

PARTICIPATORY ERGONOMICS AND PREVENTING MUSCULOSKELETAL DISORDERS IN THE WORKPLACE

1 Introduction

This discussion paper provides an introduction to the role that participatory approaches to ergonomics can have when applied to the challenge of preventing musculoskeletal disorders (MSDs) in the workplace. It sets out a contemporary view of participatory approaches, the necessary resources and evidence to show how these approaches can help to reduce MSDs. It also considers the limitations of such approaches.

Involving workers in occupational safety and health (Brück, 2016) has long been recognised as important for many reasons, including:

- the right to be informed of hazards and risks at work (Biagi, 1998);
- participation as an essential contributor to behaviour change measures, as part of a risk assessment and risk mitigation strategy (Nunes, 2016);
- the need to enable and potentially improve communication between workers and management (De Greef et al., 2004);
- promoting participation as a way of enhancing company performance (Sisson, 2000; Eurofound, 2001);
- increased acceptance of and compliance with workplace changes that workers have contributed to.

The Framework Directive for Occupational Safety and Health (Directive 89/391/EEC) emphasises the importance of consultation and the meaningful participation of workers and their representatives.

1.1 What is participatory ergonomics?

Participatory ergonomics (PE) is a term used to describe the involvement of those who undertake work and tasks in the design and re-design of the system in which their work and tasks takes place (and its components). Formal definitions have been proposed by many authors and institutions. PE has been described as ‘the involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes in order to achieve desirable goals’ (Wilson, 1995). This definition will be used for the purpose of this paper, although other definitions and supporting information are readily available from professional bodies such as the International Ergonomics Association (IEA), the Chartered Institute of Ergonomics and Human Factors, the French-speaking Ergonomics Society and many other national ergonomics societies and groups. Occupational safety and health sources (Koningsveld and De Looze, 2017) state that ‘participatory ergonomics programs seeks to maximize the involvement of the workers in this process based on the simple fact that a worker is an expert on his or her job’. PE enables those seeking to improve a work system and workers’ health to fully engage with the true nature of the work being undertaken.

1.2 Why is it important?

The importance of worker participation is enshrined in EU legislation — employers in the EU are required to inform and consult workers and allow them to take part in discussions relating to safety and health at work. It is also generally recognised that engagement with the workforce is vital to optimise change processes (EU-OSHA, 2017). This is based on the observation that the knowledge and experience of those who undertake work is valuable in both understanding the existing processes and practices required to make that work effective and in enabling the impact of changes to be optimised in terms of the future performance of the work systems. Other sources (Koningsveld and De Looze, 2017) emphasise the importance of involving the workers, stating that ‘the participatory approach to ergonomics relies on actively involving workers in implementing ergonomic knowledge, procedures and changes with the intention of improving working conditions, safety, productivity, quality, morale and/or comfort’.

1.3 Value of an inclusive, participatory process

The design of work should involve matching the needs and capabilities of those undertaking the work with the tasks they are expected to complete. Evidence from studies on occupational safety and health shows that too often this is not the case. Where the capabilities of the workers and the demands of the work are not matched, there is a very real risk of adverse outcomes. These might manifest themselves as inadequate performance of work tasks and/or a negative impact on the health and well-being of the worker. Further consideration of the impact of this mismatch on the incidence of MSDs in the workforce is given later in this document.

Matching capabilities and tasks requires a good understanding of how physical and psychological parameters vary. For example, an analysis of the distribution of aspects of physical strength or anthropometric characteristics in most workforces will show different distributions according to gender, age and sometimes ethnicity. Furthermore, there may be those within the workforce who have additional needs as a result of short- or long-term conditions. Participatory approaches enable these groups to be properly recognised in the work design process so that their needs can then be accommodated.

There is a significant body of literature regarding those members of the workforce who are disadvantaged and may therefore benefit most when included in a participatory initiative. Gender issues (Hassard, 2014) in the design and performance of work have been addressed in a number of publications, including in the European Trade Union Institute report *Integrating gender in ergonomic analysis* (Messing, 1999) and a special edition of the journal *Ergonomics* (Habib and Messing, 2012).

The needs of minority groups and those with additional needs in the workplace are often addressed through the process of inclusive design. Databases that collect information on the physical dimensions and capabilities of minority groups may be useful for design purposes, but they are often technical in nature, rarely comprehensive and usually require expert ergonomics professionals to correctly interpret and apply them.

The need to understand work as done and not work as imagined or as prescribed has led ergonomists to recognise the importance and value of working with those who actually undertake the work. This enables ergonomists to have a fuller and wider understanding of how work tasks are achieved, how they vary between individual workers and how tasks may change according to other system requirements and demands. Importantly, it also makes it possible to identify the ideas that individual members of the workforce may have to improve the performance of the system. Others have extended an analysis of the value of involving workers to include an economic evaluation (Driessen, 2012).

Finally, it is recognised that the process of undertaking a PE project may add value elsewhere in the work system, including through transfer of knowledge of both the work and the work processes and embedding understanding of and training in ergonomic principles within the organisation.

2 Approaches in participatory ergonomics

2.1 Definition and involvement of key stakeholders for participatory approaches

Involving workers in PE initiatives requires careful consideration of those who are able to optimise this process. These have been identified (Dul et al., 2012) as follows:

- 'System actors': workers and product/service users who are part of the system and who are directly or indirectly affected by its design and who directly or indirectly affect its performance. The importance of worker participation on occupational safety and health issues is recognised in a European Risk Observatory report that presents, through a qualitative study, the importance of worker representation on occupational safety and health in the EU (EU-OSHA, 2017).
- 'System experts': professionals such as engineers, psychologists, occupational safety and health specialists and ergonomists who contribute to the design of the system based on their specific professional backgrounds.

- 'System decision-makers': those (e.g. managers) who decide on the requirements for the system design, the purchasing of the system, and its implementation and use.
- 'System influencers': the media, governments, standardisation organisations, regulators and citizens who have a general public interest in work systems and product/service system design.

The 'systems experts' involved should include an ergonomics/human factors specialist, who contributes to the design by fitting the environment to humans, using a systems approach and focusing on two related outcomes, namely performance and well-being.

Box 1. A framework for participatory ergonomics

- Extent/level of the planned intervention
- Organisational or work system or a specific workplace or product
- Purpose
- For example the method of work organisation or a design exercise or the implementation of a change
- Continuity
- Continuous or a discrete (i.e. a one-off intervention) intervention
- Involvement
- Direct or through a worker representative
- Formality
- Formal (e.g. teams and committees) or informal
- Requirement
- Voluntary (the most common format) or compulsory
- Decision-making
- Workers decide or consensus or consultation
- Coupling
- Direct (views and recommendations applied directly) or remote (participants views filtered)



2.2 Setting up a participatory ergonomics project

PE projects can take many forms — from a small redesign to tackle a particular issue to a substantive workforce redeployment or a product or process change. It is important to appreciate the scope of the intervention in the workplace in question and therefore the framework required to optimise participation and implementation. One early study (Haines and Wilson, 1998) put forward the dimensions outlined in Box 1. This framework enables a rapid assessment to be made of the scope and nature of a project and therefore the level of engagement required with the workforce.

2.3 The process and steps involved

After deciding on the nature and scope of the PE project, the appropriate process to follow must be considered. This will obviously vary according to specific need, but there are generally agreed steps that should be followed.

The first of these is to generate the right climate and support for participatory approaches. Therefore, the set-up and support processes might include:

- setting up task forces;
- establishing the change management process;
- forming, building and training the team;
- training those who will be the future trainers ('training the trainers');
- undertaking appropriate stakeholder analysis (see above for stakeholder identification).

Structures and steering committees reflecting wider worker engagement and support structures are also encouraged. Hignett et al. (2005) describe (i) the importance of the decision-making process (i.e. group delegation, group or individual consultation), (ii) the mix of participants involved (i.e. operators, supervisors, middle management, union personnel, specialist technical staff, senior management) and (iii) the remit of the intervention (i.e. whether it is process development, problem identification, solution generation, solution evaluation, implementation or process maintenance).

The processes outlined above ensure a systematic approach to capturing the real experiences and knowledge of all key stakeholders, especially the workers themselves. The complexity of this process generally assumes the engagement of an ergonomist or human factors expert who has been formally trained in such methods. Having such a professional in the team is generally deemed preferable in the delivery of a human-focused system approach. Professional ergonomists and human factors experts may be found through national and international professional groups. The IEA is an international federation of human factors/ergonomics societies and networks (<https://iea.cc/>). In addition, the Federation of European Ergonomics Societies works towards the recognition of ergonomics as important to economic development, quality of life, safety and health at work and social progress in European countries.

2.4 Challenges of evaluating a real-world intervention

In workplaces, there is often a need to understand how interventions might impact the performance of work. In that case, it is important to establish which dimensions of performance are to be assessed. The World Health Organization (WHO, 2016) states that, while efficacy is a measure of whether the intervention works in principle under ideal conditions, effectiveness relates to whether the intervention works in a real-world setting. Effectiveness is therefore of greater relevance to this paper. It can be assessed in terms of the following.

- **Outputs** — the direct products/deliverables of process activities in an intervention; these can include improvements in performance.
- **Outcomes** — the intermediate changes that emerge as a result of inputs and processes. These changes may be considered to take place on three levels: the health system itself, the workforce and the organisation.
- **Impact** — the medium- to long-term effects produced by an intervention; these effects can be positive or negative, intended or unintended.

Van Eerd et al. (2010) have identified the most effective facilitators in PE interventions as:

- support for the PE programme from the organisation (management, workers and union representatives);
- resource commitment from the organisation (resources include time and money);
- open communication about the PE programme.

Ensuring support before an intervention begins is, therefore, vital to the success of the project (Cole, 2005).

There are many options for designing and evaluating a PE intervention. Table 1 illustrates study designs that can be used, along with their advantages and limitations. The strongest study design is often considered to be a randomised trial whereby the workplace changes are implemented for some individuals and their performance and well-being are then assessed relative to those for whom the changes have not been implemented. In practice, such studies may be difficult to design and implement, are hard to sustain and present challenges when assessing their impact on work performance and health.

Table 1. Types of study design

Design	Description	Advantages/limitations
Randomised controlled trials (RCTs)	A planned experiment designed to assess the efficacy of an intervention in human beings by comparing the intervention to a control condition Allocation to intervention or control is determined purely by chance	Gold standard in terms of study design Ethical considerations Difficulty of randomising subjects Inability to randomise by location. Small available sample size
Quasi-experimental studies without control groups with control groups but without pre-tests with control groups and pre-tests interrupted time series designs	This type of study aims to demonstrate causality between an intervention and an outcome but do not use randomisation	Can be used when only a small sample size is available, and randomisation is not possible Can be logistically easier to execute than an RCT Minimises threats to ecological validity Can allow for population-level generalisation of findings Using self-selected groups may minimise ethical and other concerns Lack of random assignment
Cohort studies	Longitudinal study Measures events in chronological order Used to study disease incidence, causes and prognosis	Conducted prospectively or retrospectively Can be challenging to retain individuals in the cohort over time Lack of random assignment

Source: adapted from WHO, 2016

2.5 Methods used within participatory ergonomics approaches to address musculoskeletal disorders

This section provides resources to support PE approaches in workplace interventions that aim to prevent MSDs. The links provided are for guidance only, as many other options exist for each method. This section should be read in conjunction with the OSHwiki resource on assessment of physical loads to prevent work related MSDs¹.

Some commonly used methods and examples are listed in Table 2. This is not an exhaustive list and textbooks describing these and other methods are included in the further reading list at the end of this paper.

¹ https://oshwiki.eu/wiki/Assessment_of_physical_workloads_to_prevent_work-related_MSDs

Table 2. Commonly used methods in participatory ergonomics approaches for MSDs (with some suggested links)

Method	Suggested links
Stakeholder identification and engagement	<p>This site discusses the importance of consulting stakeholders when the work comprises new technologies and when risk perceptions may affect workers:</p> <p>https://oshwiki.eu/wiki/Occupational_safety_and_health_management_and_risk_governance</p>
Task analysis	<p>This site provides a basic introduction to the principles of task analysis:</p> <p>https://en.wikipedia.org/wiki/Task_analysis (Accessed 10-11-2020)</p>
Risk assessments	<p>This site shows specific assessments for disorders affecting the back, arms and neck and their associated workplace risks:</p> <p>https://oshwiki.eu/wiki/Occupational_safety_and_health_risk_assessment_methodologies</p>
Assessing exposure to known MSD risks and risk evaluations	<p>To prevent work-related MSDs, performing a risk assessment of physical workload is an important part of risk management. This site deals predominantly with physical risk factors:</p> <p>https://oshwiki.eu/wiki/Assessment_of_physical_workloads_to_prevent_work-related_MSDs</p> <p>This site considers psychosocial factors that are known to be associated with an increased risk of MSDs:</p> <p>https://oshwiki.eu/wiki/Psychosocial_risk_factors_for_musculoskeletal_disorders_(MSDs)</p>
Interviews and questionnaires	<p>These sites detail the broad range of methods that are available to collect relevant information from and with the workforce, including interviews and questionnaire techniques:</p> <p>https://oshwiki.eu/wiki/Occupational_safety_and_health_risk_assessment_methodologies</p> <p>https://oshwiki.eu/wiki/Methods_and_effects_of_worker_participation#Questionnaires_and_interviews_on_working_conditions</p>
Checklists	<p>There are many available checklists, for example the Dutch WEBA checklist on well-being at work which is described at the following site:</p> <p>http://www.prima-ef.org/healthy-working-for-health---using-the-weba-method.html</p>
Techniques for idea generation	<p>There is a long history of such methods, arising from action research. The following article is a practical case study with methodology (Clemensen et. al., 2017)</p>
Focus groups	<p>There is a vast literature. This site lists the pros and cons of focus groups:</p> <p>https://www.gov.uk/guidance/focus-group-study-qualitative-studies</p>

3 Reviews of case studies on participatory ergonomics

There are a number of recent, authoritative reviews that have considered the efficacy of PE interventions aimed at preventing MSDs (Kennedy et al., 2010; Palmer et al., 2012, Burgess-Limerick, 2018). The methodological challenges of undertaking rigorous interventions and evaluations mean that a systematic analysis of, for example, randomised controlled trials (RCTs), is restricted to a small number of studies. Reviews that have less stringent criteria for inclusion of studies in their analysis are necessarily constrained when drawing conclusions. This is because less rigorous study designs are subject to the limitations identified in Table 1. A consensus across reviews with regard to the effectiveness and the impact of PE on MSDs is similarly difficult to establish and summarise.

One study (Palmer et al., 2012) sought to assess the effectiveness of interventions in community and workplace settings to reduce sickness absence and job loss in workers with MSDs by looking at RCTs and cohort studies. They did not classify or analyse PE methods specifically, as such approaches are often combined with other interventions. This makes establishing their (i.e. PE studies') contribution to any overall impact difficult. Furthermore, the limitations of the methods (e.g. unblinded outcome assessment and poor randomisation protocols) may bias estimates of effect. Palmer et al. noted that, while most interventions appeared to be effective, the better quality and larger studies showed less benefit. They concluded that benefits may be small and of doubtful cost-effectiveness and that expensive interventions should be implemented only with rigorous cost-benefit evaluation planned from the outset.

A further review (Burgess-Limerick, 2018) considered the evidence to support PE approaches specifically in reducing manual work tasks and thus in reducing the incidence of occupational MSDs. This study noted that there were many variations in PE programme characteristics, such as the degree and nature of participation, the extent of expert facilitation and assistance provided, the nature and extent of the training provided to teams, and the tools employed to assist teams in identifying issues and developing solutions. The study concluded that 'harnessing the expertise of the workers who undertake the tasks through a participatory ergonomics process has potential to both ensure that the solutions proposed are optimal and will be accepted by workers'.

Others (Kennedy et al., 2010) have considered only upper limb disorders and have recommended that interventions are not restricted to simple, or only, workstation adjustments. They recommend combining such interventions with ergonomics training, indicate the paucity of high-quality occupational safety and health interventions that evaluate upper extremity MSDs and highlight the lack of focus on traumatic injury outcomes or workplace-mandated pre-placement screening exams.

Studies in the educational sector have also made use of PE approaches. For example, the ErgoKita study (Hauke et al., 2020), utilised PE to engage nursery-school teachers in an ergonomic intervention study aimed at reducing musculoskeletal demands through improving equipment and enhancing behaviour to reduce the risk of developing an MSD.

3.1 Case studies applying participatory ergonomics to address musculoskeletal disorders in the workforce

3.1.1 Case study: evaluation of a participatory ergonomic intervention process in kitchen work (Pehkonen et al., 2009)

Aims: to increase workers' knowledge and awareness regarding the ergonomics of their work and to encourage workers to be active participants in developing ergonomics and in implementing improvements in kitchen ergonomics.

Method: the study was performed in municipal kitchens in four large cities in Finland. Kitchens with at least three full-time employees working for at least 6 hours per day were included. Kitchens were randomised to an intervention or a control group. Workers developed their working conditions over an 11- to 14-month intervention period. This was achieved through active group work during which problems were identified. They then generated and evaluated solutions for the problems. The changes were implemented by the workers, middle management and technical staff, working together.

An ergonomist initiated and then guided the process, as well as training the participants. The ergonomist was also available for consultation. A local steering group was set up to improve the exchange of information between the research group and food service management in two cities. Evaluative data were collected using research diaries, questionnaires, and focus group interviews, and 402 workplace changes were implemented.

Results: the intervention model proved feasible and the PE approach was mostly described as motivating. The workers' knowledge and awareness of ergonomics increased, which improved their ability to tackle ergonomic problems by themselves. The changes in ergonomics were perceived to decrease physical load and improve musculoskeletal health. Lack of time and motivation, and insufficient financial resources, were identified as limitations and the workers expressed a wish for more support from the management, technical staff and ergonomists.

Conclusion: the PE approach was feasible and motivating. The workers' knowledge and awareness of ergonomics increased. Most workers were satisfied with the intervention and most felt that it had a positive influence on physical load and musculoskeletal health.

3.1.2 Case study: 'Participatory ergonomics applied in installation work' (de Jong and Vink, 2002)

Aim: to reduce the musculoskeletal workload in installation work.

Method: all 7,000 workers in an installation company were informed of the objective to improve efficiency by reducing sick leave caused by musculoskeletal workload during maintenance or construction operations. This required identifying major loading tasks and then creating and prioritising solutions in group sessions. Promising solutions were then tested during real operations. Implementation and the sharing of knowledge throughout the company took place and further solutions were sought. Safety and health specialists completed a questionnaire and asked their workers about the effects of the workplace intervention, to evaluate both the effect of the intervention and the participatory process.

Results: workers reported a 'good' or 'very good' reduction in musculoskeletal workload and were satisfied. The project was cost-effective within 1 year. However, the authors suggested that adding organisational measures or system solutions and more direct participation might have improved the impact of the intervention. Limiting factors for adoption of the solutions were their perceived applicability and limited acceptance by the workforce.

Conclusion: the company considered the project successful because improvements aimed at reducing musculoskeletal workload were implemented and cost-effective outcomes were shown within 1 year. Scientific limitations of the study were noted.

3.1.3 Case study: 'A randomised and controlled trial of a participative ergonomics intervention to reduce injuries associated with manual tasks: physical risk and legislative compliance' (Straker et al., 2007)

Aim: to undertake and evaluate a PE intervention designed to reduce the risks of injury associated with manual tasks.

Method: an RCT of 117, small- and medium-sized food, construction, and health sector workplaces were audited by government inspectors in Australia. They used a manual tasks risk assessment tool. Forty-eight volunteer workplaces were then randomly assigned to either the experimental or the control group, with the experimental group being given a manual tasks risk assessment tool. To evaluate the effect of the tool, the inspectors audited the workplaces 9 months after the intervention.

Results: there was a significant decrease in estimates of risk from manual tasks, and this suggested better legal compliance in the experimental group. The intervention was more effective at reducing some types of risk exposure, for example time-based risk factors (task duration, cycle time) and awkwardness risk factors, than others, for example exertion risk factors.

Some of the workplaces in the control group attempted interventions of their own. This may have diminished the observed differences in estimates of manual risk between the experimental and control groups.

Conclusion: a PE intervention can be effective in reducing the risk of MSDs in the workplace.

3.1.4 Case study: ‘Process evaluation of a participatory ergonomics programme to prevent low back pain and neck pain among workers’ (Driessen et al., 2010)

Aim: to evaluate the process of the Stay@Work PE programme, including perceptions regarding the implementation of the prioritised ergonomic measures.

Method: a cluster RCT was conducted in departments of four Dutch companies (a railway transportation company, an airline company, a steel company, and a university, including the university’s medical hospital). Departments assigned to the intervention followed PE steps guided by a professional ergonomist. They identified and prioritised risk factors for low back pain (LBP) and neck pain (NP), and they designed and prioritised ergonomic measures.

Results: 37 departments were included, with 19 departments randomised to the intervention group. Of these, 10 were characterised by heavy mental workloads, one department had a light physical workload, four departments had mixed workloads (physical and mental), and four departments had heavy physical workloads. Sixty-six ergonomic measures were prioritised by the working groups. In total, 34 % of all prioritised ergonomic measures were perceived as implemented, while the workers in the intervention departments perceived 26 % as implemented.

Conclusion: the results of this process evaluation showed that PE can be a feasible and successful strategy for developing an implementation plan for tackling prioritised risk factors for LBP and NP. It also enabled the prioritisation of ergonomic measures to prevent LBP and NP. Recruitment, reach, fidelity and satisfaction in relation to the PE programme were good. However, despite the positive rating of the PE programme, the implementation of the prioritised ergonomic measures was lower than expected.

3.1.5 Case study: ‘Effects of participatory ergonomic intervention on the development of upper extremity musculoskeletal disorders and disability in office employees using a computer’ (Baydur et al., 2016)

Aim: to evaluate the effect of the PE method on the development of upper extremity MSDs and disability in office workers.

Method: a randomised controlled intervention study was conducted among 116 office workers using computers. Those in the intervention group were taught office ergonomics and the risk assessment method. The participants conducted a trial implementation of the risk assessment of their office environment. Solutions determined after the implementation of the risk assessment were implemented by the participants. The upper body-related symptoms of the office workers were regularly followed up every month during the 10-month post-intervention period.

Results: the number of workers developing symptoms on the right side of the neck and in the right wrist and hand was significantly lower in the intervention group than in the control group. Neck disability/symptom scores over time were significantly lower in the intervention group than in the control group.

Conclusion: the PE intervention decreased the probability of musculoskeletal complaints and disability/symptom level in office workers.

3.1.6 Case study: ‘A low-cost and efficient participatory ergonomic intervention to reduce the burden of work-related musculoskeletal disorders in an industrially developing country: an experience report’ (Bernardes et al., 2020)

Aim: to evaluate the effects of a PE intervention in reducing exposure to work-related risk factors for work-related MSDs in a Brazilian garment company.

Method: the implementation strategy of a PE intervention conducted in the quality control department of a medium-sized Brazilian garment company followed the nine steps presented by Vink et al (2008). Workers’ exposure to risk factors was investigated using the Rapid Upper Limb Assessment method.

Results: a low-tech and low-cost method of reducing workers’ exposure to WMSD risk factors was proposed, prototyped, tested and, finally, introduced in the workplace. Before the ergonomic intervention, the most severe and frequent ergonomics problem in the quality control department was the static maintenance of shoulder postures when performing tasks. As a result of the ergonomic intervention, two such tasks were totally eliminated and another modified so that workers could perform it with their shoulders in a relaxed position.

Conclusion: a low-tech and low-cost solution that successfully reduced workers’ exposure to work-related MSD risk factors was proposed, prototyped, tested and introduced in the workplace. PE interventions can be a feasible and effective approach to reducing exposure to risk factors for work-related MSDs in industrially developing countries. The authors identified the following reasons for the success of this intervention: use of a stepwise approach; strong management support; workers’ participation; establishment of a steering group; conducting a broad analysis of the occupational tasks; checking the effects, including side effects, at an early stage; and a positive cost–benefit ratio.

3.1.7 Case study: ‘Effects of a participatory ergonomics intervention with wearable technical measurements of physical workload in the construction industry: cluster randomised controlled trial’ (Brandt et al., 2018)

Aim: to investigate whether or not a PE intervention with technical measurements could reduce the number of events with excessive physical workload during a working day.

Method: a cluster RCT involving 80 construction workers was conducted with technical measurements. These consisted of inertial measurements, surface electromyography, heart rate monitoring and video recordings of physical workload. Assessments were made at baseline and at 3- and 6-month follow-up intervals. The intervention consisted of three workshops based on individual technical measurements of excessive physical workload. The control group received handouts about work-related MSDs and lifting guidelines from the Danish Working Environment Authority. These handouts described the association between these disorders, their impact on working life, regulations intended to prevent them, the precautions that should be taken to limit them, and regulations on lifting, pushing and pulling, and the risk of injuries.

Results: no difference was found in the number of events with excessive physical workload between the intervention group and the control group. There was a reduction in general fatigue after a typical working day and a perceived increase in workers’ influence on their own work in the intervention group compared with the control group.

Conclusion: the intervention did not reduce the number of events with excessive physical workload during construction work, but it did lead to decreased general fatigue and an increased sense of having an influence on one’s own work.

4 Success factors, limitations and lessons learned

The characteristics of those interventions that have achieved the greatest success with PE approaches have been identified in a review by the Canadian Institute for Work and Health (Cole, 2005). Its recommendations include the following:

- PE approaches should be formally documented and should describe the participants, the nature of ergonomic changes, and the intensity of the ergonomic intervention process (level of participation, extent of involvement).
- Evaluation of these interventions should include control groups whenever possible.
- Those designing the study should consider the possibility of randomisation when many sites or organisations are involved.
- Those who design, carry out and evaluate such interventions in the workplace should consider the presence of co-interventions and potential confounders.
- They should also continue to measure important risk factors for musculoskeletal symptoms.

Others (Haines and Wilson, 1998; Burgess-Limerick, 2018) have indicated the importance of having:

- support for the intervention from the organisation (management, co-workers and union representatives);
- resource commitment from the organisation (that is, time and money);
- open communication about the PE intervention.

Some researchers (Haines and Wilson, 1998) also indicate areas of concern such as workers becoming experts in the participatory process and becoming less valuable than those with knowledge of the work itself — that is, no longer a typical worker.

Implementing and assessing the impact of workplace and work system interventions is both complex and challenging. PE approaches appear to have many potential benefits. Measuring these benefits in well-designed, controlled studies is subject to many constraints, including keeping other workplace factors constant (as they might otherwise confound the study), applying suitable tools to assessing the impact (subjective assessments may be subject to bias), having sufficient access to organisational data (e.g. sickness absence data and injury data) and continuing an intervention for a sufficient length of time to observe the impact on the incidence of MSDs in the worker population(s) under study. Some studies (Haukka et al., 2008; Driessen et al., 2011) that have attempted to undertake larger, controlled interventions for MSDs in workplaces have documented these limitations carefully. In some instances, the hypothesised success of interventions has not been seen, which has given rise to speculation regarding the efficacy of such approaches. The authors of such studies recognise the challenges of establishing and maintaining such interventions in modern, complex work systems. However, such issues have long been recognised in all complex interventions designed to improve health (Campbell et al., 2000).

Summary

PE approaches are well-established in ergonomics literature. The process for undertaking such studies has been developed for use in many settings and with varying aims. In theory, they enable those who actually undertake the work to influence decision-making as to how this work could be undertaken to optimise performance and well-being. These approaches should engage with all workers and thus provide a voice for minority groups.

The use and benefits of PE when addressing MSDs in the workplace have been explored in a significant, but not large, number of studies, which have been critically reviewed. The success of PE approaches has been demonstrated through small interventions in a variety of workplaces.

However, there are significant challenges in both designing and conducting robust studies of this nature. These are well recognised in the scientific and epidemiological disciplines. Therefore, results from PE studies must be interpreted against this background of substantial methodological challenges. Larger, controlled studies have often shown only a limited impact with regard to reduction of MSDs, but many studies have recognised limitations resulting from study design, resources available to fully implement any changes identified as required and follow-up issues relating to outcome variables (e.g. health, sickness absence and injury).

In summary, PE approaches bring benefits by raising awareness of ergonomic risks in the workplace and by encouraging and enabling the workforce to assess risks and find solutions through their collaborative efforts. It is also evident that assessing the longer-term impact of such interventions shows partial, limited support for a positive impact on musculoskeletal symptoms, injuries or sickness absence, although all the studies are subject to important methodological limitations.

Further reading

- Eeckelaert, L., 'Strategies to tackle musculoskeletal disorders at work', OSHwiki, EU-OSHA (European Agency for Safety and Health at Work), 2020. Available at: https://oshwiki.eu/wiki/Strategies_to_tackle_musculoskeletal_disorders_at_work
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