safe work australia

National Hazard Exposure Worker Surveillance:

Exposure to dust, gases, vapours, smoke and fumes and the provision of controls for these airborne hazards in Australian workplaces

July 2010

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Acknowledgement

This report was commissioned and developed by the Australian Safety and Compensation Council (ASCC), which is now known as Safe Work Australia. The survey was administered and data collected by Sweeney Research. The data analyses were undertaken and the report written by Dr Fleur de Crespigny, Safe Work Australia. The report has been peer reviewed by Assoc. Prof. Dino Pisaniello, School of Population Health & Clinical Practice, University of Adelaide.

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Foreword

The Australian Safety and Compensation Council (ASCC) (now Safe Work Australia) requested the development and fielding of the National Hazard Exposure Worker Surveillance (NHEWS) survey to determine the current nature and extent of Australian workers' exposure to selected occupational disease causing hazards. The survey also collected information from workers about the controls that were provided in workplaces to eliminate or reduce these hazards. The results of the NHEWS survey will be used to identify where workplace exposures exist that may contribute to the onset of one or more of the eight priority occupational diseases identified by the National Occupational Health and Safety Commission (NOHSC) in 2004. These diseases are; occupational cancer, respiratory diseases, noise-induced hearing loss, musculoskeletal disorders, mental disorders, cardiovascular disease, infectious and parasitic diseases and contact dermatitis.

The NHEWS survey was developed by the ASCC in collaboration with Australian OHS regulators and a panel of experts. These included Dr Tim Driscoll, Associate Professor Anthony LaMontagne, Associate Professor Wendy Macdonald, Dr Rosemary Nixon, Professor Malcolm Sim and Dr Warwick Williams. The NHEWS survey was the first national survey on exposure to workplace hazards in Australia.

In 2008, Sweeney Research was commissioned to conduct the NHEWS survey using computer assisted telephone interviews (CATI). The data, collected from 4500 workers, forms a national data set of occupational exposures across all Australian industries. The survey was conducted in two stages. The first stage (n=1900) focussed on the five national priority industries as determined by NOHSC in 2003 and 2005. These industries were selected to focus the work under the National Strategy 2002-2012 relating to reducing high incidence and high severity risks. The priority industries are Manufacturing, Transport and storage, Construction, Health and community services and Agriculture, forestry and fishing. The second stage (n = 2600) placed no restrictions on industry.

An initial report on the results of the NHEWS survey can be found on the Safe Work Australia website[1]. It contains a descriptive overview of the prevalence of exposure to the nine studied occupational hazards within industries and the provision of the various hazard control measures.

This report focuses on the exposure of Australian workers to dust, gases, vapours, smoke and fumes and the control measures that are provided in workplaces that eliminate, reduce or control worker exposure to these airborne hazards. The aims of this report are threefold:

1. to describe the percentage of workers who are exposed to dust and/or gases, vapours, smoke or fumes and the employment and demographic factors that distinguish workers exposed to these airborne hazards
2. to provide a description of the types of dust and/or gases, vapours, smoke or fumes that workers with high odds of exposure to airborne hazards are typically exposed to, and
3. to describe the employment and demographic factors that affect the provision of controls against airborne hazards in Australian workplaces.

Based on these findings, the report will make policy recommendations, disease prevention initiatives and recommendations for future research in this field.

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[1] http://www.safeworkaustralia.gov.au/swa/AboutUs/Publications/2008ResearchReports.htm

Contents

Glossary

ASCC	Australian Safety and Compensation Council
CATI	Computer assisted telephone interviews
COPD	Chronic obstructive pulmonary disease
GVSF	Gases, vapours, smoke or fumes
MOCA	4,4’-methylene bis (2-chloroaniline)
NDS	National Data Set for Workers’ Compensation Based Statistics
NEC	Not elsewhere classified
NFI	Not further identified
NHEWS	National Hazard Exposure Worker Surveillance
NOHSC	National Occupational Health and Safety Commission
PAH	Polycyclic aromatic hydrocarbons
TOOCS	Type Of Occurrence Classification System – version 2.1
URTI	Upper respiratory tract infection

Summary

Airborne hazards in the workplace, such as dusts, gases, vapours, smoke and fumes have the potential to cause or exacerbate a range of serious respiratory diseases. These include asthma, chronic obstructive pulmonary disease, asbestosis and cancers of the respiratory system such as mesothelioma and lung cancer. The list of agents of respiratory disease is increasing as a result of improving knowledge and constant changes in industrial processes and materials. Due to the long latency of many respiratory diseases it is essential that workers' exposure to dusts, gases, vapours, smoke and fumes are minimised. Undertaking monitoring on a regular basis will facilitate the identification of workers at risk of developing respiratory diseases and enable occupational health and safety (OHS) / workplace health and safety (WHS) and workers' compensation policies to be targeted effectively. In the long term, it is hoped that this process will reduce the burden of work-related respiratory diseases and contribute to fulfilling the aspiration of Australian workplaces being free of injury and disease.

In 2008, the National Hazard Exposure Worker Surveillance (NHEWS) survey was developed to determine Australian workers' current levels of exposure to various workplaces hazards, including their exposure to the airborne hazards dust, gases, vapours, smoke and fumes. In particular, workers were asked how long they were exposed for and what types of dusts, gases, vapours, smoke or fumes they were exposed to. Workers were also asked to indicate whether or not particular types of airborne hazard controls (masks, respirators, ventilation systems or reducing exposure time) were provided in their workplaces. Alongside the exposure and controls data, the NHEWS survey also collected detailed demographic and employment information.

This report contains the findings of a detailed analysis of the data on airborne hazards. Statistical tests (logistic regressions) were performed to investigate what demographic and employment factors affected the likelihood that a worker reported they were exposed to dust and/or gases, vapours, smoke or fumes. Logistic regressions were also used to determine what demographic, employment and exposure factors affected the likelihood workers were provided with some types of airborne hazard control. In order to model exposure, the types of airborne hazards workers reported exposures to were grouped in the broadest categories (as surveyed); dust; and gases, vapours, smoke or fumes. Workers were either exposed to these types of airborne hazard on their own or they were exposed to both dust and gases, vapours, smoke or fumes. Descriptive statistics were used to describe, in more detail, the different types of airborne hazard workers reported exposure to. The main findings of the report are outlined below.

SUMMARY OF THE MAIN FINDINGS OF THE REPORT
o 39% of Australian workers were exposed to airborne hazards in the workplace
o Young workers were more likely to be exposed to airborne hazards than older workers, reported longer durations of exposure and had the highest representation in six of the 11 airborne hazard types
o Industries with the highest likelihoods of exposure to airborne hazards included: Manufacturing, Transport & storage, Construction and Agriculture, forestry & fishing
o Occupations with the highest likelihoods of exposure to airborne hazards included: Technicians & trades workers, Machinery operators & drivers and Labourers
o 23% of workers who reported they were exposed to airborne hazards were not provided with any airborne hazard controls. 22% were provided with one control and 55% were provided with more than one airborne hazard control.
o The industries that were least likely to provide more than one airborne hazard control included: Transport & storage, Agriculture, forestry & fishing and Education
o Further research is required to determine whether or not the reported exposures are hazardous for human health and whether or not control provision is adequate
o Ongoing and improved surveillance of airborne hazard exposure is recommended

Findings in detail

What proportion of Australian workers are likely to be exposed to airborne hazards in the workplace?

Approximately 39% of Australian workers were estimated to be exposed to airborne hazards in the workplace (refer to Table 3). Of the exposed workers, almost half were exposed to dust only; about 20% were exposed to gases, vapours, smoke or fumes only; and around 30% were exposed to both dust and gases, vapours, smoke or fumes.

What were the main airborne hazards workers reported exposures to?

For the purposes of descriptive analyses dusts, gases, vapours, smoke or fumes were grouped into 11 broad categories that described the type of airborne hazard by its physiological action and potential health effects (refer to Table 2). Only airborne hazards for which 10% or more of workers reported exposure are listed here (refer to Figure 3).

- 42% of exposed workers were exposed to Low toxicity dusts
- 22% of exposed workers were exposed to Combustion products
- 19% of exposed workers were exposed to Organic materials
- 17% of exposed workers were exposed to Organic chemicals
- 17% of exposed workers were exposed to Acids and alkalis
- 14% of exposed workers were exposed to Metals
- 14% of exposed workers were exposed to Wood and related dust
- 13% of exposed workers were exposed to Industrial and medical gases and fumes

Just under half of the workers who reported they were exposed to airborne hazards reported they were exposed to more than one broad type of airborne hazard. Nearly 30% of exposed workers reported exposure to two types of airborne hazard and a further 13% reported exposure to three types of airborne hazard.

What factors affected whether or not a worker reported exposure to airborne hazards?

The following results were obtained from the logistic modelling of a restricted data set, comprising the 10 industries in which 50 or more workers were surveyed. The Mining industry was not included in the restricted data set. There were several demographic and employment factors that affected whether or not workers reported that they were exposed to airborne hazards (refer to pages 20-31 and Table 5). These included:

- Sex
    - Male workers were between 1.5 and 2.6 times more likely than female workers to report exposure to airborne hazards.
- Age
    - Workers aged between 25 and 44 were 1.5 times more likely to be exposed to dust only than workers aged 55+ years.
    - All workers younger than 55+ years had increased odds of exposure to both dust and gases, vapours, smoke or fumes. The greatest increase in the odds of reporting exposure to these hazards was observed in workers aged 25-34, who were three times more likely to report exposure to these hazards than the oldest workers, while the youngest workers (15-24 years) were more than twice as likely. The youngest workers also had the highest representation in six of the 11 airborne hazard categories.
- Income

    - Income was the least important predictor of exposure in the models. However, workers who earned between $50 000 and $74 999 were almost twice as likely as the highest earners to report exposure to dust only.
    - Workers who earned between $100 000 and $149 999 were significantly less likely to report exposure to gases, vapours, smoke or fumes only than the highest earners.
- Workplace size
    - Workplace size was mainly associated with exposures to dust only. Workers in workplaces with fewer than 20 employees were significantly more likely to report exposure to dust only than workers in larger workplaces.
- Industry
    - Industry was the most important predictor of exposure to airborne hazards.
    - The odds of reporting exposure to dust only were increased by a factor of 4.6 for Construction workers, 3.1 for workers in the Manufacturing and Agriculture forestry and fishing industries and 2.0 for Transport and storage workers in comparison to workers in Health and community services.
    - Workers in the Accommodation, cafes and restaurants industry had the greatest odds of reporting exposure to gases, vapours, smoke or fumes only. The Manufacturing, Transport and storage, Agriculture, forestry and fishing and Wholesale and retail trade industries had similar odds to the Health and community services industry of reporting exposure to gases, vapours, smoke or fumes only, while the remaining industries had decreased odds of reporting exposure to this airborne hazard.
    - Workers in the Manufacturing industry had the greatest odds of reporting exposure to dust and gases, vapours, smoke or fumes. The Transport and storage, Construction, Agriculture, forestry and fishing and Wholesale and retail trade industries were also associated with increased odds of exposure to both airborne hazards in comparison to the Health and community services industry.
- Occupation
    - Occupation was second most important predictor of exposure to airborne hazards.
    - Machinery operators and drivers were the occupation with the greatest odds of reporting exposure to dust only. Technicians and trades workers, Labourers and Managers also had increased odds of reporting exposure to dust only in comparison to Clerical and administrative workers.
    - Technicians and trades workers had the greatest odds of reporting exposure to gases, vapours, smoke or fumes only. All occupations, except Managers and Community and personal services workers, had increased odds of reporting exposure to these airborne hazards in comparison to Clerical and administrative workers.
    - Technicians and trades workers and Machinery operators and drivers were more than six times more likely to report exposure to both dust and gases, vapours, smoke or fumes than Clerical and administrative workers. Community and personal services workers and Labourers also had increased odds of reporting exposure to both groups of airborne hazards.

What factors affected how long workers reported they were exposed to airborne hazards?

The employment and demographic factors that affected the likelihood of reporting exposure to dust and/or gases, vapours, smoke or fumes also affected the duration workers were exposed to these airborne hazards per week (refer to pages 23-31 and Table 14).

- In general, workers who were exposed to both hazard groups were exposed to each hazard for longer on average than workers who were exposed to only one hazard (i.e. dust or gases, vapours, smoke or fumes only).
- Male workers were exposed to airborne hazards for longer durations than female workers
- Age and workplace size both affected the duration of exposure to airborne hazards, but the relationship was complicated and driven by workers exposed to both dust and gases, vapours, smoke or fumes. Duration of exposure tended to decline with increasing worker age and increase with increasing workplace size.
- Workers who earned between $30 000 and $99 999 were exposed to airborne hazards for the greatest length of time per week on average.
- Workers in the Manufacturing, Transport and storage and Construction industries typically had the greatest average duration of exposure to airborne hazards.
- Machinery operators and drivers, Technicians and trades workers and Labourers were exposed to airborne hazards for the greatest number of hours per week on average.

What factors affected the provision of controls against airborne hazards in workplaces?

Workers who reported they were exposed to dust and/or gases, vapours, smoke or fumes were asked whether the following airborne hazard controls were provided in their workplaces: masks, respirators, ventilation systems or reducing time spent exposed to airborne hazards.

- Masks were provided to 61% of exposed workers, ventilation systems to 48% of exposed workers and respirators to 35% of exposed workers. 40% of exposed workers were able to reduce the time spent exposed to airborne hazards (refer to Table 9).

Logistic regressions (refer to Table 10) showed that the following demographic, employment and exposure factors affected the provision of the various airborne hazard controls as follows:

- Sex
    - Sex affected the provision of masks and ventilation systems.
    - Male workers were more likely to report the provision of masks and ventilation systems than female workers.
- Type of employment
    - Type of employment only affected the provision of masks.
    - Permanent workers were more likely to report they were provided with masks than fixed term or casual workers.
- Income
    - Income only affected the provision of respirators and ventilation systems
    - Workers who earned less than $30 000 were significantly less likely to report they were provided with ventilation systems than the highest earning workers ($150 000 or more). The other income brackets had similar odds of provision of ventilation systems to the highest earners.
- Workplace size
    - Workplace size also only affected the provision of respirators and ventilation systems.
    - The likelihood that these controls were provided increased with increasing workplace size.
- Type of exposure

- The type of airborne hazard exposure (dust and/or gases, vapours, smoke or fumes) affected the provision of each type of airborne hazard control.
- Masks were most likely to be provided to workers who were exposed to dust and gases, vapours, smoke or fumes
- Respirators were least likely to be provided to workers who were exposed to dust only.
- Ventilation systems were most likely to be provided to workers who were only exposed to gases, vapours, smoke or fumes.
- Workers exposed to both dust and gases, vapours, smoke or fumes were least likely to be able to reduce the time they were exposed to these airborne hazards.

- Industry
    - Industry affected the provision of each type of airborne hazard control.
    - Workers in the Health and community services, Construction and Manufacturing industries were the most likely to be provided with masks
    - Workers in the Education, Property and business services, Transport and storage and Health and community services industries were least likely to be provided with respirators.
    - The odds of ventilation systems being provided were greatest for workers in the Manufacturing, Wholesale and retail trade, Accommodation, cafes and restaurants, and Government administration and defence industries.
    - Workers in the Health and community services, Property and business services, and Education industries were least likely to be able to reduce their exposure time to airborne hazards.
- Occupation
    - Occupation affected the provision of each type of airborne hazard control.
    - Technicians and trades workers and Managers were most likely to be provided with masks.
    - Sales workers, Professionals and Labourers were least likely to be provided with respirators.
    - Community and personal services workers, Labourers and Machinery operators and drivers were least likely to be provided with ventilation systems.
    - Labourers and Machinery operators and drivers were least likely to be able to reduce their exposure time to airborne hazards.

The employment, demographic and exposure factors that affected how many of the surveyed airborne hazard controls were provided to workers exposed to airborne hazards were also investigated. Only industry, occupation, workplace size and worker income affected the likelihood that one, two, three or four controls, as opposed to no controls, were provided (refer to Table 9 and Table 11).

- 23% of exposed workers were not provided with any of the airborne hazard controls surveyed.
- 22%, 20%, 18% and 17% of exposed workers were provided with one, two, three and four airborne hazard controls respectively.
- Workplace size most strongly affected the odds of being provided with four controls as opposed to no controls. The odds of four controls being provided increased with increasing workplace size.
- Similarly, income also most strongly affected the odds of being provided with four controls as opposed to no controls. The odds of four controls being provided increased

with increasing worker income. However, there was no difference between workers who earned $75 000 to $149 999 and those who earned $150 000 or more.

- The effect of industry and occupation depended on how many controls were considered in the model. Generally speaking, workers in the Manufacturing industry and Technicians and trades workers had the greatest odds of being provided with one, two, three or four controls each as opposed to no controls. Full details are presented in the results section and Table 19 in Appendix B.

Policy implications and recommendations

A substantial proportion of the Australian workforce is exposed to airborne hazards. Furthermore, large proportions of the exposed workers are exposed to substances known to be associated with the development or exacerbation of severe respiratory diseases. Policy measures and initiatives should be based on information on current exposure to airborne hazards (such as the NHEWS survey findings) rather than relying on long latency disease statistics. This will better protect today's workers from contracting respiratory diseases in the future as a result of their current exposures to airborne hazards.

The following are recommendations arising from this report (refer to pages 45-47):

- Focus current compliance campaigns and policy initiatives on industries and occupations with the greatest odds of exposure to airborne hazards, and those where workers reported exposure to airborne hazards with the most serious health consequences. These include:
    - Workers in the Construction, Manufacturing, Agriculture, forestry and fishing and Transport and storage industries
    - Technicians and trades workers, Labourers and Machinery operators and drivers
- Focus on the exposure of young workers and develop initiatives to reduce exposure to airborne hazards in the younger age groups
- Continue surveillance of exposure to airborne hazards
    - Improve the surveillance survey instrument by improving identification of airborne hazards, linking hazard exposure to control provision and use, expand information collected on airborne hazard controls to include measures of training and other types of controls, increasing sample size in the non-priority industries
    - Consider addition of questions on health consequences of exposure to airborne hazards to airborne hazard exposure surveillance survey
    - Surveillance should be undertaken on a regular basis (every five years at least)
    - Establish a time series data base on airborne hazard exposure in Australian workers

Introduction

It is well established that exposure to airborne hazards, such as dusts, gases, vapours, smoke or fumes, in the workplace is associated with the development of a wide range of respiratory diseases (LeVan et al. 2006). These include asthma, chronic obstructive pulmonary disease (COPD), silicosis and cancers such as mesothelioma and lung cancer. Some of these diseases, e.g. the mineral dust induced pneumoconioses such as silicosis, have declined in recent times owing to better control of exposure (Balmes et al. 2003; Sigsgaard et al. 2010). However others, such as the obstructive lung diseases, occupational asthma and COPD, remain on the rise (Moscato and Rampulla 2003; Sigsgaard *et al.* 2010) despite increasing knowledge and recognition of occupational causes. Today, asthma is considered the most common occupational respiratory disease (Houba *et al.* 1998; Meyer *et al.* 1999; Moscato and Rampulla 2003), while COPD is one of the leading causes of death worldwide (Meldrum et al. 2005; Rabe et al. 2007). Approximately 15% of asthma and between 15% and 20% of COPD cases are thought to be due to occupational exposures (Balmes et al. 2003; Driscoll et al. 2005). However, the estimate for COPD may understate the risk for non-smokers, with a recent Swedish study attributing 50% of COPD cases in non-smokers to occupational exposures (Bergdahl et al. 2004).

Workers are exposed to a wide variety of dusts, gases, vapours, smoke or fumes that each can potentially give rise to one or more respiratory diseases. Some diseases, such as silicosis or asbestosis, arise from exposure to single substances – crystalline silica or asbestos. Others, such as asthma, can be triggered by a broad range of hazards, including allergens, chemical irritants, hard metals (Kusaka et al. 1996), tobacco smoke and organic dusts (e.g. those from cotton, wood, and grain) (Monsó *et al.* 2000; Driscoll *et al.* 2005). In fact, more than 250 substances have been shown to cause sensitiser-induced asthma (Balmes et al. 2003) and the list is growing. As an additional example, causes of COPD include dusts from coal, silica and other organic materials, inorganic dusts (e.g. asbestos, man made mineral fibres, cement, concrete and quartz), gases and irritants (e.g. epoxy resins, isocyanates and organic solvents) and fumes (e.g. diesel exhausts, metal fumes and asphalt) (Balmes *et al.* 2003; Hnizdo and Vallyathan 2003; Bergdahl *et al.* 2004; Sigsgaard *et al.* 2010). The list of agents of respiratory disease (and indeed types of respiratory disease) is increasing, in part as a result of constant change in industrial processes and materials (Viegi and Di Pede 2002; Sigsgaard *et al.* 2010). It is therefore essential to instigate constant surveillance of workforce exposures to airborne hazards in order to identify both new and old risks of respiratory disease (Sigsgaard et al. 2010).

Occupational respiratory diseases are common in a range of occupations. For example, mining, farming, manufacturing and service work (e.g. hairdressing) have traditionally been high risk occupations (Ross and Murray 2004; Schenker 2005; Sigsgaard *et al.* 2010). Workers in construction, plastics and rubber manufacturing, textiles, spray painters and welders have high prevalences of COPD (Meldrum et al. 2005). Bakers have high and increasing rates of allergic asthma triggered by exposure to wheat flour and other cereal species (Houba et al. 1998). 'Newer' professions such as public administration, education and cleaning are now also associated with high rates of occupational lung disease (Sigsgaard et al. 2010). This may be partially because technological advances sometimes result in an expansion of the occupations or people at risk of exposure to airborne hazards. Alternatively, more recent, large scale, cross sectional studies may be better able to identify groups of at risk workers that are spread across industries. For example cleaners could probably have been identified as at risk earlier if, historically, there had been more broad, across-industry studies (Sigsgaard et al. 2010).

Australian workers' compensation statistics reveal relatively low rates of claims for respiratory diseases. Between 2000-01 and 2007-08, 3.7 workers in every 100 000 claimed workers' compensation for respiratory diseases caused by dusts, gases, vapours, smoke or fumes[2]. This

[2] Dusts, gases, vapours and fumes cannot always be specifically identified in the NDS workers' compensation data, therefore this figure represents a best estimate for respiratory diseases caused by airborne hazards. The estimate was obtained by restricting the data to respiratory diseases caused by

amounted to $250 million in workers' compensation payments over the eight year period and an estimated total economic cost to Australians of $165 million annually (Safe Work Australia 2009). However, due to the long latency of many of the conditions and difficulties demonstrating occupational causes, it is likely that workers' compensation statistics underestimate the incidence of these occupational diseases (Australian Safety and Compensation Council 2006) and therefore the social and economic burden for Australians.

Table 1 presents a breakdown of the Australian workers' compensation claims by type of non-malignant respiratory disease (i.e. excluding mesothelioma and other cancers of the respiratory system) and the causative agency over the eight year period, 2000-01 to 2007-08. Approximately 30% of the claims were for asbestosis, 26% were for 'other diseases of the respiratory system', which includes colds and influenza, and 23% were for 'other respiratory conditions due to substances', which includes the effects of chemicals or dusts. Asthma accounted for a further 17% claims and the remainder (4%) were claims for the compound respiratory disease category[3]; chronic bronchitis, legionnaire's disease and pneumoconiosis (excluding asbestosis).

In terms of the agency of respiratory disease, the most common was 'other non-metallic minerals and substances', which includes such substances as synthetic mineral fibres, glass fibres, ceramic fibres, fibreglass and roofing bats. These substances resulted in more than 1100 asbestosis claims[4] and the greatest number of claims for the compound respiratory disease category 'chronic bronchitis, legionnaire's disease and pneumoconiosis'. Not surprisingly, asbestos was also a major agency of respiratory disease. However, the second most common causative agency was 'dust, not elsewhere classified', which includes sand, soil, ash, mud and scale. This agency was responsible for the largest number of asthma claims and significant numbers of 'other diseases of the respiratory system' and 'other respiratory conditions due to substances'. The most common disease causing agency for workers' compensation claims in this latter category of respiratory diseases was industrial gases and fumes. The most common causative agency for other diseases of the respiratory system was 'human factors', which is not surprising considering that many of the respiratory diseases included in this category are infectious diseases of humans, such as the common cold or influenza and non-chronic bronchitis and pneumonia.

Workers in the Manufacturing industry accounted for 30% of the successful workers' compensation claims made during the period 2000-01 to 2007-08. It is important to note that these data include all successful claims and they are not scoped to exclude claims that resulted in less than a week's absence from work[5]. Of the claims from the Manufacturing industry, over half were for asbestosis (Figure 1). The same was true for the respiratory disease claims within the Construction industry. Other industries with high numbers of workers' compensation claims include the Education, Health and community services, Transport and storage, Property and business services and Government administration and defence industries. The types of respiratory diseases commonly subject to workers' compensation claims varies considerably between the industries. The Education and Health and community services industries have high numbers of claims for Other diseases of the respiratory system – common cold, influenza etc, asthma and other respiratory conditions due to substances. The Construction industry recorded the greatest number of Chronic bronchitis, Legionnaires disease and Pneumoconiosis claims.

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the following agencies: animal, human or biological agencies, chemicals and chemical products and materials and substances.

[3] These three categories of respiratory disease are reported together in this report because they are associated with very few workers' compensation claims.

[4] It is unclear why these asbestosis claims have been attributed to this agency of disease. They may be wrongly classified by workers' compensation authorities or it may not be certain that the worker was exposed to asbestos during the course of their work.

[5] Most NDS publications are restricted to 'serious' claims that result in a week or more absence from work

Table 1. The number of workers' compensation claims between 2000-01 and 2007-08 for respiratory diseases. The data are restricted to those respiratory diseases caused by the following agencies of disease: animal, human and biological agencies, chemicals and chemical products, and materials and substances. The data include all successful claims. Data source: National Data Set for compensation-based statistics (NDS), Safe Work Australia.

Agency of respiratory disease	**Asbestosis** *Excludes mesothelioma*	**Asthma** *Includes allergic bronchitis & asthmatic bronchitis*	**Other diseases of the respiratory system** *Includes URTI, common cold, influenza, non-allergic & non-chronic bronchitis, pneumonia, & hay fever*	**Other respiratory conditions due to substances** *Includes effects of chemicals or dusts*	**Chronic bronchitis - Legionnaires disease - Pneumoconiosis excluding asbestosis** *Includes COPD silicosis, emphysema and allied conditions*	**Total**
Other non-metallic minerals & substances *Includes synthetic mineral fibres, glass fibres, ceramic fibres, fibreglass, roofing batts*	1110	9	16	16	60	1211
Dust, not elsewhere classified *Includes sand, soil, ash, mud & scale*	54	241	203	227	50	775
Asbestos	621		25	37	16	699
Industrial gases & fumes *Includes argon, nitrogen, acetylene, oxygen & carbon dioxide*	<5	148	164	260	6	579
Other chemical products *Includes glue & dyes*		127	141	197	10	475
Fire, flame & smoke	<5	76	110	148	<5	338
Human agencies *Includes other people & condition of affected person*	<5	18	285	11	8	324
Other basic & unspecified chemicals *Includes carbon dioxide in form of dry ice*	<5	90	87	132	<5	316
Paint & varnish *Includes water or oil based paints, acrylic paints, vehicle paints, inks, printing inks, rust & conversion treatments*		85	45	68	<5	200
Biological agencies		6	147	<5	36	193
Other substances *Includes rubbish / garbage & potting mix*	<5	33	48	30	6	120

Agency of respiratory disease	**Asbestosis** *Excludes mesothelioma*	**Asthma** *Includes allergic bronchitis & asthmatic bronchitis*	**Other diseases of the respiratory system** *Includes URTI, common cold, influenza, non-allergic & non-chronic bronchitis, pneumonia, & hay fever*	**Other respiratory conditions due to substances** *Includes effects of chemicals or dusts*	**Chronic bronchitis - Legionnaires disease - Pneumoconiosis excluding asbestosis** *Includes COPD silicosis, emphysema and allied conditions*	**Total**
Other nominated chemicals *Includes cadmium, MOCA, acrylonitrile, thallium, vinyl chloride, PAH, pentachlorophenol*	<5	19	28	38	<5	88
Animal agencies	<5	10	38	9	<5	60
Chlorine		9	18	26		53
Other materials & objects *Includes coins, cloth, rags & dusters*	<5	<5	34	11	<5	52
Acids		<5	12	26	<5	43
Pharmaceuticals		18	9	16		43
Animal treatment chemicals		16	8	17	<5	42
Food		9	15	15		39
Detergents		15	11	11		37
Plant treatment chemicals		6	9	12	<5	29
Diesel exhaust fumes		8	7	6	<5	22
Non-bituminous hydrocarbon fuels		<5	<5	15		21
Cement & lime	<5	<5	6	11		20
Sawn or dressed timber		5	8	<5	<5	15
Organic solvents		<5	6	<5		14
Plastic materials, synthetic resins & rubbers		5		7	<5	14
Bricks & tiles & concrete, cement & clay products, not elsewhere classified		5	<5	<5		12
Other agencies of respiratory disease *Includes all agencies with <12 claims*	6	17	33	24	12	92
TOTAL	**1810**	**991**	**1520**	**1382**	**223**	**5926**

URTI: upper respiratory tract infection --- *MOCA*: 4,4'-methylene bis (2-chloroaniline) --- *PAH*: polycyclic aromatic hydrocarbons

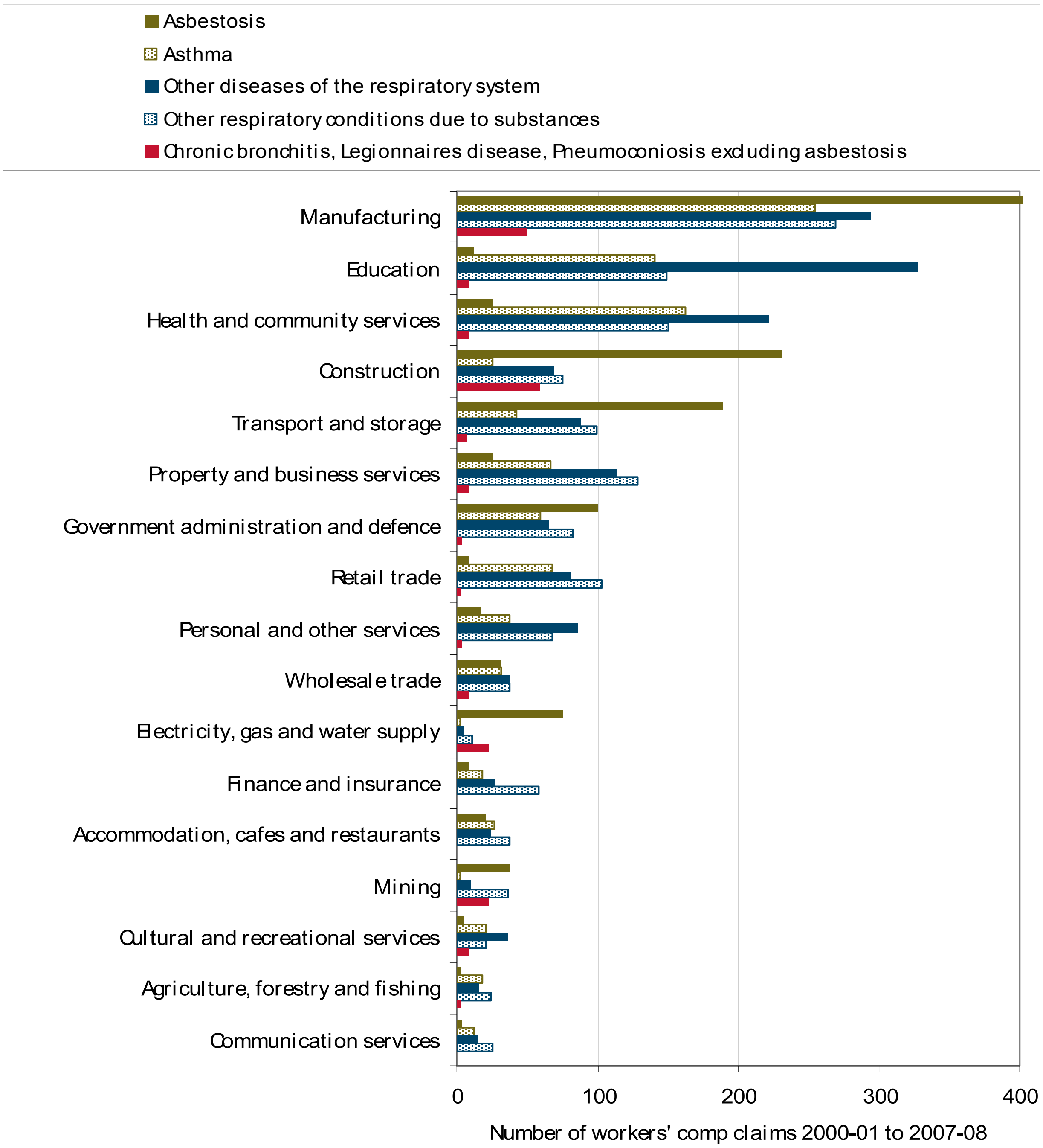

Figure 1. The number of workers' compensation claims for respiratory diseases during the period 2000-01 to 2007-08 by worker industry. These data include all successful workers' compensation claims. The number of asbestosis claims in the manufacturing industry is 991.

Despite the workers' compensation statistics discussed above, in reality there is limited information available on the extent of work-related respiratory diseases in Australia. As mentioned previously, this largely results from the fact that many respiratory diseases have long latency periods and it is often very difficult to identify respiratory diseases that arise from occupational causes. In addition, there is also very little information available about what hazards workers are exposed to during the course of their work. With these problems in mind, a report prepared by the National Occupational Health and Safety Commission (NOHSC) in 2006 identified the need for research that encompasses a comprehensive national surveillance scheme that identifies workplace hazards and facilitates effective targeting of preventative measures for respiratory diseases (Australian Safety and Compensation Council 2006). This process would also facilitate the early identification of new risks for respiratory diseases, both in terms of new airborne hazards and new exposures to old or previously known hazards.

The National Hazard Exposure Worker Surveillance (NHEWS) survey was developed in an effort to start to address this recommendation. The survey was designed to estimate the exposure of Australian workers to airborne hazards, namely dust, gases, vapours, smoke or fumes. Participating workers were asked to estimate the length of time they were exposed to dust and separately to gases, vapours, smoke or fumes. The workers were also asked to list (specifically) the types of dust and/or gases, vapours, smoke or fumes to which they were exposed. In addition to exposure data, the NHEWS survey collected information on the provision of certain types of airborne hazard control in the workplaces of exposed workers. Alongside the exposure and controls data, detailed demographic and employment data were collected from each worker. This is of particular importance because demographic factors such as sex, education and income are known to affect the risk of mortality from respiratory diseases (Prescott et al. 2003).

Together, these data provide estimates of the likelihood of workers' exposure to airborne hazards with respect to key demographic and employment factors including industry and occupation of employment. They will also be used to identify patterns in the provision of airborne hazard control based on employment and demographic factors. The ultimate aim of this research is to use these analyses to identify cohorts of workers potentially at risk of developing respiratory diseases based on their exposure to airborne hazards and the provision of airborne hazard controls in the workplace.

Overview of NHEWS survey methodology

The NHEWS survey collected data on workers' exposure to dust and to gases, vapours, smoke and fumes from 4500 Australian workers using computer assisted telephone interviews (CATI). Survey participants were asked to estimate the duration (hours per day or hours per week) they were exposed to dust and to gases, vapours, smoke and fumes. Workers who reported that they were exposed to dust, gases, vapours, smoke or fumes were then asked what the main types of dust or gases, vapours, smoke and fumes in their workplace were. Workers who reported exposure were also asked whether they / their employer (depending on whether or not they were self employed) do any of the following to prevent breathing in dust, gases, vapours, smoke or fumes or other things in the air: provide masks, provide respirators, provide ventilation systems or reduce the time spend in places where there are dust, gases, vapours, smoke or fumes.

The data collected in the NHEWS survey were analysed using logistic regression models. These models described the odds of reporting exposure to dusts and/or gases, vapours, smoke or fumes with respect to employment and demographic factors. These categories were used because they reflect the way the survey was undertaken. In addition, logistic regressions described the odds of exposed workers being provided with particular types of control measures against airborne hazards with respect to the employment and demographic characteristics of the workers. Analyses investigating how many controls were provided were also undertaken. Analyses involving the duration workers were exposed to airborne hazards were undertaken with non-parametric Kruskal-Wallis tests.

Only workers with known occupation and/or who worked in industries in which more than 50 workers were surveyed and in which more than 40 exposures were reported were included in the logistic regressions and Kruskal-Wallis tests. Imposing these restrictions on the data improved the stability and fit of the models. The restrictions were not based on any expectation concerning exposure to dust, gases vapours and fumes. Therefore, some industries (e.g. Mining) with high exposure to these substances have not been included in these analyses. This means that the results of this report do not describe the complete picture of occupational exposure to dust, gases, vapours, smoke or fumes for Australian workers.

The types of dusts, gases, vapours, smoke and fumes that workers reported they were exposed to, were classified in to 11 different types of airborne hazard (refer to Table 2). The classification scheme was based on the physical properties of the dusts, gases, vapours, smoke or fumes and their components, with particular focus on the elements of these that were most significant for respiratory diseases. The aim was to develop groups of airborne hazards without overlaps, although this proved very difficult. For example, some of the substances reported by survey participants could have been classified in more than one category. These hazard groups tend to have particular health effects e.g. they are carcinogens or irritants. Their effects are not limited to respiratory diseases. This is reflected in the description of the potential health effects of exposure to these hazards presented in Table 2.

The types of dusts, gases, vapours, smoke and fumes were also grouped according to the Type of Occurrence Classification System (TOOCS version 2.1) (National Occupational Health and Safety Commission 2002), which is used to classify the agency of injury or illness in the National Data Set (NDS) for compensation-based statistics. This latter categorisation can only be considered a rough approximation because, in some cases, the NHEWS data were not detailed enough to specifically identify the airborne hazard. However, categorising the data as per TOOCS facilitates a comparison between workers' compensation statistics and reported exposure to airborne hazards.

The data presented in this report are unweighted and are therefore only representative of the survey sample. Unless otherwise stated with 'all workers' the data presented in this report relate to the restricted data. Descriptive statistics generally, but not always, pertain to the whole data set. Full details of the survey design, fielding methodology and the data analysis methodology can be found in Appendix A of this report.

Table 2. The 11 types of airborne hazard (dark grey cells) and the NHEWS response categories for exposures to dusts (white cells), gases, vapours, smoke and fumes (light grey cells) that were included in each hazard type. The potential health effects of each type of airborne hazard are shown in the blue cells at the base of the table.

Types of airborne hazards	Low toxicity dusts	Wood & related dust	Acids & alkalis	Organic materials	Metals	Dusts from processed materials	Organic chemicals	Combustion products	Industrial & medical gases & fumes	Pesticides	Chemicals NEC
NHEWS airborne hazard exposure response categories included in type of airborne hazard	Environmental dust	Particle board, MDF	Fertiliser dust	Household dust	Metal dust	Asbestos	Diesel dust	Combustion dusts	Industrial gases & fumes	Plant treatment chemicals	Chemical dust
	Dirt / road dust	Wood dust	Concrete, cement, plaster dust	Dust from crops / harvest / grain	Welding dust	Brake dust	Paint dust	Carbon monoxide	Pharmaceuticals	Animal treatment chemicals	Other basic & unspecified chemicals
	General dust nfi		Lime dust	Paper dust	Ferrous & non ferrous metal	Brick / clay dust	Rubber dust	Diesel exhaust fumes			Unspecified toxic chemicals
	Crushed rock / gravel		Bases & alkalis	Textile, cotton, fibre dust		Sandblasting / abrasive dusts	Paint, varnish	Fire, flame & smoke			Other chemical products (glue & dyes)
	Stone dust		Cleaning chemicals & disinfectants	Processed food dust		Silica dust / sand dust	Plastic materials, synthetic resins & rubbers	Non-diesel exhaust fumes			Manufactured explosive substances
	Fibreglass dust		Chlorine	Body dust, skin dust, tooth particles		Insulation dust	Bitumen, asphalt, tar, pitch				
	Plastic dust		Acids	Nail dust		Carbon black	Organic solvents				
	Glass dust			Animal dust		Coal dust	Non-bitumous hydrocarbon fuels				
	Salt dust			Biological		Tile dust					
	Chalk dust			Oil & fat							
	Hot water / steam			Sewerage							
Potential health effects of airborne hazard	**Inflammatory response to pneumoconioses**	**Asthmagen, Carcinogen**	**Irritants**	**Asthmagen, Allergen**	**Poisoning, Sensitiser, Carcinogen, CNS disorders, Reproductive toxin**	**Irritant, Carcinogen**	**Poisoning, Carcinogen, CNS disorders, Mutagen, Sensitiser, Reproductive toxin**	**Carcinogen, Asthmagen, Poisoning, Irritant**	**Poisoning, Cytotoxin, Asphyxiant, Irritant, CNS disorders**	**Poisoning, CNS disorders, Carcinogen**	**Range of effects**

Results

This section provides an overview of the main results of the NHEWS survey. Detailed statistical information such as model output, test statistics and *p*-values are presented in Appendix B. All the results presented here are supported by formal statistical analyses and are statistically significant at the 0.05 level. Except where otherwise stated (with 'all workers'), the data analyses presented here pertain only to workers from a restricted set of industries and with known occupation. A descriptive overview of the results for the remaining industries is published on the Safe Work Australia website[6].

Exposure to dust and/or gases, vapours smoke or fumes

Just over 43% (1947) of the workers interviewed in the NHEWS survey reported that they were exposed to dust and/or gases, vapours, smoke or fumes. When the data were weighted in an attempt to reflect the entire working population of Australia, 39.5% of workers were estimated to be exposed to airborne hazards. The difference between the survey sample estimate and the weighted estimate is due to bias in the survey towards the five national priority industries, which have some of the highest percentages of workers exposed to airborne hazards. Because quotas were applied to the sampling in the first wave of the survey it is difficult to assess how accurate the data weighting process is. However, it is probably reasonable to assume that around 39% of workers in Australia are exposed to airborne hazards.

The remainder of the analyses in this report were undertaken on unweighted data and it is important to be clear that the results should not be interpreted as population level estimates. They merely reflect the patterns in the survey sample. However, it is likely that estimates from industries with large sample sizes in the survey can be treated with a reasonable amount of confidence.

Table 3 shows the breakdown of workers who reported exposure to airborne hazards by whether or not they were exposed to dust or gases, vapours, smoke or fumes, or both. In total 1544 workers reported exposure to dust and 1014 workers reported exposure to gases, vapours, smoke or fumes. Of these, 611 reported exposure to both groups of airborne hazards. Almost half (48%) of the workers who reported they were exposed to dust, gases, vapours, smoke or fumes reported they were exposed to dust hazards only, 31% reported they were exposed to dust and gases, vapours, smoke or fumes and 21% reported they were exposed to gases, vapours, smoke or fumes only.

Table 3. Exposure to airborne hazards (all workers): the number and percentage of workers who reported exposure to dust and/or gases, vapours, smoke or fumes (GVSF). Numbers in ( ) parentheses are for the restricted data set used in the multinomial logistic regression. Numbers in [ ] parentheses are the weighted estimates.

Airborne hazard worker reported exposure to	Number of workers	Percentage of workers surveyed	Percentage of exposed workers
Dust only	933 (886)	20.7% (21.6%) [18.1%]	48% (48.5%) [45.8%]
GVSF only	403 (369)	9.0% (9.0%) [9.8%]	21% (20.2%) [24.7%]
Dust AND GVSF	611 (573)	13.6% (14.0%) [11.6%]	31% (31.3%) [29.4%]
Not exposed	2553 (2274)	56.7% (55.4%) [60.5%]	-
Total	4500 (4102)	100.0%	100%
Total exposed to airborne hazards	1947 (1828)	43.3% (44.6%) [39.5%]	

Also shown in Table 3, in parentheses, are the final sample sizes for the restricted data set used in the multinomial logistic regression examining the employment and demographic factors that affected whether or not workers reported exposure to dust and/or gases, vapours, smoke or fumes. The data were restricted by industry and occupation. Only industries in which more than 50 workers were surveyed and in which more than 40 exposures were reported were included

[6] http://www.safeworkaustralia.gov.au/swa/AboutUs/Publications/2008ResearchReports.htm

in the model. Workers for whom occupation could not be determined were also excluded. Restricting the data did not alter the distribution of exposures to airborne hazards substantially. However, it did result in a slight increase in the percentage of workers exposed to airborne hazards. This was mainly due to the poorly sampled industries also having low incidences of exposure. The Mining industry was a major exception to this general pattern. Although only 38 workers were surveyed, it recorded the highest percentage (79%) of workers who reported exposure to airborne hazards of all the industries. This is probably not an anomaly because it is well known that the Mining industry has high risks of exposure to airborne hazards.

Workers were asked how long they were exposed to dust and to gases, vapours, smoke or fumes. Figure 2 shows the average hours per week workers reported they were exposed to these airborne hazards. Workers were exposed to dust for longer on average than they were exposed to gases, vapours, smoke or fumes. Workers who were exposed to dust and gases, vapours, smoke or fumes were exposed to each of these hazards for longer on average than workers who were exposed to only one of these hazards. It was not possible to determine from the data whether or not workers who reported exposure to dust and gases, vapours, smoke or fumes were exposed to these hazards simultaneously or separately. Therefore, the overall duration of exposure of these workers to airborne hazards could be considerably longer if the exposures occurred separately.

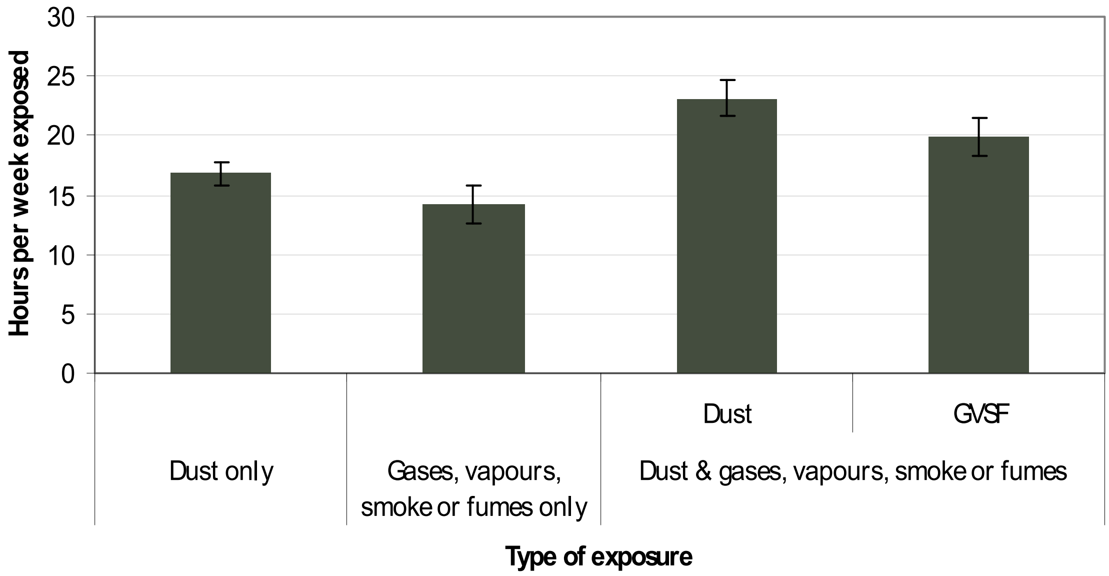

Figure 2. All workers who reported exposure to airborne hazards: the mean (±95% confidence interval) duration of exposure to airborne hazards by type of exposure

The types of airborne hazard Australian workers reported exposure to

Low toxicity dust was the main broad type of airborne hazard Australian workers reported they were exposed to (Figure 3). This group of airborne hazards included such substances as environmental dust, dirt/road dust, chalk dust, fibreglass dust and hot water/steam. Over 40% of the workers who reported they were exposed to airborne hazards reported exposure to substances included in this grouping of hazard types. Combustion products (carbon monoxide, diesel / non-diesel exhaust fumes, smoke), which was reported by 22% of workers who reported they were exposed to airborne hazards, was the second most common type of airborne hazard exposure. This was followed by Organic materials, Organic chemicals, Acids and alkalis, Metals, Wood and related dust and Industrial and medical gases and fumes, which were each reported by between 10% and 20% of the workers who reported exposure to airborne hazards.

Some workers were exposed to multiple types of airborne hazard within the same broad airborne hazard grouping. For example painters were often exposed to paint and to organic solvents, which were both classified in Organic chemicals. However, in most cases, less than 3% of workers who reported exposure to each broad type of airborne hazard reported exposure to more than one substance within that category. Workers were also exposed to multiple types of broad airborne hazard groups. For example, workers who engaged in welding were typically exposed to Industrial and medical gases and fumes and Metals. Indeed, just under half of the workers who reported they were exposed to airborne hazards were exposed to more than one broad type of airborne hazard, with nearly 30% of exposed workers exposed to two types of hazard and a further 13% exposed to three types of airborne hazard.

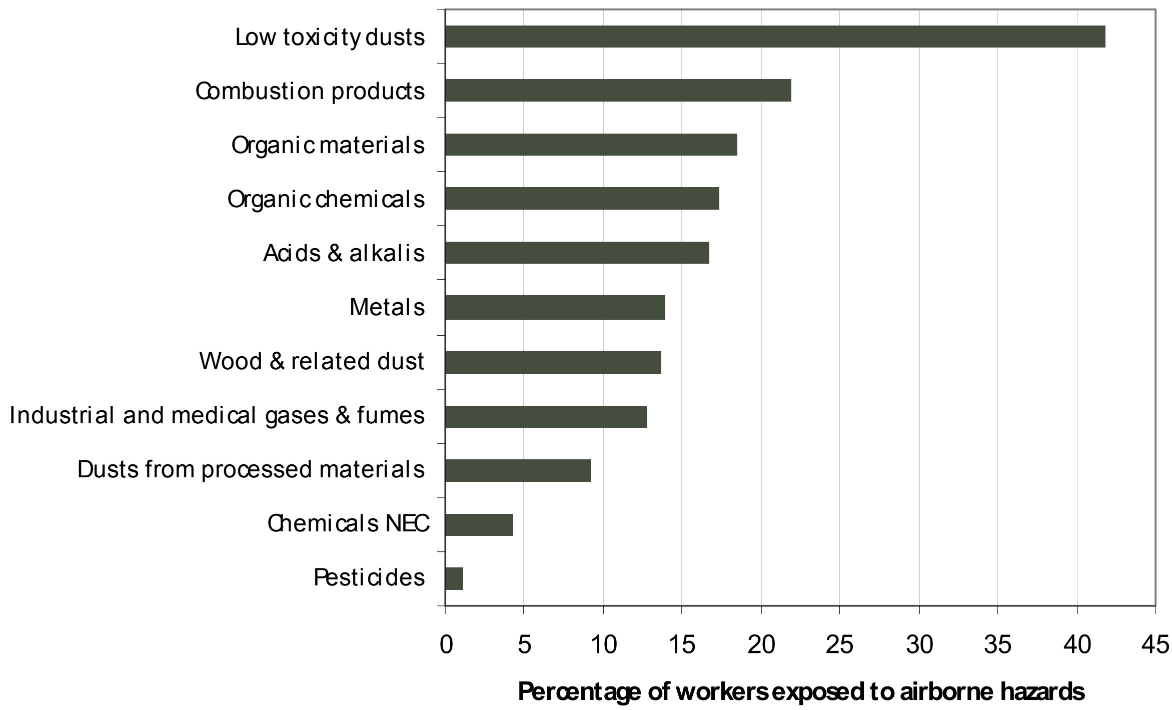

Figure 3. The percentage of workers who reported exposure to airborne hazards by the type of airborne hazard they reported exposure to. Some workers reported exposure to multiple hazard types.

The types of airborne hazard workers reported exposure to were also classified following the TOOCS 2.1 classification for agency of respiratory disease (refer to Appendix A Table 12 for classification information). As can be seen in Table 4 and Figure 4, the types of substances recorded as the agency of respiratory disease in workers' compensation claims do not necessarily reflect the pattern of exposure to airborne hazards in the workplace. It should be noted that these data can provide a rough comparison only. Classification of the NHEWS data in the TOOCS system was difficult owing to the limited information available. In addition, only one agency of disease can be linked to a workers' compensation claim whereas multiple exposures to airborne hazards were allowed in the NHEWS data set. Furthermore, there is no way of determining whether or not the NHEWS exposures were dangerous to worker health whereas all the workers' compensation claims have arisen from a dangerous exposure.

The most common agency of injury or illness that NHEWS survey participants reported exposure to was Dust not elsewhere classified. This was followed by Diesel exhaust fumes, Ferrous or non ferrous metal, Sawn or dressed timber, Biological agencies, Carbon monoxide and Cement or lime, which were each reported by at least 12% of the workers who reported exposure to airborne hazards. However, a much larger percentage of workers reported exposure to these substances in the NHEWS survey than the percentage of respiratory diseases these agencies accounted for in the workers' compensation data (Figure 4). In contrast, relatively more workers' compensation claims were attributed to Other non-metallic minerals and substances and Asbestos than the percentage of workers who reported exposure to these substances in the NHEWS survey.

Table 4. Types of dust, gases, vapours, smoke or fumes exposures that gave rise to workers' compensation claims for respiratory diseases and were reported in the NHEWS survey

AGENCY OF RESPIRATORY DISEASE As classified by the Type of Occurrence Classification System (TOOCS) used in the NDS workers' compensation data	Percentage of workers' compensation claims[1]	Percentage of workers who reported exposure[2]
Other non-metallic minerals & substances *Includes synthetic mineral fibres, glass fibres, ceramic fibres, fibreglass, roofing batts*	20.4	4.8
Dust, not elsewhere classified *Includes sand, soil, ash, mud & scale*	13.1	34.8
Asbestos	11.8	0.3
Industrial gases & fumes *Includes argon, nitrogen, acetylene, oxygen & carbon dioxide*	9.8	10.8
Other chemical products *Includes glue & dyes*	8.0	1.80
Fire, flame & smoke	5.7	6.3
Human agencies *Includes other people & condition of affected person*	5.5	-
Other basic & unspecified chemicals *Includes carbon dioxide in form of dry ice*	5.3	1.5
Paint & varnish *Includes water or oil based paints, acrylic paints, vehicle paints, inks, printing inks, rust & conversion treatments*	3.4	6.1
Biological agencies	3.3	12.7
Other substances *Includes rubbish / garbage & potting mix*	2.0	-
Other nominated chemicals *Includes cadmium, MOCA, acrylonitrile, thallium, vinyl chloride, PAH, pentachlorophenol*	1.5	-
Animal agencies	1.0	-
Chlorine	0.9	0.6
Other materials & objects *Includes coins, cloth, rags & dusters*	0.9	1.9
Organic solvents & Detergents	0.9	5.4
Acids	0.7	1.2
Pharmaceuticals	0.7	2.2
Animal treatment chemicals	0.7	0.4
Food	0.7	0.9
Plant treatment chemicals	0.5	0.8
Diesel exhaust fumes	0.4	15.7
Non-bituminous hydrocarbon fuels	0.4	7.3
Cement and lime	0.3	11.6
Sawn or dressed timber	0.3	12.9
Plastic materials, synthetic resins & rubbers	0.2	3.4
Bricks & tiles & concrete, cement & clay products, not elsewhere classified	0.2	2.8
Other agencies of respiratory disease *Includes all agencies with <12 workers' compensation claims*	1.6	Not calculated
TOTAL	100	**-**

1. These data include all successful workers' compensation claims categorised as a respiratory disease (excluding mesothelioma and other cancers of the respiratory system) that were caused by one of the following agencies of disease: animal, human and biological agencies, chemicals and chemical products, and materials and substances.
2. Unlike workers' compensation claims, which can have only one agency of disease / injury, participants in the NHEWS survey could describe their exposure to multiple hazards. Therefore, these data do not sum to 100% but were calculated by dividing the number of people who reported exposure to each hazard by the total number of people who reported exposure to airborne hazards.

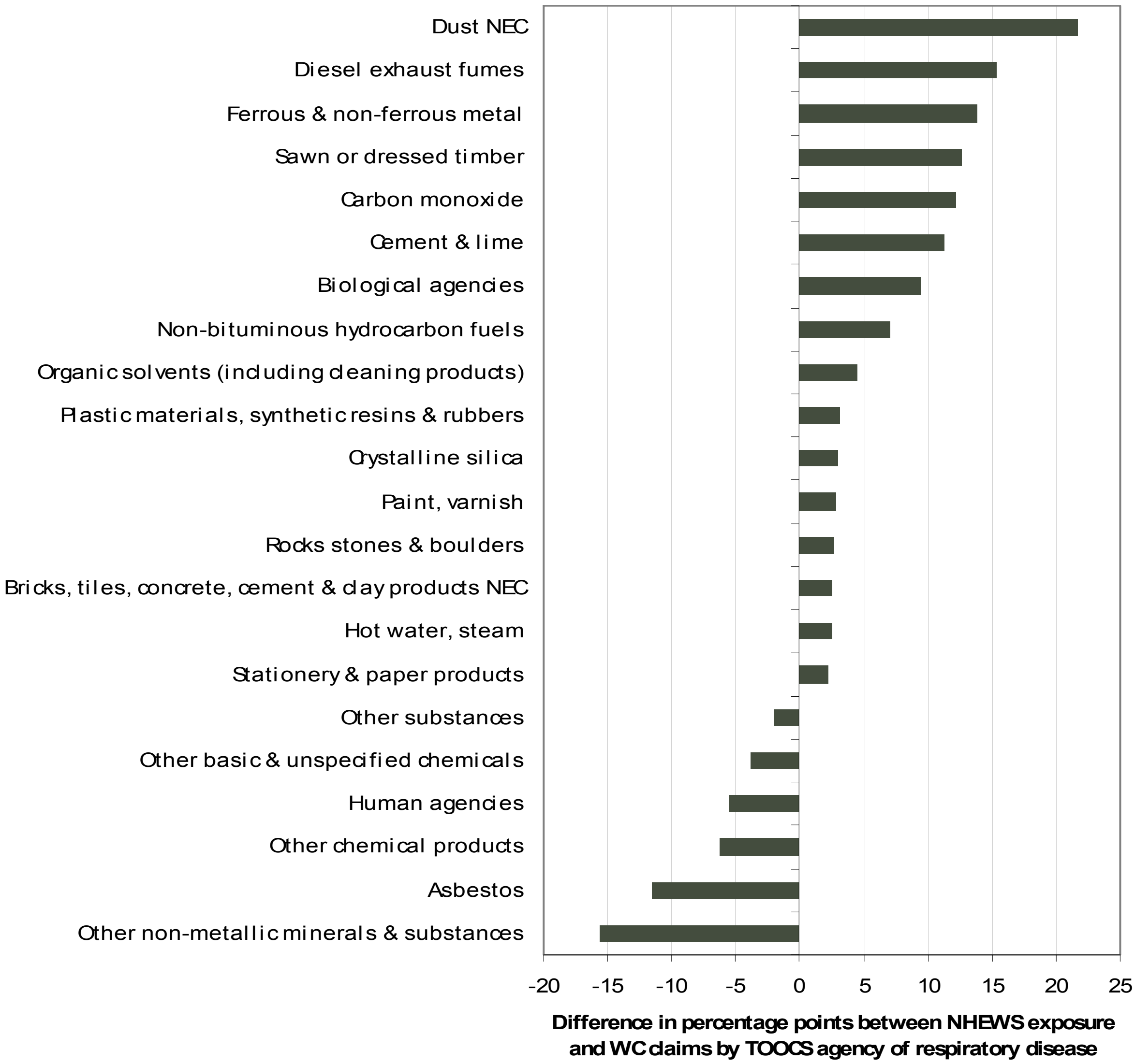

Figure 4. The difference between the percentage of workers who reported exposure in the NHEWS survey and the percentage of workers' compensation claims (2000-01 to 2007-08) by the agency of respiratory disease (as classified by TOOCS). Positive percentage point differences indicate that a larger percentage of workers reported exposure to the agency of respiratory disease than the percentage of workers' compensation claims accounted for by the agency. Negative percentage point differences indicate that the percentage of workers' compensation claims accounted for by an agency is greater than the percentage of workers who reported exposure to the agency in the NHEWS survey. Only agencies where the difference was ≥2 percentage points are shown.

It is not surprising that there is not a perfect match between exposure to hazards and agency of compensated respiratory disease when one considers the different health risks of these airborne hazards. However, these differences could be due in part to current work practices not reflecting past work practices and occupational exposures to airborne hazards. The incidence of long latency diseases, such as asbestosis, will reflect past work practices and exposures not captured in the NHEWS survey. This may mean that the pattern of exposures captured in the NHEWS survey will be associated with different patterns of respiratory disease in the future. The differences may also reflect how well occupational exposures to certain airborne hazards are attributed to respiratory disease both by medical practitioners and in workers' compensation schemes. For example, certain types of woods are known asthmagens but workers may be less likely to claim workers' compensation for this disease than for asbestosis and/or medical professionals may be less likely to consider occupational exposures in the diagnosis of asthma than they would for asbestosis. Hence the pattern of workers' compensation claims may not necessarily reflect the true incidence of occupational respiratory disease. These possibilities reinforce the need for continued airborne hazard exposure surveillance and epidemiological modelling of future respiratory (and other) disease based on current exposures.

Employment and demographic factors that affected exposure to airborne hazards

A multinomial logistic regression found that there were several demographic and employment factors that affected whether or not a worker reported exposure to dust and/or gases, vapours, smoke or fumes. These were worker sex, age and income, workplace size, industry and occupation. Table 5 presents the parameter estimates of the minimal multinomial logistic regression model and describes the likelihood of reporting exposure to airborne hazards for each factor level relative to the factor reference group. The full model output can be found in Appendix B (Table 13).

Worker sex

Male workers were more likely to report exposure to dust and/or gases, vapours, smoke or fumes than female workers (Table 5). The odds of male workers reporting exposure to dust only were 1.5 times greater than those for female workers. Male workers had similarly increased odds of reporting exposure to gases, vapours, smoke and fumes only. However the odds of reporting exposure to both dust and gases, vapours, smoke or fumes were increased by a factor of 2.6 by being male relative to being female.

Sex by types of airborne hazard

Male and female workers had different patterns of exposure to the types of airborne hazard. In general, larger percentages of male workers were exposed to the airborne hazards than female workers. For instance, 17% of male workers were exposed to Metals but only 4% of female workers and 16% of male workers were exposed to Wood and related dust compared to 7% of female workers (Figure 5). However, in contrast to this pattern, 32% of female workers were exposed to Organic materials compared to just 14% of male workers. These differences in exposure to airborne hazard are likely to result in different health outcomes for the sexes.

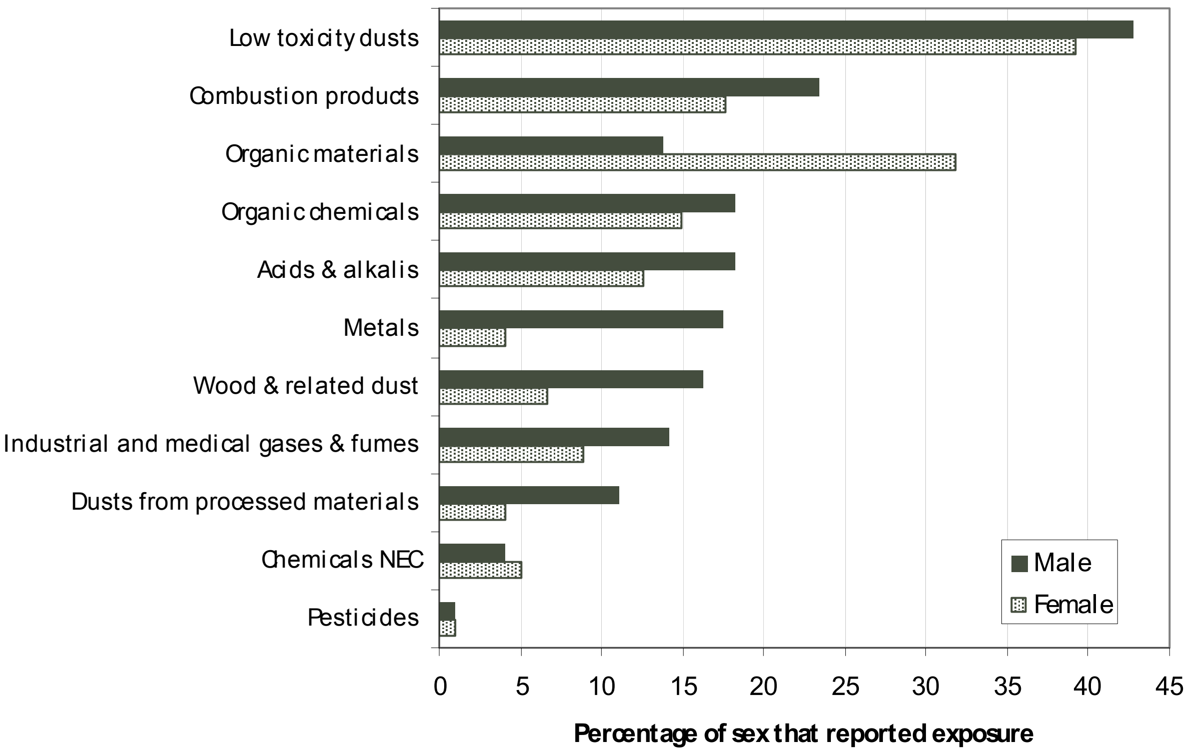

Figure 5. Type of airborne hazard: the percentage of workers exposed to airborne hazards who reported they were exposed to each type of airborne hazard by worker sex

Table 5. The parameter estimates of the multinomial logistic regression model examining the likelihood of reporting exposure to dust and/or gases, vapours, smoke or fumes. Only statistically significant differences in odds of reporting exposure are presented.

MODEL FACTORS	**Exposed to dust only**		**Exposed to gas, vapour, smoke or fumes only**		**Exposed to dust and gas, vapour, smoke or fumes**	
The reference group in the model is 'not exposed'	**The odds of reporting exposure to dust are…**	**…by a factor of (Odds ratio) relative to the factor reference group**	**The odds of reporting exposure to GVSF are…**	**…by a factor of (Odds ratio) relative to the factor reference group**	**The odds of reporting exposure to dust and GVSF are…**	**…by a factor of (Odds ratio) relative to the factor reference group**
Sex						
Male	Increased	1.49	Increased	1.61	Increased	2.64
Female	Reference group		Reference group		Reference group	
Age (years)						
15-24					Increased	2.14
25-34	Increased	1.48			Increased	2.99
35-44	Increased	1.50			Increased	1.70
45-54					Increased	1.69
55+	Reference group		Reference group		Reference group	
Income						
Under $30 000						
$30 000 to $49 999						
$50 000 to 74 999	Increased	1.90				
$75 000 to $99 999						
$100 000 to $149 999			Decreased	0.31		
$150 000 or over	Reference group		Reference group		Reference group	
Workplace size (# employees)						
Less than 5	Increased	1.80				
5 to 19	Increased	1.64				
20 to 199						
200 or more	Reference group		Reference group		Reference group	

Table 5 continued

MODEL FACTORS The reference group in the model is 'not exposed'	Exposed to dust only		Exposed to gas, vapour, smoke or fumes only		Exposed to dust and gas, vapour, smoke or fumes	
	The odds of reporting exposure to dust are…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of reporting exposure to GVSF are…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of reporting exposure to dust and GVSF are…	…by a factor of (Odds ratio) relative to the factor reference group
Industry						
Manufacturing	Increased	3.08			Increased	5.97
Transport & storage	Increased	1.99			Increased	3.83
Construction	Increased	4.61	Decreased	0.37	Increased	3.24
Agriculture, forestry & fishing	Increased	3.10			Increased	3.31
Wholesale & retail trade					Increased	2.16
Accommodation, cafes & restaurants			Increased	2.89		
Property & business services			Decreased	0.45		
Government administration & defence			Decreased	0.34		
Education			Decreased	0.58		
Health & community services	Reference group		Reference group		Reference group	
Occupation						
Managers	Increased	2.55				
Professionals			Increased	2.24		
Technicians & trades workers	Increased	4.30	Increased	5.19	Increased	6.67
Community & personal services workers					Increased	2.43
Labourers	Increased	3.96	Increased	4.78	Increased	4.68
Sales workers			Increased	2.47		
Machinery operators & drivers	Increased	4.65	Increased	4.87	Increased	6.05
Clerical & administrative workers	Reference group		Reference group		Reference group	

Sex by duration of exposure

Worker sex also affected the duration of exposure to dust and/or gases, vapours, smoke or fumes (Appendix B, Table 14). When comparing within exposure type, male workers were exposed to airborne hazards for longer durations than females (Figure 6). However, comparing across exposure types, workers who were exposed to dust and gases, vapours, smoke or fumes were exposed for longer durations than workers exposed to dust only or gases, vapours, smoke or fumes only. Further, female workers exposed to both airborne hazards were exposed to dust for longer durations per week than male workers who were exposed to dust only. Similarly, female workers exposed to both airborne hazards had almost the same duration of exposure per week to gases, vapours, smoke or fumes as male workers who were exposed to gases, vapours, smoke or fumes only.

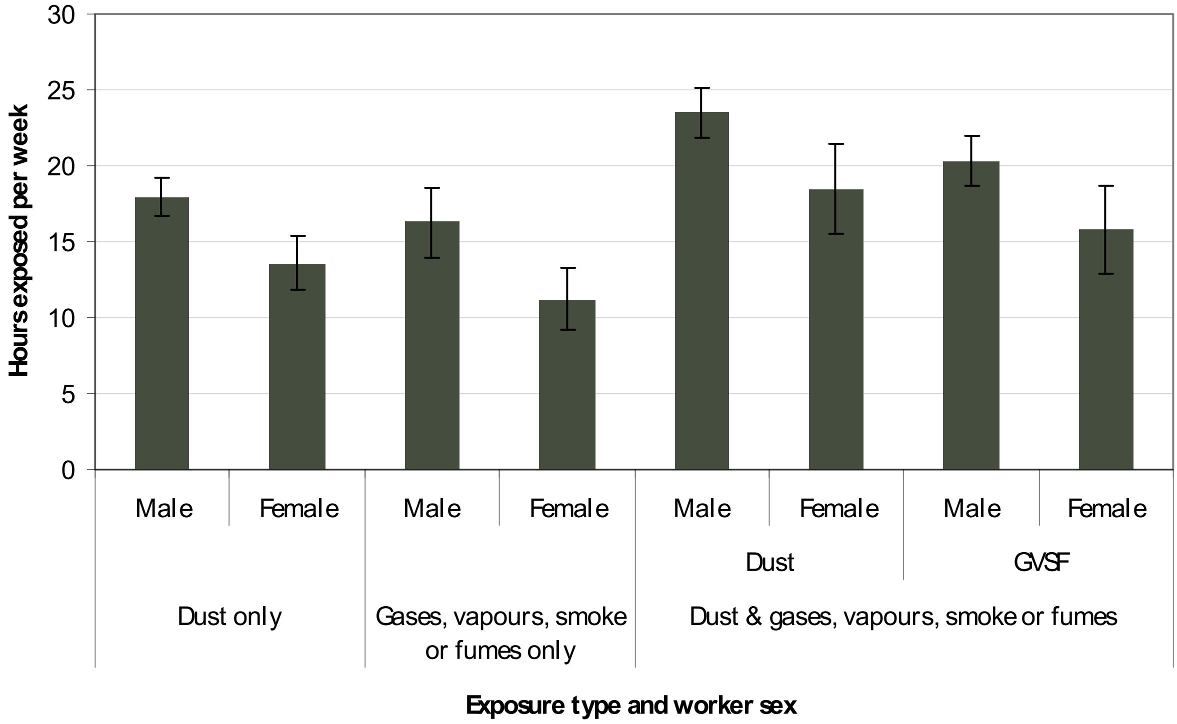

Figure 6. The mean (±95% confidence interval) duration of exposure to dust and/or gases, vapours, smoke or fumes (GVSF) by worker sex

Worker age

The relationship between worker age and reporting exposure to airborne hazards depended on the hazard type (Table 5). Workers aged between 25 and 44 years had increased odds of reporting exposure to dust compared to workers 55 years or older, while all age groups were equally likely to report exposure to gases, vapours, smoke or fumes. In contrast all workers younger than 55 years had increased odds of reporting exposure to dust and gases, vapours, smoke or fumes compared to the 55 years and older workers. However, of these, workers aged 25-34 had the greatest odds and were almost three times more likely to report exposure to both types of airborne hazard than the oldest workers.

Age by type of airborne hazard

Workers who reported they were exposed to airborne hazards differed by age in terms of the types of airborne hazards they were likely to be exposed to (Table 6). Workers aged 15-24 years recorded the greatest percentage of workers exposed to six of the 11 types of airborne hazard. These included Organic chemicals, Acids and alkalis and Metals. The age group that recorded the greatest percentage of workers exposed to Low toxicity dusts (the most common type of airborne hazard) was 25-34 year olds, in which 47% of workers reported exposure. By contrast, 36% of 55+ year old workers reported exposure to this hazard. The 55+ year age group recorded the greatest percentage of workers who reported they were exposed to Organic materials (23%) and the 45-54 year age group recorded the greatest percentage of workers who reported exposure to Combustion products (23%) of all the age groups. The 35-44 year old age group had intermediate percentages of workers who reported exposure to each of the different types of airborne hazards.

Table 6. Type of airborne hazard: The percentage of exposed workers, within age groups, who reported they were exposed to each type of airborne hazard

	The percentage of workers within each age group that were exposed to each airborne hazard				
AIRBORNE HAZARD	**15-24**	**25-34**	**35-44**	**45-54**	**55+**
Low toxicity dusts	37	47	43	43	36
Combustion products	21	20	23	24	19
Organic materials	16	17	18	17	23
Organic chemicals	21	20	17	15	18
Acids and alkalis	21	20	17	16	13
Metals	19	16	12	16	11
Wood and related dust	19	15	13	14	11
Industrial and medical gases and fumes	16	15	12	14	10
Dusts from processed materials	13	10	8	9	9
Chemicals not elsewhere classified	3	8	3	4	5
Pesticides	1	2	1	1	1

Age by duration of exposure

There were statistically significant differences in the durations workers were exposed to dust and to gases, vapours, smoke or fumes with respect to worker age (Appendix B, Table 14). However, the relationship was largely driven by workers who reported they were exposed to dust and to gases, vapours, smoke or fumes. There was no statistical difference between the various age groups in terms of the duration of exposure to either dust only or gases, vapours, smoke or fumes only. However, as can be seen in Figure 7, for workers who reported they were exposed to both dust and gases, vapours, smoke or fumes, the duration of exposure to dust tended to decline with increasing age. There was no statistical difference in the durations of exposure to gases, vapours, smoke or fumes between the different age groups of workers exposed to both types of airborne hazard.

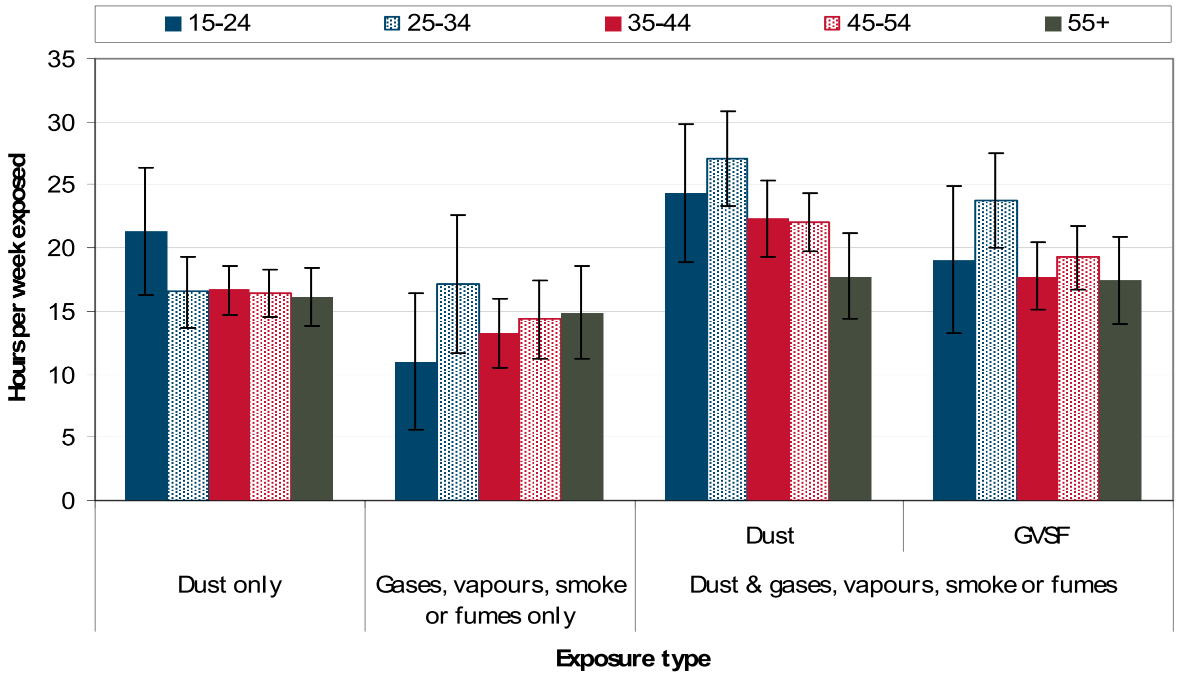

Figure 7. The mean (±95% confidence interval) duration of exposure to dust and/or gases, vapours, smoke or fumes (GVSF) by worker age group

Income

Worker income had a significant association with reporting exposure to airborne hazards. However, this was one of the least important factors in the regression model. As can be seen in Table 5, workers who earned between $50 000 and $74 999 were 1.9 times more likely to report exposure to dust than workers earning in excess of $150 000. However, all other income brackets had the same odds as the highest earners of reporting exposure to dust. Workers who earned between $100 000 and $149 000 had decreased odds of reporting exposure to gases, vapours, smoke or fumes relative to those who earned $150 000 or more. Again, all the remaining income brackets had similar odds of reporting exposure to gases, vapours, smoke and fumes relative to the highest earners ($150 000+). The odds of reporting exposure to dust and gases, vapours, smoke or fumes were not affected by income.

Income by duration of exposure

There were statistically significant differences in the duration workers were exposed to dust or gases, vapours, smoke or fumes with respect to worker income (Appendix B Table 14). As can be seen in Figure 8, workers whose income was greater than $30 000 but less than $100 000 recorded the longest durations of exposure to dust and to gases, vapours, smoke or fumes. Only very few workers earned $150 000 or more so the duration of exposure data for airborne hazards for these workers shows considerably more variation than for the other income brackets. These data should be interpreted with caution. However they do indicate a trend towards increased exposure durations to airborne hazards in the highest income brackets, particularly for workers exposed to gases, vapours, smoke or fumes.

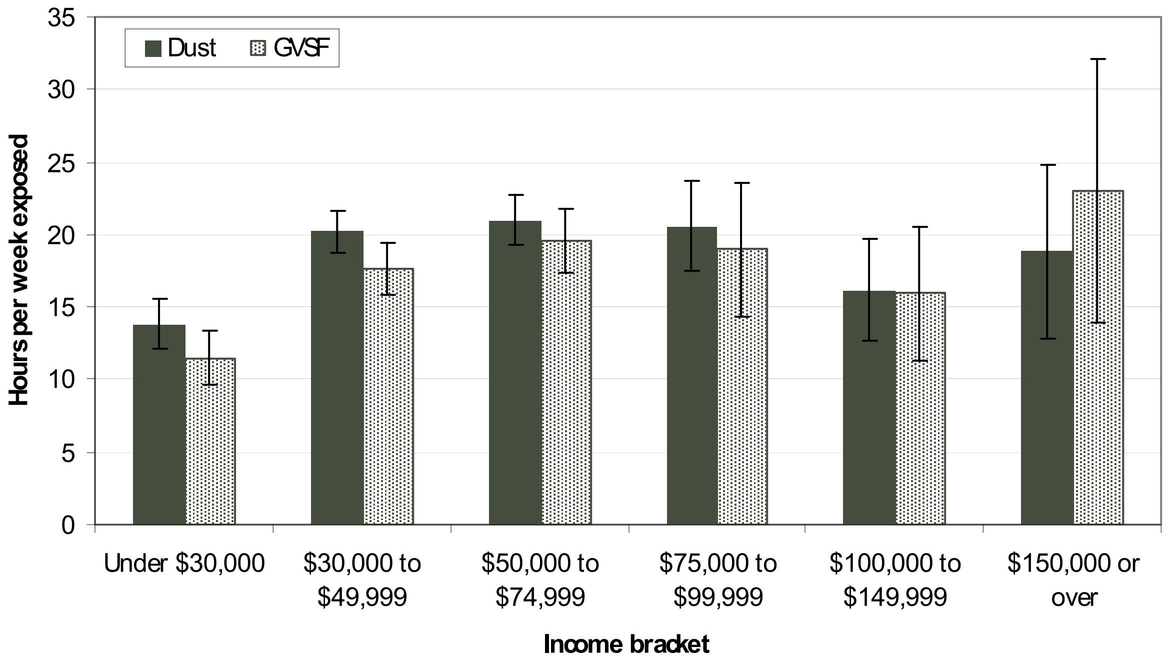

Figure 8. The mean (±95% confidence interval) duration of exposure to dust or gases, vapours, smoke or fumes (GVSF) by worker income bracket

Workplace size

Workplace size, as estimated by the number of employees working in the workplace, also affected the likelihood of reporting exposure to airborne hazards. However, like income, workplace size was not one of the most important predictive factors in the regression model. Workplace size only affected the odds of reporting exposure to dust (Table 5). The odds of reporting exposure to dust were increased by a factor of 1.8 by working in a workplace with less than five employees and by a factor of 1.6 by working in a workplace with between 5 and 19 employees relative to working in a workplace with 200 or more employees.

Workplace size by duration of exposure

Workplace size also affected the duration (number of hours per week) workers were exposed to airborne hazards (Appendix B Table 14). However, this was only true when workers were exposed to both dust and gases, vapours, smoke or fumes. There was no relationship between workplace size and the duration workers were exposed to either dust only or gases, vapours, smoke or fumes only. As is shown in Figure 9, the mean duration of exposure to dust and gases, vapours, smoke or fumes increased with increasing workplace size when workers were exposed to both types of airborne hazard.

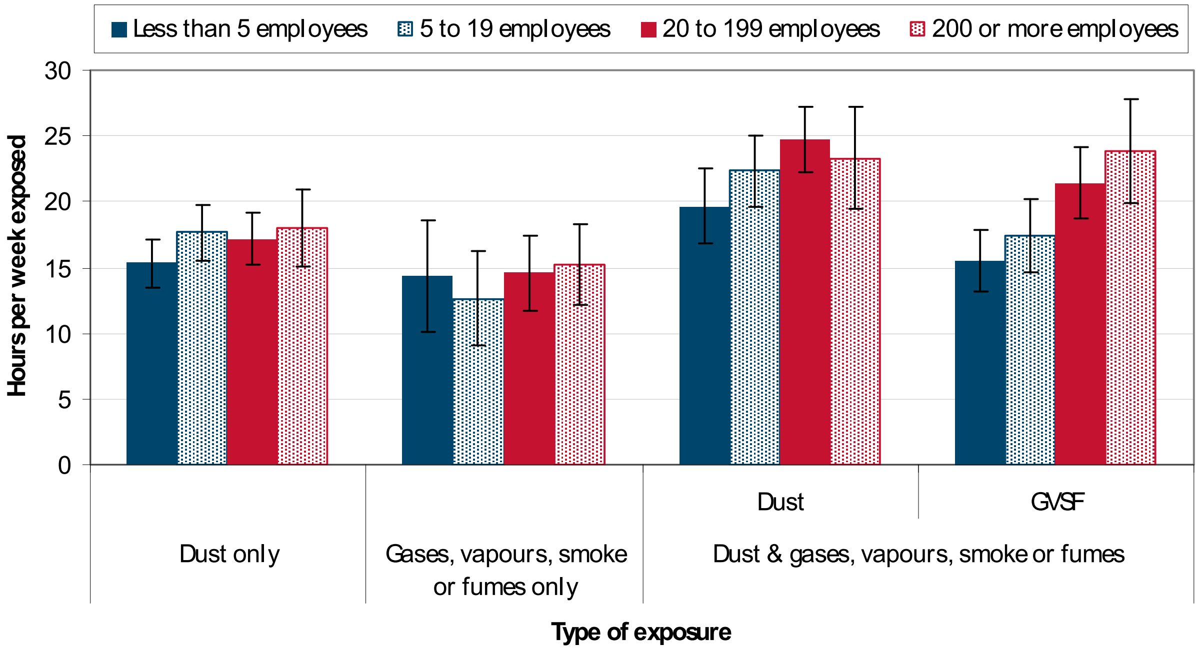

Figure 9. The mean (±95% confidence interval) duration of exposure to dust and/or gases, vapours, smoke or fumes (GVSF) by workplace size

Industry of main employment

Industry of main employment was the most important factor in predicting whether or not a worker reported exposure to airborne hazards. As can be seen in Table 5, there were four industries associated with increased odds of reporting exposure to dust only relative to the Health and community services industry. Listed in order of decreasing odds ratios (in parentheses), these were the Construction (4.6), Agriculture, forestry and fishing (3.1), Manufacturing (3.1) and Transport and storage (2.0) industries.

A different pattern was observed when considering exposure to gases, vapours, smoke or fumes only. Workers in the Accommodation, cafes and restaurants industry were almost three times more likely to report exposure to gases, vapours, smoke or fumes than workers in the Health and community services industry. In contrast, workers in the Education (0.58), Property and business services (0.45), Construction (0.37) and Government administration and defence (0.34) industries were significantly less likely than workers in the Health and community services industry to report exposure to gases, vapours, smoke or fumes only.

The odds of reporting exposure to both dust and gases, vapours, smoke or fumes were significantly increased by working in the Manufacturing (6.0), Transport and storage (3.8), Agriculture, forestry and fishing (3.3), Construction (3.2) and Wholesale and retail trade (2.2) industries compared to the Health and community services industry.

Industry by type of airborne hazard

There were predictable differences between the industries in terms of the types of exposures to airborne hazards that were reported by workers (Table 7). The Agriculture, forestry and fishing industry recorded the highest percentage of workers (68%) who reported exposure to Low toxicity dusts. In comparison just 23% of Health and community service workers reported exposure to this group of substances. Agriculture, forestry and fishing also recorded almost all the exposures to Pesticides. The Construction industry recorded the highest percentages of workers who reported exposure to Wood and related dust (30%), Acids and alkalis (35%) and Dusts from processed materials (17%). The Transport and storage industry recorded the highest percentages of workers exposed to Organic chemicals (26%) and Combustion products

(48%), which reflect the high exposure of workers in this industry to fuel vapours and exhaust fumes. The percentage of workers who reported exposure to Combustion products was also high in the Accommodation, cafes and restaurants industry probably due to cooking related exposures to gases, vapours, smoke and fumes. This industry also recorded the greatest percentage of workers exposed to Organic materials (46%). Exposure to Organic materials was also high in the Health and community services industry (36%), as was exposure to Industrial and medical gases and fumes (21%). However, of all the industries, the Manufacturing industry recorded the greatest percentage of workers who reported exposure to Industrial and medical gases and fumes (23%) and Metals (35%).

Table 7. Type of airborne hazard: The percentage of exposed workers, within industries, who reported they were exposed to each type of airborne hazard

	The percentage of workers within each industry who were exposed to each airborne hazard									
TYPE OF AIRBORNE HAZARD	Manufacturing	Transport & storage	Construction	Agriculture, forestry & fishing	Health & community services	Wholesale & retail trade	Accommodation, cafes & restaurants	Property & business services	Government administration & defence	Education
Low toxicity dusts	31	49	45	68	23	45	44	52	43	44
Combustion products	16	48	13	22	16	25	44	19	28	25
Organic materials	16	17	6	24	36	25	46	21	28	16
Organic chemicals	23	26	14	7	13	19	17	15	11	16
Acids and alkalis	12	7	35	7	14	11	20	15	15	7
Metals	35	8	12	6	1	5	0	3	7	4
Wood and related dust	12	3	30	9	5	13	2	13	11	10
Industrial and medical gases and fumes	23	6	9	6	21	6	0	4	11	7
Dusts from processed materials	8	10	17	2	0	5	0	9	4	8
Chemicals not elsewhere classified	5	3	3	2	6	5	0	4	2	10
Pesticides	0	0	0	8	1	0	0	0	0	0

Industry by duration of exposure to airborne hazards

Like exposure, industry of main employment affected the number of hours workers reported they were exposed to airborne hazards per week (Appendix B, Table 14). Figure 10 shows the mean (± 95% confidence interval) durations workers reported they were exposed to dust or to gases, vapours, smoke or fumes. Two industries, Accommodation, cafes and restaurants and Government administration and defence, have very wide 95% confidence intervals of the mean. This is a result of small sample sizes in these industries and these duration of exposure data should therefore be interpreted with caution. For the majority of industries, workers were exposed to dust for more hours per week than they were exposed to gases, vapours, smoke or fumes. However, the reverse was true for the Transport and storage, Wholesale and retail trade and Health and community services industries. The Transport and storage industry recorded the greatest average exposure to gases, vapours, smoke or fumes (21 hours per week) while the Manufacturing industry recorded the longest average exposure to dust (23 hours per week). A breakdown of the average duration of exposure by exposure type (dust and/or gases, vapours, smoke or fumes) and industry is presented in Appendix B, Figure 18.

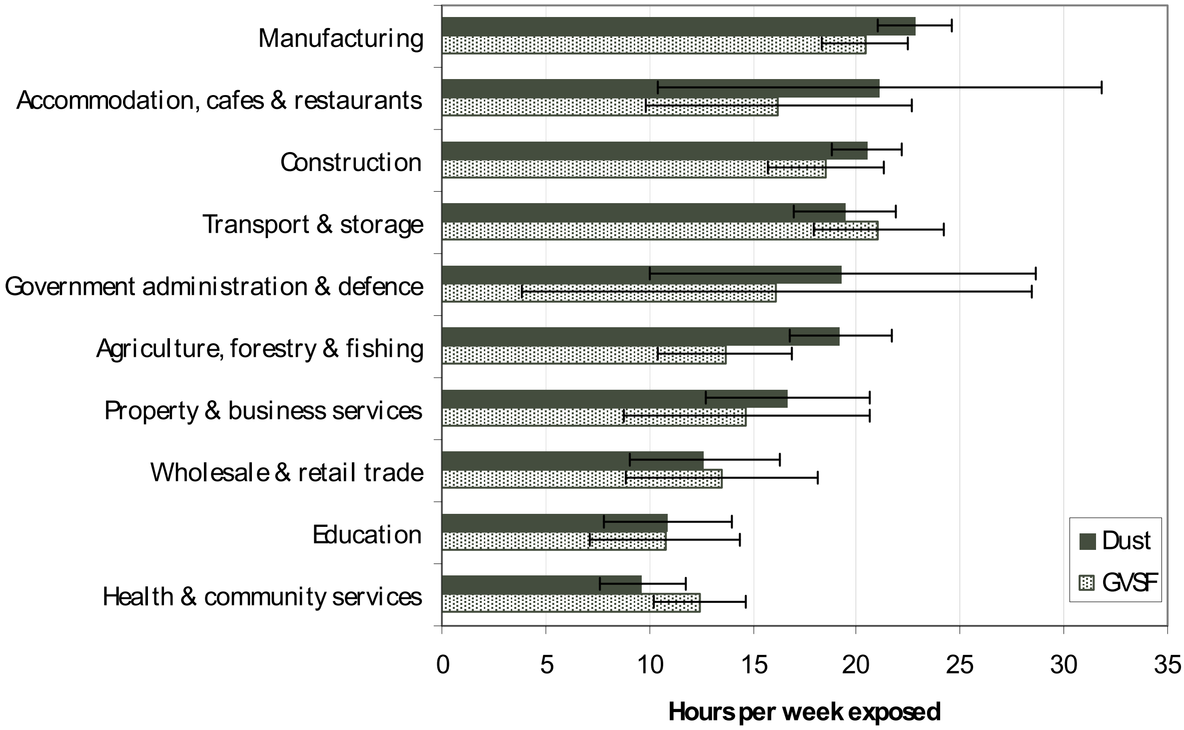

Figure 10. The mean (±95% confidence interval) duration of exposure to dust or gases, vapours, smoke or fumes (GVSF) by industry of main employment

Occupation of main employment

After industry, occupation of main employment was the second most important factor in predicting whether or not workers reported exposure to airborne hazards. As is shown in Table 5 , the logistic regression model revealed that Technicians and trades workers, Machinery operators and drivers and Labourers consistently had increased odds of reporting exposure to airborne hazards compared to Clerical and administrative workers.

There were four occupations with increased odds of reporting exposure to dust only relative to Clerical or administrative workers. These were (odds ratios in parentheses): Machinery operators and drivers (4.7), Technician or trades workers (4.3), Labourers (4.0) and Managers (2.6). Workers in all occupations except Managers and Community and personal services workers, had increased odds of reporting exposure to gases, vapours, smoke or fumes only compared to Clerical and administrative workers. Of these, Technicians and trades workers, Machinery operators and drivers and Labourers had the most dramatically increased odds (by a factor of 5.2, 4.9 and 4.8 respectively) of reporting exposure to gases, vapours, smoke or fumes only. The odds of reporting exposure to both dust and gases, vapours, smoke or fumes as opposed to not reporting exposure to any airborne hazards, were increased by working as a Technician or trades worker, Machinery operator and driver, Labourer and Community and personal services worker compared to working as a Clerical and administrative worker.

Occupation by type of airborne hazard

The types of airborne hazard workers were exposed varied with occupation (Table 8). Of the occupations, Technicians and trades workers recorded the greatest percentages of workers who reported they were exposed to Acids and alkalis (26%), Metals (25%), Wood and related dust (22%) and Dusts from processed materials (13%). This occupation also had the second greatest percentage of workers who reported exposure to Industrial and medical gases or fumes (19%). Machinery operators and drivers recorded the greatest percentages of workers who reported exposure to Low toxicity dusts (53%) and Combustion products (35%) across occupations. A large percentage (33%) of Community and personal service workers also reported exposure to Combustion products. This could be due in part to the inclusion of fire fighters in this occupational grouping. However, Community and personal service workers also recorded the greatest percentage of workers exposed to Organic materials, which include household dust, sewerage, human and animal body dusts.

Table 8. Type of airborne hazard: The percentage of exposed workers, within occupations, who reported they were exposed to each type of airborne hazard

	The percentage of workers within each occupation who were exposed to each airborne hazard							
TYPE OF AIRBORNE HAZARD	Managers	Professionals	Technicians & trades workers	Community & personal service workers	Clerical & administrative workers	Sales workers	Machinery operators & drivers	Labourers
Low toxicity dusts	49	35	36	31	38	50	53	48
Combustion products	16	18	17	33	25	22	35	23
Organic materials	21	18	12	34	22	22	16	26
Organic chemicals	13	13	20	15	16	28	21	15
Acids and alkalis	11	13	26	9	7	9	9	21
Metals	7	7	25	2	11	3	12	10
Wood and related dust	15	6	22	9	7	9	8	14
Industrial and medical gases and fumes	5	20	19	10	6	2	8	10
Dusts from processed materials	9	6	13	3	5	3	11	7
Chemicals not elsewhere classified	2	8	6	1	3	2	4	2
Pesticides	2	0	1	1	1	0	1	2

Occupation by duration of exposure to airborne hazards

Occupation of main employment also affected the number of hours per week workers reported they were exposed to airborne hazards (Appendix B, Table 14). Workers from the three occupations (Technicians and trades workers, Machinery operators and drivers and Labourers) that were consistently associated with high odds of reporting exposure to airborne hazards also recorded the greatest average weekly hours of exposure to airborne hazards (Figure 11). Of these, Machinery operators and drivers recorded the longest average exposures to both dust and gases, vapours, smoke or fumes. All occupations except Professionals recorded longer average exposures to dust than to gases, vapours smoke or fumes. A further breakdown of the average duration of exposure by exposure type (dust and/or gases, vapours, smoke or fumes) and occupation is presented in Appendix B, Figure 19.

Figure 11. The mean (±95% confidence interval) duration of exposure to dust or gases, vapours, smoke or fumes (GVSF) by occupation of main employment

Airborne hazard controls

Participants in the NHEWS survey who reported that they were exposed to dust or gases, vapours, smoke or fumes were asked whether or not the following airborne hazard controls were provided in their workplaces[7]: masks, respirators, ventilation systems and reducing time spent exposed to airborne hazards. As shown in Table 9, between 35% and 61% of exposed workers were provided with at least one of these control measures in their workplace, while 22% of exposed workers were not provided with any control measure or did not know what controls were provided against airborne hazards.

Responses other than those specifically surveyed were also recorded when provided by survey participants. Approximately 5% of workers gave unprompted responses. These included; ‘monitoring gases’, ‘water carts’ and ‘training’ but also ‘open the doors/window’, ‘keep car windows up’ and the comment that ‘masks are uncomfortable / not worn’. Therefore, the other control measures category includes some valid control measures but also many dubious forms of airborne hazard control.

The number of surveyed control measures provided in workplaces is also shown in Table 9. Approximately 17% of workers exposed to airborne hazards were provided with each of the four hazard control measures surveyed, while 23% of exposed workers reported that none of the surveyed hazard controls were provided. The vast majority of this latter figure was accounted for by workers who said that no control measures (‘nothing’ or ‘don’t know’) were provided. The remainder was accounted for by those workers who only provided an ‘other’ response. Workers who only provided an ‘other’ response amounted to 1.5% of all the exposed workers. Of the workers who were provided with airborne hazard control measures, the greatest percentage was provided with just one control measure. As the number of controls provided increased, the percentage of workers provided with controls decreased.

Table 9. Airborne hazard control provision in Australian workplaces: the percentage of workers who were exposed to airborne hazards by control type and number of controls provided

Control measures against airborne hazards (Multiple responses allowed)	Number of workers who reported control was provided	Percentage of workers exposed to airborne hazards
Mask	1191	61%
Respirator	679	35%
Ventilation systems	931	48%
Reduce time exposed to airborne hazards	776	40%
Other control measures (unprompted responses)	99	5%
Nothing / don’t know	421	22%
Sum of control measures (excluding ‘other’ responses)	**Number of workers**	**Percentage of workers exposed to airborne hazards**
No airborne hazard control[1]	451	23%
1 control measure	419	22%
2 control measures	397	20%
3 control measures	356	18%
4 control measures	324	17%
Total	1947	100%

1. Includes Nothing/don’t know and Other control measures

[7] It should be noted that the airborne hazard control provision questions did not relate to the previous week as did the exposure questions. It is therefore possible that workers reported the provision of controls for hazard exposures that did not occur in the reference week. This may lead to the overestimation of the number or type of controls provided for particular airborne hazard exposures.

Figure 12 and Figure 13 show the percentage of workers who reported they were exposed to airborne hazards who also reported that no airborne hazard controls were provided in their workplaces by industry and occupation of employment. Workers in the Education industry were most likely to report that no controls were provided. In this industry 38% of exposed workers said that no controls were provided. Other industries in which at least 30% of exposed workers reported no controls were provided include Accommodation, cafes and restaurants, Health and community services, Transport and storage and Wholesale and retail trade. In all, more than one quarter of exposed workers reported no controls were provided in eight of the ten industries presented in this report. Only the Construction and Manufacturing industries had fewer than 20% of exposed workers report no controls were provided. Of these two industries, the Manufacturing industry recorded the lowest percentage (14%) of workers who said no airborne hazard controls were provided.

Figure 12. All workers exposed to airborne hazards: The percentage of workers within each industry who reported they were provided with no airborne hazard controls

Similar to the pattern by industry, more than 25% of workers exposed to airborne hazards reported that no controls were provided in six of the eight occupations. For instance, more than 35% of workers in the following occupations reported that no airborne hazard controls were provided: Community and personal service workers (42%); Sales workers; and Clerical and administrative workers. Only Managers (18% reported no controls provided) and Technicians and trades workers (12% reported no controls provided) had fewer than 25% of workers unprotected by the airborne hazard controls surveyed in this study.

Figure 13. All workers exposed to airborne hazards: The percentage of workers within each occupation who reported they were provided with no airborne hazard controls

Employment, demographic and hazard exposure factors that affected the provision of airborne hazard controls

To determine which employment, demographic and exposure factors affect the provision of controls against airborne hazards in workplaces the data were modelled in two ways. The first approach studied the provision of each of the four types of airborne hazard control surveyed individually (masks, respirators, ventilation systems, reducing exposure time). The second approach examined what employment, demographic and exposure factors affected how many of these controls were provided to workers exposed to airborne hazards. The full statistical output from these models can be found in Appendix B: Provision of the individual controls – Table 15 through to Table 18; Number of controls – Table 19.

The provision of individual airborne hazard controls

Seven demographic, employment and exposure characteristics were identified as being important factors in the provision of the individual airborne hazard controls (Table 10). These factors; sex, employment type, income, workplace size, exposure type, industry and occupation, produced statistically reliable models for each of the airborne hazards and explained the largest amount of variation in the provision of these controls. However that said, for two of the models in particular (ventilation systems and reducing exposure time), the models did not explain very much of the variation in the provision of these controls (14% and 9% respectively). For these controls, no combination of employment and demographic factors predicted the provision of these controls much better than model presented. This means that the NHEWS survey either did not collect data on factors that are associated with the provision of these controls or that there is no predictable, consistent pattern in the provision of these controls. The latter explanation is a strong possibility because the NHEWS survey collected information on a very wide range of exposures to dust and gases, vapours, smoke or fumes with a wide range of associated health risks. Although a health risk variable was not included in the current survey, it is possible that such a factor could be a strong predictor of control provision and result in models that explain more variation in the provision of airborne hazard controls.

The impact of each of the seven demographic and employment factors on control provision depended on the individual controls concerned. For instance, worker sex only affected the provision of masks and respirators. Female workers were less likely than males to be provided with both these forms of airborne hazard controls. Type of employment (permanent, fixed term or temporary/casual) affected the provision of masks only. Permanent workers were more likely than temporary/casual workers to be provided with masks. Fixed term workers had similar odds of being provided with masks to temporary/casual workers.

Workplace size affected the provision of respirators and ventilation systems. For both these airborne hazard controls, the odds that they were not provided to exposed workers were increased for workers in smaller workplaces compared to the largest workplaces. For ventilation systems, only workers in workplaces with less than 20 employees had increased odds of this control not being provided. In contrast, all workplaces with fewer than 200 workers had increased odds of respirators not being provided but the odds of no provision declined with increasing workplace size.

Table 10. The parameter estimates of four logistic regression models examining the likelihood of the provision of each of four airborne hazard controls: masks, respirators, ventilation systems and reducing exposure time to dust and/or gases, vapours, smoke or fumes. Grey areas indicate factors that did not have a significant effect on the provision of the individual controls. Only statistically significant differences in odds of reporting exposure are presented.

MODEL FACTORS	**MASKS**		**RESPIRATORS**		**VENTILATION SYSTEMS**		**REDUCE EXPOSURE TIME**	
The reference group for each model was 'control provided'	The odds of masks **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of respirators **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of ventilation systems **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of 'reducing exposure time' **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group
SEX								
Male	Decreased	0.71	Decreased	0.50				
Female	Reference group		Reference group		Reference group		Reference group	
TYPE OF EMPLOYMENT								
Permanent	Decreased	0.50						
Fixed term								
Temporary/casual	Reference group		Reference group		Reference group		Reference group	
INCOME								
Under $30,000					Increased	4.34		
$30,000 to $49,999								
$50,000 to $74,999								
$75,000 to $99,999								
$100,000 to $149,999								
$150,000 or over	Reference group		Reference group		Reference group		Reference group	
WORKPLACE SIZE – number of employees								
Less than 5			Increased	2.54	Increased	2.37		
5 to 19			Increased	1.90	Increased	1.51		
20 to 199			Increased	1.61				
200 or more	Reference group		Reference group		Reference group		Reference group	

Table continued on next page

Table 10 continued **MODEL FACTORS** The reference group for each model was 'control provided'	MASKS		RESPIRATORS		VENTILATION SYSTEMS		REDUCE EXPOSURE TIME	
	The odds of masks **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of respirators **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of ventilation systems **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of 'reducing exposure time' **not** being provided were…	…by a factor of (Odds ratio) relative to the factor reference group
TYPE OF EXPOSURE								
Exposed to dust only	Increased	1.54	Increased	1.54			Decreased	0.72
Exposed to GVSF only	Increased	1.92			Decreased	0.70	Decreased	0.64
Exposed to dust AND GVSF	Reference group		Reference group		Reference group		Reference group	
INDUSTRY								
Health & community services			Increased	2.02	Increased	1.67	Increased	2.40
Transport & storage	Increased	2.61	Increased	2.79	Increased	2.71		
Construction					Increased	2.55		
Agriculture, forestry & fishing	Increased	1.77			Increased	2.17		
Wholesale & retail trade	Increased	2.49						
Accommodation, cafes & restaurants	Increased	3.31						
Property & business services	Increased	4.41	Increased	2.66	Increased	2.25	Increased	2.41
Government administration & defence	Increased	2.16						
Education	Increased	6.13	Increased	9.94	Increased	2.45	Increased	2.24
Manufacturing	Reference group		Reference group		Reference group		Reference group	
OCCUPATION								
Managers								
Professionals	Increased	1.76	Increased	2.43				
Clerical & administrative workers	Increased	2.06						
Community & personal services workers	Increased	2.24			Increased	1.90		
Labourers	Increased	1.53	Increased	1.60	Increased	1.86	Increased	1.90
Sales workers	Increased	3.18	Increased	7.51				
Machinery operators & drivers	Increased	1.64			Increased	1.80	Increased	1.74
Technicians & trades workers	Reference group		Reference group		Reference group		Reference group	

Worker income was associated with the provision of respirators and ventilation systems. The reference group within the income factor was the highest earning group – those earning $150 000 or more. However, this reference group was not significantly different from most of the other income brackets, suggesting the highest earning group has intermediate odds for the provision of these controls. The only exception to this was in terms of the provision of ventilation systems, where the odds that this control was not provided were more than four times greater for workers who earned less than $30 000 than the odds for the highest earners. Figure 14 provides a rough guide to the modelled effect of income on the provision of these controls. It should be noted that the graph does not control for the effects of other factors like is done in the model. Therefore, the pattern presented in the graph does not necessarily reflect the effect of the factor levels on the provision of the controls. Nevertheless, as predicted the highest earners are intermediate in terms of control provision. Workers earning less than $75 000 appear to be least likely to be provided with respirators or ventilation systems whereas workers earning between $100 000 and $149 000 are the most likely to be provided with these controls.

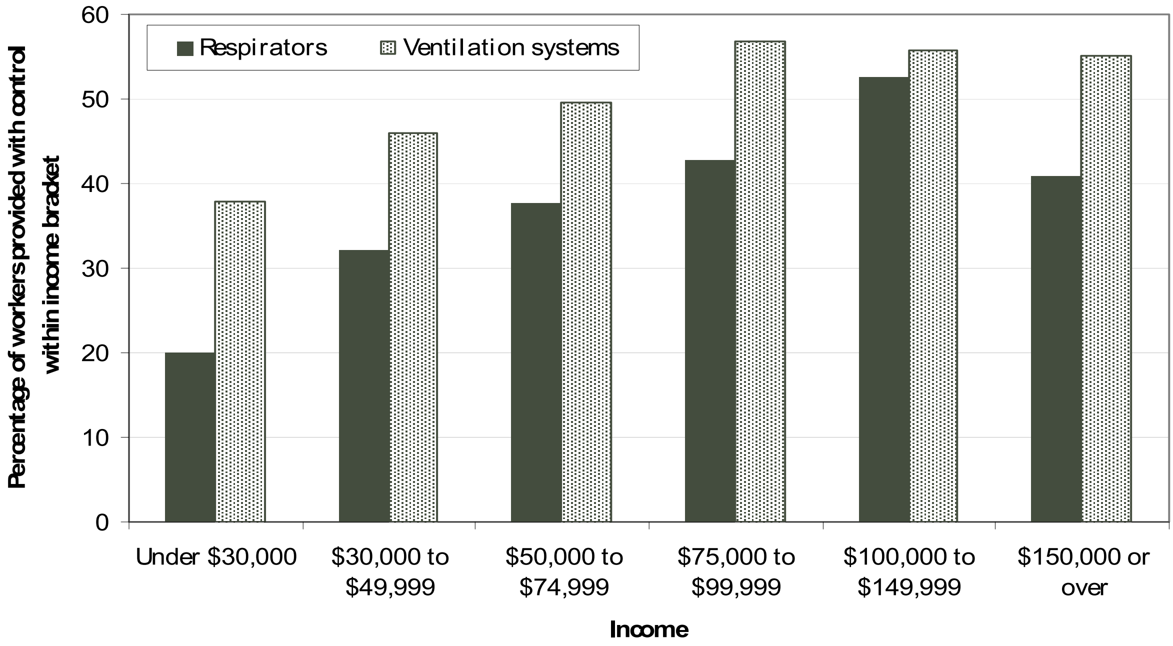

Figure 14. The percentage of workers provided with respirators and ventilation systems by worker income

The remaining three factors; type of exposure, industry and occupation significantly affected the provision of each type of airborne hazard control. However, the way the factors affected the controls varied. The odds of masks not being provided to exposed workers were increased if the worker was exposed to dust only or to gases, vapours, smoke or fumes only, compared to being exposed to both types of airborne hazard. Similarly, the odds of not being provided with a respirator were increased if the worker was exposed to dust only compared to being exposed to both dust and gases, vapours, smoke or fumes. In contrast, the odds of not being provided with ventilation systems were decreased for workers exposed to gases, vapours, smoke or fumes only compared to workers exposed to dust and gases, vapours, smoke or fumes. Furthermore, compared to workers exposed to both airborne hazards, workers exposed to dust only or gases, vapours, smoke or fumes only were more likely to be able to reduce the time they were exposed to these airborne hazards.

Compared to the Manufacturing industry, workers in all the modelled industries except Health and community services and Construction had increased odds of not being provided with masks. The industry least likely to provide masks was the Education industry, which was over six times more likely than the Manufacturing industry to not provide this control. The Education industry was also least likely to provide respirators. In this case it was almost ten times more likely than the Manufacturing industry to not provide this control. Other industries with increased odds of not providing respirators relative to the Manufacturing industry included Health and community services, Transport and storage and Property and business services. With the exception of the Wholesale and retail trade, Accommodation, cafes and restaurants and Government administration and defence industries, all other industries had increased odds of not providing ventilation systems compared to the Manufacturing industry. In contrast, with the exception of the Education, Health and community services and Property and business services industries, which had increased odds of not reducing exposure to airborne hazards, all other industries had similar odds to the Manufacturing of enabling workers to reduce their exposure. Of the industries included in the models, two; Education and Property and business services, had increased odds of not providing each of the four airborne hazard controls. A further two industries, Health and community services and Transport and storage had increased odds of not providing three of the four airborne hazard controls.

Occupation also significantly affected the odds of being provided with each of the four airborne hazard controls. Of the eight occupations, Labourers and Machinery operators and drivers had increased odds (compared to Technicians and trades workers) of not being provided with all four or three of the controls respectively. Relative to Technicians and trades workers, Sales workers were the occupation least likely to be provided with masks or respirators.

Provision of airborne hazard controls with respect to the type of airborne hazard exposure

The provision of airborne hazard controls also varied with the type of airborne hazard workers reported exposure to. As can be seen in Figure 15, masks were most commonly provided to workers exposed to Industrial and medical gases and fumes and workers exposed to Metals. In both cases approximately 81% of workers exposed to these types of airborne hazards were provided with masks. In comparison, only around 50% of workers exposed to Combustion products and Organic materials were provided with masks. In fact, workers exposed to these two types of airborne hazard generally recorded the lowest percentage of workers provided with any of the airborne hazard controls. Ventilation systems were provided to at least 64% of workers who were exposed to Metals, Industrial and medical gases and fumes and Chemicals not elsewhere classified. Provision of respirators was most common for workers who were exposed to Metals.

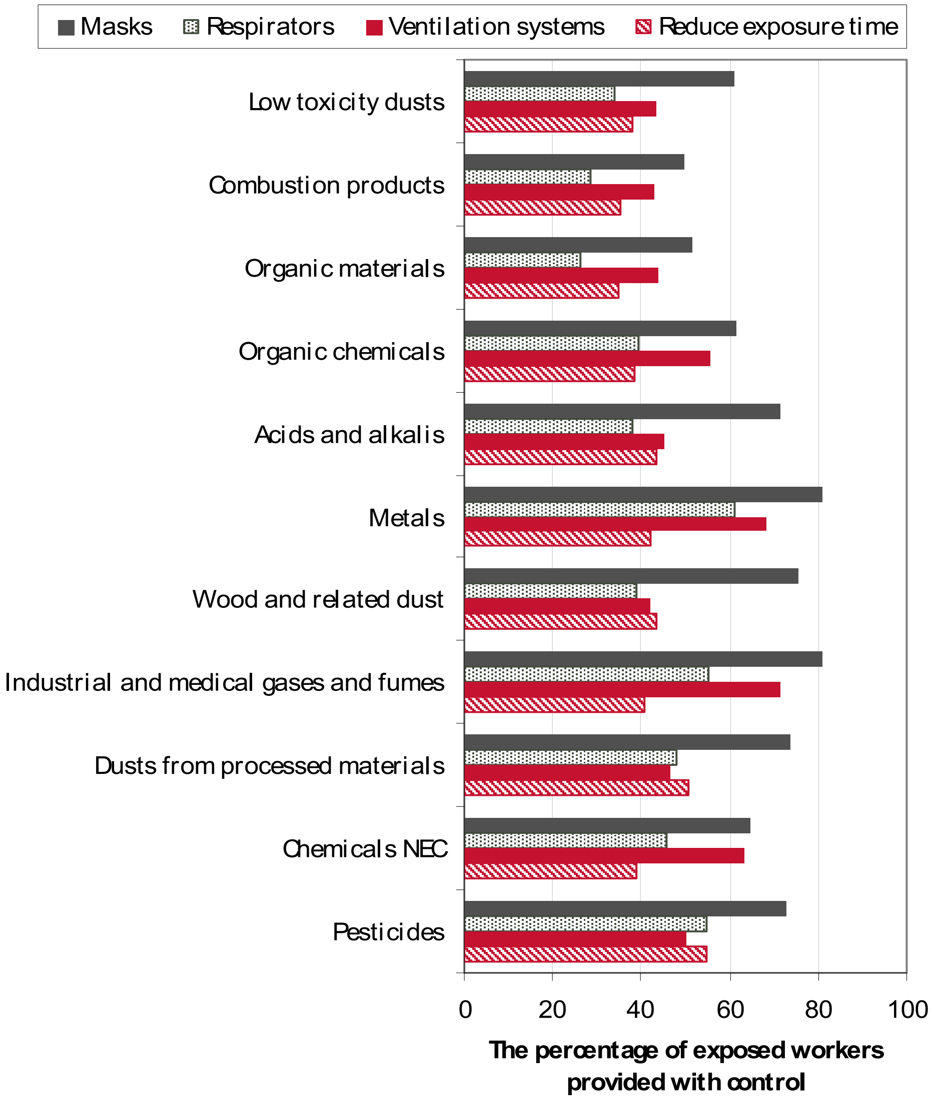

Figure 15. The percentage of exposed workers provided with each control type by the type of airborne hazard workers were exposed to

The number of airborne hazard controls provided

The seven employment and demographic factors that affected the provision of the individual airborne hazard controls were included as fixed factors in the model examining how many types of control were provided to exposed workers. Of these, only four factors were important predictors of how many controls were provided (Table 11). These were occupation, industry, workplace size and worker income. Somewhat surprisingly, the type of exposure (dust and/or gases, vapours, smoke or fumes) did not affect how many airborne hazard controls were provided in workplaces. The reduced model, containing only factors that significantly affected how many controls were provided, explained about 20% of the variation observed in this measure of airborne hazard controls [Appendix B (Table 19)]. Although this is not very large, it probably reflects the diverse nature and health effects of airborne hazards captured in this survey. Furthermore, number of controls does not necessarily reflect the quality or appropriateness of the controls for particular airborne hazards. For instance one control may be entirely sufficient for one type of airborne hazard or very inappropriate for another. Unfortunately, it is impossible to assess the suitability of the control measures for the airborne hazards workers are exposed to in this study.

Occupation of main employment had an important effect on the number of airborne hazard controls provided to exposed workers. Compared to Technicians and trades workers, workers in nearly all the other occupations had decreased odds of being provided with one, two, three or four control measures as opposed no control measures. The main exception to this were Managers, who had similar odds of reporting they were provided with two, three or four control measures as Technicians and trades workers. In addition, Professionals had similar odds of being provided with two control measures as opposed to no control measures as Technicians and trades workers. Sales workers also showed a similar pattern of airborne hazard control provision to Technicians and trades workers however these findings may have been affected by the small sample of Sales workers in the survey. Further research on control provision to this occupation is required to confirm this result.

Like occupation, industry of main employment had a significant effect on the number of controls provided to workers exposed to airborne hazards. However, there were no differences between the industries in terms of the odds of providing one control measure as opposed to no control measures. When compared to the Manufacturing industry, three industries had decreased odds of providing two types of airborne hazard control as opposed to no control measures: Transport and storage, Agriculture, forestry and fishing and Education. All industries, except Wholesale and retail trade, had decreased odds of providing three controls as opposed to no airborne hazard controls when compared to the Manufacturing industry. The odds of providing four types of airborne hazard control, as opposed to no controls, were decreased for all industries except Construction, Wholesale and retail trade, Accommodation, cafes and restaurants and Government administration and defence when compared to the Manufacturing industry. These findings complement those of the models examining provision of the individual airborne hazard controls. The Manufacturing industry appears to be the best performing industry in terms of control provision and this is closely followed by the Construction industry. The provision of controls to workers in the Wholesale and retail trade, Accommodation, cafes and restaurants and Government administration and defence industries also appears to be similar to the Manufacturing industry. However the analyses for these latter three industries may have been affected by small sample sizes and further investigation is required to confirm these findings.

Figure 16 provides a general illustration of the relationship between the number of controls provided to exposed workers and the industry of employment. It should be noted that, unlike in the multinomial logistic regression, the effects of other employment or demographic factors have not been controlled in this figure. Therefore, the patterns in the graph do not necessarily reflect the statistical effect of each industry on the number of controls provided. Readers should refer to the model output in Appendix B, Table 19, to confirm the relationship between factor levels and the number of controls provided.

The results of the logistic modelling and Figure 16 indicate that the Education industry was the worst performing industry in terms of the number of airborne hazard controls provided to exposed workers. The Education industry was significantly less likely to provide two, three and four controls compared to the Manufacturing industry (Table 11 with the odds of provision of three or four controls dramatically reduced by factors of 0.05 and 0.07 respectively. This is illustrated in Figure 16, where it can be seen that the Education industry recorded the highest percentages of exposed workers who were provided with zero or one control only and the smallest percentages of exposed workers who reported they were provided with three or four airborne hazard controls. It is not clear why the Education industry seems to have poor airborne hazard control provision and further investigation is required to determine whether or not Education workers are exposed to hazardous airborne substances and whether or not control provision is adequate for the exposures concerned.

Like Education, two other industries (Transport and storage and Agriculture, forestry and fishing) also had decreased odds of providing two, three or four controls. These industries require similar further investigation to determine whether or not the airborne hazard control provision is sufficient for the exposures reported by these workers.

Table 11. The parameter estimates of the multinomial logistic regression examining the number of airborne hazard controls provided in workplaces where workers reported exposure to dust and/or gases, vapours, smoke or fumes. Only statistically significant differences in odds presented.

MODEL FACTORS The reference group in the model is 'no controls provided'	ONE CONTROL		TWO CONTROLS		THREE CONTROLS		FOUR CONTROLS	
	The odds of one control (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of two controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of three controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of four controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group
INDUSTRY								
Health & community services					Decreased	0.345	Decreased	0.291
Transport & storage			Decreased	0.392	Decreased	0.350	Decreased	0.233
Construction					Decreased	0.608		
Agriculture, forestry & fishing			Decreased	0.524	Decreased	0.479	Decreased	0.403
Wholesale & retail trade								
Accommodation, cafes & restaurants					Decreased	0.114		
Property & business services					Decreased	0.211	Decreased	0.230
Government administration & defence					Decreased	0.174		
Education			Decreased	0.420	Decreased	0.050	Decreased	0.073
Manufacturing	Reference group		Reference group		Reference group		Reference group	
OCCUPATION								
Managers	Decreased	0.552						
Professionals	Decreased	0.511			Decreased	0.360	Decreased	0.241
Clerical & administrative workers	Decreased	0.284	Decreased	0.345	Decreased	0.290	Decreased	0.172
Community & personal services workers	Decreased	0.273	Decreased	0.427	Decreased	0.200	Decreased	0.245
Labourers	Decreased	0.492	Decreased	0.518	Decreased	0.422	Decreased	0.256
Sales workers			Decreased	0.262			Decreased	0.145
Machinery operators & drivers	Decreased	0.455	Decreased	0.341	Decreased	0.308	Decreased	0.323
Technicians & trades workers	Reference group		Reference group		Reference group		Reference group	

Table continued on next page

MODEL FACTORS The reference group in the model is 'no controls provided'	ONE CONTROL		TWO CONTROLS		THREE CONTROLS		FOUR CONTROLS	
	The odds of one control (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of two controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of three controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group	The odds of four controls (compared to none) being provided were…	…by a factor of (Odds ratio) relative to the factor reference group
WORKPLACE SIZE								
Less than 5							Decreased	0.265
5 to 19							Decreased	0.405
20 to 199							Decreased	0.537
200 or more	Reference group		Reference group		Reference group		Reference group	
INCOME								
Under $30,000	Decreased	0.306			Decreased	0.268	Decreased	0.166
$30,000 to $49,999							Decreased	0.237
$50,000 to $74,999							Decreased	0.305
$75,000 to $99,999								
$100,000 to $149,999								
$150,000 or over	Reference group		Reference group		Reference group		Reference group	

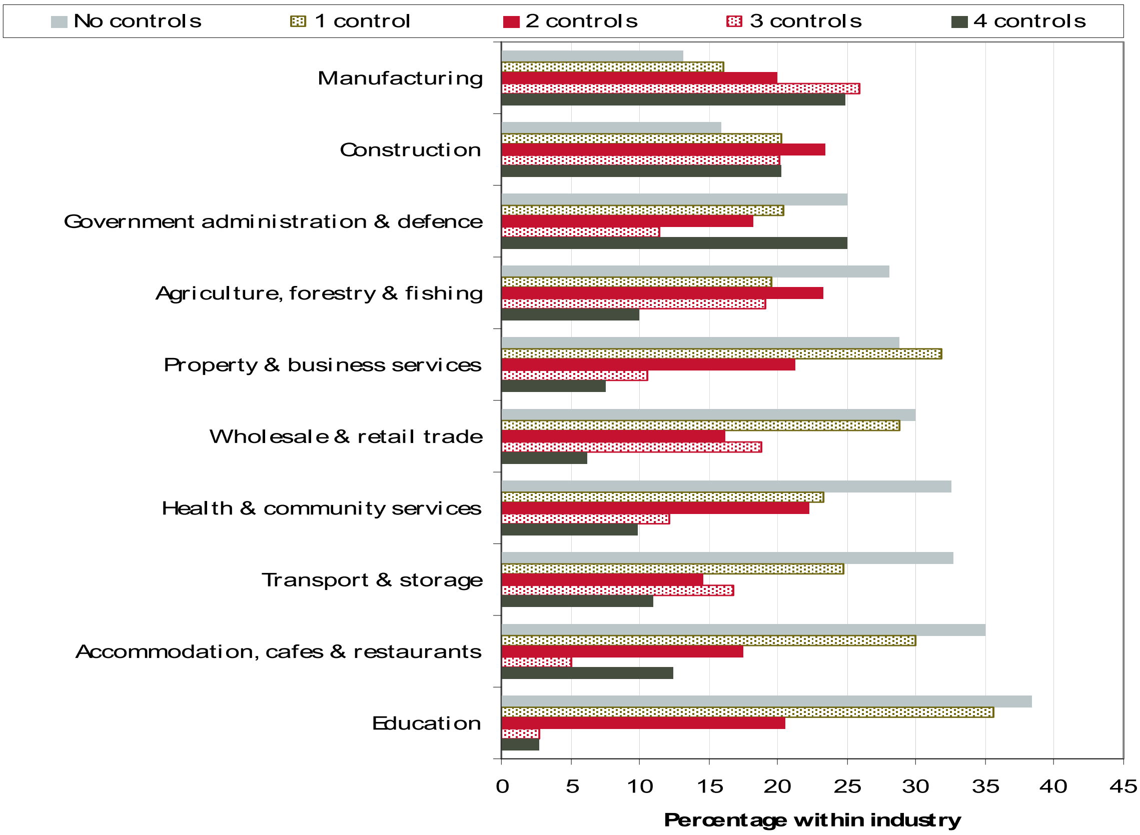

Figure 16. The number of airborne hazard controls provided to exposed workers: the percentage of workers within industry of main employment by the number of controls provided

The logistic regression showed that workplace size affected how many airborne hazard controls were provided to exposed workers. However, the model parameter estimates revealed that workplace size only significantly affected the odds of the provision of four airborne hazard controls as opposed to the provision of no controls. When compared to the largest workplaces (200 or more employees), the smallest workplaces (< five employees) were associated with the greatest decrease in odds of providing four controls measures as opposed to none. The odds of providing four airborne hazard controls became more favourable with increasing workplace size but they were still significantly reduced in comparison to workplaces with 200 or more employees. There were no differences between the various workplace sizes in terms of the odds of providing one, two or three forms of airborne hazard control as opposed to no controls when each workplace size was compared to the largest workplaces (200 or more employees).

Worker income was associated with the number of controls provided to workers exposed airborne hazards. Similar to workplace size, the model parameter estimates revealed that the main effect of income was on the provision of four airborne hazard controls as opposed to none. Workers who earned less than $75 000 had significantly decreased odds of being provided with four controls as opposed to none when compared with the highest earners ($150 000 or more). Furthermore, as income decreased so did the odds of being provided with four controls. In addition to workers in the lowest income bracket (those earning less than $30 000) having the lowest odds of being provided with four controls as opposed to none, they also had decreased odds of being provided with one or three airborne hazard controls as opposed to none. These findings indicate that low income earners may be more at risk of developing respiratory diseases because they are not provided with the same level of airborne hazard control as other, more highly paid workers.

The number of airborne hazard controls provided with respect to the type of airborne hazard exposure

The number of airborne hazard controls provided to exposed workers depended on what airborne hazard the worker was exposed to. As can be seen in Figure 17 workers who were exposed to Organic materials were most likely to be provided with no controls. More than 20% of workers exposed to Low toxicity dusts and Combustion products were also provided with no airborne hazard controls. In contrast, workers exposed to Industrial and medical gases and fumes were most likely to be provided with four types of airborne hazard control. Large percentages of workers exposed to Metals were also provided with three or four airborne hazard controls.

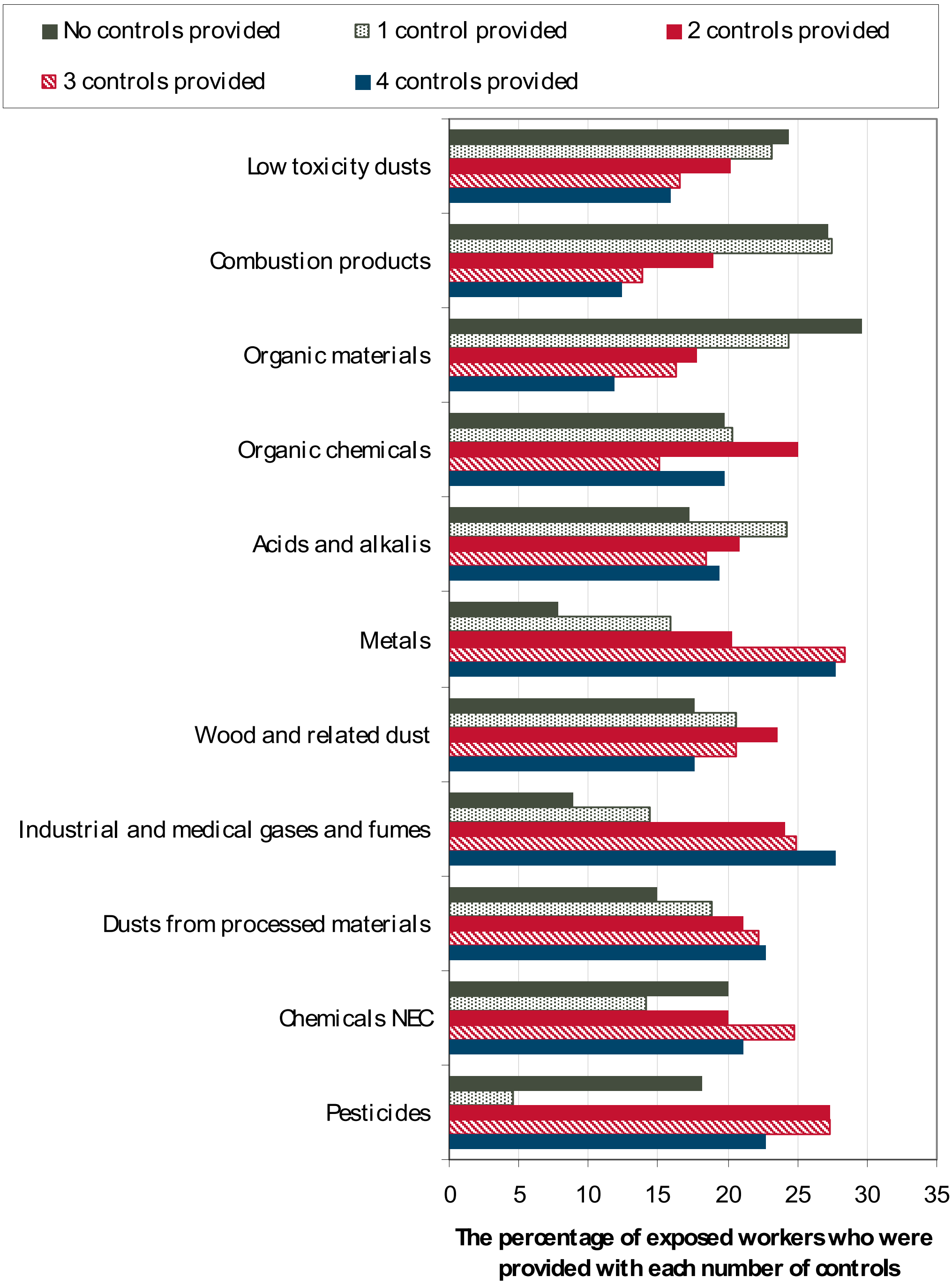

Figure 17. The percentage of exposed workers who were provided with each number of controls by type of airborne hazard workers were exposed to

Policy implications and recommendations

This study has found widespread exposure in the Australian working population to dusts, gases, vapours, smoke and fumes. Large proportions of these exposures were to airborne hazards with known associations with major respiratory diseases, such as cancer (mesothelioma and lung), asthma, chronic obstructive pulmonary disease and pneumoconioses such as silicosis and asbestosis. Demographic and employment factors affected both the likelihood of exposure to airborne hazards and the provision of airborne hazard controls in the workplace. This information provides a current picture of airborne hazard exposure in Australian workplaces and can be used to make general predictions about future incidences of occupational respiratory diseases. Studies of this kind are essential owing to rapid changes in technologies, industrial processes and materials, which result in the appearance of new agents of respiratory disease and changes in the groups of workers exposed. These studies provide policy makers with up to date information about exposures, upon which they can act, without depending on long latency disease frequency changes in the population. As such, they should be undertaken on a regular basis, of at least every five years. Furthermore, changes in exposure to airborne hazards can be tracked over time, which may lead to more efficient targeting of resources to combat the incidence of occupational respiratory diseases. In all, this will result in better protection of today's workers because it will reduce the incidence of future respiratory diseases that result from current exposures to airborne hazards.

The likelihood of exposure to airborne hazards was greatest for workers in the Construction, Manufacturing, Agriculture, forestry and fishing, and Transport and storage industries. In terms of occupation, Technicians and trades workers, Labourers, and Machinery operators and drivers had consistently high odds of exposure to airborne hazards. These groups of workers also tended to have the longest average durations of exposure to airborne hazards. Furthermore, these groups of workers recorded the largest percentages of workers exposed to the major types of airborne hazards. Some of these hazards are associated with serious respiratory diseases. In terms of sheer numbers of workers exposed to airborne hazards, these industries and occupations should be focussed on for compliance with regulations. This focus is supported by workers' compensation statistics, which show that these industries have the highest rates of claims for respiratory disease[8]. However, smaller groups of workers, particularly those exposed to the airborne hazards with the greatest health risks, should not be overlooked.

Undertaking a national study on hazard exposure requires very large numbers of participants in order to capture a representative sample of Australian workers. This study focussed its sampling on the national priority industries because these industries have the highest rates of injury. This has meant that some of the remaining industries have not had sufficient sample sizes for inclusion in these analyses. For example, the Mining industry was excluded because fewer than 40 workers were surveyed. However, it is well known that the Mining industry has high levels of exposure to airborne hazards. It is therefore important that future surveillance of airborne hazards, through national surveys, is adequately funded to obtain sufficient sample sizes across all industries for high level statistical analyses. This is the only way to ensure that policy makers are provided with the best and most useful information on the current hazard exposure of Australian workers.

Worker age affected the likelihood of exposure to airborne hazards, with younger workers having greater odds of exposure to airborne hazards than older workers and generally reporting longer durations of exposure to airborne hazards. Furthermore, younger workers recorded the largest percentage of workers exposed to more than half of the broad types of airborne hazard.

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[8] An exception to this rule is the workers' compensation data for the Agriculture, forestry and fishing industry. However, a large proportion of workers in this industry are not covered by workers' compensation schemes since they are self employed. It is therefore vital that these workers are not overlooked from a policy perspective.

Efforts should be made to develop our understanding of why young workers are more likely to be exposed to airborne hazards and to reduce their exposure to these hazards.

Workplace size affected both exposure to airborne hazards and the provision of airborne hazard controls. In particular, the likelihood of exposure to dusts was increased in smaller workplaces and the likelihood of provision of airborne hazard controls that required higher technology or expense (ventilation systems and respirators) was reduced in smaller workplaces. Further research is required into the nature of airborne hazard exposure and control provision in small workplaces with a particular focus on the barriers and enablers to reducing exposure and improving control provision.

Three industries had decreased odds of providing two, three or four airborne hazard controls relative to the Manufacturing industry. These were the Transport and storage, Agriculture, forestry and fishing and Education industries. Of these, the Education industry had the most dramatically decreased odds of control provision, especially for the provision of three or four controls. While each of these industries need further investigation in terms of the adequacy of the controls provided for their airborne hazard exposures, the data indicate that the Education industry need to be investigated as a matter of priority. However, it should be noted that it is possible that the airborne hazard controls provided in the Education industry are sufficient for the exposures concerned since the NHEWS data do not provide any estimates of the health risks associated with exposures to airborne hazards.

Unfortunately, this study was unable to assess the actual health risks of individual exposures to airborne hazards. This requires *in situ* measured exposures to substances and assessment of hazard control use[9]. Furthermore, airborne hazards consist of a very broad range of substances with a wide range of health effects but for modelling purposes exposures were grouped into dusts or gases, vapours, smoke or fumes. Consequently, the analyses are not sensitive to airborne hazard type. This has important ramifications for the interpretation of the analyses on the provision of airborne hazard controls since provision of controls is likely to be directly related to the type of airborne hazard exposures in workplaces. Future research should endeavour to link exposures with the controls provided against these exposures in order to obtain more meaningful data.

Although formal statistical analysis that related control provision to type of airborne hazard exposure (except in the very general dust versus gases, vapours, smoke or fumes sense) was not undertaken, descriptive analyses revealed that the type of airborne hazard affected the provision of the individual controls and the number of controls provided in workplaces. In general, workers exposed to Metals and/or Industrial and medical gases and fumes tended to have high incidences of provision of each type of control and were most often provided with three or four types of airborne hazard control. In contrast, workers exposed to Organic materials and Combustion products had low control provision. Given that these two types of airborne hazard were amongst the most common types of airborne hazard exposure, this means that substantial numbers of workers may be underprovided with controls and therefore at risk of developing respiratory diseases. Further, workers exposed to Organic materials were a reasonably distinct cohort of workers. They tended to be female and work in Community and personal service occupations and in the Health and community services or Accommodation, cafes and restaurants industry. Dusts and gases, vapours, smokes or fumes that are categorised under Organic materials are typically asthmagens or allergens. Uncontrolled or poorly controlled exposures to these substances may be contributing to the rise in incidence of occupational asthma. Effort should be made to better protect workers exposed to these substances. Further investigation and consideration of the relationship between type of airborne hazard exposure and control provision is required.

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[9] Obtaining this information is currently beyond the scope of this research owing to the huge expense involved in collecting these data.

To summarise, the main recommendations of this study are as follows:

- Focus current compliance campaigns and policy initiatives on industries and occupations with the greatest odds of exposure to airborne hazards, and those where workers reported exposure to airborne hazards with most serious health consequences.
- Focus on the exposure of young workers and develop initiatives to reduce exposure to airborne hazards in the younger age groups.
- Focus on reducing exposure to airborne hazards and improving control provision for airborne hazards in small to medium sized workplaces.
- Focus on determining whether control provision in the Transport and storage, Agriculture, forestry and fishing and Education industries are sufficient and adequately protect workers from exposure to airborne hazards.
- Continue surveillance of exposure to airborne hazards, and
    - Improve the surveillance survey instrument by improving identification of airborne hazards, linking hazard exposure to control provision and use, expand information collected on airborne hazard controls to include measures of training and other types of controls, and increasing the sample size in the non-priority industries.
    - Consider addition of questions on health consequences of exposure to airborne hazards to airborne hazard exposure surveillance survey.
    - Surveillance should be undertaken on a regular basis (every five years at least).
    - Establish a time series data base on airborne hazard exposure in Australian workers.
- Attempt to predict future occupational respiratory disease rates based on current exposures to airborne hazards using epidemiological modelling techniques.

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Appendix A. Detailed methodology

Survey design

The purpose of the NHEWS survey was to gather information to guide decision makers in developing prevention initiatives that ultimately lead to a reduction in occupational disease. Therefore, the survey was designed to collect demographic (e.g. sex, age, educational qualifications) and employment information (occupation, industry, employment conditions, size of workplace) in addition to worker exposure to a variety of different occupational hazards and information about the hazard controls provided in the workplace.

The design and wording of the survey was undertaken by the ASCC in consultation with Australian OHS regulators and a panel of experts. It was based on existing Australian and international hazard exposure survey instruments. For example, these included the European Working Condition Survey, the National Exposures at Work Survey (NIOSH, USA), the Swedish Workplace and Environment Survey and the Victorian WorkCover Authority Worker Survey amongst others.

A draft of the survey was reviewed by Dr Rebbecca Lilley, Preventative and Social Medicine, Injury Prevention and Research Unit, University of Otago, New Zealand who is an expert on occupational hazard exposure. Comments and feedback from her review were incorporated into the survey instrument.

Skirmish testing (undertaken on ASCC staff) and cognitive testing on eleven workers, who were of a low literacy or non-English speaking background, and worked in several industries, was undertaken in face to face interviews.

The survey was piloted by the Victorian WorkCover Authority on 160 workers using the Computer Assisted Telephone Interview (CATI) technique. This assisted in revising the survey length and correcting CATI programming issues.

Feedback from the cognitive and pilot testing was incorporated into the final survey instrument. Of particular relevance to the noise data was the recommendation that noise exposure be collected on two different scales (hours per day and hours per week) since many workers had difficulty describing a typical day at work.

The NHEWS research design and survey instrument were submitted to the University of Sydney Human Research Ethics Committee. The approval reference number is: 02-2008/10506. The research design and instrument met the National Statistical Clearing House guidelines. The research design and instrument were also in accordance with the Australian Market and Social Research Society (AMSRS) guidelines and the research company that undertook the CATI is a member of the AMRSRS and met all privacy and other guidelines.

More information, including the full survey instrument for all occupational hazards and their controls, can be found in the National Hazard Exposure Worker Surveillance (NHEWS): Survey Handbook and the National Hazard Exposure Worker Surveillance (NHEWS) Survey: 2008 Results, which are published on the Safe Work Australia website[10].

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[10] http://www.safeworkaustralia.gov.au/swa/AboutUs/Publications/2008ResearchReports.htm

Airborne hazard exposure and airborne hazard exposure control questions

The specific questions relating to exposure to dust and gases, vapours, smoke or fumes and the provision of controls for these hazards were as follows:

Dust

1. On a typical day at work last week, how long (hours per day / hours per week) did you work in a place where your work or other people's work created dust or made the air dusty?
2. What were the main types of dust at your workplace last week? Anything else?

Gases, vapours, smoke or fumes

1. On a typical day at work last week, how long (hours per day / hours per week) did you work in a place where there were gases, vapours, smoke or fumes?
2. What were the main types of gases, vapours, smoke or fumes at your workplace last week? Anything else?

Airborne hazard controls

1. Does your employer (or, in the case of self employed / contractors etc. *do you*) do any of the following to prevent breathing in dust, gases, vapours, smoke, fumes or other things in the air?
   a. Provide masks
   b. Provide respirators
   c. Provide ventilation systems, or
   d. Reduce the time spent in places where there are dust, smoke, fumes or gases

It should be noted that the airborne hazard control provision questions did not relate to the previous week as did the exposure questions. It is therefore possible that workers reported the provision of controls for hazard exposures that did not occur in the reference week. This may lead to the overestimation of the number or type of controls provided for particular airborne hazards.

Survey administration

The NHEWS survey was conducted by Sweeney Research Pty Ltd using computer assisted telephone interviews (CATI). The survey obtained an Australia-wide sample of 4500 workers across all seventeen Australian industries. Households were randomly selected using the desk top marketing systems (DTMS) database, which collects its information from directories such as the White / Yellow pages. To be eligible for the research, respondents were required to have worked in the last week and to have earned money from the work. Where more than one individual was eligible for the research, the person whose birthday came next was selected. Overall, the survey achieved a 42.3% response rate.

The sampling scheme for the NHEWS can be considered as two stages with three waves of data collection. The first wave resulted in 1900 completed interviews which met quotas by sex within industry (five national priority industries: Manufacturing, Transport and storage, Construction, Health and community services and Agriculture, forestry and fishing) within state (1300 interviews), plus an additional sample coming from state contributions (600 interviews).

The second and third waves of the survey (n_{total} = 2600) placed no restrictions on industry and differed only in that some additional questions were asked. The second wave involved recontacting those households that had not been interviewed in the first wave due to being out of scope (e.g. had no persons working in the priority industries) or quotas already being met, and had given permission to be recontacted for further studies. This wave resulted in 485 completed interviews. The third wave (n=2115) resulted in the balance of the 4500 interviews, meeting sex within state quotas.

For reporting purposes the following industries were collapsed into two integrated industries: 1) Wholesale and Retail trade and 2) Cultural and recreational services and Personal and other services.

Data analyses

The data were analysed using SPSS 16.0. All data were inspected prior to formal analysis for missing cases or unusual values. Kolmogorov-Smirnov tests were applied to all continuous data to determine whether or not the data were normally distributed. The duration of exposure to dust and gases, vapours, smoke or fumes data (see below) were not normally distributed and $\log_{10}$ transformations did not improve the fit of the data. Therefore, these data were analysed with non-parametric (Kruskall-Wallis) tests.

Duration of exposure to dust, gases, vapours, smoke and fumes

Survey participants were asked how long they worked in a place where their work or other people's work created dust or made the air dusty or where there were gases, vapours, smoke or fumes. Participants could respond in one of two scales: hours per day and hours per week. The resulting duration of exposure data therefore required conversion to a common scale. For the purposes of these analyses, hours per week was chosen as the common scale because the hours per day exposure data were considered more reliable and therefore more robust for conversion. The data were converted to hours per week as follows:

1. The average number of hours worked per day was determined by dividing the number of hours each participant reported working per week by the number of days they worked per week.
2. The proportion of daily working hours that a worker reported they were exposed to either dust or gases, vapours, smoke or fumes was determined by dividing the number of hours per day a worker reported they were exposed to each hazard by the number of hours they worked per day.
3. Some workers reported durations of exposure to hazards that exceeded the number of hours they worked per day / week. E.g. some workers reported 24h per day exposures. Since this survey is about work exposures, exposures in excess of working hours must be excluded. This was achieved by forcing all the proportions in step 2 that were greater than one, to equal one. This limits exposures to airborne hazards to the full working hours of the survey participant.
4. The proportion of daily working hours a worker was exposed to dust or gases, vapours, smoke or fumes, with forced upper end exposures, was multiplied with the number of hours a worker reported they worked per week to give the total number of hours exposed to loud noise per week.

This calculation assumes that daily exposures to dust or gases, vapours, smoke or fumes occur consistently across all days worked. The data collected on exposure per day was supposed to be for a 'typical' day at work. Any variation between days is not accommodated in this calculation and it assumes that the average daily hours of work as calculated are the real hours of work each day. If the 'typical' hours of exposure to a hazard was a 'longer' than the average day at work then the duration of exposure will be rounded down to the average daily exposure.

Workers who reported their exposure in terms of hours per week were less likely to overstate their exposure compared to their working hours. However, for any cases where this occurred, the maximum exposure was limited to the number of hours worked per week, as was done with the hours per day data.

The duration of exposure data for dust and for gases, vapours, smoke or fumes were reported separately and required separate analyses. This was because there was no way of determining whether or not workers who reported exposure to both types of airborne hazard were exposed to these hazards separately or simultaneously. Therefore, it was not possible to simply sum exposure durations for the two hazards. As a result, duration of exposure could not be included in the logistic regressions examining the provision of airborne hazard controls.

Classification of dusts, gases, vapours, smoke or fumes

Survey participants were asked to specify what the main types of dust or gases, vapours and fumes in their workplace were. Sweeney research classified the types of dusts using word recognition software. Some of the categories generated in this process were not meaningful and much of the data were reclassified using the survey verbatim and information recorded in the survey about occupation and job tasks. Likewise, the types of gases, vapours, smoke or fumes were manually coded according to the TOOCs (version 2.1) agency of injury or disease classification (National Occupational Health and Safety Commission 2002) using survey verbatim, occupation and job task information. The resultant fine scale classification of dusts, gases, vapours, smoke or fumes was then further categorised into broad and discrete types of dusts, gases, vapours and fumes (refer to Table 2 in the main body of this report) based on their physical / chemical properties and likely health effects. This classification was used in this report to describe the types of airborne hazards workers reported they were exposed to in the NHEWS survey. It should be noted that the substantial reclassification of the types of airborne hazard data undertaken during the in-depth analyses of these data has resulted in differences between the data reported here and the data reported in the preliminary descriptive findings of this study, which are published on the Safe Work Australia website.

The dusts, gases, vapours, smoke or fumes were also matched to the TOOCS (version 2.1) agency of injury or disease used in NDS workers' compensation data set. This enabled comparison of the pattern of NHEWS exposures with the pattern of workers' compensation claims by agency of respiratory disease. It should be noted that the NHEWS data could not be classified according to TOOCS easily because the NHEWS data were not usually detailed enough. For this reason, this comparison can only be used as a guide. However, future research on airborne hazards should attempt to classify self reported exposures according to the TOOCS system. The types of dust, gases, vapours, smoke and fumes reported in the NHEWS survey with respect to their TOOCS classification is shown in Table 12.

Table 12. Categorisation of the NHEWS types of dust, gases, vapours, smoke and fumes data with respect to the TOOCS classification scheme for agency of respiratory disease

Agency of respiratory disease (TOOCS classification)	NHEWS airborne hazards included in Agency classification
Other non-metallic minerals and substances *Includes synthetic mineral fibres, glass fibres, ceramic fibres, fibreglass, roofing batts*	Brake dust; Carbon black; Coal dust; Fibreglass dust; Glass dust; Insulation dust; Salt dust
Dust, not elsewhere classified *Includes sand, soil, ash, mud & scale*	Chalk dust; Dirt/road dust; Environmental dust; General dust *NFI*
Asbestos	Asbestos
Industrial gases & fumes *Includes argon, nitrogen, acetylene, oxygen & carbon dioxide*	Industrial gases and fumes
Other chemical products *Includes glue & dyes*	Other chemical products
Fire, flame and smoke	Fire, flame & smoke; Combustion dusts
Other basic and unspecified chemicals *Includes carbon dioxide in form of dry ice*	Other basic & unspecified chemicals; Chemical dust
Paint & varnish *Includes water or oil based paints, acrylic paints, vehicle paints, inks, printing inks, rust & conversion treatments*	Paint, varnish; paint dust
Biological agencies	Biological; Animal dust; Body dust / skin / tooth particles; Dust from crops / harvest / grain; Household dust; Nail dust
Chlorine	Chlorine
Other materials and objects *Includes coins, cloth, rags & dusters*	Textile, cotton, fibre dust
Acids	Acids
Pharmaceuticals	Pharmaceuticals
Animal treatment chemicals	Animal treatment chemicals
Food	Processed food dust
Plant treatment chemicals	Plant treatment chemicals
Diesel exhaust fumes	Diesel exhaust fumes; Diesel dust
Non-bituminous hydrocarbon fuels	Non-bituminous hydrocarbon fuels
Cement and lime	Concrete, cement, plaster dust; Lime/caustic dust
Sawn or dressed timber	Particle board / MDF; Wood dust
Organic solvents and cleaning chemicals	Cleaning chemicals and disinfectants; Organic solvents
Plastic materials, synthetic resins and rubbers	Plastic materials, synthetic resins and rubbers; Plastic dust; Rubber dust
Bricks and tiles and concrete, cement and clay products *NEC*	Tile dust; Brick / clay dust
Abrasive powders	Sandblasting / abrasive blasting dust
Crystalline silica	Silica / sand dust
Bitumen, asphalt, tar, pitch	Bitumen, asphalt, tar, pitch
Ferrous & non ferrous metal	Ferrous & non ferrous metal; Metal dust; Welding dust
Bases & alkalis	Bases & alkalis; Fertiliser dust;
Manufactured explosive substances	Manufactured explosive substances
Oil and fat (animal or vegetable)	Oil and fat (animal or vegetable)
Hot water / steam	Hot water / steam
Sewerage	Sewerage
Carbon monoxide	Carbon monoxide; Non-diesel exhaust fumes
Stationary & paper products	Paper dust
Rocks, stones & boulders	Crushed rock/ gravel; Stone dust

Logistic regressions

Employment and demographic factors that affect exposure to airborne hazards

The data were analysed with respect to the likelihood of reporting exposure dust and/or gases, vapours, smoke or fumes by undertaking a multinomial logistic regression that examined the impact of various demographic and employment factors. All reported exposures to airborne hazards, irrespective of duration, were assumed to be non-trivial and therefore valid for analysis. However, the data were restricted to only those workers with known occupation and/or who worked in industries in which more than 50 workers were surveyed and in which more than 40 exposures to dust or gases, vapours, smoke or fumes were reported. Imposing these restrictions on the data improved the stability and fit of the models. The restrictions were not made based on any expectation concerning exposure to dust, gases vapours and fumes. Therefore, some industries (e.g. *Mining*) with high exposure to these substances have not been included in these analyses. This means that the results of this report do not describe the complete picture of occupational exposure to dust, gases, vapours or fumes for Australian workers. Future research should endeavour to obtain larger samples of workers in the excluded industries.

The dependent variable in the regression model had four levels: not exposed to dust, gases, vapours, smoke or fumes; exposed to dust only; exposed to gases, vapours, smoke or fumes only; and exposed to both dust and gases, vapours, smoke or fumes. The reference group in the model was not exposed to dust, gases, vapours, smoke or fumes. Factors included in the model were as follows: sex, age (in 10 year age groups), income, highest education qualification, whether or not worked at night, workplace size (number of employees), industry and occupation. Non-significant factors were removed from the model following backwards stepwise deletion until the minimal model remained.

The results of the model are interpreted / expressed in the following manner: the odds of reporting exposure to dust only / GVSF only / both dust and GVSF, as opposed to not reporting exposure, are increased/decreased by a factor of *x* [odds ratio / Exp (B)] as a result of being in *y* employment/demographic factor compared to its reference group (*z* employment/demographic factor) while controlling for the effects of other variables.

Employment, demographic and exposure factors that affect the provision of controls against airborne hazards

Two approaches were taken in the analysis of the airborne hazard controls data. The first approach determined the likelihood of the provision of each type of control individually with respect to employment and demographic factors. The second approach examined the factors that affected how many airborne hazard controls were provided. Both approaches analysed a restricted data set. Only workers who had reported exposure to airborne hazards were included. Additionally, the same industry and occupation restrictions applied to the exposure analysis were applied to the controls analyses.

What factors affect the provision of individual controls?

Four multinomial logistic regression models (one for each of the airborne hazard controls surveyed) were undertaken examining the odds that each control was provided to workers who reported they were exposed to airborne hazards. The employment and demographic factors included in each model were the same. The factors were chosen because they produced models with adequate goodness of fit and they best explained the variation in the provision of the control. The factors included in each of the models were as follows: sex, type of employment (full time/fixed term/casual), income, workplace size (number of employees), type of airborne hazard exposure, industry and occupation. Non-significant factors were not removed from the model so as to be able to make direct comparisons between the various controls. The dependent variable was binary and it encoded whether or not the control was provided. The reference group for the model was ‘control provided’.

The results of these models are interpreted / expressed in the following manner: the odds of a control NOT being provided, as opposed to being provided, are increased/decreased by a factor of *x* [odds ratio / Exp (B)] as a result of being in *y* employment/demographic factor compared to its reference group (*z* employment/demographic factor) while controlling for the effects of other variables.

What factors affect how many airborne hazard controls are provided?

The number of airborne hazard controls provided to workers who reported exposure to airborne hazards was calculated by summing the positive responses to each of the four hazard controls specifically surveyed in the NHEWS study. Therefore workers could have been provided with between zero and four airborne hazard controls. The number of controls provided was the dependent variable in a multinomial logistic regression and zero / no controls was the reference group. The seven employment and demographic factors that affected the provision of the individual airborne hazard controls were included as fixed factors in the model. Non-significant factors were removed from the model following backwards stepwise deletion until the minimal model remained.

The results of this model is interpreted / expressed in the following manner: the odds of one/two/three/four control(s) being provided, as opposed to none being provided, are increased/decreased by a factor of *x* [odds ratio / Exp (B)] as a result of being in *y* employment/demographic factor compared to its reference group (*z* employment/demographic factor) while controlling for the effects of other variables.

Appendix B. Detailed statistical findings

Appendix B presents the statistical output of the various models and data analyses that underpin the findings of this report.

Exposure to airborne hazards

Table 13. Output of the multinomial logistic regression examining exposure to airborne hazards

EXPOSURE TO AIRBORNE HAZARDS

MODEL INFORMATION

	Likelihood ratio tests		
Model Fitting Information	**Chi-square**	***df***	***P***
FINAL MODEL – minimal model	1419.42	87	0.000

	Likelihood ratio tests		
Model Factors	**Chi-square**	***df***	***P***
Intercept	0.00		.
Sex	45.62	3	0.000
Age	45.93	12	0.000
Income	26.83	15	0.030
Workplace size (number of employees)	20.17	9	0.017
Industry	264.07	27	0.000
Occupation	238.29	21	0.000

Goodness of fit	**Chi-square**	***df***	***P***
Pearson	6234.84	6252	0.559
Deviance	4637.51	6252	1.000

Pseudo R-square	
Nagelkerke	0.349

MODEL PARAMETER ESTIMATES

MODEL LEVELS AND FACTORS The reference group in the model is 'not exposed to airborne hazards'	**Wald**	***df***	***P***	**Odds ratio Exp(B)**	**95% confidence interval of Exp(B)**	
					Lower Bound	**Upper Bound**
EXPOSED TO DUST ONLY						
Intercept	97.99	1	0.000			
SEX						
Male	11.20	1	0.001	1.49	1.18	1.89
Female	.	0	.	.	.	.
AGE (years)						
15-24	2.10	1	0.147	1.39	0.89	2.18
25-34	5.97	1	0.015	1.48	1.08	2.02
35-44	9.25	1	0.002	1.50	1.16	1.95
45-54	0.44	1	0.509	1.09	0.85	1.40
55+	.	0	.	.	.	.
INCOME						
Under $30,000	2.06	1	0.151	1.56	0.85	2.85
$30,000 to $49,999	3.69	1	0.055	1.75	0.99	3.11
$50,000 to $74,999	4.92	1	0.027	1.90	1.08	3.33
$75,000 to $99,999	1.89	1	0.170	1.52	0.84	2.74
$100,000 to $149,999	0.27	1	0.604	1.18	0.63	2.22
$150,000 or over	.	0	.	.	.	.

MODEL LEVELS AND FACTORS The reference group in the model is 'not exposed to airborne hazards'	Wald	*df*	*P*	Odds ratio Exp(B)	95% confidence interval of Exp(B)	
					Lower Bound	Upper Bound
EXPOSED TO DUST ONLY – continued						
WORKPLACE SIZE						
Less than 5 employees	13.49	1	0.000	1.80	1.32	2.47
5 to 19 employees	10.05	1	0.002	1.64	1.21	2.22
20 to 199 employees	2.35	1	0.125	1.24	0.94	1.64
200 or more employees	.	0	.	.	.	.
INDUSTRY						
Manufacturing	33.03	1	0.000	3.08	2.10	4.52
Transport & storage	8.94	1	0.003	1.99	1.27	3.13
Construction	57.98	1	0.000	4.61	3.11	6.83
Agriculture, forestry & fishing	25.69	1	0.000	3.10	2.00	4.80
Wholesale & retail trade	1.62	1	0.203	1.41	0.83	2.38
Accommodation, cafes & restaurants	0.01	1	0.903	1.05	0.49	2.24
Property & business services	0.79	1	0.375	1.24	0.77	2.01
Government administration & defence	0.24	1	0.621	0.87	0.49	1.52
Education	1.01	1	0.314	1.27	0.80	2.02
Health & community services	.	0	.	.	.	.
OCCUPATION						
Managers	21.15	1	0.000	2.55	1.71	3.80
Professionals	1.08	1	0.299	1.24	0.83	1.86
Technicians & trades workers	53.23	1	0.000	4.30	2.91	6.37
Community & personal services workers	2.21	1	0.137	1.49	0.88	2.52
Labourers	42.02	1	0.000	3.96	2.61	6.00
Sales workers	3.48	1	0.062	1.72	0.97	3.04
Machinery operators & drivers	45.13	1	0.000	4.65	2.97	7.28
Clerical & administrative workers	.	0	.	.	.	.
EXPOSED TO GASES, VAPOURS, SMOKE OR FUMES ONLY						
Intercept	37.53	1	0.000			
SEX						
Male	9.73	1	0.002	1.61	1.19	2.17
Female	.	0	.	.	.	.
AGE (years)						
15-24	1.28	1	0.257	1.38	0.79	2.43
25-34	0.37	1	0.545	1.14	0.75	1.72
35-44	1.21	1	0.271	1.21	0.86	1.70
45-54	0.05	1	0.823	0.96	0.69	1.34
55+	.	0	.	.	.	.
INCOME						
Under $30,000	0.68	1	0.410	0.73	0.35	1.54
$30,000 to $49,999	0.00	1	0.995	1.00	0.50	2.00
$50,000 to $74,999	0.00	1	0.966	1.01	0.51	2.00
$75,000 to $99,999	0.00	1	0.998	1.00	0.49	2.05
$100,000 to $149,999	5.94	1	0.015	0.30	0.12	0.79
$150,000 or over	.	0	.	.	.	.

MODEL LEVELS AND FACTORS The reference group in the model is 'not exposed to airborne hazards'	Wald	*df*	*P*	Odds ratio Exp(B)	95% confidence interval of Exp(B) Lower Bound	Upper Bound
EXPOSED TO GASES, VAPOURS, SMOKE OR FUMES ONLY – continued						
WORKPLACE SIZE						
Less than 5 employees	0.00	1	0.993	1.00	0.67	1.50
5 to 19 employees	0.23	1	0.634	0.91	0.63	1.33
20 to 199 employees	0.26	1	0.611	0.92	0.67	1.26
200 or more employees	.	0	.	.	.	.
INDUSTRY						
Manufacturing	1.91	1	0.167	1.36	0.88	2.10
Transport & storage	2.28	1	0.131	1.47	0.89	2.44
Construction	10.50	1	0.001	0.37	0.20	0.67
Agriculture, forestry & fishing	1.01	1	0.315	0.73	0.39	1.36
Wholesale & retail trade	0.81	1	0.367	0.73	0.37	1.44
Accommodation, cafes & restaurants	11.60	1	0.001	2.89	1.57	5.31
Property & business services	5.98	1	0.014	0.45	0.23	0.85
Government administration & defence	8.18	1	0.004	0.34	0.16	0.71
Education	3.94	1	0.047	0.58	0.34	0.99
Health & community services	.	0	.	.	.	.
OCCUPATION						
Managers	3.80	1	0.051	1.83	1.00	3.36
Professionals	8.86	1	0.003	2.24	1.32	3.82
Technicians & trades workers	34.13	1	0.000	5.19	2.99	9.02
Community & personal services workers	2.97	1	0.085	1.74	0.93	3.26
Labourers	28.01	1	0.000	4.78	2.68	8.53
Sales workers	5.65	1	0.017	2.47	1.17	5.22
Machinery operators & drivers	25.88	1	0.000	4.87	2.65	8.97
Clerical & administrative workers	.	0	.	.	.	.
EXPOSED TO DUST AND GASES, VAPOURS, SMOKE OR FUMES						
Intercept	88.56	1	0.000			
SEX						
Male	37.69	1	0.000	2.64	1.94	3.60
Female	.	0	.	.	.	.
AGE (years)						
15-24	8.27	1	0.004	2.14	1.27	3.60
25-34	33.49	1	0.000	2.99	2.06	4.33
35-44	9.45	1	0.002	1.70	1.21	2.39
45-54	10.12	1	0.001	1.69	1.22	2.32
55+	.	0	.	.	.	.
INCOME						
Under $30,000	0.23	1	0.629	0.84	0.42	1.68
$30,000 to $49,999	0.01	1	0.932	0.97	0.51	1.84
$50,000 to $74,999	0.01	1	0.923	0.97	0.52	1.82
$75,000 to $99,999	0.80	1	0.370	0.73	0.37	1.44
$100,000 to $149,999	0.46	1	0.499	0.78	0.38	1.60
$150,000 or over	.	0	.	.	.	.

MODEL LEVELS AND FACTORS The reference group in the model is 'not exposed to airborne hazards'	Wald	*df*	*P*	Odds ratio Exp(B)	95% confidence interval of Exp(B) Lower Bound	 Upper Bound
EXPOSED TO DUST AND GASES, VAPOURS, SMOKE OR FUMES ONLY – continued						
WORKPLACE SIZE						
Less than 5 employees	1.14	1	0.286	1.22	0.85	1.74
5 to 19 employees	0.79	1	0.373	1.17	0.83	1.66
20 to 199 employees	0.27	1	0.601	0.92	0.68	1.25
200 or more employees	.	0	.	.	.	.
INDUSTRY						
Manufacturing	47.11	1	0.000	5.97	3.58	9.94
Transport & storage	21.66	1	0.000	3.83	2.17	6.73
Construction	17.84	1	0.000	3.24	1.88	5.59
Agriculture, forestry & fishing	15.05	1	0.000	3.31	1.81	6.07
Wholesale & retail trade	4.32	1	0.038	2.16	1.05	4.46
Accommodation, cafes & restaurants	0.07	1	0.784	0.85	0.28	2.64
Property & business services	0.16	1	0.686	1.16	0.57	2.36
Government administration & defence	0.01	1	0.938	1.03	0.49	2.14
Education	3.17	1	0.075	1.79	0.94	3.38
Health & community services	.	0	.	.	.	.
OCCUPATION						
Managers	0.28	1	0.599	1.17	0.66	2.06
Professionals	0.33	1	0.566	1.18	0.68	2.04
Technicians & trades workers	56.61	1	0.000	6.67	4.07	10.93
Community & personal services workers	6.46	1	0.011	2.43	1.23	4.82
Labourers	32.80	1	0.000	4.68	2.76	7.93
Sales workers	0.09	1	0.758	0.87	0.37	2.07
Machinery operators & drivers	43.84	1	0.000	6.05	3.55	10.30
Clerical & administrative workers	.	0	.	.	.	.

Duration of exposure to airborne hazards

Table 14. Kruskal-Wallis tests statistical output: these statistical tests examined the relationship between each factor and the duration of exposure to dust or gases, vapours, smoke or fumes (GVSF)

Factor	Type of airborne hazard exposure		Chi-square	*df*	*P*
SEX	All dust exposures		27.71	1	0.000
	All GVSF exposures		21.64	1	0.000
	Exposed to dust only		14.97	1	0.000
	Exposed to GVSF only		5.74	1	0.017
	Exposed to dust & GVSF	Dust	6.55	1	0.011
		GVSF	5.16	1	0.023
AGE	All dust exposures		14.24	4	0.007
	All GVSF exposures		13.81	4	0.008
	Exposed to dust only		2.94	4	0.568
	Exposed to GVSF only		2.15	4	0.709
	Exposed to dust & GVSF	Dust	14.62	4	0.006
		GVSF	9.14	4	0.058
INCOME*	All dust exposures		31.53	5	0.000
	All GVSF exposures		17.31	5	0.004
WORKPLACE SIZE	All dust exposures		12.75	3	0.005
	All GVSF exposures		7.17	3	0.067
	Exposed to dust only		4.11	3	0.250
	Exposed to GVSF only		1.95	3	0.583
	Exposed to dust & GVSF	Dust	8.63	3	0.035
		GVSF	13.57	3	0.004
INDUSTRY*	All dust exposures		104.30	9	0.000
	All GVSF exposures		45.25	9	0.000
OCCUPATION	All dust exposures		105.00	7	0.000
	All GVSF exposures		64.83	7	0.000
	Exposed to dust only		53.17	7	0.000
	Exposed to GVSF only		24.74	7	0.001
	Exposed to dust & GVSF	Dust	41.54	7	0.000
		GVSF	37.83	7	0.000

* The relationship between this factor and duration of exposure could not be tested with respect to the different combinations of exposure to airborne hazards (dust only, GVSF only, dust and GVSF) due to small sample sizes in some exposure type / factor level combinations

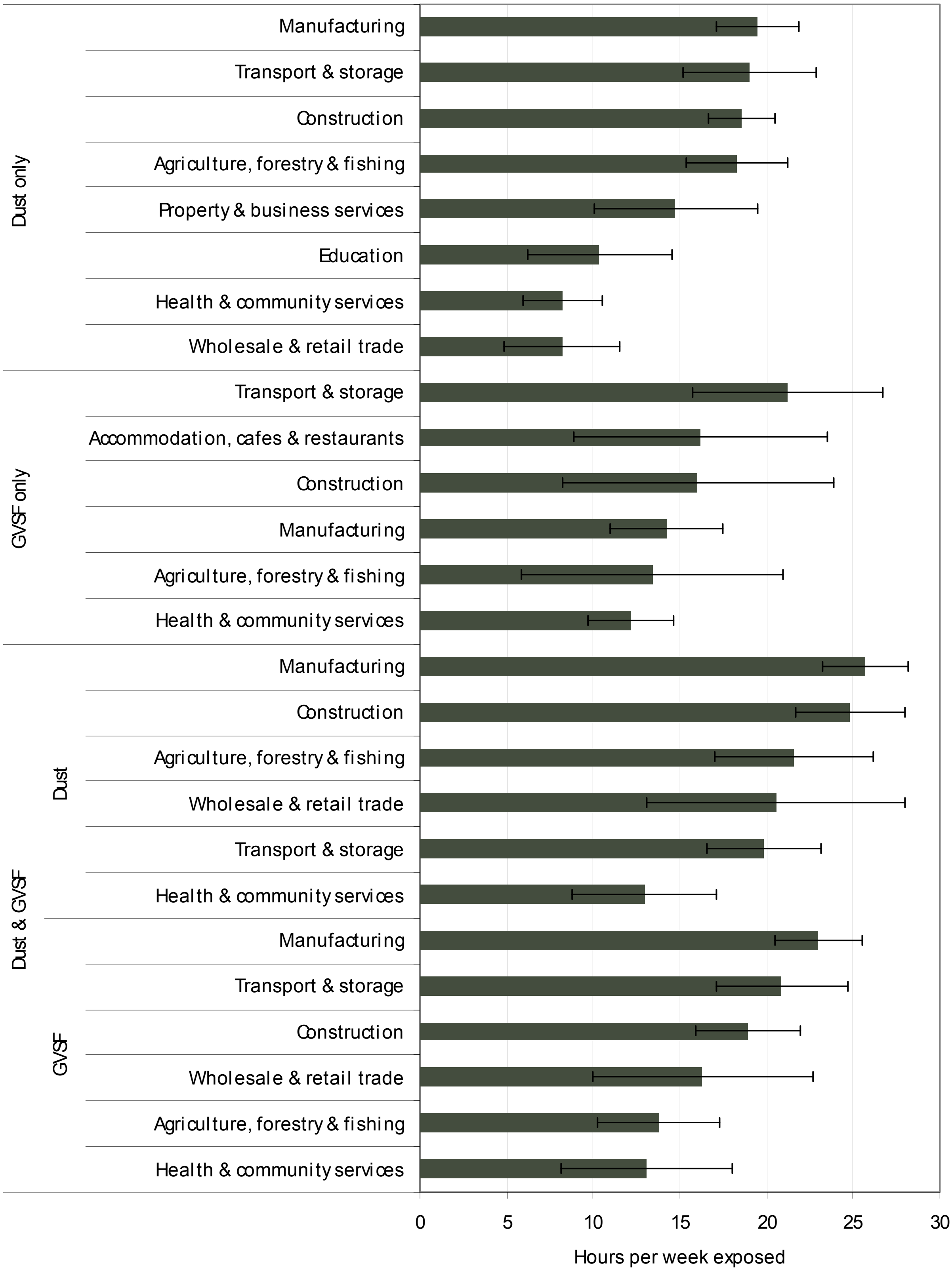

Figure 18. The mean (±95% confidence interval) duration of exposure to dust and/or gases, vapours, smoke or fumes (GVSF) by industry of main employment. Durations of exposure based on 20 or fewer workers within industries and exposure types are not shown.

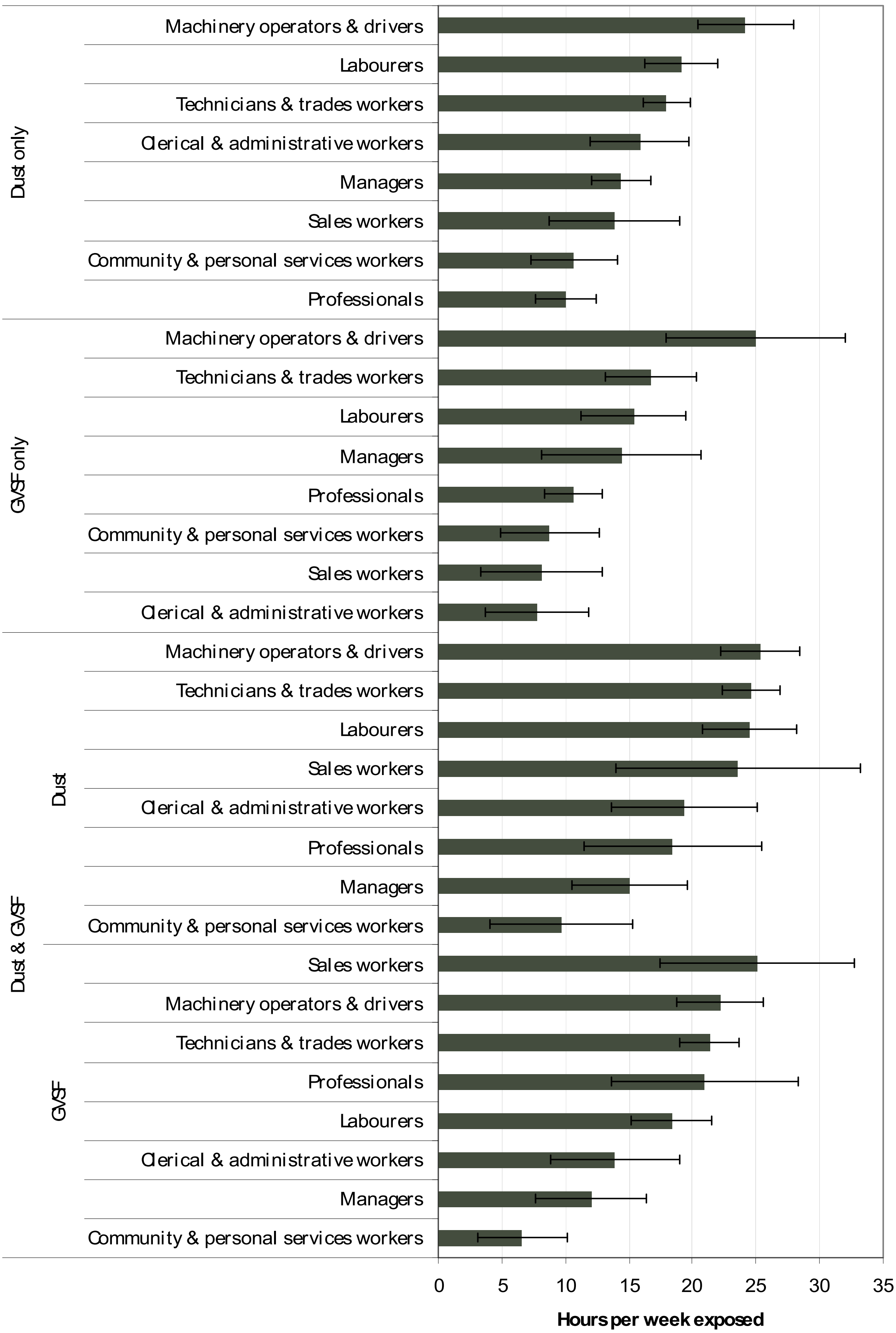

Figure 19. The mean (±95% confidence interval) duration of exposure to dust and/or gases, vapours, smoke or fumes (GVSF) by occupation of main employment

Factors that affect the provision of individual airborne hazard controls

Table 15. Statistical output of the logistic regression examining the provision of masks

PROVISION OF MASKS

MODEL INFORMATION			
	Likelihood ratio tests		
Model Fitting Information	**Chi-square**	***df***	***P***
FINAL MODEL - minimal model	222.170	29	0.000
	Likelihood ratio tests		
Model factors	**Chi-square**	***df***	***P***
Intercept	0.000	0	.
Sex	3.846	1	0.050
Type of employment	14.046	2	0.001
Income	2.612	5	0.760
Workplace size – number of employees	5.222	3	0.156
Type of exposure	14.429	2	0.001
Industry	61.014	9	0.000
Occupation	17.786	7	0.013
Goodness of fit	**Chi-square**	***df***	***P***
Pearson	816.333	834	0.663
Pseudo R-square			
Nagelkerke	0.213		

MODEL PARAMETER ESTIMATES

MODEL FACTORS The reference group in the model is 'Control provided'	Wald	*df*	*P*	Odds ratio [Exp(B)]	95% Confidence interval for Exp(B) Lower Bound	 Upper Bound
Intercept	4.709	1	0.030			
SEX						
Male	3.862	1	0.049	0.708	0.502	0.999
Female	.	0	.	.	.	.
TYPE OF EMPLOYMENT						
Permanent	13.516	1	0.000	0.498	0.344	0.722
Fixed term	0.661	1	0.416	0.718	0.324	1.594
Temporary/casual	.	0	.	.	.	.
INCOME						
Under $30,000	0.393	1	0.531	1.494	0.426	5.238
$30,000 to $49,999	0.208	1	0.648	1.326	0.394	4.460
$50,000 to $74,999	0.258	1	0.612	1.366	0.410	4.551
$75,000 to $99,999	0.000	1	0.998	1.001	0.289	3.469
$100,000 to $149,999	0.187	1	0.666	1.334	0.361	4.922
$150,000 or over	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
Table 15 continued					95% Confidence interval for Exp(B)	
MODEL FACTORS **The reference group in the model is 'Control provided'**	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
WORKPLACE SIZE						
Less than 5 employees	4.985	1	0.026	1.699	1.067	2.705
5 to 19 employees	1.364	1	0.243	1.257	0.856	1.845
20 to 199 employees	0.575	1	0.448	1.139	0.814	1.595
200 or more employees	.	0	.	.	.	.
TYPE OF EXPOSURE						
Exposed to dust only	8.149	1	0.004	1.542	1.145	2.076
Exposed to GVSF only	12.793	1	0.000	1.921	1.343	2.748
Exposed to dust AND GVSF	.	0	.	.	.	.
INDUSTRY						
Health & community services	2.980	1	0.084	1.582	0.940	2.662
Transport & storage	20.398	1	0.000	2.612	1.722	3.962
Construction	0.445	1	0.504	1.148	0.766	1.720
Agriculture, forestry & fishing	4.404	1	0.036	1.769	1.038	3.015
Wholesale & retail trade	6.830	1	0.009	2.486	1.256	4.922
Accommodation, cafes & restaurants	7.538	1	0.006	3.313	1.409	7.792
Property & business services	16.080	1	0.000	4.412	2.136	9.116
Government administration & defence	4.383	1	0.036	2.161	1.050	4.447
Education	26.322	1	0.000	6.133	3.068	12.264
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	0.420	1	0.517	1.191	0.701	2.024
Professionals	4.825	1	0.028	1.762	1.063	2.920
Clerical & administrative workers	6.381	1	0.012	2.064	1.176	3.622
Community & personal services workers	5.959	1	0.015	2.243	1.173	4.292
Labourers	4.212	1	0.040	1.527	1.019	2.289
Sales workers	8.561	1	0.003	3.175	1.464	6.885
Machinery operators & drivers	5.765	1	0.016	1.644	1.096	2.466
Technicians & trades workers	.	0	.	.	.	.

Table 16. Statistical output of the logistic regression examining the provision of respirators

PROVISION OF RESPIRATORS

MODEL INFORMATION			
	Likelihood ratio tests		
Model Fitting Information	**Chi-square**	***df***	***P***
FINAL MODEL - minimal model	262.052	29	0.000
	Likelihood ratio tests		
Model factors	**Chi-square**	***df***	***P***
Intercept	0.000	0	.
Sex	11.922	1	0.001
Type of employment	3.312	2	0.191
Income	13.980	5	0.016
Workplace size	16.547	3	0.001
Type of exposure	8.512	2	0.014
Industry	49.174	9	0.000
Occupation	26.251	7	0.000
Goodness of fit	**Chi-square**	***df***	***P***
Pearson	901.252	834	0.053
Pseudo R-square			
Nagelkerke	0.251		

MODEL PARAMETER ESTIMATES

MODEL FACTORS The reference group in the model is 'Control provided'	Wald	*df*	*P*	Odds ratio [Exp(B)]	95% Confidence interval for Exp(B): Lower Bound	95% Confidence interval for Exp(B): Upper Bound
Intercept	0.909	1	0.340			
SEX						
Male	11.602	1	0.001	0.499	0.334	0.744
Female	.	0	.	.	.	.
TYPE OF EMPLOYMENT						
Permanent	3.002	1	0.083	0.691	0.455	1.050
Fixed term	0.056	1	0.813	0.896	0.362	2.220
Temporary/casual	.	0	.	.	.	.
INCOME						
Under $30,000	2.868	1	0.090	2.686	0.856	8.428
$30,000 to $49,999	1.768	1	0.184	2.083	0.706	6.146
$50,000 to $74,999	1.406	1	0.236	1.909	0.656	5.555
$75,000 to $99,999	0.176	1	0.675	1.266	0.421	3.812
$100,000 to $149,999	0.031	1	0.860	0.900	0.281	2.890
$150,000 or over	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
Table 16 continued **MODEL FACTORS** **The reference group in the model is 'Control provided'**	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**95% Confidence interval for Exp(B)**	
					Lower Bound	**Upper Bound**
WORKPLACE SIZE						
Less than 5 employees	13.781	1	0.000	2.539	1.552	4.152
5 to 19 employees	10.156	1	0.001	1.901	1.281	2.822
20 to 199 employees	7.444	1	0.006	1.607	1.143	2.260
200 or more employees	.	0	.	.	.	.
TYPE OF EXPOSURE						
Exposed to dust only	8.373	1	0.004	1.544	1.151	2.073
Exposed to GVSF only	2.395	1	0.122	1.343	0.924	1.951
Exposed to dust AND GVSF	.	0	.	.	.	.
INDUSTRY						
Health & community services	5.584	1	0.018	2.021	1.127	3.621
Transport & storage	21.881	1	0.000	2.791	1.815	4.290
Construction	0.156	1	0.693	1.076	0.748	1.548
Agriculture, forestry & fishing	0.326	1	0.568	0.856	0.501	1.461
Wholesale & retail trade	3.214	1	0.073	2.197	0.929	5.195
Accommodation, cafes & restaurants	0.472	1	0.492	1.399	0.537	3.644
Property & business services	5.186	1	0.023	2.664	1.146	6.191
Government administration & defence	1.600	1	0.206	1.602	0.772	3.323
Education	13.377	1	0.000	9.941	2.903	34.036
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	0.087	1	0.768	1.079	0.651	1.789
Professionals	10.431	1	0.001	2.429	1.417	4.162
Clerical & administrative workers	3.419	1	0.064	1.840	0.964	3.510
Community & personal services workers	1.246	1	0.264	1.524	0.727	3.195
Labourers	5.243	1	0.022	1.595	1.070	2.379
Sales workers	9.801	1	0.002	7.510	2.125	26.538
Machinery operators & drivers	1.419	1	0.234	1.264	0.860	1.857
Technicians & trades workers	.	0	.	.	.	.

Table 17. Statistical output of the logistic regression examining the provision of ventilation systems

PROVISION OF VENTILATION SYSTEMS			
MODEL INFORMATION			
	Likelihood ratio tests		
Model Fitting Information	**Chi-square**	***df***	***P***
FINAL MODEL - minimal model	146.788	29	0.000
	Likelihood ratio tests		
Model factors	**Chi-square**	***df***	***P***
Intercept	0.000	0	.
Sex	1.940	1	0.164
Type of employment	1.937	2	0.380
Income	11.715	5	0.039
Workplace size – number of employees	14.834	3	0.002
Type of exposure	12.443	2	0.002
Industry	43.943	9	0.000
Occupation	17.028	7	0.017
Goodness of fit	**Chi-Square**	***df***	***P***
Pearson	865.010	834	0.222
Pseudo R-square			
Nagelkerke	0.142		

MODEL PARAMETER ESTIMATES						
MODEL FACTORS					**95% Confidence interval for Exp(B)**	
The reference group in the model is 'Control provided'	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
Intercept	5.183	1	0.023			
SEX						
Male	1.936	1	0.164	0.787	0.562	1.103
Female	.	0	.	.	.	.
TYPE OF EMPLOYMENT						
Permanent	0.288	1	0.592	1.103	0.771	1.578
Fixed term	1.885	1	0.170	1.755	0.786	3.920
Temporary/casual	.	0	.	.	.	.
INCOME						
Under $30,000	4.606	1	0.032	4.342	1.136	16.600
$30,000 to $49,999	3.771	1	0.052	3.637	0.988	13.391
$50,000 to $74,999	2.942	1	0.086	3.106	0.851	11.339
$75,000 to $99,999	2.094	1	0.148	2.656	0.707	9.969
$100,000 to $149,999	0.603	1	0.437	1.729	0.434	6.889
$150,000 or over	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
Table 17 continued **MODEL FACTORS** **The reference group in the model is 'Control provided'**	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**95% Confidence interval for Exp(B)**	
					Lower Bound	**Upper Bound**
WORKPLACE SIZE						
Less than 5 employees	14.152	1	0.000	2.375	1.513	3.726
5 to 19 employees	5.079	1	0.024	1.513	1.055	2.169
20 to 199 employees	2.767	1	0.096	1.308	0.953	1.796
200 or more employees	.	0	.	.	.	.
TYPE OF EXPOSURE						
Exposed to dust only	2.334	1	0.127	1.239	0.941	1.631
Exposed to GVSF only	4.156	1	0.041	0.700	0.497	0.986
Exposed to dust AND GVSF	.	0	.	.	.	.
INDUSTRY						
Health & community services	3.911	1	0.048	1.670	1.005	2.778
Transport & storage	23.780	1	0.000	2.708	1.815	4.042
Construction	25.619	1	0.000	2.552	1.775	3.668
Agriculture, forestry & fishing	8.384	1	0.004	2.166	1.284	3.653
Wholesale & retail trade	0.089	1	0.765	1.107	0.569	2.152
Accommodation, cafes & restaurants	0.061	1	0.805	1.107	0.494	2.479
Property & business services	5.152	1	0.023	2.247	1.117	4.519
Government administration & defence	1.443	1	0.230	1.533	0.763	3.080
Education	7.560	1	0.006	2.452	1.294	4.647
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	1.155	1	0.282	1.312	0.800	2.151
Professionals	1.786	1	0.181	1.392	0.857	2.262
Clerical & administrative workers	3.149	1	0.076	1.638	0.950	2.827
Community & personal services workers	4.038	1	0.044	1.901	1.016	3.555
Labourers	10.043	1	0.002	1.862	1.268	2.736
Sales workers	0.009	1	0.926	1.035	0.497	2.158
Machinery operators & drivers	9.248	1	0.002	1.799	1.232	2.627
Technicians & trades workers	.	0	.	.	.	.

Table 18. Statistical output of the logistic regression examining whether or not workers were able to reduce the time they were exposed to airborne hazards

REDUCE EXPOSURE DURATION

MODEL INFORMATION			
	Likelihood ratio tests		
Model Fitting Information	**Chi-square**	***df***	***P***
FINAL MODEL - minimal model	84.995	29	0.000
	Likelihood ratio tests		
Model factors	**Chi-square**	***df***	***P***
Intercept	0.000	0	.
Sex	0.005	1	0.941
Type of employment	1.187	2	0.552
Income	9.901	5	0.078
Workplace size	3.267	3	0.352
Type of exposure	7.915	2	0.019
Industry	20.763	9	0.014
Occupation	22.889	7	0.002
Goodness of fit	**Chi-square**	***df***	***P***
Pearson	899.983	834	0.056
Pseudo R-square			
Nagelkerke	0.087		

MODEL PARAMETER ESTIMATES

MODEL FACTORS The reference group in the model is 'Control provided'	Wald	*df*	*P*	Odds ratio [Exp(B)]	95% Confidence interval for Exp(B)	
					Lower Bound	Upper Bound
Intercept	1.368	1	0.242			
SEX						
Male	0.005	1	0.941	0.987	0.694	1.403
Female	.	0	.	.	.	.
TYPE OF EMPLOYMENT						
Permanent	0.435	1	0.510	0.881	0.605	1.284
Fixed term	1.143	1	0.285	0.653	0.299	1.426
Temporary/casual	.	0	.	.	.	.
INCOME						
Under $30,000	1.259	1	0.262	1.822	0.639	5.196
$30,000 to $49,999	2.089	1	0.148	2.088	0.769	5.669
$50,000 to $74,999	2.718	1	0.099	2.298	0.855	6.179
$75,000 to $99,999	0.331	1	0.565	1.349	0.486	3.745
$100,000 to $149,999	0.580	1	0.446	1.525	0.515	4.521
$150,000 or over	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
Table 18 continued **MODEL FACTORS** **The reference group in the model is 'Control provided'**	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**95% Confidence interval for Exp(B)**	
					Lower Bound	**Upper Bound**
WORKPLACE SIZE						
Less than 5 employees	1.165	1	0.280	1.282	0.816	2.014
5 to 19 employees	2.608	1	0.106	1.353	0.937	1.954
20 to 199 employees	2.606	1	0.106	1.300	0.945	1.787
200 or more employees	.	0	.	.	.	.
TYPE OF EXPOSURE						
Exposed to dust only	5.065	1	0.024	0.722	0.543	0.959
Exposed to GVSF only	6.468	1	0.011	0.636	0.449	0.901
Exposed to dust AND GVSF	.	0	.	.	.	.
INDUSTRY						
Health & community services	10.115	1	0.001	2.404	1.400	4.128
Transport & storage	1.314	1	0.252	1.269	0.844	1.907
Construction	0.344	1	0.557	0.899	0.631	1.282
Agriculture, forestry & fishing	0.134	1	0.715	1.104	0.650	1.875
Wholesale & retail trade	0.776	1	0.378	0.738	0.376	1.451
Accommodation, cafes & restaurants	1.186	1	0.276	1.596	0.688	3.702
Property & business services	4.714	1	0.030	2.409	1.089	5.326
Government administration & defence	0.010	1	0.919	1.037	0.513	2.095
Education	5.086	1	0.024	2.241	1.111	4.518
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	1.575	1	0.209	0.735	0.454	1.189
Professionals	1.055	1	0.304	1.291	0.793	2.104
Clerical & administrative workers	1.634	1	0.201	1.440	0.823	2.517
Community & personal services workers	0.520	1	0.471	1.281	0.654	2.508
Labourers	10.127	1	0.001	1.898	1.279	2.816
Sales workers	3.223	1	0.073	2.001	0.938	4.269
Machinery operators & drivers	8.014	1	0.005	1.742	1.186	2.558
Technicians & trades workers	.	0	.	.	.	.

Factors that affect the number of airborne hazard controls provided

Table 19. Output of the multinomial logistic regression examining provision of airborne hazard controls

PROVISION OF AIRBORNE HAZARD CONTROLS

MODEL INFORMATION

	Likelihood Ratio Tests		
Model fitting information	**Chi-square**	***df***	***P***
FINAL MODEL - minimal model	355.546	96	0.000

	Likelihood Ratio Tests		
Model factors	**Chi-square**	***df***	***P***
Industry	96.088	36	0.000
Occupation	66.143	28	0.000
Workplace size – number of employees	39.478	12	0.000
Income	44.817	20	0.001

Goodness of fit	**Chi-square**	***df***	***P***
Pearson	2160.387	2104	0.192

Pseudo R-square	
Nagelkerke	0.196

MODEL PARAMETER ESTIMATES

MODEL LEVELS AND FACTORS					**95% Confidence interval for Exp(B)**	
The reference group for the model is 'no controls provided'	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
ONE CONTROL PROVIDED						
Intercept	8.068	1	0.005			
INDUSTRY						
Health & community services	0.057	1	0.811	0.924	0.486	1.759
Transport & storage	0.766	1	0.381	0.788	0.462	1.344
Construction	0.014	1	0.905	0.970	0.585	1.608
Agriculture, forestry & fishing	1.129	1	0.288	0.715	0.385	1.327
Wholesale & retail trade	0.017	1	0.895	1.058	0.461	2.427
Accommodation, cafes & restaurants	0.026	1	0.872	0.927	0.368	2.334
Property & business services	0.001	1	0.975	0.988	0.463	2.109
Government administration & defence	0.101	1	0.751	0.846	0.302	2.369
Education	0.000	1	0.987	0.994	0.464	2.129
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	4.009	1	0.045	0.552	0.308	0.988
Professionals	4.665	1	0.031	0.511	0.278	0.940
Clerical & administrative workers	13.801	1	0.000	0.284	0.146	0.552
Community & personal services workers	9.977	1	0.002	0.273	0.122	0.611
Labourers	7.652	1	0.006	0.492	0.298	0.813
Sales workers	2.331	1	0.127	0.496	0.202	1.220

MODEL PARAMETER ESTIMATES						
MODEL LEVELS AND FACTORS					**95% Confidence interval for Exp(B)**	
The reference group for the model is 'no controls provided'	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
ONE CONTROL PROVIDED continued						
OCCUPATION continued						
Machinery operators & drivers	9.204	1	0.002	0.455	0.273	0.757
Technicians & trades workers	.	0	.	.	.	.
WORKPLACE SIZE						
Less than 5 employees	0.065	1	0.798	1.069	0.641	1.782
5 to 19 employees	0.276	1	0.599	0.874	0.529	1.443
20 to 199 employees	0.006	1	0.937	1.019	0.642	1.618
200 or more employees	.	0	.	.	.	.
INCOME						
Under $30,000	4.432	1	0.035	0.306	0.102	0.921
$30,000 to $49,999	3.013	1	0.083	0.384	0.131	1.131
$50,000 to $74,999	3.428	1	0.064	0.362	0.123	1.061
$75,000 to $99,999	2.553	1	0.110	0.391	0.124	1.237
$100,000 to $149,999	3.266	1	0.071	0.319	0.092	1.102
$150,000 or over	.	0	.	.	.	.
TWO CONTROLS PROVIDED						
Intercept	8.211	1	0.004			
INDUSTRY						
Health & community services	3.006	1	0.083	0.563	0.294	1.078
Transport & storage	10.139	1	0.001	0.392	0.221	0.698
Construction	0.096	1	0.757	0.926	0.567	1.511
Agriculture, forestry & fishing	4.276	1	0.039	0.524	0.284	0.967
Wholesale & retail trade	2.235	1	0.135	0.484	0.187	1.253
Accommodation, cafes & restaurants	2.157	1	0.142	0.465	0.167	1.292
Property & business services	2.246	1	0.134	0.543	0.244	1.207
Government administration & defence	1.132	1	0.287	0.572	0.204	1.601
Education	4.183	1	0.041	0.420	0.183	0.964
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	1.429	1	0.232	0.705	0.397	1.251
Professionals	3.301	1	0.069	0.562	0.302	1.046
Clerical & administrative workers	9.764	1	0.002	0.345	0.177	0.673
Community & personal services workers	4.331	1	0.037	0.427	0.192	0.952
Labourers	6.617	1	0.010	0.518	0.314	0.855
Sales workers	5.422	1	0.020	0.262	0.085	0.809
Machinery operators & drivers	14.963	1	0.000	0.341	0.198	0.589
Technicians & trades workers	.	0	.	.	.	.
WORKPLACE SIZE						
Less than 5 employees	0.038	1	0.846	0.950	0.566	1.594
5 to 19 employees	1.055	1	0.304	0.766	0.461	1.274
20 to 199 employees	1.140	1	0.286	0.772	0.480	1.241
200 or more employees	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
MODEL LEVELS AND FACTORS					**95% Confidence interval for Exp(B)**	
The reference group for the model is ‘no controls provided’	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
TWO CONTROLS PROVIDED continued						
INCOME						
Under $30,000	2.665	1	0.103	0.382	0.120	1.213
$30,000 to $49,999	0.891	1	0.345	0.581	0.188	1.796
$50,000 to $74,999	2.199	1	0.138	0.426	0.138	1.316
$75,000 to $99,999	0.562	1	0.453	0.634	0.193	2.086
$100,000 to $149,999	2.548	1	0.110	0.347	0.095	1.272
$150,000 or over	.	0	.	.	.	.
THREE CONTROLS PROVIDED						
Intercept	11.537	1	0.001			
INDUSTRY						
Health & community services	8.478	1	0.004	0.345	0.169	0.706
Transport & storage	14.105	1	0.000	0.350	0.203	0.606
Construction	3.954	1	0.047	0.608	0.372	0.993
Agriculture, forestry & fishing	5.405	1	0.020	0.479	0.258	0.891
Wholesale & retail trade	2.483	1	0.115	0.482	0.195	1.195
Accommodation, cafes & restaurants	7.410	1	0.006	0.114	0.024	0.545
Property & business services	9.278	1	0.002	0.211	0.078	0.574
Government administration & defence	6.332	1	0.012	0.174	0.044	0.679
Education	14.473	1	0.000	0.050	0.011	0.235
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	1.167	1	0.280	0.728	0.410	1.294
Professionals	8.499	1	0.004	0.360	0.182	0.716
Clerical & administrative workers	11.898	1	0.001	0.290	0.143	0.586
Community & personal services workers	8.826	1	0.003	0.200	0.069	0.578
Labourers	10.424	1	0.001	0.422	0.250	0.713
Sales workers	3.500	1	0.061	0.382	0.139	1.047
Machinery operators & drivers	18.446	1	0.000	0.308	0.180	0.527
Technicians & trades workers	.	0	.	.	.	.
WORKPLACE SIZE						
Less than 5 employees	2.909	1	0.088	0.618	0.356	1.074
5 to 19 employees	0.929	1	0.335	0.771	0.455	1.308
20 to 199 employees	0.075	1	0.784	0.934	0.576	1.517
200 or more employees	.	0	.	.	.	.
INCOME						
Under $30,000	4.616	1	0.032	0.268	0.081	0.891
$30,000 to $49,999	1.505	1	0.220	0.484	0.152	1.543
$50,000 to $74,999	0.882	1	0.348	0.576	0.182	1.822
$75,000 to $99,999	0.296	1	0.586	0.713	0.211	2.406
$100,000 to $149,999	1.923	1	0.166	0.394	0.105	1.470
$150,000 or over	.	0	.	.	.	.

MODEL PARAMETER ESTIMATES						
MODEL LEVELS AND FACTORS					**95% Confidence interval for Exp(B)**	
The reference group for the model is 'no controls provided'	**Wald**	***df***	***P***	**Odds ratio [Exp(B)]**	**Lower Bound**	**Upper Bound**
FOUR CONTROLS PROVIDED						
Intercept	25.681	1	0.000			
INDUSTRY						
Health & community services	9.916	1	0.002	0.291	0.135	0.627
Transport & storage	21.397	1	0.000	0.233	0.126	0.432
Construction	0.815	1	0.367	0.794	0.482	1.309
Agriculture, forestry & fishing	6.173	1	0.013	0.403	0.197	0.825
Wholesale & retail trade	2.751	1	0.097	0.375	0.118	1.195
Accommodation, cafes & restaurants	2.488	1	0.115	0.393	0.123	1.254
Property & business services	7.121	1	0.008	0.230	0.078	0.677
Government administration & defence	0.625	1	0.429	0.670	0.248	1.808
Education	11.028	1	0.001	0.073	0.015	0.341
Manufacturing	.	0	.	.	.	.
OCCUPATION						
Managers	3.107	1	0.078	0.583	0.320	1.062
Professionals	15.428	1	0.000	0.241	0.118	0.490
Clerical & administrative workers	17.070	1	0.000	0.172	0.075	0.397
Community & personal services workers	7.727	1	0.005	0.245	0.091	0.660
Labourers	20.876	1	0.000	0.256	0.143	0.459
Sales workers	7.117	1	0.008	0.145	0.035	0.599
Machinery operators & drivers	16.469	1	0.000	0.323	0.187	0.558
Technicians & trades workers	.	0	.	.	.	.
WORKPLACE SIZE						
Less than 5 employees	20.971	1	0.000	0.265	0.150	0.468
5 to 19 employees	11.053	1	0.001	0.405	0.237	0.690
20 to 199 employees	6.490	1	0.011	0.537	0.333	0.866
200 or more employees	.	0	.	.	.	.
INCOME						
Under $30,000	8.606	1	0.003	0.166	0.050	0.551
$30,000 to $49,999	6.097	1	0.014	0.237	0.075	0.743
$50,000 to $74,999	4.247	1	0.039	0.305	0.098	0.943
$75,000 to $99,999	0.969	1	0.325	0.551	0.168	1.805
$100,000 to $149,999	0.864	1	0.353	0.554	0.160	1.923
$150,000 or over	.	0	.	.	.	.

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