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Bushfire Smoke Pollution, Albury, 2003: The acute health impact

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List of Acronyms

ABC	Australian Broadcasting Commission
ABH	Albury Base Hospital
ABS	Australian Bureau of Statistics
ARI	Acute Respiratory Infection
CATI	Computer Assisted Telephone Interviewing
CDC	Centres for Disease Control and Prevention
COPD	Chronic Obstructive Pulmonary Disease
DEC	Department of Environment and Conservation
ED	Emergency Department
EDIS	Emergency Department Information System
EHB	Environmental Health Branch
EPA	Environmental Protection Authority
HEPA	High Efficiency Particulate Air
HOIST	Health outcomes information statistical toolbox
ICD	International Classification of Diseases
LGA	Local Government Area
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
PEFR	Peak Expiratory Flow Rate
PM10	Particulate matter with an equivalent aerodynamic diameter of 10 micrometers or less
PM2.5	Particulate matter with an equivalent aerodynamic diameter of 2.5 micrometers or less
PSA	Public Service Announcements
TEOM	Tapered Element Oscillating Microbalance
WHO	World Health Organisation

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Executive Summary

During January/February 2003 smoke from bushfires in north east Victoria blanketed southern NSW including Albury. The Public Health Unit (of the former Greater Murray Area Health Service) in Albury became a key agency in providing health advice. This report describes the event, the public health role and the direct health impacts of the smoke pollution measured by reviewing Emergency Department attendances and undertaking a community survey. The survey also examined the effectiveness of health advisory messages.

The scientific literature states that increased levels of particulate matter (which may be measured as PM10) is associated with increased rates of respiratory and other diseases and that people with pre-existing respiratory and cardiovascular conditions, as well as children and the elderly, are at increased risk of the effects of smoke pollution.

Based on the draft "Air Pollution Health Alert" information from the NSW Department of Health and the NSW Department of Environment and Conservation (DEC) along with PM10 data from the Environmental Protection Authority monitoring sites in Albury, the 40 days of the smoke pollution were categorised as the following; 7 days were considered hazardous for the general population, 4 days very unhealthy, 5 days unhealthy and 12 days unhealthy for sensitive individuals. The peak PM10 result was achieved on 22nd January when the daily average was 414.6ug/m^3. The National Environmental Protection Measure for ambient air quality in Australia states a standard of 50ug/m^3 for the daily average PM10 and that this level should not be exceeded more than 5 times per year.

Public health action included the provision of health advisory information to the general public, health professionals and organisations. In addition, Public Health undertook health surveillance to monitor the impact of the event and identified specific interventions to reduce health effects of the smoke on the population.

During the smoke pollution period attendances at the Emergency Department of Albury Base Hospital were increased for a number of respiratory and other conditions. The increase was statistically significant for the ICD classification of "respiratory symptoms" but not asthma. Presentations for eye conditions were also significantly increased.

A community survey was conducted using the Computer Assisted Telephone Interview system operated by NSW Health. The survey revealed that 70 per cent of the Albury population experienced some health effect of the smoke with the most common complaints being eye irritation, cough, throat irritation, shortness of breath and headache. Seventy four per cent of people reported being aware of the health advisory messages with television being the most common source of health messages. People who heard the messages were significantly more likely to change their behaviour and reduce their exposure to the smoke pollution.

The report emphasises the important role Public Health plays in the provision of health advice and the surveillance of health effects during a smoke pollution event.

1.0 Introduction

From early January to the third week of February 2003, bushfires in North East Victoria resulted in a smoke haze across areas of southern NSW including Albury. At times the level of air pollution was extreme. From early in the smoke event, the Public Health Unit (of the former Greater Murray Area Health Service) dealt with enquiries from the media, Councils, schools, sporting organisations and event organisers, as well as the general public, about the possible health effects of the smoke.

Public Health provided advice based on information from the Environmental Health Branch (EHB) of the NSW Department of Health and from the available literature. To support this advice Public Health was able to draw on data from the air quality monitoring equipment based in Albury operated by the Environmental Protection Authority (EPA). This equipment provided daily counts of particulate matter with an equivalent aerodynamic diameter of 10 micrometers or less (PM10). The peak daily PM10 result exceeded 400ug/m^3 on 23rd January. This day also saw the peak hourly PM10 reading of 938ug/m^3.

The smoke pollution changed rapidly according to the prevailing winds and it was difficult to provide timely information about the possible health affects. As the air pollution became worse public health messages were escalated in line with draft "Health Alerts" prepared by the EHB. Numerous public events were cancelled and there was speculation on the health impact of the smoke pollution. Public Health staff monitored Emergency Department presentations at Albury Base Hospital. However there was little information available on the impact of the smoke on the broader community apart from anecdotal reports. The effectiveness of health messages was also unknown.

Funding provided by the EHB allowed a survey of the Albury community to be undertaken using Computer Assisted Telephone Interviewing (CATI). The aims of the survey were to determine the health impact of the smoke and the effectiveness of public health advisory messages.

This report describes this extreme smoke pollution event, including the air quality results, the public health response, the impact on Emergency Department presentations and the methodology and results of the CATI survey.

2.0 Literature Review

This literature review has a focus on the health impact of smoke and specifically increased PM10 levels originating from bushfires or agricultural burning. A detailed review of the health impact of particulate pollution is not included and it is acknowledged that there is already evidence of a strong association between particulate pollution and increased morbidity and mortality. Studies, predominantly in urban areas, have demonstrated an association between particulate air pollution and increased risk of death, particularly in the elderly and those with underlying respiratory and cardiac disease. Available data suggest that there are increasing effects with increasing exposure and that no threshold level has been identified.[1,2]

Smoke from bushfires contains a range of potentially harmful chemicals and particulates. The size of particulates produced during fires is important as smaller particles can be inhaled and cause adverse health effects in the respiratory tract. Smaller particles, PM2.5, are considered to present a higher risk because these are able to penetrate deeper into the respiratory tract. [1,2,3]

In Australia, The National Environment Protection Council released a National Environment Protection Measure (NEPM) for ambient air quality in June 1998 and revised this document to include an advisory level for PM 2.5 in 2003. For PM10 the NEPM standard/goal is for a daily maximum of 50ug/m^3 with a maximum number of days exceeding this level set at 5 days per year. [3]

There is an increasing body of literature about the health effects of bushfire smoke. Studies have generally focussed on one or more of the following three aspects: the impact on Emergency Department attendances and usage of other health services; the effect of bushfire smoke on symptoms and medication use and; population studies of the health effects of bushfire smoke and the effectiveness of public health interventions.

Studies examining the impact of smoke pollution on Emergency Department attendances for asthma have produced inconsistent results. Following smoke pollution from back burning in 1991, a weak association between particulate air pollution and asthma attendances at five Sydney metropolitan hospitals was found.[4] A review of asthma attendances at three metropolitan hospitals following bushfires around Sydney in 1994 found no increase.[5] The previous studies have been identified as lacking methodological rigour and may not have had the power to detect increases in asthma presentations.[6,7] Smith et al undertook a study of asthma attendances at seven public hospitals in and around Sydney following the 1994 bushfires. The attendances during two six week periods were analysed; one period a year prior to the bushfires and the other during the bushfires. No increase in asthma presentations was identified and the maximum daily nephelometer reading was not significantly associated with asthma presentations at the Emergency Departments[6.] The authors acknowledge that public awareness of the possible health effects of the smoke may have resulted in people avoiding exposure to the smoke. The

authors also suggest that differences in the make up of bushfire smoke compared with typical urban pollution may be important. It was suggested that the health impact of the smoke may not have been serious enough for people to seek medical attention. The smoke haze was present for a seven day period with a peak hourly PM10 result of 250ug/m^3. Morgan et al studied the effects of a range of air pollutants on hospital admissions for the period 1990 to 1994. This study found that an increase of particulate concentration from the 10th to the 90th percentile was associated with a 3 per cent increase in hospital admissions for chronic obstructive pulmonary disease.[8]

Duclos et al reviewed ED presentations at fifteen hospitals in six counties following bushfires in California in 1987. Presentations were compared with two reference periods. There were significant increases in attendances for "asthma" and "other upper respiratory infections". The observed/expected ratios for visits by people with asthma and COPD were 1.4 and 1.3 respectively. Air monitoring data was inconsistently collected over this period and no correlation with ED presentations was undertaken.[9]

An increase in Emergency Department presentations for asthma in children less than 12 years of age associated with elevated PM10 levels was identified in two large general hospitals in Singapore. The smoke pollution originated from forest fires on Sumatra.[10] Johnston et al found a significant increase in asthma presentations to Royal Darwin Hospital Emergency Department with increasing PM10 levels. This study was conducted over a 7 month period with a PM10 peak level of 70ug/m^3. The PM10 level exceeded 40ug/m^3 on 16 days of the study period. The strongest association was found when PM10 levels exceeded 40ug/m^3 and when a lag time of 5 days for ED presentation was factored into the analysis.[11]

Long et al studied the health effects of agricultural smoke from stubble burning on a group of people with mild to moderately severe chronic airflow obstruction who were enrolled at that time in a separate lung health study. The PM10 level during the period of the pollution event ranged from 80 to110 ug/m^3. Forty two per cent of participants reported that symptoms including cough wheezing, chest tightness and shortness of breath developed or became worse and 20 per cent reported breathing trouble. Thirty seven per cent of people reported that they were not bothered by the smoke. People with asthma and chronic bronchitis were more likely to be affected. Bronchial hyper responsiveness and the degree of airways obstruction were not associated with an increase in symptoms in the participants.[12]

Two further studies have been published on the health impact of the 1994 bushfires around Sydney. One examined the peak expiratory flow rates (PEFR) in 32 children with wheeze who were taking part in a longitudinal study of air pollution. The pollution event lasted about 7 days and the peak daily PM10 result was 210ug/m^3. The study did not find an association between the bushfire period or the PM10 result and evening PEFR.[13] A second report examined respiratory symptoms and beta agonist use in the same 32 children. This study reported the peak PM10 result as 130ug/m^3 for

this period. The researchers proposed a measure they referred to as the bushfire fraction of the total PM10 concentration. This was calculated by subtracting the average PM10 concentration from the total PM10 result for the bushfire period. The study found an association between the bushfire PM10 concentration and the prevalence of evening wet cough but not the prevalence of evening dry cough, wheeze or beta agonist use.[14]

Aditama reported on the health, economic and environmental impacts of the extreme pollution events in Indonesia associated with forest fires in the 1990s and specifically on respiratory health associated with the 1997 fires. Presentations for acute respiratory infection (ARI) were reported to increase by 1.8 times in South Kalimantan province and by 3.8 times in the south of Sumatra. The study cites a report from the Jambi province stating an increase in deaths in the pulmonary ward of the hospital of between two and four times and an increase in respiratory disease of 51 per cent.[15]

Following forest fires in Humboldt County, California in 1999 the Centres for Disease Control and Prevention (CDC) undertook a study to assess the health impact and to evaluate the interventions used during the smoke pollution. The study population was residents of the Hoopa Valley National Indian Reservation. The CDC reviewed data on medical visits for respiratory disease and undertook a survey of the community. The smoke event lasted about 70 days and on 15 days the daily PM10 result exceeded 150ug/m^3. On two days the value exceeded 500ug/m^3. Over the course of the smoke event, visits to the medical centre for respiratory disease were 52 per cent higher than the same period in the previous year and PM10 levels were positively correlated with weekly attendances for respiratory illnesses. The survey was completed by 289 of the 385 residents (75.1%). Increased respiratory problems were reported by 62 per cent of those interviewed. While more people with pre-existing conditions reported respiratory symptoms, the difference was not statistically significant. Of the 289 respondents, 48.8 per cent evacuated to another location, 35 per cent wore a mask or face covering and 34per cent operated a high efficiency particulate air (HEPA) filter. Eighty two per cent of respondents recalled a public service announcement (PSA) and of these 66 per cent reported action to reduce smoke exposure. People reported staying inside as the most common action. Respondents who recalled a PSA were statistically less likely to report worsening respiratory symptoms than those who could not. The researchers found that mask use was ineffective and positively associated with outdoor exposure. It is suggested that this is because of inconsistent use of the masks without appropriate fit testing or because the types of masks used were of variable effectiveness. The duration of evacuation was shown not to be protective as only 17 per cent were away at the time of the worst smoke conditions. The unpredictability of the smoke exposure was the contributing factor to this. The use of HEPA filters was associated with a reduced odds ratio of reporting lower respiratory tract symptoms. Of people who recalled a PSA, 51.7 per cent heard this message on a radio or scanner. This was followed by 37 per cent who heard the message from clinic personnel and 21 per cent from friends of family.[16]
In late October and early November 2003 wildfires occurred in southern California. Children enrolled in the Children's Health Study were surveyed via

questionnaire delivered by mail in late 2003 or as part of the ongoing study in the first 7 months of 2004 to determine the health impact of the smoke pollution. There was wide variation in smoke pollution severity across the study communities with the highest 5 day mean PM10 of 250 ug/m^3. A total of 4609 students took place in the survey out of a possible 6424. Exposure was determined by reporting the smell of smoke. Symptoms commonly reported include itchy/watery eyes (34.6%), irritated eyes (35.5%), sneezing/blocked nose (41.3%), and sore throat (32.7%). Children with asthma were two to three times more likely to report symptoms than non asthmatic children. People with asthma were more likely to take preventative action such as wearing a mask or staying indoors. The authors concluded that wildfire smoke leads to acute exacerbations of respiratory and eye symptoms and increased use of health services. The importance of obtaining timely responses to symptom related information following a smoke event was highlighted.[17]

Johnston et al studied 251 adults and children with asthma over a 7 month period. The study was conducted in Darwin, Australia during the dry season where vegetation fire smoke produces approximately 95 per cent of the particulate matter. The PM10 for this period ranged from 2.6 to 43.3ug/m^3. Approximately half the group were less than 18 years of age. Fifty seven per cent identified vegetation fire smoke as a trigger of their asthma symptoms. The PM10 level was significantly associated with the onset of symptoms, commencing oral medication, the mean daily symptom count and the mean daily dose of reliever medication. PM10 was not associated with increased health care attendances or missed work/school. The article supports the view that there is no threshold level for health effects of particulate matter.[18]

3.0 Bushfire Smoke Pollution: January- February, 2003 Albury, NSW

3.1 Air Quality Measures

The NSW Department of Environment and Conversation (DEC) operate an air quality monitoring site at Jelbart Park in Albury. The site measures PM10 using a Tapered Element Oscillating Microbalance (TEOM). The PM10 is calculated as the arithmetic mean of the 24 1-hour averages from the previous day and is presented as a 24 hour summary figure. For calculation of the 24 hour average at least 75 per cent of the hourly averages must be available. Daily summary information is published by the DEC on the world wide web (http://www.environment.nsw.gov.au/airqual/web24hsum.asp).
During the smoke event, results of hourly average PM10 readings and daily averages were made available to Public Health staff by the Environmental Protection Authority of the DEC.

The National Environment Protection (Ambient Air Quality) Measure (NEPM) published by the National Environment Protection Council specifies the standards and goal for a number of pollutants including PM10. The NEPM also specifies the Australian Standard Methods for pollutant monitoring. For PM10 the NEPM recommends that the average daily result should be a maximum of 50ug/m^3 and that this level should not be exceeded on more than 5 days per year.

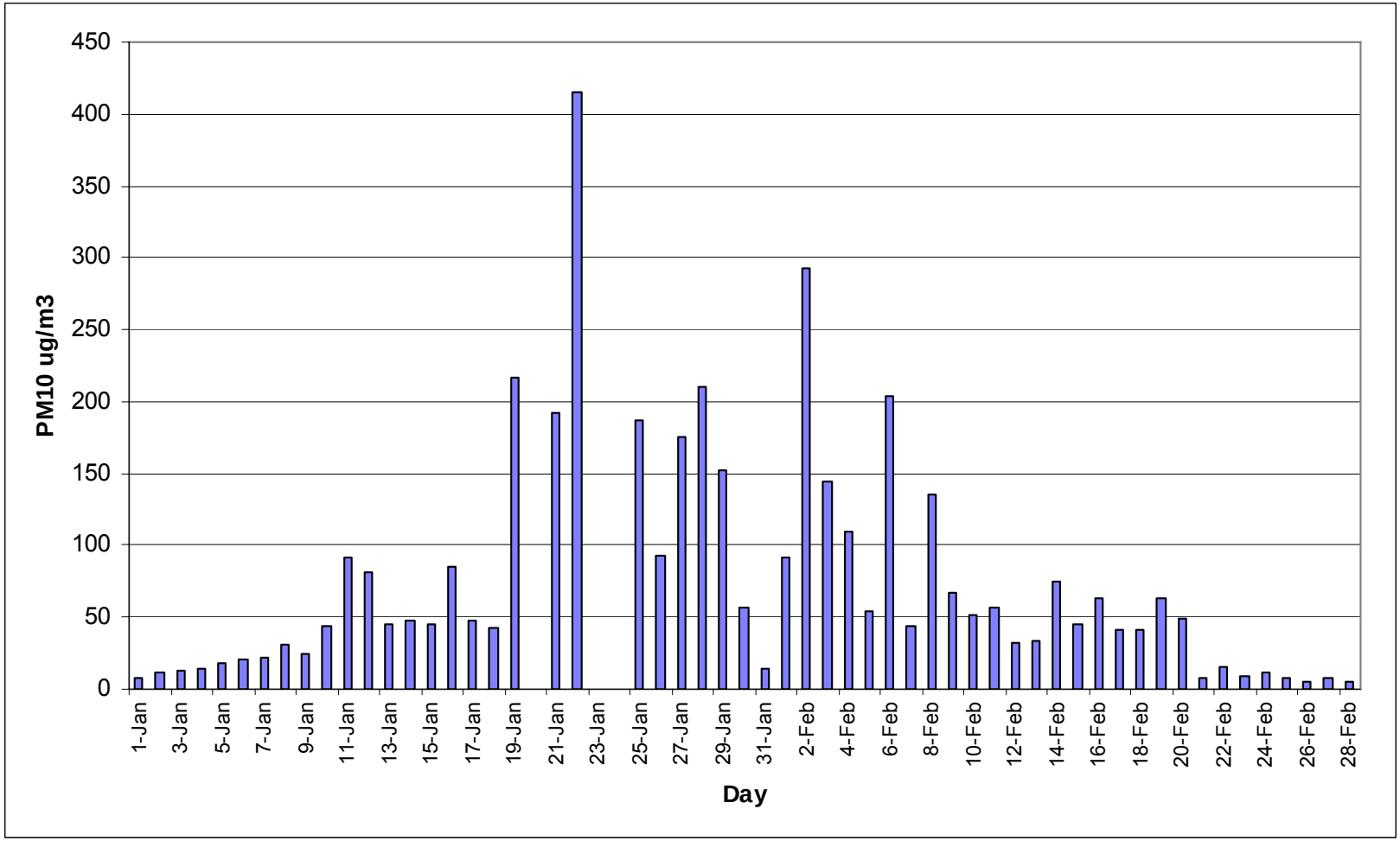
The daily average PM10 results for the Jelbart Park monitoring site in Albury during the bushfire smoke event are shown in Figure 1. On three days, 20th, 23rd and 24th of January the average daily PM10 result was not able to be calculated as the monitoring device was rendered inoperable by the high pollution levels. For these three days, hourly results were possible for 13, 10 and 11 readings respectively. Using these readings the average daily results for the 20th, 23rd and 24th of January 2003 were 263.2, 701.6 and 139.5 ug/m^3 respectively. The Environmental Health Branch of the NSW Department of Health issued a draft information sheet for NSW Health Public Health Units in January 2003 which identified PM10 levels on which to base advice to the public. This information sheet described daily averages of between 50ug/m^3 and 99ug/m^3 as “Unhealthy for sensitive individuals”, between 100 and 149 as “Unhealthy”, between 150 and 200, “Very Unhealthy” and greater than 200 as “Hazardous”. Subsequently the NSW Department of Health in cooperation with the Department of Environment and Conversation published “Air Pollution Health Alerts” on the NSW Department of Health web site (http://www.health.nsw.gov.au/living/airpollution.html).[19]

Based on the criteria listed above and using the results from the complete daily averages and the three days where averages were based on a limited number of readings, we can classify the days during the smoke event. Of the 40 days between 11th January and 19th February inclusive, 7 days were considered hazardous, 4 days very unhealthy, 5 days unhealthy and 12 days unhealthy for sensitive individuals. Extreme pollution results were obtained on

22nd January where the daily average was 414.6ug/ m^3 and on 23rd January where the daily value based on 10 readings was 701.6ug/ m^3. For the hourly PM10 results the peak figure was 938ug/ m^3 on the evening of the 22nd January. Unfortunately the equipment failed after this reading when it became blocked with material from the smoke pollution.

The degree of smoke pollution in Albury during the period of the bushfires changed rapidly according to prevailing winds and the pollution did not worsen or improve incrementally during the event. It was therefore not possible to provide escalating health alerts and it proved difficult to issue timely advice about the possible health effects of exposure. For example on the 22nd January the 7am hourly average was 57 ug/m^3, at 9am 320 ug/m^3 and at 11am 784 ug/m^3. Similarly on 25th January the hourly average was 600 ug/m^3 at 10 am, 202 ug/m^3 at 11am and 31 ug/m^3 at noon. To provide timely public health advice and to allow the public and others to make an assessment of the exposure risk, visibility was used as a proxy for air pollution based on information from the World Health Organisation.[2] Public Health staff estimated visibility using known landmarks and roughly correlated this with hourly PM10 averages obtained from the DEC the following day. While this would require local validation during other smoke pollution events and further work is required to refine the validity of this relationship, visibility as a proxy for air pollution provided a rapid method for Public Health staff and others to assess the current exposure risk. Promotion of this information to the public was found to be useful in allowing them to make their own decisions about their outdoor activity (Appendix 1)

Figure 1: Daily average PM10 results (ug/m^3) for January/February 2003, Albury, NSW



3.2 Public Health Action

Public Health played an important role in the response to the smoke pollution event. Major functions undertaken by public health staff included providing public health advisory information, surveillance of ambient air quality and health impacts as well as the identification and consideration of public health interventions.

3.2.1 Public Health Advisories

Public Health was the main agency responsible for the dissemination of information and advice. This included numerous media interviews with radio, television and newspaper which allowed public health messages based on the draft NSW "Health Alerts for Air Pollution" and other relevant literature to be conveyed to the public. Initially during media interviews, emphasis was placed on the health effects of the smoke on susceptible people such as those with existing respiratory or cardiovascular disease, children and the elderly. As the pollution worsened and reached very unhealthy or hazardous levels the information was targeted to the general community in line with the health alerts. With the rapidly changing smoke conditions, the media outlets were increasingly used to convey information about smoke pollution which encouraged people to make their own assessment of the risk of exposure. Early public health messages advised at-risk individuals to avoid outdoor strenuous exercise, take their medication as prescribed and follow established action plans and to seek medical attention if they experienced asthma, chest pain or shortness of breath. As the pollution worsened the general public was advised to reduce the level of outdoor activity. Initially this was stated as strenuous outdoor activity but when hazardous levels were achieved people were advised to stay indoors as much as possible. Further health messages included wearing a P2 class mask and switching air conditioning units to recycle mode. During the peak pollution period the public was advised to consider leaving the area if they were being seriously affected by the smoke.

A fact sheet was prepared and sent to all General Practitioners and hospitals in the affected area. Similar information was sent to all aged care facilities, child care facilities and schools given that the elderly and children are considered more susceptible to the effects of smoke pollution. Public Health handled numerous enquiries from schools who were considering the cancellation of outdoor events due to concerns about the smoke pollution.

Advice provided by Public Health and the presence of smoke pollution had an impact on a range of community events. The bushfire period coincided with the Albury-Wodonga Festival of Sport. Following public health advice the outdoor opening ceremony was postponed and a number of events were altered or cancelled. The Victorian Country Athletics Championships in Wodonga were cancelled as were the Australia Day celebrations and many local sporting events. Public Health played a key role in providing advice to these organisations on the smoke pollution and possible health effects.

Public health also managed enquiries from businesses and organisations employing outdoor workers. Employers (and sometimes employees) sought advice about the need to restrict or postpone outdoor work. Again the public health advice emphasised awareness of an increased risk for susceptible people, to reduce the level of outdoor activity when pollution was evident and to offer personal protective equipment such as a P2 mask if outdoor activity was unavoidable.

3.2.2 Surveillance

Public Health staff monitored smoke pollution and specifically PM10 levels in cooperation with the EPA. Data from the Jelbart Park monitoring site was useful in providing initial measures of the smoke pollution to guide public health advisories. PM10 results for the previous day were obtained from the EPA web site. Later local EPA staff facilitated access to hourly PM10 data. Unfortunately this information was not timely enough and the conditions changed too quickly to use this data for immediate public health advice. The PM10 data did facilitate a means of roughly correlating pollution levels with estimates of visibility which were then used to provide timely public health advice as the situation worsened.

Public Health staff monitored Emergency Department (ED) presentations for respiratory disease through regular contact with the ED. In addition, a number of sentinel General Practitioners provided anecdotal advice about primary care presentations related to the smoke pollution. Regular contact with aged care facilities allowed Public Health to monitor the impacts on this susceptible group. Surveillance became more important as the pollution worsened and hazardous levels were achieved over a number of days. The possible health impact of this level of pollution was unknown and public health staff were considering other interventions such as the establishment of clean air centres, widespread use of P2 masks and evacuation of susceptible people. However surveillance information indicated that a major increase in presentations for respiratory or other conditions was not occurring at that time.

3.2.3 Public Health Interventions

Early in the event, public health actions focussed on providing information and advice particularly to susceptible people. Advice was generally related to self monitoring of conditions such as asthma and complying with action plans or use of prescribed medication. Other advice focussed on behaviour change including remaining indoors, reducing the level of strenuous outdoor activity and use of recycled air conditioning. As pollution became worse behaviour change messages were directed to the whole community. In addition the use of P2 masks was suggested as was leaving the area for people severely affected. A number of interventions and the issues faced will be discussed in more detail.

3.2.3.1 Masks

The WHO provides recommendations on the use of masks during smoke pollution events originating from vegetation fires.[2] In consultation with the

Environmental Health Branch of the NSW Department of Health it was determined that P2 masks would be the appropriate personal protective equipment. Public health staff identified local suppliers of P2 masks and determined approximate local stock levels. During public health advisory statements the use of P2 masks for people who were particularly susceptible to the smoke or needed to spend time outdoors was recommended. Local hospitals were encouraged to access a supply of P2 masks. A relatively small proportion of the population reported using a mask during the pollution event. It is unclear how effective masks were and how well users complied with fit check directions. No advice was provided by public health in regard to fit checking of masks or use of masks according to the manufacturer's instructions. Mott et al found mask use to be ineffective and positively correlated with outdoor exposure.[16]

3.2.3.2 Clean Air Respite Facilities

WHO guidelines suggest the use of clean air filters in households of people susceptible to bushfire smoke. Others suggest the establishment of clean air shelters, facilities which have high quality air conditioning units able to filter most of the particles. Public health staff accessed portable air cleaning units and a clean air room was established at Albury Base Hospital. This room had limited use by patients from the hospital. While information on availability and costs of air cleaning equipment was accessed, further air cleaning devices were not employed by Public Health during the pollution event.

Public health staff identified a number of large licensed clubs in Albury which had air conditioning units capable of substantially reducing the particulate matter entering the building. For one club, the air conditioning system employed HEPA filters. Public health approached these facilities with a view to establishing clean air shelters. This was not progressed although it was reported that residents did make use of these clubs by their own choice.

The use of portable HEPA filters has been reported as being successful in reducing fine particle pollution in houses.[16] The promotion of portable HEPA filters was not included in the routine public health advisories although, in the process of investigating the establishment of clean air facilities, public health staff identified a number of businesses able to provide portable HEPA air cleaners for hire. The use of HEPA air cleaners may provide susceptible individuals with an effective method of reducing exposure to particle pollution during a bushfire smoke event and a reasonable alternative to evacuation.

3.2.3.3 Cancellation and Postponement of Events

As discussed above, public health staff had a major role in providing advice to a broad range of organisations which resulted in the cancellation or postponement of outdoor events. The cancellation of events such as regional sporting events had an economic cost to the community. In some cases, event organisers requested a direction from Public Health to cancel or postpone events however they were informed that Public Health provided advice only on the risks associated with the pollution levels being experienced. In other cases, schools and child care facilities were advised to

restrict outdoor activity for children and these recommendations were well implemented.

3.2.3.4 Evacuation

As smoke pollution worsened and levels in the hazardous range were achieved, consideration was given to the possible need for evacuation. Public health advisories had by that stage, suggested that sensitive individuals should consider leaving the area. However evacuation of a larger proportion of the population would have presented a significant logistical and economic challenge. Public health staff discussed this matter with the Local Emergency Management Committee and agreed that further consideration would be given if primary care practitioners indicated a marked increase in presentations associated with the smoke pollution. Fortunately this did not occur. Some residents did however choose to leave the area because of the smoke. It was not possible to predict the duration or severity of the smoke pollution and changes in wind direction did provide respite from time to time. As the event lasted almost six weeks, evacuation for most of the population was not a realistic option.

3.3 Impact of smoke pollution on Emergency Department Presentations at Albury Base Hospital

People with existing respiratory disease and cardiovascular disease are considered more likely to experience adverse health effects from exposure to bushfire smoke. Data on presentations to the Emergency Department (ED) of Albury Base Hospital (ABH) were reviewed to identify evidence of increased morbidity resulting in ED presentation during the period of bushfire smoke pollution.

3.3.1 Methods

Data for presentations to the Albury Base Hospital ED were accessed from HOIST (Health Outcomes Information Statistical Toolkit), a data warehouse hosted by Epidemiology and Surveillance Branch of the NSW Department of Health. EDIS (Emergency Department Information System) is a computerised system of recording ED presentations, including preliminary diagnoses coded by the International Classification of Disease version 9 (ICD9). A number of diagnostic categories and codes were chosen for examination (Table 1) based on the likely impact of smoke pollution on respiratory and cardiovascular systems. EDIS data were extracted from HOIST using SAS analytical software for all presentations to the ED of ABH in the months of January and February of 2003 and comparison years 2000 to 2002.

The proportion of presentations for selected conditions over the previous 3 years was compared with the presentations during the bushfire smoke period. A χ^2 test (1*df*) was used and performed manually. The level of significance was chosen as $p < 0.05$.

Table 1: Coding and categories used in analysis of Emergency Department presentations

Presenting symptoms/ conditions	ICD9 categories	ICD9 codes
Respiratory Disease	Asthma	493.00-493.99
	Other respiratory (non-asthma)	460-492.99
	Respiratory symptoms	786.00-786.49
Chest pain	Chest symptoms	786.50-786.59
Heart Disease	Heart	401-429, 785.0, 785.1
Stroke	Stroke	430-438
Eye and Adnexa	Eye	360.42-379.99
All other diagnoses		All codes not included above

3.3.2 Results

The bushfire smoke did not result in an increase in overall ED presentations when compared with the previous three years (Table 2) A review of selected diagnostic categories of ED presentations showed increases in respiratory related categories and chest symptoms (Table 2, Figure 2). While presentations for asthma and respiratory disease (excluding asthma) were

increased over the previous 3 year average these were not statistically significant. However, a significant increase was seen in the "respiratory symptoms" classification across all age groups. This classification is contained in the ICD9 category of "Symptoms, signs and ill defined conditions". The respiratory symptoms classification includes respiratory abnormality (shortness of breath and respiratory distress) as well as stridor and cough. The classification of chest symptoms is also included in the category of "Symptoms, signs and ill defined conditions" and includes chest pain, precordial pain and painful respiration. The chest symptom grouping was increased when compared with the previous 3 years but not at a level of statistical significance. Studies of the impact of smoke pollution have generally focussed on asthma presentations and sometimes COPD. This study found that significant increases in ED presentations occurred for conditions classified in the category of "Symptoms signs and ill defined conditions" but not in the ICD9 category of Respiratory Disease.

T**able 2:** Emergency Department presentations at Albury Base Hospital by ICD 9 category for selected conditions in January/February 2000-2002 (average) and 2003.

ICD 9 Category	2000-2002 average ED presentations (% of total)	2003 ED presentations (% of total)	Statistical Significance
Asthma	40 (1.0)	50 (1.3)	$\chi^2 = 1.02$ p = 0.312
Other respiratory (non asthma)	167 (4.2)	174 (4.4)	$\chi^2 = 0.085$ p = 0.770
Respiratory symptoms	42 (1.1)	70 (1.8)	$\chi^2 = 6.82$ **p = 0.009**
All respiratory categories[#]	*249 (6.3)*	*294 (7.4)*	$\chi^2 = 3.53$ p = 0.06
Chest symptoms	111 (2.8)	137 (3.4)	$\chi^2 = 2.55$ p = 0.110
Stroke	19 (0.5)	18 (0.5)	$\chi^2 = 0.04$ p = 0.845
Coronary heart disease inc hypertension	88 (2.2)	72 (1.8)	$\chi^2 = 1.80$ p = 0.180
Eye/adnexa	52 (1.3)	75 (1.9)	$\chi^2 = 4.00$ **p = 0.046**
All other diagnoses	3433 (86.8)	3397 (85.0)	
Total	**3953 (100)**	**3993 (100)**	

Source: HOIST NSW Department of Health
Includes Asthma, respiratory (non asthma) and respiratory symptoms

Presentations for asthma at the ED of ABH for January and February of 2003 numbered 50. This compares with an average number for the same period in the previous 3 years of 40. The high spring peaks for asthma presentations each year contrast with the presentations during the pollution period in 2003 (Figure 3). Compared with the spring asthma peaks which are predominantly related to rye grass and other pollen allergy, the severe bush fire smoke pollution produced a relatively modest increase in ED presentations for asthma. When presentations for January 2003 alone are compared with January averages for the previous 3 years the increase is of marginal statistical significance (χ^2 = 3.08 1 *df*, p = 0.079). A peak in asthma ED

presentations has previously been described to occur in February each year and it is unclear of the impact of this on the comparison between 2003 and the previous 3 years.[20]

For people who presented with asthma to the ED, 64 per cent were female compared with 55, 33 and 53 per cent for the previous 3 years. Across other respiratory and chest symptom classifications male and female presentations were similar. For people who were classified as having chest symptoms, 25 (18.2%) were less than 25 years of age. This compares with an average of 12 presentations for this age group over the previous 3 years (data not shown)

Presentations for eye related conditions increased by 27 per cent over the previous 3 year average. This is not unexpected given that eye irritation is a common feature of exposure to smoke pollution. Presentations at the ED for coronary heart disease or stroke showed no increase over the previous 3 years (Table 2).

Appendix 2, Figures 4-7 shows ED presentations for selected conditions over the period of the bushfire event with daily PM10 data. Further analysis is required to investigate the correlation between the onset of symptoms, the PM10 results and the duration of the event. While total ED presentations remained constant over this period, a trend of increasing presentations for respiratory and chest symptom related classifications was evident. This requires further investigation to determine if this trend was significant although it is reasonable to assume that with exposure to the smoke pollution lasting weeks, an increasing number of people experienced respiratory and breathing complaints.

Figure 2: Percent of total ED presentations for selected conditions for Jan/ Feb 2000-2002 and 2003.

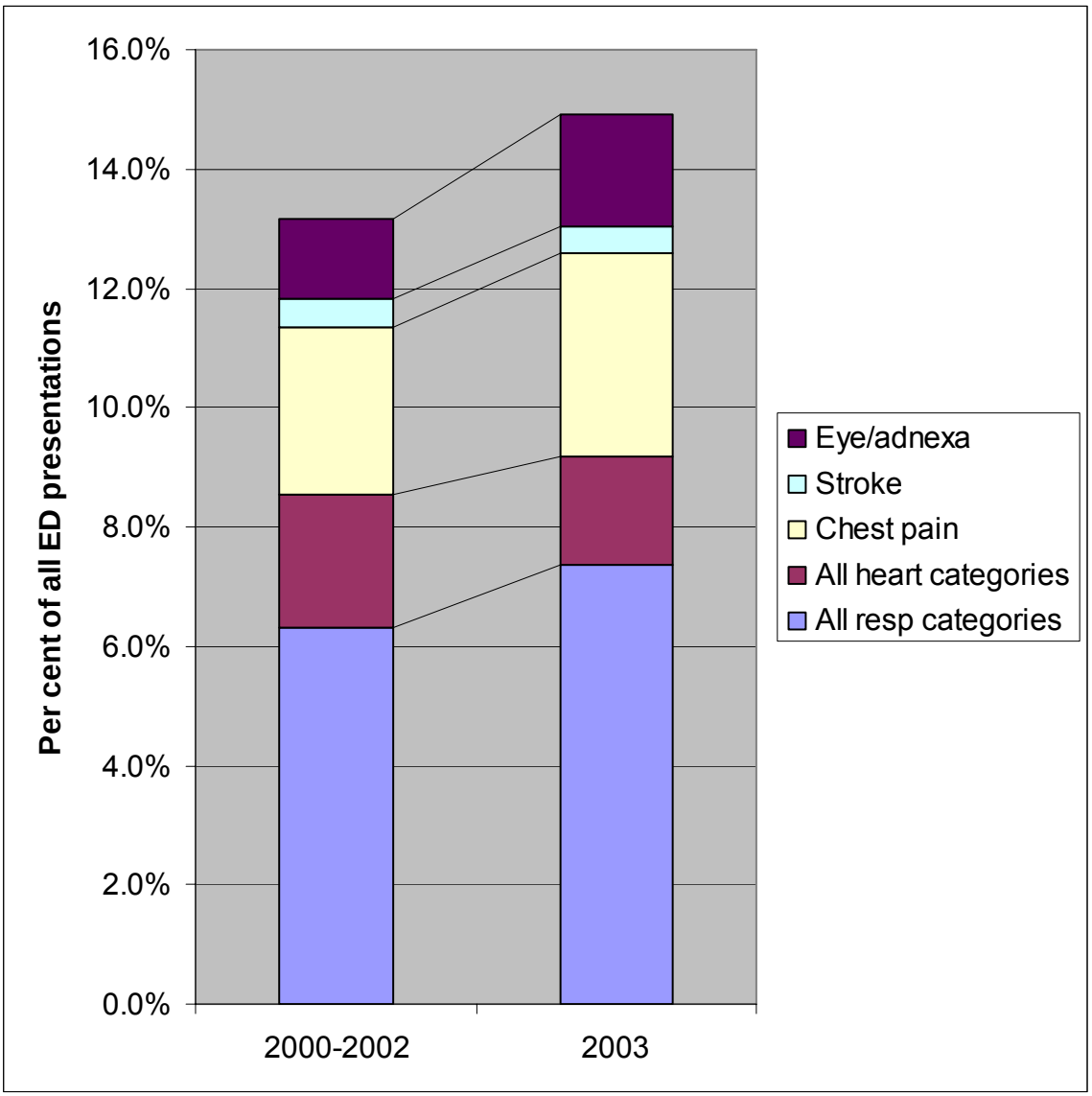
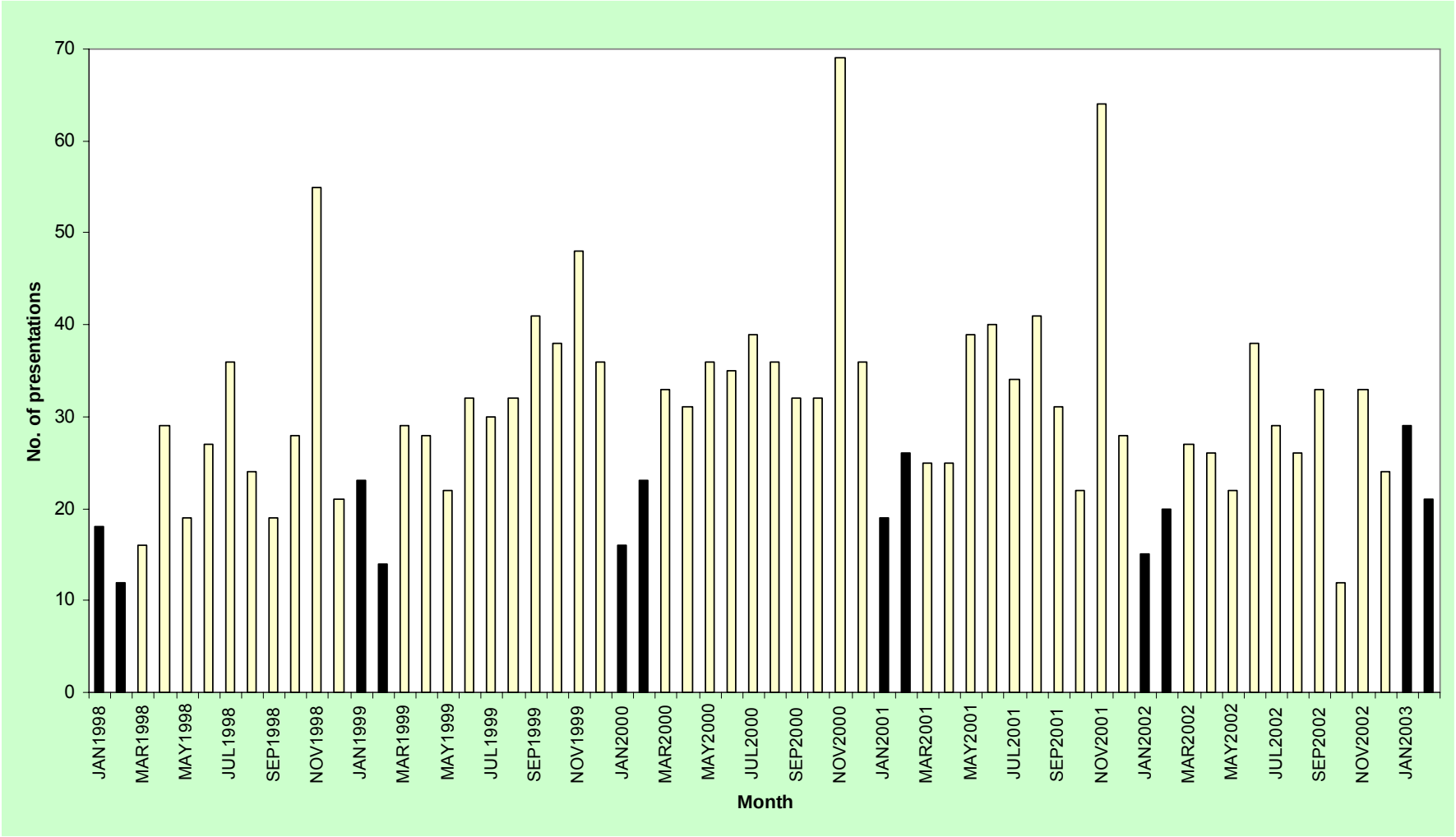


Figure 3: Presentations to Albury Base Hospital ED for asthma 1998-2003 with January /February highlighted



3.3.3 Discussion of Emergency Department Presentations

The bushfire smoke pollution produced an increase in ED presentations for respiratory and chest related classifications. This is not unexpected given the extreme smoke pollution experienced. Increased presentations occurred for a range of respiratory signs and symptoms which were given a diagnostic classification included in the category of "Symptoms, signs and ill defined conditions". It is possible that this classification was more likely to have been assigned if the individual did not have a pre-existing condition such as asthma. However to confirm this proposal would require a review of the medical records. In assessing the health impact of smoke pollution, researchers should consider presentations classified under the "Symptoms, signs and ill defined conditions" as well as asthma and other specific respiratory classifications. The findings of the review of ED presentations are consistent with the literature in that bushfire smoke increases respiratory symptoms including cough, wheezing, shortness of breath and chest tightness in susceptible people. Morgan et al demonstrated increases in ED presentations for all respiratory conditions, COPD and asthma associated with bushfire pollution.[8]

The increase in asthma presentations during the bushfire event is modest when compared with spring asthma peaks and the increase in presentations for other respiratory and chest symptoms. People with pre existing asthma are considered more likely to develop symptoms during a smoke pollution event.[2] It is unknown what proportion of people with asthma experienced a hypersensitive reaction to allergens in the smoke compared with those who experienced deteriorating lung function because of inflammation caused by inhaled particulate matter. It is possible that people with a pre-existing diagnosis of asthma are more likely to be classified as an asthma presentation. Long et al found that bronchial hyperresponsiveness was not significantly associated with the development of symptoms in subjects with existing respiratory disease following exposure to smoke from agricultural burning.[12]

Females comprised 64 per cent of presentations for asthma during the bushfire smoke period while other respiratory classifications showed generally equal proportions of females and males. The relevance of this finding remains unclear. Long et al studied symptoms in people who were enrolled in a Lung Health Study following exposure to smoke from agricultural burning and found that women were significantly more likely to report respiratory symptoms.[12] Children and the elderly are considered at higher risk of the effects of bushfire smoke. While more presentations for chest symptoms occurred in children during the bushfire event, an increased proportion of children were not seen in other respiratory classifications. Increased rates of presentation were not seen for older age groups across any of the reviewed classifications.

The quality of information contained in EDIS is influenced by the comprehensiveness of the medical record and the automatic coding process as well as by the classification system used. It is unclear what impact these issues have had on the ED data used in this analysis. This study found a

significant increase in presentations, likely to be smoke related, classified in the “Symptoms, signs and ill defined conditions”. Other studies have focussed on the relationship between smoke pollution and asthma and sometimes COPD presentations which, based on the experience of this study, would underestimate the health impact of the event. It is suggested that a review of medical records of people presenting with asthma and other respiratory symptoms at the time of the bushfire smoke would be beneficial in further describing the health impact of the pollution event.

It is also unclear what influence public health advisories had over ED presentations. It is possible that, by heeding public health advice, the number if ED presentations was reduced. On the other hand public health advisories recommended that people with breathing difficulties should seek medical attention and this may have increased presentations.

Finally, the analysis of ED presentations at ABH for the bushfire period has not been exhaustive and a number of important issues are yet to be investigated.

- What is the relationship between the PM10 levels and the number of, and reasons for, presentations to ED? An analysis should incorporate the investigation of lag times on this relationship.
- An examination of the medical records of people who presented at the ED with smoke related conditions during the bushfire smoke event may provide further information on the nature of presenting symptoms and allow a better description of the morbidity that the bushfire smoke produced.
- What is the significance of apparent increasing trends in ED presentations for respiratory and chest related symptoms over the course of the event and what are the implications for populations exposed to high levels of smoke pollution for an extended period?
- Smoke pollution and increased PM10 is associated with increased mortality. High pollution levels are also associated with low birth weight. Was the bushfire pollution event associated with increased mortality in the community or increased prevalence of low birth weight babies?

3.4 Survey of Health Effects of Bushfire Smoke and Effectiveness of Public Health Interventions

3.4.1 Introduction

The bushfire smoke pollution in Albury in January/ February of 2003 produced PM10 levels of particulate pollution not previously reported in Australia with daily average PM10 results peaking above 400ug/ m^3. Based on 10 readings only, the peak PM10 period was experienced on the 23rd January when the average PM10 result was 701ug/m^3. This was alarming to public health staff who were providing health advice and monitoring the health effects of the pollution. Draft information from the NSW Department of Health on Air Pollution Health Alerts identified that 24 hour average PM10 results of greater than 200ug/m^3 are considered hazardous for the general population. When PM10 levels more than twice this top alert level were achieved and the smoke pollution appeared to be worsening, public health staff had little information to draw on in regard to the likely impact on the population. Health advisory messages and options including the establishment of clean air centres and evacuation were considered. However the health impact of this extreme event and the effectiveness of the public health interventions undertaken remained unknown. The Environmental Health Branch of the NSW Department of Health provided funding which allowed a survey of the Albury community to be undertaken using a Computer Assisted Telephone Interview (CATI) process operated by the NSW Health Survey Program. The aim of the survey was to determine the health effects of the bushfire smoke and the effectiveness of public health interventions.

3.4.2 Methods

The survey questionnaire was developed by public health staff in consultation with staff of the Environmental Health Branch and the CATI Unit of the Epidemiology and Surveillance Branch of the NSW Department of Health. A copy of the questionnaire is found in Appendix 3. The telephone numbers were selected randomly from a bank of numbers for the Albury Local Government Area (LGA) and trained interviewers at the CATI Unit were used to undertake the interviews. The survey was restricted to the Albury LGA to limit any effect of different levels of exposure to the bushfire smoke. People aged 16 years and above were questioned with the survey and where the selected household respondent was less than 16 years of age a parent was asked to complete the survey on the child's behalf. Informed consent was obtained at the commencement of the interview. Once the household was contacted the respondent was randomly selected from all household members. Respondents who were not in Albury at the time of the bushfire smoke event or those who did not speak English were excluded from the survey. The 2001 ABS Census reported that 0.3 per cent of the Albury LGA population could not speak English well or not at all.

A pilot survey was conducted of 12 respondents to trial the process and the questionnaire. The common responses to the open ended questions of the pilot survey were used to identify the main categories for responses to the

open ended questions in the main survey although allowance was made for accepting other responses.

The responses were weighted according to the December 2002 Estimated Resident Population for the Albury LGA calculated from the 2001 Census. Ethical approval for the study was obtained through the Greater Murray Area Health Service Ethics Committee.

The survey was conducted over a 2 week period in late February and early March 2003.

3.4.3 Results

Using the random digit dialling system, a total of 1463 calls were made to achieve 415 interviews. There were a total of 97 refusals including both household and respondent refusals, giving a response rate of 81.1 per cent. Twenty six responses were excluded from the analysis because the selected respondent was not in Albury at the time of the bushfire smoke pollution to give a final total of 389 interviews. The responses were weighted for household size and to the Albury population so that the results are reported as a percentage of the Albury population and weighted persons estimates rather than a percentage or number of respondents to the questionnaire. The person estimates are rounded to the nearest whole number.

The health effects

Symptoms experienced

Seventy per cent of the Albury population reported suffering from some type of health effect due to the smoke, which equates to around 30,500 people.

Table 3: Symptoms reported by age

Symptoms	0-15	16-24	25-39	40-59	60-74	75 +	All ages	Estimated Persons
Eye irritation	33.0	51.5	61.9	63.6	58.8	42.6	52.8	22922
Coughing	26.0	29.9	34.7	35.9	37.3	30.8	32.4	14032
Throat irritation	24.5	26.0	29.7	31.2	34.9	32.5	29.0	12580
Shortness of breath	14.0	28.3	21.3	28.5	31.9	34.8	24.3	10521
Headache	19.1	15.8	18.6	22.7	25.3	7.1	19.4	8428
Wheezing	7.3	17.2	8.8	13.0	15.8	11.2	11.6	5013
Asthma	8.4	16.7	9.3	12.2	5.4	12.4	10.7	4632
Anxiety	8.7	8.1	3.9	11.1	18.5	5.9	9.0	3921
Depression	1.6	0.0	2.6	8.2	17.7	4.3	5.0	2171
Other	1.7	0.0	10.3	3.2	9.0	3.1	4.5	1951
Bronchitis	6.5	0.0	0.0	0.5	3.1	2.7	2.1	909
Angina	0.0	0.0	0.0	0.8	0.0	0.0	0.2	92
No symptoms %	*41.6*	*32.4*	*29.0*	*20.3*	*19.7*	*36.0*	*29.6*	*12846*
Any symptoms %	*58.4*	*67.6*	*71.1*	*79.7*	*80.3*	*64.0*	*70.4*	*30537*

Notes: Percentages based on all respondents (n=389)

The most common symptoms were eye irritation (53%), coughing (32%) throat irritation (29%), shortness of breath (24%) and headache (19%). Across the age groups, children were least likely to have reported specific symptoms and the 50-59 and 60-74 year age groups were most likely to have been affected (note: symptoms for children may be underreported as they would be difficult to detect in toddlers and babies) (Table 3). Females were more likely to report symptoms than males, 74 per cent of females compared to 67 per cent of males.

Health risks

People who had no respiratory or heart conditions were less likely to suffer health effects due to the smoke than those with the "risk" conditions. People with asthma were most likely to suffer some type of symptoms (88%), followed by those with respiratory conditions (including asthma) (85%) and those with heart disease/ high blood pressure (83%) compared to people with no reported health conditions (62%) (Table 4).

Around 40 per cent of the people with asthma said the smoke had induced asthma symptoms, near 50 per cent had a cough, 44 per cent had shortness of breath and 26 per cent had wheeze.

Table 4: Reported symptoms by "risk" condition

	REPORTED HEALTH CONDITION				TOTAL
Symptom	None	Heart	Respiratory	Asthma	POP
Eye irritation	47.2	60.9	63.7	66.1	52.8
Coughing	24.7	47.3	47.6	49.4	32.4
Throat irritation	25.1	36.6	34.9	34.9	29.0
Shortness of breath	15.0	43.2	42.5	44.2	24.3
Headache	17.8	21.9	23.6	22.2	19.4
Wheezing	6.0	20.4	24.0	25.6	11.6
Asthma	1.1	19.1	33.3	39.1	10.7
Anxiety	5.7	19.2	16.1	16.3	9.0
Depression	3.3	13.6	6.5	6.1	5.0
Other	5.2	6.2	3.4	2.9	4.5
Bronchitis	0.7	1.9	5.1	5.7	2.1
Angina	0.0	1.6	0.0	0.0	0.2
No symptoms	37.6	17.4	15.1	11.9	*29.6*
Any symptoms	62.4	82.6	84.9	88.1	*70.4*

Note: Percentages are calculated on the 77 people who had heart conditions, 224 had no conditions, 105 with respiratory conditions (including asthma) and 82 who had asthma. Some people had more than one condition and are therefore included in more than one category.

Spending time working outdoors

People who were working (paid or unpaid work and not on holidays) were asked if they spent much of the time during the smoky periods working outside. Of those who said they spent most of the time working outdoors, 82 per cent said they had some type of smoke-induced symptoms. This reduced with the amount of time spent working outdoors with 71 per cent of those who spent some time working outdoors experiencing symptoms and only 66 per cent of those who spent very little time outdoors. However those who reported

spending “no time” working outdoors experienced symptoms in 84 per cent of cases (based on 159 people who were working (paid or unpaid) 33 most, 38 some, and 87 little or no time outside).

Cigarette smoking status and symptoms

Cigarette smoking was also considered to be a risk factor for susceptibility to smoke-induced symptoms. Current smokers experienced symptoms in 76 per cent of cases, past smokers in 84 per cent of cases and non-smokers had the lowest level at 65 per cent of cases (based on 73 current smokers, 103 past smokers and 144 non-smokers, aged 16 years or over).

People who sought treatment

Five per cent of people reported seeking treatment from a health professional for the symptoms induced by the smoke, this equates to an estimate of 2,000 people. Half of these sought treatment from a General Practitioner, about one-quarter at an ED and a further quarter consulted a pharmacist. Note, that in the survey sample, only 21 people sought treatment, 14 at GPs, two at ED and four at a pharmacy, thus the population estimates are difficult to interpret due to small numbers

Public Health Advisories

Who heard the messages

Seventy-four per cent of the Albury population, who were in the area at the time of the bushfires, heard, saw or read of the health warnings delivered by Public Health. Of the adult population (aged 16 years or greater) 76 per cent of males heard the messages compared to 73 per cent of females. People aged over 75 years were the least likely to recall hearing the messages (58%), across all other age groups the percentage who heard the messages was 73 per cent or greater (Table 5).

Those with higher levels of education were more likely to recall hearing the messages than those with lower education levels. Eighty per cent of those with tertiary education heard the messages compared to 72 per cent with Diploma or TAFE qualifications, 72 per cent who had completed high school, 69 percent who had completed to school certificate level and 62 per cent who had completed primary school only.

Those who were not currently working or looking for work were the least likely to hear the messages (68%), this is likely due to the those in the older age groups being in this category. Seventy-seven per cent of the unemployed reported having heard the message, compared to 73 per cent of people who were working.

What was the source of the health warnings

Of those who heard the warnings 68 per cent recalled seeing them on television, 41 per cent read them in the newspaper and 53 per cent heard them on the radio (Table 5). Television was the most effective medium for

message delivery across all age groups except the 25-39 year olds, where hearing the messages on radio was more likely to be reported. Of the radio stations specified on which the messages were heard, the locally broadcast ABC was the most frequently mentioned at 34 per cent, followed by 32 per cent reporting the local commercial station of STAR FM (Table 5).

Other sources of information about the health messages included friends, relatives or work colleagues (10%) and other sources mentioned were school newsletters, doctor, hospital (3%).

Table 5: People who heard/read/saw messages, by age group

	Parents[c]	16-24	25-39	40-59	60-74	75 +	All ages	Estimated Persons
Heard/read warnings	74.1	72.8	78.6	74.4	75.4	57.7	74.2	32201
▪ **Television**[a]	72.3	72.8	55.8	51.6	52.9	40.1	67.6	21753
▪ **Newspaper**[a]	38.5	31.6	40.3	35.5	26.4	36.4	40.9	13182
▪ **Radio**[a]	55.5	51.9	57.7	35.9	36.7	31.9	52.9	17042
- **2AY**[b]							15.1	2574
- **ABC (local)**[b]							34.1	5807
- **The RIVER**[b]							16.5	2819
- **STAR FM**[b]							31.6	5380
- **Don't recall station**[b]							4.3	729

Notes
a) Percentage for television, radio and newspaper is calculated on the total number who heard/read messages in each age group, multiple response allowed.
b) Specified radio station percentages are based on those who said they heard it on radio (n=165), multiple response allowed.
c) Parents refers to parents/carers of the 0-15 year olds included in the survey

Main message of the public health advisories

People were asked an open-text question about what they recalled as the main message from the health warnings. These responses were categorised in the following table, multiple issues were coded and respondents could possibly have mentioned one or all categories (Table 6). Over half the people who heard the messages said the main message was to stay indoors, avoid going outside, or stay indoors as much as possible. Close to a third of people mentioned that there was a health risk for people who had asthma or other respiratory problems and approximately one-quarter of people mentioned that people should reduce their outdoor activities/ exercise. Only eight per cent reported that there was a particular risk for children or the elderly.

Interestingly, 3 per cent interpreted health warnings/messages as the fire-danger warnings as opposed to the health warnings regarding smoke exposure.

Table 6: Reported main message of the health warnings

The main message	Per cent	Estimated Persons
Stay indoors	53.5	17219
Risk for people with asthma and other respiratory problems	31.7	10199
Reduce/avoid outdoor activities	24.5	7872
Wear a mask	13.5	4350
Other	8.7	2787
Risk for children	7.9	2553
Risk for older people	7.8	2506
Avoid the smoke	3.6	1165
Risk from fire/ fire danger warnings	3.2	1036
Risk for people with heart conditions	0.5	176
Leave the area	0.3	91

Note: Percentages are calculated on the 296 respondents who heard the messages.

Who was the message aimed at

People were asked an open-text question about who they recalled the message was aimed at. These responses were categorised in the following table, multiple issues were coded, respondents could possibly have mentioned one or all categories (Table 7). Around two-thirds of people responded that the messages were aimed at everyone (general public, the local community etc). A further 30 per cent said the messages were aimed toward people who have asthma or other respiratory and breathing problems. 23 per cent of people said the messages were aimed at older people and 15 percent at children.

Table 7: Who was the message aimed at

Who the message was aimed at	Per cent	Estimated Persons
General public/community/everyone	65.5	21077
People with asthma, respiratory problems	31.9	10266
Older people	23.4	7524
Children	15.0	4835
People with health problems /illnesses	5.5	1754
Active / “outdoors” people	4.7	1523
People in the fire-danger areas	0.2	73

Note: Percentages are calculated on the 296 respondents who heard the messages.

Behaviour change at time of high smoke levels

It is estimated by the study that 18,400 people changed their behaviour because they heard health messages. This equates to a behaviour change *due to the messages* by 57 per cent of the people who heard the messages, and a change *due to the messages* by 43 per cent of the overall Albury population (Table 8).

If people said they did not change their behaviour due to hearing the messages they were then asked if they changed their behaviour due to the smoke (this category includes those who did not hear the messages). The study estimated that there were a further 12,030 people who reported changing their behaviour due to the smoke. In total there were an estimated 30,470 people who modified their daily activities in some way during the period of high air pollution, which equates to 70 per cent of the Albury population (Table 8).

Table 8: – Reporting behaviour change by whether heard messages

	Per cent	Estimated Persons
People who heard messages[a]:		
Changed behaviour – reported changing because of message	57.3	18442
Changed behaviour – reported changing because of smoke	18.7	6041
Total who heard messages and changed behaviour	76.0	24483
Did not change behaviour	23.2	7449
People who did not hear messages[b]:		
Changed behaviour – because of smoke	53.6	5989
Total population[c]:		
Changed behaviour – reported changing because of message	42.5	18442
Changed behaviour – because of smoke or messages	70.2	30471
Did not change behaviour	29.8	12912

Note:
a) Percentages are calculated on the 296 respondents who heard the messages.
b) Percentages are calculated on the 93 respondents who did not hear the messages
c) Percentages are calculated on the 389 respondents

People who heard the messages were twice as likely to change their behaviour (Odds Ratio= 2.15 [95%CI:1.29-3.58]), as those who had not heard the messages –(unweighted data). People who heard the health messages changed their behaviour in 76 per cent of cases whether they stated this was due to health messages or not, compared to only 54 per cent of people who did not hear the messages (Table 8).

Males were less likely to report changing their behaviour due to hearing health warnings than females, with 52 per cent of males saying they changed compared to 63 per cent of females (Table 9).

Of all age groups, children were most likely to have modified their behaviour due to their parents hearing the warnings (73%). Older people were least likely to have changed their behaviour due to hearing the messages (older people are also less likely to spend time outdoors, or doing outdoor activities).

Table 9: Changed behaviour, reason by age (per cent)

	0-15	16-24	25-39	40-59	60-74	75 +	All ages	Estimated Persons
Changed behaviour due to health warnings[a]	73.1	48.3	61.8	48.9	51.6	40.4	57.3	18442
▪ Males	70.2	50.2	49.6	36.6	58.1	29.8	51.7	5508
▪ Females	76.8	46.3	73.3	62.3	46.1	47.6	63.0	7487
Changed behaviour due to smoke[b]	69.0	33.4	39.5	54.7	40.3	37.3	48.2	12030
Heard messages and reported no behaviour change[a]	15.4	36.8	21.3	19.9	35.3	41.0	24.0	7719
Heard messages and changed behaviour [a]	84.5	63.2	78.7	80.1	64.7	59.0	76.0	24483
Changed behaviour at time of high smoke levels (all) [c]	85.8	56.8	68.9	71.2	63.5	52.0	70.2	30471
Heard messages and changed behaviour due to them (all) [c]	54.1	35.1	48.6	36.7	38.9	23.3	42.5	18442

Notes:
a) Percentages are calculated by age group of those who heard the messages (n=296)
b) Percentages are calculated by age group of all respondents except those in (a) (n=227)
c) Percentages based on all respondents (n=389)

Of adults, older males were the group least likely to change their behaviour (30%) due to the messages overall, and females aged 25-39 years were the group most likely to have changed (73%) (Table 9).

People who reported changing their behaviour during the bushfire period were then asked what they had changed. The most frequent response was to have stayed inside as much as possible (88 per cent of persons) followed by reducing outdoor activities (54 per cent) and closing windows and doors (44 per cent). There were no major differences between the behaviour changes in those who heard the messages and those who did not, although more people, who heard the messages and said they did not change because of them, said they reduced their outdoor activities level.

Wearing a class P2 particle-filtering mask was indicated for use by those at high risk needing to go outdoors on smoky days. Only a small number of people surveyed said they wore a mask which equated to 6 per cent of the population, the majority of these were people who had heard the messages.

Table 10: Changed behaviour, what did you do?

	Reason for behaviour change			Total	
	Due to message (a)	Due to smoke - heard messages (b)	Due to smoke - didn't hear messages (c)	Per cent	Estimated Persons
Stayed inside as much as possible	89.7	84.3	87.2	88.1	26845
Reduced outdoor activities	52.0	62.3	51.6	54.0	16442
Closed windows and doors	45.1	40.9	44.0	44.0	13408
Dried clothes inside	17.7	26.9	13.8	18.7	5710
Travelled out of area	11.7	23.3	13.8	14.4	4400
Put ceiling fans on	10.5	14.9	2.9	9.9	3015
Other	8.3	0.0	3.4	7.0	2139
Wore a mask	8.1	3.5	1.3	5.9	1782
Increased regular medication	2.3	0.0	1.3	1.6	497
Fire fighting	1.7	1.0	0.0	1.2	366
Commenced taking medication	1.5	0.0	0.0	0.9	273

Notes: Multiple response allowed.
a) Percentage based on 162 changed behaviour due to messages;
b) Percentage based on 52 people heard messages but said they changed due to smoke (not messages)
c) Percentage based on 51 people who changed because of smoke, but didn't hear messages

The effect of risk conditions on message recall and behaviour.

People with respiratory conditions were more likely to report having recalled the messages as well as to have changed their behaviour due to the messages than people with other conditions or no conditions (Table 11).

Table 11: Heard warnings and behaviour change by condition (per cent)

	REPORTED HEALTH CONDITION				TOTAL
	None	Heart	Respiratory	Asthma	POP
Heard messages	71.1	75.8	81.6	82.4	74.2
Changed behaviour due to messages	55.0	53.4	61.4	63.0	57.3
Changed behaviour (total who heard messages)	75.1	73.0	79.9	81.8	76.0
Changed behaviour (did not hear messages)	49.6	58.3	69.2	79.9	53.6

Note: Percentages are calculated on the 77 people who had heart conditions, 224 had no conditions, 105 with respiratory conditions (including asthma) and 82 who had asthma. Some people had more than one condition and are therefore included in more than one category.

Who message was aimed at by presence of "risk" conditions:

People with heart conditions or respiratory conditions were no more likely to recall the message being aimed at people with these conditions than people who had no "risk" health conditions. People with no reported risk conditions were more likely to recall that the message was aimed at people with

respiratory disease (35%), than people who reported having respiratory disease (27%). People who reported being asthma sufferers were more likely to respond that the message was aimed at everyone/ general public than those with no risk conditions.

Table 12: Who was the message aimed at, by condition

The message aim	REPORTED HEALTH CONDITION None	Heart	Respiratory	Asthma	TOTAL POP
General public/community/everyone	63.6	64.2	69.9	72.7	65.5
People with asthma, respiratory problems	34.9	27.2	26.6	26.5	31.9
Older people	24.2	29.4	22.2	21.6	23.4
Children	14.6	21.0	16.2	17.4	15.0
People with health problems /illnesses/heart	5.1	5.7	6.4	6.5	5.5
Active / "outdoors" people	4.0	13.8	5.9	6.8	4.7

Note: Percentages are calculated on the 169 people who had no conditions, 56 who had heart conditions, 84 with respiratory conditions (including asthma) and 68 who had asthma (AND had heard the messages). Some people had more than one condition and are therefore included in more than one category.

3.4.4 Discussion of Survey

This study describes the impact of an extreme smoke pollution event on a community over a 40 day period and demonstrates substantial health effects, particularly on people with pre-existing respiratory and cardiovascular disease. The findings are consistent with other studies of smoke pollution which have found an increased rate of respiratory symptoms, eye and throat irritation as well as exacerbations of existing respiratory and cardiopulmonary conditions.[12,15-17] The findings may be generalised to other populations exposed to bushfire smoke pollution. The study also demonstrated the benefit of public health advisories disseminated through main stream media to elicit behaviour change and reduce exposure to bushfire smoke. These findings are consistent with other studies.[16,17]

The survey of Albury residents was conducted shortly after the smoke pollution occurred, with the survey completed within about 3 weeks of the PM10 levels returning to normal following the smoke event. The timeliness of the survey should have served to minimise the possibility of recall bias. Kunzli et al noted the importance of the timeliness of obtaining symptom related information with their study collecting information up to 7 months after the event. In that study, for some symptoms the reporting decreased over time and for eye related symptoms the reporting increased over time.[17]

This survey assumed that the Albury LGA experienced uniform levels of pollution during the smoke pollution event. While the TEOM operated by the EPA is located in a geographically central area of the Albury LGA, it is possible that parts of Albury experienced different pollution levels. This may have resulted in different exposures for residents. However the size of the Albury LGA at the time of the survey was 106 sq km, a relatively small area, and it is likely that this area experienced reasonably consistent smoke

pollution levels. The survey incorporated no individual measures of exposure to the smoke pollution although people who were not in Albury at the time of the pollution were excluded from the survey. The public health messages and the smoke pollution altered the behaviour of a large proportion of the population and as a result a reduction in individual exposure is likely to have occurred. It is proposed that this would have contributed to a reduction in the health impact of the smoke pollution.

The public health messages and other media coverage of the fires and smoke pollution did identify symptoms related to smoke exposure such as sore and itchy eyes, headache and sore throat. The messages also advised people with breathing difficulty to attend the ED. This may have served to reinforce opinions about the symptoms experienced by the survey respondents. Also in interpreting the results of this survey caution is appropriate since symptoms, exposures and behaviours were self reported.

While it is not possible to quantify the effects or dismiss the possibility of biases, it is considered that the issues discussed above have not had a significant effect on the validity of the results of the survey.

The finding that 70 per cent of the population of Albury had some health effect due to the smoke is consistent with Mott et al's study where over 60 per cent of the community reported symptoms. People with underlying respiratory or cardiovascular disease were more likely to report symptoms with 88 per cent of people with asthma reporting symptoms and almost 83 per cent of people with cardiovascular disease. Studies have consistently shown that people with underlying respiratory and cardiopulmonary conditions to be more likely to experience symptoms associated with exposure to smoke pollution.[12, 16,17]

Despite the extreme pollution levels and the high proportion of residents experiencing symptoms, 5 per cent of the respondents reported seeking treatment for symptoms associated with the smoke pollution. Mott et al reported that medical clinic visit for respiratory illness increased by 52 per cent.[16] Kunzli et al reported that 10.6 per cent of children exposed to smoke pollution visited a doctor for smoke related symptoms and it is acknowledged that children are more susceptible to the effects of smoke pollution.[2,17]

Seventy four per cent of respondents reported hearing, seeing or reading the public health advisories suggesting that the mainstream media can be used successfully to disseminate public health messages about smoke pollution. Given that elderly people are more susceptible to the effects of smoke pollution and just less than 58 per cent of respondents 75 years and over reported awareness of the messages, it may be necessary to explore other mechanisms to inform older people. However the level of exposure for older people and therefore the level of risk remains unknown since they reported that they were less likely to spend time outdoors. This may reflect the more sedentary lifestyle of older people.

Television news broadcasts were the most commonly cited sources of information. The ABC radio, which plays an important role as the identified

emergency broadcaster, is another major source of information for the public. In smoke pollution events it is considered important that early in the event an agency is identified and becomes recognised by both the public and other agencies as the source of health advisory information. It is appropriate that the local Public Health Unit undertake this role in cooperation with the EPA where possible.

The respondents reported the main message of the health warnings to be "stay indoors" with 53.5 per cent of people who heard the public health advisories, recalling this message. A further 24.5 per cent recalled the message to be to "reduce/ avoid outdoor activities". This relatively simple message does appear to be effective in both reducing exposure to the smoke and reducing strenuous outdoor activity. It is reported that up to 75 per cent of particle pollution can penetrate into houses. However this assumes a regular exchange of air which would be minimised by keeping doors and windows closed and an air-conditioning system on recycle mode.[2]

Of people who heard the public health advisory messages, 76 per cent changed their behaviour. This was significantly different from the proportion that did not hear the advisories and changed behaviour (54%). Of parents who heard the public health advisories 73 per cent changed the activities of their children less than 16 years of age as a result of the health message. The effectiveness of the public health advisories is supported further by the reported behaviour change with most people reducing their outdoor exposure (Table 6). This was particularly the case for people with pre-existing conditions.

The benefit of masks in mitigating the impact of smoke pollution remains uncertain. Kunzli et al reported that wearing masks during a smoke pollution event had a beneficial effect .[17] Mott et al found mask use to be ineffective and positively associated with outdoor exposure. The authors suggested that inconsistent use of masks and perhaps lack of appropriate fit testing as well as the variability in the effectiveness of masks chosen for use, may be contributing factors. In the Albury study, 5.9 per cent of people reported wearing a mask. While information was provided through the public health advisories on the recommended type of mask and when to wear the mask, no information was given on the need for fit checking.[16] With only a limited time to get across public health messages in the main stream media it remains unclear if public health should actively promote the use of masks to the public. It may be better to specifically target mask use for people who are required to be outdoors and who can be given additional information on how to fit check masks and replace these when required. Included in the category for masks may include essential service workers. Current mask designs are unsuitable for children or people with beards. Masks are uncomfortable to wear, contribute to heat stress and increase air flow resistance which may increase the risk for people with respiratory of cardiopulmonary disease. Mask use may provide the wearer with a false sense of protection causing them to ignore other public health messages.[21]

With more than 70 per cent of the Albury community changing their behaviour as a result of the smoke pollution and just over 70 per cent, (equivalent to 30537 people) experiencing symptoms, the impact of this event on the community was substantial. Included in the group who changed their behaviour is an estimated 4400 people who left the area because of the smoke pollution. The study provides evidence that simple public health advisories are successful in changing behaviour and reducing exposure to smoke in populations during pollution events. The public health messages achieved higher levels of recognition and behaviour change in people with pre-existing respiratory and cardiovascular conditions. This is consistent with other studies.[17]

4.0 Conclusion

This report describes the health impacts on the community of Albury of an extreme smoke pollution event in early 2003 which lasted over 40 days and with PM10 results reaching levels described as “hazardous”. The report highlights the important and legitimate role of Public Health as a key source of public health information during pollution events. Public health advisories were well recognised and resulted in a significant behaviour change in a large proportion of the community.

It is not possible to quantify the morbidity that public health interventions avoided however it is proposed that simple health advisory messages for the general population along with advice which resulted in the cancellation of community events were effective in reducing exposure to smoke pollution and therefore symptoms associated with smoke exposure. The survey revealed that people with pre-existing health conditions were more likely to have heard and heeded health advisories and it is proposed that substantial morbidity was avoided for this group.

Public Health staff should be prepared for providing advice which may result in the cancellation or postponement of public and sporting events and changes to outdoor work practices. These issues have important economic and social impacts on the community.

The report identifies the need for further work on a number of issues. The use of visibility as a proxy for smoke pollution proved a valuable tool for Public Health practitioners by providing a timely means of assessing the risk of exposure to the smoke pollution. It is proposed that the promotion of visibility as a proxy for smoke pollution could become an important part of public health advisory statements and a means of encouraging the public to make their own assessment of risk from smoke pollution. However further work is required to validate the relationship between PM10 levels and visibility.

The literature contains inconsistent results on the benefits of wearing masks during smoke pollution events. While masks can theoretically provide protection from particulate pollution, further work is required to determine the circumstances where masks should be recommended. Recommendations for wearing masks should be accompanied by information including what type of mask to use, how masks are fitted and checked as well as how often masks should be changed.

The promotion of portable air cleaners employing HEPA filters should be considered as part of future public health advisories for at risk individuals or groups. This equipment is available for hire. Consideration should be given to providing access to air cleaners for disadvantaged groups.

This study does not examine the impact of the smoke pollution on mortality and other outcomes such as low birth weight which have been reported as a

result of smoke pollution. Also the long term effects of a single severe smoke event such as the one experienced in Albury in 2003 are unknown.

5.0 References

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6.0 Appendices

Appendix 1: Smoke Pollution Fact Sheet

Health Effects

The health effects from breathing bush fire smoke vary between people and can range from an irritation of the eyes and respiratory tract, to more serious disorders such as asthma, bronchitis and reduced lung function. The type of effect depends on a variety of factors such as a person's age, their susceptibility, the composition and concentration of the smoke and the duration of the exposure. Yet, not everyone who is exposed to the smoke will have health problems and most healthy adults who experience symptoms will recover quickly and not suffer any long-term consequences. However, there are other people are at an increased risk of experiencing more severe acute and chronic symptoms from smoke exposure. These people include:

- Individuals with asthma and other respiratory disease.
- Individuals with cardiovascular disease.
- The elderly.
- Children.
- Smokers.

Recommendations

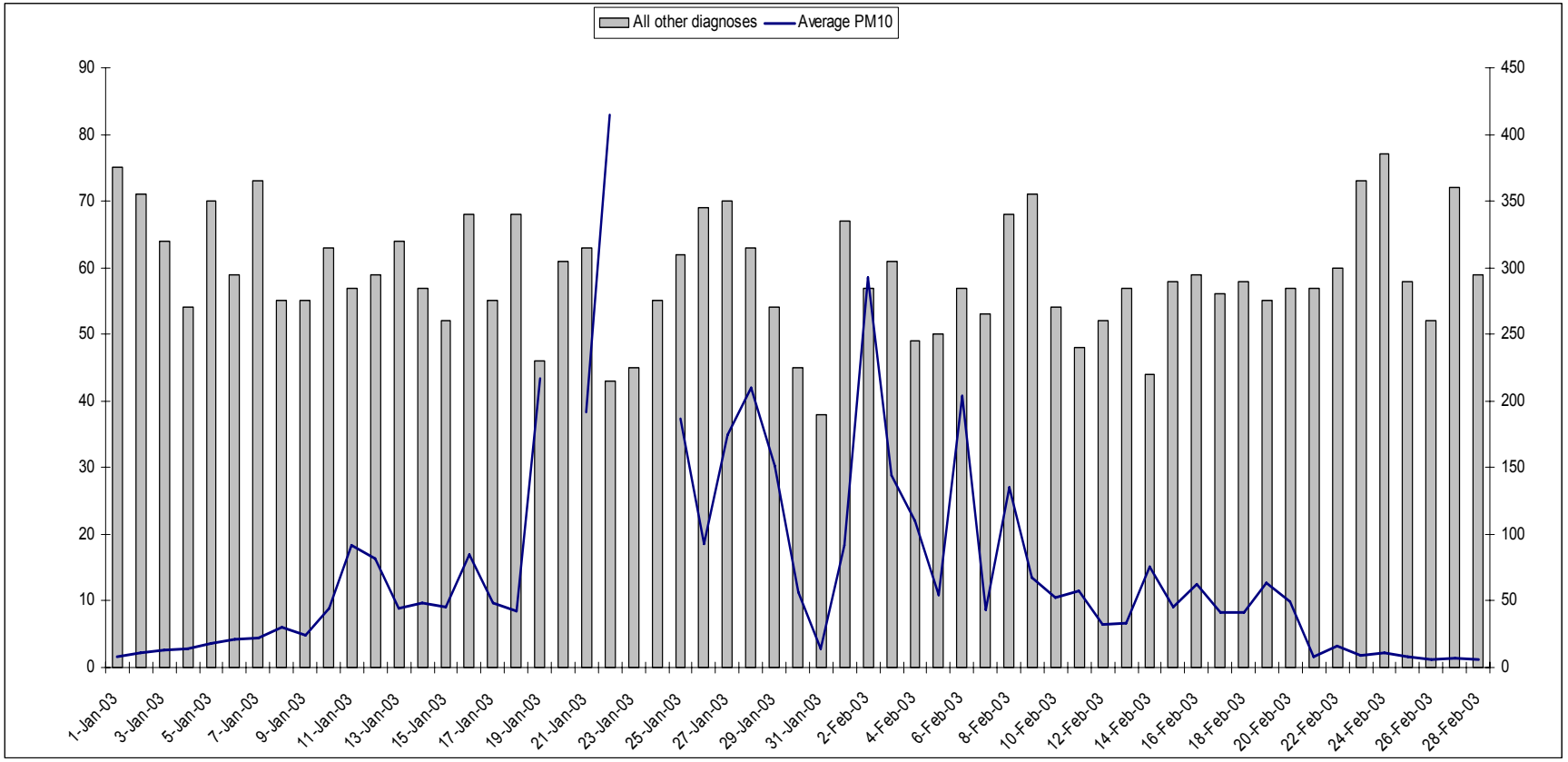
The table below is intended as a guide for the general community to reduce the possible health effects from inhaling bush fire smoke. The Centre for Public Health will provide information through the media on smoke levels. Because the conditions can change rapidly the level of visibility provides an indication of particle pollution. To use the visibility guide, face away from the sun and determine the limit of visibility by looking at what distance known landmarks totally disappear.

Warning Level	Advice to the Community
Low Level (Unhealthy for sensitive people) (Visibility 5 – 8 km)	**People at special risk (see above) should:** • Pay attention to symptoms and follow your asthma management /action plan. • Minimize the time spent outdoors & stay indoors with doors and windows closed. • Avoid indoor smoke (cigarettes, wood stove) and vacuuming. • Keep more than a five-day supply of medication. • If symptoms persist contact your doctor. • If driving is unavoidable, drive with the car air conditioner on recycle mode.
Moderate Level (Unhealthy) (Visibility 2 – 5 km)	**People at special risk should:** • Wear a face-mask with a "P2" rating if outside the house. • Rest and limit any physical activity. **The general population should:** • Minimise the time spent outdoors & stay indoors with doors and windows closed. • If driving is unavoidable, drive with the car air conditioner on recycle mode. • Seek medical attention if experiencing chest pain or difficulty breathing. • Turn home air conditioning to recycle mode.
High Level (Very Unhealthy) (Visibility 1 – 2 km)	**People at special risk should:** • Consider leaving the area. • Contact your General Practitioner and discuss options. **The general population should:** • Wear a face mask with a "P2" rating if outside the house. • Avoid vigorous outdoor activity, consider re-scheduling outdoor sport events.
Severe Level (Hazardous) (Visibility less than 1km)	**The general population should:** • Rest and avoid outdoor activity (All previous recommendations apply)

Note: Logos and other identifications removed

Appendix 2: Daily Emergency Department presentations for selected conditions Jan/Feb 2003 with PM10 daily averages (ug/m^3)

Figure 4: ED presentations to Albury Base Hospital for diagnoses other than respiratory/chest symptoms/coronary heart disease and stroke and daily PM10 results



Note: Breaks in graph are due to missing data on those days

Figure 5: ED presentations to Albury Base Hospital for asthma, respiratory disease excluding asthma and respiratory symptoms and daily PM10 results

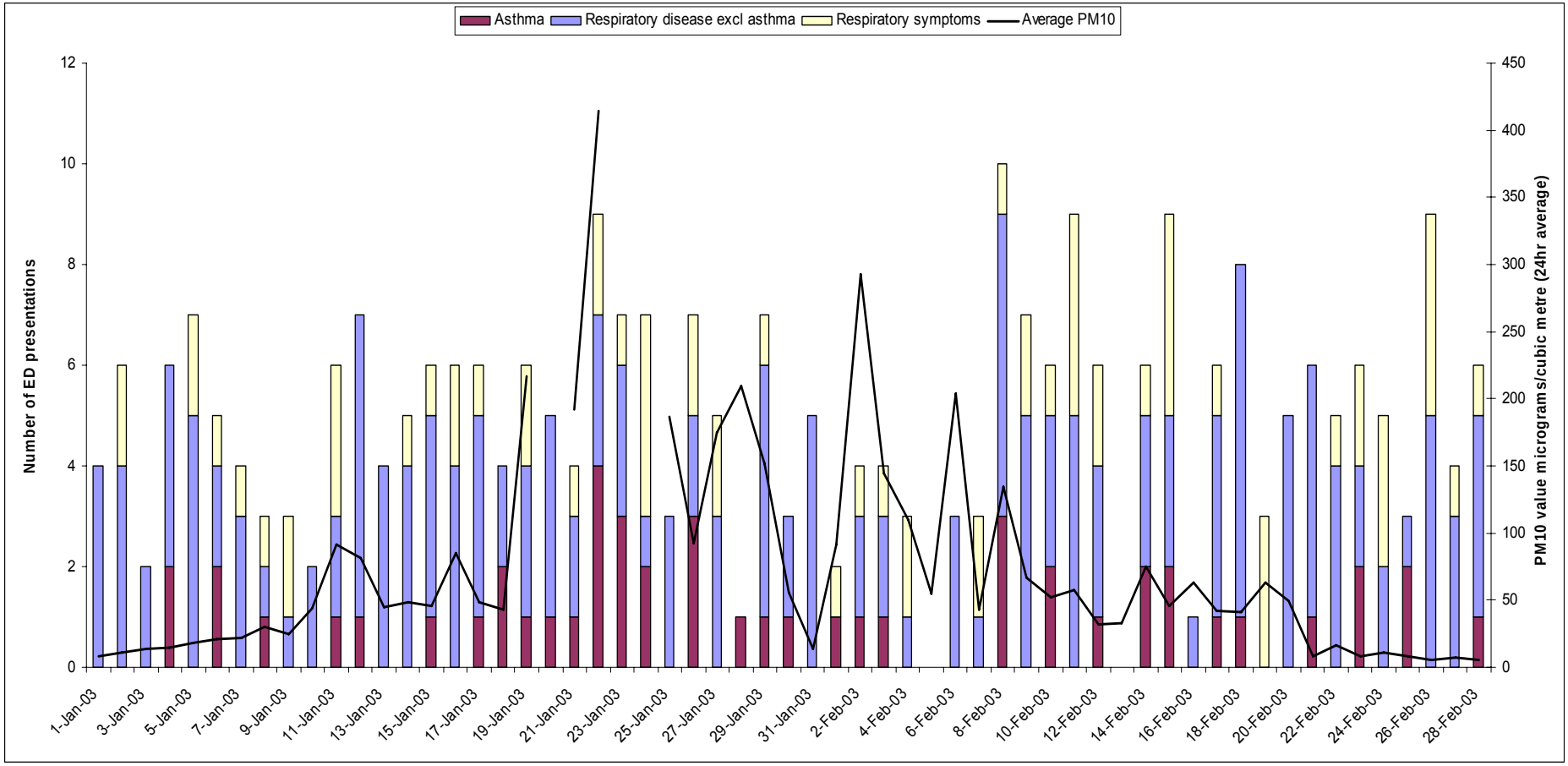


Figure 6: ED presentations to Albury Base Hospital for chest pain and daily PM10 results

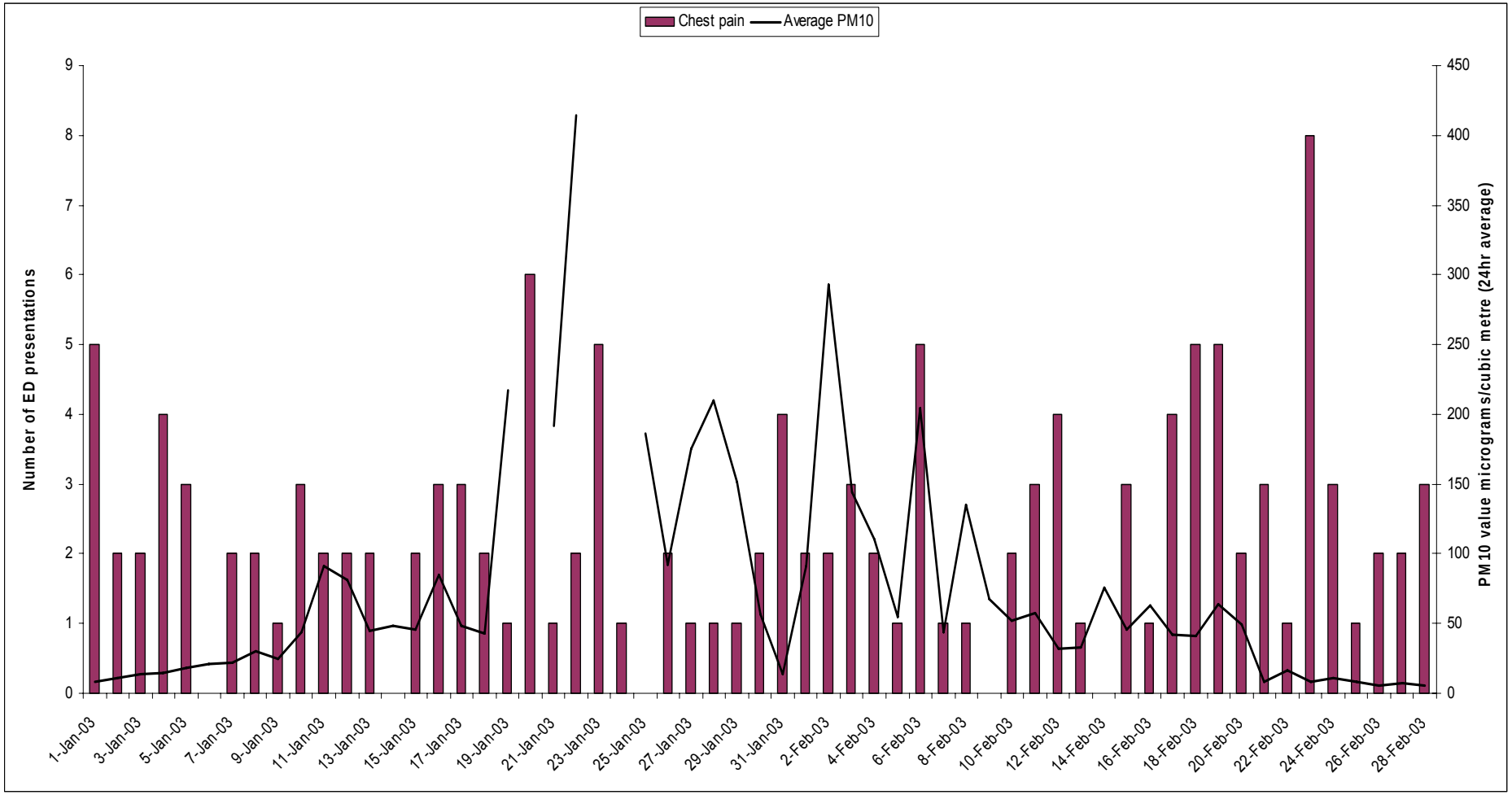
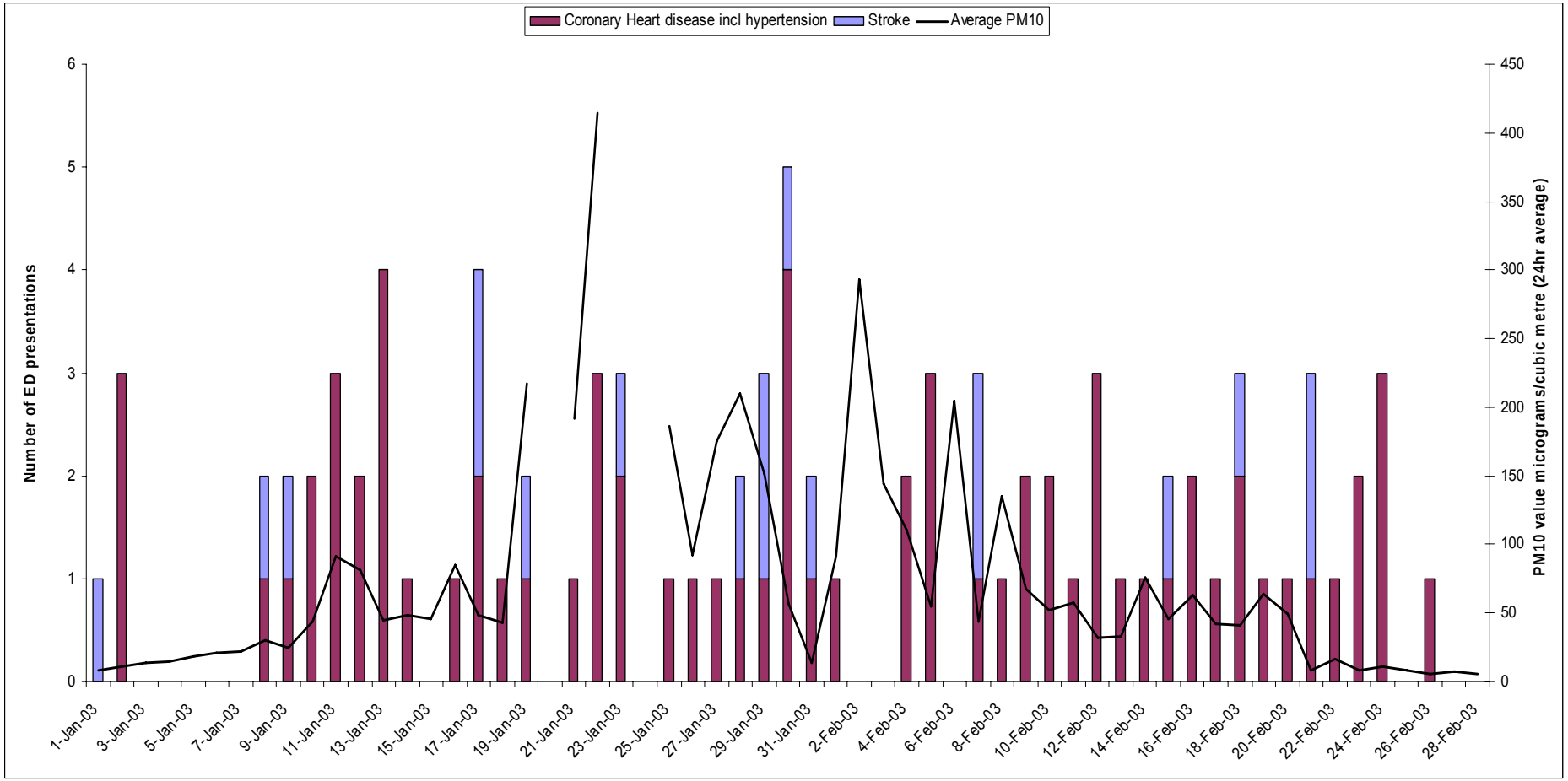


Figure 7: ED presentations to Albury Base Hospital for coronary heart disease (including hypertension) stroke and daily PM10 results



Appendix 3: Survey Questionnaire

INTRO:

Hello – my name is ……. I'm calling from the NSW Department of Health. We are conducting an important survey on the bushfire smoke experienced in you area from fires in North East Victoria since mid January this year. The survey will take around 5-10 minutes.
It is really important that our study represents the whole community and we would be most grateful if you could help us. All information will be kept confidential.

1. Yes
2. No

IN10 – Firstly can I just confirm that you live in the Albury area?

INT1a – Your phone number has been chosen at random from all possible telephone numbers in your area. We would like to make a random selection of a person in your household to interview.

If a child under 16 years of age is selected we would interview the parent or main carer of that child.

So that we can randomly select one person from your household can you please tell me, how many people, including yourself, live in your household?

_____

Now can you tell me if you are the oldest, second oldest, third oldest...xth oldest living in your household?

1. Oldest
2. Second oldest
3. Third oldest
4. Fourth oldest
5. Fifth oldest
6. Sixth oldest
7. Seventh oldest
8. Eighth oldest
9. Ninth oldest
10. Tenth oldest
11. Eleventh oldest
12. Twelfth oldest
13. Thirteenth oldest

We have done the random selection and we would like to interview ……. / in your household?
Could I please speak to that person?
Is that person a child under 16 years of age?

1. Yes, that's me
2. Yes, another person but not available now ⇐ MAKE APPOINTMENT
3. Yes I'll get the person
4. Yes my son/daughter (OR OTHER PERSON UNDER 16)

R Refused ⇐ Thanks and Goodbye

IF RESPONDENT <16
Because we will conduct this survey about a person under 16 years of age we need to speak with the person who knows most about that persons health.

Are you the main carer of this person?

If NO then ask to speak to the child's main carer and repeat introduction.

1 Continue

Could I have the given name of this child?

_____

Your help with this survey would be voluntary. All that is involved is answering some questions about the bushfire smoke experienced in your area from fires in North East Victoria.
The survey takes between 5 and 10 minutes. You can stop at any time or simply refuse to answer a question should you prefer.

Please be assured that all the answers to questions remain completely confidential, except where you volunteer information that we are required to report by law.

IF Respondent <16
All the answers that you give to the questions remain completely confidential. However if you tell us additional information about breaking the law or that suggests a child is being abused or neglected, then we are required to report this to the appropriate authority such as the Department of Community Services.]

1. Yes
2. Yes, but not available now ⇐ MAKE APPOINTMENT

R Refused ⇐ Thanks and Goodbye

INT3. Have you/ Has [child] been living or working in Albury during periods of high smoke levels for any period of time from mid January this year?
   1. Yes – go to Q1
   2. No – ineligible - terminate
   3. Don't know/Refused - terminate

TERMINATE- Thank you – we are only interested in those who have spent time in Albury during January February this year.

Media awareness:

MED1 Since mid January have you/or [child] seen or heard any health warnings about the local bushfire smoke?

1. YES
2. NO - go to Q6a
3. don't know - go to Q6a
4. refused go to Q6a

MED2 If yes, where did you/or [child] see or hear it? (prompt only if necessary)

- TV segment
- Newspapers article
- Information on radio (specify station_____)
- Information from friends, relatives, workmates etc
- Information from Doctor
- Information from Pharmacist
- Other information – specify

MED3 What was the main message of this information?

FREE TEXT_____

MED4 Who was the message directed to?

FREE TEXT_____

ACT1 Did you/ [child] change your/his/her daily activities because of these messages –

1. Yes (go to Q7)
2. No (got to Q6a)
3. Don't know –(go to Q8)
4. Refused –(go to Q8)

ACT2 Did you/ [child] change your/his/her daily activities because of the smoke-

1. Yes (go to Q7)
2. No (go to Q8)
3. Don't know –(go to Q8)
4. Refused–(go to Q8)

ACT3 What did you/[child] do?
[PROMPT: WHAT ELSE DID YOU DO?]
[MULTIPLE RESPONSE]

- Travelled/stayed out of area as much as possible
- Stayed inside as much as possible
- Stayed in air-conditioned buildings as much as possible
- Reduced outdoor activities level
- Increased regular medication
- Commenced taking medication
- Closed windows and doors
- Fighting fires
- Wore a mask
- Dried clothes inside
- Put ceiling fans on
- Other [SPECIFY]_____
- Don't Know
- Refused

MAS1 Can you tell me what type of mask you/[child] wore?
[Do not read out]

1. Class P2 mask
2. The one recommended at the store
3. The one recommended by TV/Radio/Newspaper/Health warning
4. Surgical mask
5. Sanding mask
6. Other [SPECIFY]_____
7. Don't remember

HEA1 Did you/[child] have any of the following health problems from the bushfire smoke?
[multiple response]

- Eye irritation
- Throat irritation
- Shortness of breath
- Coughing
- Wheezing
- Asthma
- Bronchitis
- Headache
- Depression
- Anxiety
- Angina or other heart conditions
- Other [SPECIFY]_____
- None of the above
- Don't Know
- Refused

HEA2 Did you/[child] seek treatment from a health professional for any of these health problems?

1. Yes
2. No go to Q13
3. Don't Know
4. Refused

HEA3 Who did you/[child] see?
[MULTIPLE RESPONSE]

- GP
- Emergency Department
- Other – specify_____
- Don't Know
- Refused

CON1 Have you/Has [child] ever been told by a doctor that you/he/she have/has any of the following conditions?
[read out; multiple response]

- Asthma
- Chronic Obstructive Pulmonary Disease or Airways Disease-COPD or COAD
- Other respiratory disease, (emphysema, pleurisy, bronchitis….)
- Angina
- High Blood pressure / hypertension
- Heart attack
- Heart failure
- Other heart disease _____
- Or suffered a stroke?
- None of the above

Now we are coming to the last section of the survey. I am going to ask some routine questions about your background.

DEM1 Could you please tell me how old you are /child is today?

1. _____Age in years

X Don't know
R Refused

DEM2 Are you/Is child male or female? Only if not obvious

1. Male
2. Female

END OF SURVEY FOR RESPONDENTS < 16

DEM3 Which of the following best describes your cigarette smoking status?

1. I smoke daily
2. I smoke occasionally
3. I don't smoke now, but I used to
4. I've tried it a few times but never smoked regularly
5. I've never smoked
6. Don't know
7. Refused

DEM4 What is the level of the highest qualification you have completed?

1. Completed School Certificate/ Intermediate/ Year 10/4th Form....
2. Completed HSC/Leaving/Year 12/ 6th Form
3. TAFE Certificate or Diploma
4. University, CAE or some other tertiary institute degree or higher
5. Other [SPECIFY]_____
6. Completed Primary School
7. Completed years 7-9

88888 Don't Know
99999 Refused

DEM5 In the last week, which of the following best describes your employment status?

1. Worked for payment or profit
2. Worked for payment/profit but absent on paid leave, holidays, on strike/stood down
3. Unpaid work in a family business
4. Other unpaid work
5. Did not work
6. Did not have a job

X Don't know/Not sure
R Refused

DEM6 During the smoky days since mid-January how much of the time would you say you spent working outdoors (paid or unpaid work)

[Read out]

1. Most of the time
2. Some of the time
3. Very little time
4. No time
5. Don't remember

That completes the survey – thank you for taking the time to help us. The information will be used to help us to understand the effects of bushfire smoke in the community and how to keep the community informed.