

## **OBESITY AND THE NSW MINERALS INDUSTRY**

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## Executive Summary

Obesity is a major health and societal issue affecting all population groups. Prevalence of overweight and obesity in Australia has steadily increased over the past 30 years and is forecast to continue increasing. Overweight and obesity reduces life expectancy and is strongly associated with several chronic diseases and poorer quality of life. Health problems related to excess weight impose a substantial economic and personal burden. If obesity rates continue to increase, it is conceivable that the health and economic cost of obesity will grow to overwhelming proportions.

The fundamental cause of overweight and obesity is an energy imbalance between energy consumed and energy expended. When more energy is consumed than is expended, the excess energy is stored as body fat. An individual's dietary intake and physical activity are directly and indirectly influenced by a wide range of social, environmental, behavioural, genetic and physiological factors. Dietary intake and physical activity are influenced by the work, school and home environment, social networks, and more broadly by community, national and international factors influencing access to healthy food and opportunities for physical activity. Sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education affect food availability and the physical environment at an individual level by influencing access to healthy food and proximity to walking tracks, bike paths and swimming pools.

The increasing prevalence of overweight and obesity in Australia has significant consequences for both employers and employees. An individual's BMI is highly predictive of employee health care costs. When compared to healthy weight workers, obese workers have higher rates of absenteeism, reduced productivity, increased injury and illness and slower recovery. Obesity also increases the risk of fatigue, disability and death. In addition, obese workers are at greater risk of negative attitudes and discrimination.

There is a high proportion of overweight and obesity among NSW coal mines employees. Waist and body mass index (BMI) measurements collected for 10,870 employees (94.6% male) during periodic assessments from 2012 to 2014 were analysed. The prevalence of overweight and obesity among NSW coal miners was found to be 83.4%, which is higher than national and state levels, 63% and 52.5% respectively, and a WA mining population (69.6%). Obesity increased with age but was similar across operations (open cut versus underground) and by location (based on geographical area). Two methods for classifying overweight and obesity were analysed, BMI and waist measurement. Both methods demonstrated a high prevalence of overweight and obesity.

Rather than clear causative relationships, obesity develops as a result of multiple factors, between which there is complex interplay. Consideration of the factors contributing to obesity in the mining industry will assist with developing suitable approaches for improving diet and physical activity among mining employees, thereby reducing obesity prevalence. The factors found to be associated with obesity that may predispose the NSW coal mines population to a high prevalence of overweight and obesity include; low education and occupational status, low health literacy, long working hours, sedentary nature of work, workplace stress, low autonomy and control, mental illness, alcohol use and social factors.

Strategies to address obesity will be most effective if implemented in a range of settings, reflecting the multifactorial nature of obesity. The workplace is an important setting for obesity prevention and management whereby individual behaviour change can be supported by social leadership, a supportive culture and environment, and workplace policy and systems. Focusing interventions only on individual behaviours fails to address the environmental and social factors influencing physical activity opportunity and food and beverage choices that predispose people to obesity. However, there is still much to be

learnt about what approaches will prove to be the most effective in preventing and managing obesity in the workplace.

Weight loss programs that address the fundamental energy imbalance that causes overweight and obesity achieve tangible outcomes. The criterion for a successful weight loss program is a 5% to 10% reduction in initial weight, which brings about significant improvement in medical and psychosocial outcomes. These improvements are observed even if weight remains in the overweight or obese weight categories and even when weight is regained. The success and subsequent return on investment of any workplace program is ultimately determined by the level of employee engagement. Although mandatory programs require participation, they do not promote engagement.

The “**World Class Miners**” campaign makes a clear commitment and builds awareness that the NSW Mining Industry aspires to go beyond simply creating jobs and generating money for the NSW economy, to reducing the impact on the environment, innovative technology, world leading safety and building stronger communities. The extent of the obesity problem identified in the present report provides a new opportunity to demonstrate the next frontier of being World Class Miners. Never before has an industry-wide approach to obesity been reported. Thus, the opportunity exists to engage key stakeholders and experts in developing a comprehensive, industry-wide blueprint for the prevention and management of obesity.

Effective weight management is a new area of investment for the industry and brings with it both enormous challenge and the potential for great benefit.

The following recommendations are made for the prevention and management of overweight and obesity in the NSW Minerals Industry:

- Convene key stakeholders and obesity experts to create a blueprint to set clear policy direction to address obesity prevention and management in the industry;
- Lead an industry-wide change for better health by implementing innovative and effective workplace policies, systems and environmental approaches;
- Shift from an ad-hoc site-by-site approach and engage key stakeholders in developing a coordinated, comprehensive, industry-wide approach;
- Establish a clear commitment to the blueprint and its recommendations, across all facets of the industry: leadership, culture & environment, systems & policy and people;
- Engage in a ‘learning by doing’ approach, or a staged trialing of interventions, accompanied by good monitoring and evaluation over the longer term;
- Improve research, evaluation, monitoring and surveillance to understand the effectiveness of different workplace strategies targeting obesity and overweight on individuals, the workplace and the broader community.

# 1. Introduction

Overweight and obesity are one of the most prevalent risk factors affecting the health of the all Australians, including those in the New South Wales (NSW) coal mining workforce. Effective weight management is a new area of investment for the industry and brings with it both enormous challenge and the potential for great benefit.

## 1.1 Aim of this Paper

This paper presents data on current overweight and obesity rates for employees in NSW coal mining operations and comparisons with other state and national data. The scale and impact of overweight and obesity on individuals and the workplace is discussed. The characteristics of effective strategies for achieving and maintaining a healthy weight in the context of the workplace are described. The report is a preliminary step in the introduction of initiatives by the NSW Minerals Industry to support individuals and workplaces to promote lifestyle habits to maintain a healthy weight and optimise health and wellbeing.

## 1.2 Methods

The prevalence of overweight and obesity in the NSW Minerals Industry was based on data provided by Coal Services Health from 3-yearly periodic medicals conducted between January 2012 and December 2014. No data was available from metalliferous or other mining sectors. The obesity data for the NSW Coal Industry workforce was compared with published state and national obesity data. The literature review included the current impact of overweight and obesity on individuals and workplaces, as well as the key principles and considerations for effective workplace strategies for preventing and managing overweight and obesity. Published research articles and reports from relevant organisations were included in the literature review.

## 1.3 The NSW Mining Industry Workforce

NSW Mining plays an important role in the state's economic prosperity, not only in our mining communities, but statewide {Council, 2014 #15}. The number of people employed in mining in NSW grew steadily between 2003 and 2012 when record highs in mining employment were reached {NSW Minerals Council, 2012 #16}. In 2012, a total of 24,989 people were employed in the NSW mining industry {NSW Minerals Council, 2012 #16}. This growth has been tempered by changes to market conditions in the second half of 2012, particularly in the coal sector {NSW Minerals Council, 2012 #16}. In 2013/14, the NSW Minerals Council conducted a survey of 22 mining and exploration companies which found that NSW mining companies employed 1,967 fewer people in 2013/14 than the previous year {NSW Mining, 2014 #17}. A number of coal mines have been placed into care and maintenance. Many employees at those operations were redeployed to other sites within affected companies to minimise the impact on the workforce. However, there have been some job losses and some expansion projects have been put on hold until conditions improve {NSW Minerals Council, 2012 #16}.

Women make up a small but increasing percentage of the mining workforce. The number of women employed in the mining industry across Australia grew by 82% between November 2009 and November 2012 {NSW Minerals Council, 2012 #16}. A recent NSW Mining survey found that women comprised 9% of the full-time equivalent workforce, with similar figures to Australian Bureau of Statistics data of 10.32% of women employed in mining and related industries in NSW {NSW Mining, 2014 #18}. Women

are employed predominantly as machinery operators or drivers (30%) with a small percentage (0.5%) in board or executive management roles {NSW Mining, 2014 #18}.



## 2. Obesity in Australia

Obesity is now a major health and societal issue for Australia (6). Excess body fat is an established risk factor for numerous chronic diseases and premature death (7). The effects of overweight and obesity are widely recognised as one of Australia's leading health concerns, affecting individuals in all age and socioeconomic groups (8).

### 2.1 Defining Obesity

Body Mass Index (BMI), waist circumference (WC) and waist-to-height ratio (WtHR) are well established indexes for classifying overweight and obesity, with increasing values independently associated with increased disease risk (9).

#### Body Mass Index (BMI)

The international definition for overweight and obesity is based on BMI which is calculated by dividing weight in kilograms by height squared in metres ( $\text{kg/m}^2$ ) (10). The BMI categories used to define overweight and obesity are shown in Table 1.

**Table 1: International BMI classification in adults (10)**

BMI ( $\text{kg/m}^2$ )	Classification
<18.5	Underweight
18.5-24.9	Healthy weight
25.0 – 29.9	Overweight
$\geq 30.0$	Obese

BMI = body mass index

$\text{kg/m}^2$  = weight (kg)/height squared ( $\text{m}^2$ )

The same BMI cut-offs are applied to males, females and adults of all ages (10). A BMI in the 'overweight' or 'obese' category is an indication that 'excess body fat has accumulated to an extent that is likely to be detrimental to health' (8).

#### Limitations of BMI

There are some limitations to the use of BMI. There is evidence that the associations between BMI, percentage of body fat, and body fat distribution can vary across different populations {WHO, 2015 #24}. However, the health risks associated with increasing BMI are continuous {WHO, 2015 #24} and BMI appears to be as strongly correlated with various metabolic and disease outcomes, as well as, more direct measures of body fatness such as waist circumference {Gierach, 2014 #39}, skinfold thickness measurements, bioelectrical impedance, densitometry (underwater weighing) and dual energy x-ray absorptiometry (DEXA) {CDC, 2015 #36; Sun, 2010 #27}. Such methods are not readily available, and are either expensive or need to be conducted by highly trained personnel. Furthermore, many of these methods can be difficult to standardize across observers or machines, complicating comparisons across studies and time periods.

Age, gender and muscle mass can influence the interpretation of BMI. On average, older adults tend to have more body fat than younger adults for an equivalent BMI. Women, on average, have greater amounts of total body fat than men with an equivalent BMI. Muscular individuals, or highly-trained athletes, may have a high BMI because of increased muscle mass.

While BMI is not a direct measure of body fat, it is inexpensive, easy-to-perform, suitable for large scale studies and correlates with disease outcomes. A review of BMI cut-off points and their application to different populations was undertaken and the cut-off points shown in Table 1 established as the international BMI classification (10).

### Waist circumference

As waist circumference increases, so too does the risk of developing metabolic syndrome which is defined as a group of coexisting metabolic risk factor, such as central obesity, lipid disorders, carbohydrate disorders and hypertension {Gierach, 2014 #39}. Metabolic factors increase the risk of developing metabolic diseases such as heart disease, Type 2 diabetes and high blood pressure {Gierach, 2014 #39}. Currently accepted cut-off points for waist circumference and associated health risk are shown in Table 2.

**Table 2: Waist Circumference Cut-off points for metabolic risk\* {WHO, 2008 #78}**

Risk of metabolic disease	Classification	
	Males	Females
<b>Low</b>	<94cm	<80
<b>Increased</b>	94-101.9	80-87.9
<b>Substantially increased</b>	102+	88+

\*Coexisting risk factors, such as central obesity, lipid disorders, carbohydrate disorders and hypertension, which increase the risk of developing cardiovascular disease and type 2 diabetes.

The level of association between BMI and waist circumference is often significant but can vary (11). It is desirable to obtain both BMI and waist circumference where possible (9). Waist measurements can be prone to measurement error due to differences in measurement techniques and individual factors of the subject, specifically posture, phase of respiration, abdominal tension and stomach contents (9).

### Waist-to-Height Ratio

Waist-to-height ratio (WHtR) has been proposed as an alternative measure of obesity. WHtR is a good proxy for central fat, which has greater health risks than fat stored in other areas of the body (13). When interpreting WHtR values the same cut-off (0.5) can be used for males and females for all ages (13). Values greater than 0.5 indicate an increased risk of morbidity and mortality due to obesity related illness (13). The WHtR supports a simple health message, 'Keep your waist circumference to less than half your height'.

## 2.2 Causes of Obesity

The fundamental cause of overweight and obesity is an energy imbalance between energy consumed and energy expended {WHO, 2015 #26}. Excess body weight results from prolonged energy imbalance, with the excess energy stored as body fat {National Health and Medical Research Council, 2013 #12}. Globally, there has been an increased intake of energy-dense foods; and a reduction in physical activity due to the increasingly sedentary nature of many forms of work, transport and increasing urbanisation {WHO, 2015 #26}.

An individual's dietary intake and physical activity are directly and indirectly influenced by a wide range of social, environmental, behavioural, genetic and physiological factors (8). Physiologically, body weight is regulated through a complex system of interactions and feedback mechanisms that regulate appetite, energy intake and energy expenditure (8). Diet and physical activity are also influenced more broadly through policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education (14). It has been well documented that policy can drive changes in the physical, economic and socio-cultural factors that contribute to obesogenic environments (15).

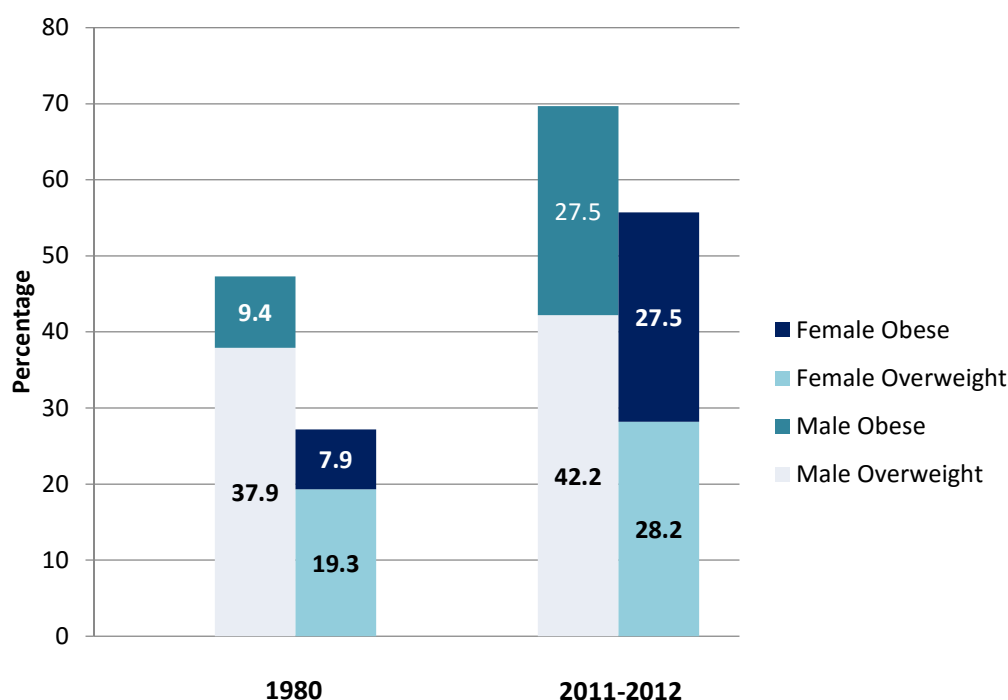
## 2.3 Trends and scale of the Problem

The prevalence of overweight and obesity in Australia is currently 63% (35% overweight and 28% obese) (16). Australia has the fourth highest prevalence of obesity among OECD countries (17). Over the past 30 years, the prevalence of overweight and obesity in Australia has steadily increased (8) and is forecast to continue increasing (18).

While overweight and obesity are prevalent in all population groups, variation exists in their distribution across the Australian population. **The prevalence of overweight is higher in males than females** (42% versus 35%), while obesity is similar among males and females (28%) (19). **Obesity is particularly prevalent among those in the most disadvantaged socioeconomic groups** (20), Aboriginal and Torres Strait Islander peoples and many people born overseas (20). **Obesity is also more prevalent in rural and remote areas compared to urban areas** (8, 20). **The proportion of adults who were overweight or obese was lower among people living in major cities (52%) and increases with geographic remoteness** (Inner regional - 56%, and outer regional and other areas - 60%) (20, 21).

### Overweight and obesity rates continue to increase

Obesity prevalence has increased rapidly since 1980 and continues to increase. In 1980 the proportion of men who were obese was 9.4% (22) which increased to 27.5% by 2011-12 (16). In the same period, obesity prevalence more than tripled in women, with an increase from 7.9% (22) to 27.5% (16) as shown in Figure 1.



**Figure 1: Increasing prevalence of overweight and obesity from 1980 to 2011-12**

Obesity levels are predicted to continue to increase during the next decade across all age groups (8). Projections estimate that the prevalence of overweight and obesity will increase to over 70% by 2025, with one third of Australian adults classified as obese (6).

## 2.4 Health, social and economic impact of obesity

Health problems related to excess weight impose substantial economic burden on individuals, families and communities. Overweight and obesity is strongly associated with several chronic diseases, reduced life expectancy and poorer quality of life (8). Overweight and obesity reduces life expectancy and increases risk of disease (13). Obesity-related conditions include sleep apnoea (23, 24), cardiovascular disease, Type 2 diabetes, osteoarthritis, reflux and some cancers (8). As BMI increases, so too does the severity of health complications related to excess weight. One kilogram of weight gain increases diabetes risk by 4.5%–9.0% and cardiovascular disease risk by 3.1% (25). Obesity is associated with a 6–20 year decrease in life expectancy (25). Analysis of prospective data shows that a 30 year old male, non-smoker with a BMI of 40 is expected to live 10.5 years less than a 30 year old male, non-smoker with a BMI of 24 (13). The odds of developing obesity-related illness over a ten year period are shown in Table 3.

**Table 3: Ten-Year risk of developing an Obesity-Related Comorbidity: Data from the Nurses' Health Study (n=77,690, women) and the Health Professionals Follow-up Study (n=46,060, men)**

Obesity-Related Disease	Women (n=77,690)		Men (n=46,060)	
	Obese BMI – 30.0 to 34.9	Morbidly Obese BMI ≥ 35	Obese BMI – 30.0 to 34.9	Morbidly Obese BMI ≥ 35
Adjusted Odds Ratios (95% CI)				
<b>Diabetes</b>	10.0 (8.4-11.8)	17.0 (14.2-20.5)	10.0 (8.4-11.8)	17.0 (14.2-20.5)
<b>Heart Disease</b>	1.5 (1.3-1.7)	1.5 (1.3-1.8)	1.5 (1.3-1.7)	1.5 (1.3-1.8)
<b>Stroke</b>	1.0 (0.8-1.4)	1.1 (0.8-1.7)	1.0 (0.8-1.4)	1.1 (0.8-1.7)
<b>Hypertension</b>	2.1 (1.9-2.2)	2.3 (2.1-2.6)	2.1 (1.9-2.2)	2.3 (2.1-2.6)
<b>Colon Cancer</b>	1.3 (1.0-1.7)	1.8 (1.3-2.6)	1.3 (1.0-1.7)	1.8 (1.3-2.6)
<b>Gallstones</b>	2.5 (2.3-2.7)	3.0 (2.7-3.3)	2.5 (2.3-2.7)	3.0 (2.7-3.3)

1. BMI indicates body mass index; CI, confidence interval
2. Odds Ratios have been adjusted for age, smoking status and race.
3. Adapted from {Apovian, 2013 #129}

As BMI increases, there are measurable declines in physical function, quality of life and mood (27). There is a complex relationship between obesity and mental illness. Schizophrenia, bipolar disorder and depression, have all been shown to be associated with increased risk of overweight and obesity (28, 29).

The financial costs of obesity in Australia in 2008 were estimated at \$58 billion per year (30). This estimate includes \$8.3 billion in financial costs and \$49.9 billion in the value of lost wellbeing, which accounts for years of healthy life lost through disability and /or premature death (30).

### 3. Obesity and the workplace

The increasing prevalence of overweight and obesity in Australia has significant consequences for both employers and employees. When compared to healthy weight workers, obese workers have higher rates of absenteeism, reduced productivity, increased injury and illness and slower recovery (30). Obesity also increases the risk of disability and death (31). In addition, obese workers are at greater risk of negative attitudes and discrimination which may translate into absences from work (31). Excess weight is a risk factor for many health conditions that are not life threatening, such as musculoskeletal disorders and sleep apnoea, but can interfere with an individual's capacity to work (31). Cardiorespiratory fitness may also impact on work effort and impair an employee's ability to stay at work during a minor illness (31).

#### 3.1 Increased absenteeism

Between 2006 and 2010, absenteeism rates in Australia increased from 8.5 days per person to 9.87 days per person (32). In 2010, workplace absences in Australia were estimated to cost an average of \$3,741 per employee per year (32). An estimated 75% of unplanned absences are for illness, demonstrating a clear link between worker health and absenteeism (32).

Obese workers take more sick leave than healthy weight workers and for a longer duration (33-37). In Australia, obese employees are 17% more likely than non-obese employees to be absent from work for at least one day. In addition, the average length of absenteeism is greater for obese and overweight employees (3.2 days) compared to non-obese employees (2.3 days for underweight and 2.8 days for healthy weight) (30). In 2001, obesity was associated with over 4 million days lost from the Australian workplace (30).

#### 3.2 Increased presenteeism

Presenteeism is a self-reported measure of diminished on-the-job work performance due to health or life problems (35). Presenteeism occurs when employees are at work but are not fully functioning (32). Overweight and obese workers have a higher incidence of presenteeism (35). The estimated cost of presenteeism is between three and four times that of absenteeism (32), however, since most employers do not routinely measure presenteeism (35) it is considered a 'hidden' cost. The true cost of an unhealthy workforce is likely to be much larger than estimated (32).

#### 3.3 Lower productivity

Obesity has been associated with productivity loss (34, 38). It has been reported that the healthiest employees are almost three times more productive than their unhealthy colleagues (39). Healthier employees report working approximately 143 effective hours per month compared to 49 effective hours worked per month for a worker with poorer health (39).

#### 3.4 Increased injury and duration

Workers that are overweight or obese and physically unfit have been reported to have significantly higher incidence of workplace accidents and nonfatal injuries (30, 36). Injury recovery times have also been reported to be longer (36), as excess weight has the potential to exacerbate the severity of the

injury, and add complications to the treatment of injuries (30). The mechanism for exacerbating the severity of lower limb injuries is illustrated by the contribution of excess bodyweight to increased knee load at a ratio of 1:4, so that each kilogram of weight places 4 kilograms of load on the knee (40). The association of obesity and musculoskeletal injuries is not limited to lower limb. Upper-limb musculoskeletal disorders, such as Hand-Arm Vibration Syndrome (HAVS), have been shown to be associated with obesity (34).

### **3.5 Reduced earning potential**

Obesity may directly and indirectly affect earning potential. Obesity is likely to impact directly on earning potential by reducing work opportunity and performance {Schulte, 2007 #52}. Indirect impacts to earning potential occur when people are required to leave the workforce, reduce their hours, or take a temporary leave of absence for health reasons {Georgetown Health Policy Institute, 2004 #30}.

### **3.6 Increased risk of fatigue**

Obesity has also been shown to significantly increase the risk of fatigue, which is a recognised health, safety and business risk within the mining industry. An American study examined the complaints of Excessive Daytime Sleepiness (EDS), a marker of fatigue, on 16,583 men and women and found that BMI was independently associated with EDS with an effect size second only to depression, and an association stronger than Sleep Disordered Breathing (SDB), such as sleep apnoea. They found a dramatic increase in the prevalence of EDS around a threshold of BMI that is considered to be overweight (BMI =28). The authors reported that their findings were consistent with previous studies that have observed a strong association between BMI and EDS in the absence of SDB (42).

### **3.7 Increased health care and worker's compensation costs**

A worker's BMI is highly predictive of health care costs (34) and there is evidence of higher worker's compensation claims costs in overweight and obese workers in the mining industry. One study found that BMI was the only significant predictor of employee health care costs ( $P=0.009$ ), while age, gender, race, education and smoking status were not significant predictors (36). A 'J-shaped' curve exists for health care costs and BMI, with the lowest costs occurring at a BMI of 25-27 (43). One study found that medical expenses increased from \$114 for healthy weight employees to \$573 for overweight employees and \$620 for obese employees (30). Physical activity appears to be a mediating factor within BMI categories, with lower costs associated with higher physical activity levels (36). Workplace health spending is 36 percent higher on obese workers than in healthy weight workers, and most of this higher spending is due to the treatment of obesity-related conditions such as diabetes, hyperlipidemia, and heart disease (35). The indirect costs of obesity, such as absenteeism, presenteeism, lost productivity and workers compensation claims, may be greater than the direct medical costs (35, 41, 44).

Worker's compensation claims have been shown to be significantly affected by obesity and physical activity. Coal Services Health reported in a conference presentation (unpublished) in 2010 on worker's compensation claims costs during a 3-year period (from 1/1/08 to 31/12/10) for all NSW Coal Mine Workers (CMW). The total claims costs were significantly higher for overweight and obese workers, when compared with healthy weight workers, as indicated in Table 4. This can be explained by the greater proportion of the workforce being in the overweight and obese BMI categories. However, the average claims cost was higher for overweight and obese individuals, when compared with healthy weight workers.

**Table 4: Claims cost, by BMI**

	Normal	Overweight	Obese
<b>Total claims cost</b>	\$16,806,445	\$27,941,601	\$27,476,755
<b>Average claims cost</b>	\$52,685	\$54,895	\$55,734
<b>Total number of claims</b>	319	509	493

Inadequate physical activity was associated with significantly higher claims costs, particularly when combined with obesity. Table 5 shows that, when compared to their colleagues who report adequate activity, CMW who undertake inadequate activity have 19% more claims, 14% or approximately \$7,000 greater average cost of claim and are costing the industry \$10 million more over the 3-year time period. When CMW are physically inactive and obese, worker's compensation costs are magnified with a significantly higher average claims cost (\$67,280). When comparing claims for obese individuals with and without adequate activity, the number of claims for those with inadequate activity are only marginally higher (5%). However, there is a 76% or approximately \$29,000 greater average cost of claim, which is costing the industry \$7.5 million more over the 3-year time period. This information contributes a substantive financial imperative to address obesity and physical inactivity in the mineral industry.

**Table 5: Claims cost, by Exercise Pattern**

	All weight categories			Obese weight categories		
Activity Pattern	Total claim cost	Average claims cost	Total number of claims	Total claim cost	Average claims cost	Total number of claims
Adequate	\$28,630,330	\$50,053	572	\$8,920,237	\$ 38,284	233
Inadequate	\$38,902,984	\$56,959	683	\$16,483,525	\$ 67,280	245
Variance	↑\$10,272,654	↑14%	↑19%	↑\$7,563,288	↑76%	↑5%

### 3.8 Safety and modifications to the working environment

With increases in overweight and obesity, it is likely that modifications will be required to the design of working environments, including plant and equipment, to ensure suitability for overweight and obese employees (30). Current standards may need revisions to ensure weight capacities for equipment such as ladders, hoists, elevators, seats and forklifts are appropriate for an increasingly overweight population (30).

The impact of overweight and obesity on the suitability, effectiveness and availability of personal protective equipment (PPE) is not well understood (34). The design and testing of PPE, such as respirators, hard hats, safety glasses and gloves, needs to consider workers with larger body dimensions to ensure all PPE achieves the required level of protection (30).



### **3.9 Specific cases in the NSW Minerals Industry**

There have been a number of cases whereby a mining operation has stood down or terminated on the basis of an employee's weight and the related safety implications. In these cases, it was determined that the individuals were considered unable to effectively carry out their job and were a danger to both themselves and their colleagues. In one case, a claim for compensation was filed by the individual for psychiatric injury as a consequence of the termination. However, the ruling was found in favour of the workplace. The workplace and the insurer argued that they were not able to disregard specialist medical advice in respect to the obese worker, as well as the risk the obesity presented to the individual and others in the workplace, and that their termination was lawful and reasonable with respect to the organisations' legal obligation to control risk in the mining operation. The court noted that the worker would not be able to fulfil the inherent duties of the role which included ability to walk on uneven ground; walk a reasonable distance; get on and off a machine; and act and assist in an emergency situation. It is worth noting that the workplace had implemented a range of Employee Assistance initiatives to support the worker which amounted to a reported \$40,000.00 on top of backfilling the workers position.

There have been a number of other cases where mine workers have been stood down for safety reasons, which have included "significant risk" of heart attacks or exceeding the "tolerance limits" of equipment, for example, seats in heavy vehicles not rated to take weights above 120 kilograms. Some individuals have been required to undergo medical examination to confirm their fitness for work and undergo a weight loss regime prior to their reinstatement.

## 4. Obesity in the NSW Minerals Industry

### 4.1 Scale of the Problem

The overweight and obesity data presented below comes from a dataset provided by Coal Services Health. Waist and BMI measurements were collected during periodic assessments conducted for NSW mining employees between January 2012 and December 2014. Classification of overweight and obesity were based on well-established cut-offs, as described in Section 2.1. Appendix A shows the number of records excluded from the original dataset to enable analysis of the variables for waist and BMI.

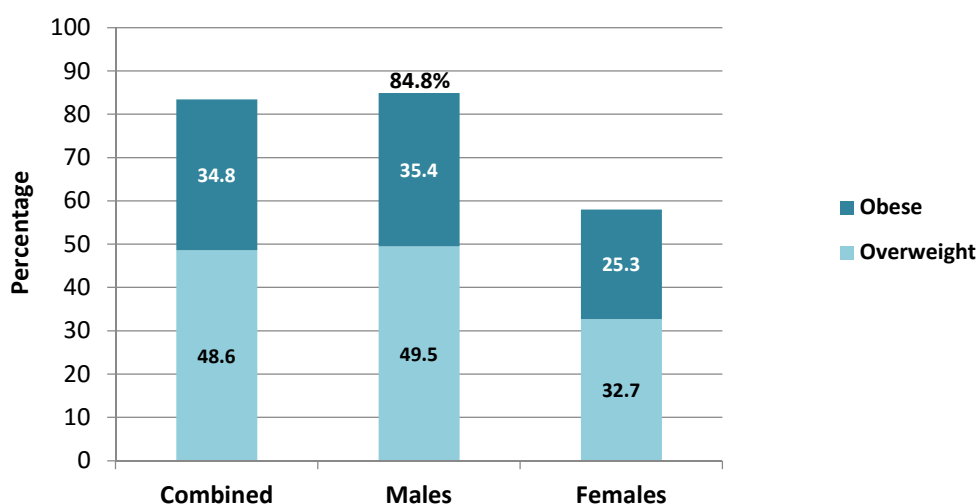
#### 4.1.1 Gender

Males had a higher prevalence of overweight and obesity (84.8%) than females (58.0%), as shown in Table 6 and Figure 2 below.

*Table 6: BMI Category, by Gender*

	Gender (n=10,796)	
	Males (n=10,211, 94.6%)	Females (n=585, 5.4%)
Mean BMI (sd)	28.6 (4.3)	26.3 (5.4)
Underweight	12 (0.1%)	13 (2.2%)
Healthy weight	1,536 (15.0%)	233 (39.8%)
Overweight	5,052 (49.5%)	191 (32.7%)
Obese	3,611 (35.4%)	148 (25.3%)

These results concur with a recent study among male NSW coal mines employees, which found the prevalence of overweight and obesity was 84.3% (45).



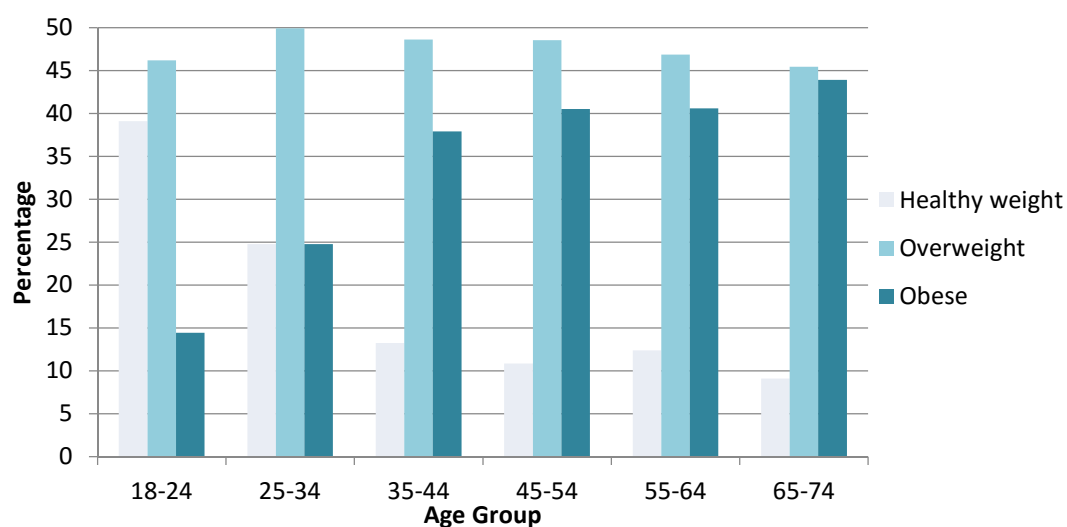
**Figure 2: Proportion of overweight and obesity, by gender**

#### 4.1.2 Age

As shown in Table 7 and Figure 3, the proportion of workers in the obese BMI category increased with age, while the proportion of workers in the healthy weight category decreased. The prevalence of overweight was relatively stable with increased age.

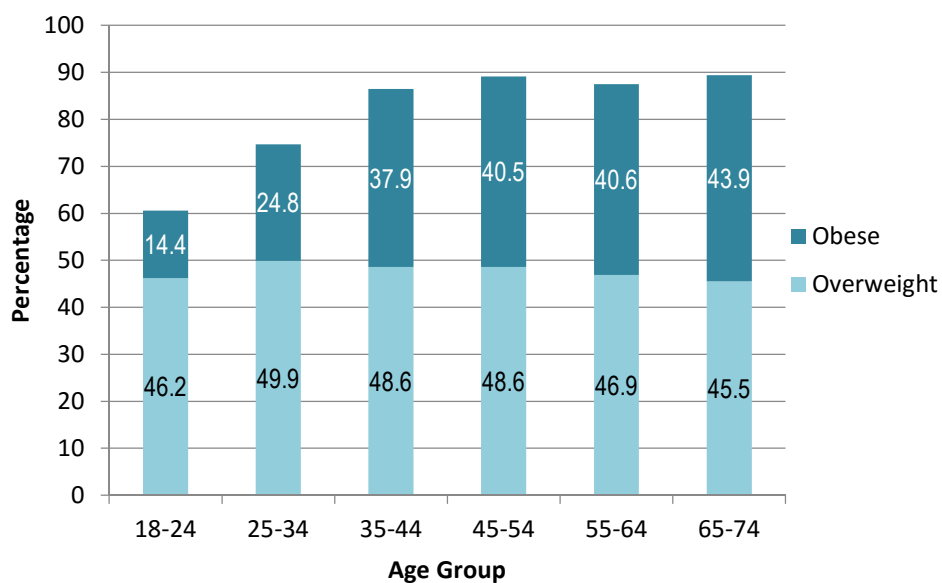
**Table 7: BMI Category, by Age**

	Age category						
	18-24 years (n=409)	25-34 years (n=2,764)	35-44 years (n=3,077)	45-54 years (n=2,881)	55-64 years (n=1,623)	65-74 years (n=66)	75+ years (n=4)
Mean BMI (sd)	-	-	-	-	-	-	-
Underweight	1 (0.2%)	14 (0.5%)	7 (0.2%)	1 (0.03%)	2 (0.1%)	1 (1.5%)	0 (0%)
Healthy weight	160 (39.1%)	685 (24.8%)	407 (13.2%)	313 (10.9%)	201 (12.4%)	6 (9.1%)	0 (0%)
Overweight	189 (46.2%)	1,380 (49.9%)	1,496 (48.6%)	1,399 (48.6%)	761 (46.9%)	30 (45.5%)	4 (100.0%)
Obese	59 (14.4%)	685 (24.8%)	1,167 (37.9%)	1,168 (40.5%)	659 (40.6%)	29 (43.9%)	0 (0%)



**Figure 3: Proportion of overweight and obese workers in NSW coal mining, by age**

When overweight and obesity were combined, there was a clear increase in obesity as age increased, as shown in Figure 4.



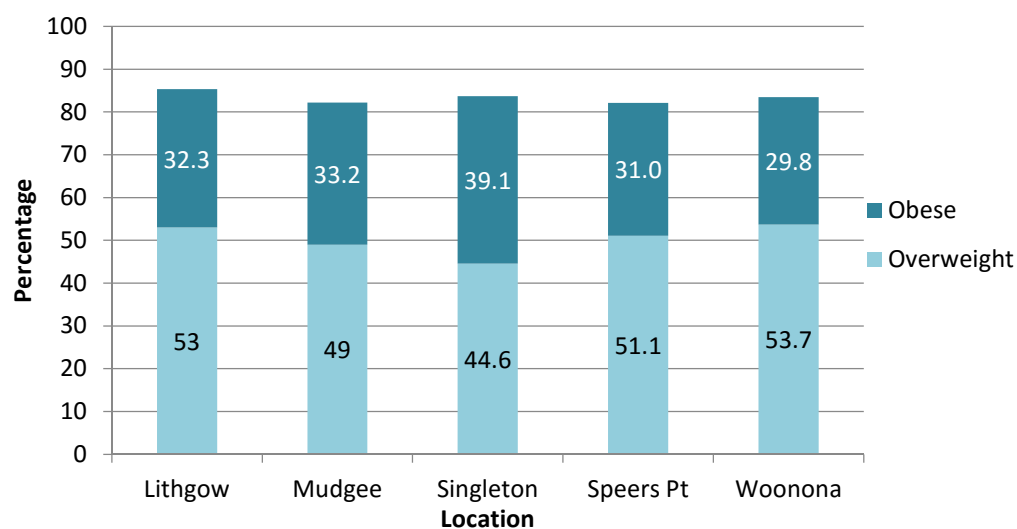
**Figure 4: Proportion of overweight and obesity by age group**

### 4.1.3 Location

Table 8 and Figure 5 show the proportion of overweight and obesity (combined) was more than 80% for each location.

**Table 8: BMI Category, by Location**

	Location				
	Lithgow (n=921)	Mudgee (n=614)	Singleton (n=5,066)	Speers Point (n=2,226)	Woonona (n=2,002)
Underweight	2 (0.2%)	5 (0.8%)	15 (0.3%)	2 (0.1%)	2 (0.1%)
Healthy weight	134 (14.6%)	104 (16.9%)	814 (16.1%)	395 (17.7%)	329 (16.4%)
Overweight	488 (53.0%)	301 (49.0%)	2,258 (44.6%)	1,138 (51.1%)	1,075 (53.7%)
Obese	297 (32.3%)	204 (33.2%)	1,979 (39.1%)	691 (31.0%)	596 (29.8%)



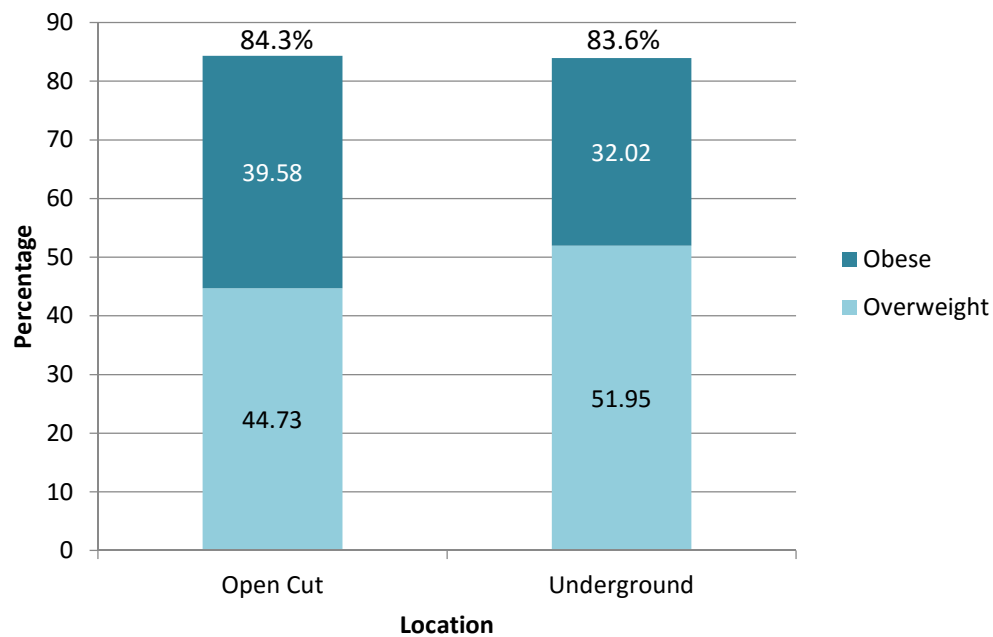
**Figure 5: Proportion of overweight and obesity by location**

#### 4.1.4 Operation

The proportion of overweight and obesity was just over 80% for both underground and open cut operations, as shown below in Table 9 and Figure 6.

**Table 9: BMI Category, by Operation**

	Operation		
	Open Cut (n=3,845)	Underground (n=4,656)	N/A (n=757)
Mean BMI (sd)	-	-	-
Underweight	14 (0.4%)	8 (0.2%)	3 (0.4%)
Healthy weight	589 (15.3%)	738 (15.9%)	171 (22.6%)
Overweight	1,720 (44.7%)	2,419 (52.0%)	381 (50.3%)
Obese	1,522 (39.6%)	1,491 (32.0%)	202 (26.7%)



**Figure 6: Proportion of overweight and obesity, by operation**

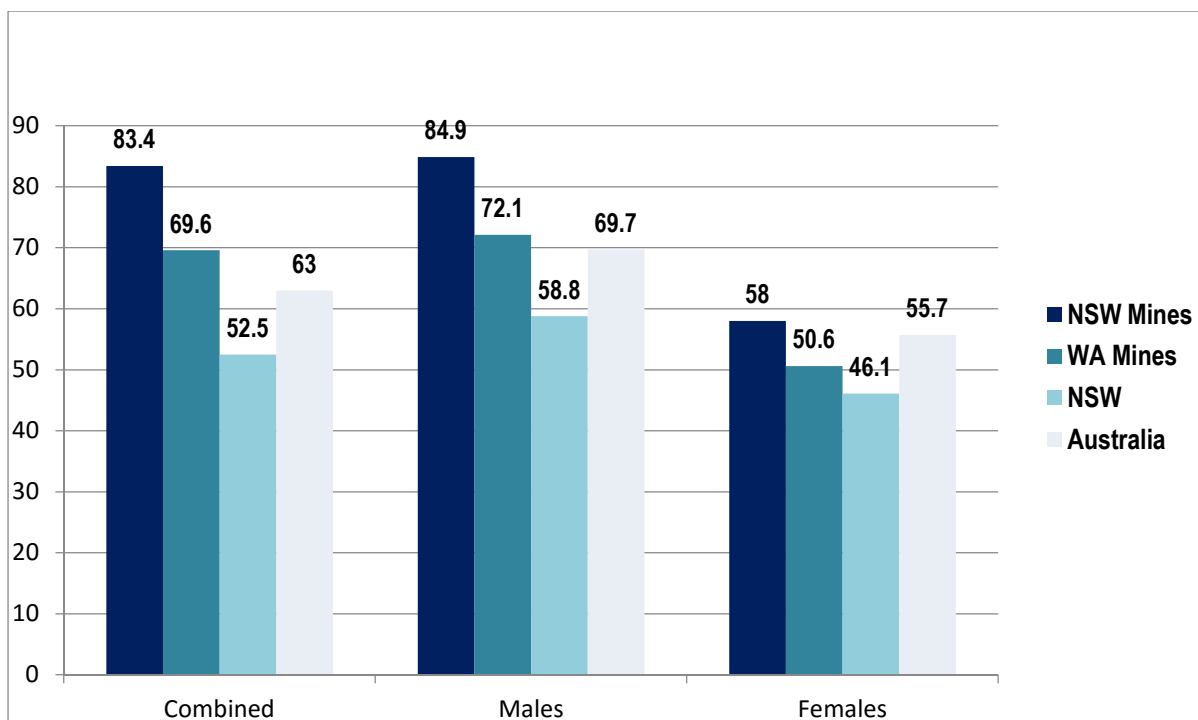
#### 4.1.5 Comparison with state, national and WA mines obesity data

The prevalence of overweight and obesity for NSW coal mines employees was higher than the prevalence based on data from WA mines (46), the NSW general population (47) and Australian general population (16) and is presented below in Table 10 and Figure 7.

**Table 10: BMI Category, comparison data**

		Overweight (%)	Obese (%)	Overweight and Obese (%)
<b>NSW Mines 2012-2014 n=10,829 (10,211 males)</b>	<b>Combined</b>	<b>48.6</b>	<b>34.8</b>	<b>83.4</b>
	Males	49.5	35.4	84.9
	Females	32.7	25.3	58.0
<b>WA Mines<sup>1</sup> 2008-09 n=29,158 (26,635 males)</b>	<b>Combined</b>	<b>42.1</b>	<b>27.5</b>	<b>69.6</b>
	Males	43.9	28.2	72.1
	Females	28.8	21.8	50.6
<b>NSW (General Population)<sup>2</sup> 2014 n=12,050 (5,124 males)</b>	<b>Combined</b>	<b>33.0</b>	<b>19.5</b>	<b>52.5</b>
	Males	40.2	18.6	58.8
	Females	25.7	20.4	46.1
<b>Australia (General Population)<sup>3</sup> 2011-12 n=14,259 (7,216 males)</b>	<b>Combined</b>	<b>35.0</b>	<b>28.0</b>	<b>63.0</b>
	Males	42.2	27.5	69.7
	Females	28.2	27.5	55.7

1. Government of Western Australia Department of Mines and Petroleum Resources Safety (2010). Weighty issues in WA Mining. MineSafe. Vol. 19, No. 1. p 18-19. {Department of Mines and Petroleum, 2010 #13}
2. NSW Population Health Survey (2014) {NSW Ministry of Health, #99}
3. Australian Health Survey 2011-12 {ABS, 2013 #9}



**Figure 7: Overweight and obesity data in NSW Mines, NSW general population, Australian general population and WA Mines, by gender**

The prevalence of overweight and obesity for the NSW General Population, as shown in Figure 6 above, was for self-reported height and weight. These figures are likely to be lower than the actual figures, due to the underestimation of BMI for self-reported data, rather than measured. In general, individuals tend to overestimate their height and underestimate their weight, resulting in an underestimation of BMI (48). There are a number of other factors influencing the accuracy of self reported data, including gender, age and weight status (48). Another factor that is likely to explain the higher prevalence of overweight and obesity in the NSW Mining data when compared with NSW and Australian General population data is that the NSW Mining data has a higher proportion of males and males consistently demonstrate a higher prevalence of obesity.

#### 4.1.6 Waist category by gender

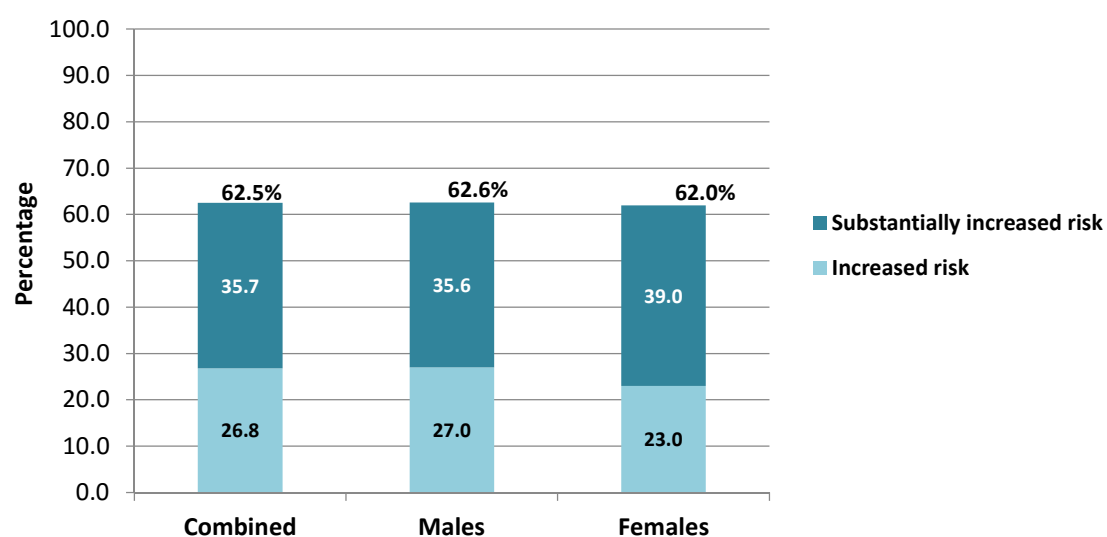
When waist measurement was used to categorise overweight and obesity, the prevalence of workers in the overweight and obese category (combined) was similar (males 62.6%, females 62%), as shown in Table 11 and Figure 8. However, the prevalence of obesity as classified by waist measurement was higher among women.



**Table 11: Waist Category, by Gender**

	Gender		
	Combined (n=10,483)	Males (n=9,921)	Females (n=595)
<b>Mean Waist (sd)</b>	97.4 (12.5)	98.1 (12.1)	86.0 (14.0)
<b>Minimal risk*</b>	3,931 (37.5%)	3,717 (37.5%)	214 (38.1%)
<b>Increased risk*</b>	2,806 (26.8%)	2,677 (27.0%)	129 (23.0%)
<b>Substantially increased risk</b>	3,746 (35.7%)	3,527 (35.6%)	219 (39.0%)

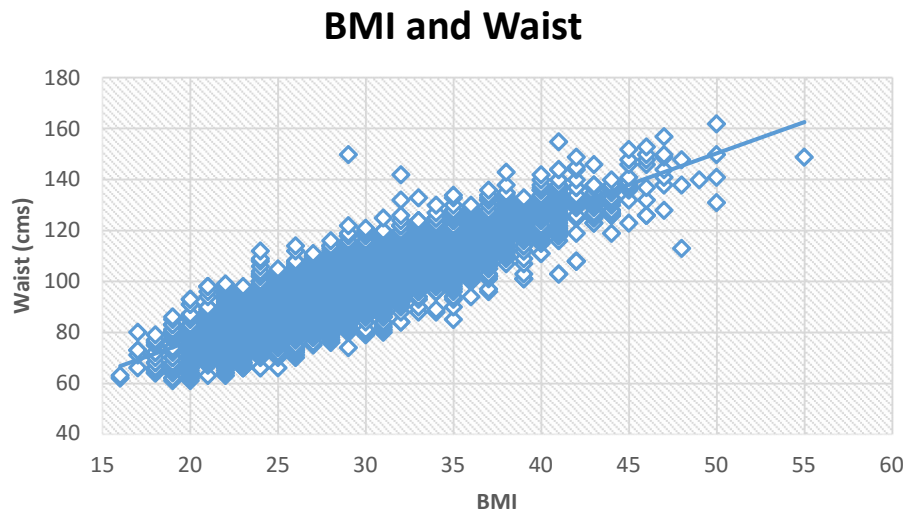
\*risk of metabolic complications associated with abdominal obesity



**Figure 8: Waist category, by gender**

#### 4.1.7 Correlation of waist and BMI

The correlation between waist and BMI was strong and highly significant ( $r=0.86$ ,  $p<0.001$ ), as shown in Figure 9. This is consistent with other studies (11).

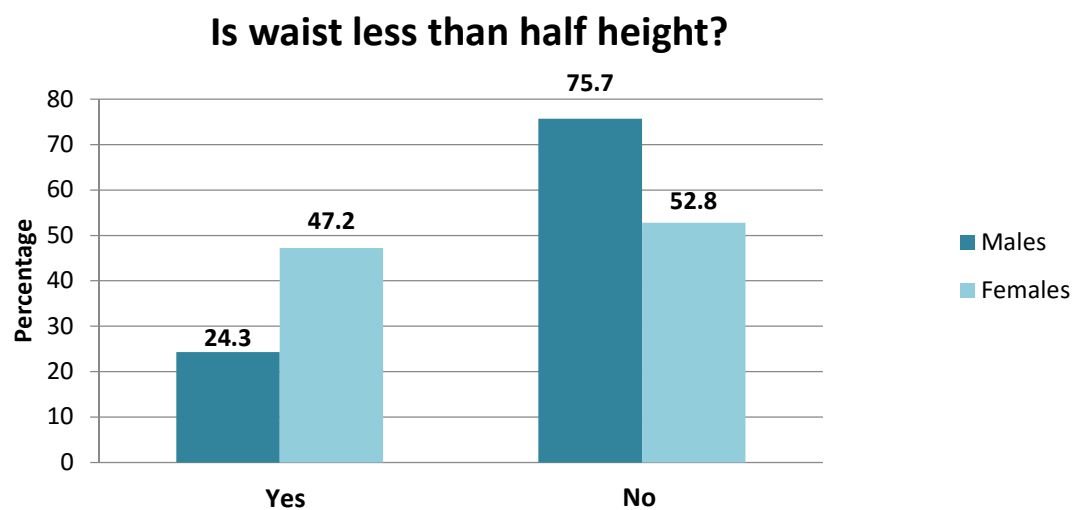


**Figure 9:**  
*Correlation  
between BMI and*

*Waist Circumference*

#### 4.1.8 Waist-to-height ratio (WHtR) by gender

Figure 10 presents the proportion of men and women with a WHtR that puts them at increased risk of obesity-related ill health. When WHtR was calculated, 75.7% of men and 52.8% of women had a ratio more than 0.5, indicating an increased risk of morbidity and mortality due to obesity-related illness (13).



**Figure 10:** *Is waist less than half height?*

## **4.2 What may predispose NSW Mine Workers to obesity?**

The high rates of obesity in NSW mine workers when compared to mine workers in other states and the general population inevitably brings into question the factors that predispose NSW mine workers to higher rates of overweight and obesity. The etiology of obesity is multifactorial and therefore, rather than clear causative relationships, there is a complex interplay between many factors. The factors outlined in this section are some of the influences on individuals that may contribute to overweight or obesity. An individual will only become overweight if their energy balance reaches a surplus through the over consumption of energy from food and a lack of energy expenditure through inadequate physical activity; energy balance (diet and physical activity). Consideration of the factors contributing to obesity in the mining industry will assist with developing suitable approaches for improving diet and physical activity among mining employees, thereby reducing obesity prevalence.

### **4.2.1 Male dominated workforce**

Men account for more than 90% of the workforce in the NSW mining industry (5). Whilst, general population data indicates that obesity prevalence is similar among males and females (28%), prevalence of overweight is significantly greater in males compared to females (42% versus 35%) (19). Further, men represented 94.3% of the data analysed for this report, which would contribute to the high rates of overweight and obesity reported.

### **4.2.2 Geographic location**

Mining operations are often located in geographically rural and remote areas and obesity has been consistently demonstrated to be more prevalent in rural and remote areas compared to urban areas (20, 8). The reasons for this are not clear, but may include reduced accessibility and increased cost of healthy food in rural and remote areas (49).

### **4.2.3 Occupational and educational status**

On the basis of income alone, most mining employees would not be classified as having low socioeconomic status (SES). However, conventional indicators for SES also include occupation and education (50) which are correlated with obesity (51). In an Australian study observing 14,799 Australian women aged 18 to 23 years, obesity was associated with low occupational and educational status (51).

Generally speaking, the mining workforce can be classified as having low occupational and educational status. The majority of the mining workforce consists of operators that require no formal education to fulfil the inherent duties of the role, other than on-the-job training. The maintenance workforce, such as fitters and turners, mechanics and electricians, make up a smaller proportion and are required to have successfully completed diploma level education before entry to the industry. Professional staff, such as engineers, surveyors and accountants, require University level Bachelor degrees and make up the smallest proportion of the mining workforce (20).

#### **4.2.4 Health literacy**

Health literacy is the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions (52). Education level and socio-economic status have been correlated with obesity and both factors have a direct impact on health literacy levels (20). Almost 60% of Australians are estimated to have inadequate levels of health literacy (53) with over 20% having very low health literacy (52). Low health literacy can be misinterpreted by health practitioners as lack of motivation (52). Research is currently underway to investigate the effectiveness of interventions aimed at supporting obese individuals with low health literacy to better manage their weight (52). Health literacy rates among mining employees would be expected to be in line with national data, due to the high proportion of employees with lower levels of education. Health literacy is therefore likely to be a contributing factor to obesity among mine employees.

#### **4.2.5 Shift work and long working hours**

The 24/7 nature of mining operations often requires long working hours and shift work, which are often associated with diminished sleep duration and quality {Lemke, 2015 #70}. The risk of obesity increases with long work hours, however, the relationship between shift work and obesity is less consistent.

A number of studies have established an association between shift work and weight gain (34). A longitudinal cohort study, followed 4,328 day workers and compared them with 2,926 alternating shift workers at a Japanese steel company over a 14-year period (1991 and 2005) to determine if there were observable difference in weight gain. The study found that shift work was an independent risk factor for weight gain and shift workers were up to 14% greater risk of gaining weight over this period when compared to their day working colleagues (55). However, some research findings do not support an association between shiftwork and obesity. A recent study among NSW coal mines employees (n=166, all male) compared the BMI for shiftworkers (n=102) and non-shift workers (n=95) and found no significant difference ( $p=0.85$ ) between the BMIs for shiftworkers and non-shift workers (45).

Long working hours is another factor that may predispose mine workers to obesity. There are many reasons why long working hours could influence a person's weight which might include limited time for preparation of healthy meals; substitution of healthy home prepared meals with pre-prepared meals, eating out or takeaways; and reduced opportunity for physical activity. One study demonstrated that men who worked long hours compared to those working standard hours had a 40% greater risk of being overweight or obese (56). There has been no such relationship established for women (57).

The interrelationship of shift work and working hours also needs to be considered. Another study observed the work and sleep patterns of 260 commercial motor vehicle (CMV) drivers. This study did not find a correlation between sleep duration and shift work, but found that the number of hours worked daily was the most significant predictor related to overweight and obesity in these workers (54).

#### **4.2.6 Sedentary nature of work**

A number of roles require workers to sit for many hours in their working day. For example, mining operators are seated whilst operating machines, maintenance workers are often working in confined spaces and professional staff seated at a desk. There is an ever-increasing body of evidence showing that workers who spend a large proportion of their day sitting are more likely to gain weight, and that the sedentary nature of the work may undo the benefits of regular physical activity (57). The Australian Bureau of Statistics report indicates a greater prevalence of overweight and obesity in those who work

as machinery operators and drivers (74%), compared to people that worked as sales workers (53%) where they are more likely to be standing and walking during the day. (57)

#### **4.2.7 Workplace stress, autonomy and control**

There is some evidence that workplace stress or job strain may be associated with increased levels of obesity, but it is far from conclusive at this stage {Schulte, 2007 #52}. Of particular interest are the studies looking at demand-control (high demand, low control) and the positive and significant relationship found with BMI {Schulte, 2007 #52}. Mining operators are required to undertake tasks that are often boring and monotonous, executed in a high risk environment, require a high degree of concentration and vigilance, for long periods of time, during hours contrary to our circadian rhythm, sometimes without the autonomy to choose alternative tasks. Such a role could be described as one that is high demand and low control. This situation is well described by mine workers where physical activity is often not a feasible alternative, and where an alternative response (such as emotional or comfort eating) or stimulus, which often comes in the form of high sugar and fat food or beverages, is sought. It is a situation that is supported by evidence illustrating that stress alters food choices and shifts it toward energy-dense items that indirectly contribute to weight gain {Wardle, 2000 #72}.

#### **4.2.8 Mental illness**

There is no published data detailing the prevalence of mental illness in the mining industry (59). However, the prevalence of the three most common categories of mental illness in Australia are, anxiety disorders (14%), mood disorders such as depression (6%) and substance use disorder (5%) (59). Approximately 2-3% of Australians are affected by less common mental illnesses such as schizophrenia and bipolar disorder (59).

There is good evidence that individuals with mental illness experience higher rates of obesity. Depression and obesity demonstrate a strong, reciprocal association. Obesity increases the risk of depression and depression is predictive of developing obesity (29). The association between obesity and anxiety disorders is less clear, however, there is a moderate level of evidence for a positive association between obesity and anxiety disorders (60). Schizophrenia and bipolar disorder are associated with an increased risk of obesity, both from the illness and as a result of treatment (28).

#### **4.2.9 Alcohol use**

Alcohol has a high energy content and contributes to an individual's energy intake (61). Many people are not aware of the calories contained in alcoholic drinks (62). In addition, alcohol consumption can lead to an increase in food intake (62). The association between alcohol intake and obesity is not linear, but differs according to patterns and levels of drinking (62). Heavy drinkers and binge drinkers (defined as consuming four or more drinks per day) are at higher risk of obesity than moderate, frequent drinkers (62).

The mining workforce has high rates of hazardous alcohol use (63) which is likely to be contributing to obesity prevalence, with further increases due to the male-dominated workforce. General population data consistently demonstrates that males are more likely to drink at risky levels and have more alcohol-related problems than females (64).

#### **4.2.10 Social factors**

The spread of obesity among social networks appears to be a factor in the prevalence of obesity. People are connected, and so their health is connected (65). Obesity has been found to cluster in social networks. In a study of over 12,000 people over 32 years, it was found that a person's chance of becoming obese increases 57% if a friend becomes obese (65). The observation that people are embedded in social networks suggests that both positive and negative behaviors might spread over a range of social ties (65). Given the powerful influence of social networks on obesity, it could be surmised that the behaviours of work colleagues are significant factors in obesity.

## 5. Prevention and Management of Obesity in the Workplace

With Australians spending approximately one third of their life at work, the workplace represents a setting of particular importance in obesity prevention by providing an arena for social leadership and peer support in tackling behaviour change, while work and employment policies and practices can enable or inhibit positive change (33, 66).

### 5.1 Key Components for Promoting Lifestyle Change in the Workplace

The workplace is an important setting for obesity prevention and management whereby individual behaviour change can be supported by social leadership, a supportive culture and environment, and workplace policy and systems. It has been recognised that focusing interventions only on individual behaviours fails to address the environmental and social factors influencing physical activity opportunity and food and beverage choices that predispose people to obesity (67). There is still much to be learnt about what approaches will prove to be the most effective in preventing and managing obesity in the workplace (33, 68). However, having identified the extent of obesity in the mining industry, the opportunity presents to play not only a part, but a leading role in setting up a healthy workplace in what clearly needs to be a multilevel strategy that includes 1) leadership, 2) policy and systems that create 3) a supportive culture and environment for 4) individual behaviour change.

#### 5.1.1 Leadership

When it comes to workplace health programs, leadership is required across all levels of the framework: culture and environment; policy and systems; engagement; behaviour change; and communication and marketing. Due to the size of the mining industry as an employer and the prevalence of overweight and obesity in the industry, effective leadership to address obesity in the mining industry will be a critical driver of wider change. Obesity is a complex societal issue and whilst the industry can take a lead from a workplace perspective, it is imperative to align with other key community leadership groups, such as:

- State and Federal Government (e.g. Local Health Districts, Primary Health Networks)
- Not-for-profit sector (e.g. Westpac Rescue Helicopter, Heart Foundation, Cancer Council, Diabetes Australia/NSW)
- Professional organisations (Dietitians Association of Australia, Exercise Sports Science Association)
- Research institutions (Universities, CSIRO)
- Insurers (Private health funds, worker's compensation)
- Industry bodies (NSWMC, Coal Services Health)
- Unions
- Private Providers

At a workplace level, senior leadership will play a number of important roles in setting and sharing the vision and connecting it with organisational values and strategy, committing budget and resources, developing policy and systems, role modelling, and finally monitoring and rewarding success (69).

Leadership is also likely to come from other key stakeholders which might include;

1) the 'workplace health and safety (WHS) committee' and 'site champions' who are often nominees from all sections of the workforce or identified as having leadership qualities and are critical to creating a sense of ownership by the workforce and are critical for their engagement;

- 2) the 'workplace health coordinator' whose primary role it is to lead the WHS committee, coordinate any health-related programs with the workplace; and
- 3) 'external stakeholders' that may include workplace health providers with specific expertise who could support the delivery of any workplace initiatives to prevent or combat obesity (69).

### 5.1.2 Culture and environment

Health promotion policy frameworks place a strong emphasis on the influence of physical and social environments on health-related behaviours (70). Certain features and characteristics of the workplace can influence eating and activity behaviours, and thereby have the potential to contribute to or protect against obesity (70). Studies have shown that cultural and social characteristics of the workplace environment, such as seeing co-workers engaging in healthy behaviours, will positively influence nutrition and physical activity behaviours and obesity (71). Environmental characteristics of workplaces that positively influence dietary intake and physical activity are those factors that make healthy food choices and physical activity opportunities easier choices, and thereby support attaining and maintaining a healthy weight. This is known as the 'gradient' for individual behaviour change. Workplaces can assist individuals in making positive behaviour change by creating a 'gradient' that makes healthy choices easier, as shown in Figure 11 below.



**Figure 11: Changing the environment makes healthier choices easier**

The steeper the gradient (the more barriers there are to healthy choices), the harder it is for individuals to make healthy choices about eating, drinking, exercising and minimising sedentary behaviours (67). Workplaces that make healthy choices easier will contribute to addressing the obesity problem. Examples may include; increased availability of healthy food (fruit bowls, water bubblers/coolers, kitchen facilities for reheating meals, vending machines with healthy food); more opportunities for



physical activity (standing workstations, stairs rather than lifts, walking meetings, bike racks, showers) and health-related social and community events (fun runs, touch football, lawn bowls, family fun days). Additional support for improving eating and increasing activity may include initiatives such as access to online dietary tracking platforms or exercise tracking devices or subsidised gym membership. Employee contribution to the financial cost of select initiatives (e.g. gym membership) appears to foster responsibility and ownership resulting in a higher rate of adherence (69).

There are limitations to what can be achieved by workplace educational and behaviour-change programs alone. Incorporating an environmental focus in worksite health behaviour interventions has been recommended (70). The culture and social climate in a workplace also influences individual health behaviour (71) and therefore obesity. The social environment shapes 'norms' which enforce patterns of social control (that can be health promoting or health damaging) thereby providing or denying opportunities to engage in particular behaviours and placing constraints on individual choice (71). Social norms, including those in the workplace, determine health behaviours and influence obesity (71). Given its influence on health behaviour, the social environment may be used to promote health. The engagement of a particular employee or group of employees in a health initiative may encourage participation of others (35). Similarly, rewards or encouragement of specific behaviours of early adopters and champions, may result in the healthier behaviours becoming more prevalent (71). Modeling healthy behaviours in the workplace may also have benefit in encouraging these positive behaviours in other employees (71). For example, if healthy foods are served at workplace-sponsored events, employees would observe each other eating healthy foods or if meetings included exercise breaks, this would provide an opportunity for employees to observe their peers being active (71). The workplace is an obvious choice for obesity interventions given the strong influence on health behaviour of the work environment. Specific tools have been developed to assess characteristics that influence health-related behaviours and identify areas for action such as the 'Checklist of Health Promoting Environments at Worksites' (CHEW) (70) and the ANGELO framework (analysis grid for environments linked to obesity) (72, 73).

### **5.1.3 Policy and systems**

A clear vision must be underpinned by policy and systems which create a supportive culture and environment by making healthy choices easier and guiding individual behaviour change. Workplaces can 'nudge' people in directions that influence their behaviour in positive ways and improve their health (74). For example, in the spirit that led many employers to ban workplace smoking, workplaces could introduce 'junk food free' work sites and instead provide healthier alternatives in canteens and vending machines (74). In order to achieve the desired outcome of prevention and management of obesity, workplace lifestyle modification program policy and systems need to address three main areas: dietary intake, physical activity and behaviour change (25).

It is particularly important that the policy and systems are shaped by the evidence-base to avoid misinformation, confusion and wasting resources on the journey to achieving desired weight loss outcomes. By way of example, the current debate as to whether nutrient composition influences weight loss outcomes have the potential to delay and/or distract weight loss initiatives. There is evidence from a large study comparing a four diets of varying nutrient composition, which found similar weight loss (4kg over 2 years) among all four diets, suggesting macronutrient composition is not important when the level of caloric restriction is held constant (75). This evidence enables a clear policy statement and methodology that will guide any initiative that restores energy balance through dietary restriction regardless of macronutrient composition. Further, this is a far easier and inclusive message and method to engage all stakeholders in our obesity prevention or management initiatives.

Access to lifestyle modification and resources to deliver such programs can be a barrier in participation and engagement in programs to tackle obesity, particularly as mining operations are often geographically located in rural and remote areas. Advances in technology and delivery of programs via telephone and internet are evolving, and whilst person-to-person interventions remain superior in weight loss and maintaining lost weight, the early results have been promising (76). Advances in technology are improving the accessibility, affordability and convenience of weight management initiatives and should be considered in any future policy and system design.

#### **5.1.4 Engagement**

The success and subsequent return on investment of any workplace program is ultimately achieved by high levels of employee engagement (69). There are a range of factors that will influence participation in lifestyle modification programs in the workplace of which leadership culture and environment and policy and systems have already been discussed. Other factors or barriers (69) for participation include:

- Targeted to an established need and interventions tailored to specific groups (e.g. based on readiness to change, demographic)
- Consultative design
- Set SMART goals
- Easy and convenient to access
- Systematic - clear outline of benefits and how to participate
- Innovative and/or novel
- Cost - free or cost-sharing basis to foster responsibility and commitment
- Incentives and rewards - encourage or maintain participation through recognition, merchandise, competitions, family subsidisation, money back guarantee [if you lose 5kg]
- Support – peer management or professional support, and extension to family members (where appropriate);
- Privacy and confidentiality – alleviate concerns of data ownership and access

These factors are critical in program design as it is the employees most in need that are the least likely to participate. Thus, maximising overall participation rates is likely to increase the high risk individuals into the program. It is important that whilst mandatory programs may require participation, they do not promote engagement (77). The average participation rate in high quality, voluntary lifestyle modification programs is 60 percent (69). Due to the wide range of factors that can influence participation, it is unrealistic to achieve 100%. However, by creating a supportive environment and culture, a variety of strategies can be utilised to remove barriers to participation and encourage employees to take action.

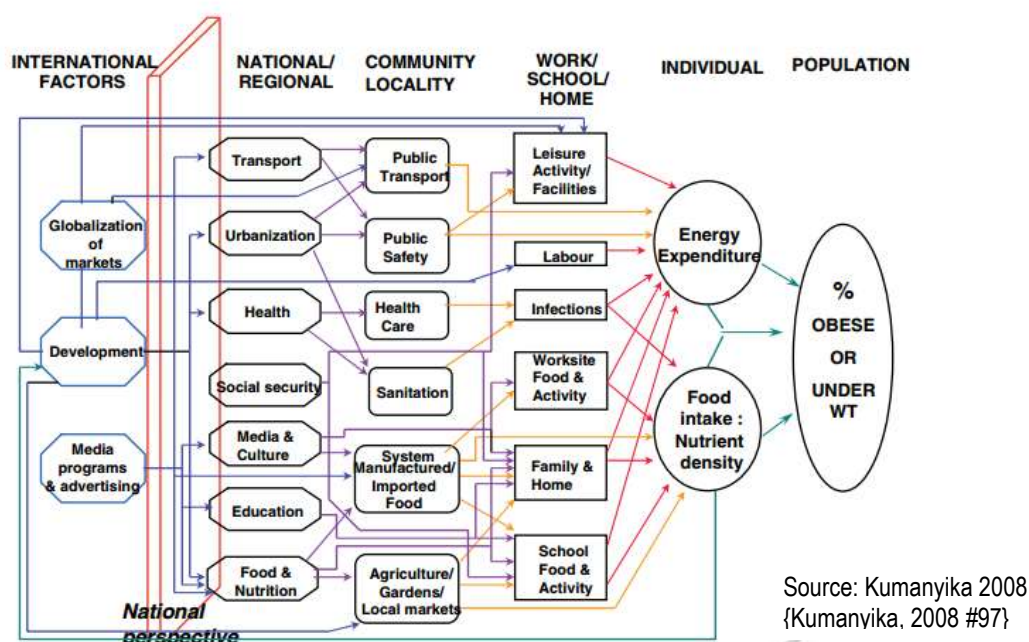
#### **5.1.5 Behaviour change**

“Eat less, move more.” It would appear that such a large problem has such simple solutions and if people were able to make the right choices the problem would not only be prevented but also treated successfully. However, individuals are not always in direct control of behaviours and choices related to eating and physical activity. These behaviours often form part of a person’s daily routine or prompted by a variety of situations and cues, and once they become a habit they are even more difficult to change. Combine these daily routines with culture and environmental factors that are becoming more obesity promoting and the decision to “eat less and move more” becomes more difficult. (8).

The daily challenges that people face in life and the underlying stress that this creates may also impact on their energy, motivation and/or priority to exercise; or lead to emotional or comfort eating which increases food intake and directly contributes to weight gain. There is a strong association between mood disorders and obesity, whereby people with obesity are more likely to become depressed over

time, and people with depression are more likely to become obese (29). Obesity may increase risk factors for depression such as body dissatisfaction and low self-esteem, which may further impact on a person body image and mood, and their ability and willingness to eat healthily and exercise regularly. Disturbed eating patterns, which may be at greater risk in shift working populations, has also been associated with increased risk of both obesity and depression. People with serious mental health issues (bipolar disorder and schizophrenia) may also be at greater risk of developing obesity, particularly those people that take antipsychotic medications. (8)

Framing obesity as simply a problem of individuals neglects the environmental and societal factors influencing our dietary choices and activity that drive obesity. Eating and drinking too much and moving too little are the causes of obesity, but what about the causes of these causes? Figure 12 illustrates the multiple levels of up-stream factors or causes of the causes. When considering any solution to the obesity problem and associated lifestyle behavioural factors facing the NSW Mining industry these must be considered.



**Figure 12: Societal factors influencing the population prevalence of obesity**

We should not be discouraged by the complexity of initiating behavioural change for successful weight outcomes. The underlying behavioural change to make a choice to quit smoking is similar to making dietary and activity choices to achieve weight loss. A comprehensive and multi-level approach to smoking has resulted in a major reduction in adult smoking rates from 35 per cent in 1980 to 13 per cent in 2013. This reduction, since its peak in the mid-1970s, has contributed to the achievement of declining death rates from coronary heart disease and stroke over the past thirty years. The success in quit programs illustrates the value of multi-sectoral action that is sustained and delivered on many fronts including regulation, fiscal policy, social marketing and education (78).

Given the strong influence of social networks on obesity, the same influences that promote obesity may also be used against it (65). If some employees make a shift to more positive health behaviours, there may be a positive influence on others. Quitting smoking, alcohol cessation and weight-loss programs that provide peer support have been reported to be more successful than those that do not (65). In

addition, team-based weight loss programs have been shown to enhance weight loss and may be a successful model for large-scale weight loss programs (79). Of further interest is that adherence to dietary modification usually increases when supported by structural changes limiting food choice, such as shopping lists, menus and dietary plans. In contrast, exercise adherence tends to improve with less structure but more opportunity. For example, positioning the car park or 'go-line' further away from the office, utilities or muster areas and standing workstations. Addressing both dietary and exercise aspects is more likely to lead to either greater or longer weight loss outcomes (25). Consequently, the workplace might provide an effective platform to positively impact on behaviours to address obesity through its potential to provide the social network to support weight loss, provide structured food choice and exercise opportunity.

### 5.1.6 Communication and marketing

Communication and marketing will be a critical element in the success of any workplace health initiative. Communication and marketing about overweight and obesity is a tricky business. Most media focusses solely on the problem and portrays overweight and obesity as a problem of individual responsibility. Whilst this gets media attention and scares people, it can create cynicism (67). Whilst this report is commissioned to establish the magnitude of the problem relating to overweight and obesity in the NSW mining industry, the opportunity exists to shift the focus to reporting a clear position the industry will take on and what it will do about the problem. Focusing on the solution can create a sense of hope, reinforce actions, and reduce alienation and defensiveness (67).

Marketing and communication messages and resources should be integrated, with advice on healthy weight, healthy eating and physical activity within the workplace and community setting, in order to establish healthy social norms (33). It will involve analysing what people need with respect to risk factors and determinants, selling the value of the solutions, and motivating the target audience to make lifestyle changes to either cease the progression or reduce the rates of overweight and obesity (69). Effective marketing will also include branding to increase program credibility, appeal and recognition (69).

Quit smoking campaigns have proven to be successful in reducing smoking rates. It should be noted that, unlike campaigns to stimulate smoking cessation behaviour that are implemented in an environment in which tobacco advertising had been banned, healthy eating campaigns will need to compete and achieve cut-through (awareness and exposure) in an environment that is dominated by food advertising (33).

A variety of communication and marketing mechanisms will be required to ensure any message is disseminated effectively, including:

- Mass media (i.e. television, radio and print)
- Online and social media (e.g. internet, Facebook, LinkedIn)
- Face-to-face individual (e.g. assessments, coaching)
- Face-to-face group (e.g. workshops)
- Self-managed programs
- Miscellaneous e.g. expos

## 5.2 What could be achieved?

Setting audacious goals is not foreign to the NSW Mining Industry. The **"World Class Miners"** campaign makes a clear commitment and builds awareness that the NSW Mining Industry aspires to go beyond simply creating jobs and generating money for the NSW economy, to reducing the impact on

the environment, innovative technology, world leading safety and building stronger communities. The goal of “**Zero Harm**” is an example of the world leading safety dimension. Zero Harm is ubiquitous and has been successfully pursued by the Mining Industry since its inception. This campaign was launched as a result of leaders’ beliefs that all deaths and injuries are preventable, and that to think otherwise is unacceptable. The extent of the obesity problem identified in the present report provides a new opportunity to demonstrate the next frontier of being World Class Miners.

### **5.2.1 Defining success**

The criteria for a successful weight loss program is a 5% to 10% reduction in initial weight. Losing 5% of initial body weight is achievable for most overweight and obese adults and brings about significant improvements in medical (e.g., diabetes, sleep apnea, diabetes, hypertension, and hyperlipidemia) and psychosocial (e.g., mood, quality of life, and body image) outcomes (25).

Research evaluating the effect of lifestyle modification programs on weight loss found that a substantial proportion (28%) of individuals lost 10% of baseline weight, 26% lost 5–9.9% and 38% lost 0.1–4.9%. In less intense interventions, 13% of participants lost 10% or more, 16% lost 5–9.9% and 27% lost 0.1–4.9% of body weight (80). Subjects achieved clinically meaningful weight loss, even when the average weight loss is modest (80).

A weight loss of 10 kg over the course of one year through a weight loss program brings about reductions in biochemical markers that are associated with:

- 21% reduction in risk for all diabetes-related complications,
- 25% reduction in diabetes mortality
- 17% reduction in total mortality
- 18% reduction in acute myocardial infarction
- 35% reduction in risk for microangiopathy.(81)

The significant and measurable improvements in individual health resulting from weight loss of 5-10% provides significant benefits to individual health, even if weight remains in the overweight or obese category and even when weight is regained (6).

### **5.2.2 Weight regain**

It is often reported that the benefits of weight loss are negated if participants regain weight after the intervention period of lifestyle modification program (25). However, it has been demonstrated that weight regain following lifestyle modification programs, while not desirable, has a legacy of the efforts which remains evident through the prevention or delay of diabetes for up to 20 years (82, 83). A lesson may well be learnt from the quit smoking fraternity to a shift the focus from ‘quality’ to ‘quantity’ of quit attempts and to encourage continued effort (84).

### 5.3 Return on investment

A reduction in the prevalence of overweight and obesity would lead to significant social and economic benefits to the health and wellbeing of individuals and their families, health care and worker's compensation costs and to the workplace which are summarised in Table 12.

**Table 12: Benefits of reduced prevalence of overweight and obesity in the workplace**

Employee	Employer	Societal
<ul style="list-style-type: none"> <li>• Improved physical and mental wellbeing</li> <li>• Reduced personal health care cost</li> <li>• Reduced risk of disability and dependence on care givers</li> <li>• Earning potential</li> <li>• Disability</li> <li>• Reduced disease prevalence and improved mortality</li> <li>• Increased enjoyment and fulfilment at work</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced absenteeism</li> <li>• Improved productivity / presenteeism</li> <li>• Lower Injury rates and return to work duration</li> <li>• Lower workers compensation costs</li> <li>• Improved workplace morale. engagement and innovation</li> <li>• Employer of choice</li> </ul>	<ul style="list-style-type: none"> <li>• Improved productivity and competitiveness</li> <li>• Lower health care costs</li> </ul>

The potential return on investment of workplace initiatives that achieve intentional weight loss of 5 to 10% are significant, but there is a paucity of evidence that has shown firstly that workplace programs that have achieved this level of weight loss and secondly have measured whether the benefit outlined in the table above have been achieved as a direct outcome.

The benefit of intentional weight loss and the behaviours associated with it (i.e. increase in physical activity, increase fruit and vegetable intake) have been shown to achieve significant reductions in mortality and morbidity from chronic disease {VanGaal, 2005 #77;World Health Organisation/World Economic Forum, 2008 #95}; and from this have estimated the economic benefit of these outcomes {Preventative Health Taskforce, 2009 #4}. For example, it has been reported that if more people were physically active for 30 minutes a day, estimates suggest the Australian healthcare system could save \$1.5 billion annually {Preventative Health Taskforce, 2009 #4}.

This is not to say that there are no studies that have established a direct causative effect of intentional weight loss programs and outcome measures that are important to the workplace. Several interventional studies have found substantial weight loss in obese subjects resulted in reduced sick leave, at least temporarily (31). Whilst this is encouraging there is clearly a need for further action and research in this area.

The opportunity for return on investment with lifestyle modification led one author in their review to quote

*“the challenge for organisations today is no longer whether or not workplace health promotion programs should be implemented but rather how they should be designed, implemented and evaluated to achieve optimal benefits (i.e. health and cost effectiveness){Russell, 2009 #96}.”*

There is always an argument of who is to take responsibility for initiatives that are not yet common workplace practice but should be considered in order to accelerate the progress in turning around the obesity epidemic. Employers, employees and society in general clearly have a common interest and will benefit from tackling the issue of obesity

## **5.4 Role of Research and Evaluation**

Research and evaluation is critical to measuring that workplace health programs are targeting and engaging the target audience, are having the desired impact and delivering on the intended ROI. Research and evaluation is therefore the 'cornerstone' of a best-practice workplace health program (69). There is a lack of evidence in the literature of effective workplace obesity prevention and management programs in the mining industry. There is also limited evidence available more broadly on effective workplace obesity prevention and management programs and these interventions are generally on an ad-hoc site specific basis. The Australian Government Preventive Health Taskforce identified that there is a clear need for research regarding obesity prevention and management, in particular a need for a more comprehensive and coordinated approach if the relative lack of evidence on obesity prevention and management is to be addressed (33).

In evaluating initiatives to build the evidence base, it is important to recognise that effective action on obesity will not be achieved by a single initiative. Specific initiatives may produce only a modest effect on energy balance, however, they may make a significant contribution when combined with other initiatives as part of a broader programme (87). There are limitations to evaluating workplace health programs using randomised controlled trial designs (88). Rather, alternative approaches have been reported (87) and may be more suitable. Factors to consider in evaluation include: behaviours to target for weight loss (89), delivery modes (90), suitability of programs to specific populations (91), adherence of programs to evidence-based guidelines (92), program reach and cost-effectiveness (93, 94).

Whilst it has been talked about, never before has an industry-wide approach to obesity been reported. Thus, the opportunity exists to engage key stakeholders and experts in developing a comprehensive, industry-wide blueprint for the prevention and management of obesity.

There are three specific areas of research and/or evaluation which are needed to improve the understanding of obesity in the NSW Minerals Industry, which include:

1. The impact that obesity is having on the workplaces that make up the Mining Industry, the people that work within it, and the communities in which they live. This will enable a clear value proposition for all stakeholders (i.e. employees, employers, unions, industry, local, state and federal government) to appropriately invest in interventions and research.
2. The factors that predispose NSW mine workers to overweight and obesity to ensure any investment in addressing the issue of obesity is targeted and will optimise the outcomes.
3. The efficacy and effectiveness of interventions which aim to address obesity in mining and the communities in which they operate. The outcomes should include assessing not only workplace health outcomes, but changes in the workplace environment and culture, and key performance indicators (including financial indicators) to ensure cost effectiveness. Typically, comprehensive programs can be expected to show a positive financial return over a period of 2-3 years (33).

## 6. Implications for the NSW Minerals Industry

In section 4.2, a number of factors were identified that may predispose NSW mine workers to an increased risk of overweight and obesity including geographic location; low occupational and education status; shift work and long working hours; work stress, low autonomy and control.

The interrelationship between the workplace, obesity and how this may impact upon occupational disease in the NSW Minerals Industry is not clear. Establishing the workplace risk factors for obesity in the mining industry and implementing strategies to address obesity has a number of implications that require consideration the prevention and management of (for a full review see (34)), which include:

- Ethical, legal and social issues
- Worker privacy and autonomy
- Employment discrimination
- Risk communication
- Workers compensation and tort liability

The data in this report shows clearly that there is a high prevalence of overweight and obesity in the NSW coal mining industry. What is not clear, is the contribution of mining as an occupation to the development of obesity. The question still remains as to the link between mining as an occupation and the risk of obesity. However, one thing that is without question is that addressing obesity in the NSW Minerals Industry will benefit all stakeholders. Thus, the focus of any future research or intervention should be towards solutions to prevent and manage overweight and obesity in the NSW Minerals Industry.



## 7. Conclusions and Recommendations

The task of addressing obesity rates is daunting. To date there has been no successful demonstration in reversing the trends of the rising rates of overweight and obesity (33). However, having identified the potential of the problem of obesity in the mining industry the NSWMC can now play, not only its part, but a leading role in addressing the prevention and management of obesity in the workplace in what clearly needs to be a multilevel strategy and will not only serve the interests of the NSW Minerals Industry, but its members, the people working in it, their families and community. Addressing the issue of obesity presents another opportunity for the NSW Mining industry to demonstrate that they are “World Leading Miners.”

On the basis of the evidence collated for this review, including the impact of obesity on the workplace and interventions to prevent and manage overweight and obesity in the workplace, the following recommendations are made for consideration by the NSW Minerals Council aimed at guiding future strategies to address the impacts of obesity in NSW Minerals Industries:

- Convene key stakeholders and experts in the field of obesity to create a blueprint to set clear policy direction to address obesity in the industry
- Lead an industry-wide change for better health by implementing innovative and effective workplace policies, systems and environmental approaches to address obesity prevention and management.
- Shift from an ad-hoc site-by-site approach and engage key stakeholders in developing a comprehensive, industry-wide approach to the prevention and management of obesity.
- Establish a clear commitment to the blueprint, and its recommendations, across all levels of the industry: leadership, culture & environment, systems & policy and people.
- Given the current paucity of evidence for effective workplace interventions, engage in a ‘learning by doing’ approach or a staged trialing of interventions accompanied by good monitoring and evaluation.
- Improve research, evaluation, monitoring and surveillance to understand the effectiveness of different workplace strategies on individuals, the workplace and the broader community.

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## Appendix A:

The original dataset contained 10,870 individual records. Some records were excluded to enable reporting of the descriptive statistics for waist and BMI. The number of records excluded from the original dataset to enable analysis of the variables for waist and BMI are shown below, resulting in datasets of 10,483 and 10,796 records, respectively.

Details	Number of records in dataset	
Original dataset	10,870	
39 records removed: Gender not indicated	↓	
	10,831 (10,245 males, 94.6%)	
35 records removed: BMI not indicated or implausible (<10, n=1 or >100, n=10).	↓	↓
<b>Dataset for BMI analysis</b>	10,796 (10,211 males, 94.6%)	
348 records removed Waist not reported (n=342) or waist implausible, <60cm (n=6)		
<b>Dataset for Waist analysis</b>		10,483 (9,921 males, 91.5%)