

factors/risk indicators and LBP was found to be rather mixed, with no single factor or set of factors predominating. The working group agreed that the following statements reflect the current state of knowledge about back pain prevention during school age (discussion of the supporting evidence can be found at www.backpaineurope.org):

- There is no evidence for or against recommending weight control as a preventive action.
- There is no evidence that antismoking campaigns will have a preventive effect.
- There is insufficient evidence to recommend for or against modification of eating habits as a preventive measure.
- There is no evidence for or against recommending modification of alcohol intake as a preventive measure.
- There is no evidence that performing sports or being physically active has a preventive effect. There is also insufficient evidence to recommend a general limitation of involvement in competitive sports participation as a preventive measure.
- There is insufficient evidence to recommend for or against modified sitting postures as a preventive action. There is also no evidence that decreasing sedentary activities will have a preventive effect.
- There is insufficient evidence to recommend for or against modification of mobility and flexibility of muscles and joints as a preventive action.
- There is insufficient evidence to recommend for or against muscle strengthening as a preventive action.
- There is no consistent evidence for or against recommending a limit to the weight of schoolbags (or for avoiding their use) or changing the type of schoolbag (or the method of carrying it) as primary preventive measures.
- There is insufficient evidence to recommend for or against modified school furniture as a preventive measure.
- There is no evidence that modification of psychological factors might have a preventive effect.

SUMMARY

The general nature and course of commonly experienced LBP means that there is limited scope for preventing its incidence (first-time onset). Because primary causative mechanisms remain largely undetermined, risk factor modification will not necessarily achieve prevention.

There is considerable scope, in principle, for preventing the consequences of LBP, e.g. episodes (recurrence), care seeking, disability and work loss. Overall, there is limited robust evidence for many aspects of prevention in LBP, yet there is evidence that prevention of various consequences of LBP is feasible. However, for those interventions where there is acceptable evidence, the effect sizes are rather modest.

The most promising approaches seem to involve physical activity/exercise and appropriate (biopsychosocial) education, at least for adults. Prevention in LBP is, arguably, as much a societal concern as an individual issue. So optimal progress on prevention in LBP is likely to require a cultural shift in the way LBP is viewed, its

relationship with activity and work, how it might best be tackled and just what is reasonable to expect from preventive strategies.

There is likely to be benefit from getting all the players onside, but innovative studies are required to understand better the mechanisms and delivery of prevention in LBP.

Anecdotally, individuals might report that various strategies work for them, but in the absence of scientific evidence that does not mean they can be generally recommended for prevention; it is not known whether some of these strategies have disadvantageous long-term effects.

Practice points

General population

- physical exercise is recommended for prevention of sick leave due to LBP and for the occurrence or duration of further episodes
- information and education about back problems, if based on biopsychosocial principles, should be considered but information and education focused principally on a biomedical or biomechanical model cannot be recommended
- there is no robust evidence for or against recommending any specific chair or mattress for prevention in LBP
- there is no evidence to support regular manipulative treatment for prevention in LBP

Workers

- physical exercise is recommended in the prevention of LBP to prevent recurrence of LBP and recurrence of sick leave due to LBP
- back schools based on traditional biomedical/biomechanical information, advice and instruction are not recommended for prevention in LBP. There is insufficient evidence to recommend for or against psychosocial information delivered at the worksite, although it can promote a positive shift in beliefs
- lumbar supports or back belts are not recommended
- temporary modified work and ergonomic workplace adaptations can be recommended to facilitate earlier return to work for workers sick listed due to LBP
- there is insufficient consistent evidence to recommended physical ergonomics interventions alone for prevention in LBP. There is some evidence that, to be successful, a physical ergonomics programme would need an organizational dimension and involvement of the workers

School age

- there is insufficient evidence to recommend for or against a generalized educational intervention for the prevention of LBP or its consequences in school children
- there is insufficient evidence to recommend modification of any of the purported risk factors to reduce back problems in school children
- despite the intuitive appeal of the idea, there is no evidence that attempts to prevent LBP in school children will have any impact on LBP in adults

Research agenda

- future studies need to be of high quality, where possible in the form of randomized controlled trials, and should include cost-benefit and risk-benefit analyses

General

- to determine the effectiveness of specific interventions aimed at specific risk/target groups
- misconceptions about back pain are widespread in adults and play a role in the development of long-term disability.[66] Further study is necessary to explore whether these misconceptions can be prevented by carefully selected and presented health promotion programmes, with the merit of demedicalizing LBP

Workers

- to study the effectiveness of physical exercise as well as daily physical activity for prevention of LBP and associated sick leave
- to study the effectiveness of physical, psychosocial and organizational ergonomic interventions (including the role of information/advice) on a variety of outcomes ranging from prevention of (recurrence of) LBP and prevention of (recurrence of) sick leave due to LBP up to compensatable LBP

School age

- to determine the effects (and likely impact) of preventive programmes and risk factor modifications during school age
- a follow-up into adulthood is needed to evaluate whether the cumulative physical load experience on the lumbar spine (e.g. from heavy book-bag carrying or sitting on unadjusted furniture) during childhood and adolescence contributes to adult LBP

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REFERENCES

1. Watson KD, Papageorgiou AC, Jones GT et al. Low back pain in schoolchildren: occurance and characteristics. *Pain* 2002; **97:** 87–92.
2. Taimela S, Kujala UM, Salminen JJ & Viljanen T. The prevalence of low back pain among children and adolescents: a nationwide, cohort-based questionnaire survey in Finland. *Spine* 1997; **22:** 1132–1136.
3. Balague F, Troussier B & Salminen JJ. Non-specific low back pain in children and adolescents: risk factors. *Eur Spine J* 1999; **8:** 429–438.

4. Andersson GBJ. The Epidemiology of Spinal Disorders. In Frymoyer JW (ed.) *The Adult Spine: Principles and Practice*. Philadelphia: Lippincott-Raven, 1997, pp. 93–141.
5. Hestbaek L, Iachine IA, Leboeuf-Yde C et al. Heredity of low back pain in a young population: a classical twin study. *Twin Res* 2004; **7:** 16–26.
6. MacGregor AJ, Andrew T, Sambrook PN & Spector TD. Structural, psychological, and genetic influences on low back and neck pain: a study of adult female twins. *Arthritis Rheum* 2004; **51:** 160–167.
7. Phelps GL, Vogel R & Shellenberger S. Treatment and outcomes in occupational low back pain: a practice evaluation and comparison with national and international guidelines. *J Agromed* 2004; **7:** 67–78.
8. Nachemson AL, Waddell G & Norlund AI. Epidemiology of neck and low back pain. In Nachemson AL & Jonsson E (eds.) *Neck and Back Pain: The Scientific Evidence of Causes, Diagnosis and Treatment*. Philadelphia: Lippincott Williams and Wilkins, 2000, pp. 165–188.
9. Croft PR, Macfarlane GJ, Papageorgiou AC et al. Outcome of low back pain in general practice: a prospective study. *BMJ* 1998; **316:** 1356–1359.
10. Hestbaek L, Leboeuf-Yde C, Engberg M et al. The course of low back pain in a general population. Results from a 5-year prospective study. *J Manipulative Physiol Ther* 2003; **26:** 213–219.
11. de Vet HCW, Heymans MW, Dunn KM et al. Episodes of low back pain: a proposal for uniform definitions to be used in research. *Spine* 2002; **27:** 2409–2416.
12. Hestbaek L, Leboeuf-Yde C & Manniche C. Low back pain: what is the long-term course? A review of studies of general patient populations. *Eur Spine J* 2003; **12:** 149–165.
13. Burton AK. Back injury and work loss: biomechanical and psychosocial influences. *Spine* 1997; **22:** 2575–2580.
14. Hoogendoorn WE, van Poppel MNM, Bongers PM et al. Systematic review of psychosocial factors at work and in private life as risk factors for back pain. *Spine* 2000; **25:** 2114–2125.
15. Linton SJ. A review of psychological risk factors in back and neck pain. *Spine* 2000; **25:** 1148–1156.
16. Ihlebæk C & Eriksen HR. Are the 'myths' of low back pain alive in the general Norwegian population? *Scand J Public Health* 2003; **31:** 395–398.
17. Scheel IB, Hagen KB, Herrin J et al. Blind faith? The effects of promoting active sick leave for back pain patients: a cluster-randomized controlled trial. *Spine* 2002; **27:** 2734–2740.
18. Linton SJ & van Tulder MW. Preventive interventions for back and neck pain problems: what is the evidence? *Spine* 2001; **26:** 778–787.
19. Lahad A, Malter A, Berg AO & Deyo R. The effectiveness of four interventions for the prevention of low back pain. *JAMA* 1994; **272:** 1286–1291.
20. US Preventive Services Task Force. Primary Care Interventions to Prevent Low Back Pain in Adults: Recommendation Statement. Rockville, MD: Agency for Healthcare Research and Quality, 2004. Online Available at: www.ahrq.gov/clinic/3rduspstf/lowback/lowbackrs.htm.
21. Young G & Jewell D, *Interventions for Preventing and Treating Pelvic and Back Pain in Pregnancy (Cochrane Review) The Cochrane Library, Issue 4*. Chichester: Wiley; 2003.
22. van Poppel MN, Koes BW, Smid T & Bouter LM. A systematic review of controlled clinical trials on the prevention of back pain in industry. *Occup Environ Med* 1997; **54:** 841–847.
23. Buchbinder R, Jolley D & Wyatt M. Population based intervention to change back pain beliefs and disability: three part evaluation. *BMJ* 2001; **322:** 1516–1520.
24. Heymans MW, van Tulder MW, Esmail R, Bombardier C et al, *Back schools for non-specific low back pain (Cochrane Review) The Cochrane Library*. Chichester: Wiley; 2004.
25. Kovacs FM, Abraira V, Pena A et al. Effect of firmness of mattress on chronic non-specific low-back pain: randomised, double-blind, controlled, multicentre trial. *Lancet* 2003; **362:** 1599–1604.
26. Fauno P, Kalund S, Andreasen I & Jorgensen U. Soreness in lower extremities and back is reduced by use of shock absorbing heel inserts. *Int J Sports Med* 1993; **14:** 288–290.
27. Tooms RE, Griffin JW, Green S & Cagle K. Effect of viscoelastic insoles on pain. *Orthopedics* 1987; **10:** 1143–1147.
28. Gebhardt WA. Effectiveness of training to prevent job-related back pain: a meta-analysis. *Br J Clin Psych* 1994; **33**(571)**:** 574.
29. Maher CG. A systematic review of workplace interventions to prevent low back pain. *Aust J Physiother* 2000; **46:** 259–269.
30. Tveito TH, Hysing M & Eriksen HR. Low back pain interventions at the workplace: a systematic literature review. *Occup Med* 2004; **54:** 3–13.

31. Waddell G & Burton AK. Occupational health guidelines for the management of low back pain at work: evidence review. *Occup Med* 2001; **51:** 124–135.
32. Kool J, de Bie R, Oesch P et al. Exercise reduces sick leave in patients with non-acute non-specific low back pain: a meta-analysis. *J Rehabil Med* 2004; **36:** 49–62.
33. Maier-Riehle B & Härter M. The effects of back schools—a meta-analysis. *Int J Rehabil Res* 2001; **24:** 199–206.
34. Symonds TL, Burton AK, Tillotson KM & Main CJ. Absence resulting from low back trouble can be reduced by psychosocial intervention at the work place. *Spine* 1995; **20:** 2738–2745.
35. Leclaire R, Esdaile JM, Suissa S et al. Back school in a first episode of compensated acute low back pain: a clinical trial to assess efficacy and prevent relapse. *Arch Phys Med Rehabil* 1996; **77:** 673–679.
36. Indahl A, Haldorsen EH, Holm S et al. Five-year follow-up study of a controlled clinical trial using light mobilization and an informative approach to low back pain. *Spine* 1998; **23:** 2625–2630.
37. 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:** 1844–1851.
38. Jellema P, van Tulder MW, van Poppel MNM et al. Lumbar supports for prevention and treatment of low back pain. *Spine* 2001; **26:** 377–386.
39. Kraus JF, Schaffer KB, Rice T et al. A field trial of back belts to reduce the incidence of acute low back injuries in New York City home attendants. *Int J Occup Environ Health* 2002; **8:** 97–104.
40. Mündermann A, Stefanyshyn DJ & Nigg BM. Relationship between footwear comfort of shoe inserts and anthropometric and sensory factors. *Med Sci Sports Exerc* 2001; **33:** 1939–1945.
41. Larsen K, Weidich F & Leboeuf-Yde C. Can custom-made biomechanic shoe orthoses prevent problems in the back and lower extremities? A randomized, controlled intervention trial of 146 military conscripts. *J Manipulative Physiol Ther* 2002; **25:** 326–331.
42. Westgaard RH & Winkel J. Ergonomic intervention research for improved musculoskeletal health: a critical review. *Int J Ind Ergon* 1997; **20:** 463–500.
43. Evanoff BA, Bohr PC & Wolf LD. Effects of a participatory ergonomics team among hospital orderlies. *Am J Ind Med* 1999; **35:** 358–365.
44. Brisson C, Montreuil S & Punnett L. Effects of ergonomics training program on workers with video display units. *Scand J Work Environ Health* 1999; **25:** 255–263.
45. Yassi A, Cooper JE, Tate RB et al. A randomized controlled trial to prevent patient lift and transfer injuries of health care workers. *Spine* 2001; **26:** 1739–1746.
46. Fredriksson K, Bildtc C, Hägga G & Kilboma Å. The impact on musculoskeletal disorders of changing physical and psychosocial work environment conditions in the automobile industry. *Int J Ind Ergon* 2001; **28:** 31–45.
47. Smedley J, Trevelyan F, Inskip H et al. Impact of ergonomic intervention on back pain among nurses. *Scand J Work Environ Health* 2003; **29:** 117–123.
48. Marras WS, Allread WG, Burr DL & Fathallah FA. Prospective validation of a low-back disorder risk model and assessment of ergonomic interventions associated with manual materials handling tasks. *Ergonomics* 2000; **43:** 1866–1886.
49. Brophy MO, Achimore L & Moore-Dawson J. Reducing incidence of low-back injuries reduces costs. *AIHAH* 2001; **62:** 508–511.
50. Koda S, Nakagiri S, Yasuda N & Ohara H. A follow-up study of preventive effects on low back pain at worksites by providing a participatory occupational safety and health program. *Ind Health* 1997; **35:** 243–248.
51. Owen BD, Keene K & Olson S. An ergonomic approach to reducing back/shoulder stress in hospital nursing personnel: a five year follow up. *Int J Nursing Studies* 2002; **39:** 295–302.
52. Charney W. The lift team method for reducing back injuries: a 10 hospital study. *AAOHN* 1997; **45:** 300–304.
53. Wergeland EL, Veiersted B, Ingre M et al. A shorter workday as a means of reducing the occurrence of musculoskeletal disorders. *Scand J Work Environ Health* 2003; **29:** 27–34.
54. Gatty CM, Turner M, Buitendorp DJ & Batman H. The effectiveness of back pain and injury prevention programs in the workplace. *Work* 2003; **20:** 257–266.
55. Krause N, Dasinger LK & Neuhauser F. Modified work and return to work: a review of the literature. *J Occup Rehabil* 1998; **8:** 113–139.

56. van der Beek AJ, Frings-Dresen MHW & Elders LAM. Effectiviteit van werkaanpassingen bij werhervatting na klachten aan het bewegingsapparaat. *Tijdschrift voor Bedrijfs-en Verzekeringsgeneeskunde* 2000; **8:** 137–143.
57. van der Beek AJ. In van Mechelen W & Twisk JWR (eds.) *Werkaanpassingen vanwege klachten aan het bewegingsapparaat.* Maarsen: Elsevier Gezondheidszorg, 2004, pp. 14–22.
58. Hadler NM. Back pain in the workplace. What you lift or how you lift matters far less than whether you lift or when. *Spine* 1997; **22:** 935–940.
59. Waddell G & Burton AK. *Concepts of Rehabilitation for the Management of Common Health Problems*. London: The Stationery Office; 2004.
60. Harreby M, Neergaard K, Hesselsoe G & Kjer J. 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:** 2298–2302.
61. Mendez FJ & Gomez-Conesa A. Postural hygiene program to prevent low back pain. *Spine* 2001; **26:** 1280–1286.
62. Cardon GM, De Clercq DLR & De Bourdeaudhuij IMM. Back education efficacy in elementary schoolchildren: a 1-year follow-up study. *Spine* 2002; **27:** 299–305.
63. Feingold AJ & Jacobs K. The effect of education on backpack wearing and posture in a middle school population. *Work* 2002; **18:** 287–294.
64. Storr-Paulsen A. The body-consciousness in school—a back pain school. *Ugeskr Laeger* 2002; **165:** 37–41.
65. Balagué F, Nordin M, Dutoit G & Waldburger M. Primary prevention, education, and low back pain among school children. *Bull Hosp Jt Dis* 1996; **55:** 130–134.
66. Goubert L, Crombez G & De Bourdeaudhuij I. Low back pain, disability and back pain myths in a community sample: prevalence and interrelationships. *Eur J Pain* 2004; **8:** 385–394.