A systematic review of workplace interventions to prevent low back pain

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A systematic review of randomised controlled trials was undertaken to evaluate the effectiveness of workplace interventions to prevent low back pain. Potential trials were located by a computerised search supplemented with citation tracking. The methodological quality of the trials was assessed on 11 criteria and the level of evidence for each intervention was determined, based upon the amount, consistency and quality of evidence from the trials. The review located 13 trials that were generally of moderate quality. The trials suggest that workplace exercise is effective, braces and education are ineffective, and workplace modification plus education is of unknown value in preventing low back pain. **[Maher CG (2000): A systematic review of workplace interventions to prevent low back pain. *Australian Journal of Physiotherapy* 46: 259-269]**

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Introduction

The cost of low back pain (LBP) attributed to work is enormous in both financial terms and suffering. For example in 1997/98, WorkCover Victoria received 7,956 LBP claims with total payments of $411 million (Victorian WorkCover Authority 1998). Workplace interventions suggested to prevent LBP include education, braces, workplace modification, lifting teams, no-lift policy, lifting aids, job placement and exercise (Zwerling et al 1997). While these interventions have become widely accepted in the occupational health field, there has been little systematic evaluation of their effectiveness.

To date, there have been two systematic reviews of workplace prevention strategies for LBP (Gebhardt 1994, van Poppel et al 1997), however they may not provide an accurate assessment of the value of prevention strategies. Gebhardt's (1994) review did not assess the methodological quality of the trials located and only considered six trials, of which only three were randomised controlled trials (RCTs), and so the study does not provide clear evidence on the effectiveness of prevention strategies. Van Poppel and colleagues' (1997) review avoided the methodological problems of the earlier study. However, the authors restricted their review to three prevention strategies: education, exercise and braces. Additionally, the authors only located 11 trials, of which only seven were RCTs. Because several RCTs were not considered by van Poppel and colleagues, there was the possibility that their conclusions were biased. Accordingly, it was thought appropriate to conduct a more comprehensive systematic review. The purpose of this review was to investigate the efficacy of workplace interventions to prevent LBP in workers.

Methods

Literature search strategy In January 1999, a search of the following databases was undertaken: MEDLINE, Embase, CINAHL, OSHROM, PEDro and Psychlit. Each database was searched to the earliest year available. To identify randomised controlled trials, a search strategy based upon the strategy described by the Cochrane back review group was used (van Tulder et al 1997) and this was coupled to search terms representing LBP and prevention, as well as with common LBP prevention interventions. Citations in the papers located were checked for additional trials.

Selection criteria To be included in the review, a study had to meet the following criteria: (1) the study was a randomised controlled trial: studies could be included if the method of allocation was not truly random but was intended to be random (eg allocation

Table 1. Methodological scores assigned to the RCTs.

	PEDro criterion											
RCT	1	2	3	4	5	6	7	8	9	10	11	Total
Shi 1993	0	1	0	0	0	0	0	0	0	0	0	1
Donchin 1990	0	1	0	1	0	0	0	0	1	1	0	4
Gundewall 1993	0	1	0	0	0	0	0	1	0	1	1	4
Kellet 1991	1	1	0	0	0	0	0	0	0	1	1	4
Donaldson 1993	1	1	0	1	0	0	0	0	0	1	1	5
Tuchin 1998	0	1	0	1	0	0	0	1	0	1	1	5
Gerdle 1995	1	1	0	0	0	0	1	0	0	1	1	5
Reddell 1992	1	1	0	1	0	0	0	0	0	1	1	5
Daltroy 1997	1	1	0	0	0	0	0	0	1	1	1	5
Walsh 1990	1	1	0	0	0	0	1	1	0	1	0	5
Alexander 1995	1	1	0	1	0	0	0	1	0	1	1	6
Linton 1989	1	1	0	1	0	0	0	1	0	1	1	6
van Poppel 1998	1	1	1	1	0	0	0	1	1	1	1	8
Total	9	13	1	7	0	0	2	6	3	12	10	

Item score 0 = absent, 1= present. The PEDro criteria are: (1) specification of eligibility criteria; (2) random allocation; (3) concealed allocation; (4) prognostic similarity at baseline; (5) subject blinding; (6) therapist blinding; (7) assessor blinding; (8) > 85% follow-up for at least one key outcome; (9) intention-to-treat analysis; (10) between group statistical comparison for at least one key outcome; (11) point estimates and measures of variability provided for at least one key outcome

by employee number); (2) the subjects in the trial were workers and the study investigated interventions in an industrial setting; (3) the study provided outcomes for LBP or, where trials reported injuries to other areas of the body, the outcomes were reported separately for LBP; (4) the study was a full paper, not an abstract, published in a peer-reviewed journal; and (5) the paper was written in English. Trials that included subjects with LBP at trial commencement were considered eligible for inclusion.

Studies were included only if the reported outcomes provide direct evidence of prevention of cases of LBP or the sequelae of LBP, eg number of episodes of LBP, duration of LBP, severity of LBP, lost work time due to LBP, direct and indirect costs of LBP. Trials where the outcomes were restricted to risk factors for LBP, eg poor lifting technique, were not considered because reversal of risk factors may not necessarily prevent LBP. The literature search and determination of eligibility were performed solely by the author.

Assessment of methodological quality All trials were rated for methodological quality using the PEDro scale, a scale based upon the Delphi list described by Verhagen et al (1998a). Most PEDro scale item components have been validated empirically (eg randomisation (Chalmers et al 1983, Colditz et al 1989, Miller et al 1989, Sacks et al 1982), concealment (Chalmers et al 1983, Moher 1998, Schulz et al 1995) and blinding (Colditz et al 1989, Schulz et al 1995). The other items have face validity but are yet to be empirically validated. The PEDro scale has been shown to have acceptably high inter-rater reliability (Moseley et al 1999). All trials were rated by two raters with discrepancies in ratings arbitrated by a third rater. All three raters were participants in Moseley and colleagues' (1999) study that demonstrated acceptable inter-rater reliability for the PEDro scale. The raters rated clean copies of the original papers and so were not blinded to the authors or journal that published the study. While blinding has been used in some previous systematic reviews,

Table 2. RCTs on the effectiveness of exercise.

RCT	Subjects	Interventions (sample size)	Follow-up period (months)	Main result
Donchin et al 1990	Israeli hospital employees	(1) Group calisthenics 45 mins, biweekly for 3/12 (*n* = 46) (2) Back school for five sessions of 90 minutes (*n* = 46) (3) No treatment control (*n* = 50)	12	Over the follow-up year gp 1 had fewer months with episodes of LBP (4.5) than gp 2 (7.3) and gp 3 (7.4).
Gerdle 1995	Swedish home care employees	(1) 1-hour training program twice a week for 1 year designed to improve co-ordination, strength/ endurance and fitness (*n* = 46) (2) Control gp (*n* = 49)	12	There was a non- significant trend for better outcome in gp 1 for sick leave (8.1 days *vs* 12.1 days) and prevalence of LBP (19% *vs* 27%).
Gundewall et al 1993	Swedish nurses in a geriatric hospital	(1) Endurance, strength exs for trunk extensors, plus functional exs to simulate pulling and pushing. 20 minutes, six times a month for 13 months. Access to physiotherapist to get advice concerning back troubles if they had any (*n* = 28) (2) No treatment control (*n* = 32)	13	Gp 1 had fewer workers with work absence during the 13 months (1/28 *vs* 12/32) *NNT = 3, 95% confidence interval (CI) 2-6 gp 1 lost less work days *mean and 95% CI for difference = 3.8 (0.3; 7.3) and had less days with complaints (53.9 *vs* 94.3). Gp 1 had less intense pain (no data provided)
Kellet et al 1991	Swedish factory workers	(1) Group calisthenics to music. One session of 30 minutes per week at work plus written commitment to exercise at least once per week for 30 minutes at home for 18 months. 10min talk on on LBP at 1/3 of exercise classes (*n* = 58) (2) No treatment control (*n* = 53)	18	In 18 months follow-up sick leave fell in gp 1 whereas the sick leave in gp 2 increased compared to 18 months prior to study; *mean and 95% CI for difference 4.49 (1.0; 8.0). The mean number of episodes of LBP fell in gp 1 and increased in gp 2; *mean and 95% CI of difference 0.46 (0.0;0.9).
Linton et al 1989 and 1992	Swedish nurses	(1) 5 week residential vigorous exercise program 4 hours per day, plus behavioural therapy program to (a) learn to control pain & (b) promote healthy life style (*n* = 36) (2) Waiting list control (*n* = 30)	6.25	Gp 1 had greater improvements post program in pain, observed pain behaviours than gp 2. The trend for increased sicklisting was broken in gp 1 but not gp 2.

All between group comparisons are statistically significant ($p < 0.05$) unless otherwise stated.
* Number needed to treat (NNT) calculated by this author from data in original paper.

recent methodological research suggests that this may be unimportant (Moher et al 1998, Verhagen et al 1998b).

Levels of evidence Summary statements on the efficacy of preventive interventions were based on a system described by van Tulder and colleagues (van Tulder et al 1997). This system considers the quality, amount and consistency of evidence from RCTs:

- Strong evidence: > 1 high quality RCT with consistent outcomes
- Moderate evidence: 1 high quality and 1 low quality RCT with consistent outcomes
- Limited evidence:1 high quality or > 1 low quality RCT with consistent outcomes
- No evidence: 1 low quality RCT, no RCTs or inconsistent outcomes

Table 3. RCTs on the effectiveness of braces.

RCT	Subjects	Interventions (sample size)	Follow-up period (months)	Main result
Alexander et al 1995	nurses and environmental services workers (health care employees)	(1) brace (*n* = 30) (2) no intervention control (*n* = 30)	3	There was no difference in work-related back injuries (1 case out of 30 subjects in gp 1 *vs* 2/29 in gp 2) or differences in the number of subjects whose pain improved during the study for neck, upper back, middle back or lower back pain.
Reddell et al 1992	USA airline baggage handlers	(1) brace with adjustable strap and Velcro fastener (*n* = 145) (2) training on spine anatomy and body mechanics (*n* = 122) (3) both (1) & (2) (*n* = 127) (4) no intervention control (*n* = 248)	8	No differences in lumbar injury incidence, lost workdays, workers compensation costs (no data provided)
van Poppel et al 1998	Dutch airline cargo workers	(1) brace with adjustable elastic side pulls, Velcro fasteners and flexible stays (*n* = 83) (2) lifting instruction and brace (*n* = 70) (3) lifting instruction (*n* = 82) (4) no intervention control (*n* = 77) intervention period was 6 months	6	Comparing subjects with braces (gps 1 & 2) to those without (gps 3 & 4) revealed no difference in % of subjects with LBP (36% *vs* 34%), risk difference and 95% CI = 1%(-10% to 14%); mean number of days per month with LBP (1.7 *vs* 2.1); % of subjects with sick leave due to LBP (13% *vs* 9%), risk difference = 4% (-3% to 11%) or mean number of days per month of sick leave because of LBP (0.4 *vs* 0.4). A per protocol analysis revealed the same result. Comparing subjects who received education (gps 2 & 3) to those without (gps 1 & 4) revealed no difference in % of subjects with LBP (35% *vs* 35%), risk difference and 95% CI = 0%(-11% to 11%); mean number of days per month with LBP (1.7 *vs* 2.0); % of subjects with sick leave due to LBP (8% *vs* 13%), risk difference = -4% (-12% to 9%) or mean number of days per month of sick leave because of LBP (0.5 *vs* 0.3)
Walsh et al 1990	USA warehouse workers	(1) brace with custom moulded lumbar insert plus 1hr training on back pain prevention and body mechanics plus brace (*n* = 27) (2) 1hr training on back pain prevention and body mechanics (*n* = 27) (3) no intervention control (*n* = 27)	6	Gp 1 had a greater improvement in mean days lost than gp 2 and gp 3, gp 2 had a larger improvement than gp 3. Mean and 95% CI for change scores were calculated as: *gp 1 -2.5 (-2.9;-1.9); gp 2 -0.6 (-1.6;0.4) gp 3 0.4 (0.2;0.6) Author reports no difference between groups for injury rate (no data provided)

All between group comparisons are statistically significant ($p < 0.05$) unless otherwise stated.
* = calculated by this author from data in original paper.

Table 4. RCTs on the effectiveness of education.

RCT	Subjects	Interventions	Follow-up period (months)	Main result
Donaldson et al 1993	Canadian hospital workers	(1) educational program for 1.5 hours in a group of 10-15 workers duringwork time (2) delayed intervention control group (Total *n* for both groups = 172)	3	No between group differences for McGill pain questionnaire scores. Mean and 95% CI between gp difference immediately post Rx*: -2.0 (-6.1; 2.1) & at 3 month follow-up as: -1.2 (-4.7;2.3).
Tuchin et al 1998	Australian mailing house workers	(1) 120 minute lecture on back care. ($n = 34$) (2) no lecture, instructed to perform an unspecified series of exercises ($n = 27$)	6	No between group differences for lost days at 3 and 6 months; mean and 95% CI *-2.2 (-5.4;1.0) & -1.1 (-3.6;1.4) For Oswestry scores at 3 months mean and 95% CI *-2.6 (-5.3;0.1)
Donchin et al 1990	See table 2			
Reddell et al 1992	See table 3			
van Poppel et al 1998	see table 3			
Walsh et al 1990	See table 3			

All between group comparisons are statistically significant ($p < 0.05$) unless otherwise stated.
* = calculated by this author from data in original paper.

A trial was considered to be of high quality if it scored at least 6/11 on the PEDro quality scale. Given that it is impossible to blind therapists or subjects in these types of trials, the maximum quality score is 9/11 and so a cut-off of 6/11 may seem excessively harsh. A sensitivity analysis was therefore undertaken to establish the effect on the results of using cut-off points of 4 and 5/11. Van Tulder et al did not provide an operational definition for contradictory outcomes however van Poppel and colleagues' previous systematic review (1997) considered results to be contradictory if < 75% of the studies reported the same outcome and this criterion was adopted in this review.

Statistical pooling was not possible, because the trials often did not present sufficient data and more importantly, there was not a common set of outcomes across the trials.

Results

Included and excluded studies The titles of 99 publications suggested possible relevance to the present review, however on detailed inspection of the full paper, only 13 met all inclusion criteria. Most excluded studies either did not have controls (25) or subjects were not randomly allocated to experimental and control groups (20). One RCT of the efficacy of exercise to prevent LBP (Ljunggren et al 1997) was excluded because the subjects were not workers, and four RCTs of workplace exercise (Harma 1988a, Hilyer et al 1990, Hinman et al 1997, Linton et al 1996) were excluded because the outcomes did not include measures of LBP. Four papers describing RCTs were excluded because the outcomes were restricted to risk factors for LBP (Carlton 1987, Daltroy et al 1993, Harma et al 1988, McCauley

Table 5. RCTs on the effectiveness of education and workplace modification. (Direct outcome measures only)

RCT	Subjects	Interventions	Follow-up period (months)	Main result
Daltroy et al 1997	USA postal workers	(1) two session back school, with 3-4 reinforcement sessions plus physical and procedural modifications to workplace. (2) no intervention control. (Total *n* for gps 1 & 2 = 4,000)	65	Gp 1 had a higher rate of injury than gp 2 however the difference was not statistically significant for back injuries (rate ratio, 1.11; 95% CI, 0.90 to 1.37). There was no difference between gps for % of total injuries that resulted in lost workdays; gp 1 (61%); gp 2 (56%). The survival analysis model of time elapsed until return to work found no significant effect associated with training. The median total cost per back injury was $309 in gp 1 and $103 in gp 2 however this difference was not statistically significant.
Shi et al 1993	county workers from divisions with high prevalence of LBP in past	(1) education, training, physical fitness activities and ergonomic improvement to workplaces (2) no intervention control (Total *n* for gps 1& 2 = 205)	12	In the 12 month period prior to intervention, intervention group costs increased by 12.9% and the control group increased by 15%. In the 12 month study period medical claims costs due to LBP decreased 15.9% in intervention group and increased 17% in control group in the 12 month period (No statistical analysis or measures of variability provided)

All between group comparisons are statistically significant ($p < 0.05$) unless otherwise stated.

1990, Scopa 1993). One RCT of workplace exercise to prevent work-related LBP (Hjelm and Hagberg 1992) was excluded because it was only a conference proceeding, although it met all other inclusion criteria. The authors reported that exercise was effective in preventing LBP, however the proceeding contained no between-group statistical comparisons and failed to provide sufficient data to allow analysis by a third party. The authors of the paper were contacted by e-mail to see if they had subsequently published the RCT in a journal, but no reply was received.

Methodological quality and outcome of the studies Table 1 lists all RCTs included in the present review, with studies ranked according to methodological quality. The quality scores of the RCTs ranged from 1 to 8 with the mean score being 4.8. None of the 13 studies blinded workers or therapists and only two blinded the assessor measuring outcome. Only one study used concealed allocation and only three used an intention-to-treat analysis.

Efficacy of exercise in the prevention of LBP Five RCTs of exercise met all inclusion criteria (Donchin et al 1990, Gerdle et al 1995, Gundewall et al 1993, Kellett et al 1991, Linton et al 1989) with the methodological quality of the trials ranging from 4 to 6. There was a variety of types of exercise programs evaluated, however all studies compared exercise with a no treatment control (see Table 2). Four low quality RCTs (Donchin et al 1990, Gerdle et al 1995, Gundewall et al 1993, Kellett et al 1991) examined whether exercise reduced the prevalence of LBP, of which three found an effect (Donchin et al 1990, Gundewall et al 1993, Kellett et al 1991). Thus there

Table 6. Levels of evidence for efficacy of different prevention methods.

Level of evidence	Efficacy
Braces	
Strong	Belts are ineffective in reducing the prevalence of LBP, severity of LBP and leave due to LBP
Education	
Moderate	Education is ineffective in reducing the prevalence of LBP, severity of LBP and leave due to LBP
Limited	Education is ineffective in reducing costs of LBP
Exercise	
Moderate	Exercise reduces LBP severity, leave due to LBP
Limited	Exercise reduces prevalence of LBP
No	Exercise reduces the cost of LBP
Workplace modification and education	
No	Education and workplace modification is ineffective in reducing prevalence of LBP, reducing costs and leave due to LBP.

is limited evidence that exercise reduces the prevalence of LBP.

One high quality trial (Linton et al 1989) and one low quality trial (Gundewall et al 1993) found that exercise reduced the severity of LBP. That is, there is moderate evidence that exercise reduces the severity of LBP. Three low quality trials (Gerdle et al 1995, Gundewall et al 1993, Kellett et al 1991) and one high quality trial (Linton et al 1989) investigated whether exercise reduced sick leave. Three of the four (including the high quality trial) reported an effect and so there is moderate evidence that exercise reduces sick leave due to LBP. No study examined whether exercise reduced the costs of LBP. Because there is only one relevant low quality study of cost-effectiveness (Gundewall et al 1993) there is currently no evidence that exercise is cost-effective in preventing LBP.

One RCT compared exercise with back school (Donchin et al 1990) but the RCT was of low methodological quality and so provides no evidence on which strategy is more effective.

Efficacy of lumbar braces in the prevention of LBP Four trials evaluated the efficacy of lumbar braces, three of the four comparing a brace with a no brace control (Alexander et al 1995, Reddell et al 1992, van Poppel et al 1998), and three of the four evaluating the brace as a supplement to an education program (Reddell et al 1992, van Poppel et al 1998, Walsh and Schwartz 1990) (see Table 3). Two of the trials (Alexander et al 1995, van Poppel et al 1998) were of high methodological quality with quality scores of the four trials ranging from 5 to 8.

The three trials that compared a brace with a no brace control found no effect on the prevalence of LBP, LBP severity, sick leave due to LBP and costs of LBP. Similar results were found for the trials that evaluated braces as a supplement to an education program. The only inconsistent result was a low quality trial (Walsh and Schwartz 1990) that found that while the brace did not reduce the prevalence of LBP, it did reduce sick leave due to LBP. Pooling both brace comparisons (ie brace versus no-brace and brace as a supplement to other interventions), and applying the rating system for the level of evidence, reveals strong evidence that braces are ineffective in reducing the prevalence of LBP, sick leave due to LBP and the severity of LBP. There was limited evidence that braces were ineffective in reducing the costs of LBP or the prevalence of other pains.

Efficacy of education in the prevention of LBP Six trials evaluated education programs. These trials had quality scores ranging from 4 to 8 (Donaldson et al 1993, Donchin et al 1990, Reddell et al 1992, Tuchin and Pollard 1998, van Poppel et al 1998, Walsh and Schwartz 1990) (see Table 4). All trials compared education with a no education control, with two trials also evaluating the efficacy of education as a supplement to a lumbar brace (Reddell et al 1992, van Poppel et al 1998). The two trials that evaluated education as a supplement to a brace (Reddell et al 1992, van Poppel et al 1998) found no effect for any outcome. Similarly negative results were found in the trials that compared education with no education, with 10 of the 12 outcome comparisons demonstrating no effect for education. Pooling both education comparisons reveals moderate evidence that education is ineffective in reducing the prevalence of LBP, leave due to LBP and the severity of LBP and there is limited evidence that education is ineffective in reducing the costs of work-related LBP.

Efficacy of workplace modification and education in the prevention of LBP Only two trials of education and workplace modification were located (see Table 5), both of low quality (Daltroy et al 1997, Shi 1993). Both trials compared education and workplace modification with a no intervention control. The Shi study provided no statistical analysis of results and, because of insufficient detail, a secondary analysis was not possible, so the results were not able to be used in the review. With only one low quality trial available, there is no evidence for or against workplace modification and education.

Sensitivity analysis A summary of the levels of evidence for each intervention is provided in Table 6. These levels of evidence are based upon a cut-off of 6/11 representing a high quality trial. The sensitivity analysis, using cut-offs of 4/11 and 5/11, generally did not change the conclusion on efficacy for exercise, braces and education, except to increase the level of evidence. For example, adopting the criterion 4/11 changes the level of evidence from limited to strong that exercise reduces the prevalence of LBP. For workplace modification and education, adoption of these less strict criteria changes the conclusion from no evidence to limited evidence that this intervention was ineffective.

Inclusion of the Hjelm and Hagberg (1992) exercise trial, which was excluded on the basis that it was a conference proceeding, does not change the conclusion of the systematic review because this study reported that exercise was an effective prevention strategy.

Discussion

The results of this review suggest that braces and education are ineffective, that workplace modification and education is of unknown value and that, in contrast, exercise programs are effective for the prevention of work-related LBP. This conclusion is similar to the conclusion of van Poppel and colleagues' (1997) systematic review, however the level of evidence for each intervention is generally stronger. For example, van Poppel concluded that there was only limited evidence that education was ineffective but the current review concluded that there was moderate evidence that education was ineffective. This difference in results is explained by the smaller number of education RCTs considered by van Poppel (4 versus 6).

Several of the results of this review were a surprise, given the general acceptance of these methods to prevent LBP in the occupational health literature. While there can be no doubt that prevention of work-related LBP should remain a goal for physiotherapists working in occupational health, the results of this review challenge many current practices. Traditionally, the approach to prevention of work-related LBP has emphasised risk control through work redesign and education (Bullock and Bullock-Saxton 1994). In fact, in many states of Australia these approaches have been given credibility through endorsement in government regulations and policies.

In Victoria, work redesign and education are endorsed in the Occupational Health and Safety (Manual Handling) Regulations 1999 (Victorian WorkCover Authority 1999). This creates a dilemma because there is no evidence that work redesign is effective, and only moderate evidence that education is ineffective for preventing work-related LBP. As the regulations are mandatory, it is likely that implementation of these questionable approaches will continue. Furthermore, the current Victorian Manual Handling Code of Practice (Victorian WorkCover Authority 1988) endorses strategies such as lifting teams and lifting aids which are as yet unevaluated for their value in preventing work-related LBP. Interestingly, neither the Regulations nor Code of Practice endorse the only intervention (exercise) that has been shown to be effective in preventing work-related LBP. Neither document provides any information on the process which was used to generate the recommendations they contain, and neither contains citations or a reference list. In the same way that there is now an expectation that external research evidence should be used to guide clinical decision making, there should be an expectation that scientific evidence should guide policy decision making.

Despite extensive searches, no trials were located that evaluated more recent interventions such as ‘no lift’ policy, lifting teams, lifting aids or job placement. At this stage, therefore, it is not possible to determine whether these interventions are helpful, harmful or ineffective. It may be prudent to delay endorsing these prevention strategies in regulations and codes of practice until their efficacy has been established in appropriate studies.

Exercise The beneficial effects of workplace exercise on work-related LBP are consistent with previous epidemiological research that has identified low levels of physical fitness (Cady et al 1979) and reduced static back muscle endurance (Biering-Sorensen 1984, Luoto et al 1995) as risk factors for LBP. The exercise programs ranged in duration from five weeks to 18 months and were not confined to local spinal exercise. Four of the five studies provided workers with general whole body fitness programs, and one provided functional exercises to simulate common work tasks as well as endurance training of the trunk extensors. At this stage, there have been no direct comparisons of the various exercise programs so it is not possible to say which approach is most effective.

While workplace exercise appears to be a promising approach to LBP prevention, the long term effect and the cost-benefit of the programs are largely unknown. Three of the five studies only followed the workers for the duration of the exercise programs, with the longest follow-up being nine months after cessation of the program. Cost effectiveness has been addressed in only one study (Gundewall et al 1993) and the analysis was overly simplistic in that the only cost considered was that of employing the physiotherapist to lead the class, and the only benefit was workday absences saved. Costs such as allowing the workers to attend the exercise program during work time, the cost of the gymnasium facilities and other benefits associated with reduced injuries, such as treatment and legal costs, need to be considered to allow a complete evaluation of the cost-effectiveness of these programs.

Education It is probably useful to consider why the education programs administered in the trials were ineffective in preventing LBP. Three trials have shown that education leads to greater knowledge (Daltroy et al 1993, Donaldson et al 1993, Donchin et al 1990) however, the two trials that also measured LBP prevalence found no effect (Daltroy et al 1993, Donchin et al 1990). Thus there is the possibility that the curriculum in the classes was inappropriate. Another potential problem with education is that even when the curriculum is appropriate, the target behaviours may not be generalised to the worksite. Carlton’s (1987) study provides an excellent example of this. Carlton educated workers in appropriate lifting. He found that when subjects were overtly watched in the laboratory, they complied with instructions and lifted in a correct manner, but when they were watched covertly at the worksite, they lifted in an inappropriate manner.

Conclusion

At present, the only workplace intervention with demonstrated efficacy in the prevention of LBP is exercise. Other common interventions have either been shown to be ineffective or have not been properly evaluated. More research is required to evaluate the effects of interventions used to prevent LBP in workers.

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