

# EUROPEAN GUIDELINES FOR PREVENTION IN LOW BACK PAIN

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**Summary of the concepts of prevention in low back pain (LBP):**

- The general nature and course of commonly experienced LBP means that there is limited scope for preventing its incidence (first-time onset). Prevention, in the context of this guideline, is focused primarily on reduction of the impact and consequences of LBP.
- Primary causative mechanisms remain largely undetermined: risk factor modification will not necessarily achieve prevention.
- There is considerable scope, in principle, for prevention of the *consequences* of LBP – e.g. episodes (recurrence), care seeking, disability, and workloss.
- Different interventions and outcomes will be appropriate for different target populations (general population, workers, and children) yet inevitably there is overlap.
- Interventions that are essentially treatments in the clinical environment, focused on management of current symptoms, are not considered as ‘prevention’ for the purposes of this guideline: they are covered in the accompanying clinical guidelines

**Overarching comments:**

- Overall, there is limited robust evidence for numerous aspects of prevention in LBP.
  - Nevertheless, there is evidence suggesting 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.
  - But, no single intervention is likely to be effective to prevent the overall problem of LBP, owing to its multidimensional nature.
- Prevention in LBP is a societal as well as an individual concern.
  - So, optimal progress on prevention in LBP will likely 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.
  - It is important to get all the players onside, but innovative studies are required to understand better the mechanisms and delivery of prevention in LBP.
- Anecdotally, individuals may 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.

**Recommendations:** These are based on systematic reviews, existing evidence-based guidelines, and scientific studies. The studies on which these recommendations are based were often variable and imprecise in specifying the interventions and outcomes investigated. Hence, it is not always possible to state exactly which outcomes will be influenced by a given intervention.

**Summary of recommendations for the general population:**

- Physical exercise is recommended for prevention of sick leave due to LBP and for the occurrence or duration of further episodes (Level A). There is insufficient consistent evidence to recommend for or against any specific type or intensity of exercise (Level C).
- Information and education about back problems, if based on biopsychosocial principles, should be considered (Level C), but information and education focused principally on a biomedical or biomechanical model cannot be recommended (Level C).
- Back schools based on traditional biomedical/biomechanical information, advice and instruction are not recommended for prevention in LBP (Level A). High intensity programmes, which comprise both an educational/skills programme and exercises, can be recommended for patients with recurrent and persistent back pain (Level B).
- Lumbar supports or back belts are not recommended (Level A).
- There is no robust evidence for or against recommending any specific chair or mattress for prevention in LBP (Level C), though persisting symptoms may be reduced with a medium-firm rather than a hard mattress (Level C).
- There is no evidence to support recommending manipulative treatment for prevention in LBP (Level D).
- Shoe insoles are not recommended in the prevention of back problems (Level A). There is insufficient evidence to recommend for or against correction of leg length (Level D).

**Summary of recommendations for workers:**

- Physical exercise is recommended in the prevention of LBP (Level A), for prevention of recurrence of LBP (Level A) and for prevention of recurrence of sick leave due to LBP (Level C). There is insufficient evidence to recommend for or against any specific type or intensity of exercise (Level C).
- Back schools based on traditional biomedical/biomechanical information, advice and instruction are 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 toward promoting activity and improving coping may promote a positive shift in beliefs (Level C).
- Lumbar supports or back belts are not recommended (Level A).
- Shoe inserts/orthoses are not recommended (Level A). There is insufficient evidence to recommend for or against in-soles, soft shoes, soft flooring or antifatigue mats (Level D).
- Temporary modified work and ergonomic workplace adaptations can be recommended to facilitate earlier return to work for workers sick listed due to LBP (Level B).
- There is insufficient consistent evidence to recommend physical ergonomics interventions alone for prevention in LBP (Level C). There is some evidence that, to be successful, a physical ergonomics programme would need an organisational dimension and involvement of the workers (Level B); there is insufficient evidence to specify precisely the useful content of such interventions (Level C).
- There is insufficient consistent evidence to recommend stand-alone work organisational interventions (Level C), yet such interventions could, in principle, enhance the effectiveness of physical ergonomics programmes.
- Whilst multidimensional interventions at the workplace can be recommended (Level A), it is not possible to recommend which dimensions and in what balance.

**Summary of recommendations for school age:**

- There is insufficient evidence to recommend for or against a generalized educational intervention for the prevention of LBP or its consequences in schoolchildren (Level C).
- Despite the intuitive appeal of the idea, there is no evidence that attempts to prevent LBP in schoolchildren will have any impact on LBP in adults (Level D).

### **Summary of recommendations for further research:**

It is recommended that the following approaches are considered for further research into prevention in low back pain. Future studies need to be of high quality; where possible that should be in the form of randomised controlled trials. It is also recommended that standards of evidence criteria for efficacy, effectiveness and dissemination should be taken into account (Society for Prevention Research 2004).

As a general recommendation, it is considered important that future studies include cost-benefit and risk-benefit analyses.

#### *General*

- Studies are needed to determine how and by whom interventions are best delivered to specific target groups.
- Good quality RCTs are needed to determine the effectiveness of specific interventions aimed at specific risk / target groups.
- Misconceptions about back pain are shown to be widespread in adults, and they play a role in the development of long-term disability (Goubert et al. 2004). Further study is necessary to explore whether these misconceptions may be prevented by carefully selected and presented health promotion programmes, with the merit of demedicalising LBP.
- More information is needed to match types of interventions with specific/relevant outcomes.
- High quality studies are recommended into the effectiveness of specific furniture to justify or refute claims by commercial interests.

#### *Workers*

- Good quality RCTs are needed to study the effectiveness of daily physical activity for prevention of LBP and for prevention of recurrence of LBP. In addition, the effectiveness of physical exercise as well as daily physical activity should be studied for prevention of (recurrence of) sick leave due to LBP.
- It is recommended to perform good quality RCTs on the role of information oriented toward reducing fear avoidance beliefs and improving coping strategies in the prevention of LBP.
- Good quality RCTs are urgently needed to study the effectiveness of physical, psychosocial and organisational ergonomic interventions on a large variety of outcomes, ranging from prevention of (recurrence of) LBP and prevention of (recurrence of) sick leave due to LBP up to compensable LBP.
- It is recommended to investigate whether effective interventions can be applied to all workers, irrespective of gender, age, seniority and/or past history of LBP. If the effective interventions have to be more tailor-made, the optimal approach for each relevant subgroup should be examined.

#### *School age*

- RCTs evaluating the possible positive effects of preventive programmes and risk factor modifications at young age on adult LBP are advocated.
- From a physiological point of view, poor life style habits and prolonged static sitting during school age on unadjusted furniture may play a role in the origin of LBP: further study is appropriate to determine any effectiveness of school-based interventions (exercise/sport, desks/seating, backpacks/bags).
- Further study with a follow-up into adulthood is needed to evaluate whether or not the physical cumulative 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.

## **Objectives**

The primary objective of the European evidence-based guidelines is to provide a set of recommendations that can support existing and future national and international guidelines or future updates of existing back pain guidelines.

This particular guideline intends to foster a realistic approach to improving prevention in respect of common (non-specific) low back pain in Europe by:

1. Providing recommendations on strategies to prevent low back pain and/or its consequences in the general population, workers, and during school age.
2. Ensuring an evidence-based approach through the use of systematic reviews and existing evidence-based guidelines, supplemented (where necessary) by individual scientific studies.
3. Providing recommendations that are generally acceptable to a wide range of professions and agencies in all participating countries.
4. Enabling a multidisciplinary approach, stimulating collaboration between the various players potentially involved in prevention, thus promoting consistency across countries in Europe.
5. Identifying ineffective interventions to limit their use.
6. Pointing to areas where more research is needed.

## **Target population**

The target population of this guideline on prevention in low back pain comprises individuals or groups that are going to develop new guidelines (national or local) or update existing guidelines, and their professional associations that will disseminate and implement these guidelines. Indirectly, these guidelines also aim to inform the general public, people with low back pain, health care providers, health promotion agencies, industry/employers, educationalists, and policy makers in Europe.

When using this guideline as a basis, it is recommended that guideline development and implementation groups should undertake certain actions and procedures, not all of which could be accommodated under COST Action B13. These will include: taking patients' preferences into account; performing a pilot test among target users; undertaking external review, providing tools for application; consideration of organisational obstacles and cost implications; provision of criteria for monitoring and audit; provision of recommendations for implementation strategies (van Tulder et al. 2004). In addition, in the absence of a review date for this guideline, it will be necessary to consider new scientific evidence as it becomes available.

## **Guidelines working group**

The guideline on prevention in low back pain was developed within the framework of the 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. The guidelines Working Group (WG) consisted of experts in the field of low back pain research. Members were invited to participate, taking into account that a range of relevant professions should be represented. The core group consisted of four women and eight men with various professional backgrounds, representing nine countries. None of the 12 members believed they had any conflict of interest.

The WG for the prevention guidelines had its first meeting in May 2001, at which three sub-groups were formed to accommodate the interventions and outcomes appropriate for prevention across the general population, workers, and during school age (the latter defined as <18 years of age). There were numerous subsequent meetings, before the outline draft of the guidelines was prepared in February 2004, following which there was a final meeting to discuss and refine this draft. Subsequent drafts were circulated among the members of the working group for their comments and approval. The penultimate draft was then sent for peer review to external experts, with the final draft being reviewed by the members of the Management Committee of COST Action B13. The full guidelines (including tables of evidence) are available at: [www.backpaineurope.org](http://www.backpaineurope.org)

## Evidence

The evidence underpinning the guideline recommendations was retrieved through systematic searches of the scientific literature up to the end of 2003. Because of the nature of the subject matter, each sub-group (population, workers, and school age) formulated its own search criteria according to what was deemed appropriate.

The working group determined that it was impossible to carry out a complete *de novo* systematic review of every aspect of prevention to an acceptable standard within an acceptable period of time. A strategy broadly conducive with the other guidelines in COST Action B13 was adopted: 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. It was decided that evidence from narrative reviews should be excluded, unless they were a synthesis of multiple reviews. It was anticipated that the field of 'prevention' in low back pain would have limited robust scientific evidence from randomised controlled trials (RCT), which are not always appropriate or practicable in this area. Therefore the group decided that studies employing scientifically weaker designs (eg controlled trials, controlled before-after trials, and interrupted time series designs) should be included in the absence of RCTs. Longitudinal epidemiological studies were also included where the group felt these added useful information.

Each sub-group formulated and itemised its specific search terms and sources (see Appendix), and determined what material should be included. Initially, the major electronic databases (including the Cochrane Library) were searched, and then supplemented by citation tracking, personal databases, and expert knowledge. No language restrictions were imposed, but non-English articles were only considered if their language was covered by a member of the working group. All sub-groups used (derivatives of) back pain as a primary keyword, which may have resulted in a few articles of potential interest being missed (such as those using terms such as medically unexplained symptoms and subjective health complaints and musculoskeletal pain).

To reduce both individual and sub-group bias, the evidence was reviewed and discussed by the entire working group, as were the resultant recommendations. Sections were added to each sub-section of the guidelines to reflect the discussion themes. The recommendations are presented separately for 'general population', 'workers', and 'school age', identified by a letter: P, W, S respectively.

The strength of recommendations was based on the four-level rating system used for the other guidelines in the COST Action B13 programme, but was slightly modified to take account of the nature of the available evidence:

**Level A:** Generally consistent findings provided by (a systematic review of) multiple RCTs.

**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 term 'weaker scientific studies' is taken to include, non-randomised controlled trials, controlled before/after studies, interrupted time series designs, and longitudinal epidemiological studies. The 'level' is a grading of the strength of the evidence; it is an indicator of confidence in the recommendation, rather than its strength or effect size].*

For this guideline, the review of the literature may best be summarised as systematic searching of the published scientific literature with mixed quantitative/qualitative evaluation of the evidence to produce best-synthesis recommendations.

## **Introduction**

### Definitions

Low back pain (LBP) is defined as pain and discomfort, localised below the costal margin and above the inferior gluteal folds, with or without leg pain. Non-specific (common) low back pain is defined as low back pain not attributed to recognisable, known specific pathology (e.g. infection, tumour, osteoporosis, ankylosing spondylitis, fracture, inflammatory process, radicular syndrome or cauda equina syndrome).

Acute low back pain is usually defined as the duration of an episode of low back pain persisting for less than 6 weeks; sub-acute low back pain as low back pain persisting between 6 and 12 weeks; chronic low back pain as low back pain persisting for 12 weeks or more. Whilst this categorisation is convenient for clinical purposes, it is less helpful when considering the matter of prevention, where back pain and its consequences tend to occur in an episodic manner (de Vet et al. 2002)

In this guideline, recommendations concern common low back pain, covering both episodic and persistent symptoms: recurrent low back pain is defined as a new episode after a symptom-free period, not an exacerbation of persistent low back pain.

The WG considered that, overall, non-specific low back pain is important not so much for its existence as for its *consequences*. Therefore, this guideline considers the consequences of common low back pain to be a primary concern for prevention. Consequences are important from the perspectives of the individual and of society. They include broad issues such as recurrence (including severity and disability), work loss, care seeking, health-related quality of life, and compensation.

### Epidemiology

The lifetime prevalence of low back pain is reported as over 70% in industrialised countries (one-year prevalence 15% to 45%, adult incidence 5% per year).. The prevalence rate during school age approaches that seen in adults (Watson et al. 2002; Taimela et al. 1997), increasing from childhood to adolescence (Balague et al. 1999), and peaking between ages 35 and 55 (Andersson 1997). Symptoms, pathology, and radiological appearances are poorly correlated. Pain cannot be attributed to pathology or neurological encroachment in about 85% of people. A role of genetic influence on liability to back pain is suggested from recent research (Hestbaek et al. 2004; MacGregor et al. 2004)

Acute low back pain is usually considered to be self-limiting (recovery rate 90% within 6 weeks) but 2%-7% of people develop chronic pain. 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), whilst 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 (Nachemson et al. 2000).

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 (Croft et al. 1998; Hestbaek et al. 2003a; de Vet et al. 2002), though for some the symptoms (and associated disability) may become persistent. Around two-thirds of people are likely to experience relapses of pain over 12-months, and around a third are likely to have relapses of work absence (Hestbaek et al. 2003b). These issues present interpretive difficulties when considering prevention, but are considered, as far as is practical, in the formulation of this guideline.

Importantly, for the scope of this guideline, back pain should be seen as an issue for all ages, and all sectors of society: the prevalence in adolescents is similar to adults (Watson et al. 2002), and the prevalence in workers generally does not dramatically differ from non-workers (Nachemson et al. 2000). 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 (Burton

1997; Nachemson et al. 2000). For instance, an episode of back pain can occur for no apparent reason or may result from some strenuous event (whether during work or leisure), whilst disability and sick leave are influenced largely by psychosocial factors (Waddell & Burton 2000).

The issue of risk factors for 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 factor for a new episode of back pain is a previous history, where the 12-month risk is approximately doubled (Hestbaek et al. 2003b). Beyond that, the most frequently reported risk factors are heavy physical work, frequent bending, twisting, lifting, pulling and pushing, repetitive work, static postures and vibrations (Andersson 1997). Psychosocial risk factors include stress, distress, anxiety, depression, cognitive functioning, and pain behaviour job dissatisfaction and mental stress at work (Andersson 1997; Hoogendoorn et al. 2000; Linton 2000). However, there is limited evidence for these [purported] risk factors, and those that are well documented frequently have small effect-sizes, which logically will compromise the magnitude of preventive interventions. Alternatively, in some occupational groups more substantial effect-sizes may be apparent in highly exposed groups. Some purported risk factors (e.g. smoking and obesity) may be more a matter of general health, yet may influence certain back pain outcomes. This guideline considers as wide a range of potential risk factors as is permitted by the available evidence on prevention. However, the risk for long-term incapacity, which is influenced by complex social factors (Waddell et al. 2003), is generally beyond the scope of this guideline.

### Outcomes and interventions

The working Group (WG) spent considerable time debating the focus of this guideline, and attempting to produce a working definition of 'prevention'.

The conceptual focus of the guideline was determined to be prevention of *future* aspects of low back pain, as opposed to manifestations of the current spell. Taking account of the epidemiology of back pain, the WG concluded that prevention of the first onset of common low back pain (especially in adults) is, to all intents and purposes, likely to be impracticable. Nevertheless, interventions directed at such were not excluded. The WG, in principle, recognised the distinction between 'primary' and 'secondary' prevention, but concluded (as have others (Jellema et al. 2001)) that the distinction is difficult to determine in practice, and preferred not to use the terms.

Certain aspects of the back pain phenomenon are generally excluded from this guideline. Severe spinal injury and serious pathology are excluded by definition. In addition, prevention of structural changes such as 'degeneration', along with risk factor modification, modification of psychosocial variables, and screening procedures (unless there is concomitant specific influence on back pain outcomes) are also excluded for adults. In recognition of widespread interest in back pain among schoolchildren, and the possibility of prevention of consequences later in life, the WG decided not to exclude general consideration of potentially modifiable risk factors for back pain in this population.

It is accepted that there is a vast number of 'interventions' that purportedly will 'prevent' (some aspect of) common low back pain, but scientific evidence may be absolutely lacking. Not all possible interventions will be included in this guideline, largely because they are idiosyncratic, non-generalisable, or untested. That is not to say they cannot be shown effective at some future date.

A broad categorisation of included interventions would be: information/advice, activity/exercise, ergonomics, organisational change, furniture, clothing, and orthoses. Clearly, some interventions involve an active element, and some will concern avoidance, whilst others may involve less direct approaches, such as addressing inappropriate beliefs (Ihlebaek & Eriksen 2003), or interfacing with social reorganisation (Scheel et al. 2002). Specific interventions may not be universally applicable; rather they will be variously suited to the general population, workers, and school age. The WG recognised the potential for overlap with the accompanying clinical guidelines addressing acute and chronic back pain, and pelvic pain, and that these 'clinical' interventions may have a preventive effect on some

outcomes. Furthermore, it was recognised that preventive interventions could not (and should not) exclude people with existing back symptoms. To accommodate these issues, it was decided that interventions that are essentially treatments focused on management of current symptoms in the clinical environment would not be considered as 'prevention' for the purposes of this guideline, unless the intervention has an explicit intent to prevent future consequences.

Judgement is necessary when using evidence statements to guide decision making, and it needs to be recognised that weak evidence statements on a particular relationship or effect does not necessarily mean that it is untrue or unimportant; it may simply reflect either insufficient evidence or the limitations of current scientific endeavour.

Of necessity, there will be some measure of overlap between interventions directed at the general population and workers. The same basic interventions may apply equally to both, but their nature and location of delivery will differ. It is possible that the evidence will overlap, and may not necessarily come to identical conclusions.

The WG recognises that access to interventions, the ability to act on health advice, and the capacity to influence ones own health can be significantly influenced by socioeconomic variables, and it has been shown that clinical guidelines generally do not take the effects of socioeconomic position into account (Aldrich et al. 2003); this is likely to be true also for other types of guidelines. It is not the purpose of this guideline to address the socioeconomic position and its influences in respect of the recommendations given here. Yet the WG would urge target groups to take social inequalities into account when considering implementation and take steps to reach populations that are relatively disadvantaged, so as to avoid the risk of increasing health inequalities. Finally, the WG offers recommendations for future research that could improve our capacity for prevention in low back pain.

## **Prevention in low back pain - general population**

### Introduction

The general population as a focus for prevention in back problems is the largest and most heterogeneous group. It includes different age groups, people with or without back pain, with or without specific spinal disorders, working and non-working people and many other possible subgroups that may or may not be mutually exclusive.

Therefore, decisions had to be made about the inclusion criteria for studies in this context. Clearly, people under the age of 18 years were excluded, since this topic is covered in another part of this guideline.

It is a different issue with regard to other characteristics, i.e. back pain or not and working or not. Although the working population is also covered in another part of this guideline, it was decided not to automatically exclude here studies that were undertaken in the working population. One reason is that many studies actually were performed at the worksite, perhaps for ease of conduct and follow-up. This does not necessarily mean that their results are not applicable to a non-working population. In fact, for the purpose of this part of the guideline, interventions at the worksite can be distinguished into those that are specific to the working community (e.g. worksite-based) and those that are more or less generalisable. These potentially valuable studies were included to inform recommendations for the general population, and the significant overlap to the section on workers was accepted.

As indicated in the general introduction, the high prevalence of back pain makes it impractical in most preventive studies to separate people with back pain from asymptomatic people. Therefore, studies dealing with symptomatic people were not excluded.

In addition to the electronic searches using general keywords to retrieve suitable articles, specific searches were also made for literature relating to the use of beds/mattresses, chairs and seats, shoe insoles, manipulation, and massage for prevention in back pain. Furthermore, information on preventing back pain in pregnancy was included. Studies of risk factor modification that did not collect health outcomes data were excluded.

## **P1 Physical exercise**

### **Evidence P1**

Two systematic reviews (Linton & van Tulder 2001; Lahad et al. 1994), two further detailed overviews that included findings from systematic reviews and RCTs (Vuori 2001; Lühmann et al. 2003), and one primary care guideline (US Preventive Services Task Force 2004) were found on exercise for LBP-prevention in the general population. The reviews are essentially based on the same studies. All 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. For pregnant women one systematic review (Young & Jewell 2003) was found, which concluded that water gymnastics has a preventive effect on future back pain.

### **Discussion / consensus P1**

The studies covered in the reviews included a variety of participants, used different exercise schedules, and measured a variety of health outcomes (e.g. duration and intensity of pain, disability, work loss). The control groups either received no intervention or information and advice. No study compared different types or intensity of exercise. The different contents of the activity programmes, their description in the papers and the different outcome criteria compromised the conclusions of the systematic reviews. The frequency and duration of the intervention programmes varied substantially, ranging from an intensive 'block' programme (8 hours daily for 5 weeks) to exercise sessions once per week for 18 months. The contents included instructions for back extensor training followed by regular training sessions for 13 months, training of trunk flexors, and general aerobic exercise.

All studies used outcome measures for pain (pain intensity, number of painful days or months or number of further pain episodes). Most studies used the number of days off work as the outcome measure for disability. Control groups variously were waiting lists, no intervention or information/education.

All the RCTs were performed at the workplace or performed in work-specific cohorts, but the contents of the programmes were not described as workplace-specific and (in principle) can be performed at the population level. Therefore results from the reviews can be considered relevant for general population.

The heterogeneity of the contents and frequency/duration of interventions makes it difficult to determine what type of intervention (specific exercises or general exercise/activity) might be the most effective. Surprisingly, since publication of the review by Lahad et al (Lahad et al. 1994), very few new RCTs on this topic have been performed. One study compared an individually designed programme using psychological principles with advice to be active along with free membership to a health club, and found no difference in pain as the outcome measure (Linton et al. 1996). Some light may be shed on different approaches by the results of the studies by Mannion et al. who compared aerobic exercise, physiotherapy and specific trunk muscle training in people with LBP persisting for several months (usually considered to represent chronic symptoms); they found no short term difference in pain intensity between the different kinds of interventions (Mannion et al. 1999).

The reviews reported consistently that exercise reduced sick leave. There were inconsistent findings with respect to pain reduction and the occurrence of further episodes. Two studies found a positive effect on future pain, whilst four studies found no change. No study reported any harmful effect of physical activity or worsening of symptoms.

The conclusion in respect of pregnancy in the Young and Jewell review, which was not of high quality (Young & Jewell 2003), is based on one study (Kihlstrand et al. 1999), comparing weekly water gymnastics with no treatment. Women in the water gymnastics group reported significantly less pain at one week after birth and were less likely to be off work due to back pain; the calculated effect sizes were small. In pregnancy it is not known, whether the positive effect of water gymnastics is related to general activity (and will then fall under our general recommendation for activity) or a specific effect of exercise in water (e.g. reduced gravitational effect). In any case the evidence is weak.

### **Recommendation P1: Physical exercise**

Physical exercise is recommended to prevent work absenteeism 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 may 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 P2 (1): Information and education**

One systematic review (van Poppel et al. 1997) found inconsistent results on the effect of information for prevention in back pain. More recently, a controlled trial of a public health multi-media campaign found improved beliefs about back pain, a reduction in days off work and reduced use of the health care system (Buchbinder et al. 2001).

### **Discussion / consensus P2 (1)**

Various studies of the effect of information and education to prevent consequences of back pain (further episodes; work loss; use of health care) yield inconsistent results. Symonds et al compared a traditional 'good posture' pamphlet to a psychosocial pamphlet focused on fear avoidance beliefs among workers. The latter pamphlet reduced the number of days of future work loss and the number of spells with extended absence (Symonds et al.

1995). In a study in a Health Maintenance Organisation Cherkin et al. sent out an educational booklet containing anatomical information as well as promoting early recovery; they compared this to usual care and to a 20-minute information session plus handing out the booklet (Cherkin et al. 1996). During one-year-follow-up there was no significant reduction between the groups with respect to health care use or symptoms. Cherkin et al compared the same booklet with chiropractic (Cherkin et al. 1998), whilst Hazard et al. compared a small pamphlet with giving no information (Hazard et al. 2000); neither found significant changes in outcome from the information. Linton and Ryberg investigated the effect of 6-session cognitive behavioural group intervention in acute or subacute back patients, comparing it with usual care (Linton & Ryberg 2001). The risk for long-term sick leave was significantly reduced in the intervention group.

A population-level approach for distributing information was used by Buchbinder et al in Australia (Buchbinder et al. 2001). The information, based on a biopsychosocial model and fostering early return to normal activities, was delivered by a mass media campaign (e.g. TV-slots with local and international medical experts and celebrities, advertising hoardings, news articles, and physician education). The follow up yielded a significant reduction in days off work and use of the health care system. In order to understand the conflicting results several aspects need to be considered.

The preventive effect of information alone may be weak. The effect size is likely to vary in combination with other interventions, such as physical exercise or treatment (the combination of physical exercise and information is discussed below in the back school section). Information may have a higher impact in a treatment setting, when people/patients are actually affected by a specific problem; they may be more susceptible to this information compared to a preventive setting, when the information is less relevant at the given time. This aspect is supported by the fact that information and education is an inherent and possibly important aspect of multidisciplinary programmes.

A narrative review by Burton and Waddell made an attempt to distinguish studies by the content of the information being transmitted (Burton & Waddell 2002). They concluded that traditional approaches based on a biomedical model can convey negative messages about back pain with damaging effects on patients' beliefs and behaviours. In contrast, carefully selected and presented information based on a biopsychosocial model may have a positive effect. They estimated the power of written information to be relatively weak nevertheless it may be cost-effective due to its low per-person costs. Recent studies (Buchbinder et al. 2001; Burton et al. 1999) variously reported positive results for beliefs, future disability, future work loss and use of health care, but older studies reported inconsistent results. Those recent studies are strongly based on the fear avoidance concept, which fits the biopsychosocial model, while many of the older studies contain a mixture of biomechanical and psychosocial information. A problem occurs in pooling or judging these studies because the 'active ingredients' and the mixture of the messages vary considerably between the different studies. In conclusion, there is evidence from the more recent studies that information based on the biopsychosocial model, focusing particularly on beliefs, is potentially beneficial for reducing work loss, further spells of LBP and the utilization of health care. However, it is appreciated that this evidence is somewhat limited. By contrast, providing information based on a biomedical model or biomechanics principles has not been shown to have a positive effect for prevention in back pain.

Information to the public comes not only from specific interventions but also from the general activities of the media, with a probability of inconsistent messages and varying intensity. Even within specific interventions, the intensity of delivery varies considerably - several group sessions will expose the recipient more intensely than will a pamphlet (Linton & Andersson 2000). Therefore, dose-response and cost-benefit aspects need to be considered; a higher intensity delivery may have a higher impact on the recipient, but is likely to be more expensive - local circumstances/needs will need to be considered. There is currently insufficient evidence from RCTs and reviews to give specific recommendations about what quantity, intensity or media may be optimal for delivering information to the population, or what the cost-benefits may be.

### **Recommendation P2 (1): 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, though the effect size may be relatively small (Level C). Information and education focused principally on a biomedical or biomechanical model cannot be recommended (Level C).

### **Evidence P2 (2): Back schools / training**

Two systematic reviews (Linton & van Tulder 2001; Heymans et al. 2004) and one review that included systematic reviews and RCTs (Lühmann et al. 1999) came to different conclusions on the effect of back schools. Linton et al. and Lühmann focused on interventions based on the Swedish back school with emphasis on proper lifting techniques. Both reviews concluded that there is no positive effect on back pain or further work loss.

The recent Cochrane review (Heymans et al. 2004) included 19 RCTs. Back school in this review was defined 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 review did not distinguish between preventive and therapeutic interventions; most studies were designed as therapeutic studies. The authors concluded that there was (1) conflicting evidence on the effectiveness of back schools, compared with other treatments for acute or subacute pain, on further work loss; (2) limited evidence that back schools show no differences in long term recurrence rates of LBP episodes. The same evidence level was found when back schools were compared to placebo treatment or waiting list controls. The authors concluded that back schools may be effective for patients with recurrent and chronic pain, with the most promising interventions being those with a high intensity (3-5 week stay in specialized centres). The effect sizes of these interventions were judged small.

### **Discussion / consensus P2 (2)**

The conclusion that there is no positive effect of back schools (Linton & van Tulder 2001; Lühmann et al. 2003) is different from the most recent review (Heymans et al. 2004), reflecting different approaches and search strategies (more studies were included in the latter).

The systematic review of Linton et al (Linton & van Tulder 2001) covers two RCTs ((Daltroy et al. 1997; Donchin et al. 1990)) and the review by Lühmann (Lühmann et al. 2003) covers three RCTs ((Daltroy et al. 1997; Donchin et al. 1990; Lonn et al. 1999)). The large study by Daltroy et al (Daltroy et al. 1997) on 2,543 postal workers investigated the effect of proper lifting techniques. The study group that was educated in the 'proper' lifting techniques according to the Swedish back school had no reduction in further episodes of back pain or days off work. Donchin et al compared back school, active exercises and no intervention in 142 hospital workers, and found that back school was less effective in the prevention of future days with back pain, compared to the active programme (Donchin et al. 1990). Lonn et al, with 81 participants, found a positive effect on future episodes and days off work in the back school group compared to no intervention; the programme was intensive (20 hours.) and the relation between active to educational elements was 2:1 (Lonn et al. 1999).

The most recent systematic review included 19 RCTs (Heymans et al. 2004). Back school in this review was defined as a group intervention, conducted or supervised by a paramedical therapist or a medical specialist, which comprised an education and skills programme including exercises. There was considerable variation between the RCTs with respect to several criteria:

- duration and content of programme: minimum 3 x 45 minutes, maximum 3-week inpatient setting
- duration of symptoms: acute, subacute, chronic patients
- pain distribution: with or without pain radiation, or not described

- control intervention: waiting list, placebo treatment, exercises, advice, spinal manipulation
- demographics: age, gender.

The authors rated the methodological quality high in four studies and low in 15 studies. One aspect of the low quality of the studies was the poor description of the exact content of the interventions. In addition to the intensity of the programme, this refers to the ratio between passive, educational elements and the active 'training' parts, as well as to the exact content and wording during the educational sessions. The latter is more difficult to describe and control compared to written information. However, the outcome may be highly influenced by the specific content of the education, in particular whether a biopsychosocial or a biomedical/biomechanical approach was emphasized. Seemingly, most studies used a combination of both, which makes it difficult to study subgroups with respect to the approach being used. Subgroup analyses for duration of symptoms [(sub)acute (<12 weeks), chronic (>12 weeks)], or occupational setting were performed. However, subgroup analysis for radiation of symptoms was not possible and neither was subgroup analysis with respect to whether different types of back school programmes may be effective in specific subgroups of patients / individuals. Therefore a cost-effectiveness analysis was not possible. For chronic LBP patients, moderate evidence was found that back schools are more effective than exercises alone, spinal manipulation, or advice alone with respect to pain relief and improvement of functional status in short-term outcomes. There was moderate evidence that back schools are not effective in the long term. The evidence was considered conflicting on whether back schools for chronic LBP patients are more effective than placebo treatment or waiting list controls for both short- and long-term outcomes for pain, (perceived) functional status and work loss (Heymans et al. 2004).

In addition to the limitations of heterogeneity of the study populations, the low methodological quality of most of the studies and the inclusion of acute and chronic patients in all studies, it is uncertain if the findings from patients can be transferred to a general population setting. The conclusion of the authors (Heymans et al. 2004) with respect to the effectiveness of very intensive (3-5 weeks) programmes brings up a problem of definitions for 'back school' and 'multidisciplinary programmes'.

### **Recommendation P2 (2): 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 may be relatively small.

### **P3: Lumbar supports / back belts**

#### **Evidence P3**

Two systematic reviews (Linton & van Tulder 2001; Lahad et al. 1994), two reviews that included systematic reviews and RCTs (Vuori 2001; Lühmann et al. 2003), and one primary care guideline (US Preventive Services Task Force 2004) evaluated five RCTs and two non-randomised 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 may even be detrimental. (This is consistent with more studies considered below in the section related to workers). The combination of back belts with back school is no better or worse than back school alone.

#### **Discussion / consensus P3**

There was consensus that, in the absence of any beneficial effect in the workplace setting, it can be concluded that there is no preventive effect for the general population. It

was noted that the US Preventive Services Task Force guideline recommended against the use of back belts in primary care (US Preventive Services Task Force 2004).

### **Recommendation P3: Lumbar supports / back belts**

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

## **P4: Furniture**

### **Evidence P4 (1): 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: seven RCTs (Kovacs et al. 2003a; Enck et al. 1999; Dobb & Driver 1993; Scriver et al. 1994; Garfin & Pye 1981; Sulzbach et al. 1995; Atherton et al. 1981) (five of which were either non-blinded or single blind); four cohort studies (Jacobson et al. 2002; Monsein et al. 2000; Haex et al. 1998; Hagino 1997); one survey (Koul et al. 2000). Eight of the 12 studies enrolled patients with chronic back pain, and two others were conducted on hospitalized patients. The design of the studies, their methodological quality and the results do not allow any conclusions with respect to prevention in back pain, though one RCT suggests patients may have less pain with a medium-firm rather than hard mattress (Kovacs et al. 2003a).

### **Discussion / consensus P4 (1)**

There is very little high quality research published on beds/mattresses, so we also contacted leading manufacturers of mattresses and asked for any data they had on-file; we were not alerted to any additional trial data from the manufacturers about back pain prevention. The only study oriented to primary prevention (Enck et al. 1999) reported an effect for improved quality of sleep on new mattresses compared to the old hotel mattresses of a different kind; there was no effect on back pain.. However, it was of low quality; very short duration of intervention (1-2 nights), outcomes assessed only on the morning after, low participation rate, and only nine mattresses were used (three of each kind). This makes any generalization of the results impossible. The survey conducted by Koul et al surveyed residents in a hospital after sleeping on foam mattresses during hospital shifts compared with cotton mattresses at home; they reported back pain on the day after a night shift (Koul et al. 2000). This was not an RCT, compared sleeping at work to sleeping at home, with no control for the effect of shift pattern, and did not specify and control the amount of hours each resident slept. The only high quality RCT in this area (Kovacs et al. 2003a) enrolled 313 adults from the community who reported persistent non-specific low-back pain. Using double blinding, participants were randomly assigned to use mattresses of two different levels of firmness (medium-firm and hard). At 90 days follow-up subjects using the medium-firm mattresses had better outcomes for pain in bed and disability compared to those using the hard mattress; during follow-up they reported less pain on rising, during the day and when lying in bed. The resulting benefits from a medium as opposed to hard mattress were interesting, and conflict with the traditional anecdotal view that harder mattresses are preferable for patients with back pain. However, the study was conducted only on subjects with persistent back pain, and was not planned as a preventive study; thus, firm conclusions on preventive recommendations for the general population cannot be derived from its results. No scientific support for manufacturers' claims of preventive benefit from particular mattresses was evident.

### **Recommendation P4 (1): Mattresses**

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

### **Evidence P4 (2): Chairs**

No acceptable evidence for any preventive aspects of chairs was found. The three studies retrieved (Van & Noteboom 1988; van Deursin & Patijn 1999; Udo et al. 1999) had inappropriate methodology.

### **Discussion / consensus P4 (2)**

No systematic reviews of studies on the effect of chairs or sitting related to prevention of LBP were found. No RCTs or acceptable controlled trials (CT) were found. A narrative review was retrieved, but that concerned (a) sitting biomechanics and (b) an 'optimal car driver's seat' (Harrison et al. 2000; Harrison et al. 1999). The one article with seeming potential in respect of prevention (Udo et al. 1999), involved small numbers and chair use was for just one hour; evaluation of the effect of different chairs on back pain over short durations may inform on comfort, but do not provide evidence on prevention. The two articles with larger numbers (Van & Noteboom 1988; van Deursin & Patijn 1999) used patients experiencing persistent back pain; the studies had methodological problems (e.g. high percent of lost to follow up, short duration of follow-up, and subjects being withdrawn due to leg pain), which compromised drawing firm conclusions.

### **Recommendation P4 (2): 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 P5**

No systematic reviews on the use of shoe insoles, shock absorbing heel inserts, or orthoses for the prevention of back pain were found. We identified seven clinical trials with an intervention aiming at reducing back pain by use of different insoles: only two of those reported a beneficial effect from orthoses (Fauno et al. 1993; Tooms et al. 1987). No acceptable study concerning prevention of LBP by correction of leg length discrepancy was identified.

### **Discussion / consensus P5**

Four non-blinded RCTs (Larsen et al. 2002a; Fauno et al. 1993; Tooms et al. 1987; Schwellnus et al. 1990), one double blind RCT (Milgrom et al. 2005) and two CTs with cross over design (Sobel et al. 2001; Basford & Smith 1988) were found. The studies included over 2,000 participants, using orthoses for five days up to three months. Overall, the quality of the studies was fair to good.

The two trials with beneficial effect (Fauno et al. 1993; Tooms et al. 1987) were the smallest studies (total 199 subjects), and had numerous methodological weaknesses (analysis not on intention to treat basis, treatment allocation not blinded, insoles used during soccer games for five days only). The larger and more methodologically rigorous studies (Larsen et al. 2002a; Schwellnus et al. 1990; Milgrom et al. 2005) found no effect of orthoses on reducing back pain. All the studies enrolled subjects with high physical activity levels (soldiers, soccer referees, nursing students and policemen), and were thus not fully representative of the general population.

In a survey of 186 Dutch orthopaedists and rehabilitation practitioners, there was agreement that the prescription of orthopaedic footwear should not be considered for back pain (Boer & Seydel 1998); this was not a scientific review but rather a report on professional opinions.

Two narrative reviews reported on correction of leg length inequality as a possible preventive measure for back pain (Brady et al. 2003; Gurney & Pye 2002). They found 12

articles that investigated the link between limb length inequality and LBP, but any association was not supported unequivocally; the only association found was when the discrepancy was over 10 mm. All the intervention studies (none of which were RCTs or CTs) included in one of the reviews concerned patients with persistent LBP; the authors concluded that there is 'limited data to support lift therapy for *treatment* of LBP' (Brady et al. 2003). Based on the above data there is no acceptable evidence for interventions aimed at correction of leg length discrepancy for prevention in LBP.

#### **Recommendation P5: Shoe insoles / correction of leg length discrepancies**

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 P6**

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

#### **Discussion /consensus P6**

In view of the contention by some manipulative practitioners that regular manipulative treatment can be helpful in preventing some consequences of back pain (e.g. reduced frequency or severity) the topic was included in this guideline.

The only retrieved RCT of manipulation with long-term (3-years) follow-up compared hospital-based physiotherapy treatment with private chiropractic manipulation (Meade et al. 1995). The chiropractic treatment involved up to 10 treatments at the beginning of the study. The results were significantly better in the manipulation group, but the fact that the intervention was only in the first few weeks provides no evidence about regular treatment. Furthermore, a cohort study of patients receiving osteopathic manipulation for LBP found during 4-year follow-up that recurrence and further care seeking were common, and that few patients were totally free of pain or disability at follow-up (Burton et al. 2004).

#### **Recommendation P6**

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

## **Prevention in low back pain – workers**

### Introduction

The focus of this section is to provide a set of evidence-based recommendations to prevent low back pain and/or its consequences in the workforce. The target population is workers with or without existing low back symptoms, but interventions targeting workers consulting health care providers were excluded. Interventions to simply reduce return-to-work time were only included if there was follow-up focussing on recurrence of LBP and/or consequences of LBP. The only exception to this rule was the intervention 'modified work', because this is not covered by the accompanying clinical guidelines.

Interventions aimed at preventing LBP in the workforce can be categorised into (i) individual focus; (ii) physical ergonomics; (iii) organisational ergonomics. All three categories were eligible, as long as they aim to reduce LBP or its consequences among workers in the occupational setting. Because similar interventions can also be implemented at the population level, there will be some overlap with the population section.

Some of the interventions include a number of discrete dimensions but, when possible, evidence for 'general' interventions was translated into specific recommendations for unambiguous and specific interventions - for instance, education was used as a main heading, with back schools and leaflets/pamphlets as subheadings. Similarly, numerous interventions include several additive dimensions, particularly for interventions described as 'physical ergonomics' - the following grouping was used: (i) physical ergonomic interventions (main component is a change focussing on biomechanical exposure at work); (ii) organisational ergonomic interventions aiming at the work organisation (alone or as the main dimension of the intervention); (iii) multidimensional interventions (interventions in which 'changing the physical and/or work organisation' is present, but not the main dimension). The included interventions are directed predominantly towards workers and their immediate environment.

Provision of occupational health services was not considered to be a preventive intervention for the purposes of this guideline, and is the subject of other national guidelines (Staal et al. 2003). However, the WG recognises that occupational health has an important role in supporting and enhancing other interventions. Occupational health interventions concerning return-to-work were included where the intervention was the provision of 'modified work' for workers sick-listed due to LBP, and the intention was return to regular work. Non-health care interventions aiming at early return-to-work were also included if there was follow-up focussing on recurrence of (sick leave due to) LBP.

Interventions directed at social change or altering the (sickness certification) behaviour of clinicians were excluded. Workplace surveillance may be useful to identify factors associated with the risk of disability due to LBP (Ferguson & Marras 1997), but since surveillance is not a preventive measure in itself, it was excluded. Similarly, medical assessment of 'fitness to work' was also excluded, though it is recognised that that could have a significant impact on lost work time.

Four types of factors are commonly found in the literature covering occupational epidemiology and ergonomics: (i) exposure to [purported] risk factors for LBP; (ii) perceived exertion, discomfort or fatigue; (iii) occurrence and/or recurrence of LBP; (iv) sick leave due to LBP. The evaluation of ergonomic interventions is often based on exposure to risk factors and on perceived exertion, discomfort or fatigue – studies having these outcomes alone were excluded, but studies reporting on the occurrence and/or recurrence of (sick leave due to) LBP were included. Occasionally, the incidence rate of back injuries is used as an outcome measure, but it needs to be acknowledged that use of the concept of 'injury' is imprecise - the reporting of an injury can be driven more by legal and compensation requirements than objectively demonstrable injury. In view of the wide variety of outcome measures found in the literature (e.g. self-reported symptoms, sick leave, occupational back pain, low back injuries, compensable LBP), it was necessary to apply a 'consensus interpretation' when formulating recommendations.

## **W1 Physical exercise / physical activity**

### **Evidence W1**

#### *Prevention of (sick leave due to) LBP*

There is evidence for moderate positive effects of physical exercise to prevent LBP. In seven different reviews, RCTs on different types of physical exercise interventions have been evaluated. The reviews are essentially based on the same studies. In addition to the reviews, two individual studies have been added (Larsen et al. 2002b; Amako et al. 2003). They do not alter the conclusions from the reviews. Six reviews concluded that there is some evidence of effect of exercise (Lahad et al. 1994; Gebhardt 1994; van Poppel et al. 1997; Maher 2000; Linton & van Tulder 2001; Tveito et al. 2004), whilst one review (Waddell & Burton 2001) 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. In the most recent review (Tveito et al. 2004) the authors 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.

#### *Prevention of recurrence of (sick leave due to) LBP*

No systematic reviews were found for this topic, but there is strong evidence for positive effects of physical exercise to prevent recurrence of LBP and limited evidence of positive effects of physical exercise in the prevention of recurrence of sick leave due to LBP. This can be concluded from four studies among workers that included recurrence of (sick leave due to) LBP (Lonn et al. 1999; Soukup et al. 1999; Taimela et al. 2000; Glomsrød et al. 2001), two of which originated from the same trial (Lonn et al. 1999; Glomsrød et al. 2001). One prospective cohort study using interrupted time series (Taimela et al. 2000) found positive effects of regular physical exercise for both recurrence of LBP and recurrence of sick leave due to LBP. An RCT evaluating the effects of a Mensendieck exercise programme reported positive effects for recurrence of LBP (Soukup et al. 1999). Recently, the conclusion from the evidence of positive effects of physical exercise in the prevention of recurrence of sick leave due to LBP was indirectly confirmed by a meta-analysis (Kool et al. 2004). It was shown that the overall effect for studies with a follow-up period of two years or longer was positive. This indicates that recurrence of sick leave due to LBP can be reduced by physical exercise. However, for the same intervention, Kool and colleagues reported that the effect on workers receiving a disability allowance was small and not significant (Kool et al. 2004).

### **Discussion / consensus W1**

There is no evidence that any particular type of exercise is superior to another. It is not clear what type of exercise, intensity or duration may be effective for prevention in LBP in workers. One of the main problems when evaluating different exercise interventions is that the descriptions of the exercise programmes, both in the reviews and in the original studies, are very limited. In one meta-analysis of the effects of physical exercise the duration of the interventions ranged from eight weeks to two years, the time of post-intervention measurement ranged from directly after the intervention to two years after the intervention (Gebhardt 1994). It is therefore difficult to interpret the results, and the combined effect size. Another problem is adherence to exercise programmes - it is often unclear if the workers actually did participate in the programme, and for how many sessions.

There are epidemiological studies suggesting that physical activity is beneficial to prevent LBP. However, the vast majority of intervention studies at the work site are physical exercise programmes, and not physical activity programmes. Physical exercise programmes are typically aimed at strengthening back extensors or flexors, increasing flexibility, or improving cardiovascular fitness. We do not know much about the possible pathways between exercise and prevention in LBP. Some of the possible physiological pathways are described by Lahad et al. (Lahad et al. 1994). It is also possible that the effect of exercise is an essentially cognitive behavioural treatment, where the main effects are related to increased activity, and a possible reduction of fear avoidance beliefs/behaviours.

The conclusions from the different reviews are quite consistent. Lahad et al reported that in all randomised trials reviewed, subjects in the intervention groups had fewer days of work loss because of back pain or fewer days with back pain than controls, yet concluded that there is limited evidence to recommend exercise to prevent low back pain in asymptomatic individuals (Lahad et al. 1994). Gebhardt concluded that exercise had a positive effect on the incidence of back pain and on sick leave (Gebhardt 1994). In the Van Poppel review, three RCTs on the effectiveness of exercise in the prevention of back pain were included, and they found limited evidence of a positive effect of exercise (van Poppel et al. 1997). The results of the studies were homogeneous, but all three studies were of low quality, and they estimated the combined effect size to be about half a standard deviation (medium effect), for both the incidence of back pain and sick leave. Maher concluded that workplace exercise is effective in preventing back pain, and specified in the conclusion that there is limited evidence that exercise reduces the prevalence of LBP (Maher 2000).

There is moderate evidence that exercise reduces the severity of LBP and that exercise reduces sick leave due to LBP. The Linton and Van Tulder review concluded that exercise showed stable positive results in RCTs, giving consistent evidence of relatively moderate utility in prevention (Linton & van Tulder 2001). Six RCTs were included evaluating the effectiveness of an exercise programme for various types of workers. The results of four of the five studies comparing exercises with no intervention showed that exercises significantly reduced back pain experience and reduced work absenteeism. They concluded that there is consistent evidence that exercise may be effective in prevention of back pain, but there is inconsistent evidence on the effectiveness of exercise when compared with other 'effective' interventions. Only one review concluded that there is contradictory evidence that various general exercise/physical fitness programmes may reduce future LBP and work loss, with a modest effect size appears (Waddell & Burton 2001) – those conclusions may depend on outcomes and definitions. The most recent review by Tveito et al included six studies that assessed the effect of exercise to prevent LBP (Tveito et al. 2004). Two studies assessed the effect of exercise on sick leave, and both showed important significant effects. However, there was a risk of selection bias and low scores on internal validity. Therefore, the authors concluded that there was limited evidence for a positive effect from exercise on sick leave. Three of the studies reported an effect of exercise on new episodes of LBP. All studies showed important significant effects between the groups, but had a risk of bias. There was limited evidence that exercise has an effect on new episodes of LBP. Three studies assessed effect on level of pain, and it was concluded that there was no evidence of effect of exercise on level of pain.

Finally, it should be stressed that it is far from clear what type of exercise, including its intensity, frequency and duration, is required to prevent occurrence or recurrence of (sick leave due to) LBP in workers. Furthermore, physical 'exercise', as reviewed here, differs from back-specific 'exercises' recommended by clinicians.

### **Recommendation W1**

Physical exercise may be recommended in the prevention of LBP (Level A). Furthermore, physical exercise may 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 W2**

#### *Prevention of (sick leave due to) LBP*

Information/advice/instruction includes a broad range of interventions, ranging from distributing pamphlets to comprehensive "back school programmes" that also include physical exercise (see discussion). Education is the term that will be used here. There is evidence of a general lack of effect from educational interventions for the prevention of (sick leave due to) LBP. In eight different systematic reviews, and one evidence review, RCTs on

different educational interventions have been evaluated. The reviews are essentially based on the same studies. In addition to the reviews, two individual studies have been added (Alexandre et al. 2001; Fanello et al. 2002). They do not alter the conclusions from the reviews. Six reviews (Lahad et al. 1994; van Poppel et al. 1997; Maher 2000; Linton & van Tulder 2001; Waddell & Burton 2001; Tveito et al. 2004) concluded that there is no effect of information/advice/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. However, the interventions had only small effects on health outcome variables and no effects on clinical variables (e.g. pain) (Maier-Riehle & Härter 2001). 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 (Gebhardt 1994).

In addition to the more 'traditional' educational interventions, two of the reviews (Linton & van Tulder 2001; Tveito et al. 2004) included a study on the effects of distributing a psychosocial pamphlet. That study specifically examined the effects of information oriented toward fear avoidance beliefs/behaviour and promoting coping, and found that the information was effective in shifting beliefs compared with no intervention, and also reported a reduction in sick leave (Symonds et al. 1995) - evidence from one non-randomised controlled trial, however, cannot be considered conclusive. Some reviews examined effects on different preventive outcomes (see discussion). The most recent and comprehensive review (Tveito et al. 2004) concluded that there was limited evidence of no effect on episodes of LBP and no evidence of effect on both pain and sick leave (Tveito et al. 2004).

#### *Prevention of recurrent episodes of (sick leave due to) LBP*

There is contradictory evidence for the effects of educational interventions in the prevention of recurrence of sick leave due to LBP. No systematic reviews were found, but conflicting results were noted in three RCTs assessing recurrence of sick leave due to LBP (Leclaire et al. 1996; Indahl et al. 1998; Verbeek et al. 2002). In one RCT no differences between the intervention and control group were found for both the number of recurrences and median duration of these recurring sick leave episodes (Leclaire et al. 1996). Another RCT reported fewer recurrences of sick leave in the intervention group than in the control group (Indahl et al. 1998). Finally, the third RCT found a significant negative effect: the risk of recurrence of sick leave in the 12-month follow-up period was 2.4 times higher for the intervention group (Verbeek et al. 2002). However, the average total duration of recurring episodes of sick leave due to LBP did not differ between the intervention and control group (Verbeek et al. 2002). These three educational interventions have a common theme (i.e. they all bring the 'important to stay active' message), but there is also substantial variation in the content of the interventions.

#### **Discussion / consensus W2**

Most reviews have been "lumping" information/advice/instruction interventions into one group, mostly named "educational interventions". Similarly, most studies included in these reviews evaluated the effects of interventions referred to as "back schools". In a review by Linton and Van Tulder only one study of information was included that was not a back school (Linton & van Tulder 2001). There is a substantial variation in the content and the descriptions of the interventions. Following development of the Swedish back school, several other back schools have been developed, i.e. the American Back school, California Back School, and Canadian Back Education Units, each differing in approach, content, length, and delivery (Schenk et al. 1996). Back schools often include information on biomechanics, lifting techniques, optimal posture, exercises, stress and pain management (Lahad et al. 1994). They build on the assumption that people have higher risks and suffer from more pain than they need to, because they lack knowledge about a variety of topics as diverse as body mechanics and stress. The programmes aim to reduce the risk of problems by increasing the participant's knowledge, which in turn will alter the person's behaviour such as lifting

technique. Back schools usually contain a series of discussions about anatomy, biomechanics, lifting, postural changes related to work, and a programme of exercises. They vary from a single session of less than an hour to several sessions (Linton & van Tulder 2001). There is also a huge variation on follow-up periods, ranging from 1 to 48 months (van Poppel et al. 1997), and on the type of education and the intensity of the classes. Interventions range across distribution of a psychosocial pamphlet, a one-hour training in body mechanics and intensive prolonged back school programmes that include home exercises. There seems to be a general trend that the workers included in these studies have heavy lifting tasks, and are generally employed in a hospital or other care giving settings.

The conclusions from different reviews are quite consistent. (Lahad et al. 1994) reported that only one of five RCTs evaluating the effects of education on LBP reported a significant decrease in subsequent LBP, but this was a trial combining exercise programmes with education. Lahad et al concluded that the studies offer minimal support for the use of educational strategies to prevent LBP (Lahad et al. 1994). Van Poppel et al concluded that there is limited evidence that education, varying from instructions on lifting techniques to back schools, is not effective in prevention of incidence of back pain, and sick leave due to back pain (van Poppel et al. 1997). Maher evaluated trials where education was compared with a no education control, and two trials also evaluating the efficacy of education as a supplement to a lumbar brace (Maher 2000). Pooling both education comparisons reveals moderate evidence that education is ineffective in reducing the prevalence of LBP, sick leave due to LBP, and the severity of LBP. In the review by Linton and Van Tulder, the conclusions about the effectiveness of the preventive interventions are based on the reported outcomes on the key variables of pain, report of injury, dysfunction, time off work, and health care utilisation (Linton & van Tulder 2001). They reported that six of nine RCTs did not find any significant difference on any of the outcome variables when comparing back school intervention to usual care or no intervention, or between different types of back schools. One RCT found a negative effect when back school was compared with McKenzie-style treatment. Only one RCT reported a significant positive effect on initial sick leave and duration of symptoms. Linton and Van Tulder concluded that there is strong and consistent evidence that back schools are not effective in preventing back pain (Linton & van Tulder 2001). Waddell and Burton concluded that there is strong evidence that traditional biomedical education based on an injury model does not reduce future LBP and work loss (Waddell & Burton 2001).

The most recent review by Tveito et al reported data from a total of 10 educational interventions (Tveito et al. 2004). Six studies reported the effect of educational interventions on sick leave due to LBP, and it was concluded that there was no evidence of effect on sick leave from educational interventions. Two of the included studies reported a positive effect on sick leave in the intervention group, yet there was no significant difference between intervention and control group. The effect of educational interventions on new episodes of LBP was assessed in six studies. Four of these studies did not demonstrate any significant effects, and the other two had methodological weaknesses. Based on this, the authors concluded that there is limited evidence for no effect of educational interventions on new episodes of LBP. Three methodologically weak studies assessed the effect from educational interventions on level of pain. The authors concluded there is no evidence for an effect of educational interventions on level of pain (Tveito et al. 2004).

There seem to be a general trend that the strength of the evidence and conclusions seem to be increasing with time. The most recent reviews (Linton & van Tulder 2001; Waddell & Burton 2001; Tveito et al. 2004) have the strongest conclusions. In several studies strong positive effects were found in the intervention group, but when compared to a control group there are seldom significant differences between intervention and control groups. Despite the findings in many of the reviews, and lack of evidence favouring any type of education, there may still be a potential effect from information/advice/instruction – the nature and delivery of the information may be important (Tveito et al. 2004). Waddell and Burton concluded in their review that there is preliminary evidence that interventions addressing beliefs and attitudes may reduce future work loss due to LBP (Waddell & Burton 2001). One

educational programme (Versloot et al. 1992), which has been included in several reviews, was not primarily focused on body mechanics, but on stress and coping strategies. That study showed a reduction in absenteeism compared to a control group. This reduction was not observed in the incidence of absence, but in the duration of absence among workers having prolonged absence. This is similar to the finding in respect of a psychosocial pamphlet (Symonds et al. 1995). The review by Maier-Riehle and Härter suggests that the traditional back schools may have been effective in teaching about the spine and 'correct' lifting techniques, and it may be that they (temporarily) change the way people do things (Maier-Riehle & Härter 2001). It should be noted that there is no universal agreement on whether there is a 'correct' lifting technique, and the overall content of back schools may give contradictory messages resulting in the lack of effects on back pain and sick leave.

When evaluating and recommending information/advice/instruction we are combining differences in the content of the information, and the different methods of distribution, into one large group of educational interventions. This is problematic, but the current scientific literature does not permit more specific recommendations about the content of the information/advice/instruction or about the different means for distributing the information. However, interventions incorporating ideas from the accompanying clinical guidelines on acute and chronic LBP, where information about the good prognosis and advice to stay active is important, should be considered.

### **Recommendation W2: Information / advice / instruction**

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 toward promoting activity and improving coping, can promote a positive shift in beliefs (Level C). Whilst 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 W3**

There is evidence of no effect from the use of back belts/lumbar supports in the prevention of LBP. In seven reviews, RCTs on the use of back belts have been evaluated. The reviews are essentially based on many of the same studies. In addition to the seven reviews, one individual study has been added (Kraus et al., 2002), which did not alter the conclusions from the reviews.

Three reviews concluded that there was strong evidence that lumbar support is not effective for prevention in LBP (Maher 2000; Linton & van Tulder 2001; Waddell & Burton 2001). One review (Jellema et al., 2001) concluded that there is moderate evidence that lumbar supports do not prevent LBP (Jellema et al. 2001), another concluded that there is no evidence of effect of back belt for prevention in LBP (Tveito et al. 2004), and two reviews concluded that there is insufficient evidence of the efficacy of lumbar supports (Lahad et al. 1994; van Poppel et al. 1997). The most recent reviews report the strongest evidence that lumbar supports are not effective for prevention in LBP. Most of the reviews concluded that there was strong evidence of no effect of back belts for prevention in LBP (Maher 2000; Linton & van Tulder 2001; Waddell & Burton 2001). Krause et al studied the use of back belts in a population of more than 12,000 female home attendants, and they suggested that this was associated with some reduction in risk of low back injury (Kraus et al. 2002). Inspection of the findings, however, revealed that this preventive effect was far from significant when controlling for confounders.

### **Discussion / consensus W3**

Back belts, supports and braces cover a variety of devices used by workers, yet there is now general consensus that back belts are not effective for prevention in LBP. Back belts are often used in combination with other interventions, and it is then difficult to determine if a possible benefit may be due to back support or an educational component of an intervention.

Compliance with wearing lumbar support varies substantially. The information on compliance is often neglected in the original studies. In the Van Poppel review, two of five studies reported compliance with wearing the lumbar support (van Poppel et al. 1997). Compliance seems to range from 43% of the subjects who wore the belt at least half the time to 80% of the subjects wore the belt most of the time (Jellema et al. 2001).

Van Poppel concluded that after applying a rating system for level of evidence, the results indicated that there was no evidence for or against the effect of lumbar support (van Poppel et al. 1997). This was mainly due to the contradictory outcomes of the studies. The Van Poppel review (van Poppel et al. 1997) included three RCTs; none of these reported any difference in back injury incidence. The Jellema et al review (Jellema et al. 2001) is an extensive review including five randomised preventive trials. They concluded that there was moderate evidence that lumbar supports are not effective for primary prevention. No evidence was found on the effectiveness of lumbar supports for secondary prevention. The number and type of control interventions used in the preventive studies varied considerably. In the Jellema et al review lumbar support versus no intervention, lumbar support versus other types of intervention, and lumbar support as supplement to another type of intervention versus the other type of intervention was examined (Jellema et al. 2001). Four RCTs reported no difference in back pain injury or incidence of LBP compared to no intervention. In three RCTs, no differences were found in sick leave. The authors concluded that there is moderate evidence that lumbar supports are not effective for primary prevention of LBP. Two RCTs reported no significant difference between intervention and control groups on incidence of LBP and sick leave due to LBP. In addition, Jellema et al concluded that lumbar supports are not more effective than other types of prevention of LBP (Jellema et al. 2001). For the incidence of LBP these authors concluded that there is limited evidence that a lumbar support added to a back school programme is not more effective than a back school programme alone. However, there is limited evidence that a lumbar support added to a back school programme is more effective than back school alone regarding the number of days absent from work due to back injury. Finally, no evidence was found for effectiveness in the prevention of recurrence of LBP episodes (Jellema et al. 2001).

Maher compared brace with no brace control and found no effect on the prevalence of LBP, severity, and sick leave (Maher 2000). Similar results were found for the trials that evaluated braces as a supplement to an education programme. Maher was also pooling data on both brace comparisons (i.e. brace versus no-brace and brace as a supplement to other interventions), and applying the rating system for the level of evidence, reveals strong evidence that braces are ineffective in reducing the prevalence of LBP, sick leave due to LBP and the severity of LBP (Maher 2000). Linton and Van Tulder concluded that there is strong and consistent evidence that lumbar supports are not effective for the prevention of LBP (Linton & van Tulder 2001). Four RCTs and two controlled trials (CT) were identified on the preventive effect of lumbar supports in various types of working populations. Three RCTs showed that there were no significant differences on any of the outcome measures when lumbar supports were compared with no intervention. No effect was shown when compared with training or education involving anatomy, body mechanics or lifting instructions. Similarly, the remaining RCT did not find any difference between lumbar supports and back-prevention training versus training only.

Linton and Van Tulder (Linton & van Tulder 2001), in general accord with Jellema et al (Jellema et al. 2001), reported that lumbar supports did seem to reduce the number of days lost from work when compared to no intervention. However, this was based on subgroup analysis and not RCTs. The most recent review by Tveito et al reported results from five studies assessing the effect of back belts on LBP (Tveito et al. 2004). In common with others, they discussed the problems with compliance; the belts may feel uncomfortable and

hamper movements, which may lead to non-compliance and/or drop-out. Two of three studies did not find any significant effects on sick leave. The authors concluded that there is no evidence of effect of back belts on sick leave. Three studies assessed the effect of back belts on new episodes of LBP. Two studies did not find significant effects, though one study with weak methodology reported an effect. The authors concluded that there is limited evidence that back belts have no effect on new episodes of LBP. Only one study in this review assessed effect on level of pain, and found no significant effect. The authors concluded that there is no evidence of effect of back belts on level of pain (Tveito et al. 2004). Based on all these reviews there is no evidence to support the use of lumbar supports.

#### **Recommendation W3: Back belts / lumbar supports**

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

#### **W4: Shoe inserts, shoe orthoses, shoe in-soles, flooring and mats**

##### **Evidence W4:**

There is evidence of no effect of shoe inserts/orthoses in the prevention of workers' LBP, which is concluded from two RCTs (Mündermann et al. 2001; Larsen et al. 2002a) reporting no preventive effects on lower back injury and back problems, respectively. There is no scientific evidence of a preventive effect of shoe in-soles, flooring or mats, because no studies relevant to prevention outcomes in LBP were found.

##### **Discussion / consensus W4**

Although the RCT, among military personnel, performed by (Mündermann et al. 2001) was of good quality, one might question its statistical power to detect differences as to a reduction in low back injuries. After completion of the 4-month period of wearing shoe inserts that were not custom-made, only 34 subjects from the insert group and 45 from the control group returned a completed injury questionnaire. Three subjects in the insert group (8.8%) suffered from lower back injuries as opposed to five subjects in the control group (11.1%); this difference was not statistically significant. A good-quality RCT among military conscripts, in which custom-made, semi-rigid biomechanical shoe orthoses were provided to conscripts in the intervention group and no intervention was given to the control group, showed a statistically significant difference between the intervention and control group for 3-month prevalence of 'back or lower extremity problems' (Larsen et al. 2002a). However, a further look into the results of this RCT revealed that this was due to differences in the prevalence of shin splints and, to a lesser extent, Achilles tendonitis. For 'back problems' there was no difference at all between groups. Hence, for the purpose of the present guideline it has to be concluded that shoe orthoses do not have a preventive effect in LBP.

Articles reviewing the literature on the effects of flooring (Redfern & Cham 2000), and the effects of floor mats (e.g., (Cham & Redfern 2001) together with a couple of studies evaluating the effects of floor mats as well as shoes in-soles or shoe softness (King 2002; Hansen et al. 1998) were found. In all studies subjective short-term outcomes, such as lower-back discomfort/fatigue, were used. Some studies included objective outcomes, such as movement of centre of gravity or electromyography from the lumbar paraspinal muscles. However, none of the studies used outcomes relevant to prevention in LBP. Hence, it is concluded that there is no evidence that shoe in-soles, soft shoes, soft types of flooring or antifatigue mats have a preventive effect in LBP.

#### **Recommendation W4: Shoe inserts, shoe orthoses, shoe in-soles, flooring and mats**

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

## **W5: Physical ergonomics**

### **Evidence W5**

There is evidence from two systematic reviews. Westgaard & Winkel found a general lack of success from mechanical exposure interventions (Westgaard & Winkel 1997), whilst Linton and van Tulder offered a negative conclusion about the role of ergonomic interventions (Linton & van Tulder 2001). Three subsequent good quality studies (Evanoff et al. 1999; Brisson et al. 1999; Yassi et al. 2001) reported that physical ergonomics interventions may reduce the prevalence and severity of LBP. Two other recent good quality studies did not report an improvement following changes intended to reduce exposure to physical risk factors (Fredriksson et al. 2001; Smedley et al. 2003). Physical ergonomic interventions that include an organisational 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 limited supportive evidence from one systematic review (Westgaard & Winkel 1997). In respect of reducing [reported] back injuries, occupational or compensable LBP in particular, there are several studies (Evanoff et al. 1999; Marras et al. 2000; Brophy et al. 2001; Koda et al. 1997; Owen et al. 2002), reporting physical ergonomics interventions to be successful, though only one (Evanoff et al. 1999) was of high quality. The only RCT (Yassi et al. 2001) did not find lower injury rates in the intervention groups.

### **Discussion / consensus W5**

#### *Prevalence and severity of LBP*

Five recent studies show positive results: for prevalence and duration of LBP (Brisson et al. 1999); for prevalence of LBP (Evanoff et al. 1999; Shinozka et al. 2001; Yassi et al. 2001) for prevalence and severity of LBP (Aaras et al. 2001). Three of those studies (Brisson et al. 1999; Evanoff et al. 1999; Yassi et al. 2001) can be considered as good quality studies.

A training programme focused on awareness of preventing musculoskeletal symptoms, psychosocial factors and coping was studied in one RCT (Morken et al. 2002). The intervention groups implemented ergonomic changes, but there was no significant change in musculoskeletal symptoms (including LBP). The authors suggested that the post-intervention survey was performed relatively early, at a time when many of the ergonomic solutions planned in the intervention groups (workplace redesign, changing work tools; job variation) had not been implemented.

Two conditions for a successful intervention (organisational dimension and involvement of the workers) are stressed in the conclusion of the review by Westgaard and Winkel, which deals with 'musculoskeletal health' in general (Westgaard & Winkel 1997). These two conditions are also explicitly present in two successful interventions (Brisson et al. 1999; Evanoff et al. 1999).

The third condition, i.e. the need to substantially change the exposure to the purported risk factors, is discussed in two good quality negative studies (Fredriksson et al. 2001; Smedley et al. 2003). Smedley et al. considered that the improvement in exposure to physical risk factors measured in the study was too small for any reduction in back pain to be expected (Smedley et al. 2003). In the other negative study (Fredriksson et al. 2001) the workers stated that their level of physical exertion was higher after the implementation of the ergonomic changes. The opportunity to influence the work had also decreased. The authors concluded that it is important to pay attention to the psychological dimension of the intervention (Fredriksson et al. 2001).

One study found that the positive effects of the interventions occurred only for workers less than 40 years of age (Brisson et al. 1999). Thus, it might be that ergonomic preventive interventions are less relevant for some sub-groups of workers (e.g., the older ones, or those with severe back disorders).

The magnitude of the effect differed between studies. It should be noted that the magnitude of a change is sensitive to the measure (relative or absolute decrease). Furthermore, work places exist where a majority of workers will develop LBP regardless of whether physical ergonomic interventions are implemented or not, hence the success of

such interventions may depend on the mechanical exposure at work (Westgaard & Winkel 1997). For frequently occurring conditions such as LBP it is unrealistic to expect to reduce the prevalence to zero. For example, in the study by Evanoff et al, the prevalence decreased from 73% to 56% in the intervention group, which appears substantial. However, the prevalence remained high at 15 months follow-up (Evanoff et al. 1999).

#### *Back injuries, occupational or compensable LBP*

In the review by Westgaard and Winkel there is no conclusion specifically for [reported] injuries, occupational or compensable low back pain (Westgaard & Winkel 1997). According to the authors, however, some physical ergonomics interventions suffer from inadequate description of health outcomes. If just administrative data are recorded, it is uncertain if the observed changes reflect improvements in health.

Six recent studies gave conclusions on these aspects of LBP in relation to ergonomic interventions (Koda et al. 1997; Evanoff et al. 1999; Marras et al. 2000; Yassi et al. 2001; Brophy et al. 2001; Owen et al. 2002). Among the five studies concluding a positive effect of the intervention, only one (Evanoff et al. 1999) was of good quality. The other ones were low quality studies: either the number of subjects was not given (Koda et al. 1997; Marras et al. 2000), or only the number of events (injuries, lost workdays) was given without reference to a population (Owen et al. 2002). The only RCT (Yassi et al. 2001) did not conclude a positive effect; in this study, musculoskeletal injury rates were not significantly altered in the intervention groups.

Several additional remarks can be made about these outcomes: the rate of events such as compensable low back pain is often low, leading to a lack of statistical power in the studies. The report of such events is strongly sensitive to organisational and administrative factors. One consequence of an intervention may be to actually increase the awareness of low back problems, including administrative notifications. This might be a problem for studies on LBP in general (Smedley et al. 2003).

The magnitude of the effect seems very large in the low quality study by (Koda et al. 1997): a reduction from 318 to 87 compensated LBP cases per year. However, the magnitude of any positive effect tends to be less in the good quality studies, suggesting that the large effects observed in some lower quality studies are a methodological artefact and not (or not exclusively) related to the intervention.

In the systematic review that offered a negative conclusion about the role of ergonomic interventions (Linton & van Tulder 2001) no RCTs or CTs evaluating the effectiveness of physical ergonomics interventions were identified, reflecting the lack of ergonomic literature in their search strategy.

Finally, LBP has not been the only (or necessarily the major) condition evaluated in numerous studies of physical ergonomics; whether LBP and other musculoskeletal disorders are equivalent in this respect remains to be determined.

#### **Recommendation W5: Physical ergonomics**

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 organisational 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 may be modest.

## **W6: Organisational ergonomics**

### **Evidence W6**

There is inconsistent evidence that work organisation interventions are successful for reduction of LBP. This conclusion is based on two studies, one positive with a low methodological quality (Charney 1997) and one negative with moderately high methodological quality (Wergeland et al. 2003).

### **Discussion / consensus W6**

This type of intervention is not studied separately in systematic reviews. None of the interventions in the review by Westgaard and Winkel covered 'work organisation' as the main dimension, even though it is a component of many intervention studies (Westgaard & Winkel 1997). One study (Charney 1997), reports positive results of an intervention dealing with work organisation: the implementation of lift teams in ten hospitals in order to reduce lifts by nurses. However, the methodological quality of the Charney study is low (group size unknown).

The effect of a reduction of daily working hours was studied in one intervention. The prevalence of LBP did not change significantly between the intervention and reference groups (Wergeland et al. 2003).

There are insufficient data to make recommendations about ergonomic interventions focussing primarily on work organisational issues, irrespective of the LBP dimension considered. However, previous comments dealing with physical ergonomics interventions stress that not taking into account the organisational aspects may have negative effects, and epidemiological studies indicate that work organisational factors (especially psychosocial factors) are associated with various dimensions of LBP.

### **Recommendation W6: Organisational ergonomics**

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

## **W7: Multidimensional interventions**

### **Evidence W7**

There is evidence from two systematic reviews (Gatty et al. 2003; Tveito et al. 2004), that multidimensional interventions (some of which included an ergonomics component) have a positive effect for prevention in LBP. Tveito et al concluded that comprehensive multidisciplinary and multimodal treatment interventions can have a positive effect for some, but not all LBP outcomes (Tveito et al. 2004). However, the effective dimensions and the particular outcomes they influence are uncertain.

### **Discussion / consensus W7**

One high quality systematic review (Gatty et al. 2003) included five studies classified as 'education and task modification'. In two of those studies the educational part of the interventions included lifting techniques (patient transfer techniques; 'proper' lifting). In two others a 'workstation redesign' dimension was also present. In one of these, the additional components focussed on 'proper' lifting, exercise and pain management, whilst in the other they focussed on care providers, and the educational dimension was hands-on practice with devices such as walking belts and hoists. In the three studies (out of five) with a good research design, more positive than negative outcomes were associated with the intervention. These positive outcomes ('back pain days', 'back injuries') differed across the three studies. Despite these mixed results, the authors of the review suggested that programmes including education and task modification, addressing the specific problems

identified in the workplace, involving the staff and the workers, can have positive results. The term 'education' in this conclusion must be understood in a broad sense, since it comprises various kinds of interventions. The conclusion of the systematic review by Gatty is not changed by taking into account one additional original study (Leclerc et al. 1997). In this study positive effects of the intervention were observed for one subgroup, but it is difficult to know which component of the programme (ergonomic changes or exercises) had a positive effect.

The review by Tveito et al described four multidisciplinary and multimodal treatment programs, and found moderate to limited evidence that these programs can have an effect on some outcomes (e.g. sick leave, recurrence, pain, costs), yet each program may influence only some of the outcomes. Some of these interventions were essentially clinical in nature, putting them outside the scope of this guideline, though others were occupational health interventions that involved workplace interventions (e.g. an ergonomics component) (Tveito et al. 2004).

#### **Recommendation W7: Multidimensional interventions**

Whilst multidimensional interventions at the workplace may 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 may be modest.

### **W8: Modified work for return to work after sick leave due to LBP**

#### **Evidence W8**

There is moderate evidence of positive effects of modified work to promote return to work after sick leave from regular work due to LBP. Studies on the effects on return to work of modified work have been evaluated in three reviews (Krause et al. 1998; van der Beek et al. 2000; van der Beek 2004). However, they included studies covering all workers with disabling injuries and workers with musculoskeletal disorders (not only LBP). When focussing on just LBP, only four studies were found. Positive results (shorter return-to-work time) were found in one RCT (Loisel et al. 1997), one controlled before-after study (Yassi et al. 1995) and one prospective cohort study using interrupted time series (Anema et al. 2004). A retrospective study using an interrupted time series design (Hiebert et al. 2003) did not shorten work absence.

#### **Discussion / consensus W8**

Irrespective of the evidence on physical and organisational ergonomics to specifically influence outcomes, the WG endorses the pragmatic view that '*Work should be comfortable when we are well, and accommodating when we are ill*' (Hadler 1997), and recognises that ergonomics has a role in formulating modified work to facilitate early return to work (Waddell & Burton 2004). The reviews covered interventions focussing on workers absent from work due to injuries or disorders in parts of the body other than the low back. Therefore, the evidence from individual studies concerning LBP specifically was taken into account. The reviews combined several types of modified work interventions into one group. First of all, modified work is often part of a multidimensional intervention, so that the separate effects of modified work and the other parts of the intervention can not be disentangled (Yassi et al. 1995). Secondly, quite a few interventions can be regarded as 'modified work', but there is substantial variation as to the content of these interventions. The three predominant categories are: (1) light duty or work restriction or adapted job tasks; (2) reduction in the working hours/day and/or working days/week; (3) ergonomic changes to the workplace. Depending on the social system in different countries, modified work can also involve 'therapeutic return to work' or 'work trial'. It is difficult to separate what could be effective in these different scenarios. Hence, there is no evidence that any type of modified work is superior to another, but based on the studies of (Loisel et al. 1997) and (Anema et al. 2004) it can be concluded that there is evidence to support ergonomic workplace adaptations in

respect of facilitating return to work. Moreover, there is an indication that this is not just an 'attention effect'; it has been reported that a physiotherapist worksite visit, including information and advice but without actual workplace adaptation, did not add any further value to the effects of a back school-type of mini-intervention during which exercises and advice on work activities were given (Karjalainen et al. 2004). There is general agreement among occupational health guidelines that modified work should be a temporary measure, and that there is no need for the worker to be pain-free before returning to work (Staal et al. 2003); modified work can be seen as a component of a wider range of rehabilitation strategies (Waddell & Burton 2004). It must be acknowledged that there are a number of problems to implementing modified work concerning knowledge, understanding, availability of alternative duties and resistance from co-workers (van Duijn et al. 2004), and procedures may be needed to ensure restricted duties are appropriately lifted rather than being allowed to become permanent (Hiebert et al. 2003).

**Recommendation W8: Modified work for return to work after sick leave due to LBP**

Temporary modified work (which may include ergonomic workplace adaptations) can be recommended, when needed, in order to facilitate earlier return to work for workers sick listed due to LBP (Level B).

## **Prevention in low back pain – school age**

### **Introduction**

During the last few decades, an increasingly large number of surveys have demonstrated that non-specific LBP in schoolchildren is much more frequent than previously thought. Simultaneously, different surveys have been published reporting factors associated with or predisposing to LBP. The methodological quality of the studies improved progressively over time and is now moving from cross-sectional studies allowing just obtaining figures of prevalence and associated factors to longitudinal studies reporting incidence and possible causal relationships. Furthermore, clinical and epidemiological data, analysis of risk factors, imaging and immunohistological findings draw attention to the early degenerative changes of the spine, and to the concept of precocious prevention. In addition, there is some evidence that back pain at young age has a predictive value on LBP as an adult (Harreby et al. 1995).

While the epidemiology of back pain at young age has been described extensively, studies evaluating the effects of interventions to prevent LBP or the consequences of LBP in schoolchildren are still sparse. As a result the aim to formulate evidence based guidelines for prevention in LBP among schoolchildren could not be accomplished. However, the conclusions of the literature search may give guidance for further development and evaluation of preventive interventions during school age.

In order to provide evidence for relevant prevention strategies, intervention studies deserve priority, yet evaluating modifiable [purported] risk factors for back pain and its consequences in schoolchildren is relevant to the development of preventive interventions, so these are incorporated below. Since primary causative mechanisms for most LBP remain undetermined, the term 'risk indicators' is most appropriate when considering risk, but for convenience (and in correspondence with much of the literature) the term 'risk factors' will be used here. Modification of risk factors, without evidence of influence on LBP outcomes, can not be considered prevention.

### **Intervention studies**

#### **S1: School-based interventions**

##### **Evidence S1**

In schoolchildren, only five school-based intervention studies that included the evaluation of back pain or the consequences of back pain could be located. All five studies evaluated intervention programmes comprising a variable number of hours education in back care principles. Four studies were controlled. In the controlled trial of Mendez et al. an independent health check 4 years after programme application tended to favour the intervention pupils, requiring less medical treatment for LBP (Mendez & Gomez-Conesa 2001). The controlled before-after trial of Cardon et al. showed a positive effect of back education on back pain prevalence after the programme and 3 and 9 months later (Cardon et al. 2002b). Similarly, the controlled trial of Feingold and Jacobs, involving a small sample of children, reported a positive effect on back pain (Feingold & Jacobs 2002). In contrast, in the study of Storr-Paulsen, the educational intervention did not have effect on back pain of the pupils after one year of intervention (Storr-Paulsen 2002).

During the 3-year period analysed in the uncontrolled intervention study of Balagué et al. there was an overall reduction in prevalence of LBP, and recollection of participation in the prevention programme was associated with increased self-reported LBP but with significantly decreased utilization of medical care (Balagué et al. 1996).

### **Discussion / consensus S1**

Studies evaluating the effects of interventions to prevent LBP or the consequences of LBP in schoolchildren are still sparse.

**While it can be concluded that the results of the intervention studies are promising, differences between the interventions and the limitations of the studies (such as primary reliance on self-reports in children and the use of quasi-experimental designs) dictate a need for cautious interpretation and do not permit recommendation of back care education for prevention of LBP in schoolchildren. Moreover, a follow-up into adulthood is missing and there is insufficient information to be able to specify precisely what may be the important/effective components of such interventions.**

In only one study (Cardon et al. 2002a) was the possibility of a harmful effect from an educational intervention programme on fear avoidance beliefs evaluated – it was found that the intervention did not have a detrimental effect on fear avoidance beliefs. Other studies on possible harmful effects could not be located.

### **Recommendation S1: school based interventions**

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

### **Modifiable risk factors**

In order to provide evidence for relevant prevention strategies, intervention studies deserve priority. However, intervention studies are still sparse and no studies could be located that evaluated the effects of risk factor modification on back pain or on the consequences of back pain in schoolchildren. Therefore it was decided to include information on modifiable risk factors, taking into account that risk factor modification, without evidence of concomitant influence on outcomes, cannot be considered prevention.

The following, potentially modifiable, risk factors were located in the literature search: 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.

#### Life style factors

- **S2: Overweight / obesity**

#### **Evidence S2**

The most carefully designed study on the association between LBP and body mass index (BMI) is the prospective population-based cohort study of Jones et al., reporting that neither BMI nor its change over the follow-up year was associated with an increase in the risk of future LBP (Jones et al. 2003).

#### **Discussion / consensus S2**

The present literature search shows that an association between LBP and BMI is unproved, and the influence of obesity during school age on adult LBP is unclear. According to Lake et al. obesity in early adulthood increases the risk of back pain onset among women, whereas BMI at age 7 years has no relationship with the onset of pain in either sex (Lake et al. 2000). **It can be concluded that there is no evidence for or against recommending weight control as a preventive action for LBP in schoolchildren.**

- **S3: Smoking**

**Evidence S3**

The 'association' between back pain and smoking among schoolchildren has been shown in four studies (Feldman et al. 1999; Harreby et al. 1999; Lebkowski 1997; Kristjansdottir & Rhee 2002). In contrast to these findings Kovacs et al found no association between LBP and cigarette smoking (Kovacs et al. 2003b).

**Discussion / consensus S3**

There are few direct data regarding the pathologic origin of back pain during school age, or regarding any pathogenic effects from smoking. According to Harreby et al smoking habits in schoolchildren may indirectly reflect psychosocial and social problems as the main causes in developing LBP (Harreby et al. 1999). **It can be concluded that there is no evidence that anti-smoking campaigns will have a preventive effect in LBP in schoolchildren.** However, as more adverse reactions to smoking are discovered and publicized it is hoped that the appeal of smoking will be diminished in young people.

- **S4: Eating habits**

**Evidence S4**

Kristjansdottir and Rhee identified a strong positive relationship between back pain and eating habits, namely irregular meals, fast food, snacking and coffee drinking (Kristjansdottir & Rhee 2002).

**Discussion / consensus S4**

Besides its cross-sectional design this one study (Kristjansdottir & Rhee 2002) has the limitation that the many associated factors accounted for less than 10 % of total variance of back pain in the sample, suggesting the existence of other potential factors that were not measured, yet contributed to the incidence of pain. **There is insufficient evidence to recommend for or against modification of eating habits as a preventive measure for LBP in schoolchildren.**

- **S5: Alcohol intake**

**Evidence S5**

The recent cross-sectional study of Kovacs et al found no association between LBP and alcohol intake in a large sample of schoolchildren (Kovacs et al. 2003b).

**Discussion / consensus S5**

As reported by the authors, the risk of underreporting of alcohol intake can not completely be ruled out (Kovacs et al. 2003b). **There is no evidence for or against recommending modification of alcohol intake as a preventive measure for LBP in schoolchildren.**

- **S6: Sports / physical inactivity**

**Evidence S6**

In addition to three studies pointing out the risk for LBP in young athletes (Ogon et al. 2001; Hutchinson 1999; McMeeken et al. 2001), several studies evaluated the risk of physical activity and sports in non-athlete populations, and found a gender-specific positive link between sports participation and back pain (Korovessis et al. 2004; Kovacs et al. 2003b; Harreby et al. 1999; Burton et al. 1996). Also, two studies found a positive association between LBP and high leisure physical activity (Kujala et al. 1996; Newcomer & Sinaki 1996). Similarly the prospective study of Jones et al. showed an increased risk for LBP in those undertaking a high level of physical exercise (Jones et al. 2003). On the other hand,

Kristjansdottir and Rhee reported a negative correlation between back pain and sports participation or physical activity (Kristjansdottir & Rhee 2002). Similarly, Salminen et al pointed out low leisure-time physical activity as a risk factor (Salminen et al. 1995) and Szpalski et al reported a higher incidence of LBP in 9-12 year old children not walking to school compared to children walking to school, while sports participation had no significant influence (Szpalski et al. 2002). On the other hand Sjolie reported that the distance walked / bicycled to school was slightly shorter among adolescents reporting LBP (Sjolie 2003). However the use of a cross-sectional design and a small study group (n = 88) does not allow generalizing findings of the latter study. Finally, according to the findings from five studies, the total amount of physical activity was not associated with back pain reports in schoolchildren (Cardon et al. 2004; Feldman 2001; Iyer 2001; Watson et al. 2003; Widhe 2001). Furthermore, Wedderkopp et al recently used accelerometers to objectively measure childrens' activity, and reported no association between back pain and physical activity levels (Wedderkopp et al. 2003).

#### **Discussion / consensus S6**

From the literature search it can be concluded that in children and adolescents there are indications that high performance training in certain sports can increase the risk for back pain, whereas the relationship between leisure time physical activity and back pain suffers from inconsistencies. **There is no evidence that performing sports or being physically active has a preventive effect on LBP in schoolchildren. There is also insufficient evidence to recommend a general limitation of involvement in competitive sports participation as a preventive measure for LBP in schoolchildren**

- **S7: Sedentary activities**

#### **Evidence S7**

Sheir-Neiss et al reported that the adolescents with back pain reported significantly more hours watching TV than those without back pain (Sheir-Neiss et al. 2003), and Grimmer and Williams found gender- and age- specific associations between the amount of time spent sitting and recent LBP (Grimmer & Williams 2000). However, in two other studies the association between LBP and hours of leisure sitting was not significant (Kovacs et al. 2003b; Watson et al. 2003). Similarly, Jones et al prospectively demonstrated that prior sedentary activities cannot be considered a short-term risk factor for future LBP (Jones et al. 2003). On the other hand, in the cross-sectional study of Gunzburg et al in 9 year old children, back pain reports were higher in children who played video games for more than 2 hours per day, whereas this was not the case for children who watched television for more than 2 hours per day (Gunzburg et al. 1999). Lebkowski reported a positive correlation between LBP and 'incorrect' sedentary position (Lebkowski 1997), and in the study of Viry et al sitting on the edge of the chair while completing a questionnaire was significantly associated with a history of a physician visit for back pain (Viry et al. 1999).

#### **Discussion / consensus S7**

According to the narrative review of Balagué et al sitting was found to be the most common factor associated with back pain (Balagué et al. 1999). From the present review it can be concluded that the association between LBP and sitting in schoolchildren remains unclear. Furthermore, a study evaluating whether the loading on young growing body structures, associated with poor prolonged sitting postures or sedentary behaviour, has an impact later in life could not be located. **There is insufficient evidence to recommend for or against modified sitting postures as a preventive action for LBP in schoolchildren. There is also no evidence that decreasing sedentary activities will have a preventive effect on LBP in schoolchildren.**

- **S8: Work**

**Evidence S8**

In the study of Feldman et al working increased the risk to suffer LBP in school-aged children (Feldman et al. 2002). Similarly, Harreby et al found a positive association between LBP and jobs, involving a heavy load on the lower back (Harreby et al. 1999). Also, in the cross-sectional survey based study of Watson et al, children with a part time job had a 60% increase in odds of reporting LBP, although among those with a part time job there was no association with reporting lifting heavy items (Watson et al. 2003). Also, in the recent prospective study of Jones et al, having a part time job significantly increased the risk for LBP (Jones et al. 2003).

**Discussion / consensus S8**

It can be concluded that working is associated with reported LBP in European schoolchildren. However, there is no evidence that modification of working has a preventive effect on LBP in schoolchildren. Moreover, it needs to be taken into account that work exposure in European schoolchildren is only part-time (which is different from work exposure in most adults), and that muscle fatigue from working may have influenced pain reports. Furthermore study findings were not controlled for social class. **There is insufficient evidence to recommend modification of working as a preventive measure for LBP in schoolchildren**

Physical factors

- **S9: Physical fitness**

**Evidence S9**

According to a recent study there is no correlation between back pain and fitness parameters in 9 to 11 year olds (Cardon et al. 2004). On the other hand, two studies have reported that poor self-reported physical fitness increased the risk for back pain in schoolchildren (Kristjansdottir & Rhee 2002; Sjolie 2002).

**Discussion / consensus S9**

Findings in the literature are conflicting; besides the cross-sectional designs, two studies were limited by the use of self-reported fitness (Kristjansdottir & Rhee 2002; Sjolie 2002) so the validity can be questioned. **It can be concluded that there is no evidence that being fitter has a preventive effect on LBP in schoolchildren.**

- **S10: Mobility / flexibility**

**Evidence S10**

Feldman et al found that tight hamstrings and quadriceps muscles were associated with the development of LBP (Feldman 2001). In contrast, Harreby et al reported no significant correlation between LBP and tightness of the hamstring muscles (Harreby et al. 1999). A correlation between hypermobility and LBP could not be confirmed in three studies (Harreby et al. 1999; Widhe 2001; Burton et al. 1996), and Feldman did not find an association between lumbar flexion and the development of LBP (Feldman 2001). On the other hand, Salminen et al found that decreased spinal mobility was associated with LBP in adolescents (Salminen et al. 1995).

**Discussion / consensus S10**

Since findings in the literature are conflicting, it cannot be concluded that there is a relationship between LBP and mobility and flexibility in schoolchildren. **There is insufficient**

**evidence to recommend for or against modification of mobility and flexibility of muscles and joints as a preventive action for LBP in schoolchildren.**

- **S11: Muscle strength**

**Evidence S11**

Feldman found that poor isometric abdominal muscle strength was not a risk factor for the development of LBP in adolescents (Feldman 2001). In contrast, Newcomer and Sinaki found that increased trunk flexor strength was positively associated with LBP in adolescents (Newcomer & Sinaki 1996), whereas in the prospective study of Lee et al lower trunk extensor muscle strength rather than trunk flexor muscle strength was found to be a risk factor of LBP incidence (Lee et al. 1999). Additionally, Sjölie and Ljunggren found that insufficient strength and stability in the low back are important for both current and future back pain (Sjölie & Ljunggren 2001). In line with these findings, Salminen et al reported in a study with a strong longitudinal design that decreased spinal strength increased the risk for back pain in schoolchildren (Salminen et al. 1995).

**Discussion / consensus S11**

In line with the review of Balagué et al it can be concluded that LBP in schoolchildren cannot simply be attributed to muscle weakness (Balagué et al. 1999). **There is insufficient evidence to recommend for or against muscle strengthening as a preventive action for LBP in schoolchildren.**

School-related factors

- **S12: School bags**

**Evidence S12**

Various studies (Watson et al. 2003; Goodgold et al. 2002; Grimmer & Williams 2000) have reported no associations between backpack-related factors and back pain at a young age. Other studies, though, have described an association between backpack load and LBP (Negrini & Carabalona 2002; Szpalski et al. 2002; Siambanes et al. 2004). In the recent study of Sheir-Neiss et al, carrying a sports bag in addition to a backpack was not associated with back pain, though adolescents with back pain carried significantly heavier backpacks in comparison with those without back pain (Sheir-Neiss et al. 2003). Furthermore, two studies reported no significant association between LBP and the manner in which books were carried (Kovacs et al. 2003b; Korovessis et al. 2004). Similarly, the study of Jones et al showed no association between a short-term risk for LBP and mechanical load across the range of weights commonly carried to school by children (Jones et al. 2003). According to Negrini and Carabalona other factors, such as fatigue and time spent carrying, may be directly related to back pain in addition to the weight of the backpack (Negrini & Carabalona 2002).

**Discussion / consensus S12**

While there are legal regulations applicable to adults in order to control exposure to loads carried at the work place, in most countries back pack weights for schoolchildren are not regulated. The WG recognises there is a widespread interest in 'heavy' school bags as a potential risk factor for low back pain. However, in line with the recent review of Mackenzie et al, conflicting study results are found for the association between back pack related factors and LBP in schoolchildren (Mackenzie et al. 2003). A major problem is that, at best, many studies looked only once at the actual weight of back packs, yet large variations between the days of the week within the same class of the same school have been found (Negrini & Carabalona 2002). **It can be concluded that there is no consistent scientific evidence for or against recommending a clear limit to the weight of school bags (or for avoiding**

**use of schoolbags), changing the type of school bag or the method of carrying the school bag as primary measures for reducing LBP in schoolchildren.**

- **S13: School furniture**

**Evidence S13**

Milanese & Grimmer, in a cross-sectional study, reported on 1269 schoolchildren aged 8-12 years from Australia (Milanese & Grimmer 2004). Recent reports of headache or spinal pain (cervical, thoracic or lumbar) were analyzed in comparison with several anthropometric variables as well as with the relationship between the latter and the school furniture (the furniture used at home was not examined). The smallest students showed the best fit with school furniture, while the tallest ones (4<sup>th</sup> quartile) showed higher odds of reporting LBP.

**Discussion / consensus S13**

There have been attempts to prevent LBP by modifications of school furniture (Hopf et al. 1996; Knusel & Jelk 1994; Linton 1994), and from a physiological point of view the need for adjustable and dynamic furniture seems reasonable to prevent present and future LBP. Limon et al recently evaluated the biomechanical appropriateness of the environment in elementary schools in Israel (Limon et al. 2004). Nearly 15% of the first graders and 20% of the 6<sup>th</sup> graders had inappropriate chairs, and in a large percentage of classes children were not sitting in front of the teacher. However, that study does not provide any evidence of the possible value of preventive interventions based on such factors. Whilst three studies (Parcells et al. 1999; Denis et al. 2003; Panagiotopoulou et al. 2004) indicated a mismatch between students' bodily dimensions and classroom furniture, a possible association with LBP was not evaluated. Furthermore, Troussier et al, studying 8 to 11 year olds, reported no significant differences in back pain prevalence between those who used Mandal's furniture and those who used ISO standard furniture during 4 to 5 years (Troussier et al. 1999).

It can be concluded that the possible protective role of adjusted school furniture remains unclear. The association reported by Milanese and Grimmer is not confirmation that an intervention on school furniture would be appropriate to prevent LBP, since age cannot be excluded as a confounding variable (Milanese & Grimmer 2004). **There is insufficient evidence to recommend for or against modified school furniture as a preventive measure for LBP in schoolchildren.**

Psychosocial factors

- **S14: Psychosocial factors**

**Evidence S14**

According to a study of Balagué et al, psychological factors, labelled "positive" were associated with a reduction of lumbar pain whilst those factors considered "negative" were accompanied by an increase of this sort of pain (Balagué et al. 1995). Moreover, in a recent study, Watson et al it was suggested that psychosocial factors are more important than mechanical factors for LBP occurring in young populations (Watson et al. 2003). Similarly, Szpalski et al found that lower scores for happiness, the quality of falling asleep and health perception were associated with higher back pain reports in 9-12 year olds (Szpalski et al. 2002), and Gunzburg et al found in 9- year olds that general well-being was correlated with back pain (Gunzburg et al. 1999).

In line with these findings, numerous recent studies in schoolchildren reported an association between back pain and psychological factors, such as morning tiredness and parental support (Kristjansdottir & Rhee 2002), poor well-being and, in particular, poor self-perceived fitness (Sjolie 2002), a higher degree of somatising, diminished self-esteem and augmented negative affect (Staes et al. 2003), disliking going to school (Storr-Paulsen 2002),

psychosomatic factors (van Gent et al. 2003), life quality (Harreby et al. 1999) and poor mental health (Feldman 2001). Furthermore, according to the prospective study of Jones et al high levels of adverse psychosocial exposure, the presence of conduct problems, such as anger, disobedience and violence, and high levels of hyperactivity were associated with an increased risk to develop LBP in adolescents (Jones et al. 2003).

#### **Discussion / consensus S14**

Since back pain reports in schoolchildren are mainly associated with psychosocial factors and since it is shown in the literature that LBP in the young is mostly benign and self-limiting (Burton et al. 1996; Salminen et al. 1999), it can be argued that there is limited scope for generalized prevention of LBP in schoolchildren, and that medicalising the symptoms in schoolchildren needs to be avoided (Balagué et al. 2003; Burton et al. 1996; Burton 1996). Furthermore, an aggregation of symptoms retrieved by questioning children can be misleading, and the definition of boundaries between pain as an experience, as opposed to pain as a sign of “a medically significant” disease, is sometimes difficult. Children are in a general learning process, including expression of pain in an adequate and acceptable fashion, both socially and culturally. Therefore, it may be time to look at what pain, aches, disability and “disease” mean to schoolchildren themselves, and not to simply apply adult definitions to assess children and LBP (Balagué et al. 2003). **However, there is no evidence that modification of psychological factors may have a preventive effect on LBP in schoolchildren.** Moreover, it can be questioned to what extent psychosocial risk factors are modifiable in schoolchildren.

## **Recommendations for future research:**

### ***General***

It is reasonable to suggest that further research is needed to determine the causal factors (and interactions between them) for LBP. However, in view of the general nature of LBP, the WG considered that further research into preventing the undesirable consequences of LBP is likely to have a greater impact. The following are lists of what the WG decided could advance our knowledge in this respect.

### ***Population***

- Studies are needed to determine how and by whom interventions are best delivered to specific target groups.
- Good quality RCTs are needed to determine the effectiveness of specific interventions aimed at specific risk / target groups.
- High quality studies are recommended into the effectiveness of specific chairs, mattresses etc. to justify or refute claims by commercial interests.
- Misconceptions about back pain are shown to be widespread in adults, and they play a role in the development of long-term disability (Goubert et al. 2004). Further study is necessary to explore whether these misconceptions may be prevented by carefully selected and presented health promotion programmes, with the merit of demedicalising LBP.
- More information is needed on what preventive interventions are currently used, and by whom, so that any disadvantageous practices may be corrected.
- More information is needed to match types of interventions with specific/relevant outcomes.

### ***Workers***

- Good quality RCTs are needed to study the effectiveness of daily physical activity for prevention of LBP and for prevention of recurrence of LBP. In addition, the effectiveness of physical exercise as well as daily physical activity should be studied for prevention of (recurrence of) sick leave due to LBP.
- It is recommended to perform good quality RCTs on the role of information oriented toward reducing fear avoidance beliefs and improving coping strategies in the prevention of LBP.
- More good quality RCTs are needed to determine the effectiveness of distributing (psychosocial) educational pamphlets at the worksite, in terms of the impact on sick leave, and to study the effectiveness of education on the prevention of recurrence of sick leave due to LBP and, importantly, to determine precisely what advice/instruction and mode of delivery may be most effective.
- Good quality RCTs are urgently needed to study the effectiveness of physical as well as organisational ergonomic interventions on a large variety of outcomes, ranging from prevention of (recurrence of) LBP and prevention of (recurrence of) sick leave due to LBP up to compensable LBP.
- In studies evaluating the effectiveness of physical or organisational ergonomic interventions at the workplace, randomisation at the individual level is often not feasible. It is recommended to perform more good quality cluster-randomised studies instead of non-randomised trials, controlled before/after studies, studies with interrupted time series, or etiological studies.

- It is recommended to investigate whether effective interventions can be applied to all workers, irrespective of gender, age, seniority and/or past history of LBP. If the effective interventions have to be more tailor-made, the optimal approach for each relevant subgroup should be examined.

### **School age**

- RCTs evaluating the possible positive effects of preventive programmes and risk factor modifications at young age on adult LBP are advocated.
- Studies to determine the most important/feasible outcomes (occurrence, recurrence, disability etc) for prevention during school age are advocated.
- From a physiological point of view, poor life style habits and prolonged static sitting during school age on unadjusted furniture may play a role in the origin of LBP: further study is appropriate to determine any effectiveness of school-based interventions (exercise/sport, desks/seating, backpacks/bags).
- Misconceptions about back pain are shown to be widespread in adults, and they play a role in the development of long-term disability (Goubert et al. 2004). Further study is necessary to explore whether these misconceptions may be prevented by carefully selected and presented health promotion programmes in schoolchildren, with the merit of demedicalising LBP.
- More study is needed to investigate the relationship between catastrophic thinking about pain, pain severity and pain-related disability in children.
- Further study with a follow-up into adulthood is needed to evaluate whether or not the physical cumulative 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.
- Future projects should be of outstanding methodological quality and probably interdisciplinary to take into account all the specificities of schoolchildren.

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## **POTENTIAL CONFLICTS OF INTEREST**

### **WORKING GROUP 3 (Prevention in LBP)**

This declaration of potential conflicts of interest has been signed by the following members of the COST B13 Working Group on European guidelines for prevention in low back pain:

I have not received and will not receive any economic or other type of support for myself or my research that constitutes any conflict of interest for any statement in these guidelines.

I am not currently or have not been previously hired by or supported by any organisation that receives financial benefits from the promotion of any specific interventions recommended in these guidelines.

**F Balagué**  
**AK Burton**  
**G Cardon**  
**HR Eriksen**  
**O HÄNNINEN**  
**EL HARVEY**  
**Y Henrotin**  
**A Lahad**  
**A Leclerc**  
**G Müller**  
**AJ van der Beek**

## Appendix: Search strategies adopted by the three sub-groups

The electronic literature was searched to the end of 2003, but additional studies that became available during the preparation phase of the guideline were potentially acceptable. Any such additional papers were subjected to the same selection/discussion process as used throughout. (The results from the 'general population' search were also made available to the other sub-groups).

### General population

1) Database: MEDLINE <1966 to November Week 2 2003>Search Strategy:

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1  exp Back Pain/ (14645)
2  backache.ti.ab. (1182)
3  exp Back/ (10421)
4  lumbar trauma.ab.ti. (11)
5  lumbar pain.ab.ti. (500)
6  lumbosacral.ab.ti. (4994)
7  sacrum.ab.ti. (1855)
8  sacroiliac.ab.ti. (1492)
9  lumbago.ab.ti. (666)
10 or/1-9 (31053)
11 meta-analysis/ (5319)
12 review literature/ (951)
13 meta-analy$.tw. (10329)
14 metaanal$.tw. (398)
15 (systematic$ adj4 (review$ or overview$)).mp.
[mp=title, abstract, cas registry/ec number word, mesh
subject heading] (6238)
16 meta-analysis.pt. (8663)
17 review.pt. (991875)
18 review.ab.ti. (302776)
19 review literature.pt. (35150)
20 or/11-19 (1142807)
21 case report/ (1114672)
22 letter.pt. (520048)
23 historical article.pt. (207391)
24 review of reported cases.pt. (48579)
25 review_multicase.pt. (7789)
26 or/21-25 (1751195)
27 20 not 26 (1023081)
28 guideline.pt. (12130)
29 practice guideline.pt. (7890)
30 guideline$.mp. (75311)
31 (practice adj2 guideline$).mp. (5216)
32 (clinical adj2 guideline$).mp. (5009)
33 28 or 29 (12130)
34 30 or 31 or 32 (75311)
35 10 and 34 (342)
36 35 and 33 (15)
37 33 or 34 (82023)
38 20 or 37 (1204152)
39 38 not 26 (1079738)
40 10 and 39 (2701)
41 pc.fs. (533014)
42 40 and 41 (226)
43 from 42 keep 1-226 (226)
[27 articles retrieved]

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2) Database: PsycINFO <1974 to December Week 2 2003>Search Strategy:

```

1  exp Back Pain/ (1230)
2  backache.mp. (48)
3  back ache.mp. (1)
4  backpain.mp. (2)
5  back pain.mp. (1647)
6  lumbar pain.mp. (11)
7  lumbar trauma.mp. (0)

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8  lumbosacral.mp. (82)
9  sacroiliac.mp. (2)
10 sacrum.mp. (2)
11 lumbago.mp. (10)
12 or/1-11 (1774)
13 exp Meta Analysis/ (2518)
14 exp Literature Review/ (20905)
15 meta-analy$.tw. (5386)
16 metaanal$.tw. (127)
17 (systematic$ adj4 (review$ or overview$)).mp. (1015)
18 review$.mp. (126040)
19 or/13-18 (129557)
20 guideline$.mp. (15747)
21 practice guideline$.mp. (606)
22 (practice adj2 guideline$).mp. (901)
23 (clinical adj2 guideline$).mp. (863)
24 or/19-23 (141987)
25 12 and 24 (185)
26 prevent$.tw. (46525)
27 25 and 26 (26)
28 from 27 keep 1-26 (26)

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[26 articles retrieved]

3) Database SPORT Discus 1998-2003/11, SPORT Discus 1830-1997: Search History

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#27 (("PREVENTION-" in DE,SH) or (prevent*)) and ((back
pain) or (backpain) or (back ache) or (backache) or
(lumbago) or (("BACK-" in DE,SH) or ("BACK-PAIN" in
DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or
(sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar
pain)) and ((meta-analy*) or (("META-ANALYSIS" in
DE,SH) or ("REVIEW-" in DE,SH)) or (practice adj2
guideline*) or (practice guideline*) or (guideline*) or
(clinical guideline*) or (review*) or (systematic* (review* or
overview*)) or (meta analy*) or (metaanal*)) (61 records)
#26 ("PREVENTION-" in DE,SH) or (prevent*) (22523
records)
#25 "PREVENTION-" in DE,SH (13822 records)
#24 prevent* (22523 records)
#23 (meta-analy*) or (("META-ANALYSIS" in DE,SH) or
("REVIEW-" in DE,SH)) or (practice adj2 guideline*) or
(practice guideline*) or (guideline*) or (clinical guideline*)
or (review*) or (systematic* (review* or overview*)) or
(meta analy*) or (metaanal*) (39647 records)
#22 practice adj2 guideline* (0 records)
#21 clinical guideline* (24 records)
#20 practice guideline* (75 records)
#19 guideline* (3489 records)
#18 review* (34465 records)
#17 systematic* (review* or overview*) (2605 records)
#16 meta analy* (298 records)
#15 metaanal* (25 records)
#14 meta-analy* (279 records)
#13 ("META-ANALYSIS" in DE,SH) or ("REVIEW-" in
DE,SH) (12173 records)
#12 (back pain) or (backpain) or (back ache) or (backache)
or (lumbago) or (("BACK-" in DE,SH) or ("BACK-PAIN" in
DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or
(sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar
pain) (2827 records)

```

#11 lumbago(49 records)  
 #10 sacrum(59 records)  
 #9 sacroiliac(96 records)  
 #8 lumbosacral(421 records)  
 #7 lumbar trauma(0 records)  
 #6 lumbar pain(18 records)  
 #5 back pain(1375 records)  
 #4 backpain(3 records)  
 #3 back ache(6 records)  
 #2 backache(403 records)  
 #1 ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)(2059 records)

The search: (("PREVENTION-" in DE,SH) or (prevent\*)) and ((back pain) or (backpain) or (back ache) or (backache) or (lumbago) or ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or (sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar pain)) and ((meta-analy\*) or ("META-ANALYSIS" in DE,SH) or ("REVIEW-" in DE,SH)) or (practice adj2 guideline\*) or (practice guideline\*) or (guideline\*) or (clinical guideline\*) or (review\*) or (systematic\* (review\* or overview\*)) or (meta analy\*) or (metaanaly\*))

[61 articles retrieved]

4) Database: Ovid MEDLINE(R) <1966 to March Week 1 2004>Search Strategy:

1 exp Back Pain/ (14569)  
 2 backache.ti.ab. (1161)  
 3 exp Back/ (10493)  
 4 lumbar trauma.ab.ti. (11)  
 5 lumbar pain.ab.ti. (506)  
 6 lumbosacral.ab.ti. (5011)  
 7 sacrum.ab.ti. (1866)  
 8 sacroiliac.ab.ti. (1494)  
 9 lumbago.ab.ti. (669)  
 10 or/1-9 (31069)  
 11 randomized controlled trial.pt. (185019)  
 12 controlled clinical trial.pt. (65578)  
 13 intervention studies/ (2574)  
 14 experiment\$.tw. (683435)  
 15 (time adj series).tw. (4356)  
 16 (pre test or pretest or (posttest or post test)).tw. (5563)  
 17 random allocation/ (49999)  
 18 impact.tw. (131529)  
 19 intervention?.tw. (169823)  
 20 chang\$.tw. (1120541)  
 21 evaluation studies/ (114609)  
 22 evaluat\$.tw. (918798)  
 23 effect?.tw. (1975899)  
 24 comparative studies/ (1095665)  
 25 animal/ (3554364)  
 26 human/ (8339907)  
 27 25 not 26 (2745335)  
 28 or/11-24 (4505652)  
 29 28 not 27 (3057401)  
 30 10 and 29 (9693)  
 31 pc.fs. (534034)  
 32 30 and 31 (616)  
 33 from 32 keep 1-616 (616)  
 [616 articles retrieved]

5) Database: PsycINFO <1974 to March Week 1 2004>Search Strategy:

1 exp Back Pain/ (1250)  
 2 backache.mp. (49)  
 3 back ache.mp. (1)  
 4 backpain.mp. (2)  
 5 back pain.mp. (1679)  
 6 lumbar pain.mp. (11)  
 7 lumbar trauma.mp. (0)  
 8 lumbosacral.mp. (83)

9 sacroiliac.mp. (2)  
 10 sacrum.mp. (2)  
 11 lumbago.mp. (10)  
 12 or/1-11 (1808)  
 13 prevent\$.tw. (47433)  
 14 randomi#ed controlled trial\$.tw. (1623)  
 15 randomi#ed.tw. (8541)  
 16 exp Treatment Effectiveness Evaluation/ (5674)  
 17 exp Program Evaluation/ (8239)  
 18 exp Preventive Medicine/ (836)  
 19 intervention stud\$.tw. (1270)  
 20 experiment\$.tw. (129060)  
 21 (time adj series).tw. (1939)  
 22 (pre test or pretest or post test or posttest).tw. (8700)  
 23 random\$ allocat\$.tw. (612)  
 24 impact\$.tw. (64599)  
 25 intervention?.tw. (77825)  
 26 chang\$.tw. (172045)  
 27 evaluat\$.tw. (145365)  
 28 effect?.tw. (325450)  
 29 compar\$.tw. (224626)  
 30 exp Educational Program Evaluation/ (3284)  
 31 exp Experimental Design/ (35904)  
 32 exp Mental Health Program Evaluation/ (1448)  
 33 exp Evaluation/ (33066)  
 34 exp ANIMALS/ (128836)  
 35 or/14-33 (815480)  
 36 12 and 35 (1091)  
 37 36 and 13 (70)  
 38 37 not 34 (68)  
 39 from 38 keep 1-68 (68)  
 [68 articles retrieved]

6) Database SPORT Discus 1998-2004/02, SPORT Discus 1830-1997 Search History

#35 #34 not #31(102 records)  
 #34 (("PREVENTION-" in DE,SH) or (prevent\*)) and (((back pain) or (backpain) or (back ache) or (backache) or (lumbago) or ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or (sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar pain)) and ((( post test )or( posttest )) or (( pre test )or( pretest )) or (time adj series) or (experiment\*) or ("COMPARATIVE-STUDY" in DE,SH) or ("INTERVENTION-" in DE,SH) or ("CLINICAL-TRIAL" in DE,SH) or ("RANDOMIZED-CONTROLLED-TRIAL" in DE,SH) or (intervention stud\*) or (controlled clinical trial\*) or (( randomised controlled trial\* )or( randomized controlled trial\* )) or (effect\*) or (evaluat\*) or ("EVALUATION-STUDY" in DE,SH) or (chang\*) or (intervention) or (impact)))(102 records)  
 #33 ((back pain) or (backpain) or (back ache) or (backache) or (lumbago) or ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or (sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar pain)) and ((( post test )or( posttest )) or (( pre test )or( pretest )) or (time adj series) or (experiment\*) or ("COMPARATIVE-STUDY" in DE,SH) or ("INTERVENTION-" in DE,SH) or ("CLINICAL-TRIAL" in DE,SH) or ("RANDOMIZED-CONTROLLED-TRIAL" in DE,SH) or (intervention stud\*) or (controlled clinical trial\*) or (( randomised controlled trial\* )or( randomized controlled trial\* )) or (effect\*) or (evaluat\*) or ("EVALUATION-STUDY" in DE,SH) or (chang\*) or (intervention) or (impact))(796 records)  
 #32 (( post test )or( posttest )) or (( pre test )or( pretest )) or (time adj series) or (experiment\*) or ("COMPARATIVE-STUDY" in DE,SH) or ("INTERVENTION-" in DE,SH) or ("CLINICAL-TRIAL" in DE,SH) or ("RANDOMIZED-CONTROLLED-TRIAL" in DE,SH) or (intervention stud\*) or (controlled clinical trial\*) or (( randomised controlled trial\* )or( randomized controlled trial\* )) or (effect\*) or (evaluat\*) or ("EVALUATION-STUDY" in DE,SH) or (chang\*) or (intervention) or (impact)(133205 records)  
 #31 "ANIMAL-" in DE,SH(380 records)

#30 "COMPARATIVE-STUDY" in DE,SH(26182 records)  
 #29 effect\*(52132 records)  
 #28 evaluat\*(43887 records)  
 #27 "EVALUATION-STUDY" in DE,SH(2199 records)  
 #26 chang\*(26828 records)  
 #25 intervention(3498 records)  
 #24 impact(6675 records)  
 #23 ( post test )or( posttest )(892 records)  
 #22 ( pre test )or( pretest )(719 records)  
 #21 time adj series(93 records)  
 #20 experiment\*(10908 records)  
 #19 "INTERVENTION-" in DE,SH(74 records)  
 #18 "CLINICAL-TRIAL" in DE,SH(151 records)  
 #17 "RANDOMIZED-CONTROLLED-TRIAL" in DE,SH(290 records)  
 #16 intervention stud\*(103 records)  
 #15 controlled clinical trial\*(34 records)  
 #14 ( randomised controlled trial\* )or( randomized controlled trial\* )(393 records)  
 Searches and results below from saved search history  
 BackPainPrevention  
 #13 ("PREVENTION-" in DE,SH) or (prevent\*)(23078 records)  
 #12 (back pain) or (backpain) or (back ache) or (backache) or (lumbago) or ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)) or (sacrum) or (sacroiliac) or (lumbosacral) or (lumbar trauma) or (lumbar pain)(2924 records)  
 #11 lumbago(49 records)  
 #10 sacrum(60 records)  
 #9 sacroiliac(101 records)  
 #8 lumbosacral(444 records)  
 #7 lumbar trauma(0 records)  
 #6 lumbar pain(18 records)  
 #5 back pain(1430 records)  
 #4 backpain(3 records)  
 #3 back ache(6 records)  
 #2 backache(416 records)  
 #1 ("BACK-" in DE,SH) or ("BACK-PAIN" in DE,SH) or ("LOW-BACK-PAIN" in DE,SH)(2135 records)  
 [102 articles retrieved]  
 Also, Cochrane EPOC and Back Groups contacted and asked to search their registers [no further articles found].

## Children

An electronic search on Pub Med for articles published since 1995 was performed by two independent researchers, making use of the following keywords: children OR adolescents AND back pain AND adipos\*/ antropometr\* / attention / awareness / back pack / back school / behavior\* / body mechan\* / competiti\* / computer / depress\* / educat\* / environment\*/ exercise\*/ famil\* / flexibility / furniture /health / job\* / laptop / leg inequality / leg length / leisure time / manual handling /medical attention / muscle / obes\* / overweight / performance / pezzi balls / physical activ\* / postur\* / prevent\* / promot\* / psychol\* / satchel / school achievement / schoolbag / screen / sitting / smok\* / sports /strength / stress / therap\* / tight\*/ tobacco / treatment / TV / videogames / work\* . Non-English manuscripts without an English abstract were not considered for inclusion. Citation tracking, personal databases, and expert knowledge supplemented the database research. Both researchers independently reviewed the studies and excluded manuscripts limited to specific back pain (e.g. LBP attributed to infection, tumor, fracture, ankylosing spondylitis) and non-modifiable risk factors, like age, gender, anthropometrics, parental educational level, and demographic factors. Also studies with only epidemiologic data, studies not focusing on back pain or possible consequences of back pain and studies without data for children under the age of 18 were excluded for the present review. 1124 articles were retrieved (including duplicates)

## Workers

The reference list of the UK occupational health guidelines (Waddell & Burton 2000) were searched for reviews on exercise, back belts, and education.

The databases PsychINFO and Medline were searched with the search words:

1. random\* controlled trial\*
2. controlled clinical trial\*
3. controlled trial\*
4. control group\*
5. double blind method
6. single blind method
7. 1 or 2 or 3 or 4 or 5 or 6
8. back pain
9. low back pain
10. back school
11. back injury
12. 8 or 9 or 10 or 11
13. (worksite or work-site or work site)
14. (workrelated or work-related or work related)
15. (workplace or work-place or work place)
16. (organisation\* or organization\*)
17. employ\*
18. occupation\*
19. 13 or 14 or 15 or 16 or 17 or 18
20. 12 and 19
21. 7 and 20

[37 articles retrieved]

The Cochrane Controlled Trials Register was searched with the following search words:

1. back belts – 2 studies
2. exercise and back pain – 70 studies
3. (education or back school) and back pain – 36 studies

The searches were done from year 2001 to 2003.

This search was updated in October 2003.

In addition, an additional review (Tveito et al., 2004) is included (literature search from 1980 – November 2002) on controlled workplace interventions with employees as participants, aiming to prevent or treat LBP.