Evidence-based practice for the prevention of work-related MSDs: A Personal Journey

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Extensive review by NIOSH in 1997. The 591 page document included detailed analysis of more than 600 studies. The conclusions included:

“A substantial body of credible epidemiologic research provides strong evidence of an association between MSDs and certain work-related physical factors when there are high levels of exposure and especially in combination with exposure to more than one physical factor (e.g., repetitive lifting of heavy objects in extreme or awkward postures).”

Evidence for the work-relatedness of musculoskeletal disorders? - there is lots!

US National Research Council (1998):

“The positive relationship between the occurrence of musculoskeletal disorders and the conduct of work is clear.”

“There is compelling evidence from numerous studies that as the amount of biomechanical stress is reduced, the prevalence of musculoskeletal disorders at the affected body region is likewise reduced. This evidence provides further support for the relationship between these work activities and the occurrence of musculoskeletal disorders.”

Evidence for the work-relatedness of musculoskeletal disorders? - there is lots!

National Research Council again (2001)

“The positive relationship between the occurrence of musculoskeletal disorders and the conduct of work is clear.”

“a rich and consistent pattern of evidence that supports a relationship between the workplace and the occurrence of musculoskeletal disorders of the low back and upper extremities. This evidence suggests a strong role for both the physical and psychosocial aspects of work.”

National Research Council (2001). *Musculoskeletal disorders and the workplace: Low Back and Upper Extremities. Panel on Musculoskeletal Disorders and the Workplace*, Commission on Behavioral and Social Sciences and Education; Board on Human-Systems Integration; Institute of Medicine; Division of Behavioral and Social Sciences and Education; National Research Council.
A more recent review (da Costa & Viera, 2010) restricted to longitudinal epidemiological investigations concluded that:

“Risk factors with at least reasonable evidence of a causal relationship for the development of work-related musculoskeletal disorders include: heavy physical work....

The most commonly reported biomechanical risk factors with at least reasonable evidence for causing WMSD include excessive repetition, awkward postures, and heavy lifting.”

Most recent evidence is from two three year longitudinal studies. Sterud & Tynes (2013) concluded that:

“highly demanding jobs, prolonged standing and awkward lifting were the most consistent and important predictors of low back pain”

while Coenen et al, (2013) followed up 1745 workers and concluded that:

“cumulative back loads assessed by video and force measurements is a significant risk factor for low back pain”


How can work-related musculoskeletal disorders be prevented?

“Safe lifting” training is common - does it work?
Most controlled studies of training have shown it to be ineffective in reducing accidents and injuries related to lifting (NIOSH, 1981; p.146)

Full squat increases lumbar compressive force, energy expenditure, quadriceps force & knee instability

"Most controlled studies of training have shown it to be ineffective in reducing accidents and injuries related to lifting" (NIOSH, 1981; p.146)
“There is ... **no justification** for advocating lifting from a **full squat** posture. ... lifting from semi-squat postures ... allows a pattern of interjoint coordination which appears to be functional in reducing muscular effort. **Lifting training is generally ineffective**...”

(Burgess-Limerick, 2003)
“A large-scale, randomized, controlled trial of an educational program to prevent work-associated low back injury found no long-term benefits associated with training.”


“little evidence supporting the effectiveness of technique and educational based manual handling training. There was considerable evidence that principles learnt during training are not applied in the working environment…”

“limited to moderate evidence that, on average, there was no significant difference in reports of back pain, back-related disability or absence from work between groups who received training on proper lifting techniques and assistive devices and those who received exercise training, back belts or no training.”


“the evidence suggests manual handling training is not effective at causing a change in employee’s manual handling behaviour following training or at reducing WRMSDs.”

If not training, then what?

**Identify** hazardous manual tasks and **eliminate** them.

If the potentially harmful tasks cannot be eliminated, **redesign** the tasks to **reduce exposure to** the task characteristics which increase injury risk.

- High exertion
- Awkward postures
- Static or repeated similar movements
- Long duration
- Heat, Cold, Vibration
- Stress, time pressure

Ensure participation of those involved - **Participatory Ergonomics**
Participatory ergonomics means people being actively involved in designing workplace changes which will improve their productivity, safety, and health.

or as John Wilson put it:

“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 to achieve desirable goals”

Randomized controlled trial of PErforM, a participatory ergonomics intervention designed to reduce the risks of injury associated with manual tasks.

48 small to medium sized workplaces audited by inspectors using ManTRA, then randomly assigned to Experimental and Control groups.

Decreased manual task risks 9 months post-intervention

2000-2004
Evidence for the effectiveness of participatory ergonomics? - There is some.

Reducing Musculoskeletal Risk in Open Cut Coal Mining


2002-2004
Implementation of the Participative Ergonomics for Manual tasks (PEforM) programme at four Australian underground coal mines

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cSchool of Psychology, Curtin University of Technology, Australia
dMinerals Industry Safety and Health Centre, The University of Queensland, Australia

Risk assessment

Exertion

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<tr>
<th>1</th>
<th>No effort</th>
<th>2</th>
<th>Moderate force &amp; speed</th>
<th>3</th>
<th>Maximum force or speed</th>
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Awkward posture

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Vibration

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Duration

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<th>10-30 min</th>
<th>3</th>
<th>30 min - 1 hr</th>
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Repetition

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<th>2</th>
<th>Cycle time &lt; 30 s</th>
<th>3</th>
<th>Cycle time &lt; 10 s</th>
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Lessons learned

- Management commitment & visibility
- Risk analysis & evaluation required
- Site champion role is key
- Supervisor buy-in
- Communication
- Documentation success (and failures)

2002-2005
Evidence for the effectiveness of participatory ergonomics? - There is some.
Before - Static grinder

- This task involves welding 2 rail sections together and then grinding the weld so that the rail profile is maintained. Each grind took 5 - 20 mins and there was up to 30 welds per shift.
- The grinder in use had a static grinding mechanism so the worker had to lean over to grind the side of the rail whilst supporting the weight of the 68 kg grinder (pictured). Additionally, lifting the heavy grinder on and off the track and carrying it to the track could also be difficult.
- Hot, humid, localised vibration & sometimes time pressures with limited time for track closures.
A new grinder was constructed, where the grinding disc moved around the rail by turning a wheel whilst the operator stayed upright (pictured), (i.e. no bent over postures are required). The grinder also had an outrigger so the grinder’s weight is self supported at all times.

- More powerful motor which more than doubled productivity.
- Dead man safety switch installed, and an electric motor to wind the grind head down, with a ‘set button’ so that the maximum depth can be set to prevent ‘dipping’ the rail (i.e. less error).

**Risk Reductions**

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<td>Legs</td>
<td>33%</td>
<td>38%</td>
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Before - Laying tape manually

- BiTac multi-laminate tape is used across structural joints in the asphalt mat, which is often laid over many kilometres.
- E.G. - Cooroy/Bielby project required 64 km of tape to be laid.
- Each 36 m long roll weighs 11.5 kg. (Note: 64 km = 1,700+ rolls).
- A minimum 2-person task with one worker holding the roll and walking backwards with an awkward crouched posture, whilst the other worker retrieves the used backing tape for disposal.
- 5 - 7 mins per roll, for 2 - 3 hours at a time, every 2 weeks.

After - Laying with the new 'RollRunner' trolley

- A customised 3-wheeled trolley was developed by Kockums from design controls developed by Boral workers and a 'Viva - Health at work' ergonomist during a participative ergonomics workshop.
- The new (and relatively inexpensive) control not only drastically reduced the risk of musculoskeletal injury, but also had significant reductions in the time required to lay the product.
A customised 3-wheeled trolley was developed by Kockums from design controls developed by Boral workers and a ‘Viva - Health at work’ ergonomist during a participative ergonomics workshop.

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Risk Reductions

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<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Arms</td>
<td>50%</td>
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<tr>
<td>Back</td>
<td>75%</td>
<td>64%</td>
</tr>
<tr>
<td>Legs</td>
<td>67%</td>
<td>58%</td>
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Evidence for the effectiveness of participatory ergonomics? - There is some.

“participatory approaches were **often but not always successful**”

“PE interventions had a small, **positive impact** on musculoskeletal symptoms”

“A PE approach can **improve risk factors** related to WRMSD, and meaningful **worker participation** in the process is an **important** aspect for the success of such interventions.”
Evidence for the effectiveness of participatory ergonomics? - There is some.

“partial to moderate evidence that PE interventions have a positive impact on: musculoskeletal symptoms, reducing injuries and workers' compensation claims, and a reduction in lost days from work or sickness absence.”


“a systematic approach to ergonomic hazard identification, quantification and control implementation, in conjunction with requirements to establish an ergonomic process at each manufacturing plant, may be effective in reducing risk of MSD and acute injury outcomes among workers in targeted jobs”

Why are participatory approaches “often but not always successful”?

Successfully Implementing a Global Participative Ergonomics Program across Rio Tinto

Gary Dennis PhD CPE, Robin Burgess-Limerick PhD CPE and Ian Firth MSc FAIOH COH

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History
Rio Tinto Aluminiuim (RTA) implemented the ErgoAnalyst Participative Ergonomics Program in 2010 and it was adopted as the preferred level 3 assessment tool to address musculoskeletal and hand injuries across Rio Tinto globally in 2011. In subsequent years ErgoAnalyst has been adopted by the Coal, Iron Ore, Minerals, Ports and Technology businesses in 34 sites across Australia, North America, Europe and Africa.

Implementing the ErgoAnalyst Program
Selected Rio Tinto OH&S staff were trained by ErgoEnterprises to become EA-Facilitators via a range of 2 and 3 day face-to-face training packages that were supported by on-line training videos and resource materials. These EA-Facilitators then facilitated the identification, assessment and control processes in consultation with the workers as ‘task experts’. Additional training to become an EA-Specialist was also available so that they could train their own staff ‘in-house’. The ErgoAnalyst process (below) was then used to develop effective controls for the ‘Top 5’ hazardous tasks in each work area per year, and shared through the ErgoAnalyst database and a Rio Tinto eRoom via 3-page ‘Green Banners’ that describe and illustrate the benefits of the control.

ErgoAnalyst Process

Number of Tasks Analysed using ErgoAnalyst per Year

ErgoEnterprises Pty Ltd

Injury Statistics

Number of Tasks Analysed using ErgoAnalyst per Year

Results
Between 300 and 400 manual tasks have been assessed each year and the number of tasks that have had effective controls implemented has steadily increased, exceeding 200 in 2014. Over the same time period there have been decreases in musculoskeletal injuries and illnesses and these decreases have been greatest at sites where ErgoAnalyst has been most actively used to develop controls (e.g. RTA - B&A, see graph above). There have also been significant productivity benefits associated with many of these controls. Additionally, when these controls are shared these benefits can be easily replicated throughout the company without the need to re-analyse the task.

Elements Essential to Success

• Standardised risk assessment process across the business.
• Training that allowed OH&S staff to internally implement the system with improved understanding of what causes injury and how to facilitate effective risk assessments and controls development.
• Visual tool that engages the workers and allows them to understand the factors that cause both acute and cumulative risk, so that they can become involved in risk assessment and controls development.
• KPIs set to address the “Top 5” hazardous tasks for each area per year.
• A centralised data-base to document and share across the business.

What is required next?
Ensure that even more controls are shared across the business (and externally where appropriate) via the 1-Page ‘Green Banners’.

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RIO TINTO WEIPA: The Value Proposition of Good Work Design

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- Monash University Accident Research Centre, Monash University, Melbourne, AUSTRALIA
- ErgoEnterprises; Rio Tinto Weipa

ABSTRACT

Investigations were undertaken at a North Queensland mining organisation with a high level of maturity associated with good work design and participatory ergonomics practices. Lead and lag indicator reports and industry award reports were reviewed. Semi-structured and unstructured interviews were conducted with management, program coordinators and workers during a site visit. A formative process was undertaken during the investigation to determine achievements and areas for improvement, with retrospective review and consensus achieved from organisation representatives at various levels of management. Two case studies were highlighted in this paper to illustrate their good work design initiatives, one describing hand injury reduction rates and the other addressing biomechanical risk reduction for low back injury.

INTRODUCTION

What is Good Work Design?

Good Work Design represents work that provides for harmonious safe, health, and productive work that also supports the creative contributions of a diverse work team. It is underpinned by the tenets of human centred design and participative ergonomics, and advances Total Worker Health® (Sorensen et al, 2016).

Good Work Design encompasses and provides for:

1. Critical event management
2. Significant task, equipment, and work systems design or redesign
3. Strategies to optimise health & well-being
4. Social connection
5. The attainment of enterprise goals for good business performance (throughout the supply chain)
6. Good governance supported by effective knowledge systems
7. The promotion of social and environmental sustainability

To achieve good work design we need to know what “good” looks like. One may extend this line of thinking to ask: at what point have we achieved optimum performance and can it get any better?

To advance good work design, we may strive to understand the elements that contribute to positive performance. There are a range of variable circumstances such as the inherent nature of humans,
Ingredients for preventing musculoskeletal disorders (and improving productivity)

- management commitment, at all levels = resources
- a participatory process to eliminate, or redesign, hazardous tasks
- risk analysis, evaluation, and communication tools
- training for participants and facilitators (site champions)

Management commitment is the most important factor. Senior management commitment is essential but not sufficient. Middle management and supervisors must be on-board, and stay on board.