Environmental Health

The Journal of the Australian Institute of Environmental Health

...linking the science and practice of Environmental Health

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Environmental Health is a quarterly, international, peer-reviewed journal designed to publish articles on a range of issues influencing environmental health. The Journal aims to provide a link between the science and practice of environmental health, with a particular emphasis on Australia and the Asia-Pacific Region.

The Journal publishes articles on research and theory, policy reports and analyses, case studies of professional practice initiatives, changes in legislation and regulations and their implications, global influences in environmental health, and book reviews. Special Issues of Conference Proceedings or on themes of particular interest, and review articles will also be published.

The Journal recognises the diversity of issues addressed in the environmental health field, and seeks to provide a forum for scientists and practitioners from a range of disciplines. *Environmental Health* covers the interaction between the natural, built and social environment and human health, including ecosystem health and sustainable development, the identification, assessment and control of occupational hazards, communicable disease control and prevention, and the general risk assessment and management of environmental health hazards.

Environmental Health is indexed in Ulrich's Periodicals Directory, the Australasian Medical Index, and APAIS

Aims

- To provide a link between the science and practice of environmental health, with a particular emphasis on Australia and the Asia-Pacific Region
- To promote the standing and visibility of environmental health
- To provide a forum for discussion and information exchange
- To support and inform critical discussion on environmental health in relation to Australia's diverse society
- To support and inform critical discussion on environmental health in relation to Australia's Aboriginal and Torres Strait Islander communities
- To promote quality improvement and best practice in all areas of environmental health
- To facilitate the continuing professional development of environmental health practitioners
- To encourage contributions from students

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Call for Papers

The Journal is seeking papers for publication.

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Papers can be published under any of the following content areas:

Guest Editorials

Guest Editorials address topics of current interest. These may include Reports on current research, policy or practice issues, or on Symposia or Conferences. Editorials should be approximately 700 words in length.

Research and Theory

Articles under Research and Theory should be 3000-5000 words in length and can include either quantitative or qualitative research and theoretical articles. Up to six key words should be included. Name/s and affiliation/s of author/s to be included at start of paper and contact details including email address at the end.

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Articles and reports should be approximately 3000 words in length and can include articles and reports on successful practice interventions, discussion of practice initiatives and applications, and case studies; changes in policy, analyses, and implications; changes in laws and regulations and their implications, and global influences in environmental health. Up to six key words should be included. Name/s and affiliation/s of author/s should be included at start of paper and contact details including email address at the end.

Reports and Reviews

Short reports of topical interest should be approximately 1500 words. Book reviews should be approximately 700 words and Review Articles should not exceed 3000 words in length.

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Contents

In this the first issue of the Journal for 2005, we look at a diverse range of environmental health issues, from disaster management to food security. Papers also continue to reflect the interest in environmental health issues relating to air pollution. Smith et al. address the topic of air pollution, researching the associations between cigarette smoking, nearby industry and high lung cancer mortality in an industrial-residential region of North-West Adelaide. Tong et al. review epidemiological evidence regarding the relationship between exposure to ambient air pollution and cardiopulmonary disease mortality rates in Australia. In addition to reviewing the literature, Tong et al reveal the gaps in current knowledge on the impact of air pollution on population health, and call for further research on this topic.

Earl et al. contribute two papers to this issue of *Environmental Health*, researching public health impacts at outdoor music festivals. The literature review and international study provide a close look at lessons learnt through the Glastonbury Festival held in Somerset, England and aim to provide a model for the successful planning and management of health and safety issues at large public events in Australia. The participation of environmental health professionals in the management of crowds at outdoor music festivals is highlighted.

Hygiene and food security issues also feature, with Monaghan's qualitative study taking readers to Afghanistan to explore knowledge of hygiene and hygiene behaviour within the population of Kandahar. Monaghan's culturally sensitive study managing to collect responses from both men and women in the area, with research resulting in the formation of a women's hygiene promotion volunteer program.

In contrast, Donoghue et al. research food security issues for permanent residents of caravan parks. The issue of food security is often related to third-world countries, however, this is becoming a more prominent issue within sub-groups of industrialised nations. The paper focuses on members of caravan parks in the City of Greater Dandenong, and provides an interesting examination of a topic largely ignored by local government research within Australia.

After examining music festivals in England, visiting Kandahar, and studying food security in Victoria, we travel to Banda Aceh and emergency management. Adams report describes the deployment of Health Team "Foxtrot" to Banda Aceh in the early stages of the disaster response after the devastating earthquake and tsunami. Health Team "Foxtrot" included medical personnel, public health experts and Environmental Health Officers. Health Team "Foxtrot" collaborated with WHO, UNICEF and the Indonesian Ministry in addressing important issues such as waste disposal, reducing the number of disease vectors, and supplying clean water, while assessing the needs of 83 Internally Displaced Persons (IDP) camps in the area. As readers will know this work continues today and will do so for some considerable time into the future.

Wastewater management and stormwater pollution are priority issues for many environmental health practitioners. Morrison et al. explore the use of digital monitoring to detect contamination levels in stormwater using temperature and flow. Digital monitoring could provide an improved yet simple tool for environmental protection and regulation and evaluation of stormwater quality in the future.

Further reports on disaster management strategies, policy or reports, would be most welcome for submission to the Journal. Any

potential contributors should contact Jim Smith for further information on submitting manuscripts to the Journal.

I would like to take the opportunity to thank some stalwarts of *Environmental Health*. Eve Richards has been a foundation member of the Advisory Board, a contributor and strong supporter of the Journal and it is with regret that we have received her resignation from the Board. On behalf of the Institute and the Advisory Board we thank her for her sustained contribution and wish her well in her endeavours in environmental health. John Murrihy, our foundation Chair of the Advisory Board, has been replaced by Bruce Morton, Vice President and Director of the AIEH Board of Directors. We extend our deep gratitude to John for steering the Advisory Board and providing great support to and for the journal since its inception. Thanks John and welcome Bruce.

The Institute is currently promoting a course in Disaster Management to be held in Cairns on the 7th to the 12th August 2005. Registration closes on 16th July 2005, so please book early as places are limited. For more information, visit the website of the Australian Institute of Environmental Health.

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Back to TOC

A Study of Associations between Cigarette Smoking, Nearby Industry and High Lung Cancer Mortality in North West Adelaide

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An industrial/residential region in North West (NW) Adelaide has lung cancer standardised mortality twice that expected. We conducted a case control study to evaluate potential risk factors, including residential exposures to industrial air pollution. The cases were from the Cancer Registry, and controls from the electoral roll. Lifetime exposure indices were calculated: cigarette smoking (pack-years), passive smoke duration, hobbies, occupation exposures by hygiene panel (weighted by intensity, duration), residential pollution exposure model (proximity to industry, duration, time down-wind) for six industries. The analysis was conditional logistic regression. One hundred and forty two (142) lung cancer cases, and 415 controls (response rates: 62%, 52%) were interviewed. Participating controls resided closer to industry than non-participants. Relationships with lung cancer ($p<0.05$) were for smoking pack-years (dose response relationship evident, OR up to 9.25, 95%CI: 4.62, 18.55 for 40 pack-years) and age left school <14 years (OR 2.52, 95%CI: 1.29, 4.95). No other risk factors were demonstrated, including cumulative residential exposure to the six industries. The conclusions were that cigarette smoking is the primary cause of elevated regional lung cancer mortality. While having more thorough exposure assessment than previous reports, our results might have been affected by limited participation. Future public health initiatives to curb lung cancer mortality in NW Adelaide should focus on smoking prevention and reduction strategies.

Key words: *Air Pollution; Lung Cancer; Case-control; Smoking; Occupation*

Primary lung or bronchial cancer is responsible for over 1 million deaths worldwide annually (Ferlay 2001). Tobacco smoking has been strongly linked to lung cancer (Koop 1964), with associations also with certain occupations (Pohlabeln et al. 2000). However, some people with lung cancer recall little or no exposure to cigarette smoke (Williams & Sandler 2001) and may not have had exposure to purported occupational carcinogens either. Emission exposure due to a residential proximity to some industries may be relevant, but has been the subject of only limited research to date (Weed 1997).

North West metropolitan Adelaide, South Australia, has regions with lung cancer standardised mortality ratio (SMR) up to

two times that expected from state averages, and up to four times that of nearby suburbs (Figure 1). Within this 88 Km^2 area of North West Adelaide reside approximately 100,000 people or 10% of the population of metropolitan Adelaide. The area contains 205 industries which are licensed by the State Government Environmental Protection Agency (EPA) to carry out "prescribed activities", comprising over one third of all licensed industry in metropolitan Adelaide. These licenses permit those industries to carry out activities that would be potentially polluting, and they are therefore required to regularly report their emissions to the (EPA). The majority of these local North West industries are permitted to carry out air polluting activities. Specific former and current industries of interest within this North West area are summarised in Table 1. Each of these industries is associated with lung carcinogens, with International Agency for Research on Cancer (IARC) ratings of group 2A or higher (the substance is known or probable to be carcinogenic) (National Toxicology Program 2000).

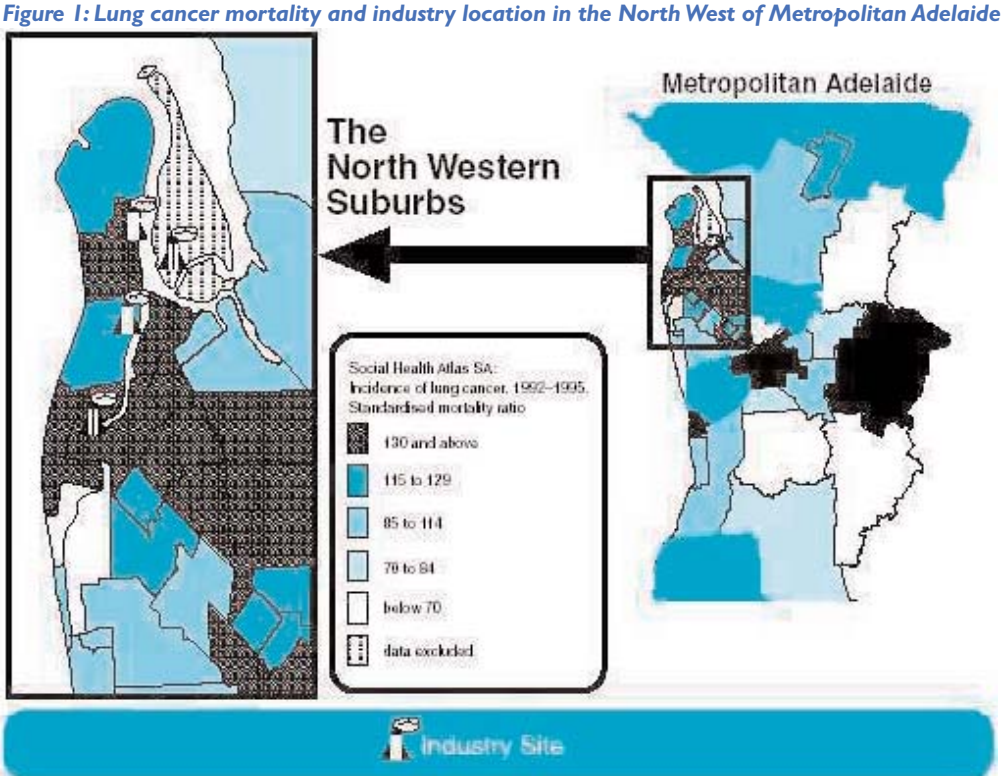
We have reviewed the available literature (Whitrow et al. 2003) and demonstrated that the methodologically strongest retrospective studies were by Barbone et al.

Table 1: Industry type and potential lung carcinogenic emissions of the six industries selected from the NW of Adelaide

Industry	Industry Type	Potential emissions
A	Cement manufacture	Crystalline silica
B*	Asbestos manufacture, not currently operational	Asbestos
C	Power station	Polycyclicaromatic Hydrocarbons
D	Mineral building product manufacture	Fine Particulate
E	Cement and soda ash manufacture	Crystalline silica
F	Light industry	Polycyclicaromatic Hydrocarbons, Diesel Exhaust, Fine Particulate

* Not currently operational

Figure 1: Lung cancer mortality and industry location in the North West of Metropolitan Adelaide



(1995), Jockel et al. (1992) and Nyberg et al. (2000), and two studies by Pope et al. (2002, 1995) were the strongest prospective studies. Relative strengths of these studies were efforts to measure confounders and environmental exposures, attempts to evaluate a dose response relationship, and to consider temporality.

Three of these five studies reported a significant positive relationship (Barbone et al. 1995; Pope et al. 1995; Pope et al. 2002). Barbone et al. (1995) also demonstrated a clear dose response relationship. However, two of the five studies demonstrated no relationship despite similar strengths of design, and the negative study by Nyberg et al. (2000) was notable for statistical power relevant to the other studies, with 1,042 cases and 2,364 controls. Limitations common to these studies include, absence of consideration of wind direction and strength (Williams & Ogston 2002), misclassification as a result of grouping large residential areas into "exposed", or "not exposed", and use of contemporary air quality parameters or use of incomplete retrospective historical air quality data of sulphur dioxide and ozone that may not be indicative of relevant lung carcinogen exposure. The relative causative roles of cigarettes, occupational, and residential exposures in this region are unclear. Although we have previously reported a slightly elevated prevalence of smoking in the region compared to national data (Pilotto et al. 1999), this is unlikely to explain variation in lung cancer SMR within the region. Therefore, we aimed to perform a case control study in the north west of Adelaide utilising optimal reported measurements of cigarette smoking, environmental tobacco smoke exposure, occupational and hobby related exposures to known or potential lung carcinogens, and measurement of residential exposure to industrial emissions incorporating measurement of residential distance from industry, duration and regional wind direction frequencies.

Methods

All cases of primary lung cancer residing within the study's geographical area (North West metropolitan Adelaide, postcodes 5007 to 5023 inclusive, see Figure 1), and diagnosed during the study recruitment period (April 1999 to July 2002) were eligible to participate. These cases were identified from the South Australian Cancer Registry database. The comprehensive and valid qualities of this registry have been reported (Bonett et al. 1992). In the first instance, the diagnosing or primary care doctor was required to contact the patients to seek their consent to participate in the study. For deceased cases, the next of kin (NOK) of the patient was invited to participate.

Controls (aged 18 years and over) were selected from residents of the study's geographical area according to the South Australian State Electoral Roll (SASER). Controls were excluded if they had been diagnosed with primary lung cancer prior to April 1999. Random numbers were generated from SASER using STATA software program (STATA 1999) in order to provide three age and gender matched controls to each case. If a control declined to participate or could not be contacted a replacement matched control was again randomly selected. Non-English speaking subjects were able to participate by provision of an interpreter.

Cases and controls were interviewed. A sub-sample of control subjects (n=5) and their nominated NOK were asked to participate in interviews in order to provide an indication of the validity of NOK information. Controls and their NOK were advised not to consult one another about the forthcoming face to face interviews, which were conducted separately, with agreement assessed by Kappa Statistic and intraclass correlation.

Residential areas, such as Port Adelaide, which are in close proximity to industry are associated with low socioeconomic status, which in turn is associated with a high prevalence of cigarette smoking (Glover

1996). Our questionnaire was therefore designed to measure these and other known potential confounders of any relationship between residential proximity to industry and lung cancer. Individual risk factors were included in the questionnaire if evidence existed identifying them as potential confounders. Based upon the reported literature the risk factors we selected were: age of smoking commencement, daily dose, duration of smoking, years since ceased smoking (Koop 1964; Peto et al. 2000; Shields 2000; Shields et al. 1995; Simonato et al. 2001), environmental tobacco smoke ETS exposure according to duration at work and at home (Taylor et al. 2001), lifetime occupational potential lung carcinogen exposure (Steenland et al. 1996), family history of lung cancer (Bromen et al. 2000), socioeconomic status (Faggiano et al. 1997).

We selected a comprehensive questionnaire format (Ahrens & Merletti 1998), which had previously been evaluated for validity and reliability as the basis for our core interview. This questionnaire has been used to investigate associations between lung cancer and occupations (Jockel et al. 1998; Pohlabeln et al. 2000), family history of lung cancer (Bromen et al. 2000), tobacco smoking (Agudo et al. 2000; Simonato et al. 2001) and ETS exposure (Boffetta et al. 1998; Jockel et al. 1998). The questionnaire was combined with an event history calendar to facilitate recall through cross-referencing of major lifetime events to dates (Belli 1998), and underwent local pilot testing. A pool of four interview staff interviewed all of the participating subjects. As it was not possible for interviewers to be blinded to the case or control status of each subject, all interviewers undertook training to standardise data acquisition.

Residential exposure to industry was estimated according to residential proximities to each of six past and present major industries within the study region, with adjustment for regional wind frequency and duration of residence. A seventh residential exposure to industry variable was created by summing all six individual exposures to provide a composite exposure score (Brown et al. 1984). The six industries were selected as all are large factories with potential for lung carcinogens emissions (as determined by a panel of occupational hygienists), and all are registered as licensed industry with the Environmental Protection Authority. Table 1 indicates the types of industry selected and the potential lung carcinogens released and Figure 1 demonstrates their location within the study area. Residential addresses and local industries were assigned x and y coordinates using a Geographical Information System (GIS), enabling the distance from residence to each factory to be calculated using Pythagorus theory. Ten years of 30 minutely wind direction data from monitors at a nearby airport were provided by the Bureau of Meteorology, and proportion of time that each residence was within a 22.5 degree downwind arc from each industry was determined, with final exposure determined by an extract from the Guassian plumage modelling equation (Rogers et al. 1999).

$$\text{Exposure} = \text{Duration (yrs)} * \frac{\text{Downwind frequency}}{\text{Distance} * (2\pi/16)}$$

This model provides a simple and acceptable proxy for exposure estimations for epidemiological studies (Barratt 2002; Pless-Mulloli et al. 2000; Williams & Ogston 2002). Australian residential exposure to industry during previous residences outside of the North Western suburbs of Adelaide was estimated as a separate risk factor, without GIS data. Records of current licensed industry (registered to carry out polluting activities and required to report emission data) were obtained from the relevant environmental protection authority in each state. Subjects were considered exposed if they resided in the same suburb as any licensed industry that our occupational and hygiene panel

assessed as a potential emitter of carcinogens. Years of exposure by number of local industries were used to quantify exposure. Cigars and tobacco pipe use was converted to the equivalent number of cigarettes according to previously reported methods (Boffetta et al. 1999). Family history of lung cancer was considered as having a direct blood relative with a primary lung cancer diagnosis (parent or sibling only). Socio-economic status was measured by age at leaving school (Australian Bureau of Statistics 2001).

Occupational exposure to lung carcinogens was estimated by a panel of three occupational hygienists according to their previously reported methods (Gun et al. 1991) with blinding of panel members to case or control status. Each panel member was blinded to case or control status of interview data. Independently they assessed the likelihood of exposure to each potential occupational carcinogen as "probable", "possible" or "unlikely". These comprised asbestos, crystalline silica, formaldehyde, polycyclicaromatic hydrocarbons (PAH) diesel exhaust and small particles (<2.5 microns: $PM_{2.5}$). They also assessed the level of exposure as "high", "medium", "low" or "very low" according to Australian and American guidelines (ACGIH 2002; NOHSC 2002), and then worked to attain a consensus. Retest agreement by the panel was evaluated using data from 31 occupations by intraclass correlation coefficient (Siemiatycki et al. 1997), high levels of agreement having been previously reported with similar methods. Total occupational exposures used previously reported weightings method for dose/year and total dose years (Jockel et al. 1992). Hobbies involving mechanical repairs, house renovation, or pottery work and sculpting have the potential for exposure to asbestos, polycyclic hydrocarbons, and silica. Exposures to these hobbies were estimated using the same methodology, and quantified by duration of participation.

Differences between cases and controls for dichotomous variables were assessed by Fisher's Exact test. Exact Chi-squared tests were used for other categorical variables. Independent samples t-tests were used for normally distributed continuous variables, and Exact Mann-Whitney U tests for continuous variables not normally distributed. Univariate conditional logistic regression was used to provide matched analysis for individual variables. Multivariate conditional logistic regression was to assess joint predictors.

Ethics approval was obtained through the Research and Ethics Committees of 13 regional metropolitan public and private hospitals.

Results

Participation rate

Two hundred and forty one (241) cases and 880 controls were eligible to take part in the study. However, we were unable to contact 49 cases (20%) and 190 controls (22%).

The participation rate for cases was 142/192 (74%) compared with 415/690 (60%) for controls (Chi-squared=12.316 on 1df, $p<0.001$).

There was no difference for participants and non-participant cases with respect to proximity to each of the six industries.

Participating controls did not live closer to their nearest industry than non-participating controls (Mann Whitney U test $P=0.598$). However control subjects were significantly more likely to participate in the study if they lived close to Industry D (median 4.7 vs 5.4km) or Industry F (median 5.5 vs 4.0km). Although there was no significant difference between control participants and non-participants for distance from each of the other four industries.

Out of the 142 cases included in the study, 76 (54%) had already died, and the next of kin provided the pertinent information.

Analysis of cases and controls (unmatched, unadjusted)

Demographic, family history and socio economic status

The demographic characteristics of each study group are shown in Table 2. Cases and controls had similar age and gender distributions. However, cases left school at an earlier age. A slightly greater percentage of cases with a family history of lung cancer were not statistically significant.

Table 2: Comparison of cases and controls with respect to demographic, family history and age left school

	Cases		Controls		Sig
	N	%	N	%	
Age group					0.818
<60	14	10	38	9	
60-69	33	23	98	24	
70-79	58	41	155	37	
80+	37	26	124	30	
Total	142	100	415	100	
Gender					1.000
Male	99	70	290	70	
Female	43	30	125	30	
Total	142	100	415	100	
Age left school					0.034
<14 years	33	24	68	16	
14 -15 years	75	55	218	53	
>15 years	29	21	129	31	
Total	137	100	415	100	
Family member with lung cancer					0.095
No	124	87	382	92	
Yes	18	13	33	8	
Total	142	100	415	100	

Exposure to cigarette smoke

Cigarette smoking status and passive smoking status is shown in Table 3. Cases were more likely to have ever smoked (OR=4.1, CI: 2.35, 7.46) and to have had prolonged passive exposure to cigarette smoking at home but not at work.

Table 3: Comparison of smoking variables

	Cases		Controls		Sig
	N	%	N	%	
Pack-years smoked					<0.001
0	17	12	150	36	
<10	12	8	51	12	
10-19	9	6	50	12	
20-29	16	11	48	12	
30-39	20	14	31	7	
40+	68	48	85	20	
Total	142	100	415	100	
Passive exposure at home					0.006
0 years	16	11	52	13	
<20 years	20	14	78	19	
20-39 years	44	31	169	41	
40+ years	62	44	116	28	
Total	142	100	415	100	
Passive exposure at work					0.396
0 years	34	24	80	19	
<20 years	35	25	110	27	
20-39 years	36	25	130	31	
40+ years	37	26	95	23	
Total	142	100	415	100	

Residential exposure

Exposure to any of the six industries or summative industrial exposure was not associated with case or control status (Table 4). Only exposure to Industry C approached statistical significance, and for this industry, controls were more likely to be exposed than cases (p=0.07).

Occupational exposure to lung carcinogens

Occupational exposure to various potential carcinogens, as measured by the occupational hygiene panel, was not related to lung cancer. Analysis with exposure weighting estimates found a similar result.

Hobbies

Based on small numbers, cases were significantly more likely to have ever undertaken pottery (OR= 4.25, CI: 1.4, 17.23), but there was no association with mechanics and home renovation as hobbies.

Table 4: A comparison between cases and controls in relation to residential exposure to industry scores* for each identified industry and composite exposure scale

	Cases		Controls		Sig
	N	%	N	%	
Industry A					0.144
<1.0	64	45	142	34	
1.0 - 1.4	23	16	83	20	
1.5 - 2.9	26	18	90	22	
3.0+	29	20	100	24	
Total	142	100	415	100	
Industry B					0.198
<1.0	74	52	182	44	
1.0 - 1.4	21	15	68	16	
1.5 - 2.9	17	12	78	19	
3.0+	30	21	87	21	
Total	142	100	415	100	
Industry C					0.070
<1.0	79	56	193	47	
1.0 - 1.4	19	13	74	18	
1.5 - 2.9	33	23	88	21	
3.0+	11	8	60	14	
Total	142	100	415	100	
Industry D					0.128
<1.0	59	42	133	32	
1.0 - 1.4	26	18	76	18	
1.5 - 2.9	23	16	98	24	
3.0+	34	24	108	26	
Total	142	100	415	100	
Industry E					0.351
<1.0	88	62	228	55	
1.0 - 1.4	17	12	62	15	
1.5 - 2.9	20	14	55	13	
3.0+	17	12	70	17	
Total	142	100	415	100	
Industry F					0.308
<1.0	44	31	101	24	
1.0 - 1.4	24	17	82	20	
1.5 - 2.9	38	27	135	33	
3.0+	36	25	97	23	
Total	142	100	415	100	
Composite					0.276
<6.0	48	34	117	28	
6.0 - 7.9	25	18	62	15	
8.0 - 17.9	43	30	131	32	
18.0+	26	18	105	25	
Total	142	100	415	100	

** Residential score = (Duration of residence (yrs) * Downwind frequency) divided by (Distance (km) * (2π/16))*

Conditional logistic regression (matched, unadjusted with inclusion of all seven residential exposures to industry)

All potential risk factors or confounding variables for lung cancer were individually entered as independent variables in conditional logistic regression analyses. Table 5 displays those variables, which were significant at $p \leq 0.1$ in the unmatched analysis.

Table 5: Results of conditional logistic regression for selected variables (based upon p<0.1 in unmatched analysis)

Variable	O.R.	95% CI (O.R.)	Sig
Age left school			
>14 years	1.00		
14 years	1.58	0.96 - 2.60	0.070
<14 years	2.12	1.18 - 3.81	0.012
Family history of lung cancer			
No	1.00		
Yes	1.58	0.35 - 1.16	0.140
Pack-years smoked			
0	1.00		
<10	2.43	1.06 - 5.55	0.035
10-19	1.69	0.07 - 4.05	0.243
20-29	3.43	1.59 - 7.44	0.002
30-39	6.33	2.83 - 14.16	<0.001
40+	8.46	4.39 - 16.30	<0.001
Passive exposure at home			
0 years	1.00		
<20 years	0.81	0.38 - 1.73	0.594
20-39 years	0.79	0.41 - 1.51	0.478
40+ years	1.63	0.87 - 3.05	0.129
Industry C exposure			
<1.0	1.00		
1.0 - 1.4	0.66	0.37 - 1.16	0.145
1.5 - 2.9	0.93	0.57 - 1.51	0.773
3.0+	0.39	0.19 - 0.80	0.010
Home renovation			
No	1.00		
Yes	0.63	0.39 - 1.01	0.053
Pottery			
No	1.00		
Yes	4.84	1.40 - 16.68	0.013

Leaving school early, cigarette smoking, and having pottery as a hobby were all risk factors for lung cancer, whereas residential exposure to Industry C had a negative effect, but no others including composite score had an association.

Conditional logistic regression (matched, adjusted)

Those variables significant ($p<0.1$) in the matched unadjusted analysis, were included in a multivariate conditional logistic regression analysis. (Tables 6 and 7) Pack years of cigarette smoking and earlier age of leaving school were both positively associated with lung cancer in this study, while residential exposure to industries C and F were negatively associated.

Table 6: Results of multivariate conditional logistic regression - Residential exposure to Industry C

Variable	O.R.	95% CI (O.R.)	Sig
Age left school			
>14 years	1.00		
14 years	1.63	0.93 - 2.85	0.085
<14 years	2.45	1.24 - 4.83	0.009
Pack-years smoked			
0	1.00		
<10	2.43	1.02 - 5.76	0.043
10-19	1.53	0.61 - 3.84	0.363
20-29	3.28	1.45 - 7.38	0.004
30-39	7.36	3.09 - 17.52	<0.001
40+	8.86	4.39 - 17.87	<0.001
Industry C exposure			
<1.0	1.00		
1.0 - 1.4	0.64	0.34 - 1.23	0.179
1.5 - 2.9	1.04	0.59 - 1.81	0.897
3.0+	0.37	0.16 - 0.83	0.016

Table 7: Results of multivariate conditional logistic regression - Residential exposure to Industry F

Variable	O.R.	95% CI (O.R.)	Sig
Age left school			
>14 years	1.00		
14 years	1.76	1.00 - 3.11	0.051
<14 years	2.52	1.29 - 4.95	0.007
Pack-years smoked			
0	1.00		
<10	2.39	1.03 - 5.59	0.044
10-19	1.71	0.69 - 4.25	0.250
20-29	3.18	1.43 - 7.11	0.005
30-39	7.37	3.08 - 17.60	<0.001
40+	9.25	4.62 - 18.55	<0.001
Industry F exposure			
<1.0	1.00		
1.0 - 1.4	0.47	0.24 - 0.94	0.034
1.5 - 2.9	0.64	0.36 - 1.15	0.139
3.0+	0.77	0.42 - 1.41	0.388

Due to the participating controls residing closer to industry than non-participants, we reanalysed the data post hoc using an adjusted residential exposure score for cases. The adjustment involved calculating the average distance from industry of both participating and non-participating (contacted but declined to take part) controls. We then calculated the percent difference between this mean and the distance from each industry for participating subjects as follows:

$$\text{Percentage change} = \frac{100\ (D_{(m)}-D_{(p)})}{D_{(p)}}$$

Where - $D_{(p)}$ = Distance participating controls live from industry

$D_{(x)}$ = Average distance from industry for participating and non-participating controls

This percentage change was then used to adjust the distance from industry for all residential addresses for control subjects from each respective industry, and the weighted distance then used in the residential exposure equations to derive a weighted exposure score. The use of residential exposure score adjusted for this participation bias did not alter the pattern of significant risk factors.

Conclusion

Considerable community concern regarding local industrial emissions prompted this lung cancer case control study. We demonstrated a clear dose response relationship with cigarette smoking, and earlier age of leaving school. We demonstrated no positive associations between lung cancer and residential exposure to industry emissions for any of six long standing major key industries separately, or when analysing with a composite exposure score. Negative associations were demonstrated for residential exposure to industrial emissions for two of six industries, although these were small and lacked dose response patterns. A final multi-variant analysis demonstrated no associations with other study factors, including occupation and hobbies.

Our study lacked sufficient power to exclude any association between lung cancer and nearby industry. No trends to suggest positive association in terms of residential exposure to industrial emissions were present. Power was limited by recruitment of incident lung cancer cases in the study region of interest over a three-year period. However, our demonstration of a clear dose response relationship with cigarette pack years provides an indication of the validity of our methods, although the progressive dose response magnitude was not as marked as a larger European case control study (Simonato et al. 2001). The negative associations with industries C and F lacked a dose response relationship and need to be interpreted with caution. Proximity to one industry may be associated with greater distance from other sites, as well as unmeasured variations in intra-regional or participant characteristics. A negative association lacks biological plausibility in terms of a protective effect. A previous study (Pawlega et al. 1997) also demonstrated a negative effect, in a similar study, which the authors did not explain, although this study had limited adjustment for confounders.

Our participating control subjects lived closer to industry than non-participants in this study, and this might have contributed to this finding. We therefore conducted a post hoc adjustment for the difference in distance from industry for participants compared to non-participant invited controls. However, there was no change in the analysis findings. Our modelling of residential exposure to industry emissions was based upon the available literature, and incorporated measurement of distance from industry, wind direction, downwind frequency, and duration downwind. Previous studies have been limited to distance from industry only. However, while air quality monitoring was performed concurrently with the case control study, it could not be used to validate the residential exposure assessment, due to the latency period. Historical air quality data was not available.

Further limitations to our study included low participation rate for both cases (56%) and controls (47%). Apart from proximity to industry difference in control participants compared to non-participants, there was no difference in relation to age or gender in participants compared to non-participants for other cases or controls. As it was not possible to blind interviewers to the case or control status of participants, we aimed to minimise bias by using a highly structured and standardised questionnaire following piloting and interviewer training. The questionnaire had previously been demonstrated to have acceptable reliability and validity (Ahrens & Merletti 1998). Further, we included an event history calender format to facilitate accurate recall and reduce interviewer bias (Belli 1998), which has not been utilised in previously reported lung cancer case control studies. Although we attempted to estimate subjects' residential exposure outside of the study area, particularly in previous residences, this lacked validation or reliability testing. Weighted kappa was used to indicate reliability. Occupational Hygiene Panel members differed considerably in their reliability. Reliability for exposure score was generally moderate with only exposure to dyes having good reliability.

Exposure estimates relied in part upon information collected from the NOK. Therefore a sub study of NOK and live control agreement was performed. This demonstrated reliability for the smoking score and occupational exposure was high (kappa=1.00), whilst that for residential exposure was very good (ICC=0.93).

The positive association between low socio-economic state, as we measured by age leaving school and lung cancer, are consistent with previous findings (Faggiano et al. 1997), and might indicate earlier life time exposure to poor diet, multiple interacting dusts from heavy industries from labouring or manual apprenticeship occupations, and other unmeasured factors.

We did not demonstrate an association between lung cancer and passive smoking in our study, which lacked sufficient power compared to the large study of Enstrom and Kabat (2003) of over 35,000 subjects, but which found no association, in contrast to a report by the United States Department of Health and Human Services reporting an increased risk of 20% (National Toxicology Program 2000). Previous case control studies investigating the relationship between lung cancer and industrial emission exposure to nearby residences have attained participation rates from 41% (Jockel et al. 1992) to 87% (Nyberg et al. 2000), with sample sizes from 194 cases/194 controls (Jockel et al. 1992) up to 1,042 cases/1,090 controls (Nyberg et al. 2000). We have previously reviewed these studies, noting limited adjustment for confounding generally, and inconsistent results (Whitrow et al. 2003). Of the strongest designed case controlled studies (Barbone et al. 1995; Nyberg et al. 2000), and cohort studies (Cohen & Pope 1995; Pope et al. 2002) all but one demonstrated a lack of a dose response relationship. Associations were inconsistent, with significant limitations including unadjusted confounding, incomplete smoking data acquisition, and failure to incorporate the effect of prevailing wind direction upon residential exposures to industrial emissions (Williams & Ogston 2002).

No case control or cohort study has been carried out in Australia to test for a causative association between lung cancer and residential exposure to industry emissions. Although Government bodies carry out regular air quality monitoring in the North West of Adelaide, this monitoring has not specifically included any potential lung carcinogens.

Better evaluation of this relationship would require a cohort design, with contemporary personal exposure measurements. However, the regional incidence of lung cancer is high in relative but not in absolute terms. Therefore, a sufficiently powerful study would require many years to achieve. Until then more sophisticated modelling to estimate personal exposures are required. Future studies should also include consideration of stack height and emission characteristics. Based on the results available to us from this study, however, we have a strengthened basis for local community anti-smoking educational initiatives.

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Back to TOC

Air Pollution and Cardiopulmonary Diseases in Australia: A Review of Epidemiological Evidence

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This paper reviews epidemiological evidence on the public health impacts of exposure to ambient air pollution in Australia and proposes research directions and strategies for future studies. Both electronic (using Medline, PubMed and Ebsco host databases) and manual literature searches were conducted, and 19 papers were identified. Of these studies 6 were irrelevant and were excluded. The 13 Australian studies were critically reviewed to establish a knowledge base for health impacts of air pollution in Australia. The weight of Australian studies reviewed indicated that air pollutants (eg, PM_{10}, O_3, and NO_2), even at levels lower than the current national standards, were associated with an increase in respiratory and cardiovascular mortality and hospital admissions. From the existing literature, gaps in the knowledge were identified, which include: disentangling health effects of a certain air pollutant from other pollutants, defining exposure thresholds, determining population exposure distributions, and assessing interactive effects of air pollution with other environmental factors. In conclusion, air pollution in Australian cities may affect population health. The data are consistent with international evidence. Due to the complexity of this issue, an integrated, systematic assessment of the health impacts of air pollution is required for further development of Australian air quality guidelines.

Key words: *Air Pollution; Australia; Epidemiological Evidence; Health*

A recent report from CSIRO suggests that approximately 2400 deaths each year in Australia are linked to air pollution, and the death toll from air pollution is higher than fatalities from road accidents (CSIRO 2004). Exposure to particulates and other ambient pollutants is now tightly linked to a wide range of health outcomes including cardiovascular disease, respiratory disease, lung cancer, and emphysema (Brunekreef & Holgate 2002). Air pollution, from both indoor and outdoor sources, has been ranked as one of the top 10 causes of the global burden of disease and injury by the World Health Organization (Murray & Lopez 1996). With the rapid pace of urbanisation globally, more people are living in large cities than ever before (Cifuentes et al. 2001). This raises concerns regarding the public health impacts of exposure to ambient air pollution in urban areas because of increased motor vehicle use.

Air pollution has arisen from a number of natural and man-made sources. Natural sources of particulates originate from matter such as sea salt, mineral and volcanic dust, bushfires, and various types of biological material, including living or dead organisms such as pollen and fungus (Matthias-Master et al. 1999). Primary anthropogenic sources arise from industrial and agricultural processes, motor vehicles, and other sources.

Aerosol pollution from motor vehicles constitutes more than 50% of the total urban particulate pollution in developed countries (Wrobel et al. 2000). Secondary anthropogenic sources arise from chemical reactions (e.g. photo-oxidation) of primary pollutants; these may arise from the environment, vehicle emissions, and other industrial sources. These reactions result in the formation of other pollutants, including ozone, peroxyacetyl nitrate (PAN), and photochemical smog which is formed by reactions of NO_2 with various hydrocarbons and sunlight.

To heighten a series of ambient air quality standards, new legislation was introduced by the National Environment Protection Council of Australia (NEPC 1998). Six major air pollutants (i.e. PM_{10}, O_3, NO_2, CO_2, SO_2 and Pb) are also called criteria pollutants as they are listed in the ambient air quality standards. This has been seen as a step forward in controlling pollutant emissions and reducing adverse public health outcomes (Table 1).

Table 1: Australian standards and goals for air pollutants

Pollutant	Averaging Period	Maximum concentration	Goal within 10 years[1]
Carbon monoxide	8 hours	9.0 ppm	1 day/year
Nitrogen dioxide	1hour	0.12 ppm	1 day/year
	1 year	0.03 ppm	None
Photochemical	1 hour	0.10 ppm	1 day/year
oxidants (as ozone)	4 hours	0.08 ppm	1 day/year
Sulfur dioxide	1 hour	0.20 ppm	1 day/year
	1 day	0.08 ppm	1 day/year
	1 year	0.02 ppm	None
Lead	1 year	0.50 µg/m^3	None
Particles as PM_{10}	1 day	50 µg/m^3	5 days/year

[1] *Maximum allowable exceedances*

Many Australian studies have reported that exposure to air pollution (e.g. particulate matter smaller than 10µm (PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3) and beta scattering by particles (b_{sp})) was associated with an increase in mortality and hospital admissions due to respiratory and cardiovascular disease and other short-term health effects (e.g. eye and throat irritation) (Denison et al. 2001; Morgan et al. 1998a, 1998b; Petroeschevsky et al. 2001; Simpson et al. 1997, 2000). With a recent focus on regional ambient air quality through the introduction of the NEPC's legislation, this paper aims to review Australian studies on the health impact of ambient air pollution.

Methods

Articles reporting on the health impacts associated with exposure to air pollution were identified using three electronic databases: Pub-Med, Medline and Ebsco host. The detailed search strings are available on request. Briefly, the key words that were used in the search included air pollution, health, bushfires, and Australia. English papers published between 1980 and 2003 were considered. Nineteen papers were identified in total, including 12 articles through an electronic search (Medline: 6; PubMed: 2; and Ebsco host: 4) and 7 through manual searches (searching major epidemiological journals and library catalogues). The papers were assessed by the authors to examine their relevance for this review. Papers were included if they were related to an assessment of the association between exposure to criteria pollutants (i.e. PM_{10}, O_3, NO_2, CO_2, SO_2 and Pb) and health outcomes (i.e. cardiovascular and respiratory diseases) in Australia. Of the 19 articles identified for the initial review, six articles were excluded because they did not examine the empirical relationship between air pollution and health outcomes (Affum et al. 2003; Hindwood & Di-Marco 2002; Jamriska et al. 1999; Jitchins et al. 2002; Koren 1995; Woodward et al. 2002). A total of 13 articles were eligible to be included and were critically reviewed below (Denison et al. 2001; Goldsmith et al. 1996; Gray et al. 1994; Jalaludin et al. 2000a, 2000b; Johnston et al. 2002; Morgan et al 1998a; 1998b; Petroeschevsky et al. 2001; Rutherford et al. 2000; Simpson et al. 1997, 2000; Smith et al. 1996).

Australian Studies of Air Pollution and Cardiopulmonary Health

In general, the association of ambient air pollution with mortality rates, hospital admissions and other health outcomes was widely assessed in Australian studies (Table 2). Gray et al. (1994) examined whether living in a region with high temperature sludge burning incinerators was associated with an increased prevalence of childhood asthma or allergy. A cross-sectional study was conducted. The sample comprised 1,339 children aged 8-12 years (response rate: 70.1%), including 713 children in two regions close to incinerators, and 626 in a control region free of sludge burning. Respiratory illness was measured by questionnaire (via schools), airway hyper-responsiveness by histamine inhalation test, and atopy by skin prick tests. Air quality data were collected for NO_2, SO_2, O_3, particulates and hydrogen sulphide during the study period. The results of the study show that concentrations of pollutants did not vary in any major way between the two regions. However, hydrogen sulphide levels in the regions close to incinerators occasionally reached detectable odour levels (3-10 ppb). The prevalence of current asthma, atopy, symptom frequency or severity of asthma, was not significantly different between the control and study regions. This suggests that high temperature sludge burning incinerators did not pose a significant risk to children's respiratory health. However, due to the inherent limitations of a cross-sectional study (e.g., both exposure and outcome were measured at a particular point of time), the results of this study need to be viewed cautiously.

Goldsmith et al. (1996) investigated the association between air pollutants and asthma admissions in Melbourne over a two-year period, using an ecological time-series analysis. Daily data on asthma hospital admissions for children (16 years and younger) were collected along with air pollution (i.e., particles, sulphur dioxide, nitrogen dioxide, and ozone) and meteorological data (i.e., maximum and minimum temperatures, humidity and barometric pressure). Geophysical, socio-cultural, meteorological, and seasonal variations of pollutants were considered. A Poisson regression-type quasi-Fourier generalised linear model was built. The result of the final model accounted for 57% of the variance in admissions. The contribution of pollution was 14%, even though no pollutant alone made a significant contribution to variance.

Smith et al. (1996) investigated the number of asthma presentations to emergency departments (ED) in western Sydney during severe bushfires in 1994. Routine ED data from western Sydney were collected over a two-week period to determine whether high particulate air pollution caused by bushfires influenced the number of asthma presentations. Exposure and outcome data were collected twice for a six-week period, one during a bushfire event and the other during a non-bushfire period as a control. Air quality data were obtained from five monitoring sites for PM_{10}, NO_2 and O_3. Meteorological data were collected from three monitoring stations to control for potential confounding effects of weather. Two analytic methods were used in this study: (1) the difference in all ED presentations due to asthma between bushfire and non-bushfire periods was compared; and (2) Poisson regression models were fitted using the daily number of asthma and obstructive respiratory presentations to each separate hospital as the dependent variables, and air pollutants as the independent variables. The findings indicated that particulates generated from major bushfires did not significantly increase the number of asthma presentations to emergency departments in Sydney.

Simpson et al. (1997) investigated the associations between outdoor air pollution

Table 2: Australian studies on air pollution and health

Australian Studies	Objectives
Gray et al 1994	To investigate whether living in a region with high temperature sludge burning incinerators was associated with an increased prevalence of childhood asthma or allergy.
Goldsmith et al 1996	To determine the contribution of cyclic geophysical and socio-cultural factors and of meteorological and pollutant variations to explained variance in asthma admissions in Melbourne.
Smith et al 1996	To determine whether there was an increase in the proportion of asthma presentations to emergency departments in western Sydney as a result of the bushfire-generated particulate air pollution.
Simpson et al 1997	To examine the associations between outdoor air pollution and daily mortality in Brisbane.
Morgan et al 1998 a	To examine the associations between air pollution and daily mortality in Sydney 1989-1993.
Morgan et al 1998 b	To examine the impact of air pollution on hospital admission in Sydney 1990-1994.
Jalaludin et al 2000 a	To examine the relationship between ambient ozone concentrations and peak expiratory flow rate (PERF) in primary school children.
Jalaludin et al 2000 b	To determine the effects of the 1994 Sydney bushfire on PEFR in children with wheeze.
Denison et al 2000	To examine the associations between ambient air pollution and daily hospital admission in Melbourne, 1991-1996.
Simpson et al 2000	To examine the effects of ambient particle pollution on daily mortality in Melbourne 1991-1996.
Rutherford et al 2000	To examine the association of outdoor air pollution and air spora with the decrease in lung function of two groups of asthmatic subjects in South east Queensland.
Petroeschevsky et al 2001	To examine the associations between outdoor air pollution and hospital admissions in Brisbane 1987-1994.
Johnston et al 2002	To examine the relationship between the mean daily concentration of respirable particles arising from bushfire smoke and hospital presentations for asthma in Darwin.

Method	Findings
• Three groups of children were included in the study; two groups lived in areas close to incinerators and the third in a control region with no sludge-burning incinerator. • Respiratory illness was measured by questionnaire, histamine inhalation test and skin prick tests.	• Pollution concentrations did not vary in any major way between the study regions and the control region. There was no significant difference in frequency or severity of asthma. • This study suggests that other factors are responsible for the high prevalence of asthma in children.
• Asthma was defined as airway hyper-responsiveness and recent wheeze. • Poisson regression-type quasi-Fourier generalised linea model was built • Children's hospital admissions for asthma were used along with pollutant data (PM_{10}, SO_2, NO_2, O_3) and meteorological data were collected.	• The contribution of pollution, with all periodic patterns estimated by Poisson ANOVA, was 14%. No single pollutant made a significant contribution to explained variance.
• Emergency room attendance records for asthma from 7 public hospitals over two 6-7 week periods. Air pollution and meteorological data were obtained from local monitoring stations	• Particulate pollution generated from a bushfire in 1994 did not increase the number of asthma presentations to emergency departments in Sydney.
• Autoregressive Poisson models	• A possible threshold of 31-102 ppb for ozone was determined but not for particulate matter
• Time-series analysis of daily death counts for both respiratory and cardiovascular causes • Statistical methods similar to APHEA protocol (use of Poisson regression)	• Current air pollution levels in Sydney are associated with increased hospitalisation for respiratory and heart disease
• Time-series analysis of the effect of outdoor air pollution on daily hospital admissions • Statistical methods similar to APHEA protocol (use of Poisson regression)	• Increased daily maximum 1 hour concentrations of NO_2 were associated with increases in childhood asthma admissions and COPD admissions. • Similarly PM was associated with increased COPD.
• Enrolled primary school children recorded PERF twice daily over an 11 month period • Air pollution, meteorological and pollen data were obtained	• Significant negative associations between daily mean deviation in PERF and same-day mean daytime ozone concentrations after adjusting for co-pollutants, time trends, meteorological variables, pollen count and Alternaria count were found. • Moderate levels of abient ozone have adverse health effects on children with a history of wheezing.
• Children with a history of wheeze were recruited into the study in which they completed a daily asthma diary. Air pollution, meteorological, pollen and Alternaria data were also obtained	• Increased levels of particulate pollution caused by the Sydney bushfires did not lead to any clinically significant reduction in PEFR in symptomatic children
• Nephelometry and mortality data were gathered for the years 1991-1996 along with O_3 and NO_2. • Missing data were estimated using the mean of the non-missing sites. • Controlling for confounders such as season and long-term trends were controlled using Poisson regression. • Non-parametric smoothing, using Generalised Additive Models (GAM)	• Positive associations were observed between both 03 and NO2 and most of the health outcomes considered. • Effects of air pollutants were strongest in the warm seasons possibly due to the photochemical smog effect
• Poisson regression and GAM were used with LOESS smoothing to control for temporal and meteorological effects.	• Results indicated that increases in 1 hour bsp levels were associated with increase risk of death of all cause mortality and increased risk of respiratory mortality in the warm season.
• Twice daily peak expiratory flow (PEF) were recorded and standardised • Participants underwent standard skin prick testing for a standard range of food and environmental allergens. • Half-hourly average concentrations of bsp03 and NO2 were obtained along with meteorological data • Data was analysed using autoregressive algorithm	• The impact of air pollutants on lung function was significant for those classified as allergic to fungal spores/pollens • The impact of air pollutants on PEF mainly affected allergic adults, significant only in seasons when these pollutants peaked • Counts of fungal spores are strongly associated with decreased lung function in allergic adults, significant only when spora peaked
• Time-series study on daily counts of emergency hospital and air pollution • Analysis followed the APHEA protocol • Controlled for a number of temporal and meteorological variables.	• Considerable seasonal variation for mean daily admissions for respiratory disease and asthma was observed • A significant association between air pollution and health was observed • Current ambient levels of air pollution in Brisbane exacerbate pre-existing respiratory condition, particularly in asthmatics and the elderly.
• Examined the level of ambient particulate matter resulting from almost continuous bushfires over a period of 6 months and asthma presentations to emergency departments.	• Significant increases in asthma presentations to emergency departments were found with each 10µm/m3 • Ambient particulates from bushfires should be considered as injurious to human health • The control of smoke pollution from bushfires should be considered

and daily mortality in Brisbane between 1987 and 1993. A total of 2,469 daily observations were used for this investigation. Data were collected for b_{sp}, NO_2, O_3, and SO_2 (half-hourly averages) for three sites across Brisbane. Average air pollution values were derived by averaging the four pollutant levels recorded at the three sites to give a value for the Brisbane region. International Classification of Disease (ICD) - 9 codes were used to identify the number of deaths from respiratory and cardiovascular disease. A similar method, developed in the Air Pollution and Health - a European Approach (APHEA) project (1995), was used in this study. Daily mortality data were analysed using generalised estimating equation (GEE) models. Confounding factors were considered which included minimum and maximum temperature and relative humidity. The results indicate that mean daily one hour maximum concentration was 24.2 ppb for O_3, 28.4 ppb for NO_2, and 9.6 ppb for SO_2, respectively, while mean daily 24-hour average level for PM_{10} was 26.9 $\mu g/M^3$. The increased total daily mortality was associated with exposure to both particulate matter (PM_{10}) and O_3, particularly for those over 65 years and those with pre-existing cardiovascular disease. An exposure threshold of 31-102 ppb (mean = 42 ppb) was suggested for the effects of ozone. This threshold is much lower than recommended standards set by NEPC at 60-120 ppb. No thresholds for PM_{10} were found, even at low levels.

Morgan et al. (1998a, 1998b) carried out two investigations into air pollution and daily mortality and hospital admissions in Sydney. The two studies used single and multiple pollutant models. Both studies used methods similar to the APHEA project (1995). Air monitoring data from between 3 and 12 sites were used according to availability. The daily average concentration and maximum 1 hour concentration was 18 and 42 $\mu g/M^3$ for PM_{10} and 13 and 26 ppb for NO_2, respectively. The daily maximum 1 hour concentration of ozone was 24 ppb. The first investigation (1998a) performed time series analysis using Poisson regression which allowed for over dispersion and auto correlation on the daily counts of respiratory, cardiovascular and all cause mortality for the period 1989-1993. They also adjusted for influenza epidemics, seasonality and cyclical factors in their data analyses. The study revealed that increased daily concentrations of particulate matter (from the 10th to the 90th percentile) resulted in an increase of 2.63% (95% confidence interval (95% CI): 0.83-4.41) for all-cause mortality and 2.68% (95% CI: 0.25-5.16) for cardiovascular mortality. Increased levels of O_3 concentrations (from the 10th to the 90th percentile) indicated increases in both cardiovascular (2.52%) and all-cause mortality (2.04%). Increased NO_2 levels (from the 10th to the 90th percentile) were associated with increased respiratory mortality (7.71%), cardiovascular (2.34%) and all-cause mortality (2.66%).

The second study by Morgan et al. (1998b) examined the effects of outdoor air pollutants on daily hospital admissions for 1990-1994. Data were collected from 27 public hospitals containing emergency departments. ICD-9 codes were used to identify asthma, chronic obstructive pulmonary disease (COPD) and heart disease. Air quality data were collected from up to 14 sites for NO_2, O_3, and particulate matter. Two daily exposure measures were calculated, one for daily mean concentration and one for the daily maximum 1 hour concentration for each of the monitoring sites. Poisson auto-regressive model was again performed on counts of daily death and major outdoor pollutants accounting for confounding factors (eg seasonal trends, day of week, and public holidays,). An increase from the 10th to the 90th percentile in daily maximum hourly concentrations of nitrogen dioxide was associated with increased admissions of

childhood asthma (5.29%) and COPD (4.60%). Particulates and ozone were also associated with heart disease admissions among the elderly (65 and over). Investigations from both studies indicate that the levels of air pollution in Sydney were associated with increased daily mortality and hospitalisation for respiratory and heart disease.

Jalaludin et al. (2000a) examined the effects of the January 1994 Sydney bushfire on evening peak expiratory flow rates (PEFR) in children with wheeze. Thirty two children with a history of wheeze were enrolled in a follow-up study (1 to 31 January 1994) and completed a daily asthma diary. Air pollution, meteorological, and pollen data were obtained for the same period. Generalised estimating equation (GEE) techniques were used to assess the association between particulate matter less than 10 μg (PM_{10}) and PEER. The peak level of PM_{10} reached 210 μg/M^3, which was almost seven times the usual PM_{10} level for that period. They did not find a significant association between the bushfire period or PM_{10} and evening PEFR, although in a subgroup of children without bronchial hyper-reactivity, a significant inverse association was observed between PM_{10} and PEFR. They concluded that the high levels of particulate pollution caused by the Sydney bushfires did not lead to any clinically significant reductions in PEFR in symptomatic children. As the authors noted, in view of a small number of children involved in this study, the associations observed need to be confirmed in larger studies. Additionally, the effect estimates may be biased because the outcome may both affect and be affected by time-dependent covariates such as medication use and time spent outdoors.

Jalaludin et al. (2000b) enrolled a cohort of 148 primary school children with a history of wheeze in an 11-month longitudinal study to examine the effect of low levels of ambient ozone on PEFR. Enrolled children recorded PEFR twice daily. Air pollution, meteorological and pollen data were also collected. Mean daytime value of ozone was 1.2 ppb (standard deviation [SD]: 0.68), while mean maximum daytime value was 2.6 ppb (SD: 1.44). Both time-series regression and GEE models were performed to assess the relationship between exposure to ozone and PEFR. There was an inverse association between daily mean deviation in PEFR and same-day mean daytime ozone concentration after adjustment for a range of confounders (e.g., time trend, meteorological variables, pollen count and co-pollutants). The association was stronger in a subgroup of children with bronchial hyperreactivity and a doctor diagnosis of asthma. However, there was no significant association between PEFR and mean daytime maximum ozone concentration.

Denison et al. (2001) examined the relationship between air pollution and daily emergency admissions to hospitals in Melbourne for 1994-1997. This study examined four criteria pollutants (O_3, NO_2, b_{sp} and CO) from up to 7 monitoring stations across Melbourne. The primary source of these pollutants was considered to be motor vehicles, some industrial processes, and domestic wood burning. Emergency hospital admission data were collected from the Department of Human Services (Victoria) and were considered for three age groups (0-14, 15-64, and over 65 years) for asthma, ischaemic heart disease, and all cardiovascular and respiratory disease. Influenza data were also included as a confounder. Lags of 1 and 2 days were considered in the analysis. Temperature and rainfall were considered as confounding variables. The APHEA protocol was followed using Generalised Additive Models (GAM) with LOESS smoothing for the statistical analysis. The results indicate that air pollution levels in Melbourne were comparable to other metropolitan areas (e.g., mean daily one hour maximum concentrations: 26.3 ppb for O_3, 5.5 $b_{sp}/10^5$M for particles, 22.9 ppb for NO_2 and 1.5 ppm

for CO). All pollutants examined in this study were found to be associated with asthma and respiratory disease, while NO_2, b_{sp} and CO_2 were associated with cardiovascular disease for those 65 years and over. The strongest health effects of O_3 were observed in the warm season, while the strongest effects of all other pollutants were observed in the cooler months.

Simpson et al. (2000) examined the short-term effects of ambient fine particle pollution (PM_{10} and $PM_{2.5}$) on daily respiratory, cardiovascular and all cause mortality for two age groups (all ages and 65+) in Melbourne between 1991 and 1996. Poisson regression models were used to determine the air pollution-health associations. Influenza, meteorological variables and temporal cycles were adjusted for. The majority (80%) of deaths occurred in those aged 65 and over. Significant associations were found between the particle measures and all cause and respiratory mortality in the warm season (November to March).

Rutherford et al. (2000) examined the association of outdoor air pollutant concentrations and air spora levels with lung function of asthmatic subjects in the subtropical environment of South-East Queensland. Individuals were recruited through respiratory clinics, advertisements, and contact from their general practitioners in Rocklea and Ipswich. Efforts were made to ensure that all participants were non-smokers, and did not spend more than 5 hours per day in air conditioning and were not exposed to any known aggravators of asthma in the workplace. Peak expiratory flow readings were recorded three times a day and were standardised. Participants underwent standard skin prick tests for a range of food and environmental allergens. Air spora were sampled daily using volumetric traps. Other pollutant data (O_3, NO_2, and b_{sp}) were collected from government monitoring sites. Confounding effects of weather were considered. The results indicate that air pollution levels did not vary substantially between Rocklea and Ipswich (e.g., Maximum 1-hour O_3: 3.5 ppb for Rocklea and 3.0 ppb for Ipswich; and 24-hour average PM_{10}: 21.6 $\mu g/M^3$ for Rocklea and 23.8 $\mu g/M^3$ for Ipswich). The allergic status and age were found to be important, with air pollutants such as ozone and particles associated with decreases in lung function among asthmatic subjects. The effect of ozone on peak expiratory flow in the allergic adults can sometimes be confounded by air spora effects, indicating that in a subtropical climate the impact of ozone on asthma severity can be accurately estimated only when the confounding effects of air spora are included.

Petroeschevsky et al. (2001) carried out an epidemiological time-series study on the relationship between daily counts of emergency hospital admissions and four pollutants (ozone, sulfur dioxide, nitrogen dioxide and particles) in Brisbane during 1987-1994. These four pollutants were used as they were considered to have the greatest impact on respiratory health. 24-hour average and maximum 1-hour concentrations were 2.74 and 7.01 $b_{sp}/10^5 M$ for particles; 0.41 and 0.92 ppb for SO_2, 1.39 and 2.82 ppb for NO_2, respectively; while 8-hour average concentration of O_3 was 1.90 ppb. Confounding factors included influenza, minimum and maximum temperature, rainfall and relative humidity. Poisson regression models were used in this study. The results indicate that particulate pollution was associated positively with hospital admissions for respiratory disease and admissions for asthma in summer, but negative associations were observed for cardiovascular admissions. Similar to the Sydney studies by Morgan et al. (1998a, 1998b), the levels of ambient air pollution in Brisbane were found to make a significant contribution to the variation in daily hospital admissions for asthma and respiratory diseases.

Johnston et al. (2002) carried out an ecological study during a six-month period

of almost continuous bushfires in Darwin. Hospital presentations for asthma were collected from the Emergency Department of the Royal Darwin Hospital using ICD codes. The exposure variable was the mean atmospheric concentration of PM_{10} collected at two locations in suburban Darwin. Potential confounding factors included acute respiratory infection. Weekdays and weekends were controlled for. Negative binomial regression was used in this study, as it was more suitable than Poisson regression models as it predicted the variance more accurately. After adjusting for confounding variables, Johnston et al. found that with every 10μg/m^3 increase of PM_{10} concentration there was a significant increase in asthma presentations. Limitations of the study included being unable to adjust for pollen and mould levels. They concluded that bushfires should be considered as equally injurious to human health as PM_{10} from other sources and the control of smoke pollution from bushfires near urban areas should be considered for future management of fire prone areas.

There are also some other studies that were conducted in non-metropolitan areas where the major source of air pollution was from industries. For example, Henry et al. (1991) examined respiratory symptoms, atopy, and bronchial reactivity in primary school children living in Lake Munmorah (LM), a coastal town near two power stations, and in Nelson Bay (NB), a coastal town free from any possible major sources of outdoor air pollution. A prevalence survey and longitudinal follow-up study were performed 1 year apart. In both studies, the prevalence of 'ever wheezed', 'current wheezing', 'breathlessness', 'wheezing with exercise', 'diagnosed asthma', and 'use of drugs for asthma' at LM were all approximately double the prevalence at NB ($p < 0.01$). The prevalence of bronchial reactivity was significantly greater at LM than NB ($p < 0.01$) at the first but not the second survey. By contrast, no significant differences were found between the two areas for skin test atopy or for parental history of allergic disease. Multivariate analysis supported the conclusion from the univariate analysis that there was more wheezing at LM compared to NB in both studies, when adjusted for atopy, smoking in the home, age, and sex. As expected, a positive skin test reaction to house dust mite was the predominant explanatory variable. Asthma was more common in the community near power stations (LM) than in the NB area. The absence of significant differences in skin test atopy and parental history of allergic disease argued against major genetic differences between the two groups. By contrast, the more common reporting of siblings' chest disease and asthma in Lake Munmorah supported an environmental cause.

To assess longitudinally the effect of living in the vicinity of coal-fired power stations on children with asthma, 99 schoolchildren with a history of wheezing in the previous 12 months were studied for 1 year, using daily diaries and measurements of air quality (Henry et al. 1992). The children had been identified in a cross-sectional survey of two coastal areas: Lake Munmorah (LM), within 5 km of two power stations, and Nelson Bay (NB), free from major industry. Daily air quality [sulphur dioxide (SO_2) and nitrogen oxides (NO_x)], respiratory symptoms, and treatment for asthma were recorded throughout the year. Measurements of SO_2 and NO_x at LM were well within recommended guidelines although they were several times higher than at NB: maximum daily levels in SO_2 were 26 μg/M^3 at LM, 11 μg/M^3 at NB; yearly average SO_2 was 2 μg/M^3 at LM, 0.3 μg/M^3 at NB; yearly average NO_x was 2 μg/M^3 at LM, 0.4 μg/M^3 at NB. Marked weekly fluctuations occurred in the prevalence of cough, wheezing, and breathlessness, without any substantial differences between LM and NB. Overall, the prevalence of symptoms was low (10% for wheezing, 20% for any symptom). Whether the daily SO_2 and NO_x levels

affected the occurrence of respiratory symptoms was investigated in children at LM using a logistic regression. For these children as a group, air quality measurements were not associated with the occurrence of symptoms.

Lewis et al. (1998) investigated the relationship between outdoor air pollution and the respiratory health of 3023 children aged 8 to 10 years from industrial and non-industrial areas in the Hunter and Illawarra regions of New South Wales. A cross-sectional survey was undertaken between October 1993 and December 1993. Summary measures of particulate pollution (levels of particles with an aerodynamic diameter less than 10 microns [PM_{10}] each 6th day) and SO_2 (daily mean and maximum hourly values) were estimated for each area using air quality monitoring station data. The average annual outdoor air pollution for the nine areas was 18.6-43.7 $\mu g/M^3$ for PM_{10} and 0.16-0.90 ppm for SO_2. The proportion of children reported to have the main outcome symptoms were: chest colds, 3.0%-9.7%; night cough, 12.3%-30.5%; and wheeze, 3.4%-11.3%. There was no significant association with SO_2, but a significant increase in the odds of symptoms per 10 micrograms/m^3 increase in PM_{10} on chest colds (odds ratio [OR], 1.43; 95% confidence interval [CI], 1.12-1.82) and night-time cough (OR, 1.34; 95% CI, 1.19-1.53), but not wheeze. Passive smoking was significantly associated with chest colds, but not with the other symptoms. Maternal allergy was associated with all three respiratory symptoms, most strongly with wheeze. These results provide evidence of health effects at lower than expected levels of outdoor air pollution in the Australian setting. They also suggest differences in contributions of environmental and hereditary factors to cough and chest colds compared with wheeze.

Gaps in Current Knowledge

A number of Australian studies have examined the relationship between air pollution and health outcomes, and they have found, to some extent, adverse health effects of air pollution in major cities. However, there are still many gaps in the knowledge base, which include evaluating spatial effects of air pollution, disentangling health effects of a certain air pollutant from other pollutants, defining exposure thresholds (e.g., the lowest observed adverse effects levels (LOAELs) and no observed adverse effects levels (NOAELs)), determining population exposure distributions, and assessing interactive effects of air pollution with other environmental factors.

Beer and Ricci (1999) proposed a quantitative risk assessment method based on population and exposure distributions using air quality data as an example. The method consists of calculating the product of two functions: a population-weighted distribution of concentrations and a concentration-response distribution. The corresponding aggregated health-risk distribution function can be produced through this process. However, the implications of this method in the development of legislation and policies for the control of air pollution in Australian cities remain to be determined.

Sullivan and Beudeker (1999) discussed new directions for impact assessment of air quality for Australia with regard to the Air NEPM and concluded that the Air NEPM is a limited public policy tool, and without other more comprehensive means of assessing air quality, the protection of both health and the environment might be undermined. The development of applicable standards for Australia rather than basing standards on overseas research is essential. Standards should be expanded to include health impacts associated with both short and long-term exposure levels. The investigation of the potential health effects of certain pollutants on sensitive individuals/groups (e.g., elderly, children or asthmatics) is also required.

To account for these gaps, the future research should focus on:

- Quantifying major health outcomes associated with air pollution using analytic epidemiological design, e.g., longitudinal cohort studies;
- Assessing interactive effects of air pollutants and other environmental hazards, e.g. weather variation;
- Defining exposure thresholds (LOAELs and NOAELs) for all criteria pollutants through incorporating both epidemiological and laboratory evidence;
- Determining population exposure distribution according to place of main exposure, e.g., home locations close to major freeways using GIS;
- Developing national standards based on both Australian and international data;
- Developing policies that ensure the guidelines for each of the criteria pollutants are met.

A workshop was held in Canberra in November 2002 to review air pollution and health research in Australia and develop visions for future research. The Air NEPMs were criticised at the workshop because the current air quality standards in Australia are largely based on overseas data. Recommendations were made for more research on air pollution and health being conducted in Australia (e.g., longitudinal cohort studies), and new standards being developed to ensure greater protection of vulnerable groups. It was also recommended that not only peak exposures but also long-term average exposure be incorporated into the standards.

Individual exposure levels may also need to be taken into consideration. Further research investigating the lowest observed adverse effect level (LOAELs) of individual air pollutants, where pollutants have a threshold (e.g., O_3) is needed. LOAELs are essential in the formulation of air quality standards if a threshold exists. Some pollutants (e.g., PM_{10}) may have no threshold and may need a different approach. In such cases, risk assessment may be used in the development of regulatory standards for the general population. The use of risk assessment would also be relevant for protecting sensitive individuals. There is increasing evidence that air pollution may also influence mortality rates of newborn babies or infants (Kunzli et al. 2000; Tong & Colditz 2004). This area requires further research and is of particular importance for estimating the life years lost which can be attributed to air pollution.

It was suggested that the association between air pollution and daily mortality may be causal and that the primary focus for reducing air pollution and the associated health effects should be to reduce vehicle dependence in major cities in Australia (Morgan et al. 1998a). The results from improved transportation in Atlanta, Georgia during the 1996 Olympic Games demonstrated the impact of excess vehicle emissions on health (Friedman et al. 2001). During this time air pollutants decreased by approximately 30% followed by a 40% decrease in the number of acute asthma attacks. Therefore, development of better, cost effective and convenient modes of public transportation within major cities would be desirable.

Conclusion

The weight of evidence from Australian epidemiological studies shows that exposure to ambient air pollution may be an important environmental risk factor for cardiopulmonary diseases. These results are consistent with overseas findings (Brunekreef & Holgate 2002; Pope et al. 1995). What is unknown is whether some health effects can be attributed to a certain air pollutant or a mixture of air pollutants, whether a true exposure threshold exists for some air pollutants (e.g., particulate

matter), to what extent air pollution impacts upon population health compared with other environmental hazards (e.g., food hygiene and water quality), and how different air pollutants interact with each other. These issues need to be addressed for the further development of specific air pollution standards in Australia.

Air pollution continues to be a major environmental hazard in most metropolitan areas. Although some steps have been taken to mitigate air pollution, further development of emission control and effective local interventions are needed to reduce the health burden of air pollution in Australia. Although investigations examining the health impacts of exposure to ambient air pollution are challenging, there is a great need to conduct further research in order to set specific standards to protect the health and wellbeing of the Australian population.

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Back to TOC

The Management of Crowds and Other Risks at Outdoor Music Festivals: A Review of the Literature

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Outdoor music festivals (OMFs) generate significant interest for environmental health professionals (EHPs). There is sufficient evidence to indicate that OMFs are associated with an increased risk to health and safety. A considerable proportion of these risks has been attributed to crowd behaviour in the general admission or 'mosh pits'. Consequently, managing the impact of crowd behaviour in these areas would have a positive impact on the safety and success of these OMFs. Improving the quality of planning, and subsequently event management, was highlighted as the best method to deal with crowd related risks. EHPs are in a position to influence the event planning processes through their involvement in local government event licensing programs. This article is based on the findings of an extensive literature review and was intended to encourage EHPs to have further participation in crowd management for OMFs.

Key words: *Outdoor Music Festivals; Public Health Risks; Event Characteristics; Risk Assessments; Event Planning and Management; Crowd Management*

There is sufficient evidence to indicate that music events including outdoor music festivals are associated with an increased risk of public health issues (Arbon 2003). These risks are increased if an OMF has a general admission area or 'mosh pit' (Milsten et al. 2003). Australia has experienced a fatality within the mosh pit at an OMF that occurred at the 2001 Big Day Out in Sydney (Crowd Management Strategies [CMS] 2002). Raineri (2004) believed that it has taken this incident to generate change and major improvements to crowd safety, infrastructure and production safety for many Australian events. However, there is still more that can be done.

The aim of this article was to encourage EHPs to consider having a larger role in crowd safety for OMFs. The discussion was based on evidence found from an extensive review of the literature on public health risks, crowd safety, and event planning, and management at OMFs.

Risks to Crowds

There are numerous public health risks associated with OMFs. The following section provides an overview of recent crowd related incidents from the media, morbidity and mortality figures, and patrons risk perceptions.

Recent crowd related incidents

The following Table (Table 1) shows notable incidents reported in the media that occurred in the last five years and their causes. This gives an indication of the trends in incidents with fires, terrorism, and gun violence among the most recent reports.

Mortality data

As shown in Table 1, deaths have occurred at OMFs. CMS (2003) reported that between 1992 and 2002, 232 people have died at music events. Upton (2004) presented alternative data from 1974 to 2003 that identified 136 crowd-related deaths. These deaths occurred during (i) ingress, and (ii) egress into events, (iii) at

Table 1: Notable public safety incidents

Year	Incident
2004	Three people shot dead (including a popular artist) at an Alrosa Villa concert Hall in America (CMS 2005).
	175 people and 714 injured from a fire in an over crowded club in Buenos Aires (CMS 2005b).
2003	21 people died in a crowd crush escaping a Chicago nightclub caused by action undertaken by security staff with emergency egress restricted (Wertheimer 2003a & 2003b).
	97 people died in a fire at a rock show at Rhode Island (Bayles & Hampton 2003; Wertheimer 2003a & 2003b).
	14 patrons and 2 terrorists died when explosives were detonated outside a rock concert at Moscow (CMS 2003).
2001	11 people died (including a police officer) and 50 injured at a Bengali New Year's concert in Bangladesh resulting from a terrorist action. 3 bombs were involved (CMS 2002).
	4 bombs were confiscated and 5 people arrested on route to the Ozzfest rock festival in George, Washington (CMS 2002).
	A girl died as a result of injuries sustained during a crowd crush at the Big Day Out festival in Sydney, Australia (2001).
2000	9 people died and 26 injured from a crowd surge at the Roskilde festival in Denmark (CMS 2001b).
	After this tragedy, the Glastonbury Festival in England was cancelled for 2001 with concern over public safety the primary cause (Avon & Somerset Constabulary 2000).
1999	There was a riot, claims of rape, numerous arrests and 10000 injured during Woodstock 1999 (CMS 2001a; Vider 2004).
	There were numerous people injured and some fatalities (including 2 deaths and the hospitalisation of 9 others after taking poisonous pills disguised as the drug 'Ecstasy') and 1322 crimes (including assaults, thefts and assorted violent acts) at the Glastonbury Festival in 1999 (USA Today (2001).
	53 people died in a crowd crush at a subway station trying to escape a hailstorm at an OMF in Belaris, Minsk (CMS 2001b).

the front of (or diving off) a stage during a performance, and (iv) falling from the balconies at arenas and stadiums (Upton 2004). For Australia, there has been no more significant an incident than the death of a young girl at a festival in 2001. Deaths are infrequent, with injuries being much more prevalent.

Morbidity data

Crowd Management Strategies (2002), an American based organisation, has collected injury data from 306 events globally, with an estimated 66,787 injuries recorded for the period between 1992 and 2002. The highest number of injuries for a single event was recorded in 1999 where the Woodstock 1999 festival had 10,000 people treated for injuries sustained (CMS 2002).

Importantly, the majority of the injuries at events are minor, with critical illnesses infrequent occurrences (Varon et al. 2003). Varon et al. (2003) and Milsten et al. (2003) found that more than 80% of the patients returned to the event. Both authors explained that this was due to most presentations being for minor trauma and headaches. Arbon (2002) found considerable variations with injury rates for mass gatherings throughout Australia, but the highest recorded rate was at a summer OMF (26.85 patient presentation rate per 1000 spectators). Generally, when compared to OMFs around the world, Australia's rates were on a par (Chapman, Carmichael & Goode 1982; CMS 2001b; Forrest 1999; Furst & Sandor 2002; Janchar, Sammaddar & Milzman 2000; Kao et al. 2001).

Risk perceptions

Earl and Van der Heide's (2001) study on patron risk perception found there was particular concern about being in the mosh pits of OMFs. A wide range of public health issues are of high concern, including access to drinking water, toilets, safe food, transportation to and from the venues, the size of the crowds, and having valuables lost or stolen. This study also highlighted the importance of having a huge focus on safety in mosh pits. The participants linked mosh pits to numerous other risks, such as being

grabbed, the need for first aid, items thrown, crowd size, losing valuables, and alcohol related behaviour.

Commons, Baldwin and Dunsire (1999) warned against using excessive control as it would limit expression for the patrons. This was an interesting point of view, however, others were adamant that public safety needs to remain the main priority for event organisers and licensing authorities (e.g. EMA 1999; HSE 1999; Upton 2004; Wertheimer 2001).

Event Characteristics and Risks

Research has identified a number of characteristics that contribute to the risks at mass gatherings (e.g. Arbon, Bridgewater & Smith 2001; Earl et al. 2004; Milsten et al. 2002, 2003; Zeitz et al. 2002). However, it was Arbon (2004) who provided the most recent and complete list of these characteristics, which included (i) the weather (temperature and humidity); (ii) duration of the event; (iii) whether the event is predominantly an outdoor or indoor event; (iv) whether the crowd is predominantly seated or mobile; (v) if the venue is bounded (fenced and secured) or unbounded; (vi) the type of event; (vii) the crowd mood; (viii) availability of alcohol and drugs; (ix) crowd density; (x) the geography of the event (topography and locality); and (xi) average age of the crowd. These studies focused on a variety of different types of mass gatherings such as sporting events, so what about OMFs specifically?

All of the characteristics identified by Arbon (2004) relate to OMFs. A study by Earl et al. (2004) found that OMFs were different from many mass gatherings. These differences were attributed to the large crowds in attendance, the influence of music on those attending and crowd mood (usually volatile with greater security demands) and demographics (often younger patrons). Arbon (2002) found there were links between increased public health risks and rock music events, particularly OMFs. Earl et al. (2004) explained that crowd crushes and intoxication were the most common factors associated with these public health risks with both influenced by changes in crowd mood and performance.

The recognition, tempo or rhythm of songs, the type and attitude of the performers or any combination of these, were closely linked to changes in crowd behaviour (Earl et al. 2004). Earl et al. reported that heavy metal, hardcore punk, and rap performances were considered highly influential on crowd behaviour.

Milsten et al. (2002) and Earl et al. (2004) considered that crowd mood was associated with a number of factors. Milsten et al. said that mood was linked to the closeness of crowds, the occurrence of incidents (such as a crowd rush), and/or the effect of the music. While Earl et al. considered that these crowds have lots of energy with a "group mentality" ("...more likely to become unruly" and "because they are much louder and they tend to follow each other") and attitude ("...there is less respect for authority at music events") that also influences mood.

Additional factors of interest were crowds that have predominantly young males in attendance, overcrowding of venues, lack of appropriate emergency management planning, or insufficient numbers of trained, experienced security staff (Earl et al. 2004).

Tools Used in Crowd Management

Risk management has been recognised as a useful tool in crowd management (Tatrai 2001, 2004). The risk-based approaches were described as two basic processes that were (i) risk assessment and (ii) the selection and implementation of management options (National Research Council 1983).

(i) Risk assessment

There was considerable endorsement for risk management for OMFs within the literature reviewed (e.g. Department of Health 2004; Emergency Management Australia [EMA] 1999; Federal Emergency Management

Association [FEMA] 2003; Health and Safety Executive [HSE] 1999). The strength of risk management is that it provides a systematic approach to the identification and management of risks. However, the quality of risk assessments at Australian OMFs has been heavily criticised in recent years (Weir 2002). Tatrai (2001), an event and crowd specialist, recommended the national Australian Standard AS/NZ 4360: 1999. Tatrai (2001) argued that its robust process and good guidance notes make it an ideal choice. Tatrai (2001) has had considerable success with this approach and was confident it would be as useful for others.

The HSE (1999) considered that any assessment should reflect current best practice. For advice on best practice, useful standards can be found in EMA (1999), HSE (1999) documents or the new draft Department of Health (2004) event guide from Western Australia. It is important to remember that risk assessments are not perfect processes. Langley (cited in Cromar, Cameron & Scott 2003) advised that it is not always possible to arrive at a definite outcome. Oosthuizen (2001) said that factors such as cost blowouts, insufficient data, poor methodology or inadequate staff capacity contributed to this (Oosthuizen 2001). In terms of OMFs, gaps within the evidence base (Arbon 2004), and limitations in event planning capabilities were highly likely to affect these processes (Au et al. 1993; EMA 1999).

The following sections provide insight into (a) the risk compliance review (or establishing the context), and (b) the risk analysis within the risk assessment processes for OMFs that EHPs may find useful.

(a) Risk compliance review

Tatrai (2001) described the first step in the risk management process as undertaking a risk compliance review. This involves undertaking an audit of all operations for the event, the intended site, the identification of key stakeholders (e.g. venue manager, promoters, contractors and sponsors) and assets (e.g. infrastructure, goodwill and publicity) (Tatrai 2001). An evaluation of crowd characteristics should be undertaken as part of the risk compliance review (HSE 1999).

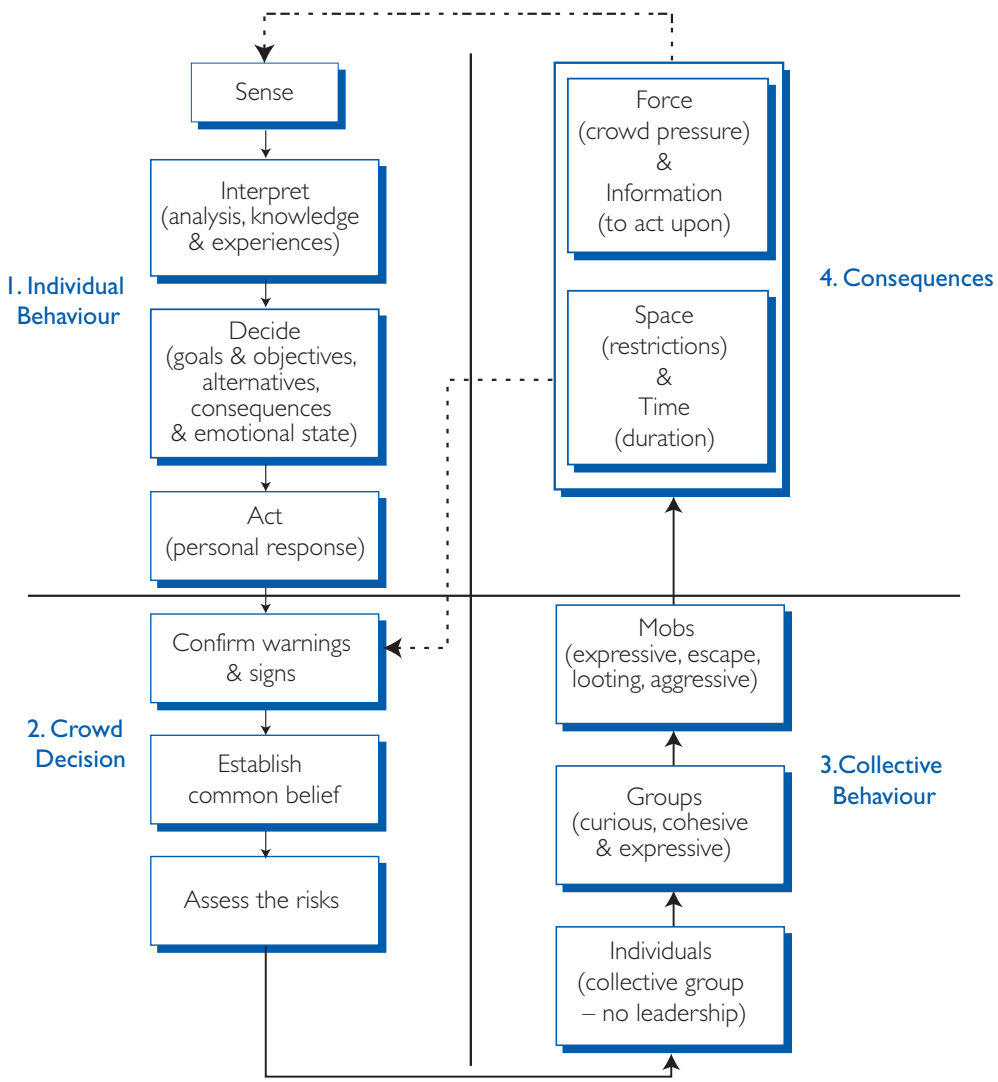
Raineri (2004) considered that the evaluation of crowd should identify (a) different social groups likely to attend (b) previous experience with these groups (c) potential behaviour patterns (d) staffing implications, and (e) the methods of communication between staff and the crowd. OMFs have become important cultural foci (Ministry of Culture 2001) and there were associations between youthful expressions and music events, and public health risks were identified within the literature (e.g. Bennett 2002). The expressions of particular interest include moshing, crowd surfing, swirling, drug and alcohol consumption, and the likelihood of violence. The likelihood of this type of expression can vary depending on the different social cliques present within the crowd (Bennett 2002).

There are many social cliques with close links to music such as Mods, Hippies, Beats, Punks, Metal Heads (also called 'Headbangers'), Skinheads, Disco, and Ravers (Forsyth, Barnard & McKeganey 1997; Weir 2000). Each of these groups brings specific values (e.g. skinheads like to be aggressive), norms (e.g. heavy metal crowds are big alcohol and drug consumers; ravers like ecstasy) and expectations (e.g. punks expect to be able to slam dance or mosh) to each event they attend. Behaviour in mosh pits should be of the most concern (Earl & Van der Heide 2001).

(b) Risk analysis

Figure 1 provides a model of behaviour within a crowd at a music event. This model shows the basic individual and group cognitive and crowd degeneration processes that can lead to adverse public health outcomes at music events. These are described as steps.

Figure 1: Crowd behaviour model (EMA 1999; Fruin 2002; Tatrai 2001)



Step 1 Individual Behaviour & Step 2 Crowd Decision

EMA (1999) suggested that crowd responses are based on a series of individual and collective behaviours. The individuals in the crowd are exposed to stimuli, make decisions, and formulate personal responses based on factors such as experience, knowledge and expectations. These responses are then communicated out through the crowd in order to affiliate with others, reduce confusion, and evaluate emotional responses. Based on decisions made within these stages, changes within the crowd behaviour are likely to result.

Step 3 Collective behaviour

Tatrai (2001) reported that there are three main classifications for crowds. These are individuals in collective groups without leadership, groups with common interests, and mobs that are responsible for the extreme reactions in crowds. Each of these crowd classifications has implications for event planning and management.

Importantly, crowds can move readily between each classification and the subcategories within them.

Type 1: Individuals within a collective group having no leadership or focus.

Type 2: Groups with common interest and the following sub-categories within these groups:

- curious crowds, such as stopping to watch a busker or spectators at the scene of an accident;
- cohesive crowds, such as attending a sporting event or theatre; and
- expressive crowds, such as patrons at a classic rock event or State of Origin rugby league crowds.

Type 3: Mobs do not occur often and form from the degeneration of Type 2 crowds. These mobs require extreme responses and expert skills to manage them. There are sub-categories to this crowd type that are:

- expressive mobs, such as post New Year's Eve crowds;
- escape mobs, such as crowds escaping a fire or explosion;
- acquisitive mobs, such as looting crowds after disasters; and
- aggressive mobs, such as the crowd at the Woodstock 1999 festival (Tatrai 2001).

Step 4 Consequences

Fruin (2002) spent many years researching crowds and has developed a model that can assist with the analysis of risks at OMFs by providing insight into the causes of crowd disasters, prevention and mitigation approaches. The elements of the model form the acronym 'FIST' that is defined as the following:

- Force: These forces are the result of pushing from within the crowd (Fruin 2002). For example, steel railings bending after crowd related incidents indicating forces exceeding 4500 N or 1000lbs.
- Information: Fruin (2002) considered that information which had affected group perceptions included sights and sounds from within the crowd, public address announcements, training and experience, actions of staff, signs, and ticketing.
- Space: Fruin (2002) said that the main features of space included projected occupancy rates, audience viewing areas, and the capacities of corridors, ramps, stairs, doors, escalators and elevators to manage crowd movement.
- Time: Fruin (2002) explained timing as the more gradual and lighter density arrival process before an event compared to the rapid egress and heavy crowd densities after an event.

(ii) The selection and implementation of management options

It is important to manage public health risks at OMFs (EMA 1999). Critical elements such as the types of barriers used, security staffing, composition of the crowds, the type of music, or choices of venues all have an effect on risks at these events. As a result, the planning stage becomes critical to ensure that appropriate and effective management options are used at these events.

(a) Event planning

Comments on event planning in Australia suggest that current methods have been inconsistent (Arbon 2004) and often ineffective (EMA 1999). Wertheimer considered that many deaths and injuries were attributable to poor event planning (Wertheimer 2000, 2001, 2002). For example, a death, 140 injuries, and significant environmental damage to Brighton beach in England occurred when 250,000 people attended an event with a planned capacity of 60,000 people (Wertheimer 2002). According to Au et al. (1993), many event organisers rely too heavily on previous experience when planning their events. This could explain deficiencies in specialist areas such as risk management (Weir 2002) and emergency planning and response (Davies 1998; EMA 1999; Wertheimer 1993). Clearly event organisers would benefit from good guidance in event planning.

The following are points for EHPs to consider regarding event planning:

- The HSE (1999) event planning guide (also known as 'The Purple Guide') that is considered the international benchmark for event planning, provides guidance on standards for (1) structures, (2) sanitation, (3) waste management, (4) sound, noise and vibration and (5) food, drink and water.

- Particularly valuable are the checklists found in the EMA (1999), FEMA (2003), Department of Human Services or Department of Health (2004) event planning guides. These checklists are useful for both event organisers and EHPs.

- The use of risk assessments was strongly encouraged (e.g. City of Edinburgh Council 2002; Civil Defence and Emergency Management 2003; EMA 1999; HSE 1999; Liquor Licensing Division [LLD] 1999; Department of Human Services 2003).

- Event planning should be able to respond to new and emerging risks, for example terrorist threats (Weir 2002) and must be based on up-to-date, thorough risk assessments with a continuous improvement focus.

Leadership in event planning (Glastonbury Festival)

The local authorities can be advocates for better public health outcomes at OMFs through their event licensing programs. The Glastonbury Festival on Worthy Farm in Somerset, England, is a good example of this. Current capacity for the event is 150,000 people.

In 2000, the Glastonbury Festival attracted an unprecedented number of gatecrashers and this, and the subsequent crime, contributed to the cancellation of the event in 2001. It was the guidance and direction provided by the event licensing authority, the Mendip District Council, that resulted in significant improvements to the management structure and operational functioning of that festival. The provision of a super security fence, greater security presence, an environmental protection program, volunteer training programs and increased coordination with the festival management have been the outstanding features within that change (Mendip District Council 2002, 2003, 2004).

(b) Event management

Both EMA (1999) and HSE (1999) asserted that good operational and strategic structures were critically important. Operationally, this means using competent staff; maintaining good control of the event (e.g. crowd numbers) and cooperation within the stakeholders (e.g. security and police) and ensuring that public health and safety remains high on the operational agenda (HSE 1999). Strategically, this means undertaking comprehensive pre-

event planning processes, establishing emergency response capabilities, and putting management processes in place as early as possible (EMA 1999; LLD 1999). Emergency management was identified as being a weakness for events in Australia, specifically emergency response, contingency planning, and consideration of extreme events (Davies 1998; EMA 1999).

(c) Crowd management

Crowd management is a major component of event planning and management. There is good guidance information available to support crowd management for OMFs. The following are features that should be considered in good crowd management.

Crowd management services

The following provides an introduction to the services and activities that make up crowd management at OMFs:

- fire safety involving safe escape routes, assembly areas, fire fighting equipment, and use of appropriate, trained staff (HSE 1999);
- first aid and medical services involving medical triage facilities, ambulances and medical and first aid staff (including mobile patrols) (Arbon 2002; EMA 1999);
- emergency management planning required for structural faults, equipment or amusement ride failure or malfunction, bomb threats, and crowd control (Department of Human Services 2003); and
- security and stewarding involving crowd control, guarding of back house, back stage, front of stage areas, cash and equipment protection, and control of entry and exits (Ministry of Civil Defence and Emergency Management [MCFEM] 2003).

Venue/site design

The HSE (1993) considers that the design and layout of the venue has a big influence on public safety. Designing for good crowd management requires maximum occupancy levels to correlate to movement capabilities of all pathways within the event (Fruin 2002). It is important to check for such features as steep slopes, dead ends, the convergence of routes, uneven or slippery flooring and the placement of facilities throughout the site (e.g. food outlets, bars, and toilets). It is also necessary to watch for reverse flows, obstructions created by queues or gathering crowds, flows mixing with traffic, and moving attractions within the crowd (Raineri 2004). Finally, ensuring there is continuous electricity for lighting within the site is also important (Fruin 2002).

Mosh pits and barriers

The HSE (1993) asserted that the management of crowds was dependent on good systems and staff experience. Upton (2004a) argued that 5% of a crowd generate up to 75% of the energy released at an event. The 5% is generally made up of the patrons located at the front of the stage in the mosh pit and therefore controlling the effects of this group is critical. Hill (2002) considered that the provision of separate mosh pits to isolate the main moshing activities from the rest of the crowd was the preferred option. This can be done using barrier systems (often referred to as 'secondary barrier systems') and there was some discourse within the literature on this topic. The examples of secondary barrier systems reported in the literature were:

- The 'D' shape barrier system where a barrier surrounds the mosh pit area with egress and access managed by security personnel (HSE 1999; Raineri 2004). Upton (2004) recommended for very large crowds to use double or triple 'D' systems if possible. This system has been used for the Big Day Out events (Raineri 2004).

- The 'finger' barrier system where there is a barrier that runs perpendicular to the stage and is connected to the front of stage barrier and divides the mosh pit laterally (HSE 1999). Security staff are positioned within the barrier system to manage crowd activities. This system was used at the Livid Festival in 2003.
- Another system is used to divide the entire general admission area into two completely separated sections with their own entrances, exits, and associated services (Upton 2004). This system was used at the Wave Aid Concert in 2004.
- The final and most advanced method to date is where the mosh pit is divided into four unique, penned zones. Each of these zones has a limited capacity (maximum of 500 patrons) with its own ingress, egress, and emergency evaluation systems and is self-contained in terms of facilities, welfare and concessions (Upton 2004). This system was used at the Roskilde Festival in recent years.

Upton (2004) recommended that the following considerations were important when making decisions about barrier configurations for mosh pit areas:

- Have a realistic approach to establishing the capacity and densities within these areas;
- Crowd conditions must be assessed by individual areas not the overall site (e.g. large video screens are most likely to be the focus of the crowds at large OMFs and this needs to be considered while undertaking risk assessments);
- An accurate assessment of the topography (e.g. incline, drainage, grass coverage, and hard standing features), crowd composition, and performers' impact is critical;
- Consideration for medical and security teams to respond, triage, and retrieve victims of crowd incidents is also important.

Information

The amount and quality of knowledge people have about the venue and the event affects the way they act, especially in emergencies. Fruin (2002) and the HSE (1993) suggested that clear sign posts and simple, audible public address messages are vital as poor communication can lead to confusion and crowd flow blockages. Also, those around them can influence the behaviour of individuals. It is important to identify leaders within the crowds, as they are likely to influence the behaviour of others.

Timing

Raineri (2004) said that the objective of temporal strategies is to keep pedestrian densities below critical levels. Examples of these strategies include staggering start times for activities within the event or mixing up the line-up for the day to allow popular acts to perform throughout the day.

Security staff

Security and stewarding services are critical to good crowd management. The HSE (1993) recommend that it is important that event organisers: (i) establish clear roles and responsibilities; (ii) document all crowd management systems; (iii) have effective review processes; and (iv) use properly trained staff. Tatrai (2001) advised that professional security staff personnel have specific operational standards and best practice approaches that describe staff ratios, training requirements, barrier systems, and related site infrastructure and it is useful to be aware of these.

The HSE (1993) added that crowd safety teams should: (i) understand crowd demographics and behaviour; (ii) regularly assess crowd safety systems for effectiveness and appropriateness during the event;

(iii) set and manage targets for crowd management; (iv) work collaboratively with key agencies (e.g. the police and the emergency services); and (v) maintain good communication and coordination with event management (HSE 1993, 1999).

Volunteer staff

It was considered important that all staff who have contact with crowds at these events are aware of the importance of good crowd safety (HSE 1993). However, for some events volunteer staff undertake these roles without the same level of training, and often experience, that the professional security staff have. Au et al. (1993) argue that there should be no distinction between paid and volunteer staff. The Glastonbury Festival has led the way in volunteer capacity development by introducing tailored training programs for its volunteers (Glastonbury Festival Limited 2001).

Earl et al. (2005) undertook a study to assess the capacity of volunteer stewards working at the 2003 Glastonbury Festival. The findings from that study showed that the volunteers within the study reported a good knowledge in public health and emergency management for that festival. There was considerable evidence from that study that the training had successfully increased volunteer capacity. Additionally, the event organisers undertook a volunteer evaluation of their own and reported similar findings. Overall, the "stewarding [volunteer] standards at the 2003 festival were the highest ever" (ACCESS 2003, p. 2). Earl et al. (2004, 2005) recommended that volunteer capacity be boosted by giving volunteers access to tailored training programs similar to those offered for the Glastonbury Festival.

Environmental Health Professionals in Crowd Management

There is sufficient evidence to indicate that music events including OMFs are associated with an increased risk of public health issues. A considerable proportion of these risks can be attributed to mosh pits and other crowd safety concerns at these events. It is clear from the evidence reported within the literature that effective event planning is critical to ensure the provision of good management strategies at OMFs. EHPs have involvement in event planning through local government event licensing programs and are well placed to influence the event planning process and achieve better public health outcomes at OMFs.

Undertaking risk assessments (HSE 1993,1999) supported by comprehensive strategic, for example, emergency response capabilities (Davies 1998), and effective operational structures, for example, security capabilities (HSE 1993) were considered critical. Minimising variations and inconsistencies within these planning processes was considered important to improving public health outcomes (Arbon 2004; EMA 1999). To help minimise these issues, there were volumes of easily assessable, resource material, and literature available electronically and in hard copy (e.g. HSE 1999 and Department of Health 2004). Some authors such as Arbon (2002, 2004) and Milsten et al. (2002) suggested that comprehensive knowledge and understanding of all the event characteristics was also beneficial. EHPs have the fundamental skills that would allow meaningful contributions to crowd management for music events, particularly OMFs. EHPs have an excellent understanding of risk assessment processes and are often involved in the event planning and approval processes so could become more involved in crowd management. It was the intention of this article to provide readers with information on crowd management and contribute to an increased understanding of that management, thus encouraging further involvement through the event planning, approval, and monitoring processes for these events.

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Back to TOC

Planning and Management for Public Health Impacts at Outdoor Music Festivals: An International Study

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In 2000 the Glastonbury Festival in England experienced an unprecedented invasion of gatecrashers that severely compromised public health and safety. This incident identified the need for a comprehensive review of planning and management procedures for that event. In order to undertake this review, the 2001 event was cancelled. Upon its return in 2002, the event demonstrated considerable improvements in health and safety with the main features being tighter security and a more secure perimeter fence. Advancements such as these have continued at each subsequent event, with the 2004 festival considered the safest to date. The Glastonbury Festival provides a model for successful management of health and safety issues for large public events. This success was made possible by the collaborative efforts of the event organiser and government agencies, in particular the Mendip District Council. This event demonstrates how the licensing process can be a useful tool to encourage good practice in public health and safety issues for large outdoor music festivals.

Key words: *Outdoor Festivals; Glastonbury; Licensing; Health and Safety*

Outdoor music festivals (OMFs) are increasingly common events on the summer entertainment landscape for youth in Australia. It has been found that attending these OMFs is associated with an increased risk of injury and in extreme cases, death (Arbon 2002, 2003). A considerable proportion of these risks can be attributed to behaviour in the general admission or standing room only areas in front of the stages or 'mosh pits'. The following are examples of critical incidents that have occurred within the mosh pit areas at OMFs:

- The deaths of nine and injuries to 26 patrons from a crowd crush at the Roskilde Festival 2000 in Denmark (Crowd Management Strategies [CMS] 2001)

- An unprecedented number of gate crashers who invaded the Glastonbury Festival 2000 (The Avon and Somerset Constabulary [A & SC] 2000); and

- The death of a young girl from a crowd crush at the Big Day Out in Australia 2001 (CMS 2001).

In Australia, it has been as a consequence of these events and, in particular, the death at the Australian OMF that "significant attention is now being paid to crowd safety and security issues, as well as infrastructure and production safety issues, by the promoters and managers of significant local live music events, such as the Big Day Out and the Valley Fiesta" (Raineri 2004, p. 2). Similarly, there has been considerable progress in Europe with both the Glastonbury and Roskilde Festivals.

This paper discusses the transition of one of these events, the Glastonbury Festival, to becoming one of the safest events in Europe and demonstrates leadership in event planning and management.

For this article, the study findings have been presented within three (3) main sections. These are:

Section 1: *The progressions of the festival from 2000 to 2004* - this section focuses on the written reports and other documents collected;

Section 2: *Comments provided by the key informants* - this section focuses on the data collected from the MDC staff on the hazards and risks associated with the festival; and

Section 3: *Successful management and planning of the event.*

The Glastonbury Festival

The Glastonbury Festival held at Worthy Farm in Somerset, England, has become recognised as one of the premier European OMFs. The festival has approximately 800 market traders and 250 different artists performing on 4 main stages, 10 marquees and numerous other smaller venues (Lakin, Brown & Williams 2001; MDC 2000). Currently, the festival population is restricted to 150 000 people (MDC 2003).

A Public Entertainment License (PEL) is required before the event can be held. The PEL authority for this festival is the Mendip District Council (MDC). The local police force, the Avon and Somerset Constabulary (A&SC), are key partners in the licensing process. Additionally, the MDC also administers the workplace health and safety legislation that is an important component of PEL.

Methods

This study has investigated why changes have occurred in event planning and management and how these changes came about for the Glastonbury Festival between 2000 and 2004. Case study methodology was chosen for this study (Yin 1994).

For this study, data were collected using two methods. The first method involved the collection of written records and artefacts covering events between 2000 and 2004. The second method involved the collection of self-report data from key informants at the MDC after the 2000 and 2004 festivals (Creswell 2003; Hedrick, Bickman & Reg 2003; Yin 1994).

Written records and artefacts

Literature and other forms of written evidence have been collected for use in this study (Yin 1994). These included media articles, MDC reports, journal articles and non-peer reviewed reports that help to explain the transition of public health and safety for the Glastonbury Festival between 2000 and 2004.

Key informants

Key informants for this study were the Senior Environmental Health Practitioners (SEHPs) employed by the MDC and involved in the approval, licensing and monitoring of environmental health hazards and risks at the Glastonbury Festival. The collection of self-report data from the SEHPs was undertaken through a series of structured survey instruments.

The first questionnaire was administered after the 2000 festival and repeated after the 2004 event. In summary, that questionnaire was divided into three main sections with the first two focusing on basic demographic data, and the identification of general public health hazards associated with the festival. The final section focused on the most significant public health hazard, the corresponding risk values and the key control measures utilised for the 2000 and 2004 events.

The questionnaire was pilot tested with local government staff regulating an OMF in Australia. The results from the pilot were analysed and the questionnaire was modified prior to use.

The participants for these components of the study were:

(i) Post 2000 festival: Ten of the SEHPs (83.0%; n=10) from a possible twelve (N=12) staff members agreed to participate; and

(ii) Post 2004 festival: Nine of the SEHPs (82.0%; *n*=9) from a possible eleven (*N*=11) staff members agreed to participate.

Additional data were collected from the 2004 study participants; these study participants were asked to rate the overall effectiveness of the 2004 event and identify the best and worst features. All the SEHPs in the 2004 cohort (100%, *n*=9) provided a rating, features, and comments.

Finally, senior management from within the 2004 cohort was asked to provide an additional assessment of management at that event. This group was asked to rate 22 variables from the Health and Safety Executives (1999) event planning guide. These variables ranged from overall layout of the festival to information and welfare services at the event. All the staff members targeted agreed to participate and provided ratings and comments (100%; *n*=5).

Section 1: The Progression of the Festival from 2000 to 2004

A turning point: Glastonbury 2000

Information from MDC reports and other documents has been used to compile a summary of the last five years of public health and safety management at the Glastonbury Festival.

The year 2000 was a major turning point for the Glastonbury Festival. The festival was experiencing escalation in public safety issues, which culminated at the 2000 event. The licensing authority and the local constabulary (A & SC 2000) described the illegal attendance at that event as unprecedented, and the additional attendance brought a major increase in crime at the event.

The A & SC (2000) considered the number of people at the event (estimated at double the licence limit) was beyond effective control with emergency management compromised and movement impeded (MDC 2000). The event planning undertaken and infrastructure provided for the 2000 festival was severely compromised (MDC 2000).

The MDC report to the Regulatory Board stated that: "...it was clear from reports that the perimeter security and regulation of numbers was completely compromised...." (MDC 2000, p. 3). The constabulary provided an explanation that: "during recent years there is a growing culture of entry without payment [and] the situation reached unprecedented proportions during the 2000 festival" (A & SC 2000 p. 3).

The MDC Regulatory Board deemed the attendance numbers at the 2000 event to be in breach of the public entertainment licence conditions and undertook legal action against the organisers. Additionally, for future public entertainment licences to be issued, the authorities would need to be convinced that the integrity of the site would remain intact and that security would be significantly increased for the event. The festival organisers, under advisement, decided not to apply for a licence to hold the event in 2001. Instead, time was taken to remedy the most significant factor impacting public safety before applying for a license to hold the festival in 2002, securing the festival site. This time was well spent.

Resurgence: Glastonbury 2002

After much deliberation, a license was issued for the festival in 2002. The event organisers were able to convince the MDC Regulatory Board that the following changes would allay the concerns identified after the 2000 event. These changes were:

- upgrading of the management structure and operational function to the satisfaction of the licensing authorities;
- the introduction of a new security fence (5 miles long, 12 feet high, and made of solid aluminium material);
- a significant increase in the provision and quality of security (MDC 2002); and

- the introduction of training programs for volunteer stewards (Glastonbury Festival Limited (2001).

The event organisers also sought the cooperation of the general public.

After the 2002 festival, a representative from the Festival Medical Services made the observation that: "within the perimeter fence, the event was orderly, calm and enjoyable...the whole event was positively influenced by the success of the perimeter security" (MDC 2002). However, the success of limiting access to the festival site created additional impacts on the surrounding communities. The impact outside of the festival included:

- ticket touts as an additional problem on nearby roads;
- groups of people ('gangs') tried to force their way into the festival through the pedestrian gates;
- robberies occurred throughout the car parking areas; and
- 'travellers' denied entry, created problems for the police and neighbouring communities (MDC 2002).

Getting better: Glastonbury 2003

"NO TICKET NO ENTRY you've helped save the festival - now give it a future".

This was the media message for the 2003 event. Most of the strategies from the 2002 event were reinstated, including the fence and increased security presence. In 2003, there was an increase in security for the surrounding areas and access to the festival site was strictly limited to ticket holders. Some additional strategies introduced that year were (a) an assessment of biodiversity within the site, (b) cleaning teams to maintain the toilets during the event, and (c) trialing new measures to protect the waterways within the festival site (fencing and signage) (MDC 2003).

The 2003 festival was considered a success both for the patrons and the surrounding communities. The MDC was happy with the progress shown at that festival with the perimeter security remaining intact, no significant breaches of the licence conditions, a successful and comprehensive monitoring program undertaken, and the multi-agency partnership being exemplary (MDC 2003).

Even better: Glastonbury 2004

"This House (of Commons, United Kingdom Parliament) congratulates Michael Eavis on the success of the Glastonbury Festival 2004 and further notes that the festival has become the largest of its kind in Europe" (House of Commons 2004). All the improved strategies from the two previous years were retained for the 2004 event and accompanied by improvements to (a) recycling services, (b) the coordination of disabled services, (c) the management of vehicle movements, and (d) enhanced emergency planning. The local constabulary also utilised bicycles and horses as their contribution to the reduction of vehicles within the site. Even though the licensing authority considered the 2004 event was the "safest yet", they still believed that an event of this size and complexity could always be improved.

Section 2: Comments Provided by the Key Informants

Main public health issues at the Glastonbury Festival

The study participants were asked to identify their main hazards for the festival (both 2000 and 2004) and rate the level of risk each of these identified hazards posed to the patrons at the event (categories ranged from "very high risk" to "very low risk").

Table 1 provides lists of the public health issues considered by the SEHPs to have affected patrons at the 2000 and 2004 events and their risk ratings.

Table 1: Public health issues for the Glastonbury Festival (2000 & 2004)

Public health impacts identified by MDC staff	Risk rating
Crowd safety	Very high risk
Contamination of the water supply	Very high risk
Food safety	Very high risk
Trips and falls	Very high risk
Hypothermia (getting soaked & being in the open)	Very high risk
Vehicle safety	High risk
Poor weather impacts (wind & rain)	High risk
Infectious diseases related to personal hygiene	High risk
Safety of structures	High risk
Drug and alcohol impacts	High risk
Dehydration	Moderate risk
Noise	Moderate risk
Illness (sunburn, sexual health)	Moderate risk
Others, no risk rating given (electrical supplies, emergency response, fire safety & violence)	no risk rating given

Main public health concerns: then and now

The SEHPs were asked to select a single public health concern that they considered had the greatest impact on the 2000 and 2004 festivals. In 2000, five public health concerns were selected with all considered very high risk (100.0% *n*=10). More than half of the study participants identified crowd safety as their main concern for that festival (60.0%, *n*=6) (Table 2).

By comparison, four concerns were selected in 2004, with only contamination of the water supply considered to be very high risk for that festival. The effects of the poor weather and vehicle safety were the most common concerns reported in 2004 with both considered high risk for that event (Table 2). Notably, crowd safety was considered a priority concern for the 2004 event.

Then: crowd safety for the Glastonbury Festival (very high risk)

Crowd safety was identified as the most common public health concern by the SEHPs in 2000. This was directly related to the high numbers of gatecrashers at that festival. One staff member concluded "that many people compromised the emergency services and considerably increased risks of crowd crushes". After limiting the numbers attending the site and providing security services, the SEHPs reported that two other methods were used in crowd management for the event. First, extensive planning was undertaken to ensure that "scheduling of the performances dispersed the patrons across the site". Second, careful consideration was given to the overall site layout and configuration to "allow for good crowd flows by minimising the potential for pinch points and bottle necks"; "ensuring adequate lighting", and "that all high traffic areas were capable of carrying large numbers of patrons".

The SEHPs also reported that the event organisers provided stewarding services". The stewarding services were composed of both volunteer and professional security guards. Additionally there was also "continuous monitoring" of crowd

Table 2: Main public health concerns - then and now

Then (2000 festival)	No. & %	Risk rating	Now (2004 festival)	No. & %	Risk rating
Crowd safety	6 (60.0%)	Very high	Contamination of the water supply	2 (22.2%)	Very high
Safety of structures	1 (10.0%)	Very high	Weather (rain & wind)	3 (33.35%)	High
Contamination of the water supply	1 (10.0%)	Very high	Vehicle safety	3 (33.35%)	High
Communicable disease	1 (10.0%)	Very high	Noise nuisances	1 (11.1%)	Moderate
Trips and falls	1 (10.0%)	Very high			
TOTALS	10 (100.0%)		TOTALS	9 (100.0%)	

movement and behaviour through observation and modelling. Finally, careful consideration was given to the selection of performers and artists to attract a broader demographic of patrons to the event.

After the event each year, the MDC "requires written documentation of risk assessments and information on all contractors on site". Meetings are held before and after the events with all the key stakeholders including the festival organisers, police, fire brigade and environmental agency. During the discussions after the event, "each area of the event is examined and all problems identified are collated and reviewed". This process includes a review of the "safety policy and the risk assessments" for that year. One officer added that "anecdotal evidence from feedback from festival goers" was also considered within this review process. Finally, "each year the event is appraised and then reported back to the (MDC regulatory) licensing committee", and "amendments to licence conditions" for the following year are then considered.

Then and now: contamination of the water supply (very high risk)

Contamination of the water supply was considered a very high risk for patrons at the 2000 and 2004 festivals. The provision of potable water for the festival involves a complex system of seven temporary reservoirs that supply a series of three under and over ground mains with peripheral pipes carrying water to standpipes, showers, and hand wash basins throughout the site. Extensive work has been undertaken to increase the permanent supply piping on the site. Planning for the water supply commences two months prior to the event and improvements are made for each event. Currently, the control measures include a regular water sampling regime, chlorination, emergency and maintenance response teams, and now security officers have been stationed at the reservoirs (MDC 2004).

Now: poor weather (high risk)

One of the most common public health concerns identified by SEHPs for the 2004 event was the impact of poor weather that included high winds and rain. One SEHP member reported that "the high winds experienced during the building of the site, particularly during the erection and finishing of the marquees and stages did put workers at risk of falls...the rain and muddy conditions again could cause problems with bacterial contamination of water and food supplies". These conditions "could cause crowd control problems and a great deal of people on the site could become ill". Additionally, services such as cleaning and garbage collection were affected. One officer considered "working in the rain" and "the MUD!" was their worst experience at this festival.

There was "contingency planning for weather impacts" within the emergency management systems for the festival. One officer reported that "the festival organisers shut all work down until the winds had subsided" to protect workers' safety. That same officer said that further strategies included "enforcing compliance with the food standards"; "animals are not allowed on the site (Worthy Farm) for 21 days before the event" and there were "regular bacterial and chemical tests of the water supply" with results "independently audited". "The festival organiser minimised the effect of the weather by introducing strict controls on vehicular movement". All these actions were used to minimise the effect the weather conditions had on public safety and food and water supplies for the festival. Overall, the poor weather conditions "were dealt with really well" at the 2004 festival according to one officer.

Now: vehicle safety (high risk)

Three of the SEHPs in the 2004 study expressed concern for pedestrian safety from the movement of vehicles within the site. "There are a number of large vehicles in close proximity to pedestrians with the potential to cause serious injury". On the

whole, traffic levels have been reduced considerably in recent festivals, however, some vehicle movement within the site is unavoidable. These vehicles include slurry and litter collection vehicles, artist vehicles, and vehicles related to performances.

To improve vehicle management for the 2004 festival, a Traffic Chaperone Plan was developed to minimise the likelihood of pedestrian injuries occurring in busy areas of the festival (MDC 2004). Implementation of the plan involved the use of stewards as escorts for all vehicles entering the main market areas between 15.00 and 03.00 hours, and stewards were placed at the busiest intersections to direct the passage of pedestrians and vehicles through those areas. Finally, the slurry and litter collection vehicles were required to have guards fitted to protect their wheel wells in order to prevent injuries.

Section 3: Successful Management and Planning of The Event

Environmental Health Indicators

The WHO (1999) recognises safe drinking water, food safety, population density, sanitation, and solid waste management as useful Environmental Health Indicators. These indicators, and the addition of environmental and nuisance reports, and crime and injury data from the festival, have been used to demonstrate the transition in the operation of the festival.

The information related to the identified environmental health indicators has been reported as counts, percentages, or by using a three-point scale. The three-point scale was used for population densities, sanitation, drinking water, solid waste management and environmental impacts. This involved summarising the data collected into one of the following categories:

- poor - issues reported and improvement needed;
- improving; or
- good - operating well.

Table 3: Environmental health indicators

Indicators	2000	2002	2003	2004
Pop'n densities	poor	good	good	good
Camping (over lic limits & new limits set for 2003)	100%	82%	59%	68%
Food borne illness	No	No	No	No
Sanitation	improving	improving	improving	improving
Drinking water	improving	improving	improving	improving
Solid waste	poor	poor	improving	improving
Complaints[1]	138	135	156[2]	97
Noise	11	9	19	27
Environment impacts	poor	poor	good	good
Injury data (cases treated)	3237	2846	2456	2456
Crime data (reported)	2367	1049	718	478

1 *These were general complaints received by the MDC during the festival and included traffic, parking, public safety etc.*

2 *There was some duplication in complaints for that year (e.g. people called two different council offices).*

It was evident that the Glastonbury Festival had demonstrated improved performance for almost all of these indicators but particularly for population (control of numbers), environmental impacts, complaints, injuries, and crime statistics, however, noise complaints have increased in recent years (Table 3).

Overall rating for the 2004 event

All the 2004 study participants were asked to rate the overall effectiveness of management for that festival. The SEHPs were given a five point scale, ranging from "not very well managed" to "very well managed", to use in this section. The study participants considered the 2004 event as well managed (second highest category). Considering the weather conditions that year, this was a high rating. The SEHPs in the 2004 study were also asked to identify the best and worst features of the 2004 event.

Best features in public health and safety for the 2004 event

Three of the 2004 study participants considered the "continued good cooperation between the different agencies" particularly "in planning the event" was the best feature. Another considered the "level of cooperation shown by the festival organisers" and the "effective organisation and management" evident during the festival were the best features. Other features were "crime was down", successfully "preventing people peeing in the rivers and streams", the introduction of plans to "control and reduce vehicular movements" and "improvements to disabled access".

Worst features in health and safety for the 2004 festival

Five of the 2004 study participants considered that the "poor weather" was the worst factor at that festival, however, one thought these issues "were dealt with really well". Another three study participants considered nuisances created by "noise from the site throughout the night" was the worst feature. The remaining study participant recalled the "toilets on the Monday when there were still lots of people were disgusting". For this participant, this was the worst feature for that festival.

A more detailed management review

SEHPs involved in management processes for the festival (*n*=5) were selected to undertake a more detailed management review for the 2004 event. They were asked to rate 22 key variables considered by the Health and Safety Executive (HSE 1999) to be important in good event management. They used the same five-point scale mentioned in the previous section.

Even though the 2004 event was affected by heavy rain, the festival ran well with no variable rated lower than "adequately managed" (Table 4).

The management staff in the 2004 study considered that 13 management variables could be improved. First, they explained why eight of the variables in the management review had been considered well managed (the second highest category).

Table 4: The overall effectiveness of the 2004 event

Adequately managed	Well managed	Very well managed
Management of vehicle movements within the festival site	Emergency planning for the festival	The overall layout of the festival
Alcohol management	Communication systems	Fire safety services for the festival
Maintenance of the showers and toilets	Crowd management inside the festival	Crowd management at the entry and exit points
Noise and sound system management	Management of parking areas	Crowd management for Pilton village and the surrounding areas
Management of amusements and other special effects	Management of camp grounds	Transport arrangements Transport arrangements to and from the festival
	Collection and disposal of sewage	Construction & maintenance of structures & installations
		Medical services
	Waste management	Information and welfare services
	Environmental management	Services for people with special needs and children

- Emergency planning was "much improved again this year but still requires development" and the lower "score reflects it (the emergency plan) was not tested (by an emergency incident)".

- The "security control centre" for the communication systems "is a superb flagship, an example for other events for internal communication although interagency communication could still be improved".

- Crowd safety within the festival site was "generally very good" and "just needs ongoing training and development of stewards".

- The management of the parking areas this year involved a "greater

deployment of security staff to reduce car crime" and was "good considering the (weather) conditions".

- The management of the camp grounds required "further pro-activity by camping wardens in terms of controlling pitches and being visible" and "(still some) over crowding but improving".

- The collection and disposal of sewage, waste management, and environmental management were "much improved" this year.

The management staff in the 2004 study also considered that five variables in the management review were adequately managed and provided some explanation for allocating this level.

- There has been "continued efforts" to improve the management of vehicle movements within the festival site and "it is getting better" with "further limits to unnecessary vehicle movements" within the site.

- It was reported that there was "not much evidence of management" of alcohol within the festival, however, numbers of arrests and ejections were lower than the 2003 event.

- For the showers and toilets there had been "improvements on 2003" but there will "always be an issue of cleaning and emptying (of the toilets)".

- In terms of noise and sound system management, the Festival is "constantly striving to minimise the impacts on the local community". However, "after hours' music management was a big let down after attempts to improve from last year" and, critically, there "needs to be better deployment of GFL (Glastonbury Festival Limited) sound consultants especially at night".

- There needs to be a review of the management of amusements and other special effects as the "firework displays were on much too late".

Discussion

The Glastonbury Festival has experienced numerous changes in public health and safety over recent years. Driving the changes are the government agencies involved in the PEL, particularly the MDC. The event has benefited considerably from these changes and received accolades after the 2004 event by being named as the 'International Music Festival of the Year', 'UK's Best Major Festival', and 'Most Innovative Festival', and commended by the British Parliament (GFL 2005). The MDC also considered the 2004 event to be the best and safest in the history of the event. This success has not come easily.

The 2000 event almost ended the festival, however, the event organisers were determined for the event to continue. They regrouped in 2001, developed new strategies to address the problems of the 2000 event, and applied for a license in 2002. The MDC granted the PEL for the 2002 event with some trepidation. However, the next event was a success, predominantly due to the new security fence, increased security capacity, better-trained volunteer stewards, effective marketing, and increased coordination of interagency and festival management. The success of the 2002 event formed a platform to build upon in the subsequent years. The MDC considered that an event of this size and complexity could always be improved.

The 2004 study findings provided some insight into the areas that could be improved for future events. The overall event was considered well managed, however, only nine of the variables in the management review were considered very well managed. Vehicle movements, alcohol management,

the amusements (fire works), and the maintenance of the showers and toilets received the lowest ratings from the SEHPs. The environmental health indicators used within this study showed that over the last four years of the festival, almost all the poorer performing indicators were showing positive trends. Noise nuisances were a particular issue for the 2004 event with an increase in the number of complaints and, not surprisingly, received a lower rating by the SEHPs. Noise management was certainly an area where further work is required. Interestingly, the impact of the poor weather conditions appeared to have little effect on the effectiveness of the management of the 2004 event.

Injuries and crime statistics from the festival have been used in the English media in recent years. Reports have shown significant reductions for both indicators in recent years - the crime statistics particularly. The injury reports were of particular interest. Previous research by Milsten et al. (2002) had found the incidence of injuries could rise during rain-affected events. However the number of injures reported for the 2004 event was the same as the 2003 event, which was predominantly dry. The associated reduction in ambient temperature (Milsten et al. 2002) and continual improvement at the event such as the better vehicle and intersection management (MDC 2004) might provide some explanation.

There was a notable change in priority public health and safety concerns between the 2000 and 2004 events. For the 2000 event, SEHPs considered crowd safety was a particular concern, however, this factor did not feature as a priority for the 2004 event. The control of patron numbers at the event was influential within this change. Vehicle safety and weather conditions were the common concerns identified for the 2004 festival and there was evidence of improvements in the management processes for these concerns. For example, the Vehicle Chaperone Plan was introduced to improve vehicle safety, and the contingency plans (e.g. stop construction work during high wind events) were used to reduce the effects of the weather.

Protecting the drinking water system at the event from contamination was considered a very high risk for both years of this study. Given the potential risk to the patrons (e.g. communicable diseases) and the festival (e.g. closure of the event) if there were problems with the water supply, this is understandable. The event organisers continued to improve the water supply system and in 2004 increased security for the reservoirs, with further works planned for the future.

Overall, there was evidence of continuous improvement for the event. The PEL process has allowed the MDC officers to have considerable input into and impact on the planning and developmental processes for the event. In 2004, it was considered that the festival site had attained maximum capacity for that site (150,000 patrons) and in the future the focus would be on fine-tuning the existing infrastructure and services.

Key messages from the Glastonbury Festival experience were to:

- maintain control of the numbers of patrons for the event and provide effective security services for the event;
- manage the issues that affect the surrounding areas in order to minimise impacts on the community;
- have an understanding by the event management of the importance of and commitment to establishing and maintaining a high standard of public health and safety for the event;
- maintain communication and cooperation between the licensing authority, key stakeholders (particularly the police services) and

the event management staff; and

- establish and maintain a presence through professional and comprehensive monitoring of the event.

Conclusion

Injuries and sometimes death are the results of poor health and safety standards at OMFs. It is important to take steps to improve these health and safety standards. The Glastonbury Festival provides a good case study demonstrating successful improvements in health and safety for that event. This success was the result of the collaborative action undertaken by the Glastonbury Festival management, MDC, and the other agencies and demonstrates how the licensing process can be used to encourage good practice in event management.

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Back to TOC

A Country's Hidden and Untapped Resource: Exploring Attitudes, Beliefs, Perceptions and Knowledge of Hygiene in Kandahar, Afghanistan

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A qualitative study based on participatory action research was used to explore attitudes, beliefs, perceptions and knowledge of hygiene and hygiene related behaviour involving 122 women and 89 men in Kandahar, Afghanistan over a four-week period in December and January 2003. Topics explored were cleanliness, health information, sanitation, flies, hand washing and diarrhoea. Generally, respondents had a good level of knowledge of basic hygiene practices and were more knowledgeable than the current hygiene training materials available. Cleanliness emerged as a consistent theme arising from participants' fundamental belief that they would be more accepted by Allah under Islamic law. Cleanliness was also associated with 'normative beliefs' or perceptions of social acceptance. Women were willing, able, and had family permission to participate in public health programs and the action from this research was the development of a women's hygiene promotion volunteer program. There are several limitations regarding the study design attributable to the culture and current security situation in Afghanistan, however, the information is worth sharing as there is limited published literature on qualitative work on Afghanistan and it may support other public health professionals in understanding hygiene practices in their communities.

Key words: *Hygiene; Health Promotion; Participatory Action Research; Volunteers; Women; Afghanistan*

Public health practice both has to describe and understand the needs of the community. It is beyond this paper to describe in detail the mortality and morbidity in Afghanistan except to state that communicable and preventable diseases are the largest contributor to high rates of mortality and morbidity. The World Health Organization (WHO 2002) estimates that the life expectancy in Afghanistan at birth in 2002 is approximately 42 years for males and 43 years for females (WHO 2002). WHO also estimates that mortality for males under 5 is 258 per 1000 live births and for females under 5 is 256 per 1000 live births (WHO 2002). In developing countries, 2.2 million people, most of them children, die every year from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene (IRC 2004).

In understanding the community and to ensure successful and sustainable behaviour change, it is imperative that there is an understanding of the forces that impact on health and hygiene behaviour; core to this are attitudes, beliefs and perceptions of individuals, the community, and society. As Downie et al. (1990, p. 3) point out "one key concept of health promotion is that of attitude, the concept of an attitude is central because it brings together beliefs, emotions and behaviours". Strecher and Rosenstock (1990) summarise the health belief model as "the collection of data on health beliefs, along with other data pertinent to the group or community setting, [which] permits the planning of more effective programs than would otherwise be possible. Interventions can then be targeted to the specific needs identified". This information can assist

communities in recognising their own knowledge and strengths, in planning and implementing public health campaigns and developing healthy public policy.

Women in Afghanistan are considered to be the "major influence in changing practices regarding personal, household and environmental hygiene" and "while water is collected by men, women and children it is the women who are the principle users of water for drinking, cooking and washing" (Danish Committee for AID to Afghanistan Refugees [DACAAR] 2000). A review of hygiene education and promotion resources and literature available in Kandahar suggested that attitudes, beliefs, and perceptions have perhaps not been explicitly explored. Hygiene education resources easily accessible and available in Kandahar such as those produced by UNICEF, the Danish Committee for Aid to Afghanistan Refugees (DACAAR), and the International Federation of the Red Cross (IFRC) were reviewed in December 2002. The resources appeared to have western concepts and values of hygiene depicted in both the artwork and in the education messages they were portraying. In some instances the pictures were unrealistic in the current situation of poverty within the country. There was limited documented information available on whether or not these resources were based on, reflect, or were related to the community's beliefs, attitudes, culture or religion or whether or not people accepted these messages. In addition, one of the recommendations from a collaborative diarrhoea reduction campaign organised by the IFRC, UNICEF, Accion Contre la Faim (ACF) and Tearfund in June 2002 suggested that a 'knowledge, attitudes, practices survey be carried out before the campaign to assist campaign planning" (Harvey et al.).

It is acknowledged that the nature of working in a developing, culturally diverse, remote, war torn and drought-affected country generates many obstacles particularly in encouraging behaviour change. There is also an added difficulty as relief and aid work is often output driven and quantitatively measured with limited time and flexibility to use health promotion processes.

Participatory action research (PAR) is the research framework that can best describe the methods used. One of the main outcomes was to encourage participation and knowledge transfer in the research design, carrying out the research and using the information to create an environment that reflects participatory action research. Baum (1998, p. 169) cites several references in *The New Public Health* and many new public health researchers agree that "whenever possible, research should be participative".

Methods

The qualitative study was conducted in the Kandahar Region between December 2002 and January 2003. The locations of the focus groups and the people selected were primarily, purposefully and conveniently selected according to:

- the water and sanitation technical program plan to link the bore sites with hygiene volunteers to support and strengthen the water program;
- the possibility of accessing women through existing contacts, systems and organisations;
- the possibility of accessing men. Men were either working or looking for work. Mosques are thought to be a key location and source for accessing men by many NGOs, however, local staff believe it was culturally inappropriate to form focus groups at mosques or prayer locations.

In keeping with the participatory framework, locally employed program staff were involved in all aspects of the study from methods of recruiting, preparing and reviewing themes for the focus groups, conducting the focus groups, translation, training preparation, conducting the training, evaluating the training, and supporting the volunteer program. Many of the women who participated in the focus groups also participated in the first hygiene promotion volunteer training course in February 2003.

The survey tool was a semi-structured questionnaire consisting of 36 questions based around several themes. The questionnaire was combined with an unstructured interview approach where program staff used the questions to guide the interview in a focus group setting. Hawe's (1990) guide to survey planning for qualitative health promotion was used as the basic framework for designing the questions. The survey tool was piloted in December 2002 and modified accordingly. Themes included people's motivations for good health, what characterises good health, type of, and access to, hygiene information, sanitation, hand washing, diarrhoea and religion.

Focus groups, as described by Rice and Ezzy (1999), have "the primary aim of describing and understanding perceptions, and beliefs of a select population to gain understanding of a particular issue from the perspective of the groups participants". The average number of participants in each focus group for women was 18 with a range from 9 to 25, while the average number for men was 12. Bender and Ewbank (1994) suggest six to ten people, although focus groups in developing countries tend to be larger, in the range of eight to 15 people. People's curiosity and poverty are two reasons that could explain high numbers of group attendance. Local staff felt it was culturally insensitive and they themselves felt uncomfortable excluding people to achieve smaller group numbers. This raises the ethical question of persuasion. There was no incentive offered for people to participate, however, each participant was given a bar of soap at the end of the session. Homogeneous focus groups were imperative, especially for women; from my observations the flow of discussions radically changed in the presence of all women compared to the presence of one man. It was important for women to feel safe to enable free discussion particularly as women carry out the majority of health care for the family and at home.

Two local hygiene program staff, a female and male hygiene officer visited selected areas and using existing networks asked both men and women if they would like to participate in a focus group regarding their attitudes, beliefs and perceptions of health and hygiene. This method appeared to be less threatening, safer and more culturally acceptable, housing compounds were also closely attached and people knew each other. Care was also needed as at that time, there was propaganda threatening women if they were seen talking with westerners. If people were willing to participate they were requested to collect several other participants thus creating the focus group. Rice and Ezzy (1999, p. 79) mention that "familiarity rather than anonymity may be the key to free-flowing discussions". In this situation, and for cultural reasons, using strangers was not practical or culturally appropriate.

Consent was gained from participants. They were informed that the information would be confidential and anonymous, and they were not required to answer any questions they felt uncomfortable with. They were also advised that the information would be used for informing health promotion training and directing public health programs.

During the pilot, responses were being translated into English, however, hygiene officers thought it was inappropriate to record the answers at the time of the focus group and believed it distracted from the flow of the discussions. This technique was

also time consuming and tiresome for local staff. To overcome this, focus group notes were recorded as soon as practicable afterwards. There are several limitations with facilitators/interviewers recalling the information accurately using this technique. However, it was considered to be culturally less threatening compared to writing down or recording conversations. The local staff had an incredible capacity for recall. Local program staff thought that people would 'say more' of what we wanted to hear if we were recording information rather than expressing their true beliefs and opinions. The focus groups were carried out in the appropriate local language, in some instances in Pashto and other instances in Dari. Both hygiene officers were proficient in Pashto, Dari and English.

There are several limitations regarding the study, particularly the sample size, method of selection, method of recording data, as well as limitations of using focus groups. The study required some degree of flexibility and compromise between design and cultural, gender, security, and accessing issues. Patton (1990, p.51) highlights that the "distinction between research and action becomes quite blurred and the research methods tend to be less systematic, more informal and quite specific to the problem, people and organisation". A further limitation is that the two hygiene officers carrying out the focus groups and translations have medical backgrounds and some words might have been translated beyond 'word for word'.

Results

Seven female and seven male focus groups were conducted independently. A total of 122 women participated in seven focus groups. They were aged approximately 16 to 50 years. Eighty-nine men, aged approximately 18 to 60 years, participated in seven focus groups. Focus groups were held in Dand (Zar shar ziarat of Torn Ghaya and Torah Pakhola), Helmund, Kajaki district, Hayraji district, Low wala district, Zirac and Barak village in Maruf district, and the Afghan Red Crescent (ARC) clinic in Kandahar, and at the Afghan Women's Association (AWA).

Perceptions of health

The first theme covered general questions on perceptions of health. Generally, female participants responded that "good health" was to be well and the benefit of being well was to be able to keep the house clean, to have the ability to pray, study, go to work, and care for the family. Women described their motivation for being well was to enable them to "keep the house and children clean", while men were motivated by the ability to work and to earn money. Female respondents said that it was easier to have good health if they had personal items such as toothbrush, toothpaste, and soap, and also access to fresh fruit. Men generally said that a strong economy and good health services made it easier for them to have good health. The majority of female participants responded that "bad health" was to be sick, not eating good food, not having proper medicines, and not being able to keep the house, children, and themselves clean. Men also described bad health as "being sick", "being lazy", "not caring for patients at home", and "eating dirty food and water". When asked, "what makes it hard for you to be well?", responses included being sick, not having good food, no soap, no water, poverty, no access to medicine, and no bathroom. Barriers to being healthy included, "lack of employment", "poor economy", "no access to power and water", "distance to the city", "sickness" and "not enough food or medicine".

Women worried about becoming sick, and about having money for medicines, medical treatment, food and clothes. One group specifically stated that they were concerned about malaria, jaundice and typhoid. Health worries for men were expressed holistically in terms of "family worries". The main worry was money to see a doctor and to buy medicines as well as the availability of

doctors. They also worried about "feeling nervous", "depressed", and "family members smoking cigarettes", "taking snuff", or "smoking hashish using chelim", and "eating dirty food".

In terms of child health, all male and female respondents identified diarrhoea as the health problem they see in children the most. Other health problems identified included coughs, fever, abdominal pains, malnutrition, chest, eye and skin infections, and vomiting. Women described their main health problem was feeling weak, having fevers, problems with childbirth, headaches, backaches, and high blood pressure.

Six of the seven women's groups perceived men's health to be the most important in the family or village. One group said that the mullahs' (religious male leaders) health was the most important. Men generally perceived that the most important person's health in the family was the "children's or infants' health", and the father's health because "he needs to be able to work and provide an income to the family".

Cleanliness

For women being clean meant washing clothes, water containers, hair, hands, and food. Being clean was also to cover pots and food from flies. Most of the male participants considered things to be clean if they washed with soap and water. This topic could have been explored further to gain a better understanding of cleaning practices and frequency.

The second question related to participants' perceptions of clean people. The majority of both male and female participants associated cleanliness with being liked or socially accepted; responses included "everyone likes clean people", "everyone wants to sit and talk with them" and clean people will be "well, happy and healthy". This is an indication of social normative beliefs; better described as a person's belief in what others think they should do as the main motivation for the behaviour.

All male participants identified "bore holes" as having the cleanest water, however, this was dependent on availability. Bore holes in Afghanistan are engineered sites where water is pumped from underground. When people could not access bores (due to long distances, location, or because they were dry) people used normal wells for drinking water using a bucket and rope type system for collection. Female participants said that clean water was "pipe water used after boiling" and "boiled water". Pipe water also refers to bore hole water as it is considered to be piped to the surface. The majority of all respondents said that when they saw people using unclean water they thought those people would be "affected by diseases and would become sick".

In terms of food safety, women said safe food was when it was "washed before eating and cooking", "when food is covered from flies", "when food is served in a clean dish", "when food is fresh", and when food is "well cooked". Men thought food was safe when it is "cooked well", "safe from flies", "washing raw food", "getting fresh meat from the market", "food that is stored in the fridge", and "not left over food".

The hygiene practices promoted by the local mullah were also explored. The majority of both men and women explained that the mullah instructs people on completing the 'wazoo' before each pray and to do 'everything' according to Islamic law. The wazoo is using water to wash several parts of the body including the face, nose, hands, feet and forearms three times before each pray. However, when there is no water, Islam law allows people to do the 'tayamum'; this practice involves using dust to cleanse instead of water. Other hygiene practices promoted by the mullah include cleaning the house, praying in a clean place, having clean clothes, and cutting fingernails. One female focus group also believed that "clean people grow well", "cleanliness was part of believing in God", and "God doesn't like dirty people".

Health information

Women advised that they obtained health information from the local radio, from discussions with other women, and from staff at clinics and doctors. Women were asked how they would like to receive health information in the future. The majority of women again preferred the radio, however, some women suggested clinics, doctors and their mothers. Women were interested in a range of different health topics including child health, women's health, how to keep children and houses clean, and food safety.

Generally, men gained health information primarily from doctors, the radio, television and people who they considered to be more educated than themselves, such as mullahs, nurses, doctors, and elders in the community.

Sanitation

Women could describe specifically where microbes came from, identifying numerous sources including flies, unsafe water, stagnant water, dirty streams, unclean food and personal uncleanliness. Men were not as specific in their descriptions with the majority of men stating that microbes came from "dirty places".

The best place for defecation identified by all females was the latrine. Male participants in Kandahar town also considered the best place to defecate was in the latrine, however, the men in the rural focus groups stated that the best place was on the "open ground" and "outside of the house for the ladies". The reason why people thought that the open ground was the best place to defecate was because the sun dried the faeces and then it could be used as compost.

Observations suggest that many people are defecating in areas other than latrines, particularly in public places such as streets and vacant land. Participants were asked what they thought about this behaviour. Generally, men thought it was "not good", however, they "were used to it" and "there is a lot of open or public space to defecate in these areas". Men thought that it was inappropriate to defecate in the front of a mosque or home, in a graveyard, and close to living areas. All women said that defecating in the street was inappropriate, it made the street "look dirty", "people walk in the shit", and "it's not good manners". Similarly, participants were asked about people who urinated in the street. Women again believed it was not "good behaviour", however, one group raised the issue of "where else should people go?" Three of the male groups believed urinating in the street was "okay". Whilst people dispose of infant faeces in the latrines, the wastewater from washing nappies is disposed of in the courtyards. Courtyards are communal and are often used for growing fruit and vegetables and for children's play areas. Several people also mentioned that people use the roof of their house to defecate as the sun destroys the bacteria.

Flies

Participants were also asked about their thoughts on flies, and generally people believed flies were dirty, caused disease, and that flies made them feel bad. Two male groups said "we cannot do anything about the flies as every house has cows" and "we are used to them". Two female focus groups identified that they could cover food and cover water jugs to protect against flies.

Four women's groups were able to associate flies and faeces with disease transmission. Comments to support this included, "flies sit on the shit then come to the house and sit on our food and make us sick", and "children get sick from playing outside as the shit mixes with the soil". There is a belief that flies have a poison wing and a honey wing. Different focus groups explained that "when a fly lands in a cup of tea, the poison wing lands first, so we push the whole fly into the tea so that the honey wing also goes into the tea". Local staff explained that people believe that the honey wing makes the tea sweet and it is then okay to drink.

Hand washing

The majority of both men and women believed that the most important time to wash hands was after using the latrine and before eating. Women said that it was important to wash hands after eating, before cooking, before washing food dishes, after cooking, before praying, and after washing babies nappies. Men also believed it was important to wash hands after urinating, before eating, and before praying when they have been in the dirt. The exception and possibly common practice due to the drought and water shortages is the practice of 'tayamum' where dust or dirt can be used to carry out the wazoo when water is not available. Although people know about hand washing after urinating, observations and discussions with local staff indicated that in the absence of water, soil can be used to dry the penis.

All participants thought that hand washing was a good behaviour and when they saw people washing their hands they believed they were "well", "clean people", "good habit", "people will like them", and they were good because they were "observing the religion". When people did not wash their hands the majority of women believed that no one would like them, they would become sick, people would think they were "dirty", and no one would like their cooking or eat their food. Men believed that those people who did not wash their hands were "careless towards the religion".

Diarrhoea

Over time continual diarrhoea or loose stools can often be perceived by society to be normal. Men described diarrhoea as "a bad disease", "a large scale illness" and a "common" illness they experienced all year independent of the seasons, as well as "children losing water from the body" and "loose motions with blood". Women also described diarrhoea as a loss of water from the body, as well as experiencing pain in the intestine. Participants were then asked what specific concerns or worries they had about diarrhoea. Men worried about children and people becoming weak, people going to the hospital, and people dying. Women worried about having money to pay for medical care and treatment as well as worrying about people dying.

Generally, both men and women thought people were suffering from diarrhoea from drinking dirty water and eating dirty food. One male group said that due to the poverty people were eating anything in the open market. The open market was considered to be unhygienic. Specific responses from women included people "eating food stored for 3-4 nights", "dirty mothers not cleaning their children", and eating "unclean vegetables". They also believed that diarrhoea was caused by "eating oily foods" from "gluttony or over eating" and from "drinking cold water after eating".

The majority of men described diarrhoea prevention as taking medicine and going to the clinic for treatment. They also mentioned diarrhoea could be prevented by "drinking tube well water", "eating hot food", "personal cleanliness", and living separately from faeces and latrines. Women were more specific regarding diarrhoea prevention. Women responded with drinking safe water, eating clean and fresh food, personal cleanliness, keeping children clean, separating personal items such as plates, glasses and the bed from the person who has diarrhoea, boiling water for drinking, not sitting next to people with diarrhoea, and people should try and work in the shade as well as take a rest during work.

Finally, of the 122 female participants, 25 nominated themselves as hygiene promotion volunteers while not one of the 89 male participants wanted to become a hygiene promotion volunteer. This was an interesting result as the local NGO claimed more than 10,000 male first aid volunteers in the region. While more women than men participated in the focus groups, it is possible that other men may have been interested in becoming hygiene volunteers. This indicates the importance of recognising resources

available and ensuring programs reflect or enhance the community's existing capacity. The topic of program evaluation must be a priority in improving health outcomes.

Discussion

Generally, participants perceived health to be a necessary quality to carry out daily life activities, such as being able to keep the house clean, pray, study and to be able to care for the family, and the ability to work and earn money to support the family. The ability to look after the family and to earn an income are the two main motivating reasons for maintaining health. Nearly all participants of both genders perceived and associated cleanliness with being liked and being socially accepted in the community. Under Islamic Law people believed that they would be more accepted by Allah if they were clean. Comments such as "if their world is clean then life after death will also be clean", and "God doesn't like dirty people".

Generally, it appears that participants had a good level of knowledge of hygiene, particularly of hand washing and diarrhoea. Women in particular were knowledgeable about microbes and could identify sources of microbes, such as flies, unsafe water, wastewater, unclean food, and personal lack of cleanliness. They could also identify practices to reduce exposure to microbes such as washing hands before eating, covering food from flies, eating well cooked food, storing food in the fridge, and defecating in a latrine. It is difficult to determine whether knowledge has been gained from existing or previous hygiene promotion programs, school education, or from knowledge and practice of Islamic law. It appears that even people with low literacy have a basic level of hygiene knowledge through religious practices. Cleanliness and hygiene is culturally acceptable and can be openly discussed. This acceptance is a major advantage in introducing hygiene promotion programs within the Afghan society, particularly for women's programs.

Given participants' knowledge of hygiene as well as diarrhoea being the "most common" illness seen in children, it is possible that enabling factors or the ability for people to carry out good hygiene practices is one of the major reasons that could explain the high incidence and prevalence of diarrhoea. Comments to support this came from men who knew that "bore holes for drinking water have the cleanest water followed by wells", however, the use of bores over wells was dependent on availability. All women knew that the best place to defecate was in the latrine, however, many people were still defecating in the street and public places. In some focus groups participants also identified infrastructure as a barrier to good health, such as "access to water", "access to power", and "no bathroom". Although people may have knowledge of good hygiene behaviours, environmental health infrastructure such as housing, clean and accessible water, latrines, food storage and money to afford hygiene equipment, such as soap, water storage containers and toilet paper, are required for people to be able to carry out these behaviours. A combination of infrastructure, information and the motivation to carry out hygiene practices is important if there is going to be a reduction in mortality and morbidity from diarrhoea.

Conclusion

The fundamental belief in Islamic law, cultural beliefs, and being socially accepted in the community, appear to be the forces that need to be considered in hygiene promotion programs to ensure successful and sustainable behaviour change. Whilst this study has several limitations in terms of the study design, the qualitative information does provide some insight, as well as demonstrates the importance of investigating attitudes, beliefs, knowledge and perceptions of the local population before developing and implementing health programs.

Women are an untapped and under utilised resource in Kandahar. They are both

willing and motivated, as well as having permission from their families to participate in such programs. Women are the main carers for their families and therefore strengthening the capacity of women through public health and hygiene programs, as well as investing in infrastructure, will have an impact on the long term mortality, morbidity, and quality of life for the people of Afghanistan.

Action arising from the research

The research was used to develop a woman's hygiene promotion volunteer program. Local staff designed volunteer selection where women must attend all five days of the hygiene-training program, have family permission, and be able to train four women each month who lived within their housing complex on hygiene issues. The hygiene team and women in the focus groups agreed that it was achievable to train four women each month. For security and safety, they were not required to go from house to house.

As women had a good knowledge of basic hygiene the 5-day training manual would build upon the existing knowledge as well as discuss the rationale and implications for poor hygiene. Many of the existing training resources give people basic information with no explanation of the implications. An example of building on existing knowledge is the cycle of gut damage from infections and diarrhoea and the link with malnutrition, susceptibility to other infections, growth rates, and the ability for children to learn. The training manual included information and activities on microbes, food safety, water safety, gut damage and malnutrition, cultural myths such as the "honey flies", techniques for good communication and health promotion principles. The training was also competency based using adult education

Pictured right: Participants in hygeine-training program, contents of hygeine kits, hygiene officers with kits, participants with their hygiene kits.

approaches where participants were required to demonstrate their understanding, skills, and knowledge of the material. All participants were assessed on each component to ensure they were comfortable and competent with the information. Competency based activities were completed orally, using pictures or photographs and by demonstration such as making up oral re-hydration fluids. The training was conducted in the local languages of Pashto and Dari. A 5-day hygiene-training course was scheduled each month for recruited hygiene volunteers with 15-18 people in each course. By the end of March 2003, 35 women had completed the training.

Following the action research continuum all training was evaluated to identify improvements or changes. At the end of each day an evaluation was conducted to determine what women liked the most, liked the least, how they felt, and what they thought we could do to improve the training. The most rewarding comment was that the women felt safe and happy. An evaluation plan was also developed to evaluate the process, and the impact and outcome of the program at 6-month and 12-month intervals.

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Endnotes

1. 'Snuff' is tobacco that is ingested by placing the tobacco in the mouth between the bottom teeth and bottom lip.

2. 'Chelim' is the pipe or equipment used to smoke hashish.

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Back to TOC

Food Security and Permanent Residents of Caravan Parks

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Lack of food security is a recognised issue at global, national, state and local community levels. In 1995, the Australian National Nutrition Survey was conducted and concluded that 5% of all persons aged 16 years and over had experienced lack of food security during the previous 12 months. The City of Greater Dandenong was identified as a municipality having higher risk markers for lack of food security than other Melbourne metropolitan areas. These markers include low income, high unemployment and low education levels. This study examines food security within a sub-group of this population, consisting of permanent residents of four caravan parks in the municipality. The goals of this study were to determine the food security status of this population and to identify sustainable strategies for Greater Dandenong City Council and local service providers to consider implementing in order to address issues impacting on this group. The study included short interviews of key informants in the lead agency to determine their understanding of factors that contribute to food security and identify possible strategies to address these issues. Analysis of these data identified key themes from the interviews. Results concluded that factors such as financial status, disability, transport, accommodation, education, and social and cultural factors contributed to lack of food security within the City of Greater Dandenong, in particular for permanent residents of caravan parks. A 26-question survey of permanent residents of caravan parks was also conducted to assess food security and gather basic demographic data. Results demonstrated that 15% of the study population experienced instances of food insecurity. Key contributing factors identified were social isolation, financial status, disability, and concern for personal safety. A number of recommendations are made to improve food security for the study population.

Key words: *Food Security; Food Access; Caravan Park Residents; Vulnerable Groups; Low Socio-Economic Status*

Not having the security of a food source that is nutritious, affordable, and reliable is a denial of basic needs, a failure of our society. It is a preventable condition that leads to many other health consequences, and a condition that brings its own suffering and distress. The focus of this project was to identify whether permanent residents of caravan parks located within the City of Greater Dandenong experience lack of food security, and recommend potential strategies to address the problems identified. Food security refers to:

> *access by all people at all times to enough food for active, healthy life. At a minimum this would include having acceptable, nutritionally adequate and safe foods available and the ability to acquire food in socially acceptable ways without resorting to emergency food supplies or coping strategies* (Kendall & Kennedy 1998).

The World Health Organization (WHO) has identified food security as a priority area for action (WHO 1986, 1997). Food security was traditionally recognised as an issue faced by third world countries, however, it is now recognised as a public health issue within industrialised countries (Food and Agricultural Organization of the United Nations 2003). More recently, there has been increasing interest in studying food

security in urban populations of industrialised countries as evidence mounts to suggest that even in the midst of plenty there are subgroups in the population who are food insecure (Holbern 2002; Starkey, Kuhnlein & Gray-Donald 1998; Tingay et al. 2003).

Accepted risk markers for lack of food security in urban areas are:

- Areas of disadvantage
- People with low incomes
- People without permanent homes or homeless
- Single parent families
- People who are isolated
- Newly arrived migrants
- People with physical or mental health problems (Strategic Intergovernmental Nutrition Alliance 2000).

In Australia, the 1992 National Food and Nutrition Policy of Australia (Commonwealth Department of Health 1992) identifies the following key issues as imperative to food security:

- social justice;
- quality of the food supply;
- community participation and accountability;
- the food and nutrition system and its wider interaction; and
- ecologically sustainable development (Commonwealth Department of Health, Housing and Community Services 1992).

The public health nutrition strategic framework document, *Eat Well Australia,* (Strategic Intergovernmental Nutrition Alliance 2000) identifies health gain initiatives for vulnerable groups and specifically:

- promoting organisational change in services;
- influencing broad social policy; and
- addressing structural barriers to safe and healthy food.

The Australian National Nutrition Survey (1995) estimated that 5% of all Australians aged 16 years and older experienced lack of food security during the previous 12 months. Booth and Smith (2001) suggest that this figure is actually an underestimate due to bias within the sample process. The groups who were at a higher risk of issues with food security, such as the homeless, were not included in the survey.

Queensland, the Northern Territory, New South Wales and Tasmania are currently the only states in Australia that have food and nutrition policies that include a goal to address food security (NSW Centre for Public Health Nutrition 2002; Northern Territory Government 2001; Queensland Public Health Forum 2002; Tasmanian Community and Health Services 1994). In Victoria, the most recent policy is from 1995 where 'Nutrition for Health' is one of the four key areas for action. This identifies a number of population groups at risk of undernutrition and includes low income households, homeless people, and older people among others. Since that time the Victorian Department of Human Services (DHS) has identified improving food security for vulnerable groups as a priority area for action (Victorian Department of Human Services 1997).

There have been few projects in local government areas in Australia addressing food security. Darebin (Cox & Ballinger 1999), Fitzroy (Cox & Wood 1992), Penrith (Reay & Webb 1998) and South Sydney (South Sydney City Council 1995) are the only local government areas that have attempted to explore and address this issue. Outcomes of these projects found that to address the food security of communities, action needs to be linked to other local

government activities such as housing strategies and urban planning.

In 2001, the Victorian DHS and VicHealth acted on the priority area of food security by providing project grants to two local government authorities in Victoria with population demographics indicating a higher number of people at risk of lack of food security than the state average. The evaluation of these projects identified possible local strategies to enhance food security in vulnerable groups and the need to link food security to a range of other community activities as essential to addressing the issue (Wood, Swinburn & Burns 2003).

Objectives of the Project

The objectives of the project were:

- To determine the food security status of permanent residents in the caravan parks in the City of Greater Dandenong; and
- To identify sustainable strategies for the Greater Dandenong City Council and local service providers to consider implementing to address the food security issues in this vulnerable group.

Permanent residents of caravan parks may be considered within the broader definition of tertiary homelessness: "People living in single rooms in private boarding houses on a long-term basis - without their own bathroom, kitchen or security of tenure" (Council to Homeless Persons 2001).

Although permanent residents of caravan parks do not strictly meet the definition of tertiary homelessness, they do share similar issues as this group including:

- The absence of or threat of loss of shelter;
- Physically inadequate accommodation;
- Lack of social and familial support networks; and
- Restrictive access to alternative housing.

Many caravan park residents choose to live in this type of accommodation rather than in boarding houses as it gives them a greater level of independence and privacy. This allows them the opportunity to prepare their own meals but they have no security of tenure and the standard of accommodation is often physically inadequate. The City of Greater Dandenong was chosen as a suitable location for this project due to the higher occurrence of risk markers for lack of food security compared with other Melbourne metropolitan local government areas.

City of Greater Dandenong

The City of Greater Dandenong (CGD) is located approximately 50 kilometres south east of the Melbourne Central Business District and has a population of approximately 130,000. It is a culturally diverse locality with 54% of residents born overseas and the number of recently arrived immigrants settling in the area continuing to rise (Greater Dandenong City Council 2003). See Box 1 for further demographic details.

Box 1

- The preferred first language of 55% of residents is non-English.
- There are more than 8,000 single parent families (27% of families in CGD).
- Approximately 10,000 people live alone.
- 14% of residents aged 15 to 24 years are unemployed compared with the metropolitan average of 9%.
- Unemployment rate of 8.8% compared with the metropolitan average of 5.6%.
- Median weekly disposable income was $295 (73% of metropolitan median) (Greater Dandenong City Council 2003).

Methods

The project had two components, a survey of lead agencies and a questionnaire of permanent residents of caravan parks. Ethics approval was obtained from La Trobe University Human Ethics Committee.

Lead agency personnel

Key informants in the lead agencies were identified in consultation with the Health Planner at Greater Dandenong City Council. The key personnel were from local council services, external services for specific community groups and Emergency Food Relief Providers. These included: Child and Family services; Youth services; Older persons services; Migrant Resource Centres; Citizens Advice Bureaus; Community Health Services' dietitians; and religious and benevolent groups.

The objectives of the survey were to:

- Elicit knowledge of food security and factors that influence or contribute to lack of food security;
- Establish referral patterns and knowledge of local emergency food relief services; and
- Identify potential strategies to address lack of food security.

Key personnel were contacted by telephone and invited to complete a qualitative questionnaire. An introductory letter, consent form, and survey were emailed to the interviewees and they were followed up by a telephone interview. The interviewer then asked 10 questions from an interview schedule to elicit knowledge of the term 'food security', to identify if service providers had clientele who lived in caravan parks, and if they believed these clients experienced lack of food security. The interviewees were asked what issues they thought might contribute to food security, if they had a process for referral for emergency food relief; and if their service offered specific services for clients experiencing lack of food security. All data were collated and common themes identified and analysed. (Hawe, Degeling & Hall 1990).

Residents of caravan parks

Four caravan parks in the City of Greater Dandenong have residents who live there permanently. These sites are all located on arterial roads with 673 caravan and cabin sites in total. Table 1 provides a summary of the size and distance to local shopping districts from each site.

Table 1: Summary of facility characteristics

Facility	Number of sites	Distance from shopping centres
A	51	0.7 km
B	71	10.0 km
C	147	0.1 km
D	404	8.0 km

Maps of each facility were obtained and each site numbered sequentially. The World Health Organization's 30 cluster sampling method was used to calculate a sample size of 240. This sampling method is particularly suited to surveys over different geographical locations Cluster sampling divides the population into groups, or clusters. Thirty clusters were selected randomly to represent the population, and then all caravans within the selected clusters are included in the sample (Australian Bureau of Statistics 2004; International Fund for Agricultural Development 2002).

Participants were personally approached at their place of residence and asked to complete a short survey by a member of the project team. The interviewer explained the purpose of the survey, and provided a copy of the project information and a consent form. The resident survey comprised 26 questions including basic demographic details, questions about how they accessed food and a series of statements used in the 1997 New Zealand National Nutrition Survey to measure their level of food security (Quigley & Watts 1997). Residents were excluded if they were under 18 years of age or had not lived at the facility for more than four weeks. Table 2 provides a summary of the distribution of completed surveys.

Table 2: Distribution of resident surveys completed

Park	Target	Surveyed	Refused	No response[1]
A	8	10	5	15
B	16	5	4	7
C	48	16	17	15
D	168	52	63	53
Total	240	83	89	90

Results

Lead agency surveys

Lead agency surveys were completed by 11 key informants. The questionnaire was designed to elicit qualitative data. Not all respondents were familiar with the term 'food security', however, they were familiar with the concept of people not being able to access food for a variety of reasons. Most thought that the clients they saw who lived in caravan parks had experienced lack of food security. All respondents indicated that personal financial difficulties contributed to this, and some identified physical disability as a contributing factor. Table 3 is a summary of the range of factors respondents identified as contributing to the lack of food security.

Table 3: Factors that contribute to lack of food security

Lead Agency Results - Factors that contribute to food insecurity of permanent residents of caravan parks	
Financial	Social and cultural
Disability and physical limitations	Education
Transport	Other factors
Accommodation	

All the respondents had some knowledge about the local emergency food relief services available, however, the extent of this knowledge ranged from a thorough understanding, to a haphazard referral to whichever organisation the service provider was aware of. Three agencies offered specific services, such as cooking, and shopping and budgeting classes, and aimed these at target groups usually related to age and culture.

Suggestions about future strategies to address lack of food security include:

- Establishing other services in the area, such as shelter for homeless and after hours' emergency services.
- Encouraging free/affordable food delivery services, particularly for the elderly.
- Improving communication to link service providers
- Improve public transport access and frequency
- Addressing support services available for migrants (and migration conditions)
- Improving education, such as cooking skills and nutritional knowledge

Residents

A total of 83 residents agreed to participate in the survey. Table 4 provides a summary of demographic data results from the questionnaire, which shows the unique differences between sites.

The survey consisted of 26 questions to ascertain the residents' demographic profile, how they accessed food, and if they experienced lack of food security. One hundred percent of the population surveyed answered these questions. The combined data report 15% of residents experienced lack of food security in the last year. Five percent of respondents stated that they had often eaten less due to lack of money and 13% stated they sometimes ate less due to lack of money. This finding was consistent across parks A, C and D, however, 100% of park B residents surveyed responded that they never experienced lack of food security. Park B had the smallest number of survey participants. Figure 1 shows the combined food security survey results.

Figure 1: Responses to food security questions (all sites combined)

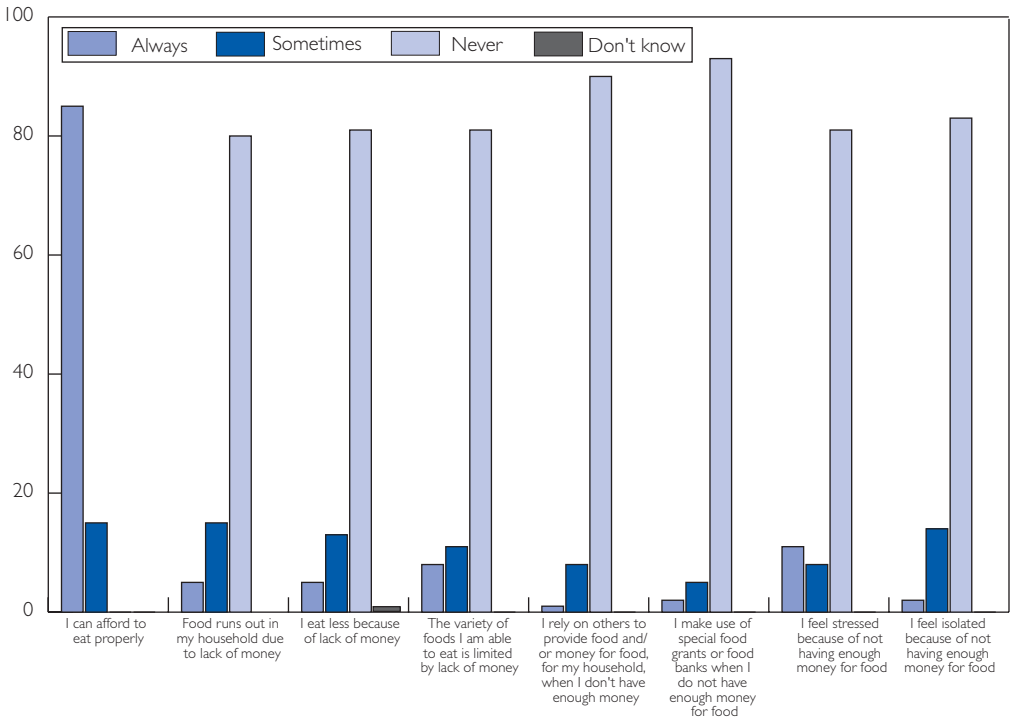

Table 4: Demographic data of surveyed group of resident

		Park A	Park B	Park C	Park D
N=Sample		5	10	16	53
Gender	Male	100%	80%	88%	28%
	Female	0%	20%	12%	72%
Age group	Up to 21 years	0%	0%	0%	0%
	21-40 years	0%	20%	38%	0%
	41-60 years	60%	30%	38%	23%
	61-80 years	40%	50%	26%	62%
	80+ years	0%	0%	0%	15%
Source of income	Salary	20%	50%	56%	4%
	Govt pension	20%	40%	44%	88%
	Other	60%	10%	0%	8%
Marital status	Single	10%	20%	44%	6%
	Married/De Facto	20%	20%	12%	40%
	Divorced/Separated	70%	60%	38%	26%
	Widowed	0%	0%	6%	26%

Six percent of residents at parks B and D, 4% at park C and none at park A reported having financially dependent children. Despite the high number of newly-arrived migrants residing within the City of Greater Dandenong, the data revealed that the majority of caravan park residents were Australian-born or had an Anglo-Saxon background. Fifty-seven percent of the combined population report being born in Australia, 19% combined population were born in England, and 7% were from New Zealand. The remaining population reported their country of birth as Europe, Egypt, Fiji, and El Salvador. This is not consistent with the multicultural nature of the City of Greater Dandenong City Council discussed above.

Eighty four percent of respondents stated that they always eat properly. Of the respondents who indicated that they could not always afford to eat properly, all were retired or not working, 69% were female and most were aged 61-80 years. Reasons for this included lack of public transport and physical difficulties walking and/or carrying shopping.

Residents who said that food often ran out in their household due to lack of money were most likely to be women (79%) and aged between 41-60 or 61-80 years. Sixty percent of residents who said they often or sometimes eat less because of lack of money

were female. Most were aged between 41-60 or 61-80 years.

Sixty three percent of respondents who said that the variety of food they ate was often or sometimes limited by lack of money were female. The proportion of respondents who rely on others to provide food when they run out was shared evenly among males and females. Eighty three percent of residents who said they rely on emergency food relief such as food banks were male.

Females (56%) were more likely to feel stressed by not having enough money for food than males (44%). Residents who responded positively to this question were more likely to be married (44%) or divorced (31%) and aged 41-60 years (37.5%) and 61-80 years (37.5%).

The proportion of male and female respondents who felt isolated by not having enough money for food was split evenly. Most were aged either 41-60 years (43%) or 61-80 years (36%). Most were not working or retired.

The project group was aware of the possible bias in the survey due to inherent differences between the residents who participated in comparison to those who refused. The demographic data gathered provide a snapshot of the population at the time of the survey, however, due to the sample size it is difficult to determine whether this is representative of the entire population of each caravan park. Random sampling start points were identified in order to minimise any bias associated with data collection.

Discussion

The project team has been able to identify the level of understanding of the term food security by lead agency personnel and determine their referral patterns. It has also been able to ascertain the level of food security of permanent residents of caravan parks located within the City of Greater Dandenong.

Lead agency personnel

The data suggest varying degrees of knowledge on the subject of food security. The knowledge and opinions of lead agency personnel varied greatly according to their client group. For example, one agency stated that lack of food security was not an issue to new migrants as food was central to their culture and well catered for within their cultural community, whereas other service providers commented on the issues of lack of money, poor knowledge of new foods, inability to speak or read English, and transport difficulties affecting new migrants' access to food.

Data on how many of the agencies had clientele within the parks varied depending on the agency's collection of addresses. The lead agencies' knowledge of emergency food providers was varied. Some had an extensive knowledge of services available, some were able to name one or two services, but were unsure of location, access criteria, and operating hours. One respondent was unable to identify any. The provision of an information sheet of all emergency food service providers, times of operation, transport options and access criteria, would assist service providers and residents to access these appropriately.

Despite a range of contributing factors being identified, these factors were not consistently identified by all respondents indicating gaps in knowledge around the issue of food security. In order for an integrated approach to food security issues to be implemented these gaps must be addressed. Education for service providers would increase knowledge of issues that influence food security. Networking among service providers at the local level would open lines of communication to discuss these issues and encourage joint strategies. This would also facilitate the identification of emerging issues impacting on food security and allow a coordinated response to be initiated by service providers.

Through the lead agency survey it also became evident that service providers had

differing knowledge of their clientele and their circumstances. There are privacy issues to be considered, however, the recording of some information about the service users would be beneficial, particularly in identifying emerging issues impacting on food security.

Respondents were able to suggest some strategies to improve food security, for example, the provision of free or affordable food delivery for the elderly residents, improved local transport to food outlets, budgeting classes, cooking skills and shopping. The challenge is to ensure that these strategies are acceptable to the community and accessible by those in need. This could be achieved by facilitating community ownership over the planning and implementation of strategies to address food security.

Local government is well placed to lead this process. They have the mandate through the development and implementation of municipal public health plans. Local government also has a clear role in advocating for the needs of its residents and has the capacity to create opportunities for community participation and social engagement. It can address the built environment and physical surrounds and acts as a service provider to vulnerable groups through its meals on wheels and home and community care (HACC) services.

Residents

Although the estimated level of lack of food security across the parks was 15%, it ranged from 0% at park B to 24% at park C. It should be noted that there were only five residents surveyed at park B and all responded negatively to all food security questions, reporting that they were food secure. These responses appeared to be in contrast with the observations of the researchers who were invited inside the caravans of three of these residents. Observations noted lack of food, inadequate storage facilities, and poor cooking facilities. This raises the possibility that the level of lack of food security is an underestimate.

There were noticeable differences between the populations at each of the caravan parks. Eighty percent of residents surveyed at parks A, B and C were single or divorced men aged 40 years and older, whereas the population of park D were predominantly female and aged 60 years and older. Park C also had a significantly higher number of younger people aged 21-40 years. A common thread across all sites was that 63% of respondents lived alone.

Park D was situated 8 kilometres from the central shopping centre and had the greatest proportion of residents aged 61 and older. Forty two percent of respondents relied on transport other than their own vehicle to access food outlets. Thirty percent indicated they had difficulty getting to and from grocery stores. Many commented on the distance required to walk from their home to access public transport, particularly those who lived at the farthest point from the entry to the park. The greatest distance from the front gates to a resident's site was 1 kilometre. Even residents of parks located closer to food outlets expressed difficulties getting to and from grocery stores - 10% at park A and 20% at park B.

The variety of circumstances in each of the parks indicates the necessity for addressing the issue of food security in different ways. Further consultation with residents at each of the caravan parks would be valuable in terms of identifying appropriate strategies to address food security at each site. Among the suggestions made by residents were regular access to a community bus to provide transport to and from food outlets and the establishment of community gardens. In order for these or any strategies to be effective, it is necessary that the residents have ownership over the project. It was suggested that a 'champion' or project leader be identified at each site in order to ensure the successful implementation of any such initiative.

The findings of both the lead agency and resident surveys must be considered with

planning an integrated local response to food security issues experienced by caravan park residents and within the wider population. In order to address the immediate food security issue of clients effectively, service providers must have a thorough understanding of the issues that contribute to the problem and knowledge of emergency food relief and preventative services available. To address food security at a community level a broader understanding is required. Studies such as this investigation contribute to the process by providing feedback from the people actually experiencing lack of food security, estimating the proportion that actually access their services, and identifying practical strategies to address food security by those in need, Until service providers have a more thorough understanding of these issues an effective response to food security issues cannot be achieved.

Conclusion

This project has provided a snapshot of the level of food security issues experienced among permanent residents of caravan parks located within the City of Greater Dandenong. Information obtained through consultation with local agencies highlights a limited understanding of food security and the factors that affect it. This indicates a need to 'up skill' service providers on this issue.

The research team recommends the following strategies to improve food security for permanent residents of caravan parks in the City of Greater Dandenong:

- Increase knowledge about food security among local service providers;
- Establish a communication network between local service providers in order to work collaboratively to address food security issues, including the identification of emerging issues;
- Encourage local service providers to gather further information about their clients in order to identify emerging issues and possible strategies to address food insecurity;
- Develop a local directory of all emergency food service providers including times of operation and maps of public transport routes to assist service providers and residents to access available services;
- Consult with caravan park residents and management for input into strategies to address food insecurity locally;
- Investigate the viability of building a community garden in a suitable venue; and
- Provide a regular community bus to transport isolated residents to a suitable shopping venue.

Many of these strategies would be applicable across other local government areas where food security is an issue.

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Back to TOC

Health Team "Foxtrot" Support to Banda Aceh

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Background

At approximately 8am on 26 December 2004, an earthquake measuring 9 on the Richter scale, the largest in the world for over 40 years, struck north-west of Sumatra. This was followed, fifteen minutes later, by a devastating tsunami which caused widespread destruction and loss of life in at least five countries. Aceh, on the island of Sumatra, close to the epicentre of the quake, suffered devastation on a scale rarely seen. More than 720,000 people in Aceh were directly affected.

The Australian Government response to this massive earthquake and resultant tsunami disaster in the Asian region was the activation of the Australian Overseas Disaster Assistance Response Plan (Aus Assist Plan). This was at the request of the Australian Agency for Overseas Development (AusAid).

Following the activation of this plan, AusAid directed Emergency Management Australia (EMA) to manage the deployment of Field Health Teams to the disaster-affected areas. Team "Foxtrot" was provided by Queensland Health and the Department of Emergency Services. Foxtrot was to be deployed to Banda Aceh, the capital of Aceh Province on the western end of Indonesia's Sumatra Island.

Photo 1: Environmental Health Team in Brisbane

Photo 2: Environmental Health Team in Aceh

Deployment preparations were then made for Health Team "Foxtrot" to deploy as an independent self-sufficient unit for up to fourteen days under some of the harshest conditions encountered by an official civilian humanitarian team.

Health Team "Foxtrot" was tasked with providing health, medical and surgical support to the disaster affected area. Consequently, the composition of the team consisted of experts in public health, surgery and general medical fields. This was unusual in that public health had been recognised as a priority for the relief effort and Team "Foxtrot" was to be the first Australian contingent to deploy public health personnel to the area.

Table 1: latest quantitative data from Aceh

Some Facts and Figures about Aceh	
Death toll	167,000
Missing	130,000
Displaced	812,000

The main body of Health Team "Foxtrot" departed Brisbane on 18 January 2005 and arrived in Banda Aceh the following day. The team was located at the Fakinah Private Hospital. This hospital was not affected by the tsunami, but did have extensive damage

as a result of the initial earthquake. However, it had been sufficiently restored to provide some operational capability.

Fakinah Hospital

The first few days for the Public Health (PH) Team in Banda Aceh were quite chaotic, with no clear mission or tasks being detailed. However, this time was spent in the immediate precinct of the Fakinah Hospital implementing procedures to reduce environmental health hazards that obviously existed. For example, prior to our arrival, all hospital waste was piled at the side of the facility and burnt daily. This included general waste, body parts and other contaminated waste and sharps, leaving a great smouldering mess (Photo 3). The Environmental Health team, (Russell Manley, Bob Lawson, Brad Adams and Sue Gibbs), was quick to beg/borrow/steal essential items, from various sources, and construct two incline plane incinerators (Photo 4). This enabled us to burn this waste at a much higher temperature and dramatically reduce the volume of waste and the risks associated with it. This very basic intervention had a dramatic effect in reducing a number of potentially major health hazards.

Another major problem identified at the Fakinah hospital were disease vectors. There were large fly populations due to the poor waste management and mosquitoes were prevalent, with both dengue and

Photo 3: Rubbish pile at Fakina Hospital

Photo 4: Incline Plane Incinerator constructed by EH Team

malaria endemic in the local population. Unfortunately, team "Foxtrot" were not deployed with the equipment to enable us to conduct any sort of vector control program. As Australian Defence Force Reservists, we eventually used our informal contacts with the Australian Defence Force to acquire a pneumatic sprayer and some pesticide to treat the waste piles and conduct a residual spray of all walls throughout the hospital. The result was dramatic with a massive reduction in flies, especially throughout the wards. Post-operation reports from the ward staff stated that this single task alone contributed hugely to the health and comfort of patients.

The Environmental Health Team also repaired and established a usable water supply for the Fakinah Hospital. With no water distribution system left intact and no large reservoirs available in the area, establishing a clean water supply was a priority for the hospital. The Team facilitated the commissioning of a new water treatment plant, supplied by Thames Water, to treat bore water supplied to the hospital until the reticulated municipal supply could be adequately restored.

IDP Camps

The next task identified by the PH Team was to collaborate with the WHO, UNICEF and the Indonesian Ministry of Health to formulate a plan for the remainder of our deployment. It was decided that the PH

Team would form four teams, with an EHO, a surveillance person and a translator in each team, and undertake rapid environmental health and communicable disease assessments of internally displaced persons (IDP) camps. There were reported to be hundreds of these camps in the area, ranging from spontaneous settlements with no real co-ordination, to family or host communities where displaced persons were "billeted" with families and were generally co-ordinated by the local area mosque and its representatives.

The PH team assessed 83 IDP camps over a five day period, with recommendations immediately fed back to organisations that could address urgent issues such as latrine construction, well construction, shelter, food supply, and so on.

The IDP camps ranged in size from 50 people to 6000 people and in conditions ranging from acceptable to those in urgent need for support (e.g. 1200 people in a camp with one toilet, one well and overcrowded accommodation). Fortunately, our surveys did not reveal any major disease outbreaks. Liaisons formed with essential relief organisations (NGOs and other health support services) will it is hoped assist in maintaining the status quo.

Sources of drinking water in these camps generally consisted of hand-dug wells, spring-fed gravity flow systems, bottled water, trucked water and water collected from canals and rivers. Quantities of drinking water available to IDPs varied by location but most were generally considered adequate at the time. However, much of the drinking water being collected from wells and other sources was contaminated and did not meet generally accepted standards for drinking water quality. Very little of this water was disinfected although most people boiled their drinking water prior to consumption, which may help explain the lack of diarrheal disease outbreaks.

Sanitation was also a significant concern in these camps, particularly during the monsoon season. Virtually no viable waste disposal systems existed throughout the region and with the high water table, the commonly used bore hole latrines contributed to the contamination of underground water supplies.

One of the other major issues in the IDP camps was overcrowding and lack of shelter. This was gradually being addressed by aid organisations. However, during our visits it was still a considerable problem with many families living, eating and sleeping in extremely crowded conditions.

Lessons Learnt

A disaster of this magnitude has shown us that we can never plan for every eventuality. No one could have foreseen an event of such magnitude which would eventually have profound global implications. Many lessons were learnt, (especially in relation to the deployment of civilians by the Australian Government) in the delivery of professional humanitarian services in a foreign territory. These lessons are already being assessed at executive level and will significantly influence the way Australia responds to future international disasters.

From the Team "Foxtrot" perspective, a number of important issues were identified as key learning points for the future. Some of these include:

- The identification and selection of team members for such a deployment was based on previous experience working as part of a team in a hostile environment. This was found to be a key determining factor in the success of Team "Foxtrot's" deployment. Incredibly, with only two days preparation, the team operated like it had been together for weeks. Without this cohesion, many of the team's achievements would not have been possible.

- As with any disaster, a co-ordinated approach to management of the

situation is essential. The establishment of partnerships and timely liaisons with relevant organisations is vital to ensure that the contribution made by the team is most productive in the strategic management of the situation.

- The early identification of a "mission" or tasking was seen to be a key issue which would enable personnel to plan effectively and be appropriately resourced.

- One of the most important lessons was that staff needed to be flexible and in an area where most of our everyday conveniences are not available, they need to be resourceful and innovative to facilitate effective problem solving. Staff needed to achieve positive results with the finite resources that existed.

There are many stories and tales to tell from the team's experience in Aceh. Every team member had a story to tell and some of the tales of survival are absolutely amazing. Being deployed to Aceh and witnessing the devastation and destruction first hand was definitely a humbling experience for all of us and we feel particularly privileged to have been selected to be a part of Health Team "Foxtrot".

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Back to TOC

Digital Detection of Wastewater in Stormwater

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Many unsewered townships in Victoria are the origin of contaminated stormwater flows that discharge through adjacent open farmland and into coastal rivers and lakes. In the past, Environmental Health Practitioners and State Authorities used microbiological and nutrient analysis of stormwater to determine the type and amount of wastewater contamination. This method generally takes several days for the results to be known and only indicates water quality at the moment the sample is taken. While microbiological sampling is still integral to the identification of specific health risks, it is often not easily understood by the public at risk. Digital monitoring using temperature and flow is an effective and simple tool for environmental protection regulation and also evaluation of existing conditions and infrastructure. The data presentation format is easily understood for public educational purposes. This sampling technique requires further investigation and research to ensure regulators and enforcement officers are provided with accurate evidence to address stormwater contamination from inadequate wastewater systems. This research presents improved detection and protracted real time monitoring of storm water to detect previously invisible wastewater discharges. It allows continuous monitoring outside typical work hours when wastewater discharges are most likely to occur. Digital monitoring may be the practical way to identify when it is best to take water samples for laboratory analysis as an alternative to the less reliable and "blind" sampling now undertaken. Digital monitoring of illegal wastewater discharges has the potential to provide the necessary data for both initiating appropriate enforcement actions and for determining wastewater planning priorities based on risk identification and analysis.

Key words: *Stormwater; Wastewater; Greywater; Temperature; Sampling; Digital*

In rural and metropolitan fringe municipalities dye testing of drains is commonly used by Environmental Health Practitioners to identify the source of alleged wastewater discharges where a complaint has been received. This method uses a fluorescein dye placed in suspected source drains and visual detection in stormwater drains, creeks, or soil. It requires a significant intrusion into workplaces or residences and results in an alarming colour change in water and potential impact on local ecology. In most cases, a positive outcome of an investigation is significant enough to justify the disadvantages, but not in all cases. Practical experience indicates that most older unsewered townships will have multiple sources of wastewater discharging beyond boundaries, thus dye testing becomes not only labour intensive but also highly intrusive to the community and the local environment.

Septic (wastewater treatment) systems use sedimentation for primary treatment of wastewater to remove solids and have been in use in Victoria (Australia) for over 100 years. These systems are not closed systems but use the local ecosystem and environment to further treat and dispose of effluent. Grey water was originally thought of as being a much lower risk than toilet waste and was allowed to discharge directly

to the stormwater system or onto adjacent vacant land.

Septic tanks and wastewater has traditionally been thought of as a 'rural' problem, however, there are still unsewered medium density suburbs close to the city, and some septic tanks in city parks. In response to drought conditions in recent times essential water conservation strategies have been implemented in Victoria, including promotion of greywater as an alternative garden water resource. While water conservation is essential for current living standards to be sustainable in Australia, greywater must be treated with caution as it can contain significant levels of pathogens (bacteria and viruses), heavy metals (mercury is often used in contact lens solution), nutrients (mostly phosphorus from cleaning agents), and salts (also from cleaning agents).

In Victoria, incentive schemes have been developed by the State Government to promote the reuse of greywater in sewered areas under strict conditions. Two distinct reuse options are available for rebate under this scheme; treated reuse systems for approved discharge below ground (excluding kitchen wastewater) and diversion systems. The latter system is not required to be approved by a Council's Environmental Health Practitioner. This has created different rules for wastewater management in the sewered areas compared with those rules for unsewered areas.

To correct the shortfalls of historical wastewater management, more resources and knowledge of treatment mechanisms is required to support the development of sustainable practices. Digital monitoring techniques using temperature and water pressure (proportional to the water volume passing through a pipe) may provide Environmental Health Practitioners and other water quality professionals with a non-invasive and simple educational and evidence gathering tool. In addition, it may provide the capability to accurately target microbial water sampling for health and environmental risk management.

There are four main contaminants of wastewater that threaten public health and the environment. These are:

- Pathogens (bacteria, viruses)
- Nutrients (nitrogen and phosphorus)
- Chemicals and heavy metals
- Endocrine disruptors (hormones, antibiotics)

Preliminary theoretical calculations of the capability of land adequately to treat wastewater onsite within the study catchment have found the existing systems or other parameters, such as soil type or rainfall parameters to be inadequate. Most of the systems are nearing or have reached the end of their anticipated lifetime and are not adequately sized for the conditions. Previous studies undertaken by Morrison (2001) have utilised this sampling technique to observe wastewater behaviour in wastewater systems.

The objectives of this research were to:

- Test professional assumptions relating to the extent of wastewater contamination of storm water by domestic wastewater from outdated onsite treatment systems;
- To conduct initial investigation of water level and temperature as wastewater signatures in low flow stormwater; and
- To initiate more constructive investigation and policy development in wastewater management of existing systems.

Method

The Minitroll probe (Figure 1) was used in this study to record water pressure (proportional to water level and flow in known volume of water) and temperature of water in a stormwater drain captured from a

Figure 1: Photo of Minitroll water level and temperature measuring probe and computer

Source: http://www.in-situ.com/In-Situ/Downloads/pdf/Specs/Marketing%20Spec%20Sheets/041027_miniTROLLss_LR.pdf

country township block. The probe logs data on an internal computer chip and is downloaded electronically to a laptop computer (or can be used on a PDA). This type of probe was originally used to monitor ground water within bores. Further information on this technology can be found on the In-situ Inc. website.

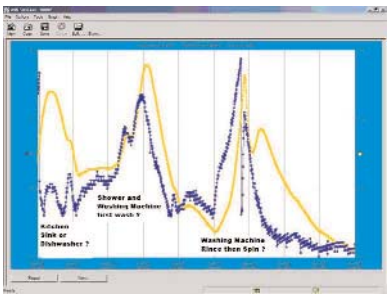
Site descriptions

Two sites were chosen because they were adjacent to residential blocks that were likely to discharge greywater (many legally, under existing permits). Observations of slimes in the base of pipes and stormwater with froth and colour suggested warm and nutrient rich greywater flows might pass through these drains.

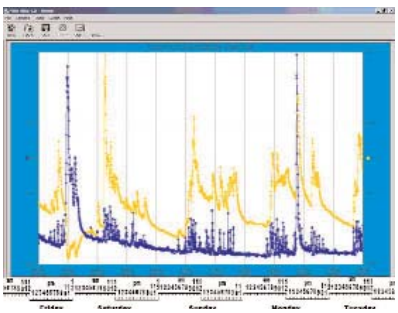
The first site was located where several open roadside drains entered a pipe passing under a highway into a receiving environment, which in this case was open bushland. The second site was located immediately within the receiving farmland below the lowest stormwater pit of a second catchment area. Both sites appeared to have discharges that could be monitored and receiving environments that needed protection.

Results

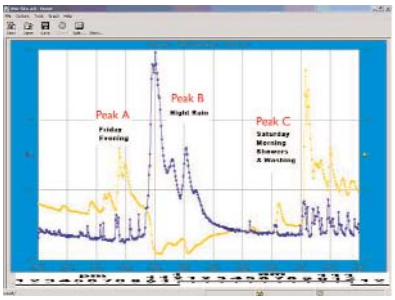
Graph 1: Site 1 - Water pressure and lagging temperature measured every 3 seconds for 80 minutes.



Graph 2: Water level and temperature monitoring over four nights



Graph 3: Site 2 - Water level and temperature monitoring overnight with rain



(Note: this graph is a subset of Graph 2)

Temperature is marked on the graph as a yellow or light line measured on the right y-axis. Water depth is marked with dark line/points and is marked on the left y-axis.

Graph 1 represents time on the x-axis at 9-minute intervals (vertical grid lines). Readings were taken every three seconds (dot points). The temperature ranged from 11.7 to 13.3°C and water depth ranged from 3.3 to 5.4 cm.

Graph 2 represents time on the x-axis at 8 hr 15-min intervals (vertical grid lines). Readings were taken every three minutes (dot points). The temperature ranged from 10.1 and 15.4°C and water depth ranged from 10.2 and 17 cm.

Graph 3 represents time on the x-axis at 2-hr intervals. Reading intervals, temperature and water depth is as per Graph 2.

Discussion

Temperatures and water pressure recorded in the drain varied by less than 2°C and 2 centimetres respectively. The variation in temperature corresponded to proportional changes in water level. A slight delay of the temperature change after water level increase or decrease was observed. This may be explained as being due to the temperature change taking longer to reach the probe than water depth. There was also a constant trickle of stormwater from earlier rain.

Graph 3 demonstrates three types of collective events that might occur in these drains outside of office hours. 'Peaks A' collectively represent the occasional wastewater discharge volumes of a Friday evening. 'Peaks B' indicate rainfall as an increase in water level with a corresponding decrease in water temperature. The rainfall event was confirmed anecdotally as no rain gauge exists within the study catchment. 'Peaks C' collectively showed the more intensive wastewater discharge volumes and frequencies of a Saturday morning. In general, these flows were more regular, higher volume and warmer. Irregular additions of peaks appear to be caused by compounding of flows. We propose that this is due to multiple discharges occurring simultaneously. Major temperature peaks might be due to dishwasher or hot washing machine cycles, and appear to coincide with logical operation times for these devices.

The explanation for the changes in Graph 1 is probably the warm wash of the first washing machine cycle discharge, then the rinse discharge, sudden stop and declining discharge associated with spin-drying.

Complete readings through the night and day during times of no discharge are useful as controls to determine background levels of temperature and water level variation. Sunshine, rainfall, air temperature and the extent of ground saturation may cause some seasonal and periodic variations to one or both parameters. However, a study conducted in Wisconsin, USA (Bohrer 2000) found that even with variation, periods of low constant air temperatures will allow monitoring of wastewater peak temperatures with confidence. Further research is required to identify that cold discharges, for example from cold clothes washing cycles, have significantly different temperature signatures. The integration of a rainfall gauge within the catchment in future research would provide an additional measure to determine discharge temperature and water level signatures. Background temperature and water levels associated with groundwater springs may also be identified by the use of a second probe located upstream of a wastewater source.

It is important to remember that this discharge is to an open stormwater drain and that any one of the peaks observed correspond to a wastewater discharge that potentially can contain pathogenic microorganisms. Typical pathogens present in the wastewater multiply exponentially in the presence of a good supply of nutrients and warmth. The results of this research indicate that the wastewater discharge to these drains introduce both growth factors that have the potential to allow pathogens to multiply to dangerous levels under favourable weather conditions.

While the presence of pathogens in stormwater drains is an indicator of a hazard, it requires human or animal contact for their presence or number to become a risk. Current knowledge on the likelihood of transmission under a variety of conditions is limited as are the resistance levels provided by individual immune systems. This missing information is required to enable a more certain risk assessment of wastewater discharges found in stormwater. Regardless, pathogenic microorganisms can be transmitted in a number of ways. These include the oral route through ingestion of food or water that has been contaminated (through flies, dirty hands, animals, or recreational contact), or blood-borne through vectors such as mosquitoes or through cuts in the skin. Through education and social development, human hygiene and contact with the contaminated source can be controlled. In contrast, control of insect or animal vectors is more problematic. The removal of the risk is the more sensible and viable management option. Environmental Health Practitioners across Victoria, Australia, are currently preparing Wastewater Management Plans to investigate the ways in which this can be undertaken. In most cases this will require the centralisation of wastewater collection and treatment in township zones, either through conventional reticulated sewerage technology or new innovative technology to ensure potable water is conserved for human consumption.

In many unsewered towns the shower water and other grey water often discharges via direct pipe connections into the street stormwater drains at comfortable temperatures of approximately 35°C. The systematic use of this type of digital assessment may provide the key evidence to prompt the State Government authorities to address these discharges to stormwater drains in all locations, not just in specific towns through fair and effective legislative and policy advances. At the broad community level, the general public can see from the readings that contamination may be traveling from their outdated systems down the street stormwater drains and its potential to be transferred directly or indirectly to human or animal recipients with serious consequences.

Historically, Environmental Health Practitioners undertook observational assessments of stormwater to detect food scraps or detergent froth. In the warmer months, odour from less dilute wastewater was also used to detect wastewater discharges of unknown sources.

The format of the generated temperature and water level charts is important as an educational tool. Wastewater discharges to stormwater can be monitored without invading private property and is relatively anonymous. It is the ideal method of explaining to a 'catchment' community why it may be necessary to conduct more detailed studies of existing systems for failure, non-conformance with current standards, and if necessary design for their upgrade. The residents of a specific catchment can see their blended cumulative impact and how much it varies. This clearly highlights their responsibility, together with the State, to rectify the situation.

Many water-sampling programs currently undertaken by a variety of authorities can fail to capture the actual level and thus the actual risk level posed by environmental contamination because they potentially miss the discharge peak levels. Data collected by the Minitroll are in real time enabling target sampling to determine the 'peak' risk levels posed by pathogenic bacteria or nutrients. This type of peak monitoring is currently in use by the United States Environment Protection Agency (USEPA) for an *E.coli* alert. Research has found that turbidity corresponds with *E.coli* levels allowing a quick in line monitoring of the river and 'No swimming alerts' to be issued.

Digital sampling over a period of several days found distinct patterns of household wastewater discharge behaviour. Weekend use appears more spread out than weekday

use. This type of sampling is a non-invasive method of studying wastewater 'habits'. These behaviours are also critical to understanding the design requirements of small-scale alternatives to sewer, including onsite wastewater treatment systems.

Even the basic water level data (and its corresponding flow calculation value) might assist the design of large-scale grey water management systems that separate contaminated flow peaks from stormwater flows for sustainable reuse. Such reuse might include the management of erosion, weed control re-vegetation, drought feed sources, and other environmental and agricultural objectives.

Temperature monitoring of flows through the length of the stormwater system might provide critical findings of typical bacterial and viral 'die off' from natural process or low water and air temperatures from rainfall events or seasonal variations.

Further Study and Environmental Health Applications

A number of further studies are planned to continue the development of this sampling method for environment protection and public health purposes. These may include:

- Control studies in sewered residential areas to monitor 'natural' fluctuations that occur in storm water drains;
- Collection of data under a variety of weather conditions observed during different times of the year;
- Use of a string of sensors, now available in cable free, water proof models, to track and test wastewater pressure and temperature signatures;
- Identification of signature peak profiles of various household fixture discharges and what part of these flow peaks is best to sample to capture realistic health risk data;
- Identification of slimes in the base of stormwater drains to determine correlation with nutrient loading experienced in stormwater drains for future use as an accurate indicator of wastewater contamination once sufficient field data is accumulated;
- Monitoring of wastewater use/discharge behaviour patterns and the ability of existing wastewater systems to effectively treat combinations of effluent flows; and
- The combination of water level and temperature monitoring of points along town sewers could be used to identify areas of likely illegal connection of stormwater often associated with sewer spills during storm events.

Conclusion

Increased stormwater temperature due to run off from warm paved surfaces in cities that have long been known to impact on waterway ecology. Raising the temperature of stormwater in unsewered town drains can rapidly incubate microbiological contaminants to dangerously high levels. Stormwater contaminated with domestic wastewater has the potential to cause disease, but as many residents in the study catchment will attest, also create offensive odours at times. Ideal temperatures and nutrients, rapid microbial growth and lack of aeration can drop oxygen levels rapidly in receiving waters to the detriment of aquatic life.

This experiment has identified clearly that grey water and treated wastewater in storm water drains can be detected by carefully monitoring temperature and water levels. This research might impact on the development of any new guidelines associated with grey water reuse and exposure, particularly from old installations.

Sampling programs can now be refined

better to capture the times, volumes and signatures of discharges. Previous assessment methods have been invasive, site specific and involved going onto individual properties. Typically, multiple properties in townships discharge wastewater to the stormwater drain being tested. If it was necessary to confirm the individual source of temperature variations then householders could log the times they use fixtures or the probe could be moved into individual source pipes.

This detection method has the potential for an increase in residential awareness in that it graphically displays a picture of the residents' impact on stormwater. It might also impact on the issue of wastewater threats to farm quality assurance programs as many of the old discharge points of wastewater are through existing farmland. This experiment has enabled the 'unseen litter' of unsewered communities in stormwater drains to materialise with this 'digitally enhanced' perspective.

Acknowledgments

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Back to TOC

Sustainability and Health: Supporting Global Ecological Integrity in Public Health

V. Brown, J. Grootjans, J. Ritchie, M. Townsend and G. Verrinder

Allen & Unwin, 2005, 327pp. ISBN 1 74114 442 6, $59.95 (paperback)

This book is the result of a Public Health Education and Research Program (PHERP) Innovation grant, which brought together academics from a range of institutions across the country to consider what is the role for public health practitioners in the sustainability governance process. As such, it represents a leading network across Australia. Indeed, beyond the named authors, at least 17 others from 10 universities were involved in a web-based discussion group, each of the chapters received considered reviewing from between two to six people, and there was an expert advisory group of 10 additional people from Canada, US, New Zealand, Sweden, and Australia. It was a mammoth effort.

I provided the title to a number of friends in the environment and sustainability field and asked them what they would have expected in a public health book with this title. Interestingly, they focused on the content areas, such as, infectious diseases and ecosystem disruption, urban form and health, environment and child health, intergenerational inequity, poverty and disease, and so on. They were surprised to see that the chapters were titled: living, listening, grounding, knowing, scoping, acting, innovating, and managing. So perhaps, the subtitle for the book should more clearly reflect what the authors sought to do, that is, consider how the public health practitioners contribute in the sustainability governance process.

The public health response for sustainable development, the core concern for the book, is outlined in Figure 1.1, in section 1.1, on the third page of Chapter 1. This figure suggests that sustainable development is the current era of public health practice, where our major risks come from global stress, and the public health response is no longer a matter of technical solutions or lifestyle change, but one of governance solutions.

So taking the intent of the authors (about governance process) as a starting point, the reader would find an excellent guide to the global policy frameworks and the action tools that should be part of the public health practitioners' armamentarium. The boxes and diagrams within the book provide clear illustrations of some of the complex concepts. The activities suggested within the chapters are useful teaching tools. Each chapter is further augmented, at its beginning, with a summary, key words, chapter outline, learning outcomes and learning activities, and readings. In other words, a very user-friendly resource book for teaching.

The book recognises the diverse disciplines and policy frameworks that contribute to the discourse on sustainability and health, and these are provided in chapters 2 and 3. Subsequent chapters provide strategies and tools for practitioners - ranging from analytical frameworks as DPSEEA, to public participation strategies, to tools for introducing change and innovation, to options for managing different organisational forms. The book tries to pack a lot in, and as such, is necessarily a high level summary of these frameworks and tools.

For those uninitiated in the relevant content areas, the book will seem abstract. For those who have been working on introducing change in public health practice, the book will be a useful reference volume as it brings together a diverse set of ideas and practices and makes sense of their interrelationships. The book is remarkably evenly written for a volume with at least five authors, and points to the importance of the workshop and chapter review processes built into the book writing process. As the book was pilot tested with students prior to its finalisation, I suspect it will be readily used in a teaching environment.

For my hard-nosed friends who work on the global stage of environment and sustainability, however, they were hoping for something a bit more performance and results oriented.

Note: Declaration of interest. The reviewer is the PhD supervisor for one of the authors - G. Verrinder.

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Back to TOC

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Back to TOC

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Back to TOC