

Mandalong Periodic-Musculoskeletal Survey Report

Hypothesis

Can a 30-45 minute musculoskeletal screen used in conjunction with Coal Services periodic health surveillance identify musculoskeletal trends within a workforce?

Background

Management from Centennial Coal Mandalong consulted with CS Health in November 2014 seeking advice on how to reduce injuries at their underground coal mine. The injury rate occurrence had increased over the previous 12 months, with the main areas of injury being to the neck, shoulder, back, knees and ankles.

A literature review^{1,2,3} conducted by CS Health identified key factors that increased the risk of sustaining a Work-Related Musculoskeletal Disorder (WMD). Possible risk factors for WMD's were found to include biological and psychosocial factors as well as environmental and workplace organisational factors. These risk factors include and are not limited to:

- *BMI*
- *Smoking*
- *Age*
- *Level of physical fitness/activity levels*
- *Muscle imbalances*
- *Self-efficacy*
- *Beliefs about pain/injury*
- *Depression/anxiety*
- *Prior injuries*
- *Comorbidities such as diabetes, hypertension and heart disease*
- *Satisfaction with employer, co-workers*
- *Perception of support in workplace*
- *Working postures*
- *Manual handling loads and frequency*
- *External stresses*

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Methodology

Periodic medicals form part of CS Health's routine Health Surveillance of the NSW mining industry. According to Mandalong's injury claims data, musculoskeletal injuries formed the largest proportion of injuries experienced by their underground mineworkers. With the goal of reducing the incidence of these injuries, a battery of more specific musculoskeletal testing was added to the standard periodic medical.

Each mineworker who was scheduled for a periodic health surveillance medical between January and December 2015 was asked if they would consent to completing an additional forty-five minute musculoskeletal assessment. 138 mineworkers consented and were assessed during this time period.

The musculoskeletal survey measurements added to the standard periodic medical were;

- Musculoskeletal screening – an assessment of walking gait, posture, joint range and muscle function
- Cardio-respiratory fitness – assessed using the Chester Step test
- Upper limb stability – measuring upper limb stability as a precursor to upper limb injury was assessed using the Closed Kinetic Chain Upper Extremity Stability (CKCUES) test
- Lower limb balance – measuring lower limb balance as a precursor to lower limb injuries using the Y-balance test
- Manual handling – an assessment of safe lifting technique and capacity using different lifting scenarios

The **CKCUES test** has been identified as a clinical outcome measure of upper extremity performance and function⁴. Underground miners frequently engage in heavy, awkward, sustained and repetitive tasks that require aspects of co-ordination, stability, speed, agility, power, endurance and strength in the upper limbs. The CKCUES test is a clinically useful test for assessing upper extremity function⁵.

The **Y-balance test** requires functional stability, flexibility, strength, proprioception, neuromuscular control and dynamic postural control of the lower limbs. The test is used to identify ankle instability and may be predictive of lower limb injury. It is used to “discriminate neuromuscular control abilities at the more demanding levels that are required for athletes, occupational workers and active individuals”⁶.

In addition to the above assessments, other physical and psycho-social measures from the standard periodic assessment that may influence musculoskeletal function were included in this report.

Each mineworker's data was recorded confidentially and stored in their medical record. Only compiled, de-identified group data was made available for analysis. This survey reports only raw scores with no statistical analysis of the data.

If during the assessment, the assessor identified a health issue that could be addressed by a CS Health professional then the service was offered and completed confidentially with the mineworker's consent.

Survey results

The following is the raw data compiled during the musculoskeletal survey is outlined below. It should be noted that as this added musculoskeletal component to the periodic assessment was voluntary, some mineworkers declined to participate in all or some of the assessment. The assessors, at their discretion, also excluded certain components of the assessment to ensure the safety of the participant in instances where there were pre-existing conditions. This explains some apparent inconsistencies in the data reported below.

Musculoskeletal screen

- 105 out of 134 tests showed no musculoskeletal concerns.
- Of the 29 assessments that were identified as having some limitation, the areas affected were as below:

Walking Gait	5
Neck range	5
Lower Back range	6
Shoulder range	6
Elbow range	0

Finger range	0
Wrist range	3
Spinal Posture	10
Leg Function	15
Shoulder Strength	3

Cardio-respiratory fitness

Poor	Below average	Average	Good	Excellent
1%	8%	18%	26%	47%

Upper limb stability

- 41 out of 120 (34%) tests indicated reduced upper limb function/performance.

Lower limb balance

- 54 out of 128 (42%) tests indicated reduced lower limb balance/performance.

Manual handling

- 14 out of 121 (12%) tests indicated reduced safe lifting/manual handling performance.

Physical activity

Each mineworker was asked to self-report their weekly activity and fitness level.

- 49% of mineworkers reported to achieve the national activity guidelines of “vigorous exercise outside work for more than 30 minutes, 4 times or more a week”

FITNESS LEVEL (self-rated)		
Poor	Average	Excellent
9%	70%	21%

Body measurements

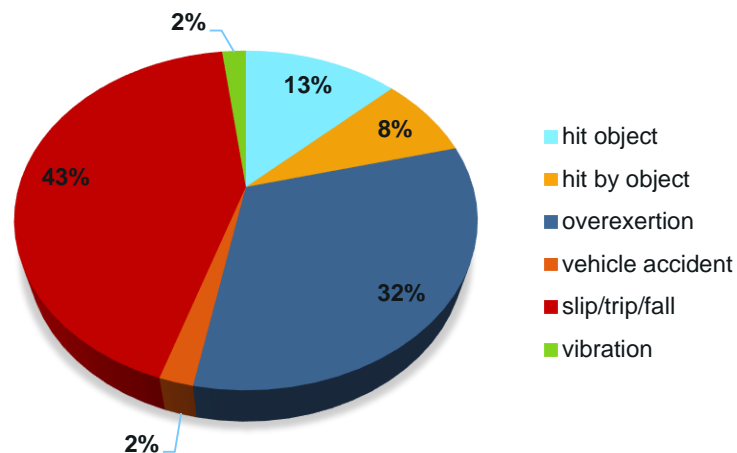
- Body Mass Index (BMI)
 - 32% of mineworkers had BMI ≥ 30 (obese range)
- Waist Hip Ratio (WHR)
 - 35% of mineworkers had WHR 0.96 – 1.00 (moderate risk)
 - 30% of mineworkers had WHR > 1 (high risk)
- 5% of mineworkers presented with a BMI ≥ 30 and a WHR ≤ 0.95 (low risk)

Musculoskeletal pain

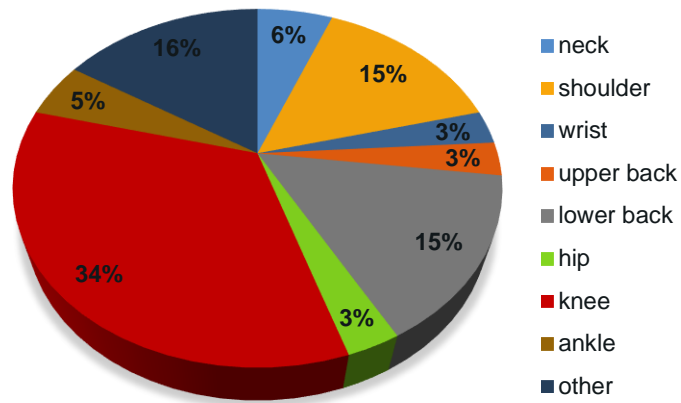
- 38% of mineworkers reported experiencing pain in the last three years
- 23% of those mineworkers reported pain had not resolved

Of those reporting pain, the charts below identify the mechanism and location:

Pain mechanism



Pain location



Psycho-social screening

- Stress

The following table indicates the proportion of mineworkers who rated themselves as moderate to high on the identified dimensions of stress:

Physical	59%
Personal / Emotional	45%
Mental / Career	44%

The following table indicates the proportion of mineworkers who responded 'yes' to the following questions:

Can you control the order and pace of your tasks?	91%
Is the order and pace of your tasks usually dependent on others?	89%
Do you usually work under time pressures and deadlines?	74%
Are you able to identify injury hazards at your workplace?	99%

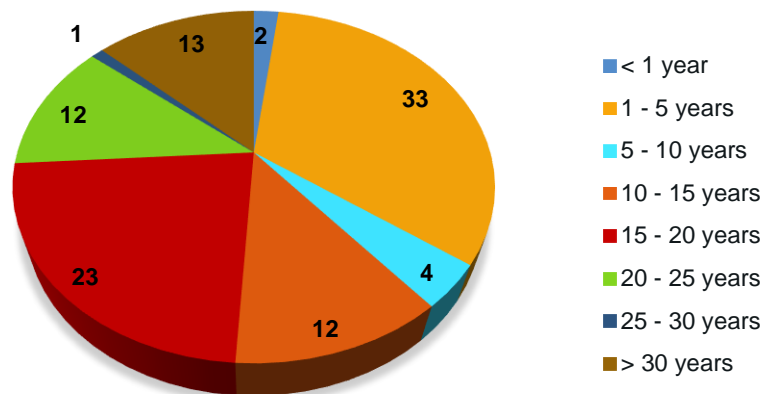
- **Work satisfaction**

The following table indicates the proportion of mineworkers at each level of work satisfaction:

Not satisfied	5%
Somewhat satisfied	44%
Completely satisfied	51%

- **Employment duration**

The chart below shows the proportion of mineworkers according to their underground employment duration:



- **K10 psychological health questionnaire**

No issues were identified amongst mineworkers completing this assessment.

- **Epworth sleepiness scale**

No issues were identified amongst mineworkers completing this assessment.

Analysis

The current survey represents a snapshot in time of a sample of underground mineworkers. These results could form the basis for further trend analysis and investigation into the following areas:

Musculoskeletal issues

The screening identified 15 mineworkers with a restriction of leg function. This testing involved both leg balance and strength tasks. Lower limb balance testing using the Y-balance test revealed 42% of mineworkers as having reduced performance. Furthermore, of the 38% of mineworkers who reported experiencing pain over the previous three years, 42% identified the legs as the location of the pain. These results could suggest the significance of leg strength and balance in the optimisation of leg function and the prevention of injury and could be a target of future intervention.

The assessment of upper limb function identified nine mineworkers as having a restriction. In the reporting of pain experienced over the last three years, 18% of mineworkers indicated the upper limb as the pain location. The CKCUES test indicated 34% of mineworkers as having reduced upper limb stability. These results perhaps indicate that the prevalence of upper limb problems are less than previous anecdotal reporting would suggest. However, given the heavy upper limb requirement of mineworkers there may be scope for intervention to improve upper limb performance.

The combined contribution by the injury mechanisms of 'overexertion' and 'slip/trips/falls' to 75% of the causes of pain/injury experienced by these mineworkers may add further support to the consideration of interventions to improve upper and lower limb function and balance.

Of the 38% of mineworkers who had experienced pain in the last three years, 23% of this group report their pain had not resolved. Further investigation of ongoing pain issues may be warranted.

Cardio-respiratory fitness was identified as being at average or better for 91% of mineworkers on both the Chester Step test and with self-rating of fitness. At odds with this is that only 49% of the group reported to achieve the levels of weekly activity recommended under the national activity guidelines.

Further to general wellbeing, 32% of mineworkers scored in the obese range of the body mass index (BMI) whilst 65% of the group scored at a moderate or high risk for health problems associated with obesity using the waist-hip ratio (WHR). These figures are comparable with the latest statistics (2011-2012) from the Australian Institute of Health and Welfare which reports that 70% of Australian adult males are classified in the obese category. While the link between these figures and musculoskeletal injury incidence is yet to be established, clearly there is room for improvement in terms of general health. Interventions aimed at dietary, exercise and other habits of healthy lifestyle would be justified.

Psycho-social

The results here indicate that despite stress levels being significant, with a range of 44% to 59% rated as moderate to high across the various dimensions identified, work satisfaction remains high with 95% of the group being somewhat or completely satisfied.

Interestingly, the employment duration statistics revealed two groups to dominate were the '1 to 5' year group at 33% and the '15 to 20' year group at 23%. Further analysis of the distribution of these groups amongst the work crews to ensure the best utilisation of their strengths might be of benefit.

Recommendations

1. Leg injuries feature prominently in the results. While the causation is likely to be multi-factorial, the data presented would support further study into the effect that improvement of leg strength and lower limb balance would have on injuries experienced.
2. Almost 40% of this sample of mineworkers had experienced pain related to work in the last three years with almost 25% of these reporting the pain to be unresolved. The factors contributing to this pain problem needs further analysis.
3. The injury mechanisms of 'overexertion' and 'slips/trips/falls' account for 75% of the pain experienced. Further investigation into the causative factors here would be of benefit.
4. The obesity 'epidemic' currently engulfing western populations is reflected in these mineworkers. It would be beneficial to provide this group with appropriate education, exercise and dietary intervention to improve this outcome.

Conclusion

The limitations of this style of research in providing clear evidence to guide practice should be acknowledged. It should be noted that the questionnaire style of some results is reliant on truthful answering which may be influenced by the ongoing employment needs of the group. Nevertheless, some interesting information has been identified which should warrant further investigation as the NSW Coal Industry continues its efforts to reduce the incidence of Musculoskeletal injury across its workforce.

CS Health would like to thank the Mandalong mineworkers who consented to being involved in this survey. A thank-you also to the Coal Services Health and Safety Trust for their support in this scoping project that provides for better identification and targeting of those factors that can be addressed to improve the health and wellbeing of the entire mining workforce.

References

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