

What constitutes effective manual handling training? A systematic review

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Background	Injuries caused by manual handling are a major burden to society. Manual handling training programmes have been designed to reduce the likelihood of injury among the workforce; however, concerns have been raised over the efficacy of current manual handling training methods.
Aims	To undertake a systematic review of the literature examining the effectiveness of different approaches to training in manual handling.
Methods	Peer-reviewed publications along with published conference proceedings published in English, between 1980 and 2009, on the topic of manual handling training comprised the search criteria. A published checklist for reviewing papers was selected, which formed the basis for assessing the quality of the papers reviewed.
Results	A total of 1827 papers were located. Following elimination of duplicates, 221 papers were collected and reviewed. Of these, 53 papers were intervention studies with the primary aim of investigating the effectiveness of manual handling training. The review identified little evidence supporting the effectiveness of both technique- and educational-based manual handling training. In addition, there was considerable evidence supporting the idea that the principles learnt during training are not applied in the working environment. Strength and flexibility training shows promise; however, further research is needed to ascertain whether such an intervention is sustainable over the long term.
Conclusions	The evidence collected indicates that manual handling training is largely ineffective in reducing back pain and back injury. High priority should be given to developing and evaluating multidimensional interventions, incorporating exercise training to promote strength and flexibility, which are tailored to the industrial sector.
Key words	Health care; injuries; interventions; low back pain; workplace.

Introduction

Musculoskeletal disorders (MSDs) have consistently remained the most commonly reported type of work-related ill-health in Great Britain according to national surveys of work-related illness [1]. Of the estimated number of individuals suffering from a work-related MSD, just over two-fifths suffer from a disorder mainly affecting their back. Back pain can arise in many work situations but is more common in tasks that involve heavy manual labour.

Manual handling has been defined as any activity requiring the use of force exerted by a person to lift, lower, push, pull, carry, move, hold or restrain a person, animal or object [2]. If these tasks are not carried out safely, there is a risk of injury and research shows a significant linkage between musculoskeletal injuries and manual handling [3,4], with the primary area of physiological and biomechanical concern being the lower back, particularly the

discs of the lumbar spine [5]. Manual handling injuries are estimated to cost the UK £2 billion a year [6].

The Manual Handling Operations Regulations [7] set out a hierarchy of control measures to reduce risk of injury, starting with the requirement to avoid hazardous manual handling wherever practicable. Where this is not possible, attention should be given to the provision of lifting aids and task/workplace design. Employers are required to provide their employees with health and safety information and training, and where relevant this should be supplemented with more specific training on manual handling injury risks and prevention [8]. Training then has a role to play in supplementing these approaches [9]. The type of training offered and its effectiveness often depends on a multitude of factors such as method of teaching, organization setting and type of training technique that is used [10]. However, concerns have been raised over the efficacy of current manual handling

training methods [11–14]. The aim of the current study therefore was to systematically review the literature to determine the effectiveness of manual handling training interventions. While previous reviews have considered interventions to reduce back pain in health care workers [11,13], this study examined the effectiveness of manual handling training interventions across all occupations.

Methods

The procedures applied for this review followed the recommendations of the Editorial Board of the Cochrane Collaboration Back Review Group [15]. A comprehensive literature search strategy was devised, selection criteria were applied to identify eligible trials, the methodological qualities of the included articles were assessed and the strength of the evidence from related studies was amalgamated. Unlike other reviews, we included studies conducted both in the workplace and in a laboratory environment, providing the primary goal of the research was to determine the effectiveness of a manual handling training intervention. We also included studies with and without control groups; however, the absence of a control group was reflected in the methodological quality assessment.

The following electronic databases were searched: ANTE (CSA Illumina), ArticleFirst (OCLC), ASSIA (CSA Illumina), Biological Sciences (CSA Illumina), Biotechnology and Bioengineering Abstracts (CSA Illumina), Computer and Information Systems (CSA Illumina), Health and Safety Science Abstracts (CSA Illumina), HSELINE, HSE website, Intute: Social Sciences, IOSH website, NIOSH website, NIOSHTIC-2, PsycINFO (CSA Illumina), PubMed, Science Direct, SPORTDiscuss, TOXLINE (CSA Illumina) and Zetoc.

The databases were searched for the following key text words in the title or the abstract: ‘manual handling’ with the Boolean ‘AND’ to the terms ‘training’, ‘manual handling training’, ‘effectiveness’, ‘efficacy’, ‘reduction in injuries’, ‘lifting’, ‘literature review’ and ‘patient handling’. The electronic databases were searched for articles published between 1980 and 2009. The search strategy also involved examining the reference lists of the relevant articles found to check for further studies.

The literature reviewed encompassed published articles, available in English in the databases listed above. The review was confined to articles in peer-reviewed journals, reports from health and safety agencies and published conference proceedings. Articles were included if they described empirical research in the laboratory or workplace interventions, providing that the focus of the study was the evaluation of manual handling training. Studies employing a broader approach to improving manual handling in the laboratory and workplace were also incorporated; in particular, studies that evaluated

the impact of exercise in improving manual handling performance were also included. Two reviewers participated in study selection. For those studies where their eligibility for the current review was unclear from their abstract and title, the full text article was obtained and assessed.

To evaluate the quality of the papers reviewed, the 27-item checklist developed by Downs and Black [16] (as used by Hignett [11]) to assess the methodological quality of both randomized and non-randomized studies of health care interventions was applied. Three reviewers independently scored the papers, and inter-rater reliability was assessed using intraclass correlation. This checklist comprised four sections, each assessing specific aspects of the quality of the paper.

Section 1 consisted of 10 questions and evaluates the general structure of the paper, including the clarity of the study’s aims, description of the interventions applied, participant characteristics, identification of confounding factors and presentation of the main findings. Section 2 comprised three questions assessing the external validity of the study, and these questions covered the representativeness of the sample used and the context in which the study was conducted. Section 3 contained seven questions assessing the internal validity (bias) of the research. Questions in this section included the blinding of participants and experimenters to the interventions/study groups, compliance with the intervention, choice of outcome measures and statistical tests. Section 4 incorporated six questions assessing the internal validity (confounding and selection bias), and questions in this section included the sampling strategy, with respect to the diversity within the population recruited and the allocation of participants to intervention/control groups, the time period over which the study was conducted and consideration of participants lost to follow-up. A final question assessing whether the study had sufficient power was also included in the checklist.

For the purpose of the current review, two additional questions were added to Section 3 of the checklist. These questions were the following: (i) ‘was a control group used?’ and (ii) ‘was there a follow-up period?’ A full copy of the modified checklist is shown in Appendix 1 (available as Supplementary data at *Occupational Medicine Online*). When scoring each paper, if a question was answered ‘yes’, 1 mark was entered alongside that question, and if a question was answered as either ‘no’ or ‘unable to determine’, a mark of 0 was given. For each paper, therefore, Questions 1–28 were either awarded a mark of 1 or a mark of 0. The marks for Question 29 (which assessed statistical power) were given on a scale ranging from 0 to 4, with 0 being ‘insufficient power to detect meaningful differences at $P < 0.05$ ’, 1 being ‘just sufficient power to detect differences at $P < 0.05$ ’ and 4 being a very large sample size ($n > 1000$) capable of detecting meaningful differences at $P < 0.001$. The maximum marks available were 32; following the scoring of each paper, its percentage mark was calculated (see Results).

Results

A total of 1827 papers were located. These were checked to eliminate duplications (arising from the different search strategies), and papers that were inappropriate to the research topic, based on their title and details contained within their abstract, were eliminated. A total of 221 papers were collected and reviewed. Of these, 53 papers were intervention studies with the primary aim of investigating the effectiveness of manual handling training, and these papers are included in this review. For the purpose of this review, the 53 intervention papers were grouped according to the type of intervention, or the population targeted, as follows: intervention studies conducted on health care workers, workplace- and laboratory-based intervention studies conducted in all non-health care organizations and workplace- and laboratory-based studies assessing the effectiveness of an exercise intervention for improving manual handling capabilities.

The quality rating (QR) of all intervention studies reviewed ranged from 31 to 84%. For papers to be published in peer-reviewed journals, it is expected that they all have certain key elements included, such as a statement of their aims/hypotheses. Therefore, the minimum QR expected would be ~20% (based on certain criteria being fulfilled to be published in a peer-reviewed journal, which automatically satisfies some questions on the checklist). With this in mind, the papers included in the current review with a QR between 0 and 49% are described as 'poor'. These papers typically had a small sample size, no control group and no follow-up. Papers with a QR between 50 and 59% are described as medium quality, those with a QR of 60–69% are described as good quality and those with a QR above 70% are described as of high quality. These papers typically contained large samples, randomization of participants into an intervention or control group, a sufficient intervention period and a follow-up assessment. Assessment of inter-rater reliability revealed an overall intraclass correlation between the three reviewers of 0.97.

Table 1 (available as Supplementary data at *Occupational Medicine* Online) summarizes interventions conducted on health care personnel, with the goal of reducing injuries associated with manual handling. Health care personnel, particularly nurses, are exposed to high levels of patient handling, and according to Helling *et al.* [25], the biggest risk facing nurses is work-related back pain. Nurses are estimated to have the highest rate of back pain (in comparison with other health services personnel), with an annual prevalence of 40–50% and a lifetime prevalence of 35–80% [32]. From the studies reviewed in Table 1 (available as Supplementary data at *Occupational Medicine* Online), there is very little evidence of the effectiveness of educational-based training for safe patient handling, whether it be nursing school based [19,21,25] or applied to qualified staff in the work-

place [20,23,28]. Strength and flexibility training as reported by Gundewall *et al.* [24] shows promise as a measure to reduce patient handling injuries, although further research is needed to ascertain whether such an intervention is sustainable over the long term and whether it has long-term benefits in terms of injury reduction. Ergonomic training interventions, particularly those that include risk assessments and the redesign of equipment and patient handling tasks, have been shown to successfully reduce the risk of manual handling injuries [27,33].

Table 2 (available as Supplementary data at *Occupational Medicine* Online) summarizes workplace- and laboratory-based intervention studies conducted in non-health care personnel with the goal of improving manual handling training. A characteristic of the studies reviewed in Table 2 (available as Supplementary data at *Occupational Medicine* Online) is a lack of control groups and/or no follow-up, and according to the QR criteria applied, the majority of studies reviewed in this section have relatively low QRs. From the research reviewed in Table 2 (available as Supplementary data at *Occupational Medicine* Online), there is little evidence of the effectiveness of manual handling training in industries outside health care. As widely reported in the health care setting [47–49], the research reported by Carlton [36] demonstrated that principles taught during training are not carried over into the work environment.

According to Garg and Moore [50], most manual handling injuries are caused by a mismatch between a worker's strength and the job requirements. One approach to reduce injuries has been to improve the physical capabilities of the worker, i.e. fitting the worker to the task. A number of studies have investigated the effectiveness of physical training in improving the capabilities for manual handling, and these studies are reviewed in Table 3 (available as Supplementary data at *Occupational Medicine* Online).

Fourteen studies investigating the effectiveness of exercise training are reviewed in Table 3 (available as Supplementary data at *Occupational Medicine* Online) with sample sizes ranging from 7 to 60, and a QR ranging from 38 to 69%. The research has examined the effects of exercise programmes on human capacity for manual handling tasks over the short term since the majority of studies had a training intervention lasting for ≤ 6 weeks (with the exception of one high-quality study [24]). The research highlights beneficial effects resulting from exercise training, in terms of improved physical capacity for manual handling tasks, over the short term. However, the majority of studies have used small numbers of university students, and little research has been conducted on workers involved with manual handling in the industrial setting. None of the research incorporated a follow-up period of a sufficient length; thus, it is unclear whether the beneficial effects seen with exercise training are maintained or how soon the effects wane following the discontinuation of training. Exercise training in the health

care setting shows promise [24,30] [Table 1 (available as Supplementary data at *Occupational Medicine* Online)]; however, further research, in the form of high-quality longitudinal studies with follow-up, is required before firm conclusions can be made.

Following a review of exercise-based training, Genaidy *et al.* [64] highlighted that no longitudinal study had been conducted to determine the best method to maintain the improved work capacity associated with exercise-based training and that no study has correlated improved physical fitness with injury statistics.

Discussion

This systematic review found that manual handling training is largely ineffective in reducing back pain and back injury. Furthermore, there was considerable evidence supporting the idea that the principles learnt during training are not applied in the working environment. A strength of the current review is the fact that it was not restrictive to a particular occupational group, enabling a comprehensive review of the effectiveness of manual handling training interventions across a range of employment sectors. The principal findings of the review are limited, however, by the high proportion of low-quality studies included in the review.

In the health care setting, there is very little evidence of the effectiveness of educational-based training for safe patient handling, whether it be nursing school based [19,21,25] or applied to qualified staff in the workplace [20,23,28]. There is also similar evidence that technique- and educational-based training are ineffective in industries outside health care [35,36,38]. In health care, there is evidence supporting the idea that the principles taught during training are not applied in the working environment [47–49], and this has also been reported in other industrial settings [36,65]. In general, evidence for the lack of effectiveness of manual handling training in the health care setting is provided from a number of studies reporting high injury rates occurring in workers who have undergone training [66–69].

The lack of effectiveness of technique- or educational-based training is widely acknowledged [11–14]. Kroemer [5] has suggested possible reasons: (i) people tend to revert to previous habits if training is not reinforced; (ii) emergency situations, the unusual case, a sudden quick movement, increased body weight or reduced physical well-being may overly strain the body and (iii) if job requirements are stressful, behaviour modification will not eliminate risk. Kroemer [5] argues that money and effort put into training would be better spent on research and implementation of techniques for ergonomic job design.

Strength and flexibility training as reported by Gundewall *et al.* [24] and Genaidy *et al.* [54–61,64] shows promise, although further research is needed to ascertain whether

such an intervention is sustainable over the long term and whether it has long-term benefits in terms of injury reduction. High-quality longitudinal randomized control trials with follow-up assessment are needed to further establish the benefits of exercise-based training interventions. It is suggested that a more general approach to improving whole body physical fitness and strength, as applied by Knapik [62], would have greater benefits in terms of reducing manual handling injuries than task-specific training alone, as used in many studies [see Table 3 (available as Supplementary data at *Occupational Medicine* Online)]. The major disadvantage of task-specific training is that performance improvements are largely restricted to the task for which the individuals are trained [62], and the benefits gained are not transferable to different tasks.

There is support in the literature for a more multidimensional and ergonomic approach to reducing the risks associated with manual handling, in terms of redesigning the workplace, as opposed to relying on the more traditional approaches of fitting the worker to the task. Castro *et al.* [70] note that health care is beginning to embrace the concept of patient care ergonomics through the implementation of safe patient handling programmes. Essential elements of such programmes include a ‘no manual lift’ policy. While such a policy requires substantial investment, Castro *et al.* [70] have reported that such programmes result in dramatic reductions in injuries. Furthermore, high-quality longitudinal randomized control trials are required to develop multidimensional intervention packages involving ergonomic training, risk assessments, physical training and job redesign, which can be applied to all industries.

In further research, the inclusion of a sufficient follow-up period is essential since a general theme observed in the current review is a lack of follow-up assessments. According to Westgaard and Winkel [71] when planning a work-based intervention study, outcome assessment requires adequate observation time to allow for the latency for the development of MSDs. They note that an observation time shorter than 6 months is problematic. When assessing outcomes, it is also important to consider psychosocial factors as Gundewall *et al.* [24] note that factors such as low job satisfaction can be a strong predictor of injury reporting. Hayne [72] states that training should start with management and work down since it is pointless training the workforce if managers/supervisors do not have the same level of knowledge. Recent research has demonstrated that MSD interventions can be made considerably more effective by tailoring interventions to managers’ and workers’ level of awareness and readiness to change [73].

In conclusion, there is little evidence for the effectiveness of educational- and technique-based manual handling training in all industries. The conclusions however are limited by the high proportion of low-quality studies, with small samples and lack of scientific rigour. There is

a pressing need for high-quality randomized control trials, involving sufficiently large samples and incorporating long-term follow-up periods. Interventions to promote physical strength and flexibility show potential; however, further research is needed to ascertain whether such an approach is sustainable and whether it has long-term benefits in terms of reducing MSDs.

Key points

- Musculoskeletal disorders remain the most commonly reported type of work-related ill-health in the UK, and they represent a major burden to society, organizations and the workforce.
- Evidence from intervention studies conducted over the past three decades indicates that manual handling training is largely ineffective in reducing back pain and back injury.
- High priority should be given to developing and evaluating multidimensional interventions, incorporating exercise training to promote strength and flexibility, which are tailored to the industrial sector.

Funding

Health and Safety Executive. Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect Health and Safety Executive policy.

Acknowledgements

We would like to thank Dr Fehmidah Munir and Kate Shaw for their assistance with the quality scoring of papers.

Conflicts of interest

None declared.

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