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European guidelines for prevention in low back pain

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EUROPEAN GUIDELINES
FOR PREVENTION IN LOW BACK PAIN

Evidence tables

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The following tables display the evidence that was reviewed for the generation of the European Guidelines for Prevention in Low Back Pain. The members of the Working Group hope these tables will be a useful resource for other researchers, as well as providing background details of the studies that were considered when making the guideline recommendations.

Three tables are presented, relating to the sections under which the recommendations were made, <general population>, <workers>, <school age>.

The citation details for the studies referred to here can be found with the main guideline document at the guidelines website (www.backpaineurope.org).

Table 1: <u>**GENERAL POPULATION**</u>

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Intervention #1 Physical exercise / physical activity					
Kool et al., 2004 ------------------ *Systematic review*	Patients with non-specific non-acute LBP with a duration of at least 4 weeks. [14]		Sick leave	There is strong evidence that sick days are reduced during the first year after a physical activity program, especially in severely disabled patients with more than 90 sick days per year under usual care in the control group.	
Lahad et al. 1994 ------------------- *Systematic review*	Inclusion criteria: RCT	Workplace interventions, including exercise and information.	Incidence and prevalence of back pain episodes, quality of life, knowledge	Limited evidence for trunk muscle exercise to reduce the incidence and duration of LBP episodes. Minimal evidence for educational strategies, no evidence for the use of lumbar supports. *Review of good quality*	(+)
Linton & vanTulder, 2001 ------------------- *Systematic review*	Inclusion criteria: RCT or CCT, preventive character.	Lumbar supports, back schools, physical exercises, ergonomic interventions, modification of risk factors	Self-reported pain, self-reported back injury, functional disability, days off work, costs	Lumbar supports: no preventive effect (A); Back schools: no effect (A); Physical exercises might prevent back pain (B/C); Ergonomic interventions and modification of risk factors: no evidence. *Review of good quality. Physical exercises seem to be the only preventive measure, though the evidence for it is not strong.*	+ / -
Luehmann et al, 2004 ------------------- *Report*	Inclusion criteria: Reviews, RCTs and systematic reviews, guidelines, meta-analyses	Several interventions including risk factor modification	Incidence and prevalence of back pain, costs	No evidence for risk factor modification to reduce incidence, prevalence or socioeconomic costs. Consistent evidence for a positive preventive effect of exercise programs. Proper information may reduce costs of back problems. *Comprehensive review of good quality.*	+ / -

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
US Preventive Task Force, 2004 ----------------- *Statement*	?	Preventive interventions	Incidence and prevalence of back pain	Evidence is insufficient to recommend for or against the routine use of interventions to prevent low back pain in adults in primary care settings. The balance between benefits and harms of different interventions could not be determined. *No review, just a statement. No information about the procedure that lead to the recommendations.*	
Vuori 2001 ----------------- *Systematic review*	Inclusion criteria: SRs, RCTs:	Physical activity for Prevention [and treatment] of acute and chronic LBP.	Incidence and prevalence of back pain	Physical activity can be effective in preventing LBP (A), but prolonged heavy loading can lead to LBP (C). Specific exercises have not been found effective in the treatment of acute LBP (A), but can be effective in chronic LBP (B). *Review of good quality*	
Waddell & Burton, 2001 ------------------ *Evidence review*				Contradictory evidence that exercise/physical fitness programmes may prevent LBP, effect size appears to be modest. Strong evidence that traditional education does not prevent LBP. Preliminary evidence that interventions addressing beliefs and attitudes may prevent LBP. Strong evidence that lumbar supports do not prevent LBP. Strong evidence that low job satisfaction and other psychosocial aspects are risk factors for LBP, modest size of the association. Limited evidence, but general consensus, that joint employer – worker initiatives can prevent LBP, but no evidence on optimum strategies and inconsistent evidence on effect size. *Evidence review of good quality used as base for British LBP occupational health guidelines.*	+ / -
Young et al. 2003 ------------------- *Systematic review*	Cochrane review	Interventions for preventing and treating pelvic and back pain in and after pregnancy	Incidence and prevalence of back pain during and after pregnancy	Water gymnastics has a positive effect on future back pain episodes (C), the effect size is small. No other intervention available demonstrated a positive effect on the outcome criteria. *Review of moderate quality*	(+)

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Intervention #2 Information / advice / instruction					
Heymans et al. 2004 --------------- *Systematic review.*	Cochrane review Inclusion criteria: RCT	Back schools, defined as a group intervention, consisting of both, an education/skills programme and exercises. No distinction between preventive and therapeutic interventions.	Incidence and prevalence of back pain episodes	Conflicting evidence on the effectiveness of back schools. Limited evidence that back schools show no differences in long term recurrence rates of LBP episodes 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) *Review of good quality. The scope and inclusion criteria of the review limit its use for preventive purposes as intensive multidisciplinary programmes for chronic patients were included.*	+ / -
Luehmann et al, 1999 --------------- *Report*	Inclusion criteria: Reviews, RCTs and systematic reviews, guidelines, meta-analyses	Back school programs including education and physical training for the primary, secondary or tertiary prevention of non-specific back pain	Incidence and prevalence of back pain	Quality of studies regarding back schools is poor; Unclear, which components are important; Unclear, which outcomes can be changed; There seems to be an effect only in workplace settings *Comprehensive review of good quality. The studies available up to 1999 did not allow a distinction between a biomechanical and a biopsychosocial approach.*	(+)
van Poppel et al., 1997 ----------------- *Systematic review*		Educational interventions	Incidence and prevalence of back pain, work absenteeism	There was limited evidence of no effect of information on prevention of LBP. *Older review mainly covering biomedical back school approaches.*	-
Cherkin et al. (1998) --------------- *RCT*	321 adults with low back pain.	Educational booklet vs. McKenzie method vs. Chiropractic manipulation	Level of function Disability Recurrence of back pain Use of back-related health care Costs of care	Physical therapy and chiropractic manipulation had similar effects and costs, and patients receiving these treatments had only marginally better outcomes that those receiving an educational booklet.	

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Linton et al. (2000) -------------- *RCT*	272 patients with acute or subacute spinal pain Pretest and 12 month follow-up	Pamphlet vs. information package vs. cognitive behavior therapy	Perception of risk for developing long-term pain Health care use Sick absenteeism	Cognitive behavior intervention decreases the risk for long-term sick leave and health care use, whereas other interventions were without effects on risk and even increase health care use. All three groups tended to improve on the variables of pain, fear-avoidance, and cognitions.	+
Lonn et al., 1999 ---------------- *Single study*	RCT Subjects with at least one episode of LBP within the last year, 1-year follow-up	Active back school program for 20 hours over 13 weeks. A session consisted of 20 minutes theory and 40 minutes exercise. The control group had no intervention.	Recurrence of LBP episodes and sick leave due to LBP. LBP in general, LBP related to 12 different daily activities, general low back function and general functional status.	Active back school reduced the recurrence and severity of new LBP episodes.	-
Burton &, Waddell 2002 ---------------- *Evidence review*	Comparison of biomedical vs. biopsychosocial information			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. The estimated power of written information may be relatively weak nevertheless it may be cost-effective due to its low per-person costs. *Evidence review of good quality*	+ / -
Intervention #3 Back belts / lumbar supports					
Jellema et al, 2001 ------------ *Systematic review*	Cochrane review Inclusion criteria: RCT or CCT.	Lumbar supports for the prevention of non-specific LBP	Incidence of LBP, Duration of LBP episode, Days of sick leave, Back specific functional status	Lumbar supports are not effective for primary prevention (moderate evidence); No evidence found for secondary prevention. *Review of good quality covering the evidence available*	-
Linton & van.Tulder, 2001	See above				

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Waddell & Burton, 2001	See above				-
Intervention #4 Mattresses					
Atherton et al, 1981	Single blinded RCT cross over	2X2 weeks cross over Firm Isometric Vs Soft Interior sprung Mattresses	VAS and range of movements	No big difference. 37% and 38% of patients showed increased or decreased movement on mattress A and B, appropriately. Patients with greater movement reported the mattress to be better and with less pain. *Small number of patients not blinded to the intervention. No 'Table 1' data reported, method of recruitment and long term effect.*	
Dubb & Driver, 1993	RCT	3 Different firmness Mattresses for 2 Days	Back Pain VAS, Quality of sleep and Mood	Back pain reduced on day 1 and quality of sleep improved on day 2 on firmer mattress. *Small number of patients, Not known if improvement sustainable.*	
Garfin & Pye, 1981	RCT	Hard, Soft Water or Hybrid Mattresses	Change in Low Back Pain and feeling comfortable	Water bed hybrid was declared inappropriate by most patients, 9/10 Had worse pain and comfort on soft bed, 6/11 found water bed better and 7/9 the hard bed better. SLR improved with pain. *Small number of patients, no blinding, no mention if research was supported by water bed company.*	
Haex et al, 1998		5 Different Stiffness Mattresses.	Change in Spinal Curvature - Standing Vs Lying	Spinal curvature when lying on one's back or side was directly correlated to stiffness of mattress and anthropometric parameters: weight, height, pelvic width and shoulder, weight per unit length etc. allowing a calculation to prescribe best mattress stiffness for patients.	
Hagino, 1997	Before-after study	Effectiveness of adjustable wood frame foam and wool mattress bed-system	Back Pain weekly diary for sleep quality, daily activity and use of analgesics.	An average steady decrease of 1/11 points (P=0.004) from the end of the first week to the end of the fifth week. No statistically significant change in other measures. *There is no report of the baseline back pain at start of the trial, no control for the placebo effect. The before and after trial should have produced return of back pain in the last week but instead there is a continuation of decrease in pain. Also, result may apply only to one kind of combo-mattress system.*	
Jacobson et al, 2002		Experimental Bedding System Vs private Bedding	Pain VAS, Spine stiffness, Quality of sleep	Reduction of back pain by 57%, shoulder pain by 60% Back Stiffness by 59% and Quality of sleep by 60% *Cohort are not really controlled because the patient is aware of the change of mattress, small number of patients*	

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Koul et al, 2000		Foam Mattresses during hospital shifts Vs Cotton Mattress at home		Pain reported on interview and with the aid of Visual Analog Pain Scale. 65.6% reported a pain level of 4/10 (median) and for 13±25.7 hours after the shift and exposure to the foam Mattress Not RCT, self report, sleeping at work *The researchers did not control for the effect of the actual late hour shift and did not quantify and controlled for the amount of hours each resident slept*	
Kovacs et al., 2003a		Firm vs medium firm mattresses:	Back Pain VAS, Disability	Medium firmness had better outcome for pain in bed, disability and less significant - pain on rising from bed. *Study of good quality. Patients had subacute or chronic pain, thus there is limited applicability of this study for preventive issues.*	
Monsein et al, 2000		New AirMattress Vs Old Spring Mattress (A-B-A) Short Term Outcomes of Chronic Back Pain on Airbed vs Innerspring Mattresses	SF-36, Back Pain VAS, Sleep VAS	95% showed improved pain by average 32%, 88% improved sleep by average 73%, 80% improved on physical functioning , 88% improved on bodily pain. *Researchers where financed by Mattress company, Patients set their firmness as wished thus resulting in wide array of firmness selection (Hard to soft) with no correlation to physical characteristics. It hasn't been shown yet that LBP is related to disturbed lumbar curvature but this research calls for experimenting with such a table.*	
Scriver et al 1994.	RCT Patients after PTCA	Exercise and/or Air Mattress	LBP by VAS and Borg scale	Statistical significant was reached for less back pain for patients on combined Exercise and Air mattress. *Not blinded, patients on combined Exercise and Air mattress had 44% more exercise on average then the exercise alone group.*	
Sulzbach et al, 1995	Cardiology patients in for PTCA	Patient Self control of bed back rest elevation (~30°) vs nurse controlled (~ 15°)	Patient comfort Back discomfort or pain	Back pain at dinner and bedtime was higher in the control group, but only the bedtime difference was statistically significant *Patients self control of environment in a hospital might influence their perception of pain to a degree*	
Intervention #4 Chairs					
Van & Noteboom 1988	RCT	sitting and LBP	pain	positive effects of rotary dynamic stimuli during prolonged sitting *abstract does not show conclusion*	

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
van Deursin & Patijn 1999	CCT	Effect of tilting seat on back, lower back and legs during sitting work	pain	rotation of horizontal plane of chair seat reduces pain	
Udo et al, 1999	CCT	effect of tilting seat on back, lower back and legs during sitting work	pain scores leg swelling EMG	pain scores were higher under fixed chair for neck, shoulders and lower back.	
Intervention #5 Shoe insoles					
Basford & Smith, 1988	RCT Non blinded	Viscoelastic polyurethane insoles	Self-report pain questionnaire	25 - shoes too tight and were dropped from further analysis (=actual use analysis!!!). 67% completed the study. Only those who had back pain (n=38) before were included – for 20 the insoles had no effect and for 17 the insoles lessened the pain for 1 the pain increased and they conclude it as back pain relief with significance – p<.02. – *Methodological mistakes in the statistics*	
Fauno et al, 1993	RCT Non blinded	shock absorbing heel inserts in soccer referees	Self-report - pre questionnaire and daily physician check-ups	The incidence of sore backs was significantly reduced by the use of (SAH) inserts. *Short follow-up, a 5-day soccer tournament*	
Tooms et al, 1987	RCT Non blinded	Viscoelastic shoe inserts in nursing students	Self report – shading of location of pain on a diagram.	Viscoelastic group reported a significant peripheral shift in pain location from back to lower extremity; the viscoelastic group also showed significant changes in duration of post-work pain and frequency of pain during the workday *no description of how they checked adherence.* *- data from 2 persons from the trial group and 6 from the control group is missing without explanation in the text.*	.
Larsen et al, 2002a	RCT	custom-made biomechanic shoe orthoses in military boots for 146 military conscripts	self-reported back and/or lower extremity problems	Actual-use analysis - back or lower extremity problems (RR 0.7, ARR 19%, NNP 5, cost 98 US dollars). intention-to-treat analysis – not significant (only for prevention of shin splints) *Back problems alone – NS in any analysis!*	

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / -ve finding
Schwellnus et al, 1990	RCT Non blinded	Shock absorbing insoles (not customized) for 1511 new military recruits		Chronic Back pain occurred in 1.2% of the experimental group and 2.4% of the control group - statistically – NS. There were significantly less stress fractures - compliance (93.6%) was checked in a sample of 143 recruits and regular random footwear inspection were preformed.	
Sobel et al, 2001	CCT	Customized insoles for policemen	Self-report - pre and post-wear questionnaires.	There was a significant reduction in tiredness in the feet at the end of the day after wearing the insoles, but no improvement in back or leg discomfort. - 17.6% were lost in the post-wear questionnaire. - Only 66% of those who answered wore the insoles for full 5 weeks. - the satisfaction with the insoles was rated – 5 on a scale from 0 to 10. - 20% had worn foot orthoses before	+

Table 2: **WORKERS**

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Intervention #1 Physical exercise / physical activity					
Lahad et al, 1994 ----------------- *Systematic review*	Hospital workers/ manual workers/ office workers. Workplace interventions.[16]		*Absenteeism, duration, quality of life* ----------------------------- Lost work days, pain	There was limited evidence of effect of exercise on prevention of low back pain. *All of the four randomised controlled studies found effect on either sick leave or days with LBP.* Review of four specific interventions. The authors concluded that there is limited evidence that exercises to strengthen back and abdominal muscles and improve physical fitness can reduce the incidence and duration of LBP episodes. They found minimal evidence for educational strategies and insufficient evidence about lumbar supports. There is no evidence for any specific effects from stopping smoking and reducing weight.	+
Gebhardt, 1994 ----------------- *Systematic review*	Nurses/hospital workers/bus drivers/factory worker. [6]		*Occurrence, duration, quality of life, absenteeism* ------------------------------ Reduction of back pain and sick leave.	There was evidence of effect of exercise on prevention of LBP. Meta-analysis of six experimental studies showed that training programmes including education and physical fitness had a statistically significant but modest effect on the incidence and duration of work loss due to LBP.	+
van Poppel et al, 1997 ----------------- *Systematic review*	Hospital/office/ shop workers. Workplace interventions. [3]		*Duration, absenteeism, recurrence, occurrence* ----------------------------- Days of LBP, days lost from work, sick leave	There was evidence of effect of exercise on prevention of LBP. This review included 11 controlled studies of which 7 were RCTs. 4 out of 5 studies of lumbar supports showed that they were ineffective. 5 out of 6 studies of very varied types of 'education' showed no effect. All three studies of various exercise programmes showed a medium effect.	+
Dishman et al, 1998 ----------------- *Systematic review*	Manual workers/ office workers. [17]		*Quality of life* ----------------------------- Physical activity/ physical fitness	There was no evidence of effect of exercise on prevention of LBP. These interventions are classified as health risk appraisal, health education, behavioural modification or cognitive behavioural programmes, exercise prescription, or combinations of these. Meta-analysis showed that the studies were heterogeneous and the effect size small (r = 0.11) and non-significant.	0

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Maher, 2000 ----------------- *Systematic review*	Hospital workers/ home care workers/manual workers. [5]		*Absenteeism, quality of life, occurrence, duration, consequences* ------------------------------ Prevalence, severity, sick leave, costs.	There was moderate evidence of effect of exercise on prevention of LBP. *Only one author, but it says in the method section that all articles were assessed by two raters.* Moderate evidence of effect of exercise in reducing severity and sick leave because of LBP, limited evidence of effect in reducing prevalence, and no evidence of effect on costs.	++
Linton & van Tulder, 2001 ----------------- *Systematic review*	Hospital workers/manual workers/office workers. [6]		*Duration, recurrence, absenteeism, quality of life* ----------------------------- Episodes of LBP, pain, function, sick leave	There was consistent evidence of moderate effect of exercise on prevention of LBP. Strong evidence that back belts and back schools are not effective in prevention of LBP. Consistent evidence of moderate effect of exercise in prevention. Ergonomic and risk factor interventions: not good quality evidence available to draw a conclusion.	+
Waddell & Burton, 2001 ----------------- *Evidence review*	[6]			Contradictory evidence of effect of exercise on prevention of LBP. Evidence review used as base for the British low back pain occupational health guidelines. Contradictory evidence that exercise/physical fitness programmes may prevent LBP, effect size appears to be modest. Strong evidence that traditional education does not prevent LBP. Preliminary evidence that interventions addressing beliefs and attitudes may prevent LBP. Strong evidence that lumbar supports do not prevent LBP. Strong evidence that low job satisfaction and other psychosocial aspects are risk factors for LBP, modest size of the association. Limited evidence, but general consensus, that joint employer – worker initiatives can prevent LBP, but no evidence on optimum strategies and inconsistent evidence on effect size.	0
Tveito et al, 2004 ----------------- *Systematic review*	Hospital workers/ manual workers. Workplace interventions. [6]		*Absenteeism, consequences, occurrence, duration, recurrence, quality of life* ------------------------------ Sick leave, cost, cost-effectiveness, new episodes of LBP, pain	There was limited evidence of effect of exercise on sick leave, costs, and new episodes of LBP. There was no evidence of effect of exercise on pain. *Recently published (2004) systematic review of good quality.*	+

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Kool et al, 2004 ----------------- *Systematic review*	Patients with non-specific non-acute LBP with a duration of at least 4 weeks. [14]		*Recurrence of absenteeism* ------------------------- Sick leave	There is strong evidence that sick days are reduced during the first year after a physical activity program, especially in severely disabled patients with more than 90 sick days per year under usual care in the control group.	+++
Larsen et al, 2002 ----------------- *Single study*	Military conscripts. RCT. [314]	One 40-minute theoretical lesson, then daily passive extensions of the back. The control group had no intervention.	*Occurrence, use of medical system* ----------------------------- Number of persons with back problems during the last 3 weeks and during the last year.	Significantly lower 1 year prevalence of back pain and less use of the medical system in the intervention group. *RCT, open allocation.*	
Amako et al, 2003 ----------------- *Single study*	Military recruits. [901]	Static stretching before and after physical exercise. The control group had no intervention.	*Occurrence* ------------------------------ Incidence of LBP	Significantly decreased incidence of LBP in the intervention group. *Controlled, but not randomised.*	
Soukup et al, 1999 ----------------- *Single study*	Subjects who had finished treatment for a LBP episode. RCT [77]	A Mensendieck exercise program consisting of exercises and ergonomic education for 20 group sessions in 13 weeks. The control group had no intervention.	*Recurrence of absenteeism* ------------------------------ Recurrence of LBP, days of sick leave, LBP, functional scores.	A Mensendieck exercise program seems efficient in reducing recurrent episodes of LBP at 3-year follow-up, but it did not influence sick leave, pain or function scores.	+

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Lonn et al, 1999 ----------------- *Single study*	Subjects with at least one episode of LBP within the last year. RCT, a 1-year follow-up [81]	The intervention group followed an active back school program for 20 hours over 13 weeks. A session consisted of 20 minutes theory and 40 minutes exercise. The control group had no intervention.	*Recurrence of absenteeism* ------------------------------ Recurrence of LBP episodes and sick leave due to LBP. LBP in general, LBP related to 12 different daily activities, general low back function and general functional status.	Active back school reduced the recurrence and severity of new LBP episodes.	+
Glomsrod et al, 2001 ----------------- *Single study*	Subjects with at least one episode of LBP within the last year. RCT, a 3-year follow-up [81]	The intervention group followed an active back school program for 20 hours over 13 weeks. A session consisted of 20 minutes theory and 40 minutes exercise. The control group had no intervention.	*Recurrence of absenteeism* ------------------------------ Recurrence of LBP episodes and sick leave due to LBP. LBP in general, LBP related to 12 different daily activities, general low back function and general functional status.	Active back school proved to have a significant long-term effect measured at the 3-year-follow-up.	+
Taimela et al, 2000 ----------------- *Single study*	Patients with recurrent or chronic back pain. A follow-up study. [125]	The intervention was an active outpatient rehabilitation program for 24 sessions in 12 weeks.	*Recurrence of absenteeism* ------------------------------ *Recurrence of persistent pain and work absenteeism.*	Recurrences of persistent pain during the follow-up were fewer among those who had maintained regular exercise habits after the treatment than those who had been physically inactive. Similarly, work absenteeism was less among physically active than among physically inactive persons.	+

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Intervention #2 Information / advice / instruction					
Education					
Lahad et al, 1994 ----------------- *Systematic review*	Hospital workers/ nurses/nurses' aides/manual workers/bus drivers. Workplace interventions.[10]		*Occurrence, duration, quality of life, knowledge* ------------------------------ Knowledge of back pain, pain control, painful months.	Minimal evidence for effect of educational strategies to prevent LBP. Review of four specific interventions. The authors concluded that there is limited evidence that exercises to strengthen back and abdominal muscles and improve physical fitness can reduce the incidence and duration of LBP episodes. They found minimal evidence for educational strategies and insufficient evidence about lumbar supports. There is no evidence for any specific effects from stopping smoking and reducing weight.	-
Gebhardt, 1994 ----------------- *Systematic review*	Nurses/hospital workers/bus drivers/factory worker. [6]		*Occurrence, duration, quality of life, absenteeism* ------------------------------ Reduction of back pain and sick leave.	Meta-analysis of six experimental studies showed that training programmes including education and physical fitness had a statistically significant but modest effect on the incidence and duration of work loss due to LBP.	+
van Poppel et al, 1997 ----------------- *Systematic review*	Manual workers/ hospital workers/bus drivers. Workplace interventions. [6]		*Occurrence, absenteeism*	There was limited evidence of no effect of educational interventions on prevention of LBP. This review included 11 controlled studies of which 7 were RCTs. 4 out of 5 studies of lumbar supports showed that they were ineffective. 5 out of 6 studies of very varied types of 'education' showed no effect. All three studies of various exercise programmes showed a medium effect.	-
Dishman et al, 1998 ----------------- *Systematic review*	Manual workers and civil servants. [13]		*Quality of life* ------------------------------ Physical activity/ physical fitness	There was no evidence of effect of education on prevention of LBP. These interventions are classified as health risk appraisal, health education, behavioural modification or cognitive behavioural programmes, exercise prescription, or combinations of these. Meta-analysis showed that the studies were heterogeneous and the effect size small (r = 0.11) and non-significant.	0

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
van Tulder et al, 1999 ----------------- *Systematic review (Cochrane)*	Nurses/manual workers. Occupational setting. [5]		*Quality of life, duration, absenteeism, occurrence, recurrence* ------------------------------ Pain, sick leave, function, disability	There was moderate evidence of effect of educational interventions on LBP. *Not prevention.* Back schools for non-specific low back pain. Moderate evidence for short time effect on chronic LBP, and moderate evidence for effect of back schools in occupational settings.	++
Maher, 2000 ----------------- *Systematic review*	Hospital workers/ manual workers. [6]		*Absenteeism, quality of life, occurrence, duration, consequences* ------------------------------ Prevalence, severity, sick leave, costs.	There was moderate evidence of no effect of education on prevention of LBP. *Only one author, but it says in the method section that all articles were assessed by two raters.* Moderate evidence of no effect of education in reducing prevalence, severity, and sick leave because of LBP, limited evidence of no effect in reducing costs.	--
Linton & van Tulder, 2001 ----------------- *Systematic review*	Hospital workers/manual workers/office workers. [14]		*Absenteeism, injury, duration, recurrence, quality of life, use of medical system, consequences* ------------------------------ Sick leave, pain, dysfunction, function, cost	There was strong evidence that education is not effective in preventing LBP. Strong evidence that back belts and back schools are not effective in prevention of LBP. Consistent evidence of moderate effect of exercise in prevention. Ergonomic and risk factor interventions: not good quality evidence available to draw a conclusion.	---
Maier-Riehle & Härter, 2001 ----------------- *Systematic review*	[18]	Back school	Pain, recurrence, function, loss of work hours, health care use, analgesics, spinal mobility, muscle strength, knowledge, posture, physical therapy, pain coping, mental health, general health	The effectiveness of back schools after 6 months post intervention is not supported. Metaanalyses yielded small to medium effects on recurrence, lost work time, use of health care, and knowledge after ≤ 6 months. After 12 months or more most of the effects disappeared, except for correct back posture where the effect size still was very large after 12 months. There were small effects on lost work time, physical therapy, and muscle strength after 6 months or more. *The authors have not specified whether the studies are work place interventions, also there is no information of prevention or treatment.*	0

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Waddell & Burton, 2001 ----------------- *Evidence review*	[6]			Strong evidence that traditional education does not prevent LBP Evidence review used as base for the British low back pain occupational health guidelines. Contradictory evidence that exercise/physical fitness programmes may prevent LBP, effect size appears to be modest. Strong evidence that traditional education does not prevent LBP. Preliminary evidence that interventions addressing beliefs and attitudes may prevent LBP. Strong evidence that lumbar supports do not prevent LBP. Strong evidence that low job satisfaction and other psychosocial aspects are risk factors for LBP, modest size of the association. Limited evidence, but general consensus, that joint employer – worker initiatives can prevent LBP, but no evidence on optimum strategies and inconsistent evidence on effect size.	---
Tveito et al, 2004 ----------------- *Systematic review*	Nurses/hospital workers, manual workers, bus drivers. Workplace interventions. [11]		*Absenteeism, consequences, occurrence, duration, recurrence, quality of life* ------------------------------ Sick leave, cost, cost-effectiveness, new episodes of LBP, pain	There was no evidence of effect of educational interventions on sick leave, costs, or pain. There was limited evidence of no effect of educational interventions on new episodes of LBP. *Recently published (2004) systematic review of good quality.*	-
Ergonomic education					
Alexandre et al, 2001 ----------------- *Single study*	Female nursing aides. RCT. [55]	Combined education and exercise intervention. The education part focused on ergonomics. The control intervention was education only, and less than the intervention group.	*Quality of life* ------------------------------ Pain	There was no significant difference between the groups on LBP after treatment. *A methodologically weak study, risk of selection bias, no description of randomisation procedures. Combining education and exercise makes it impossible to separate the effects, especially since the control group also got some education – but not as much as the intervention group.*	

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Fanello et al, 2002 ----------------- *Single study*	Nursing personnel. CCT. [272]	Theoretical instruction with special focus on ergonomics and lifting techniques, followed by individual advice.	*Occurrence, recurrence, duration, consequences.* ------------------------------ Participation in leisure time activities.	Significant between-group differences on prevalence of long-term LBP and remission of LBP, both showing positive effect of the intervention. *Methodologically weak study, not randomised.*	
Pamphlet					
Tveito et al, 2004 ----------------- *Systematic review*	Light-industrial companies. Workplace interventions. [1]		*Absence* ------------------------------ Sick leave	There was no evidence of effect of distribution of a pamphlet on sick leave. *This is evidence from only one controlled study. The study reported effect on sick leave, but evidence from one controlled, but not randomised, study is not sufficient to be classified as limited evidence of effect.*	0
Indahl et al, 1998 ----------------- *Single study*	Patients with subchronic LBP. RCT [489]	Education in a 'mini back school', which was groupwise and lasted 2 hours on the first day and 1 hour on an individual basis after 2 weeks.	*Recurrence of absenteeism* ------------------------------ Recurrence of sick leave	Informing patients with subchronic LBP about the nature of the problem led to fewer recurrences of sick leave.	+
Leclaire et al, 1996 ----------------- *Single study*	LBP patients. RCT. [168]	The intervention was a back school program. Both intervention and control group received daily physiotherapy.	*Recurrence of absenteeism* ------------------------------ Time off work for present episode, number and duration of recurrences.	A back school intervention in addition to standard care resulted in no reduction in the return to work or the number or duration of recurrences of LBP requiring compensation over a period of one year.	-

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Verbeek et al, 2002 ----------------- *Single study*	Patients with LBP for at least 10 days on sick leave. RCT [120]	The intervention was early management by the occupational physician. Both intervention and control group received standard medical treatment.	*Recurrence of absenteeism* ------------------------------ Time until return to work after a 1-year follow-up. Time until recurrence, number of days lost over a 1-year period, rates of return to work at 3 and 12 months, pain intensity, functional disability.	Early management by the occupational physician had no substantial effect on return to work or health outcomes. Recurrences occurred more frequently in the intervention group, but the total duration of sick leave in 1 year did not differ between groups. *Average total duration of recurring episodes of sick leave due to LBP did not differ between the intervention and control group.*	-
Intervention #3 Back belts / lumbar supports					
Lahad et al, 1994 ------------------- *Systematic review*	Manual workers. Workplace interventions.[2]		*Occurrence, recurrence, absenteeism, injury* ------------------------------- Days lost from work, work loss, frequency of back pain	There was insufficient evidence of effect of back belts on prevention of LBP. Review of four specific interventions. The authors concluded that there is limited evidence that exercises to strengthen back and abdominal muscles and improve physical fitness can reduce the incidence and duration of LBP episodes. They found minimal evidence for educational strategies and insufficient evidence about lumbar supports. There is no evidence for any specific effects from stopping smoking and reducing weight.	0
Maher, 2000 ------------------- *Systematic review*	Hospital workers/ manual workers. [4]		*Absenteeism, quality of life, occurrence, duration, consequences* ------------------------------ Prevalence, severity, sick leave, costs.	There was strong evidence of no effect of back belts on prevention of LBP. *Only one author, but it says in the method section that all articles were assessed by two raters.* Strong evidence of no effect of back belts in reducing prevalence, severity, and sick leave because of LBP.	---
Jellema et al, 2001 ------------------- *Systematic review (Cochrane)*	Hospital workers/manual workers. Workplace interventions. [7]		*Occurrence, injury, use of medical system, absenteeism, quality of life, consequences* ------------------------------- Days lost from work, sick leave, pain, costs, use of medicine	There was moderate evidence that back belts do not prevent low back pain. Based on five randomised and two non-randomised controlled trials, 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.	--

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Linton & van Tulder, 2001 ------------------- *Systematic review*	Hospital workers/manual workers/office workers. [4]		*Injury, quality of life, absenteeism, occurrence, use of medical system, consequences* ------------------------------- Pain, lost work days, workers' compensation, sick leave	There was strong evidence that back belts do not prevent LBP. Strong evidence that back belts and back schools are not effective in prevention of LBP. Consistent evidence of moderate effect of exercise in prevention. Ergonomic and risk factor interventions: not good quality evidence available to draw a conclusion.	---
Waddell & Burton, 2001 ------------------- *Evidence review*	[6]			There was strong evidence that back belts do not prevent LBP. Evidence review used as base for the British low back pain occupational health guidelines. Contradictory evidence that exercise/physical fitness programmes may prevent LBP, effect size appears to be modest. Strong evidence that traditional education does not prevent LBP. Preliminary evidence that interventions addressing beliefs and attitudes may prevent LBP. Strong evidence that lumbar supports do not prevent LBP. Strong evidence that low job satisfaction and other psychosocial aspects are risk factors for LBP, modest size of the association. Limited evidence, but general consensus, that joint employer – worker initiatives can prevent LBP, but no evidence on optimum strategies and inconsistent evidence on effect size.	---
Gatty et al, 2002	Manual workers. Occupational setting. [4]	Back belts	*Back injury, sick leave, cost, pain.*	No evidence of effect of back belts. *Methodologically very weak review, more narrative than systematic. Studies without control group were included. Our conclusions were based on the results from the controlled trials.*	0
Tveito et al, 2004 -------- ---------- *Systematic review*	Hospital workers/ manual workers. Workplace interventions. [5]		*Absenteeism, consequences, occurrence, duration, recurrence, quality of life* ------------------------------ Sick leave, cost, cost-effectiveness, new episodes of LBP, pain	There was no evidence of effect of back belts on sick leave, costs, and new pain. There was limited evidence of no effect of back belts on new episodes of LBP. *Recently published (2004) systematic review of good quality.*	-

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Kraus et al, 2002 ------------------- *Single study*	Home attendants. [12772]	Intervention 1: use of back belts and instruction Intervention 2: lifting advice only Control: no intervention	*Injury* ------------------------------	The group using back belts had a lower rate of low back injury than the other groups, the differences were marginally significant. *Methodologically weak, risk of selection bias. Nine units were randomised to three groups, results presented on level of subjects. Marginally significant differences in a population of more than 12 000 subjects - effect of back belts is negligible.*	
Intervention #4 Shoe inserts / shoe orthoses / shoe in-soles / flooring and mats					
Larsen et al, 2002a ------------------- *Single study*	Military conscripts. RCT [146]	The intervention group used custom-made biomechanical shoe orthoses in military boots. The control group received no intervention.	*Occurrence of pain* ------------------------------ Self reported back and/or lower extremity disorders	Preventing certain musculoskeletal problems in the back or lower extremities by using custom-made biomechanic shoe orthoses is possible. *Good-quality RCT.* *The difference found was due to differences in prevalence of shin splints and Achilles tendonitis. For 'back problems' there was no difference at all between groups. For the purpose of the present guideline it has to be concluded that shoe orthoses do not have a preventive effect in LBP.*	-
Mündermann et al, 2001 ------------------- *Single study*	Military personnel. RCT [206]	Subjects wore shoes with shoe inserts of different shape and material (hard/soft, viscous/elastic, high arch/low arch). The control condition was no insert condition.	*Occurrence of pain* ------------------------------ Footwear comfort (VAS), injury frequency was evaluated with a questionnaire.	Shoe inserts of different shape and material that are comfortable are able to decrease injury frequency. *Good-quality RCT.* *The difference in low back injuries was not statistically significant between the insert group and the control group.*	-
Intervention #5 Physical ergonomics					
Westgaard & Winkel, 1997 --------------- *Systematic review*	Based on 92 studies, 1966-1996 Not only LBP, but also upper limb disorders.	Ergonomic and work organisation interventions.	Various outcomes: pain, sick-leave, back injuries, consequences..	Among the intervention strategies which have the best chance of success: organizational culture interventions with high commitment of stakeholders, utilizing multiple interventions to reduce identified risk factors. For an intervention to be effective, it must actively involve the worker. *The conclusions are for musculoskeletal health in general, not only low back problems. It is not possible to draw conclusions specific for back problems*	Positive *Good quality, but not purely LBP*

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Linton & van Tulder, 2001 --------------- *Systematic review*	Studies from 1985 to 1998. RCT (randomised controlled trials) and CCT. A total of 27 studies, none of them evaluating the effectiveness of ergonomic interventions.		Back and neck pain problems	Ergonomic interventions: no RCTs or CCTs evaluating the effectiveness of ergonomics were identified. *The studies in this review were published exclusively in medical journals.* *Did not include studies relevant for ergonomic interventions*	Negative *Good quality,*
Koda et al, 1997 --------------- *Original study*	Subjects: employees of the Tokio Metropolitan bureau of waste management. Number of subjects: about 10000. Study design: prospective intervention trial. No control group, comparisons with national statistics. Stat: descriptive statistics	Participatory occupational safety and health program based on a small-sized group and joint employee-employer involvements. The program included analysis of occupational accidents, revision of the safety procedure manual, participatory training classes, proposals for improvements in garbage carts, trucks and pails; and in personal protective equipment.	*Compensated LBP* ------------------------------ Number of cases of compensated LBP, passively collected data available each year.	The number of compensated LBP from 1984 (beginning of the program) to 1994 decreased from 318 to 87, and the number of claimed LBP decreased from 343 to 92. at a national level, there is also a decrease, but less important. *Only numerators are given (numbers of cases).*	+ *Study design and analyses* -

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Brisson et al, 1999 --------------- *Original study*	Subjects: visual display unit workers Number of subjects: 627, 284 in the experimental group. 80% women Study design: pretest-posttest design with a reference group. Random allocation of 40 administrative and geographic units, with a stratification in order to insure comparability	Ergonomic training program (2 sessions of 3 hours) The workers had to do a self-diagnosis of his (her) workstation using a photograph taken of him (her) at work. The 2-week interval between the 2 sessions allowed the worker to apply knowledge and skills learned at the first session.	*Prevalence and duration of LBP* --------------- Prevalence and duration of LBP, with a threshold according to severity, based on answers to a self-administered questionnaire. Physical examination for workers reporting symptoms. Measurement 2 weeks before and 6 months after the intervention.	The results were similar for each of the 3 anatomic areas (neck-shoulders, wrists-hands, lower back) with both the questionnaire and the physical examination: in the experimental group the prevalence of musculoskeletal disorders decreased significantly among the subjects under 40 years of age. In the reference group there was also a decrease among the subjects under 40 years of age, but it was less marked and did not reach statistical significance. For the subjects 40 years or older, the prevalence of musculoskeletal disorders determined by the questionnaire had increased slightly after the training in both groups. Neither of these changes was significant. *The results for lower back are not given separately in details.*	Positive for subjects under 40 years *Study design and analyses* ++
Evanoff et al, 1999 --------------- *Original study*	Subjects: Orderlies in a 1200 bed metropolitan medical centre. Number of subjects: in the experimental group, 67 at baseline, 88 at 15 months of follow-up. Prospective intervention trial. Other hospital employees make the control group.	Formation of a participatory ergonomics team with three orderlies, one supervisor, and technical advisers. This team designed and implemented changes in training and work practices.	*Prevalence of LBP* *Low back injuries* --------------- Presence of back pain (self-administered questionnaire) at 1 month, 7 months and 15 months following the study inception. Reportable injury rate and number of lost days: available each year for orderlies and for the hospital.	Large and significant reduction in prevalence of low back pain in the intervention group: 73% at baseline, 56% at 15 months of follow-up. Compared to the 3 years preceding the intervention, the relative risk of low back injury among orderlies was 0.25 (95 CI 0.13-0.47) in the post-intervention period. *Symptom questionnaire: a limited number of orderlies was available for longitudinal data analysis, due to a high level of turnover.* *Low back injuries: due to turnover, the sample was different each year.*	Positive *Study design and analyses* +

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Marras et al, 2000 --------------- *Original study*	Subjects: workers in manual material handling Number of subjects not given, only the number of person-years "before" and "after" is given. Study design: an intervention group comprising 32 jobs is compared to a reference group comprising 4 jobs. On the whole, 16 companies are involved.	Addition of lift tables (8 jobs) Addition of lift aids (10 jobs) redesign of the work area (9 jobs) new production equipment (5 jobs)	Low back injuries Number of LBP recorded as injuries in the companies, and annual rates, for the periods "before" (duration: 3.3 to 10.5 years) and "after"(1 to 4.5 years) the intervention	A significant reduction in LBP injuries was observed for "lift table" and "lift aid", not for "redesign" and "equipment". For these two types of intervention, the lack of effectiveness could have been predicted, since the level of exposure was not much modified by the intervention. "Not all job changes, though initially believed to incorporate ergonomics principles, (are) effective in reducing injuries". *The pre-intervention periods for the calculation of rates seems very long for some jobs (this is not given in details in the paper). The possibility of sources of change (in addition to the intervention) over the period is not discussed.*	Positive *Study design and analyses* +-
Aaras et al, 2001 --------------- *Original study*	Subjects: visual display unit workers The exact number of subjects is not given (~ 50 male subjects in each of the three groups") Study design: Two intervention groups, T (technical) and S (software), one control group, without randomization.	"Workplace intervention": the operators were allowed to support their forearms on the table top Lighting: new lighting Optometry: optometric corrections when required	*Prevalence and severity of LBP* ------------------------ Intensity of back pain last month, according to a visual analogue scale. Evaluated at 5 points in time, including 3.5 and 6 years after the first interventions.	When comparing the same subjects regarding intensity of back pain last month, the T group reported a significant reduction in back pain after the workplace intervention. The reduction was observed yet after 3.5 and 6 years of follow-up No significant change observed in the S group. *The control group was a control group for 3.5 years only; at that time it got the intervention.* *At measurement 5 (6 years of follow-up) 23 subjects had dropped out in the T group.* *There seems to be a trend for a reduction of intensity of back pain in group T over time, which might be due to other causes than the intervention, especially because the expected positive consequences of the "workplace intervention" were for shoulder pain rather than for LBP. This point is not discussed in the paper.*	Positive for one of the two interventi on groups *Study design and analysis* + -

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Shinozaki et al, 2001 --------------- *Original study*	Subjects: forklift workers. Number of subjects: 27 forklift workers in the intervention group, compared to 233 blue-collar workers and 55 white-collar workers Male only Two successive interventions in the intervention group (first "personal" Second: "facility approach" in addition)	"personal": use of lumbar support, artic jacket, instructions for physical exercises. "facility approach": improvement of seats and tires of forklift trucks to reduce whole-body vibration. Addition of plastic curtains in the entrance of the workplace to reduce wind and cold.	*Prevalence of LBP* --------------------- Self-administered questionnaire for pain, visit to a physician for those with pain, LBP according to the physician. Evaluation at baseline, at 15 months (one year after the first intervention), at two years (9 months after the second intervention)	The prevalence in the intervention group felt from 63% at baseline to 56% after the first intervention and 33% after the second intervention. The reduction from baseline to the end of the second intervention was significant (p=0.008) and that from the end of the first intervention to the end of the second one was close to significance (p=0.07). The prevalence remained unchanged in the comparison groups. The results suggest that the facility approach may have been more effective than the personal approach. *Small sample*.	Positive *Study design and analyses* +

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Yassi et al, 2001 --------------- *Original study*	Subjects: nurses and unit assistants. Number of subjects 346 at baseline, 303 at 6 months, 261 at 1 year. Study design: Randomized controlled trial, with three arms: control, "safe lifting", "no strenuous lifting". In each arm: one surgical unit, one medical unit, one rehabilitation unit.	"safe lifting": one mechanical total body lift available, transfer belts available in each room, each ward was provided with two large and four small sliding devices. "no strenuous lifting": similar to "safe lifting" sit-stand lifts were provided but not transfer belts. Approximately 3 hours of education with practice using equipment .	*Prevalence of LBP* *Disability due to LBP* *Musculoskeletal injuries* ------------------- Frequency of back pain in the past week ("never" to "constantly", visual analogue scale). Back disability evaluated using the Oswestry Low Back Pain Disability Questionnaire. Interviews at baseline, 6 months and 1 year. Musculoskeletal injuries (not only back injuries): obtained each year from workers compensation files	The decrease in prevalence of back pain was significantly larger at 6 months in the "no strenuous lifting group" compared with the control group. It was significantly more important at 12 months in the " safe lifting group" compared with the control group. Disability scores were low and did not change during the course of the study. Musculoskeletal injury rates were not significantly altered. However, a smaller proportion of injuries to the back/trunk were found in the "no strenuous lifting" group in the one-year follow-up period.	Positive *Study design and analyses* ++
Brophy et al, 2001 --------------- *Original study*	Subjects: nursing aides of a nursing home. Number of subjects: not given. Study design: comparison before-after, no control group. Stat: comparisons between two periods	Purchase of new equipment (1993 to 1998). "ergonomics program" including training for new nursing aides, and establishment of accident review committee. Follow-up action could include disciplinary actions for non-use.	*Low back injuries* -------------------- annual rates, from 1992 to 1998. Lost workdays Associated costs.	The incidence rate was significantly lower in the period 1994-1998 ("during the intervention" than in 1992-1993 ("preintervention period"). The authors conclude that an effective ergonomics program reduces the low-back injury rate in nursing aides as well as the expenditure associated with back injury. *The two periods compared are not "before " and "after" but "before" and "during". The data indicates that the annual rate is lowest in 1995-1996, but it increases in 1997.* *The authors do not discuss the possibility of under-reporting of injuries in order to avoid "disciplinary actions".*	Positive *Study design and analyses* -

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Fredriksson et al, 2001 --------------- *Original study*	Subjects: car-body-sealing workers (both sexes) at an automobile assembly plant Number of subjects 57 in the intervention group (same persons before and after the intervention). Study design: "before-after", with a reference group that had most similar work.	Mainly "ergonomics", with a "work organisation" component. Individually adjusted workstations Increased work content and more variety in the work tasks.	*Prevalence of LBP* -------------------- Assessed by questionnaires before (March-April 1997)and after (March-April 1998) the intervention. Psychosocial working conditions (perceived importance in the work, demands, opportunities to learn, to influence work, social support) were investigated by questionnaire. Perceived and measured physical workload were also assessed.	After the intervention, the amount of musculoskeletal disorders increased in the study group. The difference was significant for neck, shoulders and hand/wrist disorders, not for low back. The perceived physical exertion was also higher, and the operators considered that the opportunity to influence their work had decreased. According to the authors, the paper illustrates the importance of paying attention to psychosocial issues in order to avoid musculoskeletal disorders after an intervention mainly aimed at physical workstation design. *The results stress another aspect of the evaluation of an intervention, the need to consider several musculoskeletal disorders: even though the effects had been positive for low back pain, they were, globally strongly negative in this study, especially for hand/wrist.*	Negative (for low back) *Study design and analyses* +
Smedley et al, 2003 --------------- *Original study*	Subjects: nurses: 1239 (817 at the intervention hospital, 340 at the comparison hospital), and 1167 (partly the same) at follow-up 32 months. More than 90% women. Study design: comparison of two hospitals (intervention hospital, comparison hospital) in the same region.	Major intervention to minimize unassisted patient handling and high-risk nursing tasks. Provision of lifting and handling equipment, (hoists transfer belts…). Almost all the nurses in the intervention hospital attended a 2-day training course in health and safety that incorporated basic aspects of manual handling.	*Prevalence of LBP* -------------------------- According to the answers to a postal questionnaire, one-month period for symptom recall. First survey between 18 and 28 months before the intervention, second survey 32 months after the baseline survey.	At the intervention site the prevalence of symptoms increased slightly (from 27% to 30%) whereas at the comparison site the prevalence remained at 27%. At the intervention hospital, although there was some improvement in the risk factors (psychosocial stressors, frequency of patient-handling activities) it was too small for any material reduction in back pain to be expected. Changes at the comparison hospital were greater than might originally have been expected. An explanation for the lack of benefit for the intervention is that the ergonomic improvements were too small. It is also possible that the reporting of LBP increased because the intervention heightened awareness.	Negative *Study design and analysis* +

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Owen et al, 2003 --------------- *Original study*	Subjects: nursing personnel:37 volunteers from the experimental site, compared to 20 from a control hospital. Women. Study design: comparison of two small hospitals (intervention, comparison), , in the same region. Five year follow-up.	Ergonomic program: use of various assistive devices in moving the patients	*Injuries and absenteeism* ------------------------------ For back and shoulders (grouped) Report of injuries, comparison of three periods: 18 months before the intervention, 18 months post-intervention, five year follow-up period.	*In the intervention hospital, the number of injuries ant lost work days decreased from the first to the second period (20 to 12 for injuries, 64 to 3 for lost work days).* In the 5-years follow-up the rates continued to decrease. At the control hospital, the rates remained stable throughout the study period. *Only numerators are given (numbers of cases), for a sample of volunteers.*	Positive *Study design and analyses* -
Intervention #6 Organisational ergonomics					
Wergeland et al, 2003 --------------- *Original study*	Subjects: employees in nursing homes, etc in 3 towns. Number: 147 in the intervention group, 286 in the reference group. Mainly women. Study design: control and intervention groups in each town; control group: same institutions and (or) job.	Reduction of daily workload from 7 or more to 6 hours (or 30 hours weekly). Full-time salary maintained. The reduction of work hours was compensated for (almost everywhere) by the employment of extra personnel	*Prevalence of LBP* ------------------------------ Presence of back pain (self-administered questionnaire). The exact wording of the questions and the recall period differed between the three towns *Same questionnaire before intervention and after 12 months (also after 6 and/or 18 months, depending on the town and the intervention/reference status).*	The results from the multiway frequency analysis were that the one year changes in the prevalence of back pain was not significantly different between the intervention and reference group. Oslo and Helsingborg: in the intervention group, increase of the prevalence of LBP during the first year of intervention, decrease after 1.5 years. Stockholm: the reference group experienced a reduction similar to that of the intervention group. An explanation for the lack of positive effect for back pain is that other factors (than the number of work hours) may be of a greater importance for the occurrence of back pain, such as the need for manual handling of heavy loads and the possibilities for safe lifting. *It seems that the analyses could not take into account the individual changes over time*	Negative *Study design and analysis* +

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Intervention #7 Multi-dimensional interventions					
Gatty et al, 2003 --------------- *Systematic review*	Nine studies on back pain and injury prevention programs Period 1995-2000. For five of them the primary prevention approach was education and task modification, adding or not workstation redesign	Multi-disciplinary, such as both education and changes in lifting techniques for hospital workers.	*Back injury; Back pain*	Positive outcomes were associated with studies reporting high compliance that used job specific and individualized/small group education and training approaches. *The conclusions might be valid for interventions combining education and change in practices (for lifting for example)*	Positive for some kinds of interventi on *Good quality*
Leclerc et al, 1997 --------------- *Original study*	Subjects: hospital, warehouse and office workers, in six companies or hospitals. Number: 275 in the intervention group, 250 in the reference group. 45% women. Study design: control and intervention groups matched on the sector, without randomisation (except in one company).	Hospital workers: ergonomic changes, and exercise. Warehouse workers: ergonomic changes (for half of the intervention group) and exercise. Office workers: ergonomic advices, changes if necessary, short training session (2-3 hours) Education of the management for a third of the intervention group.	*Severity/impact of LBP* ----------------------------- According to a self-administered questionnaire, before the intervention and one year after. Scores for LBP in the previous 6 months were calculated, they aggregate several dimensions (level of pain, duration, consequences, use of medical system).	A significant improvement was observed among hospital workers in the intervention group (p=0.01). For warehouse and office workers, no improvement was observed. For warehouse workers, the absence of positive results might be due to a heightened awareness of low back disorders due to the intervention. *The results for the various components of the score are not given separately.*	Positive for one of the three interventi on groups *Study design and analysis* +

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Intervention #8 Modified work for return to work after sick leave due to LBP					
Krause et al, 1998 ---------------- *Systematic review*	Modified work [29]		*Absenteeism* ------------------ Time to return to work.	Modified work programs facilitate return to work for temporarily and permanently disabled workers.	++
Van der Beek et al, 2000 ------------------- *Systematic review*	Modified work [10]		*Absenteeism* ------------------- Time to return to work.	Little data on effectivity of ergonomic workplace adaptations by workers with LBP. Only an indication for effectivity was found. Results on organisational interventions were very different.	+
Van der Beek et al, 2004 ------------------- *Systematic review*	Modified work or training/education [14]		*Absenteeism* ------------------- Time to return to work.	Little data on effectivity of ergonomic workplace adaptations by workers with LBP. Only an indication for effectivity was found. Studies on organisational interventions indicated a positive effect on time to return to work. *This review is an update of the review from Van der Beek et al. (2000).*	+
Anema et al, 2004 ------------------- *Single study*	Workers who are fully sicklisted (3-4 months) due to LBP. Prospective 2-year cohort study [1631]	The intervention was an ergonomic intervention: workplace adaptation, adaptation of job tasks and adaptation of working hours	*Absenteeism* ------------------ Time to return-to-work and working status at 2 specified times.	Results suggested that ergonomic interventions are effective on return-to-work of workers long term sicklisted due to LBP.	+
Hiebert et al, 2003 ------------------- *Single study*	Workers with pain-related sickness absence. Retrospective cohort study [16000]	Workers were grouped into those who had received a work restriction for their back pain and those who had not.	*Absenteeism* ---------------------- Duration of work disability.	No evidence was found for an association between a prescription of work restriction and early return to work.	-

Authors *Type of article*	Study details	Intervention(s)	Outcomes investigated	Original authors' main conclusions [*Present reviewers' comments*]	+ve / –ve finding
Loisel et al, 1997 ------------------- *Single study*	Workers with LBP. RCT [130]	The intervention consisted of the Sherbrooke model. There are 4 treatment groups: usual care, clinical intervention, occupational intervention and full intervention.	*Absenteeism* -------------------- Duration of absence from work, functional status and pain.	The full intervention group returned faster to regular work than the usual care intervention group. The specific effect of the occupational intervention accounted for the most important part of this result.	+
Yassi et al, 1995 ------------------- *Single study*	Nurses. 1-year follow-up. [1645]	The intervention was a programme for back-injured nurses on high-risk wards. The programme consisted of prompt assessment, treatment and rehabilitation trough modified work.	*Absenteeism* -------------------- Time lost and cost data.	The programme reduced the incidence and time lost due to back injuries and was cost-beneficial. *Modified work was part of a multi-dimensional intervention, so that the separate effects of modified work and the other parts of the intervention can not be disentangled*	+

Table 3a: <u>**SCHOOL AGE:**</u> overview of intervention studies

Authors	Type of article	Intervention	Description of specific outcomes	Original authors' main conclusions	+ or –ve finding
Balagué et al, 1996	Original study n: 1716 Age: 11.7	Swedish Back School was implemented by a rheumatologist to 55 primary school teachers during 2 sessions of 90 minutes plus an annual 2 hours session. Back School was then administered by the primary school teachers over a 3-year period.	- 60 % of the children did not recall the Back School - only one fifth to one third of the teachers daily integrated the Back School concept in the course of teaching - during the 3-year period analysed there was an overall reduction in prevalence of LBP and a small but significant reduction in perceived disability - in the pupils recollection of participation was associated with increased LBP prevalence (P < 0.001) and with reduction in the utilization of medical care for LBP (P < 0.05)	Introducing a primary prevention educational back program in the professional course of studies in the education for teachers would allow integration of the concepts of prophylaxis during their training and would enhance a positive attitude toward prevention, with the merit of demedicalizing LBP.	+
Cardon et al, 2002b	Original study n:696 (intervention: 347, control: 349) Age: 10.0	A back education program (6 sessions at 1-week intervals, each lasting 60 minutes) was implemented by a physical therapist to elementary school pupils through guided discovery and active hands-on methods.	Following the back education program resulted in lower self-reported back- and neck pain prevalence (n: 347) (P< 0.05) and better use of many back care principles, evaluated in a practical test (n: 198) and with a candid camera evaluation (n: 38) (P < 0.001) after the program and 3 and 9 months later.	Back education in elementary schoolchildren is efficacious up to one year. The implementation of early back education in the school timetable is advocated.	+
Feingold & Jacobs, 2002	Original study n: 17 (intervention: 9, control: 8) Age: 12.7	Pupils were shown a 30-minutes presentation in which they were taught the importance of proper wearing of a backpack, followed by practice hands-on application of the presentation, guided by the PI.	- making use of video analyses, education was found to have no effect on the posture of the children while wearing backpacks - 2 participants reported less pain in their back, 4 reported less pressure and pain on the shoulders and one reported less strain in her neck	Education regarding proper wearing of a backpack may impact the middle school aged child by improving quality of life as noted through decrease in reports of musculoskeletal pain by participants.	+

Authors	Type of article	Intervention	Description of specific outcomes	Original authors' main conclusions	+ or –ve finding
Mendez & Gomez-Conesa, 2001	Original study n: 106 (intervention: 35, control: 36, placebo: 35) Age: 9	Postural hygiene program consisting of 11 sessions (3 devoted to physiotherapy exercises, 8 to behaviour intervention - in total: 19 hours).	-level of knowledge and motor skills showed a significant increase after program completion and at 6 and 12 months follow-up (p=0.00) - some positive changes were generalized in natural situations (*P* =0.00) - an independent health check 4 years after program application tended to favour the intervention pupils, requiring less medical treatment for LBP (*P* = 0.07)	Programs involving practice and motivating strategies impart health knowledge and habits more efficiently than those restricted to the mere transmission of information. There is a pressing need for multidisciplinary interventions aimed at developing healthy habits to promote postural hygiene in childhood.	+
Storr-Paulsen, 2002	Original study n: 532 (intervention: 289, control: 243 control) Age: 6-15	Body-consciousness program through increased awareness among the teachers (information about ergonomics, posture change, advantages of physical activity)	The intervention did not have effect on back pain of the pupils after one year of intervention.	The intervention was not effective, which might be explained by the relative short time of implementation and practical problems at the school.	-

Table 3b: **SCHOOL AGE:** overview of studies on risk factors

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Balagué et al, 1995	Original study (cross-sectional survey) n: 615 Age: 14 (range12-17)	Girls reported non specific LBP more frequently than boys. Positive and negative affect scores were respectively associated with significantly reduced and increased lifetime prevalence of non-specific LBP and its consequences.	Psychological factors play a role in reporting of non-specific LBP in schoolchildren.
Burton et al, 1996	Original study (5-year longitudinal interview and questionnaire based survey) n: 216 Age: 11 (at baseline)	No statistically significant relationships were found between flexibility and any of the LBP variables. There was a positive link between sports exposure and LBP only for boys (boys had a higher exposure than girls to more strenuous sports activities). Severity of LBP was not related to sports exposure.	Back pain in adolescents is common; it increases with age and is recurrent, but in general does not deteriorate with time. Much of the symptomatology may be considered a normal life experience, probably unrelated to adult disabling trouble.
Cardon et al, 2004	Original study (cross-sectional making use of standardised fitness test and questionnaire) n: 749 Age: 9.7 (8-12)	In girls the frequency of physical activity of moderate intensity was significantly lower in the pain reporting pupils. Other physical activity estimates, physical fitness scores, BMI and body fat did not differ significantly between children with and without pain report. In girls a more negative attitude regarding the safety of physical activity was associated with pain report.	The hypothesis that fitter pupils do report less back or neck pain could not be confirmed. A longitudinal study with a follow-up into adolescence is needed to further explore the possible role of physical fitness and physical activity promotion in the prevention of back and neck pain at young age.
Feldman et al, 1999	Original study (prospective, repeated measures cohort design) n: 502 (incidence cohort 377) Age: 14	Smokers experienced LBP more than non-smokers, with a dose-response relationship between amount smoked and development of LBP.	Smoking was found to increase the risk for LBP in adolescents. If young people learn good lifestyle habits early, then perhaps the burden of disabling back pain in the population can be lessened.
Feldman et al, 2001	Same as previous study	Factors associated with development of low back pain (over a 6 months period) in adolescents were a high growth, poor quadriceps and hamstrings flexibility, working during the school year, and smoking.	More research is needed regarding prevention before people enter the workforce. Modifying risk factors such as smoking and poor leg flexibility may potentially serve to prevent the development of LBP in adolescents.
Feldman et al, 2002	Same as previous study	Adolescents who worked were more likely to develop pain, as were those who had a lower mental health score. White-collar jobs were associated with higher risk of LBP than blue-collar jobs.	The conclusion that work is associated with musculoskeletal pain development in adolescents implies that implementation of prevention strategies in the workplace should include adolescents who work.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Goldberg et al, 2000	Systematic review	Data of studies in adults are fairly consistent with the notion that smoking is associated with non-specific back pain. However there are few direct data regarding the pathologic origin of back pain in children and adolescents.	It is possible that smoking is implicated in the initiation of back pain, or in the exacerbation of pre-existing back pain or both.
Goodgold et al, 2002	Original study (cross-sectional survey) n: 345 Age: 11-14	Younger children carried proportionally greater backpack loads (scales were provided for students to weigh themselves with/ -out backpacks). Percentage of body weight carried was not related to history of back pain.	Concerns raised by parents and professionals that children are carrying heavy loads are justified, however the relationship with back pain needs further evaluation.
Grimmer & Williams, 2000	Original study (cross-sectional) n: 1296 Age: 8-12	There were gender- and age-specific associations between recent LBP and time spent sitting, load of backpack, time spent carrying backpack, and time playing sport.	Ongoing concern is warranted regarding adolescent spinal responses to repeated heavy load carriage and prolonged sitting. Parents and teachers should insist on constraints that limit load carrying and lengthy periods of sitting.
Gunzburg et al, 1999	Original study (cross-sectional) n: 392 Age: 9	There was a significant correlation between LBP and feeling of unhappiness, sleeplessness and perceptions of ill health. There was a strong correlation between LBP and the perception by the children that one or both parents were back pain sufferers. LBP reports were higher in children reporting playing video games for more than 2 h per day, but this was not so for TV watchers. The way in which the school bag was carried and sports activity were not associated with pain reports. Only one of the 19 clinical parameters was associated with self-reported LBP.	There are few clinical signs that can help to single out schoolchildren with LBP. There was a significant correlation between self-reported LBP and children's general well-being and parental history of LBP.
Harreby et al, 1999]	Original study (cross-sectional survey) n: 1389 Age: 13- 16	Recurrent/continuous LBP in a moderate to severe degree was positively correlated to BMI more than 25 kg/m^2, competitive sport for boys, poor physical fitness, daily smoking, heavy jobs in leisure time and reduced life quality. Daily smoking and heavy jobs were strongly associated with severe LBP.	The importance of the findings seems unclear. The causal importance of the associated factors in the development of severe LBP is unknown.
Hutchinson, 1999	Original study consisting of 2 parts (prospective study over 7-wk period / retrospective study over 10 month period) n: 7 / 11 Age: 15-17	Over a 7 week period the incidence among 7 members of the national team of rhythmic gymnastics was 474 musculoskeletal complaints. Retrospectively 46 musculoskeletal injuries were reported.	Rhythmic gymnasts are at relative increased risk of suffering low back complaints secondary to their sport. Rhythmic gymnastics should be included in the sports at risk of low back injury. Further study is necessary to assess whether interventions will reduce the incidence of low back complaints in this sport.
Iyer, 2001	Original study (cross-sectional survey) n: 248 (India) and 103 (US) Age: 9-20.6	50% reported shoulder / back pain attributed to school carry-on items. Pain reports were not correlated with BMI, % of body weight carried, or mood. Americans were more stressed, sad and overweighted than Indians.	Pain due to school carry-on items is a significant problem that school districts need to address.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Jones et al, 2003	Original study (prospective cohort study with1 year follow-up) n: 1046 age: 11-14 (at baseline)	There was no link between mechanical load (schoolbag weight) and short term risk of new onset LBP. Adverse psychosocial factors and other somatic complaints were predictive for future LBP.	The origins of the adult back pain "career" may begin at least as early as adolescence. As for adults, psychosocial factors are associated with an increased risk to develop LBP in schoolchildren.
Korovessis et al. , 2004	Original study (cross-sectional) n: 3441 age: 9-15	BMI did not correlate with LBP. Sports exposure seemed to increase LBP in girls. Short children who carry backpacks as heavy as do tall children at the same age were more prone to LBP. The way of carrying a backpack (one or two straps) was not correlated to LBP.	Girls at the age of 11-12 years should carry light backpacks and avoid strenuous sports to decrease the probability of experiencing dorsal pain. Shorter children should not carry as heavy backpacks as tall children at the same age. Parents should not care about the way their child caries his / her backpack.
Kovacs et al, 2003b	Original study (cross-sectional survey) n: 7361 (and 13553 parents) Age: 13 – 15	LBP was significantly associated with reporting difference in leg length, practice of any sport more than twice a week. No association was found between LBP and BMI, the manner in which books were transported, hours of leisure sitting, alcohol intake or cigarette smoking.	Adolescents have prevalence similar to that of adults. LBP is strongly associated with pain in bed or upon rising, and mildly with practising sports more than twice a week. Further longitudinal studies are needed to establish which of these factors increase the risk for LBP in adolescents.
Kristjandottir & Rhee, 2002	Original study (cross-sectional survey) n: 2173 Age: 11-12 and 15-16	Four major factors (age, morning tiredness, eating habits and parental support) emerged as factors associated with back pain in schoolchildren.	Study results highlight the importance of acquiring and practising a healthy lifestyle for the benefit of prevention and / or diminution of the burden of back pain in the present and future.
Kujala et al, 1996	Original study (3 year follow-up) n: 98 Age:10-13 (at baseline)	Sever LBP problems occurred only during the growth spurt of adolescence. Back pain was more reported in athletes (n: 29) than in non-athletes (n: 6).	Excessive loading that involves a risk for acute low back injuries during the growth spurt is harmful to the lower back.
Kujala et al, 1999	Original study (cross-sectional survey) n: 698 Age: 10-17	Low back pain, upper limb pain and lower limb pain were found more often in subjects participating in large amounts of leisure physical activity, while non-musculoskeletal pains (in particular headache) among boys tended to be less common. Co-occurrence of different musculoskeletal pains was common in subjects participating in sports.	In addition to its likely long term benefits, vigorous physical activity causes musculoskeletal pains during adolescence. This should be considered when tailoring health promotion programs to adolescents.
Lebskowski, 1997	Original study n: 2346 (and 970 high-school students) Age: 17 ±1	In pupils a correlation between LBP and incorrect sedentary position and smoking was found.	Incorrect sitting and smoking increase the risk for back pain in pupils.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Lee et al, 1999	Original study (5-year prospective study) n:67 Age: 17 ±2	Testing the isokinetic trunk performance at 60°/sec with regard to incidence of LBP revealed that the extension/flexion ratio was a more sensitive parameter than the peak torque or the left rotation / right rotation ratio in predicting future LBP episodes.	The imbalance of trunk muscle strength, *i. e.,* lower extensor muscle strength than flexor muscle strength, might be one risk factor for LBP incidence.
McMeeken et al, 2001	Original study (cross-sectional survey) n: 614 Age: 9-27	Greater incidence and magnitude (VAS) of back pain among gymnasts and dancers, compared to controls. For dancers the risk increased when the weekly activity exceeded 30 hours.	Dancers appear to increase their risk of back pain development when weekly activity exceeds 30 hours. Back pain in active and inactive adolescents presents a significant challenge for health-care practitioners.
Merati et al, 2001	Original study (experiment and retrospective survey) n: 35 Age: 11.3	The cardiovascular effort (tested by VO_2 max, pulmonary ventilation, & heart rate with/-out back pack) required for locomotion carrying backpack was minimal. Fatiguability and back pain were more likely to occur in less physically performing subjects	An improvement in the physical fitness of schoolchildren appears to be one way of preventing the occurrence of back pain during locomotion with a school backpack in children.
Milanese & Grimmer, 2004	Original study (cross-sectional) n: 1269 Age: 8-12	The first quartile (smallest students) was identified as having the 'best fit' with the school furniture. An overall higher odds of reporting low back pain was noted in students with anthropometric dimensions in the fourth quartile (the tallest students).	The degree of mismatch between child anthropometry and school furniture set-up should be further examined as a strong and plausible associate of adolescent back pain.
Negrini & Carabalona, 2002	Original study (cross-sectional) A/ n: 237 ; age: 11.3 B/ subgroup n:115; age: 11.7	A/ The backpack load borne by children exceeded the legal limits set for adults. The school system, parents and children played a role in the weight carried (weight of packs recorded on 6 days). B/ The association between pain and backpacks was indirect, i.e.: correlation with subjective fatigue and time spent carrying but not with the actual weight.	Daily backpack carrying is a frequent cause of discomfort in schoolchildren. The relationship between this load and back pain is indirect, suggesting that the existence of personal physical and psychological factors need to be investigated. The reduction of the daily backpack load is recommended.
Newcomer & Sinaki, 1996	Original study (4 years follow-up) n: 96 Age: 10 -19 (at follow-up)	Increased physical activity was significantly associated with a history of LBP (evaluated with a questionnaire containing 5 questions) and increased isometric back flexor strength was significantly associated with a history of low back pain and of LBP in the past year. The rate of change in back flexor strength over 4 years had a significantly positive association with the occurrence of LBP in the past year.	LBP is more common in children with increased physical activity and stronger back flexors. The main causes of LBP in children are musculotendinous strains and ligamentous sprains.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Ogon et al, 2001	Original study (prospective cohort study with 2 year follow-up) n: 120 Age: 17 (14-20) (at baseline)	Incidence of LBP according to radiological images at baseline in elite skiers revealed that lumbar radiographs are of limited value for predicting LBP excepted severe anterior end plate lesions.	Adolescent students of elite sports with severe lumbar anterior end plate lesions have an increased risk of having LBP develop under high performance training.
Salminen et al, 1995	Original study (prospective 3-year follow-up study) n: 1377 (follow-up: n: 62) Age: 15 (at baseline)	At base-line and at follow-up subjects with initial LBP (n: 107) were characterized by a low frequency of physical activity, decreased spinal function and strength. Disc degeneration and disc protrusion at baseline predicted future frequent LBP.	After the rapid physical growth period, there seemed to be a causal relationship between the early evolution of the degenerative processes of the lower lumbar discs and frequent LBP in several subjects.
Salminen et al, 1999	Original study (prospective 9-year follow-up study) n: 1503 (follow-up questionnaire: n: 70) Age: 14 (at baseline)	The risk of persistency of recurrent LBP was highest in individuals showing the first signs associated with disc degeneration.	Individuals with disc degeneration soon after the phase of rapid physical growth not only have an increased risk of recurrent LBP at this age, but also a long-term risk of recurrent pain up to early adulthood.
Sheir-Neiss et al, 2003	Original study (cross-sectional study) n: 1126 Age: 12-18	Self-reported back pain (month prevalence back and neck pain) was associated with poorer general health, more limited physical functioning, more bodily pain and larger BMI. As compared with no or low use of backpacks at school, heavy use was independently associated with back pain. Adolescents with back pain carried heavier backpacks (weight on one day) that represented a greater percentage of their body weight.	Adolescents with back pain are more likely to be female, have a higher BMI, report poorer health, spend more time watching TV, have a heavier backpack and carry a backpack more frequently. Efforts to minimize adolescents' backpack use are recommended.
Siambanes et al., 2004	Original study (cross-sectional) n: 3497 Age: 11-15	Controlling for age, socio-economic status, walking to and from school, and method of wear, results indicated that backpack weight, measured as a percentage of body weight, was effective in predicting back pain. The method of wear was not significantly related to the prevalence of back pain.	Results indicate that non-specific back pain affecting schoolchildren is becoming a major national, if not international, medical issue. Studies are needed to find a way to alleviate theses detrimental forces affecting adolescent schoolchildren, which clearly includes the use of school back packs.
Sjölie, 2002	Original study (cross-sectional survey) n: 105 Age: 14.7 (14-16)	There was a non-significant tendency towards an association between poor well-being and LBP. The association was the strongest for self-reported fitness, was significant for cheerfulness, but not for the calmness item. LBP was associated neither with parental pain, nor with social class.	Poor well-being, in particular poor self-perceived fitness, is associated with LBP. No associations are found between social class, parental LBP and juvenile LBP.
Sjolie, 2003	Original study (cross-sectional survey) N: 88 Age: 14.7 (14.1 -16.1)	Distance walked/bicycled to school was slightly shorter among those reporting LBP. Walking/bicycling more than 8 km weekly to regular activities was inversely associated with LBP. No associations were found between passive journeys and LBP.	The results indicate that juvenile LBP may be associated with lack of walking or bicycling, but not with use of the school for 1 h daily. The results raise the question for future research of whether lack of active transport may be one cause behind the increase in juvenile LBP.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Sjölie & Ljunggren, 2001	Original study (cross-sectional and prospective part with 3 year follow-up) n: 88 Age: 14.7 (14-16)	Low lumbar extension strength and high ratio's between lumbar sagittal mobility and lumbar extension strength were associated with LBP (cross-sectional part) and predicted future LBP (prospective part).	Insufficient strength and stability in the low back are important factors for both current and future back pain in adolescents.
Staes et al, 2003	Original study (cross-sectional survey) n: 620 Age: 17	A higher degree of somatising, diminished self-esteem and augmented negative affect were related to self-reported LBP.	Some adolescents might have traits that make them prone to become low back sufferers. Psychosocial factors should be taken into account when investigating LBP in adolescents.
Storr-Paulsen, 2002	Original study (prospective intervention study with 1 year follow up) n: 686 (and 972 parents)	Baseline values showed a correlation between age and back pain and "do not like going to school". Physically active pupils liked best going to school. Back pain was correlated with parental pain.	Psychosocial factors, like disliking going to school may be risk factors for back pain in schoolchildren.
Szpalski et al, 2002	Original study (2-year prospective longitudinal study) n: 287 Age: 9-12	Making use of a questionnaire and a medical examination it was found that the quality of falling asleep, happiness, heavy satchel, & painful lumbar muscles distinguished "never" LBP from "always" LBP. Health perception & weight were associated with "incident" LBP.	Among the few significant variables, those related to general well being and self-perception of health are prominent. It appears that psychological factors play a role in the experience of LBP, in a similar way to what has been reported in adults.
Van Gent et al, 2003	Original study (cross-sectional study) n: 745 Age: 12-14	No association was found between perceived and real weight of the bag (weight on one day). The (relative) weight of schoolbags was not related to complaints of neck and/or shoulder and back. Scores on psychosomatic questions were higher for children with complaints on neck, shoulder, back.	Psychosomatic factors appear to be more strongly related to the occurrence of neck and/or shoulder and back complaints than the type and weight of the schoolbag and other physical factors.
Viry et al, 1999	Original study (cross-sectional survey) n: 123 Age: 14	A relative schoolbag weight of 20% or more (schoolbag weight on day of survey) was associated with a history of back pain. Sitting on the edge of the chair while completing the questionnaire was significantly associated with a history of a physician visit for back pain.	A longitudinal prospective study is needed with the goal of devising preventive strategies to reduce the risk of LBP in adulthood.
Watson et al, 2003	Original study (cross-sectional study) n: 1446 Age: 11-14	School bag weight (5 day bag weight diary was used) and physical activity were not associated with self-reported LBP. Strong associations were observed for emotional problems, conduct problems, troublesome headaches, abdominal pain, sore throats and daytime tiredness.	Psychosocial factors rather than mechanical factors are more important in LBP occurring in young populations and could possibly be a reflection of distress in schoolchildren.

Authors	Type of article	Specific outcomes	*Original authors' main conclusions*
Wedderkopp et al, 2003	Original study (cross-sectional survey) n: 481, Age: 8-10 / n: 325, Age: 14-16	No association was found between objectively measured level of physical activity (making use of accelerometers) and back pain in children and adolescents.	When the level of physical activity is measured objectively, there is no association with self-reported back pain in children and adolescents. A method should be used to distinguish between different types of activities to distinguish the possible noxious and beneficial effects of physical activity.
Widhe, 2001	Original study (longitudinal study with 10 years follow-up) n: 90 Age: 5-6 (at baseline)	The kyphosis and lumbar lordosis increased by 6° each while the total sagittal mobility of the spine decreased. Posture, mobility, standing or sitting height or body weight either at 5-6 or 15-16 years of age seemed to have no significant relationship to the likelihood of LBP at the age of 15-16.	LBP is not related to posture, spinal mobility or physical activity.