

[126-522] Digging for gold and coming up blue: a health survey in the mining industry

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Introduction

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Abstract

A comprehensive health screening was conducted with 591 workers from a goldmine in Western Australia to inform company health promotion programs. We investigated lifestyle and work-related health risk factors using a specifically designed survey, screened for depression, anxiety and stress using the DASS-21 questionnaire and the AUDIT for alcohol consumption. Results show that rates of smoking, diabetes, depression and anxiety were higher than respective national rural and remote state figures. Frequent and high levels of work-related stress and personal stress were significantly associated with harmful drinking, depression, anxiety and stress, even after adjusting for a number of independent variables. The results suggest that the psycho-social working environment in the WA mining industry is challenging and may be responsible for the high rates of mental health issues observed in this study.

Keywords: alcohol, depression, anxiety, smoking, mining.

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Introduction

Mining is one of the most important industries in the Australian economy, and has recently experienced an unprecedented job growth driven by the continued rapid industrialisation of China and other fast growing Asian economies. Despite the recent global economic downturn goldmining, in particular, is moderating these negative effects in certain communities. The mining industry in Western Australia is dominated by the metalliferous sector and is characterised by a younger, predominantly male (86.1%) workforce with high incomes; mine workers on average earning double the earnings of workers in other industries.¹ However, the often hard working conditions, the remote locations of mine sites and incompatibility between the demands of work and family responsibilities lead to high workforce turnover and attrition from the industry.

Despite the fact that mining is changing into a high skills profile industry due to an increase in the use of complex, sophisticated equipment, a significant proportion of the workforce is still not formally trained.¹ Many of the demands of mining industry jobs such as long shift hours and being away from family for long periods,

isolation and stress combined with the characteristics of the workforce mean that workers often find it difficult to cope at work and this can result in increased sickness related absence.²

There is an increasing body of research linking the nature of the work and associated drug use. Factors such as issues of control, isolation and stress, linked with individuals' perceptions of their powerlessness, have been identified as factors related to depression and anxiety^{3, 4} and drug use in the workplace.^{5, 6, 7, 8}

Research on the impact of workplace and life stressors on individual health status has shown that stressors in various forms can have a significant impact on individual health, particularly cardiovascular health, with individual coping skills and mechanisms having a moderating effect.^{9, 10, 11} An adequate stress response can eliminate the effects to a significant extent, on the other hand an inadequate response, for example using alcohol and other drugs, can have direct detrimental health effects.^{12, 13} This clearly shows the complexity of workplace health and the necessity to apply a comprehensive approach to workplace health promotion, well beyond the mere physical variables in the work environment.¹⁴

Worksite health promotion programs have been shown to have positive clinical and cost-effective outcomes, especially if they provide a continuous and integrated program of health promotion and disease prevention.¹⁵

¹⁶ Today most larger workplaces have some form of health promotion program in place, with the majority trying to increase productivity and decrease absenteeism, accidents and health care costs. The most successful programs tend to be comprehensive and well integrated programs that contribute to organisational missions and goals.¹⁷

This study reports the results of a comprehensive health and lifestyle survey that was carried out prior to the introduction of a worksite health promotion program in a goldmine located in the Goldfields region of Western Australia in close proximity to the city of Kalgoorlie-Boulder. The company was interested in such a program as a way to address depression among the employees to improve their overall health outcomes and in the long term reduce cost associated with sickness-related absence. The mine comprises several sites including underground and open pit mines, processing, haulage and administration and support facilities. The aim of the survey was to collect baseline data for comparison post-intervention but more importantly to enable interventions to be tailored specifically to the needs of this particular workforce.

Methods

Questionnaire content and administration

A specifically designed questionnaire was developed for the purpose of this study. It comprised a mix of multiple choice items, Likert scale and open-ended questions on working life and stress, smoking and alcohol consumption and known risk factors for and symptoms of cardiovascular diseases and diabetes. Working life and stress measures investigated frequency and levels of stress on a four-point scale ranging from never or not at all to daily or very much. The other sections incorporated self-reported measures of known risk factors, symptoms and diagnosis of specific illnesses. The questionnaire also incorporated the short version of the Depression, Anxiety and Stress Scale (DASS-21) to document prevalence of the three disorders. DASS-21 is a short form of Lovibond and Lovibond's¹⁸ 42 item self-report measure and has been shown to possess adequate construct validity and very high reliability in a large non-clinical sample.¹⁹ To detect harmful and hazardous drinking, the Alcohol Use Disorders Identification Test (AUDIT) was also incorporated.²⁰ The questionnaire was subject to expert review and pilot-tested with a small sample of mine workers prior to general administration. This was undertaken to assess the validity, reliability and ease of administration of the survey instrument. It took approximately 20 minutes for participants to complete the questionnaire.

The company's occupational health and safety staff visited the various sites during shift changeover and offered all 921 employees the opportunity to participate in the survey. Potential survey bias was addressed by emphasising to employees that the survey was completely anonymous, company staff would have no access to crude survey data at any time, and results would be used to tailor interventions to benefit

the health and wellbeing of the employees and consequently the company. Marketing for the survey and forthcoming health promotion interventions was carried out in the weeks prior to data collection using posters and through word-of-mouth, with contact information provided for those with any queries. Respondents were also given the option of inserting a non-identifying, respondent generated alphanumeric code on the questionnaire to allow them to collect their results at a later date while maintaining anonymity. Participation was voluntary, and informed consent was required prior to completing the questionnaire. Completed surveys were collected in a sealed container and delivered to research staff for data entry. Ethical approval for the research was given by Curtin University of Technology's Human Research Ethics Committee.

Interviews with stakeholders from a number of goldmining companies in the Goldfields were also carried out to contextualise the quantitative data collected. Interviews were carried out in person, in private and the researcher took notes which were collated and analysed and common themes noted.

Analysis

The AUDIT and DASS-21 scores were calculated as per the instructions of the respective instruments.¹⁸
²⁰ Since being overweight is a risk factor for several lifestyle-related diseases, body mass index (BMI) was calculated based on the individual's self-reported height and body weight. This was then used to determine rates, within the workforce, of being overweight or obese. We conducted chi-square and t-test analyses to determine the relation between AUDIT scores, smoking; DASS-identified stress, depression, anxiety and total DASS scores and age, gender, marital status, work department, shift length, residential status, travelling time to and from work, levels and frequency of stress at work and in their private life, physical strain and its impact, overall life satisfaction and future outlook. Multiple logistic regression analysis was carried out with a separate model set up for each dependent variable. Statistical analysis was conducted using Statistical Package for the Social Sciences version 15 and STATA 11.²¹,²²

Results

Demographics

The response rate was 61% and the final sample consisted of 591 men and women over 18 years of age. The gender structure of the study population consisted of 90% (N = 530) men and 10% (N = 59) women which is representative of the company workforce, and their mean ages, weights and number of hours worked per shift are reported in Table 1. On average, workers had been employed for two years. No woman worked shifts longer than 12.5 hours and the majority of men (52.7%) worked 12 or more hour shifts. Both males and females weighed more than their average Australian counterparts; 92 vs. 84 kg and 74 vs. 68 kg respectively.²³

Table 1: Mean ages, weights and number of hours worked per shift

	Age (\pmSD)	Weight, kg (\pmSD)	Shift length, hr (\pmSD)
Female	33.5 (\pm 10.4)	73.7 (\pm 19.1)	9.0 (\pm 1.7)
Male	38.2 (\pm 14.3)	91.6 (\pm 18.2)	11.2 (\pm 1.4)
Total	35.8 (\pm 12.4)	82.6 (\pm 18.6)	10.1 (\pm 1.6)

The ethnicity of the workforce was investigated and revealed that two-thirds identified as Anglo-Australian (71.8), followed by New Zealand Maori (9.8%), European (5.8%), Australian Aboriginal (3.6%), Asian (1.9%) and the rest as other (7.0%).

The study sample was representative of the workforce's employment profile, with 48.5% working "on the surface" (eg open pit mine), 38.6% working underground, 9.9% in administration and 3% in processing. Most of the women work in administration and processing, with only 2.7% and 9.2% of the underground and surface workforces respectively being women. Approximately one-third of the workforce (32.5%) was "fly in/

fly out” (FIFO); that is, they fly in from metropolitan centres such as Perth, live in mine camps for the duration of their shift roster and then fly out for their days off.

Indicators of health status

Table 2 summarises the prevalence of a number of health status indicators for the sample population and provides the rates for national rural and remote indicators for comparison.

Table 2: Indicators of health status in the study population versus national rural and remote rates²⁴

	<i>Rural and remote rate (MC crude) %</i>			<i>Study results %</i>		
	<i>Male</i>	<i>Female</i>	<i>Total</i>	<i>Male</i>	<i>Female</i>	<i>Total</i>
Diabetes	3.8	3.4	3.6	7.5	6.8	7.2
Depression	4.3	6.6	5.4	19.3	12.7	16
Anxiety	3.4	6	4.6	13.9	7	10.4
Stress	9.8	11.8	10.8	9.2	8.6	8.9
Smoking	29.2	23.6	26.3	36.9	26.1	31.5
Binge drinking	29.9	19	–	16.1	31	24.2
Obesity	65.8	46.6	56.2	75.3	58.5	66.9

Smoking

A third of the sample smoked cigarettes, a rate higher than the national rural and remote population of 26.3% but similar to the smoking rates of other WA mine workers at 34.1%.^{24,25} More than half of smokers (51.5%) smoked 20 or more cigarettes per day, 36.5% smoked between 10–19 cigarettes per day and 12% smoked less than 10 cigarettes per day. The average number of cigarettes smoked by a smoker in the sample was 18 compared to 14 in the general population.²⁶

Alcohol use

The rates of risky drinking for short-term harm or binge drinking from a one item measure were divergent for males and females in the sample, with fewer males but more females drinking at harmful levels than their rural and remote population counterparts. Risky drinking for short-term harm constitutes drinking five or more standard drinks in one session for women and seven or more standard drinks for men.²⁷ By comparison, Clifford found that during their work period, one quarter of employees drank alcohol at “binge drinking” levels, with an even higher proportion doing so in leave periods.²⁸ Our findings were similar when AUDIT scores were analysed. The results showed that a third of those that had at least one standard drink in the year prior to the survey (44.9% males and 23.9% females) had an AUDIT score higher than 8, indicating harmful drinking.

Obesity

Two-thirds of the sample population was overweight or obese compared to 56.2% of rural and remote Australians aged 15 years and over.²⁵ However our results were similar to another study of WA mine workers found that 75% of the workforce was overweight and obese.²⁸

Males were twice as likely to be overweight or obese (OR 2.16, 95%CI 1.207–3.883, p = 0.010) and be at high risk of developing cardiovascular disease (OR 2.03, 95%CI 1.068–3.845, p = 0.031) when compared to females in the sample population. Being overweight or obese was not significantly associated with levels of physical activity at work, that is, overweight and obese employees did not carry out less physically demanding work than those that were in the normal weight range.

Diabetes

One in 14 had diabetes and one-third were at high risk of developing type II diabetes (as measured by having at least two known risk factors such as being overweight, or having a parent with the disease). Twice as many employees in our sample had diagnosed diabetes compared to their rural and remote counterparts (7.2% vs. 3.6%).

Depression, anxiety and stress

Descriptive analysis indicated that 28.5% of men and 18.6% of women were diagnosed as having depression, anxiety and/or stress. Almost one in six (17.4%) suffered from depression or anxiety or stress, and one in 20 suffered from a combination of two (5.1%) or all three (4.3%) of the conditions, with slightly more men than women affected. The rates of anxiety and depression in our sample were much higher than comparative national rural and remote figures, particularly for males. Keown also found that 28% of WA mining employees had depression or anxiety characteristics above clinical cut-off scores.²⁹

Factors associated with health status

Table 3 below summarises the variables significantly associated with harmful drinking, smoking, stress, depression, anxiety and total DASS-21 score.

Table 3: Factors significantly associated with dependent variables of interest*

<i>Dependent variable</i>	<i>Independent variable</i>	<i>Categories</i>	<i>OR</i>	<i>Multivariate analysis</i>	
				<i>95% CI</i>	<i>p</i>
AUDIT >8	Age groups	12–24 yrs	1	0.36–1.36	0.291
		25–44 yrs	0.70	0.10–0.53	0.000*
		45–64 yrs	0.23		
	Gender	Male	1	0.11–0.61	0.002
		Female	0.26		
	Marital status	Married/de facto	1	0.73–2.87	0.285
		Separated/divorced	1.45	1.59–4.91	0.000*
Single		2.79			
How stressed are you at work	Somewhat/a lot	1	0.22–0.73	0.003	
	Little/not at all	0.40			
Smoking (yes/no)	Age groups	12–24 yrs	1	1.01–3.46	0.047*
		25–44 yrs	1.87	0.44–1.91	0.812
		45–64 yrs	0.91		
	Shift length	<11 hrs	1	1.28–3.07	0.002
		>11 hrs	1.98		
Travel time to/from work	<60 mins	1	0.40–0.96	0.032	
Stress (yes/no)	Residential status	>60 mins	0.62		
		FIFO	1	1.64–12.25	0.003
	Work situation	Local resident	4.48		
		Good/very good	1	1.07–5.22	0.033
	Do you have stress at work	Average/poor	2.37		
		Few times a week/daily	1	0.20–0.97	0.041
		Few times a month/rarely	0.44		
	Perception of future	Positive/very positive	1	1.21–7.04	0.017
		Neutral/negative	2.92		
	Level of private life stress	Somewhat/very	1	0.12–0.60	0.001
Little/none		0.27			
Depression (yes/no)	Work situation	Good/very good	1	1.05–3.66	0.035
		Average/poor	1.96		
	Life satisfaction	Somewhat/very	1	1.70–6.46	0.000

		Neither/dissatisfied	3.32		
	Perception of future	Positive/very positive	1	1.37–5.24	0.004
		Neutral/negative	2.68		
	Level of private life stress	Somewhat/very little/none	1	0.22–0.71	0.002
Anxiety (yes/no)	Marital status	Married/de facto	1	0.51–2.91	0.651
		Separated/divorced	1.22	1.20–4.80	0.013*
	Employment area	Single	2.40		
		Administration/processing	1	1.21–9.52	0.020*
		Surface	3.40	0.73–5.76	0.176
		Underground	2.04		
	Do you have stress at work	Few times a week/daily	1	0.18–0.62	0.001
			0.33		
		Few times a month/rarely			
	Impact of muscle strain on life	Few times a week/daily	1	0.23–0.97	0.0242
			0.47		
		Few times a month/rarely			
	Level of private life stress	Somewhat/very	1		
DASS-21 (yes/no)	Age groups	12–24 yrs	1	0.72–3.35	0.262
		25–44 yrs	1.55	1.41–9.27	0.007*
		45–64 yrs	3.62		
	Residential status	FIFO	1	1.02–3.47	0.043
		Local resident	1.88		
	Work situation	Good/very good	1	1.29–3.92	0.004
		Average/poor	2.25		
	How stressed are you at work	Somewhat/a lot	1	0.16–0.78	0.010
		Little/not at all	0.35		
	Impact of muscle strain on life	Few times a week/daily	1	0.22–0.88	0.020
			0.44		
		Few times a month/rarely			
	Perception of future	Positive/very positive	1	1.50–5.21	0.001
		Neutral/negative	2.79		
	Level of private life stress	Somewhat/very little/none	1	0.25–0.73	0.002
			0.43		

*For each of the models, gender, marital status, hours of shift work, employment area, residential status, travelling time, work situation, work demands, influence work, stressed work, strain, strain impact, life satisfaction, perceive future, stress for private life, self-ranked stress were adjusted for.

Harmful alcohol use

Not surprisingly younger, single, male employees who were stressed at work were significantly more likely to use alcohol harmfully as measured by an AUDIT score of 8 and above, even after adjusting for other factors such as work department, shift length, residential status, travelling time to and from work, levels and frequency of stress in their private life, physical strain and its impact, overall life satisfaction and future outlook.

Smoking

Employees in the 25–45 age bracket, who worked shifts longer than 11 hours and whose travelling time to and from work was longer than 60 minutes were significantly more likely to be smokers even after adjusting

for factors such as gender, marital status, work department, residential status, levels and frequency of stress at work and in their private life, physical strain and its impact, overall life satisfaction and future outlook.

Stress

Employees who reside locally, have an average or poor work situation with frequent work-related stress and stress in their personal lives, with a neutral or negative outlook on their future were significantly more likely to be clinically stressed as measured by DASS-21.

Depression

Depression as measured by the DASS-21 was significantly associated with an average or poor work situation, dissatisfaction with life in general, a neutral or negative outlook on the future and high levels of personal stress, even after adjusting for age, gender, marital status, work department, shift length, residential status, travelling time to and from work, levels and frequency of stress at work, physical strain and its impact.

Anxiety

Single employees who work on the surface and who experience frequent stress at work, high levels of personal stress and who suffer from work-related muscle strain frequently were significantly more likely to have anxiety as measured by the DASS-21 instrument even after adjusting for age, gender, shift length, travelling time to and from work and residential status.

DASS-21 scores

Older, locally resident employees with average or poor work situations, high levels of work-related and personal stress, with a neutral or negative outlook to the future and who suffer from work-related muscle strain frequently were significantly more likely to score negatively on the DASS-21 instrument even after adjusting for gender, marital status, work department, shift length, travelling time to and from work.

Discussion

The results indicate that workers in this company have worse health indicators than similar rural and remote workers in Australia. A poor work situation, frequent and high levels of work-related stress and personal stress were significantly associated with all poor mental health scores, even after adjusting for several independent variables.

A limitation of this study is the use of self-report as the screening outcome measure and studies have shown that self-reported prevalence measures do not accurately reflect prevalence rates obtained from clinical or validated data.²⁰ Self-reported measures for behaviours with negative connotation such as alcohol use have been shown to be usually highly underreported while behaviours with positive connotation such as frequency of health care seeking have been shown to be overreported.³⁰ .³¹

We have attempted to overcome this limitation by the use of validated instruments to measure the variables of interest, eg AUDIT and DASS-21. For other variables such as physical characteristics, eg height and weight, we have had to rely on the self-report data. However, it was acknowledged that their accuracy was a limitation as research has shown that errors in self-reported height and weight were directly related to a person's age and overweight status respectively with bias and unreliability increasing directly with the age and magnitude of overweight.³² The implications for our study are that rates of obesity are likely to be under reported as are any risk factors in which height and weight or BMI are used.

The strengths of this study include the use of validated instruments to measure the variables of interest to increase the accuracy and reliability of the results and the provision of complete anonymity to participants to increase the response rate and decrease the likelihood of under reporting of self-report measures.

Despite a search of several databases and the internet, only a minimal number of similar studies were found that allowed us to discuss and compare findings.^{28,29} One of the strengths of this study is that it collected quantitative data from 591 mine employees, whereas the other studies had smaller sample sizes and focused on qualitative data. However, the main outcomes in all studies were similar, that is in the WA mining industry there are high rates of obesity and smoking as well as high rates of depression and anxiety.

A vital component that needs to be taken into account when assessing findings from health risk studies is the social and cultural context of the study population.^{33,34,35,36} In this particular example the workforce population is drawn substantially from the population of a regional mining town with a comparatively long history of a younger, male-oriented, "work hard party hard" culture. This is associated with significantly higher rates of tobacco and risky and high risk alcohol use as well as higher rates of risk-taking behaviour which increase the likelihood of chronic diseases.^{37,38} Although in this study, males did not report high levels of risky alcohol use when measured by a single question, it is well documented that self-reported drinking measures are unreliable and are usually highly underreported.³¹ This would be especially likely in our sample population which is derived from a safety oriented occupation like mining where repercussions of alcohol use or intoxication would be severe and where they are subjected to random alcohol and drug screening. However, the rates of risky drinking, when measured by the AUDIT, a validated instrument, were closer to those reported in other studies.^{25,26}

The recent changes that have occurred in the mining industry such as the higher degree of automation have led to work becoming less physically intensive and more sedentary and may provide a rationale for the high rates of obesity reported in this study. Interviews with several regional managers from a number of goldmining companies in the Goldfields have confirmed that working conditions are not as physically demanding as in the early years of mining, with approximately 15% of employees having physically demanding work consisting of frequent carrying, moving around, lifting and dropping items, climbing in and out of machinery, although physical conditions may be challenging being either too hot or too wet. Most miners, however, will be operating machinery for their entire shift, consisting of sitting and driving or sitting and pulling leavers.

Work-related stress in the mining industry is closely related to pressure to meet target deadlines of specific ounces of gold mined which are based on forecasting, that is the targets are set and the gold is sold in advance. High staff turnover contributes and exacerbates this stress through decreased productivity, declining morale amongst employees and increased difficulty in establishing and maintaining a positive mine site culture.³⁹

Reasons for the significant differences in health indicators between FIFO workers and locally residing mine workers, particularly in relation to work-related stress include the physical separation from the work environment during days off and higher income compared to resident workers. Unlike resident mine workers for whom there are expectations that they will be available for overtime and extra shifts when required, the physical distance from the work site for FIFOs provides an extra buffer from work-related stress. Furthermore, because while they are on site the living expenditures of FIFOs are greatly reduced as their meals, accommodation, local transport and other amenities are paid for in essence they receive a higher income when compared to resident workers.

In summary, even though the physical work demands in the WA mining industry are not as difficult as even 20 years ago, the mental health indicators with high levels of depression and anxiety suggest that the psycho-social working conditions are increasingly challenging and may be responsible for the high rates of mental health issues observed in this study.

Conclusion

Frequency and level of work-related stress, possibly related to pressure to meet production targets, is associated with negative mental health. Personal life stress is also significantly associated with high rates

of depression and anxiety, however, it is unclear whether work-related stress leads to personal life stress or vice versa.

Currently, the mining industry in Australia has well-developed systems in place for occupational safety and health and are beginning to investigate other factors that can impact on workplace health and safety such as lifestyle factors (smoking, alcohol and other drug use), physical health (exercise programs) and mental health (targeting stress, anxiety and depression). What is lacking is a strong evidence base for each of these areas in a workplace setting, so future research needs to focus on strengthening the empirical evidence for these types of interventions. Secondly, there is a need for a more comprehensive and proactive approach to workplace health where all of these components are integrated, rather than treated as separate entities in order to develop sustainable, evidence based model for a health workforce.

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Footnotes

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