safe work australia

ASBESTOS EXPOSURE AND COMPLIANCE STUDY OF CONSTRUCTION AND MAINTENANCE WORKERS:

FOLLOW-UP REPORT**Jun**

June 2010

Asbestos Exposure and Compliance Study of Construction and Maintenance Workers: Follow-up Report

Acknowledgement

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Executive Summary

In Australia, as a consequence of the high level of asbestos consumption in the past, large volumes of *in-situ* asbestos are still present in many older buildings and in water and sewerage pipes. Significant adverse health effects, such as lung cancer, mesothelioma and asbestosis can arise from exposure to airborne asbestos fibres which can be generated when these *in-situ* asbestos containing materials are disturbed. However, safe work practices such as those defined in regulations on management and control of *in-situ* asbestos can prevent potential exposure to airborne asbestos fibres.

It was unknown whether these safe work practices were being followed in Australia, especially among workers with high potential risk of exposure, such as construction and maintenance workers. This led Safe Work Australia to commission the Asbestos Exposure and Compliance Study of Construction and Maintenance Workers. The study targeted four trades: electricians, carpenters, plumbers and painters. The study was completed in 2009 and a descriptive research report was published in June 2010.

The present report is a follow up report of the initial descriptive report from the Asbestos Exposure and Compliance Study (the Asbestos Study). The aims of this report are:

- to conduct a brief literature review of worker safety behaviour models to provide background information on factors influencing worker safety behaviours
- to examine which factors influenced workers' understanding of the risk of asbestos, and
- to examine which factors influenced compliance with safe work practices when working with asbestos containing materials (ACMs).

Data from the computer assisted telephone interview phase of the Asbestos Study were used for this report. It was found that age and whether the person works alone or works with others did not predict understanding of the risk of asbestos. In contrast, asbestos specific occupational health and safety (OHS) training, source of information on asbestos and trade predicted workers' understanding of the risk of asbestos.

- Carpenters were more likely to report that they understood a lot about the risk of asbestos compared to painters.
- Those who had completed asbestos specific OHS training were more likely to report that they understood a lot about the risk of asbestos compared to those without asbestos specific OHS training.
- Workers who reported that their information source on asbestos was trade training or information from trade associations or trade unions were more likely to report having a greater understanding of the risk of asbestos compared to workers whose information source was newspapers / television.

Of the demographic, employment and risk perception variables tested, trade and workers' perception of their likelihood of exposure to asbestos predicted safe work practices.

- Carpenters and electricians were more likely to report that they followed safe work practices compared to painters.
- Workers who considered that exposure to asbestos was more likely at their workplace were more likely to follow safe work practices compared to those workers who thought exposure was less likely.

Although the report identified some factors that may be important for workers' knowledge about asbestos and factors that may predict compliance with safe work practices, the report's findings should be interpreted with caution and should not be generalised to the larger working population. This is because the study only included 262 workers and did not contain a random sample of workers. In addition, the information collected on risk perception, and other factors that may influence safety behaviour was very limited due to time and resource constraints.

Further research is needed to confirm this study's findings, using a validated questionnaire that is based on a well established model of worker safe behaviour. This will also shed further light on the range of factors that could influence worker safety behaviours that were not collected in the current study. Further research is also needed to validate and examine why some trades (e.g. carpenters) were more likely to follow safe work practices compared to painters in this study. This may reveal procedures and training that could be adopted by other trades to encourage better compliance with safety practices when working with ACMs.

Introduction

Exposure to airborne asbestos fibres from disturbed or damaged asbestos containing materials can lead to serious diseases such as mesothelioma, asbestosis and lung cancer (O'Regan, Tyers, Hill, Gordon-Dseagu, & Rick, 2007). Asbestos was mined for over 100 years in Australia until 1983. Australia was also a large user of asbestos (Leigh & Driscoll, 2003). For these reasons, many asbestos containing materials still persist in older buildings and homes, despite the asbestos ban in 2003.

Due to significant adverse health effects of exposure to asbestos fibres, it is important that guidelines for safe working with asbestos are followed to reduce exposures when working in buildings or with materials that could contain asbestos. It has been noted that construction and maintenance trade workers may be potentially at risk of exposure to asbestos and that they may not be aware of their potential exposure to this hazard (O'Regan et al., 2007).

In light of these concerns, in 2008, Safe Work Australia (formerly the Australian Safety and Compensation Council) commissioned research into current levels of awareness of the risk of asbestos among Construction and Maintenance workers (Safe Work Australia et al., 2010). The research also examined current compliance with safe work practices when working with asbestos containing materials (ACMs) and barriers and enablers to compliance with safe work practices. The full details of this study, including the methods and descriptive results, are available on the Safe Work Australia website.

The descriptive analysis of this research found that tradespeople were generally aware of the risk of asbestos. About half of the participants reported that they knew a lot about the risk of asbestos while the other half reported they knew a little about asbestos (Safe Work Australia et al., 2010). However, it was unclear what factors influence workers' knowledge of asbestos and whether knowledge of asbestos or risk perception translates to safety practices. Descriptive analyses also revealed differences in key variables by trade, such as occupational health and safety (OHS) training, and likelihood of exposure to asbestos fibres. This raises the possibility that a person's occupation, as well as other demographic and employment factors, play a role in safe work behaviour. Further and more in depth data analysis was needed.

The current report will firstly describe the research objectives of the report. It will then present a brief literature review of the models and studies of safe work behaviour. The Methods section then describes the data collection method, the study sample and statistical methods used in this report. The report will then present the results of further data analysis of the dataset from the Asbestos Exposure and Compliance Study of Construction and Maintenance Workers followed by a discussion of the findings and limitations of the study. Finally, policy implications and recommendations for future research will be presented.

Research objectives

This report attempts to identify factors that influence workers' knowledge of asbestos and their safe work practices using the data obtained from the Asbestos Study. If occupational diseases such as those arising from exposure to asbestos are to be prevented more effectively, a better understanding of worker safety behaviour is needed. While the asbestos study did not collect extensive information on attitudinal, perceptual, demographic and employment factors, a better understanding of factors that influence workers' safety practices may be gained from further statistical analysis of the information that was collected in the study.

The report's research objectives are informed by what is already known about what influences safety behaviour and what is feasible for analysis given the limited information collected during this study. The three research objectives of this report are:

- to conduct a brief literature review of worker safety behaviour models to provide background information on factors influencing worker safety behaviours and to inform objectives two and three
- to examine which factors influenced workers' understanding of the risk of asbestos, and
- to examine which factors influenced compliance with safety practices when working with ACMs.

Literature review

This literature review focuses on factors that influence and moderate worker safety behaviour. The studies and models discussed below are not restricted to the field of worker health and safety research. Typically, these have been developed in other fields of research (e.g. health behaviour research) and then applied to specific occupational health and safety research.

Historically, research and programs on health and safety tended to focus on awareness and knowledge raising programs and providing information on how to eliminate or reduce exposure to workplace hazards (Petrea, 2001). It was recognised that such research and programs focusing just on awareness and knowledge were not effective for examining what influences worker safety behaviour or for changing behaviour. The need for research that incorporates attitudes, beliefs, intention of workers was identified and a range of theoretical models have been proposed as the basis for developing and interpreting research into the factors that determine worker self-protective behaviour in response to workplace hazards. The remainder of this section presents a brief review of different models of self-protective behaviour that incorporates various characteristics of the worker and/or the social and work environment.

Health behaviour prediction models

In 2005, the Health and Safety Executive (HSE) in the United Kingdom (UK) published an information pack containing a selection of health behaviour models that may be useful in OHS research (2005). In 2008, the Office of the Australian Safety and Compensation Council also commissioned a literature review on conceptual models commonly used on OHS research on attitudes, perceptions and behaviours (Harris, Sav, & Sebar, 2008). These two reviews provide a comprehensive discussion of the development of different health behaviour prediction models. Some of the key models, also discussed in these two reviews, are summarised below.

Health Belief Model (HBM)

The HBM states that the likelihood of a given health behaviour is determined by threat appraisal and a cost benefit trade off. According to DeJoy (1996), the HBM model has four basic components:

- perceived susceptibility to the health problem or condition in question
- perceived seriousness of the problem or condition
- perceived benefits associated with taking a particular action, and
- perceived barriers associated with taking the action.

The model states that threat appraisal is not enough to ensure behavioural change. Only when the individual perceives the advantages of threat avoidance to outweigh the disadvantages will behaviour change occur.

The model is illustrated by the following figure (Figure 1) from early work of Rosenstock (1974).

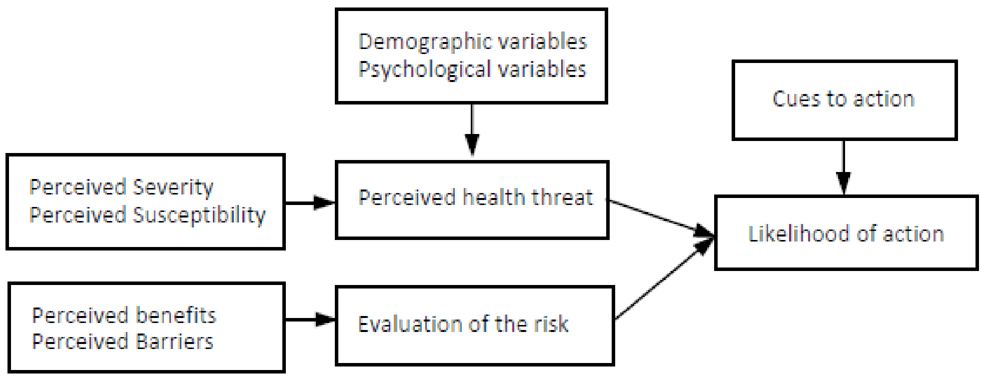


Figure 1. Health Beliefs Model (Source: Rosenstock, 1974)

The relevance of this model is that it suggests that threat appraisal is insufficient for motivating change and that health beliefs are weak predictors of change. In the case of asbestos it would mean that even the 'shock tactic' information referenced in the maintenance workers study and in recent Australian media coverage would not be a sufficient condition for change.

Theory of Planned Behaviour (TPB)

This model (an extension of the Theory of Reasoned Action) identifies intention as the common determinant of behaviour and that the components underlying intention are:

- *Attitudes* (to the behaviour), comprising beliefs about the possible consequences of a given behaviour and evaluation of whether that outcome is important.
- *Subjective norms*, that is, perceptions of any social norms or pressures to perform a given behaviour combined with an evaluation of importance.
- *Perceived behavioural control*, that is, the extent to which the individual believes they are in full control over their behaviour based on internal control factors, (e.g. abilities) and external control factors (e.g. environmental barriers) (Ajzen, 1985, 1991; Lunt et al., 2005).

The model is illustrated in the following figure from Ajzen (1991).

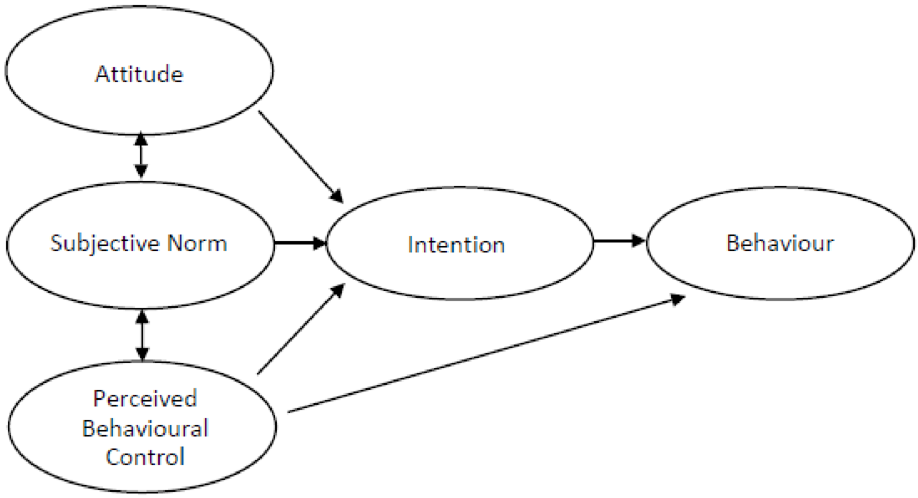


Figure 2. Theory of planned behaviour (Source: Ajzen, 1991)

A difference between HBM and TPB is that the TPB includes subjective norms as a major determinant of health behaviour. The model has not been tested for predicting behaviour, but rather research applications have concentrated on predicting intention to act.

The HSE review (Lunt et al., 2005) notes that this model has only been recently applied to occupational health and the findings from various studies imply that:

> Accurately recognising the adverse consequences of poor work practices in terms of health risks is not enough for ensuring self-protective behaviour at work. The employee must also believe that
>
> (a) they have the necessary skills for adopting safer practices,
>
> (b) that those practices will be effective in reducing risk and
>
> (c) that their surrounding social environment, as reflection of peer or managerial attitudes or organisational culture, will support them in attempts to adopt safer and healthier work practices.

and

> Interventions that simultaneously address attitudes to health risks, self-confidence, employee control over their work environment and the social norms operating within that environment are more likely to yield behavioural change than interventions that focus on just one aspect of the model. Nonetheless, findings that TPB variables better predict the intention to change rather than actual change means that such interventions will not guarantee health protective behaviour in employees.

The stages of change model

The stages of change model, or Trans-theoretical Model, proposed by Prochaska and DiClemente (1984), describes the stages that people pass through when undertaking a behavioural change. The stages are illustrated in the following figure (Figure 3).

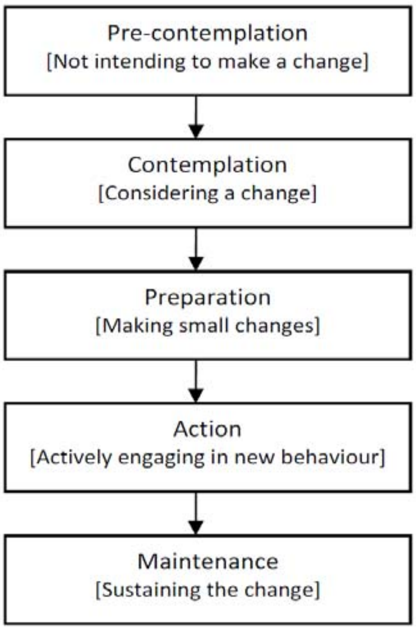


Figure 3. Stages of change model (Source: Prochaska and DiClemente, 1984)

The model emphasises the dynamic nature of the process and notes that individuals engaged in behavioural change can start at any stage in the model and relapse back to earlier stages (Lunt et al., 2005).

Stage or sequential model of workplace self-protective behaviour

De Joy (1996) sees the health behaviour protection models, discussed above, as value expectancy approaches which are 'based on the premise that people estimate the seriousness of risks, evaluate the costs and benefits of various actions, and then choose a course of action that will maximize the expected outcome'. De Joy says these models have some common elements that have application to workplace self-protective behaviour. The core elements are:

- *Threat related beliefs*, a combination of susceptibility and severity is relevant to behaviours. In the case of asbestos it would be a belief that exposure was likely and that the consequences were severe for behaviour to change.
- *Self-efficacy*, which relates to the confidence in performing the required behaviour over a period of time. In the asbestos example it would be the ability to follow control procedures on all occasions.
- *Response efficacy,* which relates to perceptions about the effectiveness of practices and controls. For asbestos it would include beliefs about the effectiveness of risk controls and protective equipment.
- *Barriers,* which relates to the barriers to safe behaviour such as time and cost. In the case of asbestos, taking shortcuts in controls or clean up in order to complete a job on time may be an example.
- *Normative expectations,* which relates to the social influences on behaviour such as management and co-workers. An example would be indifference by supervisors to safe asbestos removal practices.

In addition to these core elements, De Joy suggests that most models have concentrated on individual beliefs and have given limited attention to social and environmental factors. He refers to models that build on the individual belief models with enabling factors such as skills and reinforcing factors such as feedback from co-workers. De Joy also described how each of the categories of models reviewed has something to contribute to understanding self-protective behaviour of workers. He then integrated the elements of value expectancy models (including the HBM and TPB), environmental models (such as 'PRECEDE') and stage change models to produce "stage or sequential model of workplace self-protective behaviour" (illustrated in Figure 4 below).

In this model, De Joy (1996) sets out four stages of change - appraisal, decision making, initiation and adherence. The factors that can influence the stages were described as threat related beliefs, response efficacy, self-efficacy, facilitating conditions (includes barriers and enablers) and safety climate. De Joy proposed that these factors would have different levels of significance at different stages of the model. In the first two stages individual beliefs about the threat and the cost-benefit in motivating change are important, whereas in the initiation stage organisational factors such as management commitment and safety climate are more influential. Similarly in achieving long term adherence to safe behaviour the environmental and organisation factors are important.

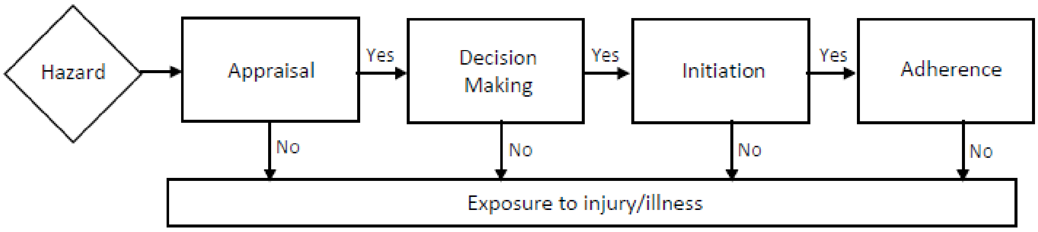


Figure 4. Stage or Sequential model of workplace self-protective behaviour (Source: DeJoy, 1996)

De Joy argues that unlike the HBM and TPB type models, the stage change approach points to the need to understand that beliefs and perceptions will vary in influence across these different stages. For example:

> Providing workers with information about particular job-related hazards is likely to be most useful for increasing awareness and a sense of personal susceptibility. But beyond this point, such information is likely to be of limited effectiveness in changing and maintaining relevant work practices. Once awareness and personal susceptibility are established, attention might better be focused on related skill development and self-efficacy enhancement, and with actions that reduce barriers and create more favourable cost-benefit ratios for safe behaviour (DeJoy, 1996).

Other theoretical models

The Risk Perception Attitude (RPA) Framework

The RPA framework was developed by Rimal and Real and is based on communication theory (Rimal & Real, 2003). In his 2008 study, Real applied this model to workplace health and safety using a sample of production workers (Real, 2008). The study builds on research showing that health related information seeking and retention of knowledge can lead to positive health outcomes.

The study uses similar concepts to the HBM and TPB models and concentrates particularly on the importance of safety efficacy (e.g. confidence in the value of controls). The framework used is called the RPA Framework, which considers the relationship between risk perception and efficacy beliefs.

> In this model the impact of perceived risk on individual self-protective motivations and behaviours is moderated by efficacy beliefs. Workers who feel efficacious, or confident in their ability to deal with a situation, will view potential risks as challenges to be overcome, whereas those lacking in efficacy may interpret themselves as vulnerable to the threat they face. Accordingly, individuals who possess high efficacy beliefs will respond differently to a given threat than would individuals lacking in efficacy. Feeling confident about enacting safety behaviours and believing that enacting such behaviour will result in safer outcomes can motivate people to set realistic safety goals, persevere in the face of setbacks, and manage their social context in order to make them safer (Bandura, 1995; Real, 2008, p. 342).

The study identified a typology of attitudinal groups as follows:

- *responsive* - high perceived risk/high efficacy belief
- *avoidant* - high perceived risk/low efficacy belief
- *proactive* - low perceived risk/high efficacy belief, and

- *indifferent* - low perceived risk/low efficacy belief*.*

These groupings have been used to predict certain health behaviours (e.g. skin cancer) and Real's study set out certain hypotheses to test the theory. The findings indicated that safety efficacy beliefs may be the most important factor in determining response to high-risk situations.

A major finding of this investigation is that the relationship between risk perceptions and safety behaviours and information-seeking intentions was stronger among those with higher efficacy beliefs than among those with lower efficacy beliefs. Those with higher efficacy were more likely to engage in consistent safety behaviours and information-seeking intentions than those with lower safety efficacy. On the whole, workers with higher efficacy beliefs had higher levels of safety behaviour, behavioural intentions, and safety information-seeking intentions than workers with lower safety efficacy.

Application of theoretical models

Safe lifting study

Johnson and Hall (2005) tested a TPB model with safe lifting behaviour in a manufacturing firm. While concluding that the model has wide application to safety related behaviour, it notes that there may be differences across types of safety behaviour. The study found that attitudes were the least influential factor and that:

> Perceived behavioural control was the largest factor…This factor was nearly three times as important as subjective norms. That is, safe-lifting was more related to a person's feeling of control than what other people thought about the behaviour (subjective norms).

Agricultural study

A sample of agricultural producers was used by Petrea (2001) to test the applicability of TPB. The focus was on use of protective equipment and the beliefs and conditions under which safe behaviour was motivated and practised. A survey of producers identified a belief that dust masks while effective were uncomfortable to wear, were not always available and that spouses and health professionals were influential groups. The study used these initial findings to customise an intervention that would increase the use of protective equipment.

The research found that attitude and subjective norms were more powerful predictors of behaviour than perceived control. In addition, the intention to wear protective equipment correlated with self-reported behaviour.

Anaesthetists study

Beatty and Beatty (2004) tested the application of TPB by examining the propensity of anaesthetists to violate three selected guidelines. In addition to the TPB model this study also uses the approach of James Reason on human error by framing the research around the category of routine violations. These violations are tolerated by the organisational culture and are not intended to do harm.

The study found that anaesthetists were vulnerable to routine violations 'creeping into their practice'. These violations were not seen as a source of potential harm and were mainly influenced by personal norms (habit). The study found:

> Rather like pure human error, those performing such violations do so largely without realising that they are violating at all. The study suggests that in preventing these violations, intellectual

perceptions of risk and patient safety play a very significant part, but even more important are the emotion-driven perceptions of how anaesthetists would feel or appear to others if they violated. However, the strongest reason for violating, in that it is most strongly correlated with reported behavioural intention for all three scenarios, is habit. This emphasises the routine nature of these violations, which in turn suggests that the most important protection, as with human error, is the awareness of individuals of the possibility of violation in their own practice. Organisational cultures that allow individuals to admit to themselves and their peers this possibility, and systems that encourage self-checking, including technological systems, are those that are most likely to help in the elimination of routine violations.

Summary

Based on the range of models presented, it can be concluded that a large number of factors such as response efficacy, workers' confidence in the ability to protect themselves, threat related beliefs or risk perception and the belief and behaviour norms in the work environment influence safety behaviour. However, the findings of the influence of such factors on self-protective behaviour have not been consistent. Some studies found peer influence important, some found perceived control the key issue and others found prior hazard knowledge to be important.

Each of the models reviewed above also has strengths and weaknesses. For example, while the HBMs broad constructs are easy to interpret, it does not contain environmental and social influences and has been criticised for its poor predictive utility (Armitage & Conner, 2000; Lunt et al., 2005). The TPB has been extensively used and accommodates environmental influences that the HBM lacks. However, it has been reported to better predict self-reported behaviours, rather than the actual, objective behaviour (Conner & Abraham, 2001) and is generally regarded as a model measuring the intention to act, rather than the actual behaviour itself (Lunt et al., 2005). Real's RPA framework, while building on the concepts of the HBM and TPB, is relatively new and has not been tested widely. De Joy's stage or sequential model of workplace self-protective behaviour contains both individual and environmental factors and incorporates the stages that a worker goes through from hazard appraisal to consistent safe behaviour. However, the staged design of this model makes it difficult to test and may explain why there has been little empirical testing or validation to date.

This report will not test any of the theoretical models discussed above. This is because the asbestos study's aims were much broader and the study was not specifically designed to test specific models due to time and resource constraints. This brief literature review on theoretical models in this report is intended to provide a background on potential factors that could impact on safe behaviour and to inform statistical analysis.

Method

This report examines data from a study of asbestos exposure and compliance in construction and maintenance workers. The study involved several stages of data collection: focus groups, computer assisted telephone interviews (CATI), face to face interviews and atmospheric sampling of airborne asbestos fibres during a selected number of construction and maintenance tasks. The current report only examines data from the CATI survey.

The CATI survey contained 28 questions on demographic and employment characteristics, training on asbestos, and questions on the tradesperson's knowledge about the risk of asbestos, their perception of the risk of exposure to asbestos, safety procedures followed when working with asbestos and barriers and enablers to following safety practices. The survey did not use any established scales. Questions in the survey were based on issues raised in focus groups (a component of the larger asbestos study which is not included in this report). A copy of the CATI survey is included in Appendix 1.

The asbestos study targeted four trades: painters, plumbers, electricians and carpenters. At least 60 interviews were conducted within each trade and all the CATI surveys were conducted by Sweeney Research, a market research company. The tradespeople for telephone interviews were randomly selected by Sweeney Research from source lists for each of the trades. Screening questions limited final participants to those who worked, at least part of the time, with ACMs.

The cost of CATI interviewing for random samples is substantially higher compared to quota sampling, especially for the current study which focused on a select group of workers whose total population only made up 2.5% of the total Australian working population (Australian Bureau of Statistics, 2010). In addition, no sampling frame that would be representative of the four trades was available. Therefore, quota sampling was used to ensure that adequate numbers of tradespersons from targeted occupations were interviewed to enable comparison between different trades.

It is recommended that this report is read in conjunction with the earlier descriptive report of the same study which is available at: http://www.safeworkaustralia.gov.au/swa/AboutUs/Publications/AsbestosExposureandComplianceStudyofConstructionandMaintenanceWorkers.htm.

Analysis

Australian demographic data from 2006 Census Population and Housing on tradespersons were obtained using CDATA Online Version 2, via the Australian Bureau of Statistics website. Population estimates of the four target trades by sex and age were obtained using custom tables.

For bivariate analyses, cross-tab analyses were conducted to determine differences in safety precaution taken by categorical variables. Chi-square tests for independence were used to determine whether or not the differences were statistically significant. If the differences were statistically significant, Phi or Cramer's V was calculated to determine the effect size.

Binomial logistic regression was carried out to determine which factors predict the understanding of the risk of asbestos or workers following safe work practices. Logistic regressions enable the prediction of a discrete outcome (such as whether a worker followed safety practices) from a set of variables such as age and trade. The goodness of fit of the logistic regression model is assessed using the goodness-of-fit Chi-square statistic (χ^2) and effect size of the model is estimated using a pseudo R^2 statistic, the Nagalkerke R^2. The contribution of an individual variable to the model is assessed using the Wald test, which compares models with and without each variable. The odds ratios of each predictor variable can be interpreted as an effect size. Odds ratios greater than one mean there is an increase in the odds of outcome relative to the factor reference group, and whilst controlling for the effects of other factors in the model. The closer the odds ratio is to one, the smaller the effect. Odds ratios between zero and one indicate a decrease in the odds of an outcome relative to the factor reference group.

It should be noted that logistic regression is an inferential statistic and should be carried out on probability samples only. As discussed previously, this study used quota sampling, a form of non-probability sampling. For this reason, the outcomes of logistic regression analyses should be interpreted with caution and should not be generalised to the wider working population of the four selected trades for this study. Further discussion on quota samples is included in the *Limitations* section of the report.

To keep the report clear and succinct, the results section of this report does not contain detailed statistical output for each analysis included in the report. Detailed statistical tables containing model output are provided in Appendix 2 for the interested reader.

All statistical analysis was undertaken in SPSS 17.0.

Results

This results section is divided into three parts:

- a description of the survey sample
- variables used for analysis in this report, and
- results for research objectives two and three of this report (objective two: to examine which factors influenced the understanding of the risk of asbestos and objective three: to examine which factors influenced workers' compliance with safety practices).

Sample for the CATI survey

A total of 262 workers from four trades (electricians, plumbers, carpenters and painters) were surveyed using the CATI method. There were 1692 calls made to landline numbers and 847 calls to mobile numbers to obtain 262 completed interviews. Based on this information, the response rate was 10.3%. However, this estimate is a conservative estimate as some of the calls made may be to disconnected numbers, fax numbers or busy/engaged phone numbers.

The majority (98%) of participants were male. Only six females were interviewed. Most workers were aged 45 years or older and almost all participants (97%) had worked in the current occupation for 10 years or more. The majority of participants (92%) were self-employed. Although most participants were self-employed, many of them worked with others and only one in four respondents reported working alone. The sample distribution of predominantly older, more experienced, and self-employed workers have also been observed in previous studies of asbestos exposure, awareness and compliance (Bard & Burdett, 2007; O'Regan et al., 2007).

Australia data on sex and age by occupation is available from the 2006 Census of Population and Ageing dataset for comparison with the Asbestos Study survey sample. This comparison is at best approximate because the asbestos CATI survey did not use the same occupation questions as in the 2006 census. The comparison showed that for the four trades included in the survey, the proportions of males and females interviewed were similar to the proportions observed in the 2006 Census (see Table 1). However, in the 2006 Census, 18-44 years age group represented 66% of those working in these four trades. In contrast, only 30% of those surveyed in this study were 18-44 years old. The over-representation of older workers in this study may be a reflection that older workers may be more aware of asbestos or more concerned with occupational health and safety issues than younger workers. Younger adults are less likely to live in households without a landline phone service and are more likely to be a primarily mobile user (Currivan, Roe, & Stockdale, 2008). The under-representation of the younger age groups in telephone surveys have been reported in many studies (Bambrick, Fear, & Denniss, 2009; Kempf & Remington, 2007; The Pew Research Center for The People and the Press, 2008).

Due to quota sampling, the sample distribution by trade was expected to be different from the population distribution as per the 2006 census data. As expected, electricians and carpenters were under-represented in the CATI sample and painters and plumbers are over-represented.

Table 1. Comparison of Asbestos CATI survey sample with 2006 Census data for the four targeted occupations

Characteristics	2006 Census Population and Ageing	Asbestos CATI Survey	Statistically different?*
Males	98.5 %	97.7 %	No
Females	1.5 %	2.3 %	
18-44 years	68.2 %	30.2 %	Yes
45 and older	31.8 %	69.8 %	
Electricians	33.4 %	25.6 %	Yes
Plumbers	20.7 %	26.0 %	
Painters	14.5 %	25.6 %	
Carpenters	31.4 %	22.9 %	

* based on Chi-square goodness of fit test, α = 0.05

Variables used in this report

The following paragraphs describe the independent and dependent variables used in the current report. All independent variables used in this report are single item measures, not theoretically based multi-item constructs. Some variables are dichotomised due to small cell sizes of some response categories.

Understanding of the risk of asbestos

Workers' understanding of the risk of asbestos was assessed by asking respondents the question, 'which of the following describes your general understanding of the risk of asbestos?' There were three response categories: 'I know a lot about asbestos', 'I know a little about asbestos' and 'I don't know much about asbestos'. Only five of 262 workers surveyed said they don't know much about the risk of asbestos. Due to the small number of workers providing this response, this category was combined with the response category, 'I know a little about asbestos'. This means that the final variable has two possible responses: 'I know a lot about asbestos' and 'I know a little about asbestos'.

This variable was then used as a dependent variable for analysis on which factors influenced workers' understanding of the risk of asbestos.

Asbestos specific OHS training

This was assessed by asking respondents whether they have completed any specific OHS training related to safe working with asbestos. Respondents could either answer 'Yes' or 'No' to this question.

This variable was included in a logistic regression model to see if it predicted a better understanding of the risk of asbestos.

Source of information on the risk of asbestos

This was obtained by asking respondents where they learnt about the risk of asbestos. There were seven pre-coded response categories. Respondents could also provide responses other than the seven pre-coded response categories and they could also nominate more than one information source. Those who nominated more than one information source were asked a follow up question about which of the information sources was most useful to them. A new variable called sources was computed from these two variables and was included in the logistic regression analysis to determine if sources of information predicted a better understanding of the risk of asbestos. For those who nominated more than one information source, responses to the question on the most useful information source was taken as the source of information. For respondents who only provided one information source, this was taken as their source of information on the risk of asbestos.

Some pre-coded response categories such as ‘WorkSafe / WorkCover advertising’ were excluded from analysis due to small sample size. The response categories ‘from my boss’ and from co-workers; were combined into a single category, ‘from co-workers or boss’, to increase cell sizes.

Variables relating to risk perception

Information on risk perception of asbestos was available from three questions measuring different aspects of risk perception. Although these are not based on any validated or known questions, they are similar to questions in the literature on risk perception (e.g. Stave, Pousette, & Torner, 2006). These questions were not combined and used as a construct, measuring the same latent variable. Rather, these three risk perception related variables were analysed individually.

The first question asked ‘when working with materials containing asbestos, how harmful do you think this could be to your health?’ Respondents were asked to select a ranking from a 1 to 5 scale, where 1 is ‘not very harmful’ and 5 is ‘extremely harmful/possibly fatal’. Due to small cell sizes for some response categories, this variable was dichotomised for analysis in this report (not harmful: response categories 1-3, harmful: response categories 4-5).

The second question asked workers to rate the seriousness of the risk of working with materials containing asbestos. This was again on a 1 to 5 scale where 1 is ‘no or negligible risk’ and 5 is ‘extremely high risk’. As with the health risk rating, due to small cell sizes for some response categories, this variable was also dichotomised (low risk: rating of 1-3, high risk: rating of 4-5).

Respondents were also asked to rate how likely they think it is that they will be exposed to airborne asbestos fibres. The rating scale was on a scale of 1 to 5 where 1 is ‘very unlikely’ and 5 is ‘very likely’. The majority of the respondents provided a rating of ‘very unlikely’ (1). Due to small cell sizes for other response categories, this variable was also dichotomised for further analysis: (‘very unlikely’: rating 1 and ‘unlikely to very likely’: ratings of 2-5).

These three risk perception variables were examined using a logistic regression analysis to determine if they were predictors of workers’ compliance with safety practices.

Demographic and employment factors

Of the limited range of demographic and employment factors collected in the telephone survey, age, trade, and working alone were selected for use in this report (Table 2). Age was recoded as a dichotomous variable due to the predominance of workers 45 years and older in the study.

Other factors such as years in current trade, employment status and gender were not included as independent variables because the overwhelming majority of participants (>90%) were males, had worked for over 10 years in their current trade and were self-employed. This meant that there were not enough cell counts for females, workers with less trade experience and workers who work for an employer to be able to compare differences with other workers.

Table 2. Summary of demographic and employment variables

Variables	Description	N (%)
Age	Dichotomous variable: 18 to 44 years and 45 years and older	18-44 years: 79 (30.2)
		45 and older: 183 (69.8)
Trade	Electricians, carpenters, painters and plumbers	Electricians: 67 (25.6)
		Carpenters: 60 (22.9)
		Painters: 67 (25.6)
		Plumbers: 68 (26.0)
Worked alone or with others?	Dichotomous variable: worked alone or worked with others	Worked alone: 69 (26.3)
		With others: 193 (73.7)

Safety practices variables

When working with ACMs, different safety practices are required depending on the stage of work (before, during and after work with ACMs). For instance, before commencing work with ACMs, workers are required to check where ACMs may be present or cordon off the area to avoid contamination. During work with ACMs, practices such as wetting down and avoiding breaking down ACMs can prevent exposure to airborne asbestos fibres. The use of appropriate tools, such as hand tools and wearing appropriate personal protective equipment, are also examples of safe work practices during work with ACMs. After work with ACMs has been completed, there are also important safety practices to follow, such as decontaminating the work site, and appropriate disposal of ACMs and any materials, such as personal protective equipment (PPE), that may be contaminated with asbestos.

In this study, participants were asked specific questions on the precautions taken before and after work with ACMs, the use of PPE during work with ACMs and the use of appropriate tools when working with ACMs (Q23b, d, f, h and j of the telephone survey) to determine safety practices at various stages of work with ACMs. Based on these five questions, five dependent variables, relating to safety practices at various stages of work with ACMs were created. If a respondent reported one or more of the safety actions for each safety precaution question, they were coded as having followed safety precautions for that particular question. For example, for Q23b, if a respondent stated that they followed either of the three prompted responses (*cordon off area*, *get instructions*, *check for presence of asbestos*), they were considered to have followed safety precautions before starting work with ACMs.

A final and sixth variable was created based on responses to the five prompted safety precaution questions. This variable was 'whether precautions were followed at all stages of working with ACMs'. To be coded as *Yes* to this dichotomous variable, a respondent would have had to have been coded *yes* to all five of the first five safety practices variables. A summary of all safety practices variables is presented in Table 3.

Table 3. A summary of safety practices variables

Safety practices variables			Description	N (%)
Variable name	Variable label	Response category		
Before work	Precautions taken before work with ACMs	Yes/No	Based on Q23b. Coded Yes if the respondent said yes to either of: check for presence of asbestos, get instructions, cordon off the area	Yes: 208 (79.4) No: 54 (20.6)
Proper tools	Proper tools were used for work with ACMs	Yes/No	Based on Q23f. Coded yes if the respondent said yes to using either only low speed tools, or hand tools	Yes: 220 (84.0) No: 42 (16.0)
PPE combined	PPE was used during work with ACMs	Yes/No	Based on Q23h. Coded yes if respondents said they either use dust masks or disposable overalls	Yes: 237 (90.5) No: 25 (9.5)
During work	Precautions taken during work with ACMs	Yes/No	Based on Q23d. Coded yes if respondents said they either wet down materials or avoid breaking materials	Yes: 220 (84.0) No: 42 (16.0)
After work	Precautions taken after work with ACMs	Yes/No	Based on Q23j. Codes yes if respondents said they either clean up the site, did washing up/ decontamination or dispose of asbestos in sealed, labelled bags	Yes: 181 (69.1) No: 81 (30.9)
All precautions	Precautions followed at all stages of work with ACMs	Yes/No	Based on the first five variables listed in this table. Coded yes if respondent was coded yes for all five of the previous safety precautions variables listed in this table	Yes: 133 (50.8) No: 129 (49.2)

While undertaking preliminary analysis for this report, other variables such as estimated frequency of working at sites containing asbestos, the rating of the ability to protect oneself from the risk of asbestos and self-reported ability to identify ACMs were examined as potential independent variables. As these variables added very little to the model and did not significantly improve the model, they were not further explored or included in the current report.

Which factors influence workers’ understanding of the risk of asbestos?

A logistic regression was run to determine what factors predict workers’ understanding of the risk of asbestos. Initial analysis showed that age and working alone were not significant predictors of understanding of the risk of asbestos. Therefore, they were excluded from the final model.

The final model presented here (Table 4) included whether the worker had asbestos specific OHS training, sources of information on asbestos, and trade. This model was statistically significant and explained approximately 20% of the variance in the understanding of the risk of asbestos. A summary of the results is presented in

Table 4 but only statistically significant differences in odds ratios are presented. For detailed statistical information on these models, please see Appendix 2.

When controlling for all the other factors in the model, workers who had asbestos specific OHS training had significantly higher odds of having a greater understanding of the risk of asbestos (a factor of 3.117), compared to those without OHS training.

Likewise, workers whose main information source on asbestos was trade training or information from trade associations or trade unions had significantly higher odds (by a factor of 3.258) of having a greater understanding of the risk of asbestos compared to those whose main information source was newspapers or TV (the reference group) when controlling for all other factors in the model.

Overall, trade was not a significant factor in predicting greater understanding of the knowledge of asbestos. However, compared to painters (the reference group), carpenters had significantly higher odds of having a greater understanding of the risk of asbestos (a factor of 2.579).

Table 4. Summary of results: Understanding of the risk of asbestos

Model factors	Understanding of the risk of asbestos	
The reference group in the model is the odds of not knowing a lot about the risk of asbestos	The likelihood of knowing a lot about the risk of asbestos was...	...by a factor of x (odds ratio) relative to the reference group, while controlling for the effects of the other factors
Trade		
Electrician		
Plumbers		
Carpenter	Increased	2.579
Painters	Reference group	
Had asbestos specific OHS training		
Yes	increased	3.117
No	Reference group	
Sources of information on asbestos		
Trade training	increased	2.997
Information from trade associations or trade unions	increased	3.258
From OHS training		
From co-workers or boss		
Personal experience/ knowledge gained on site or job		
Newspaper or TV	Reference group	

Which factors influenced workers' compliance with safety practices when working with ACMs?

Logistic regression models were again run to include all demographic, employment factors and risk perception and understanding of the risk of asbestos variables in a single model. Age, working alone, understanding of the risk of asbestos, and health risk rating of asbestos were found to be non-significant. Therefore, a final and reduced model only contained the trade and the likelihood of exposure variables. This final reduced model describes the odds of taking safety precautions as opposed to not taking safety precautions. Odds ratios greater than one for factor levels indicate that workers with that characteristic have increased odds of taking safety precautions relative to the factor reference group. The regression models for safety practices before and during work, PPE use and use of proper tools were not significant. A summary of the two significant models is presented in Table 5.

The model for precautions taken after completion of work with ACMs explained 14% of the variance. Compared to those who thought exposure was less likely, workers who thought their exposure was more likely had significantly higher odds (increased by a factor of 2.498) of following safety practices after work. Significant differences were also observed by trade. Compared to painters, carpenters had significantly higher odds (increased by a factor of 4.401) of following safety practices after work with ACMs. Electricians also had significantly higher odds (increased by a factor of 2.245) of following safety practices after work with ACMs compared to painters.

When looking at the model for following safe work practices for all stages of work with ACMs, significant differences in odds were again observed between groups of workers in terms of their perception of their likelihood of exposure to ACMs. In terms of trade, electricians, plumbers and carpenters all had significantly higher odds of following safety practices at all stages of work with ACMs compared to painters. For carpenters, the odds of following safety precautions at all stages of work with ACMs were significantly increased by a factor of 7.658, for electricians, the odds were increased by a factor of 3.190 and for plumbers, the odds were significantly increased by a factor of 2.177. This model explained 18% of the variance of following safe work practices at all stages of work.

Table 5. Summary of results: Combined variables on safety practices

Model factors	Precautions taken after work		Precautions taken at all stages of work with ACMs	
The reference group in the model is the odds of not following safety precautions	The likelihood of taking precautions after work was…	By a factor of X (odds ratio) relative to the reference group, while controlling for the effects of the other factors	The likelihood of taking safety precautions at all stages of work with ACMs was…	By a factor of X (odds ratio) relative to the reference group, while controlling for the effects of the other factors
Likelihood of exposure				
More likely	increased	2.493	increased	1.876
Less likely	Reference group			
TRADE				
Electrician	increased	2.245	increased	3.190
Plumber			Increased	2.177
Carpenter	Increased	4.401	Increased	7.658
Painter	Reference group			

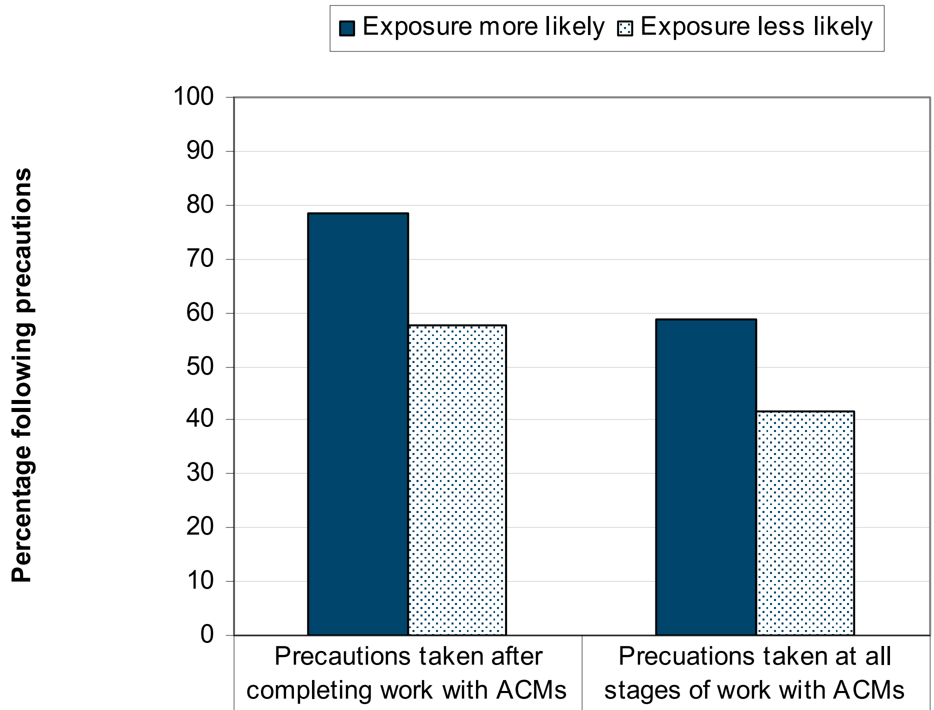
The effect of likelihood of exposure and trade on safe work practices

Descriptive data is provided in this section to provide a simple picture of the effect of likelihood of exposure and trade on safe working practices, the two variables that predicted safe work practices after work with ACMs and at all stages of work with ACMs.

Likelihood of exposure

When compared by workers' rating of their likelihood of exposure to asbestos, no significant differences were observed for PPE use, use of proper tools and precautions taken before and during work.

However, significant differences were observed for precautions taken after work and the combined safety practice variable, 'precaution taken at all stages of work with ACMs' (Figure 5). A greater proportion of workers who thought exposure was more likely reported following safety practices after work compared to workers who thought exposure was less likely (Phi= -0.171, p=0.006). A similar finding was observed for safety precautions taken at all stages of work with ACMs (Phi=-0.223, p<0.001).



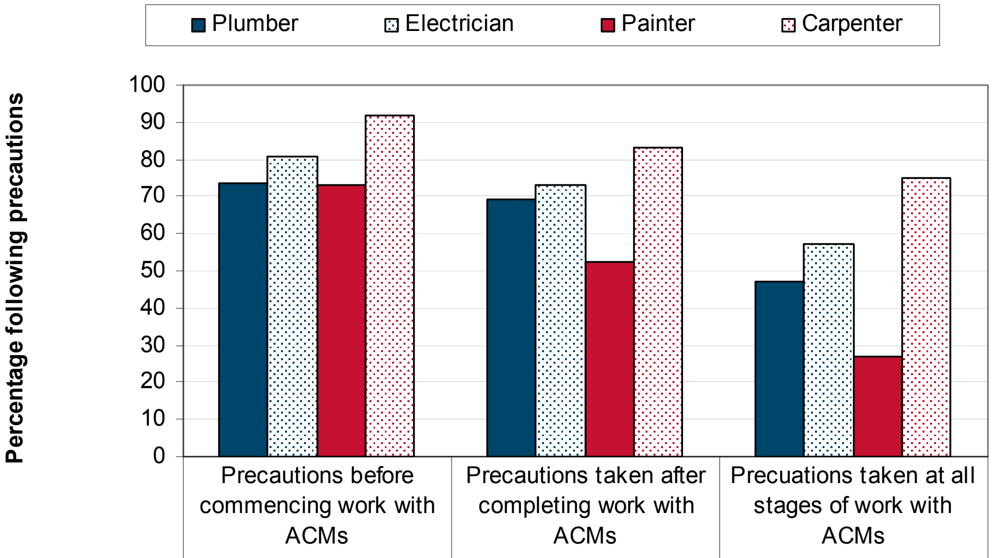
	Precautions taken after completing work with ACMs	Precuations taken at all stages of work with ACMs
Exposure more likely	78.3	58.7
Exposure less likely	57.6	41.5

Figure 5. Safety precautions taken by perception of likelihood of exposure to asbestos

Trade

When compared by trade, some differences in the following of safety practices of various stages of working with ACMs were observed. There were significant differences by trade for three of the five safety practice variables: precautions taken before work, precautions taken after work and precautions taken at all stages of work with ACMs (Figure 6). A greater percentage of carpenters followed safety precautions before, after and for all stages of work with ACMs than workers in other trades. For all three variables, a lower proportion of painters reported following safety precautions compared to workers in other trades. However, the effect size of the association between trade and following precautions before commencing work with ACMs was small at 0.181 (Cramer's V, $p = 0.035$). The effect size was slightly larger for the association between trade and following precautions after commencing work with ACMs (Cramer's V= 0.240, $p = .002$) and it was strongest for trade and following precautions during all stages of work with ACMs (Cramer's V= 0.334, $p < .001$).

No significant differences were observed by trade for the use of proper tools when working with ACMs or the use of PPE during work with ACMs.



	Precautions before commencing work with ACMs	Precautions taken after completing work with ACMs	Precuations taken at all stages of work with ACMs
Plumber	74	69	47
Electrician	81	73	57
Painter	73	52	27
Carpenter	92	83	75

Figure 6. Safety precautions taken by trade

No significant differences were observed between trades for use of appropriate tools when working with ACMs (hand tools or low powered tools) or the use of PPE or precautions taken during work with ACMs.

Summary of results

Factors influencing understanding of the risk of asbestos

Age and working alone did not predict the understanding of the risk of asbestos in this study. Of the factors tested only trade, asbestos specific OHS training and source of information on asbestos influenced workers' understanding of the risk of asbestos.

Carpenters were more likely to report that they understand a lot about the risk of asbestos compared to painters.

Workers who had asbestos specific OHS training were three times more likely to have a better understanding of the risk of asbestos compared to those who had not had asbestos specific OHS training.

Information obtained from trade training or trade associations/unions also predicted a greater understanding of the risk of asbestos compared to information obtained from newspapers / television.

Factors influencing safety practices when working with ACMs

Only two significant predictors were found for following safety practices in the current study:

- trade, and.

- likelihood of exposure to asbestos.

With regards to safety practices *after completion of work* with ACMs (proper disposal of asbestos, site decontamination):

- workers' perception of likelihood of exposure was a significant predictor of safety practices, along with trade.

Workers' perception of likelihood of exposure and trade were also significant predictors of following safety practices at all stages of work with ACMs:

- Those who perceived exposure as more likely had 1.8 times the odds of following safety practices *at all stages of work* with ACMs.

- Compared to painters, all other occupations examined (electricians, carpenters and plumbers) had significantly higher odds of following safety practices at all stages of work with ACMs.

Discussion

This study found that having asbestos specific OHS training and source of information on asbestos were predictors of workers' understanding of the risk of asbestos. To date, there are a limited number of studies examining the impact of OHS training on knowledge. However, a recent systematic review on the effectiveness of OHS training found that the effect of training on knowledge was positive and usually showed large effect sizes compared to workers with no training (Robson et al., 2010). This suggests that providing workers with specific training on safe working with asbestos does lead to workers having a better understanding of the risk of asbestos.

Surprisingly, although asbestos specific training predicted better knowledge, OHS training as an information source was not significantly different from newspapers or television in terms of increasing knowledge. This may be a reflection of the broad range of interpretations on the word 'training'. It is not known whether respondents were thinking of the same OHS training when answering the question on asbestos specific training and the question on information sources. It is also worth noting that asbestos specific OHS training does not directly predict following safety practices (results not shown), rather, it is only associated with the level of understanding of the risk of asbestos.

None of the models predicting PPE use, use of appropriate tools when working with ACMs and safety practices during work with ACMs were significant. It is unclear whether this was due to the skewness of these dependent variables (which seem unlikely) or whether factors other than those tested in this report, such as the belief in effectiveness of PPE measures, whether other workers wear PPE and appropriate tools or self-efficacy, influenced a person's decision to use PPE or appropriate tools in the current study.

Three single item measures, all measuring different aspects of risk perception, were analysed to see if they predict safe work practices. Perceived risk has long been seen as a major predictor of self-protective health behaviour (Janz & Becker, 1984). Models such as the HBM and the RPA framework had incorporated aspects of risk perception. Although risk perception has been hypothesised to predict health behaviour, evidence has been mixed with only some studies demonstrating this link (Rimal & Real, 2003). In the current study, risk perception was not considered in combination with other factors such as self-efficacy and perceived barriers.

Among the three different risk perception variables tested, workers' perception of their likelihood of exposure to asbestos predicted safe work practices. The large proportion of workers in the current study indicating that exposure was 'very unlikely' suggests that workers may not be taking the necessary safety precautions because exposure was very unlikely even though the health risks were considered high. They may be more concerned with immediate and visible hazards when working and may be less willing to spend time and effort in safety practices of less visible and long latent hazards such as asbestos. This is of concern as workers' perception of potential exposure may largely underestimate the actual likelihood of exposure. The UK plumbers study found that workers were aware of only about a third of their contact with asbestos (Bard & Burdett, 2007). Also of note is that although the majority of workers thought exposure was 'very unlikely', the CATI sample for this study was restricted to those tradespersons who reported they work with or near asbestos containing materials.

Risk perception, in terms of general risk rating of asbestos and health risk of asbestos, did not influence safety practices in this study. A similar finding of no direct link between such types of risk perception and safety practices has been reported in other studies (Eklof & Torner, 2002; Stave et al., 2006). In contrast, other studies have reported the link between risk perception and safety behaviours such as PPE use (e.g. Arezes & Miguel, 2008). Workers in the current study were generally aware of the negative consequences of exposure to asbestos fibres, yet only half of them reported following safety practices at **ALL** stages of work with ACMs. So while risk perception may still be an important factor in safe practices, its impact may be mediated by other factors, such as the self-reported ability to identify ACMs or knowing how to reduce exposure or workers' beliefs in the effectiveness of safety practices. On the other hand, as stated in the previous paragraph, workers' perception of asbestos as high risk may be balanced out by their perception that exposure is unlikely. Thus, workers may consider safety precautions unnecessary.

To our knowledge, the Asbestos Exposure and Compliance Study is the first study in Australia comparing safety practices relating to asbestos among construction and maintenance tradespersons. It provides limited but current and useful information on safe work practices and some of the factors that could influence compliance with safety practices. However, if the relationships between different demographic, employment, perceptual, attitudinal factors and safety behaviour are to be fully explored or if population estimates are to be made, future research with a representative worker sample, using a validated survey instrument, is required.

Limitations

In this study, workers' self-reported safety practices were used as dependent variables reflecting safety practices. Self-report measures may be prone to bias, and may not accurately reflect actual safety practices at workplaces. For example, it has been reported that people widely endorse items such as "I always follow safety procedures" due to a response bias of social desirability (Glendon, Clarke, & Mckenna, 2006). This social desirability bias is also reported to be more common in interviewer administered surveys (such as CATI) compared to self-administered surveys (Kreuter, Presser, & Tourangeau, 2008). In this study, workers were asked whether they follow specific safety practices such as wetting down materials, cordoning off work areas and this approach may also suffer from the same social desirability bias. Workplace observations undertaken in the current study also suggest that actual compliance with safety practices is lower than that indicated by self-report. However, these observations were made using qualitative research methods (by interviewing workers, observing work practices and making a subjective judgement). Therefore, a numerical estimate of the extent of over-reporting could not be made and the actual magnitude of over-reporting is not known.

Single item measures were used to measure potential influential factors such as risk perception and knowledge in this study. Due to time and resource constraints, no validation was carried out to determine if single item measures used were acceptable in place of some theoretically constructed multi-item measures or whether they were measuring what they were designed to measure. This may be one of the reasons why limited association was found between these variables and safety practices. In addition, it is difficult to accurately assess a person's knowledge on a topic using a single, self-report item with limited response categories. For example, there may be wide variations in the actual level of knowledge among study respondents who stated they knew a lot of about asbestos.

The study design was correlational in nature, and therefore, limited in its ability to uncover and identify the complex relationships between different factors that may positively or negatively influence safety behaviour. This study also used quota-sampling where quotas of at least 60 workers from each trade were set to ensure that there were enough numbers within each trade for comparison. Quota sampling is a method of non-probability sampling (Neuman, 2007). The use of non-probability sampling in this study means that actual standard errors could not be estimated. Many researchers have argued against the use of inferential statistics on non-probability samples, such as the quota sample used in this study (e.g. McNabb, 2004; Neuman, 2007). However, it has been noted that in some circumstances (such as lack of a sampling frame, limited time and resources as was the case in this study), non-probability sampling is the only method of sampling available or feasible (Arber, 2001; Babbie, 2004). Despite the limitations of non-probability samples, such samples (e.g. quota samples) are commonly used in healthcare research and some types of social research due to the difficulty discussed above in obtaining random samples (Babbie, 2002; Panacek & Thompson, 2007).

In the light of these limitations, the results of this study should be considered preliminary findings, subject to further research and testing. The findings of this study should not be generalised to the whole population of tradespersons as the representativeness of the study sample is unknown and the study did not use probability sampling methods.

Policy implications and recommendations

The findings of this report, in conjunction with the initial descriptive research report, provide useful insight into attitudes, awareness, knowledge and behaviour of construction and maintenance workers towards working with asbestos containing materials. Overall, the Asbestos Study found that workers had a basic general knowledge regarding the risk of asbestos. However, many felt that the risk of exposure to asbestos was unlikely. Many workers also lacked detailed knowledge on identifying and safe working with ACMs. Shortfalls in safety precautions when working with ACMs, as well as appropriate disposal of asbestos waste, were identified. Differences in trades in terms of risk perception and safety practices were also observed. A number of suggestions were put forward in the initial report and these include increasing skills for identifying ACMs, development of more practical options for asbestos disposal, inclusion of trade specific asbestos training in future trade apprentice training and incorporating practical examples in future codes and guidance so that the information may be more directly applied to workplaces.

Specifically, this report highlighted some factors such as trade and workers' perception of likelihood of exposure to asbestos that may influence worker safety behaviour when working with asbestos containing materials. However, as it was not feasible to include the full range of measures generally used to predict worker safety behaviour in the current study, the information it provides is somewhat limited. In addition, generalisation of the study's findings to the overall population of tradespersons could not be made due to its limited sample size and the use of quota sampling. While the findings of this report draw attention to some issues of relevance to worker safety and health policy on asbestos, such as the positive influence on OHS training on workers' level of knowledge, policy recommendations could not be made on the basis of these findings alone.

Further research based on one of the models reviewed in this report, using a well validated questionnaire, will provide a more complete picture of what influences workers to follow safety practices when working with ACMs. However, it should be noted that while some models may be better in some aspects than others, at present, there is no model that stands out as the best model for use in future research on asbestos. In terms of completeness, De Joy's model appears to be most complete and incorporates other well known models; however, there may be significant difficulties in trying to relate specific influential factors to different stages of self-protective behaviour.

Further research is also needed to examine which factors influenced carpenters to follow safe work practices compared to other trades. This may reveal procedures and training that could be adopted by other trades to encourage better compliance with safety practices relating to ACMs.

It is essential that any further research is conducted using a probability sampling method with a large enough sample size to enable the use of inferential statistics and to ensure the sample is representative. This is needed if data from such studies are to inform national policy on worker health and safety.

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Appendix 1: Telephone survey questionnaire

Safe Work Australia – Workplace Asbestos Study

INTRODUCTION

The information and opinions you provide in this survey will be strictly confidential and used only for research purposes. Your name and employer details cannot be linked to this survey

SECTION 1: SCREENER

SQ1	LOCATION **RECORD.**	NSW		1
		Queensland		2
		South Australia		3
		Tasmania		4
		Victoria		5
		ACT		6
		Other	**Terminate**	7

SQ2	Which of the following best describes your current trade or occupation? **SINGLE RESPONSE**	Plumber or gasfitter		1
		Electrician or telecommunications installer		2
		Painter		3
		Carpenter, builder, someone who carries out renovations		4

SQ3	Do you undertake at least some of this work on buildings that are more than 20 years old?	Yes	**Continue**	1
		No	**Terminate**	2

SQ4	In this work, do you work with or near any of the following materials? **READ OUT LIST** **MULTIPLE RESPONSE OK.** **TERMINATE IF NONE (CODE 12).**	Asbestos-cement sheet walls, eaves, roofing materials		01
		Asbestos cement flues or pipes		02
		Asbestos fire-proofing materials		03
		Asbestos insulation or lagging around pipes, ducts and hot water services		04
		Asbestos seals for ovens and boilers		05
		Asbestos fibre gaskets		06
		Backing for electrical switchboards, millboard		07
		Asbestos cement telecommunications pits		08
		Vinyl tiles and their underlay		09
		Fire doors		10
		Buried asbestos-cement products		11
		None	**Terminate**	12

SECTION 1: THE PERSON AND THEIR WORK

Q1	GENDER **RECORD**	Male	1
		Female	2

Q2	What is your age? **DO NOT READ OUT.**	18 to 24	1
		25 to 34	2
		35 to 44	3
		45 to 54	4
		Over 55	5

Q3	How long have you been working in your current trade/occupation? **SINGLE RESPONSE.** **DO NOT READ OUT.**	Less than 3 months	1
		3 months to 1 year	2
		1 year to 5 years	3
		5 to 10 years	4
		Over 10 years	5

Q4	In your current job are you… **READ OUT** **SINGLE RESPONSE.**	Working for an employer	1
		Working through a labour hire company	2
		Self employed and employing others	3
		Self-employed working by yourself	4

Ask Q5 and 6 if working for an employer or labour hire agency (codes 1 or 2 at Q4); Otherwise go to Q7

Q5	Are you employed as… **READ OUT** **SINGLE RESPONSE.**	Permanent or Ongoing	1
		Fixed term contract	2
		Temporary or casual	3

Q6	What is your best guess as to how many people the company you work for employs? **DO NOT READ OUT** **SINGLE RESPONSE.**	Less than 5	1
		5 to 19	2
		20 to 199	3
		More than 200	4
		Don't know	5

ASK ALL

Q7	In your job, do you usually work alone or with others?	Alone	1
		With others	2

Q8	Have you completed any specific OHS training related to safe working with asbestos?	Yes	1
		No	2

SECTION 3: KNOWLEDGE ABOUT THE RISK OF ASBESTOS

Q9	Which of the following best describes your general understanding of the risk of asbestos? **SINGLE RESPONSE** **READ OUT.**	I know a lot about asbestos	1
		I know a little about asbestos	2
		I don't know much about asbestos	3

Q10	When, or under what circumstances, can asbestos containing materials be harmful to people? **RECORD VERBATIM. PROBE FULLY.**

Q11	Where have you learned about the risks of asbestos? **MULTIPLE RESPONSE OK** **DO NOT READ OUT.**	Trade training	1
		Newspapers or television news	2
		WorkSafe/WorkCover advertising	3
		Information from trade associations or unions	4
		From OHS training	5
		From my boss	6
		From co-workers	7
		Other **SPECIFY**	8

Ask Q12 if multiple responses at Q11; otherwise go to Q13

Q12	Which of these information sources was most useful to you? **SINGLE RESPONSE FROM CODES SELECTED AT Q11.**	Trade training	1
		Newspapers or television news	2
		WorkSafe/WorkCover advertising	3
		Information from trade associations or unions	4
		From OHS training	5
		From my boss	6
		From co-workers	7
		Other **SPECIFY**	8

ASK ALL

Q13	Why was this information source useful to you? **PROBE FULLY.**

SECTION 4: PERCEPTION OF THE RISK OF EXPOSURE

ASK ALL

Q14	Thinking about all you know about asbestos, what is the main message that you can recall about asbestos and its risk to workers? **PROBE FULLY.**

Q15	In your current job, how likely do you think it is that you will be exposed to airborne asbestos fibres? Select a ranking from I to 5, where 1 is 'Very unlikely' and 5 is 'Very likely'. **SINGLE RESPONSE.**	Very unlikely	1
			2
			3
			4
		Very likely	5
		Don't know	6

Q16	If you are working with materials that contain asbestos, how harmful do you think this could be to your health? Select a ranking from I to 5, where 1 is 'Not very harmful' and 5 is 'Extremely harmful / possibly fatal'. **READ OUT. SINGLE RESPONSE.**	Not very harmful 1 2 3 4 Extremely harmful/possibly fatal 5 Don't know 6

Q17	When working, do you feel you are able to protect yourself from asbestos?	Yes 1 No 2

Q18 How do think the following people would rate the seriousness of the risk of working with materials containing asbestos? For each, select a ranking from I to 5, where 1 is 'No risk or negligible risk' and 5 is 'Extremely high risk'. **READ OUT. ONE RESPONSE PER LINE.**

	No risk or negligible risk				Extremely high risk	Don't know
a. Your partner (wife or husband)	1	2	3	4	5	6
b. Your co-workers	1	2	3	4	5	6
c. Your employer	1	2	3	4	5	6
d. Your close friends	1	2	3	4	5	6

Q19 How would you rate the risk of harm to workers from the following activities? For each, select a ranking from I to 5, where 1 is 'No risk or negligible risk' and 5 is 'Extremely high risk'. **READ OUT. ONE RESPONSE PER LINE.**

	No risk or negligible				Extremely high risk	Don't know
a. Working on ladders at heights above 2 metres	1	2	3	4	5	6
b. Working with materials containing asbestos	1	2	3	4	5	6
c. Working with volatile solvents	1	2	3	4	5	6
d. Working near unguarded machinery	1	2	3	4	5	6

SECTION 5: IDENTIFYING ASBESTOS CONTAINING MATERIALS

Q20	How would you normally find out whether asbestos containing materials are present at a work site? **READ OUT** **MULTIPLE RESPONSE OK.**	I look for labels on the materials 1 I ask to see the asbestos register 2 I ask the owner/manager of the premises 3 I ask my employer 4 I ask another worker 5 I use my own experience 6 The age of the building gives me a fair idea 7 I would not do anything 8 Other **SPECIFY** 9

Q21	How well do you think you are able to identify materials that contain asbestos? Would you say you…? **READ OUT.** **SINGLE RESPONSE.**	Can readily identify most of them 1 Can identify many of them 2 Have a limited ability to identify them 3 Are not able to identify them 4

SECTION 6: WORKING WITH ASBESTOS CONTAINING MATERIALS

Q22	How often do you work at a site where there are asbestos containing materials? Select a ranking from I to 5, where 1 is 'Rarely' and 5 is 'Every day'. **SINGLE RESPONSE.**	Rarely	1
			2
			3
			4
		Every day	5
		Don't know	6

Q23a.	When you are carrying out any work involving asbestos containing materials, what precaution do you take? Firstly, what precautions do you take before you start work? **RECORD FIRST MENTION WITHOUT PROMPTING, I.E. WRITE ANSWER IN SPACE PROVIDED.**

Q23b.	Which of these precautions do you take before you start work? **READ OUT** **MULTIPLE RESPONSE OK.**	Check for presence of asbestos	1
		Get instructions	2
		Cordon off areas	3

Q23c.	What precautions do you take in the way that you work? Remember we are talking about when you work with asbestos containing materials. **RECORD FIRST MENTION WITHOUT PROMPTING, I.E. WRITE ANSWER IN SPACE PROVIDED.**

Q23d.	Which of these precautions do you take in the way that you work? **READ OUT** **MULTIPLE RESPONSE OK.**	Wet down materials	1
		Avoid breaking materials	2

Q23e.	What types of tools do you use? Remember, we are talking about when you work with asbestos containing materials. **RECORD FIRST MENTION WITHOUT PROMPTING, I.E. WRITE ANSWER IN SPACE PROVIDED.**

Q23f.	Which of these types of tools do you use? **READ OUT** **MULTIPLE RESPONSE OK.**	Hand tools	1
		Only slow speed power tools	2

Q23g.	When you are carrying out any work involving asbestos containing materials, how do you protect yourself? **RECORD FIRST MENTION WITHOUT PROMPTING, I.E. WRITE ANSWER IN SPACE PROVIDED.**	
Q23h.	Which of these things do you do to protect yourself? Remember we are talking about when you work with asbestos containing materials. **READ OUT** **MULTIPLE RESPONSE OK.**	Use dust masks 1 Use disposable overalls 2

Q23i.	When you are carrying out any work involving asbestos containing materials, what do you do after you finish? **RECORD FIRST MENTION WITHOUT PROMPTING, I.E. WRITE ANSWER IN SPACE PROVIDED.**	
Q23j.	And which of these things do you do when you finish? Remember, we are talking about when you work with asbestos containing materials. **READ OUT** **MULTIPLE RESPONSE OK.**	Clean up the site 1 Wash up/decontamination 2 Dispose of asbestos in sealed and labelled bags 3

Q24	When working with asbestos containing materials how often do you follow the required safe handling precautions? Select a ranking from I to 5, where 1 is 'Never' and 5 is 'Always'. **SINGLE RESPONSE.**	Never 1 Rarely 2 Sometimes 3 Mostly 4 Always 5 Don't know 6

ASK Q25 IF CODES 3 TO 5 (Sometimes to Always) **AT Q24; OTHERWISE SKIP TO Q27.**

Q25 How important are the following factors in making you apply safe handling precautions for working with asbestos? Select a ranking from I to 5, where 1 is 'Not important' and 5 is 'Very important'. **READ OUT. ONE RESPONSE PER LINE.**

	Not important				Very important	Don't know
a. Awareness that there are materials containing asbestos	1	2	3	4	5	6
b. Media awareness campaigns	1	2	3	4	5	6
c. Views of family and friends about the risk of asbestos	1	2	3	4	5	6
d. Training in procedures for working with asbestos	1	2	3	4	5	6
e. My supervisor/boss ensures that we follow safety procedures (good supervision)	1	2	3	4	5	6
f. My co-workers all wear protection and follow the safety rules	1	2	3	4	5	6
g. I want to protect myself from exposure to asbestos	1	2	3	4	5	6
h. The necessary safety equipment is provided	1	2	3	4	5	6
i. Involvement of unions on the site	1	2	3	4	5	6
j. Fear of inspection and prosecution by OHS inspectors	1	2	3	4	5	6

If no single factor is clearly most important at Q25, then ask Q26

Q26 Which of these reasons is most important to you?
READ OUT.

Awareness that there are materials containing asbestos	01
Media awareness campaigns	02
Views of family and friends about the risk of asbestos	03
Training in procedures for working with asbestos	04
My supervisor/boss ensures that we follow safety procedures (good supervision)	05
My co-workers all wear protection and follow the safety rules	06
I want to protect myself from exposure to asbestos	07
The necessary safety equipment is provided	07
Involvement of unions on the site	09
Fear of inspection and prosecution by OHS inspectors	10
None	11

Q27	How important are the following factors in making you **not** apply safe handling precautions for working with asbestos? Select a ranking from I to 5, where 1 is 'Not important' and 5 is 'Very important'. **READ OUT. ONE RESPONSE PER LINE.**					
	Not important				Very important	Don't know
a. I am not aware of the presence of asbestos	1	2	3	4	5	6
b. I have no training in the safety procedures for asbestos	1	2	3	4	5	6
c. My supervisor/boss doesn't enforce the safety procedures (poor supervision)	1	2	3	4	5	6
d. My co-workers don't follow the safety procedures	1	2	3	4	5	6
e. I don't think there is much risk to myself from exposure to asbestos	1	2	3	4	5	6
f. I am prepared to take the risk (it's a lottery anyway)	1	2	3	4	5	6
g. I don't think the safety precautions are very effective (not worth the effort)	1	2	3	4	5	6
h. I don't have confidence in being able to take the necessary safety precautions	1	2	3	4	5	6
i. The necessary safety equipment is not provided	1	2	3	4	5	6
j. Wearing the protective equipment is uncomfortable or makes the task more difficult	1	2	3	4	5	6
k. It takes too long to follow the safety procedures (too difficult, too complicated)	1	2	3	4	5	6
l. It is too expensive to do everything by the book	1	2	3	4	5	6
m. There is little chance of being detected by OHS Inspectors	1	2	3	4	5	6

If no single factor is clearly most important at Q27, then ask Q28,

Q28	Which of these reasons is the most significant reason for not following the safety procedures? **READ OUT.**		
		I am not aware of the presence of asbestos	01
		I have no training in the safety procedures for asbestos	02
		My supervisor/boss doesn't enforce the safety procedures (poor supervision)	03
		My co-workers don't follow the safety procedures	04
		I don't think there is much risk to myself from exposure to asbestos	05
		I am prepared to take the risk (it's a lottery anyway)	06
		I don't think the safety precautions are very effective (not worth the effort)	07
		I don't have confidence in being able to take the necessary safety precautions	08
		The necessary safety equipment is not provided	09
		Wearing protective equipment is uncomfortable or makes the task more difficult	10
		It takes too long to follow the safety procedures (too difficult, too complicated)	11
		It is too expensive to do everything by the book	12
		There is little chance of being detected by OHS Inspectors	13
		None	14

Appendix 2: Detailed statistical results and model outputs

Which factors influence workers’ understanding of the risk of asbestos?

Model factors	Chi-square	d.f.	p
Omnibus test of model coefficients	35.613	9	<.001
Hosmer and Lemeshow chi-square test of goodness of fit	9.315 8		.316
Nagelkerke Psuedo R Square	.198		

Whether know a lot about the risk of asbestos	Parameter Estimates							
Model factors	B	Std. Error	Wald	df	p	Odds ratio Exp(B)	95% CI for Exp (B) Lower	Upper
Trade			5.091	3	.165			
Electrician	.311 .419 .551 1				.458 1.365		.601	3.101
Plumber	.592 .427 1.921			1	.166 1.808		.783	4.178
Carpenter	.948 .441 4.611			1	.032 2.579		1.086	6.126
Painter 0	[b]			0				
Had asbestos specific OHS training								
Yes 1.137		.339	11.261	1 .001		3.117	1.605	6.054
No 0	[b]			0				
Sources of information on asbestos			8.406	5	.135			

Appendix 2

Whether know a lot about the risk of asbestos	Parameter Estimates							
							95% CI for Exp (B)	
Model factors	B	Std. Error	Wald	df	p	Odds ratio Exp(B)	Lower	Upper
Trade training	1.098	.469	5.476	1	.019	2.997	1.195	7.515
Information from trade associations or trade unions	1.181	.593	3.966	1	.046	3.258	1.019	10.418
From OHS training	.231	.562	.169	1	.681	1.260	.419	3.795
From co-workers or boss	.520	.506	1.053	1	.305	1.681	.623	4.536
Personal experience/ knowledge gained on site or job	.510	.586	.758	1	.384	1.666	.528	5.258
Newspaper or TV	0[b]			0				
Intercept	-1.513	.434	12.149	1	.000			

a. The reference category is not knowing a lot about the risk of asbestos

b. This parameter is the reference category and is set to zero because it is redundant.

Which factors influenced workers’ compliance with safety practices when working with ACMs?

Following safety practices after completion of work with ACMs

Model factors	Chi-square	d.f.	p
Omnibus test of model coefficients	26.323	4	<.001
Hosmer and Lemeshow chi-square test of goodness of fit	2.317 6		.888
Nagelkerke Psuedo R Square	.135		

Whether followed safe work practices after completion of work with ACMs	Parameter Estimates							
							95% CI for Exp (B)	
Model factors	B	Std. Error	Wald	df	p	Odds ratio Exp(B)	Lower	Upper
Likelihood of exposure								
More likely	.913	.284	10.331	1	.001	2.493	1.428	4.350
Less likely	0^b			0				
Trade			25.798	3	.000			
Electrician	.809	.379	4.547	1	.033	2.245	1.068	4.721
Plumber	.627	.370	2.879	1	.090	1.872	.907	3.863
Carpenter	1.482	.433	11.723	1	.001	4.401	1.884	10.278
Painter	0^b			0				

Whether followed safe work practices after completion of work with ACMs	Parameter Estimates							
						Odds ratio Exp(B)	95% CI for Exp (B)	
Model factors	B	Std. Error	Wald	df	p		Lower	Upper
Intercept	-.321	.278	1.336	1	.248			

a. The reference category is not following safety practices after completion of work with ACMs

b. This parameter is the reference category and is set to zero because it is redundant.

Following safety practices at all stages of work with ACMs

Model factors	Chi-square	d.f.	p
Omnibus test of model coefficients	36.717	4	<.001
Hosmer and Lemeshow chi-square test of goodness of fit	4.761	6	.575
Nagelkerke Psuedo R Square	.175		

Whether followed safe work practices at all stages of work with ACMs	Parameter Estimates							
							95% CI for Exp (B)	
Model factors	B	Std. Error	Wald	df	p	Odds ratio Exp(B)	Lower	Upper
Likelihood of exposure								
More likely	.629	.269	5.465	1	.019	1.876	1.107	3.180
Less likely	0[b]			0				
Trade			25.798	3	.000			
Electrician	1.160	.375	9.549	1	.002	3.190	1.529	6.658
Plumber	.778	.373	4.347	1	.037	2.177	1.048	4.523
Carpenter	2.036	.410	24.599	1	.000	7.658	3.426	17.119
Painter	0[b]			0				
Intercept	-1.270	.309	16.872	1	.000			

a. The reference category is not following safety practices at all stages of work with ACMs

b. This parameter is the reference category and is set to zero because it is redundant.

The effect of perception of likelihood of exposure on safe work practices

Cross-tab analysis by trade and safety practices	Pearson chi-square	d.f. p		Phi	p
After work	12.936	1	<.001	-.223	<.001
All stages	7.667	1	.006	-.171	.006

The effect of trade on safe work practices

Cross-tab analysis by trade and safety practices	Pearson chi-square	d.f. p		Cramer's V	p
Before work	8.616	3	.035	.181	.035
After work	15.120	3	.002	.240	.002
All stages	29.154	3	< .001	.334	< .001

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