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PREVENTABLE RESIDENTIAL FIRE FATALITIES IN AUSTRALIA JULY 2003 TO JUNE 2017

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Version	Release history	Date
1.0	Initial release of document	29/08/2019

Publisher:
Bushfire and Natural Hazards CRC

ISBN: 978-0-6482756-3-3

August 2019

Citation: Coates, L., Kaandorp, G., Harris, J., van Leeuwen, J., Avci, A., Evans, J., George, S., Gissing, A., van den Honert, R. and Haynes, K., 2019, Preventable residential fire fatalities: July 2003 to June 2017, Bushfire and Natural Hazards CRC.

Credit: Metropolitan Fire Brigade.

ACKNOWLEDGEMENTS

This project was funded by the Bushfire and Natural Hazards CRC and Macquarie University. In-kind support was provided by the Metropolitan Fire Brigade (MFB), the Australasian Fire and Emergency Service Authorities Council and Risk Frontiers.

The authors wish to record their appreciation of the cooperation and feedback given by our end-users via the AFAC Community Engagement Technical Group.

This work could not have proceeded without the approval of the Macquarie University Human Research Ethics Committee, the Victorian Department of Justice Human Research Ethics Committee, the Coroners Court of Victoria Research Committee and the Western Australian Coronial Ethics Committee. Our sincere thanks go to the National Coronial Information System (NCIS) for their valued resource of coronial records and for their assistance throughout the project, especially on the part of Jessica Bryan, and to the Victorian Department of Justice and Community Safety, who manage the NCIS.

Finally, we wish to acknowledge and pay respect to all the victims of residential fires, their families and loved ones.

EXECUTIVE SUMMARY

INTRODUCTION

On average, more than one fire-related death occurs in a residential context every week in Australia. That equates to approximately the same number of deaths as occurred during the Black Saturday bushfires (173) every three years. These deaths are overwhelmingly preventable. Deaths from residential fires have significant social, economic and emotional impacts on individuals, families, communities and also on the firefighters and other emergency service workers who attend these tragic incidents.

The last published national study into residential fire fatalities in Australia was released in 2005 (Australasian Fire Authorities Council (AFAC), 2005). The current study follows on from that report but looks in greater depth at who is most at risk. It provides fire services and other stakeholders with an analysis of preventable residential fire fatalities to inform evidence-based policy and practice to reduce the number of future deaths.

AIM

The aims of this study were to:

- Create a record of all preventable residential fire fatalities since the end of the AFAC 2005 study
- Identify specific socio-demographic characteristics, risk factors and other related information associated with victims of residential fire that are noted by Coroners
- For the largest cohort of fire victims (older people), identify how many were recipients of government funded community aged care services prior to their death
- Better understand the prevalence of socio-demographic characteristics associated with fire victims in the community based on ABS data, including a projection of future risk.

METHOD

The methodology of this study is based primarily on the collection and analysis of coronial records from the National Coronial Information System (NCIS) database, supported by the analysis of publicly available Coronial reports. The NCIS database is an online facility storing coronial cases from all jurisdictions in Australia from 2000 onwards. To access the NCIS database ethics approvals were obtained from the Human Research Ethics Committees of Macquarie University and the Victorian Department of Justice and Regulation, from the Coroners Court of Victoria Research Committee and from the Western Australian Coronial Ethics Committee.

Australian records from 1 July 2003 to 30 June 2017 were accessed in the NCIS by a variety of searches. After refinement of the applicable dataset, relevant structured and non-structured data from the NCIS (comprising the summary page, police, autopsy and toxicology reports and coroner's findings) were coded for 41 fields and entered into a specially constructed Microsoft (MS) Access database – the *Preventable Residential Fire Fatalities Database*. Once complete, the data were exported to MS Excel tables and statistically analysed.

RESULTS/ DISCUSSION

Mortality statistics

This study found that at least 900 people have died in preventable residential fires in Australia from July 2003 to June 2017, averaging approximately 64 deaths per year or more than one preventable residential fire death every week. This is a national death rate of approximately 0.29 per 100,000 population. The majority of deaths occur in single fatality incidents. Between 2003 and 2017 there was no clear declining trend in fire fatalities.

The results from this study highlight that the conceptualisation of fire fatality risk is complex. The presence of a single risk factor on its own is unlikely to significantly increase a person's risk of dying in a residential fire. It is the co-occurrence of a range of factors surrounding the person, their behaviours, their residential environment and other external factors that is likely to impact their overall level of risk of having a fire that results in their death.

Fire services, individuals and other stakeholders can and should do more to reduce the rate of residential fire fatalities further, with an aim of reducing preventable residential fire deaths towards zero. Interventions to reduce the risk of residential fire for those most at risk of dying need to encompass both technological and human-centred approaches.

The residence and location

Free-standing houses/ villas were the housing type where the majority of fatal fires occurred (67.1%). However, stand-alone houses comprise 78.4% of housing stock in Australia, so other housing types may be over-represented in the fatality data. Similarly, owner occupiers were the most commonly identified property tenure (53%), but owner occupiers account for approximately 67% of all property tenures in Australia (ABS, 2017). This indicates that other tenure types, such as private and public rentals, may be over-represented in fire fatalities.

Geographically, most fatal residential fires occurred in major cities, but with regard to the death rate per 100,000 population, there was over-representation of deaths in regional and remote areas. The analysis of the fatality data in relation to areas of relative socio-economic advantage and disadvantage (IRSAD) (refer to pp.31-32 and Appendix 3) shows that most fatalities occurred in locations where there is relatively greater socio-economic disadvantage.

Fatal preventable residential fires start most commonly in the living room/ lounge or bedroom. They are not necessarily large or severe fires, with approximately half of fatal fires burning one room or less of the structure.

Seasonality

The most common characteristics of residential fires that are fatal include that they occur mostly during the Australian winter months. They occur most commonly between hours of 8pm-8am and particularly from midnight-4am.

Smoke alarms

Smoke alarms are the most important residential fire safety device. They are required by law in residential properties in all Australian jurisdictions. For this study, data on smoke alarms was collected from the narrative parts of the NCIS database. In a large majority of cases (65.9%), this information was not known. The extent that the presence of a smoke alarm was noted is low considering their importance, and considering that the absence of a smoke alarm may have had an impact on the fatality outcome (e.g., by providing an earlier warning to the fire victim.)

The people

Single variable analysis from the current research found that those most at risk of dying in a preventable residential fire included:

- Older people – people aged ≥65 represent 36.4% of total fatalities
- Young children aged 0-4 – 7.8% of all fatalities
- People who had a disability (61.8%)
- Aboriginal/ Torres Strait Islander people (over-represented by a factor of 2.5)
- People who smoked – 65.4% of known decedents were smokers
- Males – 64.3% of all fatalities (M:F death ratio 1.8), particularly those aged >45
- People who lived in the most socially and financially disadvantaged locations
- People who lived alone (44.5%)
- People who had medications (34.4%) or alcohol (32.7%) present in their blood.

By age cohort, people aged ≥65 are the group most at risk of dying in a residential fire. In the ≥65 cohort, the fatality rate increases with age; older age groups are more at risk. The data indicates that the other factors that increase risk in older people include smoking, having a disability, the presence in their blood of alcohol and/ or medications, living alone and requiring support to live at home. Where these factors are present in combination, an older person's risk may increase significantly.

The presence of a working smoke alarm may not provide early enough warning to enable older people to escape from a fire. This is an area that needs more research, but it indicates that there may be life-saving benefits if fire services and other stakeholders focus on increasing the uptake of specialist smoke alarms appropriate to the needs of older people.

The future fire fatality risk for older people is likely to be on an increasing trajectory due to a range of demographic and policy factors.

These include an ageing population and this growing population of older people "ageing in place" within their own home for longer.

Children aged 0-4 had the largest number of deaths of any 5 year age range. The cause of fire was more often lighters or matches (n=31), which may indicate that a significant number of fires were lit by children during fire-play. The link to social and financial disadvantage was particularly significant in this cohort, with almost half (48.6%, n=34) of deaths in the 0-4 age bracket occurring in locations in the top 10% of greatest socio-economic disadvantage, and 87.2% of fatalities occurred in the top 40% of locations of greatest disadvantage.

Fire safety interventions for this cohort need to be focused on increasing the basic home fire safety of families with young children, particularly in areas of social and financial disadvantage. Fire services and other stakeholders may consider interventions that partner with other services, such as maternal and child health services, to identify and reach those most at risk.

Within the fire fatality data, 46.7% (n=420) of decedents were identified as having at least one disability present. Physical disabilities comprised 46.2% of disabilities identified, while mental health and neurological disorders made up 27.8% and 9.7% of disabilities identified. People with a disability are likely to be over-represented in the fire fatality data. Mental health and neurological disorders are an identified risk factor for residential fire fatality. Similar to older people, there may be a lifesaving benefit in fire services and other stakeholders focusing on increasing the uptake of specialist smoke alarms appropriate to the needs of people with a disability.

Some 8.2% (n=57) of decedents were identified as Aboriginal, Torres Strait Islander (TSI) or both. Approximately 3.3% of the Australian population identify as Aboriginal or TSI (ABS, 2019a), meaning that this cohort are over-represented in the data by a factor of 2.5. Aboriginal/ TSI people comprised 12% of fatalities under 65 years of age and 3% of people over 65 years, likely reflecting the younger age structure of the Aboriginal and TSI population.

Smokers are over-represented to a large extent in residential fire fatalities. Of cases where the smoking status of the decedent was known (n=428), 65.4% of people were smokers. During the study period, smoking rates in Australia decreased significantly, and reduced-fire-risk cigarettes were mandated in Australia in 2010. In the 2004/5 financial year 23.3% of Australians were smokers. By 2014/15 this had decreased to 15.5%.[1] The fatality data does not reflect any decline in the number of smokers who died over the course of the study period. It is unclear why this is the case.

Smoking materials are a major cause of ignition of fatal residential fires. For those cases where the fire cause was known, over a quarter (26.7%, n=161) were caused by smoking materials (i.e., cigarettes, pipes etc), with just over a third of those (n=56) relating to smoking in bed. There was a strong link between smoking materials as the cause of fire and the residence being located in a relatively disadvantaged area,

[1] https://www.heartfoundation.org.au/about-us/what-we-do/heart-disease-in-australia/smoking-statistics (accessed 19/06/2019)

with 49% of fires caused by smoking materials occurring in the top 25% of most disadvantaged locations.

RECOMMENDATIONS

Fire services and other stakeholders may consider the following recommendations to reduce the incidence of preventable residential fire fatalities in Australia:

- Develop a national residential fire strategy with an overall aim of reducing preventable fire deaths towards zero
- Develop an annual fire fatality report that sources fire and fatality data from fire services and use this data to drive evidence based policy and practice
- Update residential fire fatality data sourced from NCIS, optimally every three years
- Consider how fire services could more pro-actively provide information and data to inform coroners, particularly around aspects of fire risk, prevention and smoke alarms
- Develop and evaluate partnership approaches to residential fire safety with other sectors such as providers of NDIS and My Aged Care services, maternal and child health services, Aboriginal services and others
- Extend the uptake of the Basic Home Fire Safety Training Materials as a unit of competency in a wider range of qualifications and sectors that provide services in the homes of people at increased risk from fire
- Consider how older people and people with a disability can more easily have access to fire safety devices appropriate to their needs, including specialised smoke alarms and residential sprinkler systems.

CONCLUSION

Preventable residential fire fatalities in Australia remain a significant public health problem, with an average of 64 fatalities each year. Deaths from residential fires have significant social, economic and emotional impacts on individuals, families, communities and also on the firefighters and other emergency service workers who attend these tragic incidents.

For the first time in over 14 years, this study provides an update on the evidence around the extent of preventable residential fire fatalities in Australia, those people most at risk and the details of fire incidents and residences where fatal fires have occurred. It provides a set of data that fire services and other stakeholders can use to develop evidence-based policy and practice to reduce the occurrence of fatal residential fires.

INTRODUCTION

On average, more than one fire-related death occurs in a residential context every week in Australia. That equates to approximately the same number of deaths as occurred during the Black Saturday bushfires (173) every three years. These deaths are overwhelmingly preventable. Previous research described residential fire deaths in Australia as a diffuse disaster (Rhodes and Reinholtd, 1998). Deaths from residential fires have significant social, economic and emotional impacts on individuals, families, communities and also on the firefighters and other emergency service workers who attend these tragic incidents.

Numerous studies have shown that certain groups of people are more at risk of dying in residential fires. The identification of risk groups enables fire services to apply a preventative rather than a reactive approach to residential fire safety.

The most recent national study into residential fire fatalities in Australia (Australasian Fire Authorities Council (AFAC), 2005) was released in 2005. The current study follows on from that report but looks in greater depth at who is most at risk. It provides fire services and other stakeholders with an analysis of residential fire fatalities to inform evidence-based policy and practice to reduce the number of future deaths.

PROJECT OVERVIEW AND AIMS

The objectives of this study were to:

- Create a record of all preventable residential fire fatalities since the end of the AFAC 2005 study
- Identify specific socio-demographic characteristics, risk factors and other related information associated with victims of residential fire that are noted by Coroners
- For the largest cohort of fire victims (older people), identify how many were recipients of government funded services prior to their death
- Better understand the prevalence of socio-demographic characteristics associated with fire victims in the community based on ABS data, including a projection of future risk, where appropriate.

This study is a progression from AFAC 2005, which found that people most at risk of dying in a residential fire in Australia included males, those aged 65 or over, children 0-4 years and adults who had consumed alcohol. This study also sought to confirm at a national level, findings from Aufiero *et al* (2011), which found that in metropolitan Melbourne, older people and people with a disability were at higher risk and that many residential fire victims were recipients of funded community care programs.

Some demographic trends, such an ageing population, ageing in place strategies and more people living alone, indicate a potential increase in future risk. This study will discuss where future residential fire fatality risk lies, based on recent trends.

The findings from this study will enable fire services and other stakeholders to improve their knowledge of preventable residential fire fatalities, the nature of the victims and the circumstances surrounding the fatalities. This information will assist to design improved community safety regulations and programs to reduce residential fire fatalities in the future.

ETHICAL CONSIDERATIONS

General

This project focused on people who had died as a result of a preventable residential fire. Due to the sensitive nature of the data accessed, ethical approvals were needed via a series of ethics committees. The process is summarised in Figure 1. A small team were approved to access the National Coronial Information System (NCIS) coronial records. A username and temporary password were assigned to each researcher and access was granted to the NCIS records provided that the researcher used a designated computer at a designated location. Risk Frontiers used a file storage system which could only be accessed by the team that was granted access to the NCIS data. Access to the *Preventable Residential Fire Fatalities Database* generated by this project is subject to meeting the same ethical approval procedures as detailed below.

Macquarie University Higher Research Ethics Committee

All research conducted by Macquarie University staff/ associates that involves or is about people requires approval from the Macquarie University Human Research Ethics Committee (Macquarie University HREC). A detailed application was submitted to the Macquarie University HREC on 9 August 2017, clarifications given 13 September 2017 and approval was given on 14 September 2017 (reference number: 5201700830).

The Coroners Court of Victoria Research Committee (CCOV RC)

Applications for access to Victorian coronial records must be approved by the Coroners Court of Victoria Research Committee (CCOV RC). This process and that of applying for the approval of the Justice and Community Safety Human Research Ethics Committee (JHREC) were done *via* the NCIS.

As Level 1 Access to Victorian data was sought, we first required a letter of endorsement from the Victorian State Coroner. To achieve this, the application was first submitted to the CCOV RC *via* the NCIS liaison officer on 6 October 2017. Clarification on two issues was submitted on 17 October 2017 and the application was endorsed by CCOV RC on 20 October 2017 (reference CCOV RC 230).

CCOV RC advises the Victorian State Coroner prior to applying to the JHREC. This application also goes to NCIS Research Committee (NRC).

The Victorian Department of Justice Higher Research Ethics Committee (JHREC)

To obtain access to the Australian data held by NCIS, approval was required through the Victorian Department of Justice and Community Safety Human Research Ethics Committee (JHREC). Approval from the Macquarie University HREC was required prior to submitting our application to the NCIS. Our original application

was submitted 6 October 2017. Approval was granted 19 December 2017 (reference CF17 27930 – JHREC and M0404 - NCIS).

Any variations to an approved project must, in any instances where there is a variation to the data being sought, or from where the data will be accessed, be done *via* an application to NCIS, which must be approved by the Victorian Department of Justice and Community Safety Human Research Ethics Committee, the CCVRC and the Western Australian Coronial Ethics Committee.

The Western Australia Coronial Ethics Committee (WACEC)

As Level 1 Access to Western Australian data was sought, we required, in addition to the above, approval by the Western Australian Coronial Ethics Committee (WACEC). To achieve this, the application was submitted *via* the NCIS liaison officer on 6 October 2017.

Clarification on several issues was requested 15 May 2018 and submitted 16 November 2018 after a series of phone calls and emails. Approval was granted 12 December 2018 (EC06-2018).

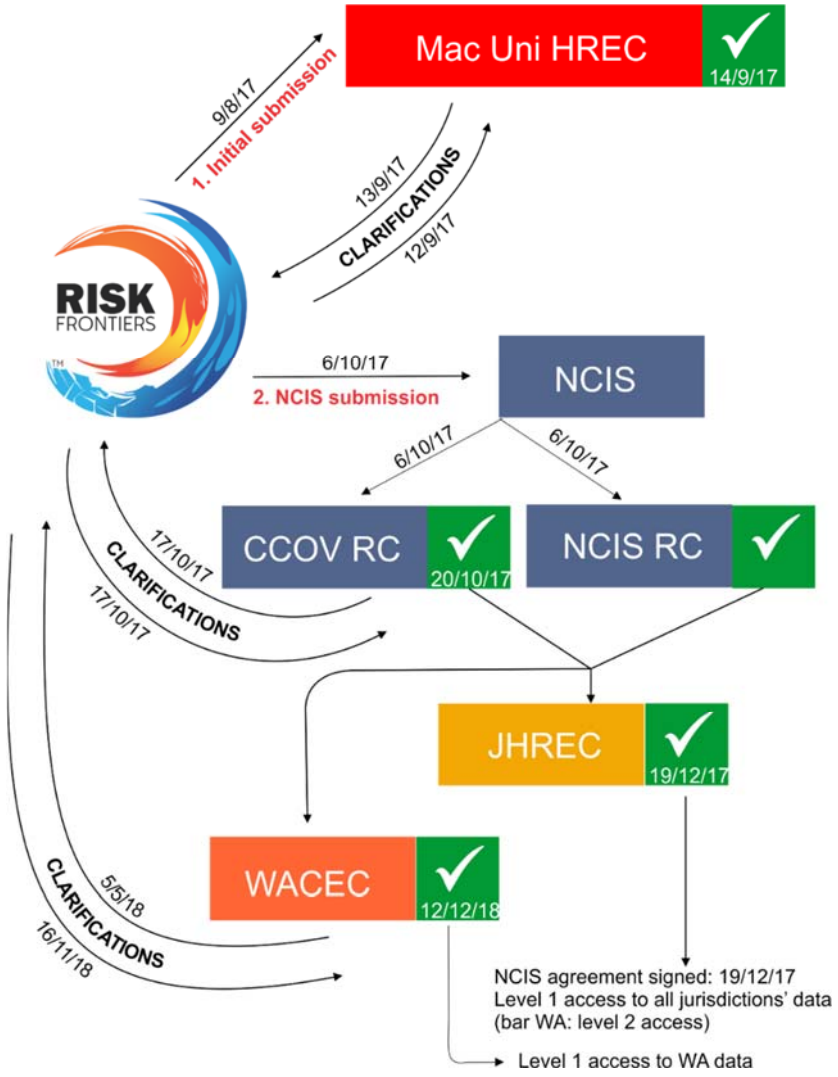

FIGURE 1: FLOWCHART OF THE ETHICS APPROVAL PROCESS

LITERATURE REVIEW

In Australia, as in other Western countries, deaths from residential fires remain a significant public health problem despite ongoing efforts to reduce the number of fatalities. Residential fire deaths carry a large social and financial cost and disproportionately impact certain population groups (Ballesteros *et al*, 2005; Clarke *et al*, 2015; Turner *et al*, 2017).

Table 1 provides an indication of the scale of fire deaths in relation to other external causes of death as recorded in *Causes of Death in Australia, 2017* (ABS, 2018), sections (V01-X59). As a comparison in relation to bushfire deaths, Blanchi *et al* (2014) reported that between 1901 and 2011 there were an average of 6.6 civilian deaths per year caused by bushfire.

Cause	Number	Standardised death rate	Years of potential life lost
Transport accidents (V01-V99)	1371	5.4	46,240
Falls (W0-W19)	2782	8.6	7007
Exposure to inanimate mechanical forces (W20-W49)	72	0.3	2099
Exposure to animate mechanical forces (W50-W64) e.g., shark bite	16	NP	418
Accidental drowning and submersion (W65-W74)	160	0.6	6200
Other accidental threats to breathing (W75-W84)	159	0.6	1968
Exposure to electric current, radiation and extreme ambient air temperature and pressure (W85-W99)	9	NP	381
Exposure to smoke, fire and flames (X00-X09)	**51**	**0.2**	**981**
Contact with heat and hot substances (X10-X19)	3	NP	NP
Contact with venomous animals and plants (X20-X29)	9	NP	241
Exposure to forces of nature (X30-X39) e.g., storm, flood, heat, cold, lightning, earthquake	47	0.2	1098
Accidental poisoning by and exposure to noxious substances (X40-X49)	1305	5.5	47,185
Overexertion, travel and privation (X50-X57)	11	NP	44
Accidental exposure to other and unspecified factors (X58-X59)	949	2.9	2218

TABLE 1: EXTERNAL CAUSES OF DEATH IN AUSTRALIA – EXTERNAL CAUSES OF DEATH SECTIONS V01-X59 (ABS, 2018)

1. THE "EXPOSURE TO SMOKE, FIRE AND FLAMES (X00-X09) CATEGORY INCLUDES ALL FIRE RELATED DEATHS, NOT JUST PREVENTABLE RESIDENTIAL DEATHS

2. NP MEANS NOT AVAILABLE FOR PUBLICATION BUT INCLUDED IN TOTALS WHERE APPLICABLE, UNLESS OTHERWISE INDICATED

Preventable residential fire fatalities have been extensively researched in Australia and internationally in developed countries. Most commonly, Australian and international studies have found that older people, young children, males, people with physical disabilities, people impaired by alcohol and people who experience

social and financial disadvantage are more likely to die in residential fires (AFAC 2005; Aufiero *et al*, 2011; Bushell *et al*, 2016; Jonsson *et al*, 2017; Runefors *et al*, 2016).

Fatal fires are often associated with smoking materials, the absence of working smoke alarms and heating and cooking activities, with victims often dying as a result of smoke inhalation (Aufiero *et al*, 2011; Bushell *et al*, 2016; Jonsson *et al*, 2017; Runyan *et al*, 1992).

The intersection and co-occurrence of these individual risk factors is complex, with an equally complex picture of the potential interventions that can be applied to reduce the risk and occurrence of residential fire fatalities (AFAC, 2005; Ballard *et al*, 1992; Bruck *et al*, 2011; Harpur *et al*, 2014; Jonsson *et al*, 2017; Liley, 2019; QFRA, 1998; Sesseng *et al*, 2017; Warda *et al*, 1999).

CONCEPTUALISING PREVENTABLE RESIDENTIAL FIRES

Around the world, fire services focus much of their prevention effort on residential fires that are variously referred to as preventable, unintentional or accidental. These terms are somewhat interchangeable. For example, Miller (2005, p. 4) notes that "unintentional fires occur from a variety of causes which are held to be largely preventable."

Previous Australian studies (e.g., AFAC, 2005; Aufiero *et al*, 2011) define a preventable fire simply as a fire that was started accidentally. Other studies (e.g., NSWFB, 2009) do not define the term at all.

The Scottish Fire and Rescue Service (SFRS) defines preventable fires as "fires where the SFRS, or other partner agencies, could have identified the individuals and implemented intervention strategies which may have minimised the chances of a fire taking place" (Ramsay, 2015). Conversely, non-preventable fires are "fires in which interventions by either the SFRS, or partner agencies, would not necessarily have affected the fire fatality outcome" (Ramsay, 2015).

Exploring this complexity (albeit using the terms unintentional/ intentional fire), Miller (2005) suggests a continuum of causation that runs from clearly unintentional through to borderline cases (where behavioural determinations or intent are unclear) and on to intentional causation (see Figure 2). Miller's model of a continuum of intentionality highlights that there is a significant grey area where intention is unclear. The definition of preventable residential fires used in this report can be found in the Methods section.

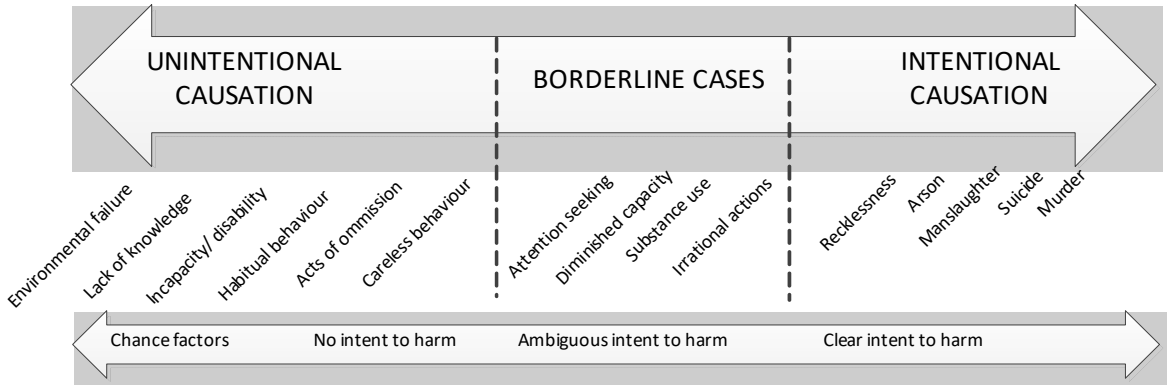

FIGURE 2: MILLER'S INTENTIONALITY, HARM AND FIRE CAUSATION MODEL (ADAPTED FROM MILLER, 2005, FIGURE 6.2A, P. 75)

MORTALITY STATISTICS

In most jurisdictions, including Australia, residential fires represent the largest category of fatal fires (AFAC, 2005; Jonsson *et al*, 2017; FSA, 2018). In comparing the residential fire fatality statistics from various jurisdictions, there can be significant variations in definitions and in the inclusion and exclusion criteria applied. These variations can make direct comparison of data from different jurisdictions difficult (FSA, 2018; Greenstreet Berman, 2012). However, comparisons can still offer interesting and useful information about risks and policies in different jurisdictions (FSA, 2018).

The majority of residential fire fatalities are single fatality incidents (AFAC, 2005; Liley, 2019). Of 366 residential fires reported in AFAC (2005), 32 (8.7%) fires resulted in multiple fatalities. Approximately 92% of incidents were single fatality fires. Liley (2019) reported that, between 2007 and 2014, 92% of fatal fires in New Zealand were single fatality incidents.

Fatality rates provide a useful way to compare the problem of residential fire deaths across jurisdictions with different population sizes and over time (Winberg, 2016). Since 1991, Fire and Emergency New Zealand (formerly New Zealand Fire Service) have commissioned regular studies into unintentional residential fire fatalities (Duncanson *et al*, 2002; Liley, 2019; Miller, 2005). These studies show a steady decline in the fire fatality rate over 23 years. It is unclear what has driven this decline (Liley, 2019). Winberg (2016) investigated fire fatality rates in the UK and USA and found that declines over ten years (2002-2012) were likely driven by the introduction of fire regulations for furniture and furnishings and for children's sleepwear.

Table 2 provides a summary of residential fire fatality rates identified in a number of studies over various jurisdictions and time periods.

Country	Years	Fatality rate per 100,000 per year (approx)	Study
Australia	1996-2003	0.29	AFAC, 2005
Belgium	2014-2015	0.6	FSA, 2018
Denmark	2011-2012	1.1	FSA, 2018
Estonia	2013-2017	3.7	FSA, 2018
Finland	2011-2012	1.4	FSA, 2018
Netherlands	2011-2014	0.2	FSA, 2018
New Zealand	1991-1997	0.8	Duncanson *et al*, 2002
New Zealand	1997-2003	0.48	Miller, 2005
New Zealand	2007-2014	0.34	Liley, 2019
New Zealand	1996-2003	0.55	AFAC, 2005
Norway	2016-2017	0.5	FSA, 2018
Poland	2011-2012	1.3	FSA, 2018
Sweden	2011-2013	1.1	FSA, 2018
United Kingdom	2014	0.6	FSA, 2018
United Kingdom	2015/2016	0.4	Bryant *et al*, 2017?
United States	2015	0.83	Gielen *et al*, 2018

TABLE 2: FIRE FATALITY RATES IN VARIOUS STUDIES

These figures give a broad indication of the scale of residential fire deaths in different jurisdictions and over time. However, they do need to be interpreted with caution due to differences in inclusion and exclusion criteria in different studies or in different jurisdictional data collections. For example, various studies have differing definitions relating to the time after an incident that a death may be included in fatality statistics. In the UK and the Netherlands, deaths at any time after an incident are included. In Norway, deaths that occur up to three months after an incident are included and in Denmark, only deaths that occur within 30 days are included (FSA, 2018).

THE FIRE INCIDENT

Most residential fire-related injuries and deaths result from smoke inhalation and toxic fumes rather than burns (Ahrens, 2013; Barillo & Goode, 1996; Edelman, 2007; Harpur *et al*, 2014). AFAC (2005) reported that, where the cause of death was known, 43% of cases were due to smoke inhalation, 23% were due to burns/ incineration, 11% due to inhalation/ burns and 9% due to a combination of causes.

The majority of preventable residential fire fatalities were found to be caused by human errors or unsafe behaviours (Miller, 2005; Rhodes & Reinholtd, 1998; Turner *et al*, 2017; Xiong *et al*, 2017).

Numerous studies, both Australian and international, have found that smoking and smoking materials are amongst the most common sources of ignition (AFAC, 2005; Aufiero *et al*, 2011; Bruck *et al*, 2011; Bushell *et al*, 2016; Elder *et al*, 1996; FSA, 2018; Hall, 1998; Jonsson *et al*, 2017; Miller, 2005; Mulvaney *et al*, 2008; NFPA, 2014; Rhodes & Reinholtd, 1998; Runyan *et al*, 1992; Sesseng *et a*l, 2017; Turner *et al*, 2017). AFAC (2005) found that 25% of fatalities in Australia from 1996–2004 were due to fires caused by smoking materials or equipment. Bruck *et al* (2011) found a similar trend in Victorian fatalities from 1998–2006.

FSA (2018) found that one of the most important risk factors was smoking, which had caused a quarter of all fatal fires in various European jurisdictions over a ten year period. Smoking materials have been found to be amongst the most common ignition source in research in other jurisdictions, including the United States (NFPA, 2014; Runyan *et al*, 1992), Sweden (Jonsson *et al*, 2017), Scotland (Elder *et al*, 1996) and New Zealand (Miller, 2005).

Research in Australia and overseas has also linked residential fire fatalities with poorly maintained electrical appliances, heating equipment, lighting equipment, electric blankets, wiring faults and electrical failure (AFAC, 2005; Elder, 1996; FSA, 2017; Irwin, 1997; QFRA, 1998; Rhodes & Reinholtd, 1998; Runyan *et al*, 1992).

Mishaps with cooking appliances and unattended cooking and gas explosions are also identified in the literature as a relatively common cause of fatal fires (FSA, 2017; Miller, 2005; Mulvaney *et al*, 2008; QFRA, 1998)

Being careless with open fire, direct contact with a heat source, flame accessibility to people who were unaware of danger, combustibles being placed too close to fires and children playing with ignition sources are other causes identified in the literature(AFAC, 2005; FSA, 2018; Rhodes & Reinholtd, 1998; Xiong *et al*, 2017).

Few studies provide information on the severity or extent of residential fires that result in a fatality. Brandweeracademie (2017), looking at fatal residential fires in the Netherlands during 2016, is one exception. This study found that 75% of fatal fires were active upon arrival of the fire service. Approximately 60% of these fires extended beyond the room of origin.

The bedroom and living room are the most common locations of ignition of fatal residential fires (e.g., Brandweeracademie, 2017; FSA, 2018; Turner *et al*, 2017). However, there is some variation. For example, Rhodes & Reinholtd (1998) found that Victorian fatal fires during 1995–1996 were more likely to start in the bedroom or kitchen.

Australian and overseas research shows that most residential fire fatalities occur at night and in the early hours of the morning (AFAC, 2005; Aufiero, *et al*, 2011; Barillo & Goode, 1996; FSA, 2018; Jonsson *et al*, 2017; Miller, 2005; QFRA, 1998; Rhodes & Reinholtd, 1998; Runyan *et al,* 1992; Shai & Lupinacci, 2003; Turner *et al*, 2017) and are more likely to occur during the colder months (AFAC, 2005; Rhodes & Reinholtd, 1998; Turner *et al*, 2017).

Inclusion of deliberate fires resulting in fatality is treated differently in various studies and jurisdictions. In many Australian and international studies, fatalities resulting from arson, murder, manslaughter or suicide are excluded from residential fire statistics (e.g., AFAC, 2005; Harpur *et al*, 2014; Turner *et al*, 2017). Some studies distinguish fatal outcomes intentionally caused by accountable adults from other types of arson: for example, fires caused by children playing or confused adults (Brandweeracademie, 2017; Greenstreet Berman, 2012). This is the approach taken in the current study and is discussed in more detail in the *Method* section, pp.24-26.

Brandweeracademie (2017) analysed the likely behaviour of fire victims during the fire. They found that nearly half of fire victims were overwhelmed by smoke or fire while asleep. A further 32% attempted to escape.

THE RESIDENCE

AFAC (2005) found that 80% of fatal residential fires occurred in stand-alone houses, followed by 6% in apartments. Mobile homes, older dwellings, dwellings with no smoke alarms and temporary dwellings have also been found across various studies to be associated with an increased risk of injury or death from residential fires (Rhodes & Reinholtd, 1998; Roberts & Pless, 1995; Runyan *et al*, 1992; Shai, 2006; Shai & Lupinacci, 2003; Turner *et al*, 2017).

Statistics about the property tenure of residential fire victims vary across different studies. AFAC (2005) found that fatalities were most likely to occur in houses that were classified as owner-occupied. In contrast, QFRA (1998) indicated that fatal fires commonly occurred in one- or two-family dwellings and these were often rental properties. Similarly, Brandweeracademie (2017) and Turner *et al* (2017) found that the majority of fatalities occurred in a rented house.

Most commonly, fire victims lived alone, with older people more likely to live alone (e.g., Brandweeracademie, 2017; FSA, 2018; Sesseng *et al*, 2017; Turner *et al*, 2017).

No previous Australian studies have considered geographic remoteness in relation to residential fire fatalities.

However, in New Zealand, Liley (2019) found that "Few fatalities occurred in rural centres, however 15% of fire fatalities occurred outside of urban or rural centres in more remote rural areas" (p. 14). In Sweden, Jonsson *et al* (2017) found that the risk of residential fire fatalities was higher in municipalities with few inhabitants and in rural areas that were characterised by an aging population, low income and low educational attainment.

The literature relating to the residential type in which fatal fires occur strongly indicates that various characteristics of the residential environment that are associated with fatal fires are also associated with other measures of social and financial disadvantage (e.g., Duncanson *et al*, 2002; Miller, 2005; Mulvaney *et al*, 2008).

Smoke alarms

Smoke alarms provide a reliable and inexpensive early warning in residential fires. They are required by law in residential properties in all Australian jurisdictions. A working smoke alarm significantly reduces the risk of death from residential fire (Aherns, 2013; Ballesteros *et al*, 2005). Tannous & Agho (2017) investigated socio-demographic predictors of residential fires from the 2014 NSW Population Health Survey and found the importance of functional smoke alarms in homes could not be overemphasised.

The risk of death in a residential fire is higher in homes which do not have a smoke alarm (Aufiero *et al*, 2011; Duncanson *et al*, 2002; Miller, 2005; Roberts & Pless, 1995; Runefors *et al*, 2016; Runyan *et al*, 1992). AFAC (2005) reported that the absence of smoke alarms can increase the possibility of a fatal fire by 60%, and low-income households are least likely to have a smoke alarm installed. In AFAC (2005), where the presence or absence of smoke alarms was noted, a smoke alarm was present in only 45% of properties.

THE PEOPLE

Age

In residential fire fatality studies from Australia and overseas, older people (usually categorised as those aged ≥65) are the most commonly identified at-risk group (AFAC, 2005; Aufiero *et al*, 2011; Bryant & Preston, 2016; Bushell *et al*, 2016; Duncanson *et al*, 2001; Elder *et al,* 1996; FSA, 2018; Halvorsen *et al*, 2017; Harpur *et al*, 2014; Jonsson *et al*, 2017; Miller, 2005; Mulvaney *et al*, 2008; NFPA, 2014; QFRA, 1998; Runyan *et al*, 1992; Sesseng *et al*, 2017; Turner *et al*, 2017).

Various studies have identified that people aged ≥65 represent a growing proportion of the population in many jurisdictions (Aufiero *et al,* 2011; Bushell *et al*, 2016; Harpur *et al*, 2014; Jonsson *et al*, 2017). For example, research examining 2570 preventable residential fire fatalities across the US between 2007 and 2011 showed that the ≥65 demographic accounted for 13% of the US population, but 31% of the recorded deaths in 2011, increasing from 19% in 2007 (Harpur *et al*, 2014).

The literature identifies a range of factors which contribute to the increased risk of older people dying in residential fires. These factors are often associated with an increase in the time it takes to detect and escape from a fire.

Research from Australia and overseas indicates that risk factors for people ≥65 include:

- Living alone (Aufiero *et al*, 2011; Bruck *et al*, 2011; Elder *et al*, 1996; Harpur *et al*, 2014)
- Having an age-related physical, cognitive or neurological illness or disability, particularly when the illness or disability reduces the ability to escape (AFAC, 2005; Aufiero *et al*, 2011; ; FSA, 2017; Harpur *et al*, 2014; Liley, 2019; Miller, 2005; Rhodes & Reinholtd, 1998; Runefors *et al* ,2016)
- Having a sensory impairment such as being deaf/ hard of hearing or blind/ low vision (Miller & Davey, 2007; Bruck, 2001)
- Using sleep medication (Bruck, 2001).

Harpur *et al* (2014) established, upon examination of 64 elderly fatalities in preventable house fires in Northern Ireland, that 78.1% had a pre-existing health condition that played a role in the ignition, propagation or outcome of the fatal fire. This research also established that, of those who had a pre-existing health condition which played a role in their death, 73.5% had a physical health condition and 42.0% had a mental health condition.

The other population cohort most commonly identified in the literature as being at greater risk of dying in a residential fire is the 0–4 age group (Barillo & Goode, 1996, Duncanson *et al*, 2002; Miller, 2005; Newton, 1997; QFRA, 1998). AFAC (2005) found that 8% of residential fire fatalities were aged 0–4 years and that young children were the second most at-risk group in the Australian population after those aged ≥65. By comparison, in New Zealand, 16% were aged 0–4 years (AFAC, 2005). These findings are consistent with other Australian and international research (e.g., Bushell *et al,* 2016; Istre *et al,* 2002; Runyan *et al,* 1992).

Gender

In Australian and New Zealand studies, males are over-represented as victims of residential fire fatalities. AFAC (2005) found that, in Australia, 60% of fire victims were male and in New Zealand, 59% were male. This is broadly consistent with findings from other Australian and international research (Bruck *et al*, 2011; Bryant *et al*, 2016; Bushell *et al*, 2016; Duncanson *et al*, 2002; Fire Service Academy, 2017; Istre, 2002; Jonsson *et al*, 2017; Miller, 2005; Mulvaney *et al*, 2008; NFPA, 2014; QFRA, 1998; Runyan *et al*, 1992; Sesseng *et al*, 2017).

Ethnicity

Few Australian studies have reported statistics relating to indigenous Australians. This is sometimes due to low numbers of fire victims identified as Aboriginal or Torres Strait Islanders (e.g., QFRA, 1998). AFAC (2005) did not collect data around indigeneity.

In other jurisdictions such as New Zealand, indigenous populations (i.e., Maori) have been found to be over-represented in residential fire fatality data (e.g., Duncanson *et al*, 2002).

Similarly, most Australian studies have not reported findings relating to other ethnic characteristics of residential fire victims (e.g., ethnic identity, country of birth, language spoken at home).

AFAC (2005) found that the majority of fire victims were Caucasian, but noted that the ethnicity of the majority of fatality victims was unrecorded.

Employment status

QFRA (1998) found that the majority of Queensland residential fire fatalities (58%) were not in the workforce, with occupations listed as pensioners, retired, on home duties or unemployed. Similarly, AFAC (2005) found that a large proportion of victims were recorded as being pensioners, retired or children.

Employment status may be correlated to other risks factors associated with residential fire fatalities, such as age and social and financial disadvantage. People experiencing social and financial disadvantage, low educational attainment and low income are highly represented in statistics on fatal fires, especially non-working households (Duncanson *et al*, 2002; FSA, 2017; Istre *et al*, 2002; Jennings, 2013; Liley, 2019; Turner *et al*, 2017).

People with higher socio-economic status or income or with positive income elasticity are more likely to purchase and maintain fire safety equipment such as smoke alarms and are less likely to be involved in a fatal fire (Munson & Oates, 1983; Liley, 2019).

Alcohol use

Several Australian studies have found strong links between alcohol use and fire fatalities (QFRA, 1998; AFAC, 2005; Rhodes & Reinholtd, 1998; Bruck *et al*, 2011). This link is also found in international studies (e.g., Runyan *et al*, 1992; Runefors *et al*, 2016; Turner *et al*, 2017).

AFAC (2005) found strong links between excessive alcohol consumption and residential fire fatalities. Rhodes & Reinholtd (1998) concluded that alcohol consumption by victims reduced their capacity to respond to the fatal fire. Bruck *et al* (2011) found that men between the ages of 18–60 were five times more likely to have consumed alcohol prior to death than males over 60. Men outnumbered women in terms of the number of victims who had ingested alcohol, with ratios of around 2:1 or higher (Bruck *et al*, 2011).

Smoking

Numerous studies, both Australian and international, have found that smoking and the presence of smoking materials significantly increase the risk of preventable residential fire fatalities (AFAC, 2005; Aufiero *et al*, 2011; Bruck *et al,* 2011; Bushell *et al*, 2016; Elder *et al*, 1996; FSA, 2018; Hall, 1998; Jonsson *et al*, 2017; Mulvaney *et al*, 2008; Miller, 2005; NFPA, 2014; Rhodes & Reinholtd, 1998; Runyan *et al*, 1992; Sesseng *et al*, 2017; Turner *et al*, 2017).

Disabilities

People who live with disability are over-represented in fire statistics (e.g., Ballesteros *et al*, 2006; Bryant *et al*, 2016; Miller, 2005; Sesseng *et al*, 2017; Turner *et al*, 2017). Disability is highly correlated to older age and is considered to increase risk of death in a residential fire due to increasing the time required to identify and escape from a fire (AFAC, 2005; Aufiero *et al*, 2011; Miller & Davey, 2007).

Brandweeracademie (2017) found that over half of fire victims in the Netherlands in 2016 had a limited or no ability to leave their home without assistance.

Previous Australian studies have provided very limited data relating to disability (e.g., AFAC, 2005).

Other risk factors

There are a range of other risk factors identified in the literature: for example:

- Returning home late at night after consuming alcohol (Duncanson *et al*, 2002)
- Unattended cooking (Turner *et al*, 2017)
- Attempted to fight the fire (Miller, 2005)
- People living in a single parent household (Bryant *et al*, 2016).

Hoarding is another such risk factor. Aufiero *et al* (2011) estimated that hoarders were between 4.8 and 9.0 times more likely to be a fire fatality than the general population. In the 62 preventable residential fire fatalities examined, hoarding was confirmed to be a contributing factor to 12 (19%) of these fatalities because hoarded materials restricted egress from the home and created an excess of flammable materials. In a study of residential fire deaths among older people in Northern Ireland, Harpur *et al* (2014) also found that hoarding was a risk factor.

CO-OCCURRENCE OF RISK FACTORS

The literature commonly identifies that, often, the variables associated with residential fire deaths appear in combination. These can be factors associated with the person and their behaviour, or a more complex combination of risks incorporating the person, the residential environment and other social and economic factors.

In relation to risk associated with the person and their behaviour, for example, Liley (2019) highlights that "combinations of limited mobility, confusion caused by alcohol or drug use, involvement with the fire ignition/ source, being asleep at the time of ignition and rapid reductions in visibility from smoke drastically reduces the chance of fire fatalities escaping from the fire event" (p.40). Sesseng *et al* (2017) identified a combination of risk factors that, together, increase fire fatality risk for people of retirement age, including reduced mobility, impaired cognitive ability, mental health conditions and smoking. People under retirement age are at increased risk if they are substance abusers, have a mental health issue, are under the influence of alcohol and/ or are smokers.

In the literature, the most commonly described combination of person/ behaviour risks are smoking and alcohol (AFAC, 2005; Ballard *et al*, 1992; Bruck *et al*, 2011; Harpur *et al*, 2014; Jonsson *et al*, 2017; QFRA, 1998; Warda *et al*, 1999). Research from Victoria found that the odds of smoking materials being the cause of the fire were 4.4 times greater where the victim had consumed alcohol (Bruck *et al*, 2011). Ballard *et al* (1992) found that households with alcohol drinkers who consumed five or more drinks per occasion were found to be at increased risk, with multivariate analysis suggesting that this was often because drinkers tended to live in households with higher smoking levels.

QFRA (1998) described the combined risk associated with alcohol and smoking as likely driven by a lack of awareness of victims of discarded cigarettes or similar due to intoxication by alcohol and being asleep.

AFAC (2005) concluded that individuals who experienced social and financial disadvantage were more likely to engage in behaviours such as smoking and alcohol consumption that increased their risk of mortality in a residential fire and further, that smokers tended to consume more alcohol than non-smokers.

APPROACHES TO THE PREVENTION OF RESIDENTIAL FIRE FATALITIES

There are a variety of risk conceptualisation and intervention models proposed in the literature. Traditionally, fire prevention, detection and evacuation have focused on engineering and technological measures. These have been very successful in significantly reducing fire fatality rates (Halvorsen *et al*, 2017). More contemporary models highlight the importance of the interaction of residents – their characteristics and behaviours – with the residential environment. These models propose interventions that can broadly be divided into technological interventions and human-centred interventions (Halvorsen *et al*, 2017; Jonsson *et al*, 2017).

For example, the Dutch model of residential fatal fire characteristics is based on research into human behaviour in fire and fire safety engineering, and can be summarised into factors related to human characteristics, building characteristics, fire characteristics and intervention characteristics (FSA, 2018).

Gielen *et al* (2018) used a population health research approach centred around an adapted Haddon Matrix and ecological model to conceptualise a range of interventions targeted to particular risks and outcomes. Gielen *et al* (2018) recognised that risk of fire fatality is reflective of the social determinants of health.

Halvorsen *et al* (2017) presented a sociological perspective that views the social and organisational surrounding not just as important context, but also as potential risk factors in themselves. The model developed by Halvorsen *et al* (2017) accounts for factors relating to the individual (e.g., mobility, cognitive function), the physical environment (e.g., presence of smoke alarms) and the social/ organisational environment (e.g., presence of in-home care, family support).

Technological approaches to risk reduction proposed in contemporary research include:

- Residential sprinkler systems (Pollack *et al*, 2015)
- Smoke alarm installation in high risk homes (Ballesteros *et al,* 2005)
- Advanced residential smoke/ fire alarms (Kellerman, 2016)
- Cooking fire hazard reduction technologies (Kellerman, 2016)
- Fire regulations for furniture and furnishings, and for children´s sleepwear (Winberg, 2016)
- Fire-safe smoking materials (Barillo & Goode, 1996).

These interventions need to be subject to evaluation of the impact of new fire protection technology on residential life safety (Kellerman, 2016).

Human-centred approaches target people most at risk such as children and older people (Barillo, 1996). This requires an understanding the socio-economic, health

and lifestyle factors underlying residential fires (Gielen *et al*, 2018; Higgins *et al*, 2015). This is complex and often exceeds the competencies and responsibilities of fire agencies (Halvorsen *et al*, 2017).

Increasingly, research is recognising that reducing the risk of residential fire fatalities requires competency and effort from a variety of professions. Collaborative partnerships between fire services and a range of other sectors may support more targeted and effective fire risk reduction (Halvorsen *et al*, 2017; Higgins *et al*, 2015).

Much of this research has occurred in the Scandinavian countries (Halvorsen *et al*, 2017; Hansson & Weinholt, 2018; Jonsson *et al*, 2017). For example, in Norway, Halvorsen *et al* (2017) identified that health and social care workers are well placed in terms of access and expertise to assist fire services to identify and manage fire risk for those most at risk in the community. The research explored partnerships between fire services and workers in property management, housing administration, health and social care. They identified that cross-sectoral approaches are difficult to maintain and vulnerable to cuts. This is because "…the topic of prevention is challenging and hard to prioritise as it is concerned with the non-occurrence of undesired events..." (p.3). Further, Halvorsen *et al* (2017) identified that there are often conflicting priorities between fire services and other sectors that care for people at risk from fire.

In Sweden, cross-sector collaborative practices are being developed, including collaboration between the fire service and homecare nurses and between the fire service and private security firms. Hansson & Weinholt (2018) found that the success of such collaborations is dependent on a complex array of factors such as occupational identity, expert-role expectations and personal motivation.

Some jurisdictions are now beginning to envision a goal of no preventable residential fire deaths. In the US, the Centre for Disease Control, the Consumer Product Safety Commission, the United States Fire Administration and other government and non-government organisations have a collaborative goal of eliminating residential fire-related deaths by 2020 (Ballesteros *et al*, 2006). In Sweden, a Vision Zero policy approach, first used in road safety, has been applied to fire safety to establish policy responses to eliminate fire related deaths (Kristianssen *et al*, 2018).

CORONIAL RECOMMENDATIONS

Few studies make findings or recommendations with regard to information in coronial records. One exception is Liley (2019) who found, with regard to New Zealand residential fire fatalities, that 15% of coronial case files had missing information about smoke alarms.

METHOD

APPROACH/ STUDY DESIGN

The methodology of this study is based primarily on the collection and analysis of coronial records from the National Coronial Information System (NCIS) database, supported by the analysis of publicly available coronial reports.

DEFINITIONS/ INCLUSION CRITERIA FOR PREVENTABLE RESIDENTIAL FIRE FATALITIES

Preventable residential fire fatalities

The research team developed the following definitions for this study.

Preventable:

Preventable fires are fires where individuals, fire services or other stakeholders may have been able to identify the risks (related to a person and/ or a physical environment) and take actions or develop intervention strategies which, if applied, may have reduced the risk of a fire taking place.

Studies on residential fire fatalities variously describe deaths from fire as preventable, unintentional or accidental. Various alternative descriptions were considered, including accidental and preventable.

An accidental fire fatality implies that the death was the result of an unfortunate circumstance that was unavoidable. This term fails to convey that there is a moral (and often a legal) imperative for individuals, fire services and other stakeholders to actively prevent fires and fire-related injury and death.

An unintentional fire fatality reflects an arbitrary categorisation around intent. Cases of suicide or murder involving fire may have a clear intent to cause harm but, in many cases, intent is unclear or unknown. In other cases there is intent to light the fire, but no intent for someone to die as a result. Similar to accidental, the term unintentional fails to convey a sense of agency.

Fire services have a legislated obligation in most jurisdictions to prevent fire. No fire death is inevitable or unavoidable and each one is a tragedy. This study posits that fire fatalities that are accidental or unintentional, amongst other categories, should be termed preventable.

Residential:

A residential setting is defined as a place where a person or persons reside without continuous external supervision, either on a permanent or temporary basis. The structure can be either permanent or temporary (e.g., a caravan or tent) but must be something that is used for sleeping and other domestic activities (e.g., cooking, eating, and sitting).

Residential settings where formally employed persons have a direct responsibility for the welfare of residents on a 24/7 basis (e.g., supervision of evacuation in the event of a fire) are excluded.

These include settings such as hospitals, prisons, nursing homes, residential care facilities and some hotels, motels and backpackers. These are excluded because responsibility for fire safety measures (both passive and active and including prevention) resides with an owner or responsible employee, rather than individually with residents. These responsibilities are often defined in regulations such as the National Construction Code.

Fire:

A fire is defined as an ignition of combustible material, regardless of whether the fire resulted in attendance of a fire service. Fatalities resulting from explosions with no fire or from inhalation of gases such as carbon monoxide with no associated fire are out of scope.

Fatality:

A fatality is defined as a death where causation, as determined by a coroner, is related primarily to the effects of fire, including causations such as smoke inhalation or burns. The death may have occurred at the time of the fire or any time after, including months after the fire incident.

Scope

Determining preventability may be limited by knowledge of what potential treatments are available. Influenced by Miller's intentionality, harm and fire causation model (Miller 2005) (see p.14 for a summary of the model), the research team developed a detailed project scope and established a process for review of borderline cases by members of the research team to agree on whether they were within or outside the project scope.

In-scope:

- The fire occurred in or around a residential building (e.g., in the back yard, garage, shed or bungalow)
- The fire occurred in a property that was not classified in the National Construction Code as a residential structure, but was being used for accommodation
- The fire occurred in a temporary, moveable or ad-hoc structure used for accommodation (e.g., a caravan, converted shipping container, tent)
- Death occurred at the time of the fire incident or any time after as a consequence of injuries sustained during the fire incident
- The Coroner determined intent of the death as being unintentional
- The Coroner determined the intent of the death as being undetermined, inconclusive, unspecified or unknown.

Borderline cases:

- The fatality occurred in an aged-care facility, prison, hotel, motel, backpackers, hospital or other residential facility. These were reviewed to determine if the residence had 24 hour supervision. For example, an aged-care facility would be out of scope but a retirement living situation (e.g., retirement village or apartments) would be in scope
- The fire was caused by fire-play by persons of any age. These were reviewed to determine if there was intent to cause harm or if there were other contextual issues such as mental health, alcohol, medication or other drugs or cognitive disorder

- The fire was caused by self-harm where there was evidence of other contextual issues such as mental health, alcohol, medication or other drugs or cognitive disability. These were reviewed to determine if there was a systemic failure that could have otherwise led to the death being prevented
- The behavioural determinants that resulted in the fire or fatality were unclear in terms of intent to cause harm, such as attention seeking, recklessness, diminished capacity, irrational actions and any overlay of mental health, alcohol, medication or other drugs or cognitive disability. These were reviewed to determine if the case was within scope
- The Coroner determined the intent of death as intentional, only where there was evidence that the decedent did not understand the consequences of their actions AND where a systemic failure by a professional service (e.g., adult mental health service) occurred that could have otherwise led to the death being prevented.

Out of scope:

- The fatality occurred as a result of a clear intent to cause harm to a person such as suicide or murder
- The fatality occurred as a result of the casualty's engagement in paid or unpaid employment (i.e., it was an occupational fatality, including firefighters or other emergency service workers)
- The incident resulting in a fatality occurred outside of a residential context (e.g., in a car (excepting if parked in a garage or on a driveway of a residence), on the street, in a park, in a shop, etc.)
- The fire resulted from a bushfire
- The fatality occurred in an aged-care facility, prison, hotel, motel, backpackers, hospital or other residential facility that has confirmed full-time (i.e., 24 hour) supervision of occupants as well as mandated minimum fire safety standards.

TIMEFRAME

The research team collected information regarding preventable residential fire fatalities for closed cases available from the NCIS database from 1 July 2003 to 30 June 2017.

CASE STUDY 1

Western Australia, 2014

Ms A died in July 2014 as a result of the effects of a fire in her home in Kalgoorlie, WA. Ms A had a long history of schizophrenia with frequent relapses. She lived alone, was under the care of a community mental health service at the time of her death and was on antipsychotic medication. Ms A also suffered from other medical issues, including hypercholesterolaemia, Type 2 diabetes, seizures, alcohol abuse and hypertension.

In 2008 and 2013, Ms A had threatened and then tried to burn her house down.

The day prior to her death, Ms A'S son had been concerned about her mental state and had tried to arrange via the police and the regional hospital for her to be admitted to hospital; but he was unsuccessful.

On the morning of the following day, the fire service attended Ms A's unit after being notified by neighbours of a smoke alarm sounding. Upon investigation, firefighters found no active fire, but significant fire and smoke damage inside the home. Ms A's body was found on a couch blocking the front door holding two cigarette lighters.

Police arson investigators classified the cause of the fire as undetermined because accidental causation could not be ruled out. The Coroner concluded that Ms A deliberately lit the fire but was unable to reach the conclusion that she had an intention to take her life. This was due to the evidence of her probable diminished mental capacity to understand the nature and consequences of her actions at the time.

Both the police and the community mental health service conducted internal reviews into their failure to provide the assistance sought by Ms A's son. The Coroner viewed these failures as a missed opportunity to get medical treatment for Ms A, potentially preventing her death.

Discussion: *This case was considered in-scope for the current study. Although the decedent was likely to have deliberately lit the fire, there was no clear intent to self-harm, and the death may have been prevented if the police and mental health service had acted within their remit and in a timelier manner. This case also illustrates the often complex and interlinked risk factors relating to mental and physical health, living circumstances and support services.*

DATA COLLECTION AND CODING

To guide the data collection, the research team formulated a coding table. This was revised periodically during the project as the kinds of data available from NCIS and the complexities of the project became apparent. The coding table is included as Appendix 2.

Information from the NCIS was de-identified and entered into a Microsoft Access database – the *Preventable residential fire fatalities database*.

A unique database identifier was given to each fatality. A second identifier was created to label individual fire events.

The *Preventable residential fire fatalities database – users guide* (2019) provides a full explanation of how to access and enter data into the *Preventable residential fire fatalities database*.

In addition, a glossary/ data dictionary defining all the terms used in the coding table, as well as the terminology used in this report, is at Appendix 3.

DATA SOURCES

Publicly available coronial reports

A search was conducted of publicly available coronial records to obtain case studies to illustrate key trends and research findings, as material from the closed NCIS database cannot be used in a way that might identify the decedents. These case studies appear at relevant points throughout the report. The case studies are from cases where an inquest occurred and where the Coroner determined it appropriate to make the findings publicly available. These cases are not necessarily representative of the full range of fire fatalities.

This exercise also enabled a cross-check of the data to ensure that no cases of preventable residential fire fatalities had been missed in searches of the NCIS database.

NCIS

The National Coronial Information System (NCIS) is a secure database of information on deaths reported to a coroner in Australia and New Zealand. Ethics approvals are required to gain access to the NCIS database. Data includes demographic information on the decedent, contextual details on the nature of the fatality and searchable medico-legal case reports including the coronial finding, autopsy and toxicology report and police notification of death, as described on p.35 (Limitations/ caveats section).

To determine whether a case should be included in the *Preventable residential fire fatalities database* required an examination of any attached police, autopsy or toxicology reports or coronial findings.

As an example of how data is retrieved, to determine whether a decedent had been affected by taking either alcohol, medications or other drugs, the toxicology report was a key source. When these reports were not attached to a case, quite often the data could be found by a close examination of the police and/ or the coroners' reports.

Searches undertaken of the NCIS database

Eleven different queries were run on the NCIS database, using both the "mechanism of injury" and "object or substance producing injury" search phrases in the NCIS query design. These queries are listed in Table 3, along with the initial number of records returned. The results from the queries were filtered at a high level, using some of the NCIS fields returned.

Records were removed if:

- The "incident country" was not Australia
- "Activity 2" returned *chroming*, *criminal activity*, *violent behaviour,* etc
- "Incident - location 2" returned *highway/ freeway*, *parking area*, *watercraft*, *paddock/ field* etc., as opposed to residence
- "Incident - loc 1", "activity 2" or "PRI – Mechanism 2" referred to transport
- "PRI - object description", "sec 1 - object description" or "sec 2 - object description" were *bushfire* or *wildfire*.

NCIS query:				Number of cases returned
Mechanism or object	**Level/ category 1**	**Level/ category 2**	**Level/ category 3**	
mechanism of injury	thermal mechanism	heating	contact with fire or flame	2560
mechanism of injury	thermal mechanism	heating	heating, whole body: natural source	362
mechanism of injury	thermal mechanism	heating	heating, whole body: man-made source	38
mechanism of injury	thermal mechanism	heating	inhalation of smoke from burning object/ substance	919
mechanism of injury	thermal mechanism	heating	other specified heating	0
mechanism of injury	thermal mechanism	heating	unspecified heating	9
mechanism of injury	thermal mechanism	other specified thermal mechanism		1
mechanism of injury	thermal mechanism	unspecified thermal mechanism		2
mechanism of injury	threat to breathing	confinement in oxygen-deficient place		803
object or substance producing injury	fire, flame, smoke	[all secondary categories utilised i.e., fire, flame, smoke, and unspecified as to whether fire, flame or smoke caused the injury]		2762
self immolation				221

TABLE 3: QUERIES RUN FROM NCIS AND NUMBER OF CASES RETURNED, BEFORE INITIAL SCREENING.

From an initial 7677 records (with many of these records repeats, as the same record was returned *via* more than one of the 11 queries run), a total of 3344 records remained. This was reduced further by some fine-tuning after manually viewing the cases. For example, cases where the cause of death mentioned suffocation via noxious gases other than those caused by fire, cases which mentioned car collision and further irrelevant cases not previously picked up were removed. The remaining cases were then examined individually (by summary sheet or, where necessary, by attached reports) in order to make the final determination as to whether they were in or out of the project scope. In some instances where this determination was unclear, the de-identified salient points of cases were referred to an expert panel consisting of experienced members of the research team, where a final determination was made.

DATA ANALYSIS

The Definitions/ Glossary (Appendix 3) provides explanations of the terms used in the following sections.

Initially, each of the 41 variables in the coding tables (Appendix 2) was analysed independently. The data were analysed on a national level and then for each Australian jurisdiction (states and territories). These results are presented under subheadings relating to:

- Overall mortality statistics and trends
- Information about the fire incidents resulting in fatalities
- Information about residences where fatal fires occurred
- Information about the people who died in residential fires
- Information about coronial recommendations.

The level of detail provided in jurisdictional analyses (Appendix 5) were dependent on the number of fatalities in each jurisdiction, due to needing to ensure that individual cases could not be identified in the report.

Where possible, the raw numbers of fatalities were normalised by viewing the fatality numbers against a background population of the particular group of interest. Fatality rates are reported per 100,000 of the background population. This method enables the comparison of fatalities over time and across jurisdictions, to take into account changes over time, such as increases in population.

Analysis of the co-occurrence of risk factors

The literature indicates that the co-occurrence of multiple risk factors is likely to increase a person's overall risk of dying in a residential fire. To attempt to understand what combinations of risk factors were found amongst the decedents, co-occurrence analyses were undertaken.

The co-occurrence of significant variables – that is, whether any risk factors co-occurred in common across the cases – were identified and analysed. This analysis was undertaken in two ways, in order to test slightly different attributes of the data.

Contingency table testing

Contingency table testing tests pairs of variables for the degree of association to each other, under an assumption of independence of (no relationship between) those variables. The aim was to identify which pairs of variables occurred together significantly more (/ less) than would be expected under an assumption of independence between the two variables.

This type of analysis does not tell the specific increase in likelihood from, for example, being "a smoker" and being "over 65 years", but it does identify if certain variables occurred together more (/ less) than expected under an assumption of independence. If there is a significant association between two variables, this identifies that the variables may have a certain interdependence or relationship.

Machine learning

Machine learning (ML) enables consideration of a number of different variables at the one time, rather than just pairs of variables. The methods and results from the machine learning analyses are in Appendix 4 and the salient results are reported in the *Results* section. In both ML approaches the category of interest was the *≥65 years of age* group as this was the age cohort with the greatest overall risk of dying in a residential fire. It was determined that principle component analysis was unsuitable as it is designed for interval-scaled data and the fatality data is categorical in nature. The data fields were used to create 21 predictors of fire risk (some of which were used twice – e.g., *employment status* and *retired/ pension* – the latter of which is a subset of the former).

The first ML approach, Random Forest supervised machine learning, aimed to find the most important variables for fire fatalities in the *≥65 years of age* category), compared to the group aged below 65 years of age.

The second ML approach was clustering. This is the most common form of unsupervised learning. To accommodate the nominal variables, the Gower distance was used to assign distances and weights. The Gower distance is a mathematical way of assigning value/ importance to different categories. For the clustering algorithm, partitioning-around-medoids (PAM) was chosen for its ability to handle custom distance matrices (assigned by the Gower distance) and to select an exemplar for each cluster (useful for nominal data). This was used in conjunction with the two most optimal numbers (most efficient splits) of clusters of four and then 13 clusters (groupings where a number of the decedents had similar characteristics). Appendix 4 and the Glossary (Appendix 3) explain these terms further.

From a statistical perspective, the more that data is divided, and the smaller the totals, the less significant the data becomes. When it comes to looking at the jurisdictions individually with many of the co-occurence variables, it is only statistically reasonable to examine those jurisdictions with larger sample sizes: namely, NSW, Victoria and Queensland. The sample sizes of all the other jurisdictions were too small.

Socio-economic indices

The Australian Bureau of Statistics' (ABS) Socio-Economic Indexes for Areas (SEIFA) data product was used to analyse the socio-economic status of areas where residential fire deaths occurred. SEIFA are derived from the ABS five-yearly Census of Population and Housing, and are calculated using principal component analysis. The data enables the assessment of the relative welfare of Australian communities (ABS, 2016a).

The Index of Relative Socio-economic Advantage and Disadvantage (IRSAD), created by the ABS from 2016 census data to summarise socio-economic conditions within defined areas, is used when the topic being analysed is likely to be affected by both advantage and disadvantage.

A low index score indicates a lack of advantage and relatively greater disadvantage, and a high score indicates greater advantage and a relative lack of disadvantage. The percentile data which divides the indices for areas into 100 equal groups was used for analysis.

The lowest scoring 1% of areas are represented by a percentile number of 1, up to the highest scoring 1% of areas represented by a percentile of 100. An area with a percentile of 25 therefore has an IRSAD lower than 75% of all the SA1 areas in Australia. SA1, or Statistical Areas Level 1, are geographical areas within the Australian Statistical Geography Standard, and are generally the smallest areal unit for the release of census data, having a population of between 200 and 800 people (ABS, 2016b).

ArcGIS was used to join the SEIFA data product to a feature class of SA1 areas using a common 11-digit identification code. The SA1 areas were spatially joined to the feature class of points. These points were then joined to a table exported from the database that included the information of interest using the database primary key. The data was filtered by categories to extract subgroups of cases and an average percentile was calculated for each subgroup. IRSAD percentile histograms were also generated for all cases, cases by jurisdiction and cases by subgroups of interest.

Population projections

Several data sources were used to understand the impacts of future population changes on risk factors identified in earlier project stages – that is, whether risks are likely to increase or decrease. The data sources that scope how people will live in the future were chosen. These included the ABS population projections, and research and publications from the Australian Institute of Family Studies and the United Nations.

Results have been provided nationally for projection timeframes available. Projections relating to fire fatality risk factors were examined, including persons aged 65 and above, people of male gender, people living in remote areas, people of indigenous descent, smokers, people influenced by alcohol or drugs and people living alone. Other factors aside from those fields contained within the coding table were also examined, including modernisation of residential developments over time and the influence of a changing climate.

Predictions for changes in the number of persons in these high-risk groups were made based on projected change in the population of demographic groups correlated with increased risk of death due to residential fire. These assessments rely on the assumption that there will be negligible change in relation to which demographic factors correlate to an increased risk.

LIMITATIONS/ CAVEATS

DATA SOURCES

National Coronial Information System

Many different searches were applied to the NCIS database, but it cannot be guaranteed that all cases in the NCIS within the scope of the current study were found. However, a search was run of each jurisdiction's coronial website for all publicly accessible coronial reports pertaining to residential fire fatalities. This took place in early February 2019 and the only additional cases relevant to the current project were from FY18, which was outside the scope of this project, and four cases from the early to mid-2000s, which had been closed (i.e., available for viewing) after the finalisation of data collection. It is likely that most if not all available (i.e., closed) cases of residential fire fatalities entered into NCIS have been located.

Within the NCIS database, access is granted only to those cases deemed "closed". Table 4, taken from information supplied by NCIS, illustrates the proportion of cases closed (available for viewing) by year for the whole of Australia – and the relatively large proportion of cases from the 2016-2017 financial year (FY17) (and FY18 – not utilized in this study) that were still open and not accessible to the researchers for this study. Thus, the total number of cases able to be accessed for the latter years is incomplete and the true influence of this data on the interpretations from this analysis are not known. By inference, this is likely to result in an under-estimate of the number of preventable fire deaths in these years.

Financial year	% closed	% open	Total cases
2014-2015	93	7	18966
2015-2016	92	8	19251
2016-2017	77	23	19100
2017-2018	53	47	17726

TABLE 4: NCIS CASES AVAILABLE FOR VIEWING, FY 2015 TO FY 2018

1. AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J. BRYAN)

Therefore, caution should be taken when viewing tables and charts of time series as, for example, trends that show a decrease of a particular characteristic over time may, to some extent, be reflecting the higher proportion of "open" cases that could not be included in the current study.

State and Territory data on NCIS closed *vs*. open cases is displayed in Appendix 1. For Victoria, only 45% of cases were closed for FY17. Looking back further in the record, FY16 and FY15 have good representation (92% and 93%, respectively). Most of the other jurisdictions have a good representation of cases for FY17 – 90% or more for all but the Australian Capital Territory (ACT) (89%) and New South Wales (NSW) (82%). NSW shows similar figures for FY16 and FY15 – 87% and 89% respectively.

To ensure that the data accessed from NCIS and reported in the current study remained de-identified – that is, that individual people cannot be identified from the information given – the research team adhered to data reporting restrictions set by the NCIS. One restriction was that any figure of less than five was reported as "<5". This becomes more critical the more the data is divided so, for example, when reporting some of the lower-fatality jurisdictions for gender and age across time, or some of the less common categories of data fields, this study is not able to give the exact number that should populate a particular cell in a table.

Data differences between jurisdictions and over time

Jurisdictions have dealt with data destined for coronial files in different ways, and the amount and type of data collected varied between jurisdictions and over time.

Victoria had fairly good records throughout the time period examined. Most of the cases accessed in the early and recent part of the time period had findings reports attached, although fewer reports were attached to cases from around 2010-2011.

New South Wales (NSW) had fairly detailed police reports and, in more recent years, these changed from a typewritten sheet to several pages of a template form, including details such as whether smoke alarms were noted. However, while there was space for much data about the decedent, it was not necessarily filled out. In addition to the police report, NSW also generally had either toxicology or autopsy reports but only fairly rarely was a findings report included. In most instances it was noted, "case dispensed - no formal finding". In more recent years, a greater number of the cases accessed had findings reports attached.

Queensland also had fairly good records, with descriptive police reports and reasonably detailed findings reports, throughout the time period examined, although the earlier reports were somewhat sparse of detail.

In general, records originating in Tasmania had the best detail throughout the time period sampled, especially about the circumstances of the fire.

The data contained in the Western Australia reports was also quite good, with all four types of reports more often than not attached to each case.

Neither South Australia nor the Northern Territory had as much detail, in general, about the decedent, with police reports in particular tending to be sparse of detail. No coronial findings were available from South Australia via the NCIS.

The Australian Capital Territory (ACT) had fairly good records available throughout the time period examined.

Low-fatality jurisdictions

ACT, Northern Territory and Tasmania had very few residential fire fatalities. For the purposes of data analysis, these jurisdictional data sets were not large enough to enable a robust analysis of trends. This was also true, to a lesser extent, for South Australia and Western Australia.

Data fields within NCIS

The source of many of the data collected in this study was unstructured data from the NCIS (i.e. from police, autopsy or toxicology reports or coronial findings). This unstructured data was entered into structured data fields within the *Preventable residential fire fatalities database* (the database created for the current study). Where particular variables were not mentioned in the NCIS data, this does not necessarily indicate that the variable was not present. For a variable to be mentioned, it would need to be considered pertinent to the case (particularly in the narrative of the police report or the coronial findings). Additionally, the recording of these many variables was dependent on the researcher being able to identify from the NCIS data that the variable was present in the unstructured data. The figures below are likely to be an under-representation. For this reason, many fields contain a high proportion of cases where the variable was unknown. This means that data presented in this report may represent a lower bound.

Neither the *English as a second language* (ESL) or *visa status* coding fields proved useful. The NCIS fields used to determine it were basically the same as those used to determine the coding fields of *country of birth* and *years in Australia*. It is recommended to dispense with this database field. It does not add any data to the database.

Service (in-home support) linkages were rarely cited in any reports attached to coronial cases and, if they were, these were not always government-funded linkages. Very rarely was any data given on aids and equipment.

Where coronial cases had sparse data overall or if a report was not attached, application was made to NCIS for further data. This was given where available, however, due to jurisdictional data restrictions and document availability, the NCIS was not always able to provide additional data.

Publicly available coronial records

A limited number of coronial records are available for public viewing online and some of these were selected as case studies to exemplify aspects of the research results. This step was taken due to the strict regulations around the use of NCIS data, which prohibit the release of any identifiable data. The publicly available coronial records are generally cases where a coroner considered there was value in making the details of the case broadly available. These cases are very relevant to the question of fire fatality prevention, but do not necessarily give a true representation of the range of all research results.

RESULTS - AUSTRALIA

Results for each Australian state and territory are at Appendix 5. Across Australia, at least 900 deaths occurred as a result of preventable residential fires during the 14 years from 1 July 2003 to 30 June 2017. This figure is a lower bound due to the limitations of the study outlined in the Limitations/ caveats section.

MORTALITY STATISTICS

Number of deaths

Table 5 shows the number of deaths from FY 2004 to FY 2017 for Australia and each jurisdiction, as a percentage of the total. In addition, it gives the comparative fatality rates per 100,000 population across the Australian jurisdictions.

Jurisdiction	Number of deaths	% of deaths	Fatality rate (per 100,000 persons)
NSW	276	30.7%	0.28
VIC	254	28.2%	0.33
QLD	147	16.4%	0.24
SA	78	8.5%	0.34
WA	88	9.8%	0.28
TAS	33	3.7%	0.47
NT	17	1.9%	0.54
ACT	6	0.8%	0.12
Australia	900	100.0%	0.29

TABLE 5: FATALITIES BY AUSTRALIAN JURISDICTION, FY 2004 TO FY 2017, AS TOTAL DEATHS, PERCENTAGES AND FATALITY RATES

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

2: GREEN-COLOURED FATALITY RATES ARE BELOW THE NATIONAL AVERAGE, RED-COLOURED FATALITY RATES ARE ABOVE IT.

3. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS FROM FY 2017 IN THE FOLLOWING PROPORTIONS: 23% FOR AUSTRALIA AND, FOR NSW: 18%, VIC: 55%, QLD: 10%, SA: 6%, WA: 5%, TAS: 18%, NT: 6% AND ACT: 11%. TABLES A1-3 & A1-4 IN APPENDIX 1 GIVE THE FIGURES FOR FY 2015 & 2016.

4: IN ONE CASE THE JURISDICTION WAS UNKNOWN: THIS CASE WAS ADDED TO THE AUSTRALIA ROW. THEREFORE, THE TOTAL NUMBER OF DEATHS FOR AUSTRALIA IS ONE MORE THAN THE SUM OF ALL JURISDICTIONS.

Table 5 and Figure 3 show that most deaths (30.7%, n=276) have occurred in NSW, closely followed by Victoria (28.2%, n=254) and then QLD (16.4%, n=147), with fewer deaths occurring in TAS, NT and ACT.

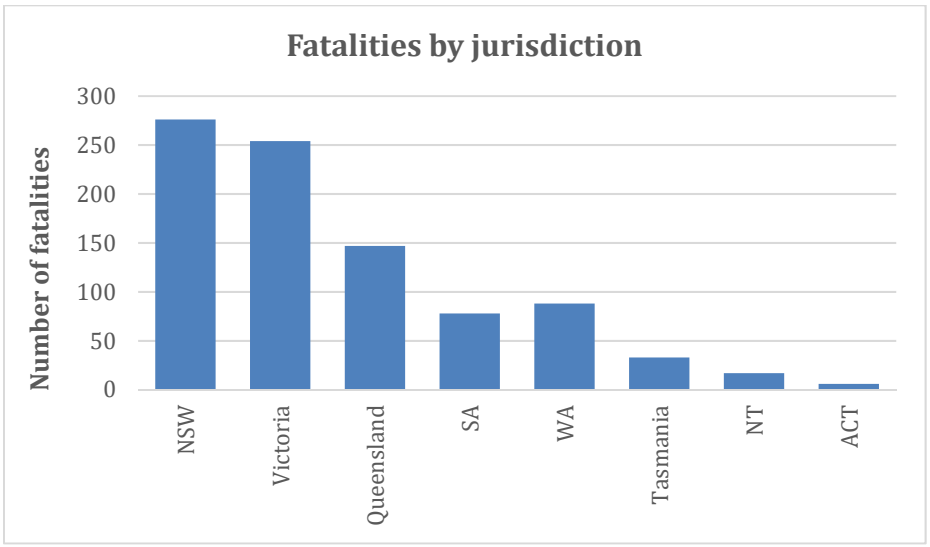

FIGURE 3: FATALITIES BY JURISDICTION, FY 2004-FY 2017

Table 6 shows the total deaths across Australia and its jurisdictions by year of fire incident causing the death. As discussed in the *Limitations* section, the FY 2017 figures represent a lower bound.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
NSW	22	36	29	12	19	18	20	16	23	19	19	16	15	12	276
VIC	11	28	13	20	30	20	23	17	18	14	20	17	13	10	254
QLD	10	11	8	11	14	18	10	7	21	5	7	10	9	6	147
SA	7	<5	6	13	7	<5	<5	5	5	6	6	<5	5	6	78
WA	6	6	6	9	6	8	9	8	5	6	7	<5	<5	8	88
TAS	11	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	33
NT	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	17
ACT	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	6
Australia	69	92	64	69	81	73	67	56	73	51	60	54	47	44	900

TABLE 6: TOTAL FATALITIES BY AUSTRALIAN JURISDICTION, FY 2004 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 2004 IS THE FY 1 JULY 2003 TO 30 JUNE 2004) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: IN ONE CASE THE JURISDICTION WAS UNKNOWN: THIS CASE WAS ADDED TO THE AUSTRALIA ROW. THEREFORE, THE TOTAL NUMBER OF DEATHS FOR AUSTRALIA AT THE "2015" AND THE "TOTAL" COLUMNS IS ONE MORE THAN THE SUM OF ALL JURISDICTIONS.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS FROM FY 2017 IN THE FOLLOWING PROPORTIONS: 23% FOR AUSTRALIA AND, FOR NSW: 18%, VIC: 55%, QLD: 10%, SA: 6%, WA: 5%, TAS: 18%, NT: 6% AND ACT: 11%. TABLES A1-3 & A1-4 IN APPENDIX 1 GIVE THE FIGURES FOR FY 2015 & 2016.

4: ALL FIGURES LESS THAN 5 HAVE BEEN DENOTED "<5", AS PART OF OUR AGREEMENT IN RELATION TO ACCESSING NCIS CASES.

Figure 4 depicts the total fatalities for the whole of Australia. In addition, the data from the AFAC (2005) study from FY 1997 to 2003 have been included to show an indicative trend over a longer period of time (note: in AFAC (2005), data was not available for some years and jurisdictions and the methodology

was significantly different to the current study as data was sourced from fire services, not from coronial data).

The total number of deaths for the time period FY 1997-2003 was 395 and the average annual death toll was just over 56, as compared to 64 deaths per year for the current research period. This may be a reflection of the differing data sources and availability, as discussed above.

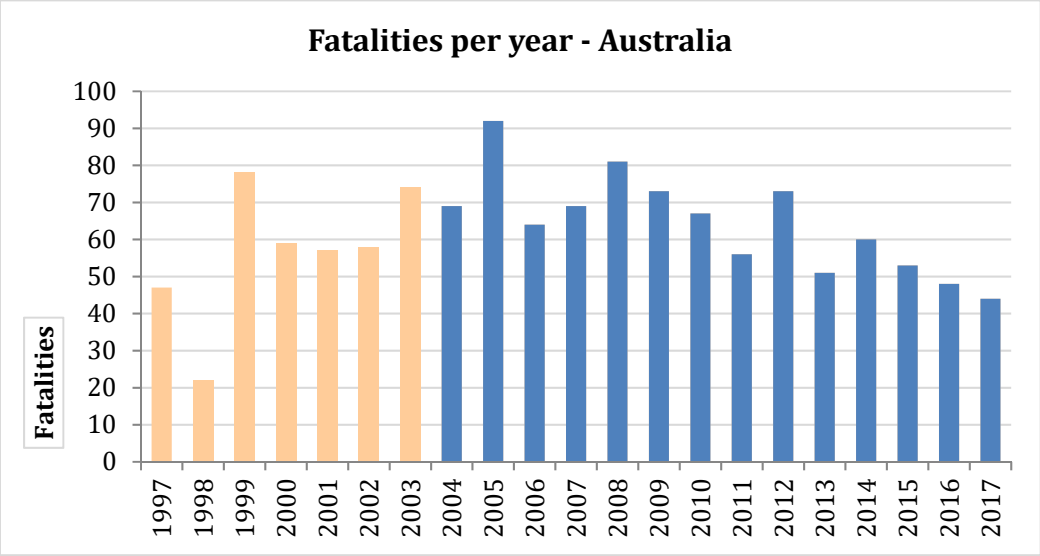

FIGURE 4: TOTAL FATALITIES ACROSS AUSTRALIA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

3: THE COLUMNS SHADED ORANGE/ PINK ARE FROM THE AFAC 2005 STUDY AND REPRESENT A LOWER BOUND OF DEATHS AS DATA FROM NT IS MISSING FROM THE RECORD, AND THERE ARE SOME YEARS OF MISSING DATA FROM SOME JURISDICTIONS.

Similar charts for each jurisdiction are located in Appendix 5. Accounting for the caveats outlined in the notes for Figure 4, there is no particular trend visible.

Fatality rates

Fatality rates are reported per 100,000 of the background population. This method enables the comparison of fatalities over time and across jurisdictions. The Northern Territory has the highest fatality rate (0.54 deaths per 100,000 population), closely followed by Tasmania (0.47). South Australia (0.34) and Victoria (0.33) are also just above the national average of 0.29 (Figure 5).

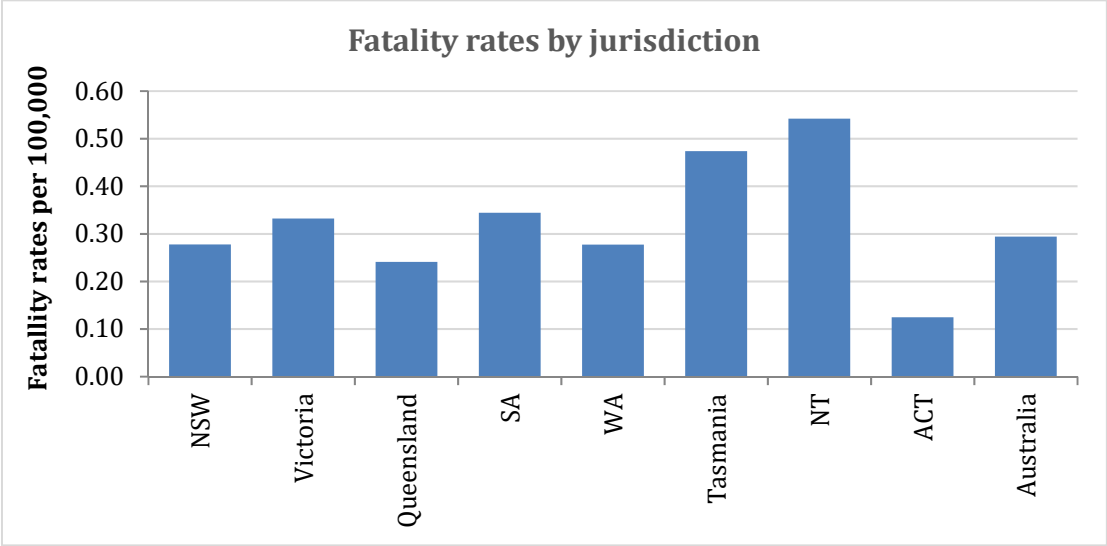

FIGURE 5: FATALITY RATES BY JURISDICTION, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY 2004 TO 2017) OF RECORD.

2. REFER TO METHODS SECTION, *DATA ANALYSIS*, FOR FATALITY RATE CALCULATION.

Figure 6 depicts the fatality rate per 100,000 for the whole of Australia. In addition, the data from the AFAC (2005) study from FY 1997 to 2003 have been included to show an indicative trend over a longer period of time (noting that: in AFAC (2005), data was not available for some years and jurisdictions and the methodology was significantly different to the current study).

There is no particular trend visible in the entirety of the data (FY 1997-2017) and a slight downward trend for FY 2004-2017.

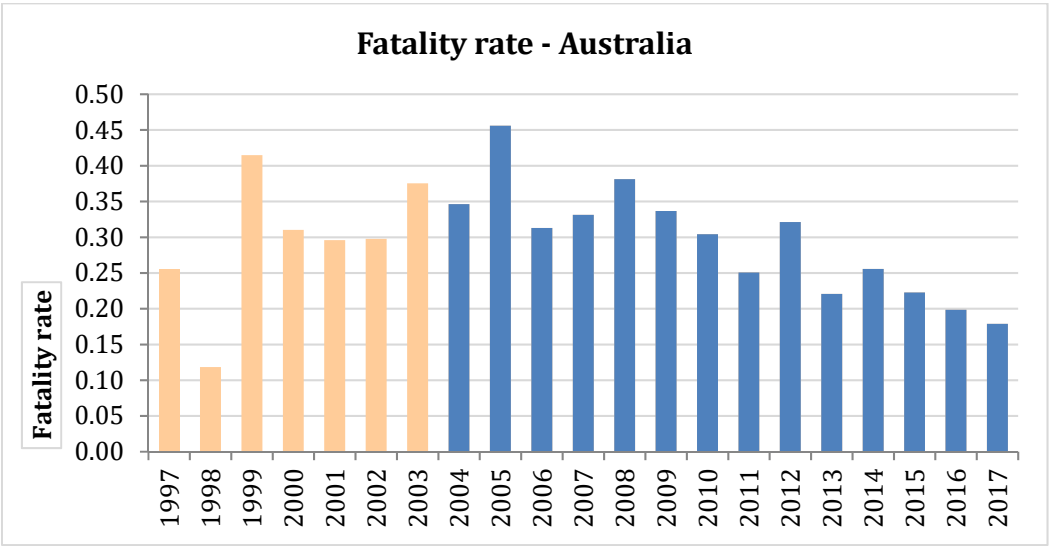

FIGURE 6: FATALITY RATE PER 100,000 POPULATION FOR AUSTRALIA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

3: THE COLUMNS SHADED ORANGE/ PINK ARE FROM THE AFAC 2005 STUDY AND REPRESENT A LOWER BOUND OF DEATHS AS DATA FROM NT IS MISSING FROM THE RECORD, AND THERE ARE SOME YEARS OF MISSING DATA FROM SOME JURISDICTIONS.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

Table 7 shows the fatality rates per 100,000 population for Australia and each jurisdiction. This is the number of fatalities seen in relation to the estimated population of each jurisdiction in each year. In Table 6, those figures coloured red sit above the national average for that year.

Australia saw its highest fatality rate in FY 2005: 0.46 per 100,000 population. This was a year where several jurisdictions had relatively high fatality rates. The lowest fatality rate for Australia as a whole (where data is considered complete) was 0.20 in FY 2016, followed by 0.22 in FY2013 and FY 2015.

State	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NSW	0.33	0.54	0.43	0.18	0.27	0.26	0.28	0.22	0.31	0.26	0.25	0.21	0.19	0.15
VIC	0.22	0.56	0.26	0.39	0.57	0.37	0.42	0.31	0.32	0.24	0.34	0.28	0.21	0.16
QLD	0.26	0.28	0.20	0.27	0.33	0.42	0.23	0.16	0.46	0.11	0.15	0.21	0.19	0.12
SA	0.46	0.26	0.39	0.83	0.44	0.12	0.18	0.30	0.30	0.36	0.36	0.18	0.29	0.35
WA	0.30	0.30	0.29	0.43	0.28	0.36	0.39	0.34	0.21	0.24	0.28	0.08	0.08	0.31
TAS	2.28	0.62	0.00	0.20	0.60	0.99	0.39	0.39	0.20	0.00	0.00	0.39	0.19	0.38
NT	0.49	1.46	0.00	1.40	0.91	0.44	0.00	0.43	0.00	0.00	0.41	1.23	0.81	0.00
ACT	0.30	0.30	0.60	0.00	0.00	0.28	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00
Australia	0.35	0.46	0.31	0.33	0.38	0.34	0.30	0.25	0.32	0.22	0.26	0.22	0.20	0.18

TABLE 7: FATALITY RATES BY AUSTRALIAN JURISDICTION, FY 2004 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 2004 IS THE FY 1 JULY 2003 TO 30 JUNE 2004) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: ABS POPULATION ESTIMATES FOR EACH YEAR WERE USED TO DETERMINE THE FATALITY RATES

3. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS FROM FY 2017 IN THE FOLLOWING PROPORTIONS:23% FOR AUSTRALIA AND, FOR NSW: 18%, VIC: 55%, QLD: 10%, SA: 6%, WA: 5%, TAS: 18%, NT: 6% AND ACT: 11%. TABLES A1-3 & A1-4 IN APPENDIX 1 GIVE THE FIGURES FOR FY 2015 & 2016.

4: IN ONE CASE THE JURISDICTION WAS UNKNOWN: THEREFORE, THE TOTAL KNOWN CASES DISPLAYED IS 899 RATHER THAN 900.

Multiple fatality fires

Table 8 shows the numbers of deaths associated with each fire event. Most fatalities (83.7%, n=753) occurred in single fatality fire events. There were two events where 5 or more people were killed. There were also seven 4-fatality events and seven 3-fatality events.

Number killed in the fire	Number of fire incidents	Total deaths	% of deaths
1	753	753	83.7%
2	41	82	9.1%
3	7	21	2.3%
4	7	28	3.1%
>4	2	16	1.8%

TABLE 8: MULTIPLE-FATALITY INCIDENTS, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015

CASE STUDY 2

Queensland, 2011

The 2011 Slacks Creek House Fire caused the greatest loss of life in a single residential fire in Australian history. Two families lived in the two-storey residence. At the time of the fire there were 14 people at home and 11 people died; eight of them children under the age of 18.

The fire started just before midnight in an office on the ground floor of the property. Fire investigators suspected that a desk lamp may have caused the fire, but the exact cause was unable to be determined.

The first neighbour to call emergency services just after midnight estimated that the flames were across a third of the house and progressing quickly. An officer from the then Queensland Fire and Rescue Service (QFRS) stated that this was 'the most well-developed house fire I have attended since joining the QFRS and also in my 32-year career'.

Bedrooms in the residence were located upstairs and all of them were occupied at the time of the fire. Upon discovering the fire, one resident attempted to extinguish it, but did not alert sleeping residents to initiate an evacuation. There were two smoke alarms located in the upstairs section of the house but neither was working. The Coroner found that there was a reasonable prospect that some of the decedents upstairs could have escaped if they had been alerted more quickly, either by a smoke alarm or by a resident.

Discussion: *This case is a tragic illustration of the importance of working smoke alarms and home escape plans. It shows that residents need to understand how quickly residential fires can develop and the importance of rapid evacuation.*

As a result of this fire, the Queensland Government passed legislation specifying that by 2027 all Queensland dwellings will be required to have interconnected photoelectric smoke alarms in all bedrooms, in hallways that connect bedrooms with the rest of the dwelling and on every level.

Cause of death

The *cause of death* is determined by the Coroner. The cause of death categories align with what is recorded in the NCIS database.

Almost half (44.8%, n=398) of the 889 fatalities for which these data were known were due to smoke inhalation (including inhalation of carbon monoxide and other toxic gases from smoke or fire). The next highest category was burns, with 18.9% (n=168) of fatalities. However, this should be viewed in relation to deaths which occurred after the fire incident, due to medical complications arising from burns. There were another 12.1% (n=108) fatalities due to this cause, totaling 31.0% (n=276) deaths due to burns. A further 17.2% (n=153) of fatalities were caused by a combination of burns and smoke inhalation. The results are detailed in Figure 7.

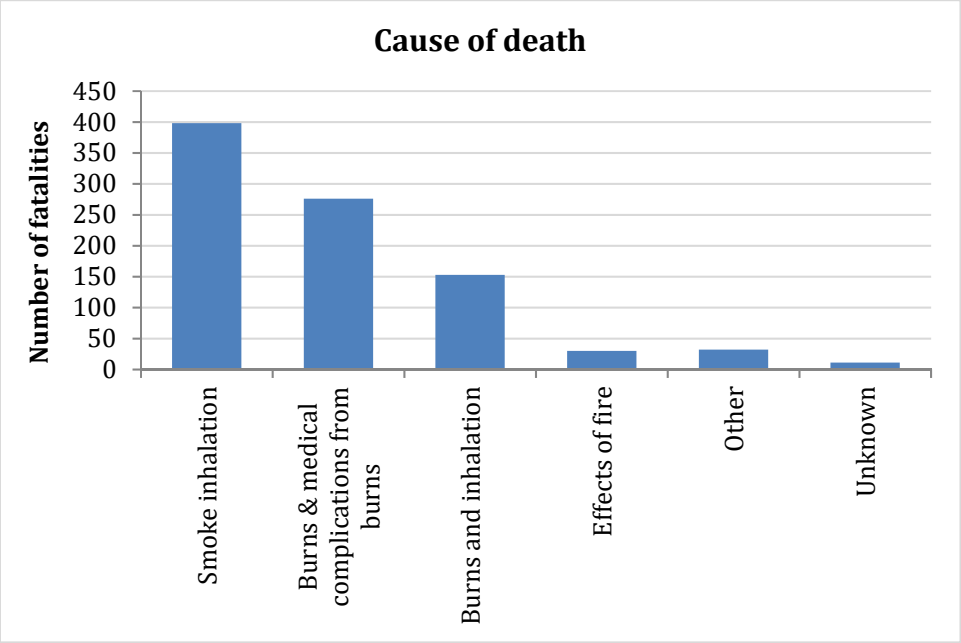

FIGURE 7: CAUSE OF DEATH, FY 2004 TO FY 2017

1. SMOKE INHALATION INCLUDES THE INHALATION OF CARBON MONOXIDE OR ANY OTHER TOXIC GASES FROM SMOKE OR FIRE.

2. BURNS & MEDICAL COMPLICATIONS FROM BURNS INCLUDES DEATH DUE TO BURNS, WHETHER IMMEDIATE OR AT ANY TIME AFTER THE FIRE INCIDENT DUE TO COMPLICATIONS ARISING FROM THE EFFECTS OF BURNS (E.G., FROM THE CLOSING DOWN OF BODILY SYSTEMS DUE TO THE EFFECTS OF BURNS).

3. BURNS AND INHALATION INDICATES CASES WHERE THE CORONER DID NOT OR COULD NOT DISTINGUISH BETWEEN SMOKE INHALATION AND BURNS AS THE PRIMARY CAUSE OF DEATH.

4. "EFFECTS OF FIRE" IS A TERM THAT WAS USED IN SOME CORONIAL AND AUTOPSY REPORTS AND, WHEN THE PRIMARY CAUSE COULD NOT BE DETERMINED BY THE DATA ENTRY TEAM OTHER THAN THAT IT WAS DIRECTLY CAUSED BY THE FIRE, THIS CATEGORY WAS USED.

5. "OTHER" INCLUDES CARDIAC ARREST, INJURY (CRUSH, FALL, ETC.) INDIRECTLY CAUSED BY THE FIRE.

The research team conducted analysis of fatality data relating to the 0-4, 5-19, 20-64 and 65+ age brackets. These age segmentations most closely correspond to how fire agencies have typically "segmented" fire safety interventions. The segmentations can be described as young children (and their families (0-4), school fire safety education (5-19), broad population (20-64) and older people (65+).

Figure 8 shows that 60% of deaths in the 0-4 age group are due to *smoke inhalation*, a greater percentage than any other age group. Both the 5-19 and 20-64 age groups show just under 50% of known fatalities due to *smoke inhalation*.

Conversely, there are a greater percentage of fatalities in the ≥65 age group due to *burns and medical complications from burns* – 38% compared to 36% for *smoke inhalation*.

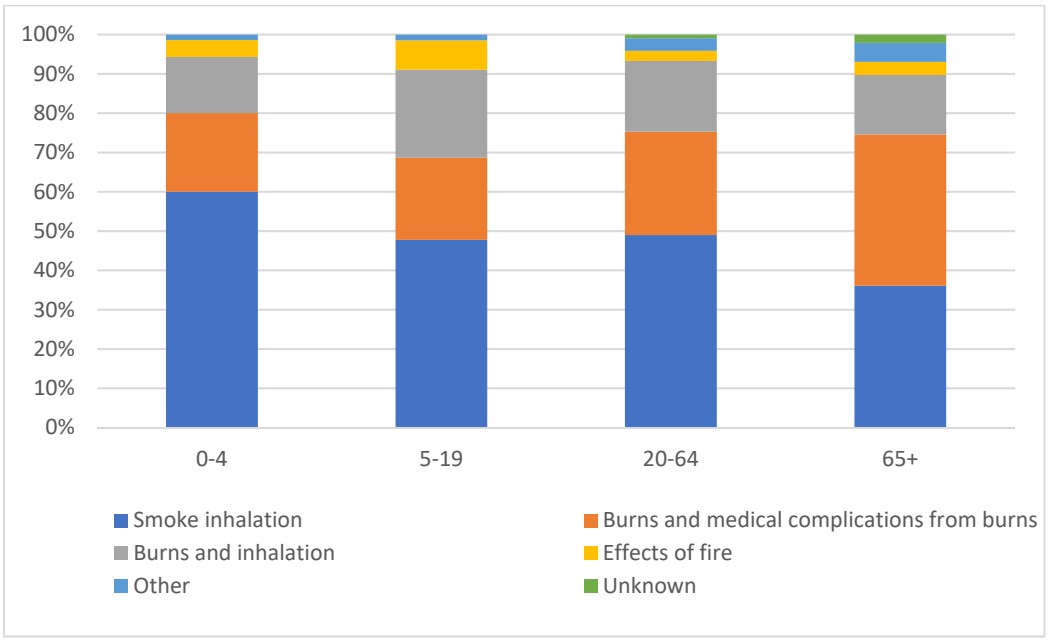

FIGURE 8: CAUSE OF DEATH *VS* AGE COHORTS, FY 2004 TO FY 2017

Time of death after fire incident

Data was collected on the year and month of fire incident and death. Data was not collected on the day the death occurred, or on the number of days after the fire incident that the death occurred. In most cases (94.1%, n=847), the death occurred in the same month as the fire incident. In 5.9% of cases (n=53), death occurred one month or more after the fire incident. The cause of death in the majority of these cases was complications arising from burns. Table 9 illustrates the date of death relative to the date of incidence.

Death occurred…	Number of deaths	% of deaths
Same month as incident	847	94.1%
One month later	33	3.7%
Two months later	12	1.3%
Three months later	5	0.6%
Four to twelve months later	<5	N/A

TABLE 9: DATE OF DEATH RELATIVE TO DATE OF FIRE INCIDENT, FY 2004 TO FY 2017, AS TOTAL DEATHS AND PERCENTAGES

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

The time of death relative to the fire incident was analysed in relation to the age of the decedents, to try to understand if there is any link between age and ongoing intensive specialised medical treatment due to fire related burn injuries that subsequently result in death. Some 94% of decedents died in the same month as the fire incident. Of the 4% who died in the following month, the greatest number (21.2%, n=7) came from both the 65-69 and the 80-84 age groups, with most of the remainder spread across the 40-44 to 85-89-year groups.

A similar pattern holds when the total of deaths that occurred during the one to twelve months after the fire incident are considered. The age groups with the most fatalities were 65-69 (15%, n=10) and 80-84 (14%, n=8), with a fairly even spread from the 30-34 to the 85-89 age groups.

FIRE INCIDENT DETAILS

Cause of fire

For a third of the cases (33.8%, n=304), the cause of the fire was not known. For those cases that were known, over a quarter of deaths (26.7%, n=161) were caused by *smoking materials*, with just over a third of those (34.8%, n=56) occurring whilst in bed. A *lighter/ matches* were involved in a further 12.1% (n=73) of cases. The next most common cause was a *heater or similar* (11.9%, n=72), followed by an *electrical fault* (10.9%, n=66). The full results are shown in Figure 9.

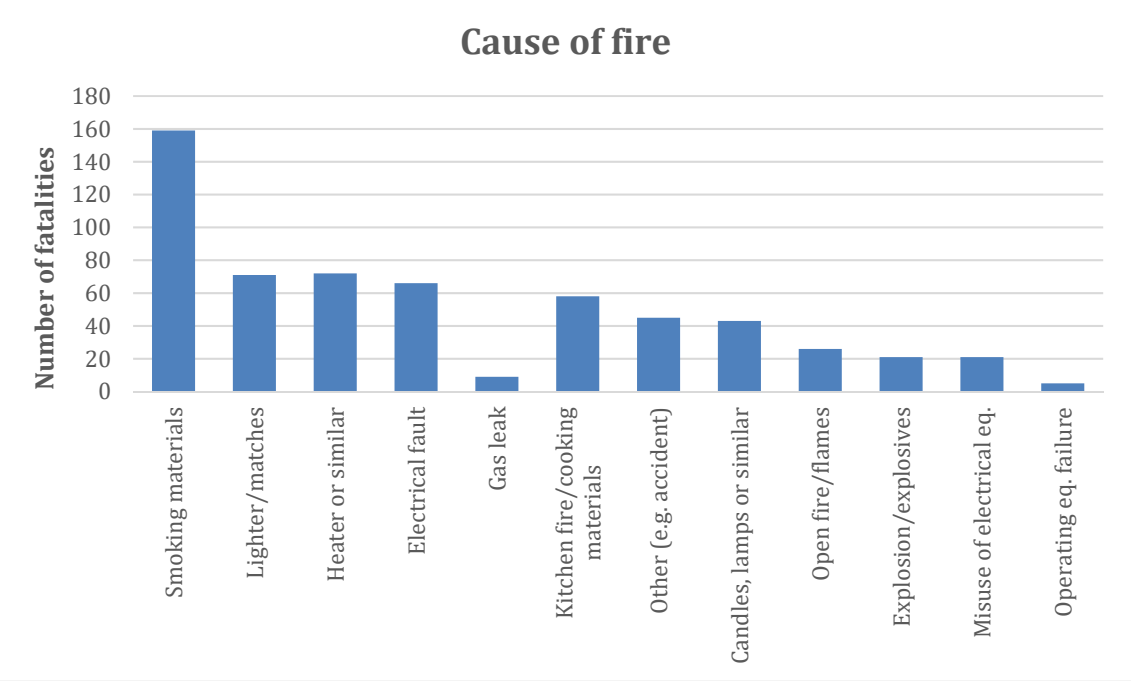

FIGURE 9: CAUSE OF FIRE, FY 2004 TO FY 2017

1. THE "OPERATING EQ. FAILURE" CATEGORY INCLUDES THE INCORRECT USE OF EQUIPMENT.
2. THE UNKNOWNS HAVE BEEN OMITTED FOR GREATER CLARITY.

To determine whether any of these trends have changed over time, the five most common fire causes were analysed in terms of year of fire occurrence.

There was a definite downward trend for the cause of fatal fires being *heater or similar* and, to a lesser extent, *kitchen fire/ cooking materials*, *electrical faults* and *lighter/ matches*. There is no particular trend apparent for *smoking materials* when looking at the full period of record but there is a downward trend from 2008 onwards.

Analysis of the causation data using contingency table testing was conducted (see Method section, p.30). This analysis showed that cause of fire was highly significantly related to *time of day*.

Time of day had a highly significant (0.5%) relationship with the following fire causes:

- *Cigarette or similar* (including smoking in bed) – less people than expected died between 12am-4am and more than expected died between 4-8am and 8pm-12am
- *Electrical fault* – more people than expected died between 12am-4am, and less than expected died between 4-8pm
- *Misuse of electrical equipment* – more people than expected died between 12am-4am
- *Kitchen fire/ cooking materials* – less people than expected died between 12am-4am and more than expected died between 4-8am and 4-8pm
- *Candles, lamp or similar* – more people than expected died between 8pm-12am
- *Lighter/ matches* – less people than expected died between 12am-4am and 8pm-12am and more than expected died between 12-4pm.

Gender was analysed against cause of fire. Males were over-represented in fatalities where the cause was a *gas leak* (100% of fatalities were males), *explosion/ explosives* (85.7%), *other (e.g., accident)* (82.2%), *operating equipment failure* (80.0%) and *smoking materials* (73.1%).

Females were over-represented in fatalities where the cause was *candles, lamp or similar* (51.2% of fatalities were females), *electrical fault* (45.5%), *lighter/ matches* (43.7%) and *misuse of electrical equipment* (42.9%).

Analysis using contingency table testing showed that cause of fire was highly significantly (0.5%) related to whether the decedent was a *smoker* or not. Significantly more smokers than expected died in fires caused by *cigarette or similar* and by *cigarette or similar and smoking in bed*. Conversely, significantly less non-smokers than expected died in fires caused by *cigarette or similar* and by *cigarette or similar and smoking in bed*, and significantly more than expected died in fires caused by *lighter/ matches*, by *candles, lamp or similar* or by *other (e.g., accident)*.

Severity of fire

There were a large number of unknowns in this category: n=207, or 23.0% of the sample. Of the remainder, the largest number of people (36.1%, n=250) were killed in fires that burnt at least one room.

The next largest number of people (22.4%, n=155) were killed in fires that destroyed the entire residence, followed by 19.9% (n=138) in fires after which major repairs were required. The full results are shown in Figure 10.

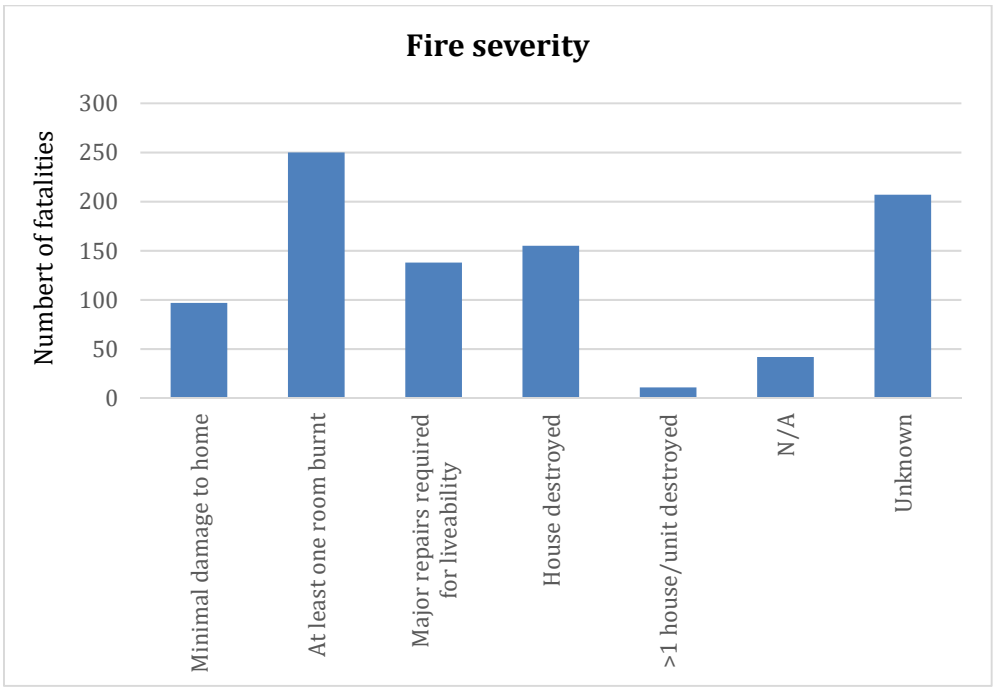

FIGURE 10: FIRE SEVERITY, FY 2004 TO FY 2017

1: N/A WAS USED IF, FOR EXAMPLE, DECEDENT'S CLOTHING CAUGHT FIRE, OR DECEDENT WAS OUTSIDE HOUSE, ETC, AND THUS NO PART OF THE HOUSE WAS BURNT.

The severity of the fire was compared to the cause of the fire. Table 10 shows that, of the known and applicable cases (49.7%, n=447), most causes of fire had the potential to destroy the entire house. However, in most of the different causes of fire, large numbers of people were killed in fires that did not require major repairs or destroy the entire residence. An exception to this was the *misuse of electrical equipment*, where the greatest number of deaths occurred when major repairs were required. In the case of *explosion/ explosives*, more than one house was destroyed in several cases. In the case of *smoking materials*, a relatively large number of decedents died where minimal damage to the home had been incurred (25.4%, n=30 for minimal damage; 40.7%, n=48 for at least one room damaged). The subset of those who had been smoking in bed was very similar in terms of percentages (25.5%, n=12 for minimal damage; 36.2%, n=17 for at least one room damaged).

Location of incident	Min damage to home	At least 1 room burnt	Major repairs reqd for liveability	House destroyed	>1 house destroyed	Total
Heater or similar	9	24	8	12	0	**53**
Open fire/ flames	8	<5	<5	5	0	**18**
Smoking materials	30	48	22	16	<5	**118**
Electrical fault	<5	24	17	13	0	**57**
Operating equipment failure	0	<5	0	<5	0	**<5**
Misuse of electrical equipment	0	5	8	5	0	**18**
Explosion/ explosives	<5	7	<5	<5	<5	**14**
Kitchen fire/ cooking materials	15	13	11	6	0	**45**
Candles, lamp or similar	<5	18	5	7	<5	**33**
Other (e.g., accident)	13	7	5	<5	0	**29**
Lighter/ matches	5	25	14	6	0	**50**
Gas leak	<5	<5	<5	0	0	**8**
Total	**88**	**180**	**96**	**76**	**7**	**447**

TABLE 10: FIRE SEVERITY VS CAUSE OF FIRE, FY 2004 TO FY 2017

1: "OPERATING EQUIPMENT FAILURE" WAS USED IF, FOR EXAMPLE, SOMEONE WAS INCORRECTLY USING THE EQUIPMENT.

2. ONLY THOSE CASES KNOWN AND RELEVANT HAVE BEEN INCLUDED IN THE TABLE.

Location of ignition point

In almost a quarter of cases (24.3%, n=219), the location of ignition point was unknown. Of the known cases, the most common location of ignition point was the *living room/ lounge* (28.0%, n=202) and the *bedroom* (27.0%, n=195) (Figure 11). The next most common location was the *kitchen* (13.6%, n=98). The *other* category (16.6%, n=120) included cases where the ignition point was outside the house (apart from in a garage or shed).

The location of ignition point was a field where multiple responses were possible, so there were 722 responses from known 681 cases. Of the 39 cases with multiple responses, two had three responses and 37 had two responses. The most common of the latter were *room below the decedent's room* plus *other* (13 cases) and then *bedroom* plus *living room/ lounge* (four cases) and *kitchen* plus *living room/ lounge* (two cases).

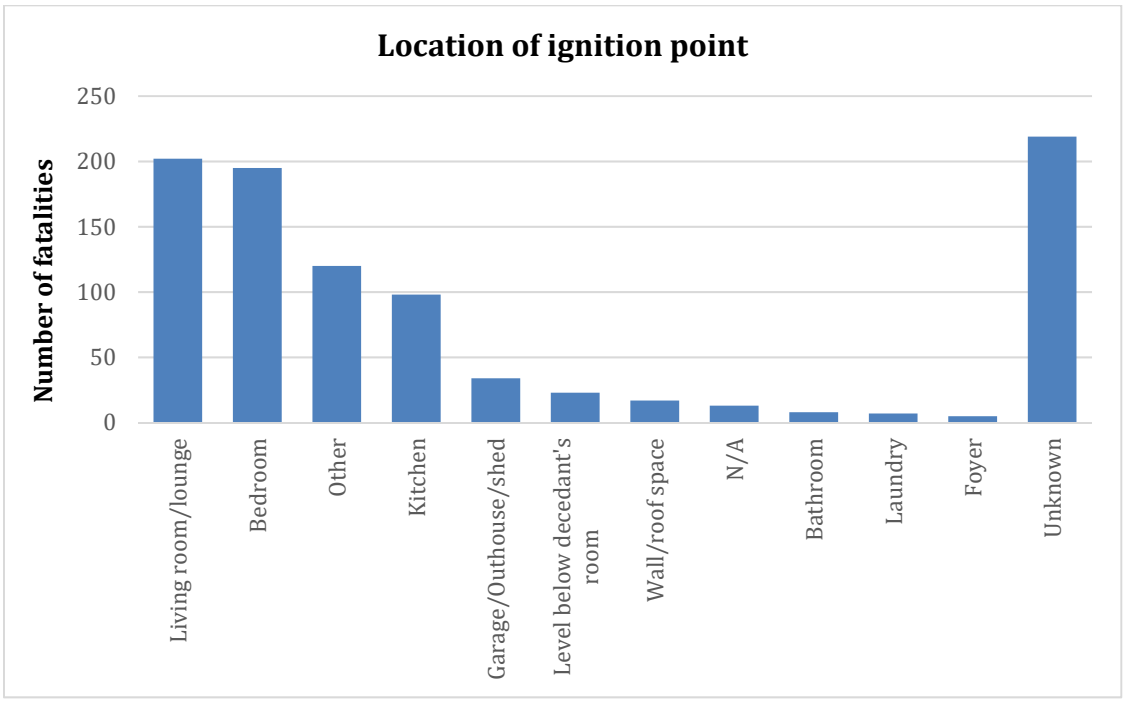

FIGURE 11: LOCATION OF IGNITION POINT, FY 2004 TO FY 2017

Time of day

Information on time of day (to the exact hour) of the fire incident was not known for almost a quarter (24.7%, n=222) of cases. For the remaining 678 cases, Figure 12 shows that fires that occurred from 24:00 to 00:59 hours – that is, between midnight and 1am – were more frequent (10.6%, n=72) than those in any other hour in the day. The next most common times of day were the hours directly following that – i.e., from 1am to 5am.

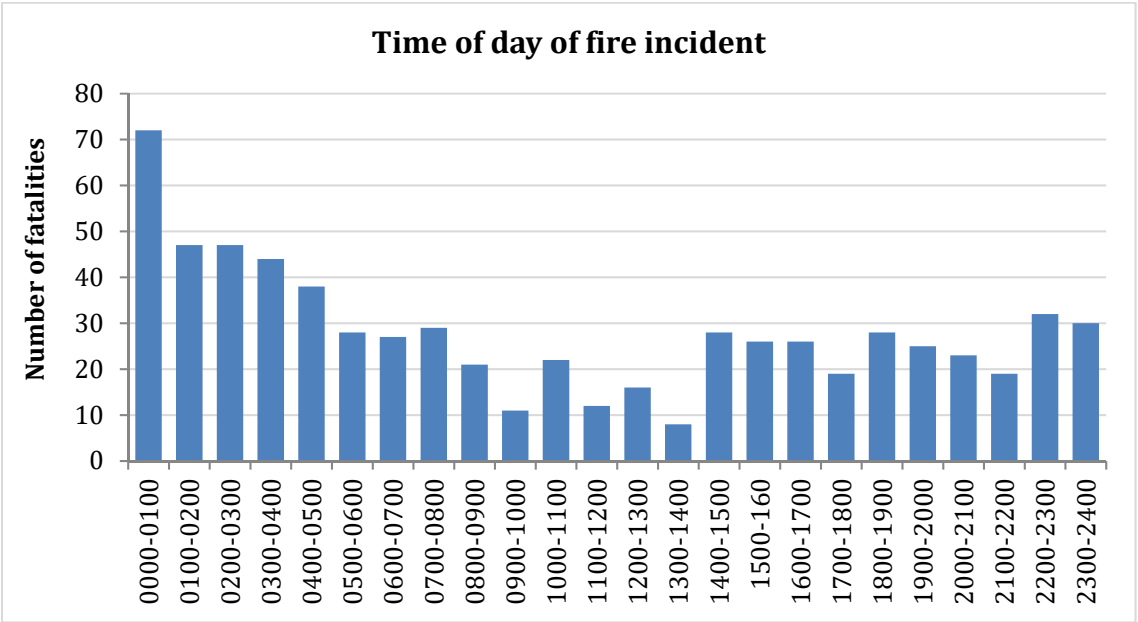

FIGURE 12: TIME OF DAY OF FIRE INCIDENT, FY 2004 TO FY 2017

1. NOTE: THERE WERE 226 (24.7%) UNKNOWNS WHICH HAVE BEEN OMITTED FROM THIS FIGURE FOR GREATER CLARITY.

Month of incident

The month of incident was known for 899 out of 900 cases. As Figure 13 shows, the most common month for fatal fires was August (13.9%, n=124) followed by July (12.1%, n=109).

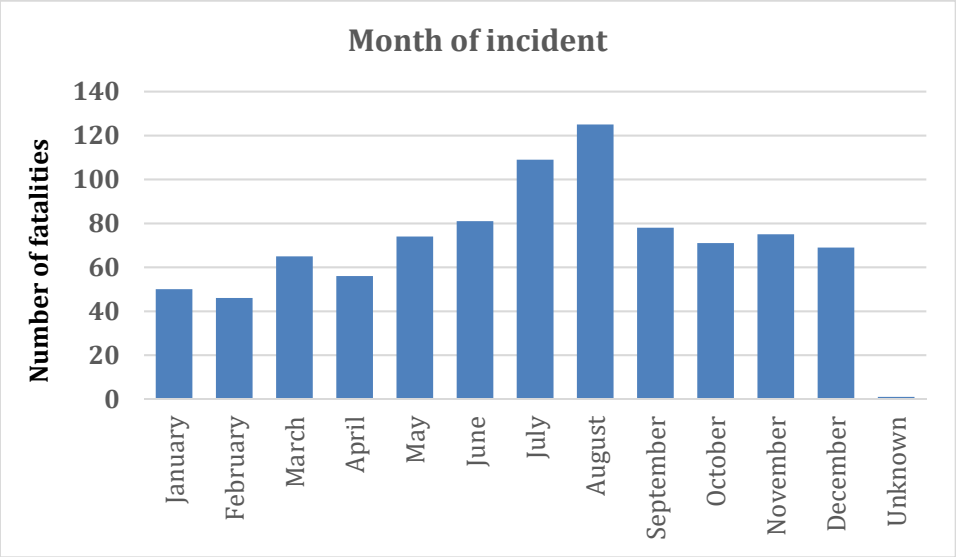

FIGURE 13: MONTH OF FIRE INCIDENT, FY 2004-FY 2017

A separate analysis was run testing the significance of the *month of fire incident* to the *cause of fire*. It resulted in high significance (<0.1%), in that more than expected died from fires caused by heaters/ fires in May-June and July-August, and less than expected in January-April and November-December.

Location of fatal incidents

The locations of the fire incidents are shown on Figure 14. Where point locations appear uniquely – that is, not in association with any other fatal incidents – these have been shifted slightly to ensure no cases can be identified from the map. The greatest concentration of point localities occurs around the capital cities of Victoria, New South Wales, Queensland, South Australia and Western Australia.

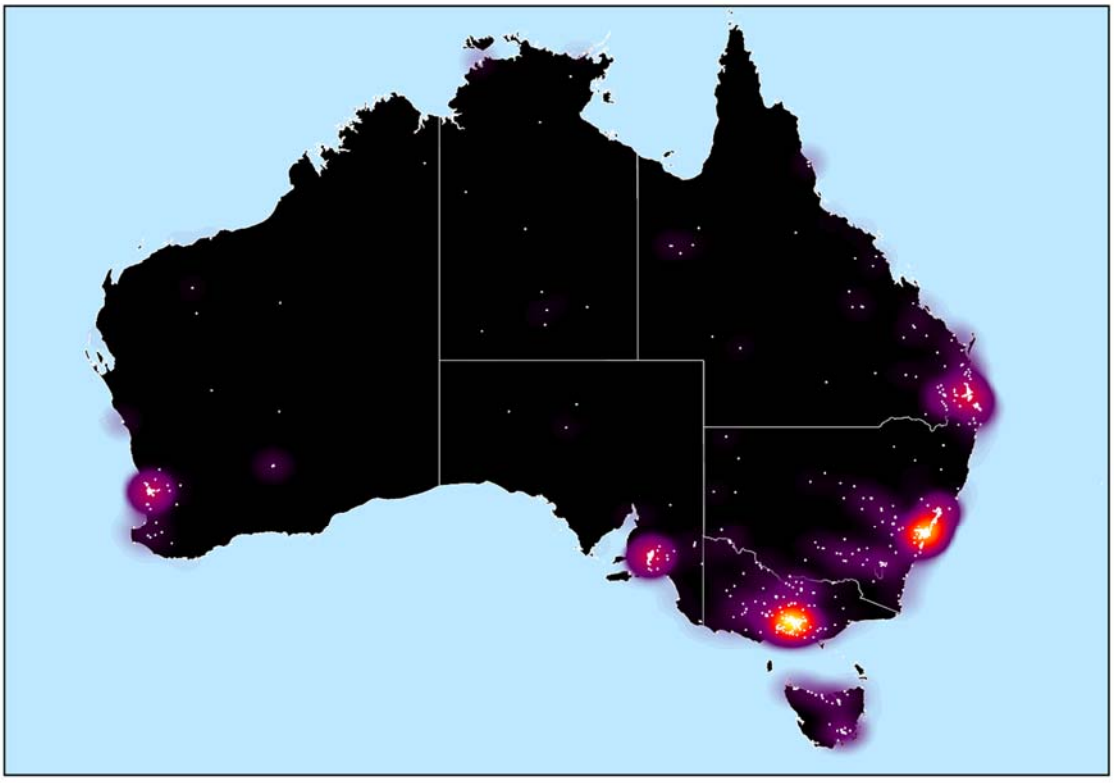

FIGURE 14: FIRE INCIDENT LOCATIONS, FY 2004 TO FY 2017

1. THE DOT POINTS OCCURRING UNIQUELY (REMOTE FROM ANY OTHER POINTS) HAVE BEEN SHIFTED SLIGHTLY; THE "HEAT MAP" AREAS SHOW THE "INTENSITY" OF THE NUMBER OF POINTS AT LOCATIONS.

Remoteness of fatal incidents

The Remoteness Area structure (RA), from the Australian Statistical Geography Standard, was used to determine whether the fire incident occurred in an urban or a rural location (ABS, 2016b; ABS, 2018a). RAs are based on the Accessibility/ Remoteness Index of Australia, an index based on the measurement of road distances to service centres. Refer to Appendix 2 (Coding tables) and table A2-8 for further information on RA.

Over half (55.1%; n=493) of the deaths for which the RA was known occurred in major cities, as shown in Table 11.

Location of incident	Number of deaths	% of deaths
Major cities	493	55.1%
Inner regional areas	209	23.4%
Outer regional areas	143	16.0%
Remote areas	29	3.2%
Very remote areas	20	2.2%
No usual address	<5	N/A
Unknown	5	

TABLE 11: FATALITIES BY REMOTENESS OF LOCATION, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

These figures were converted into fatality rates per 100,000 by applying the background population RA statistics from the ABS. Figure 15 shows that those decedents from remote and very remote areas of Australia are over-represented. That is, these populations have a higher risk of dying in a preventable residential fire.

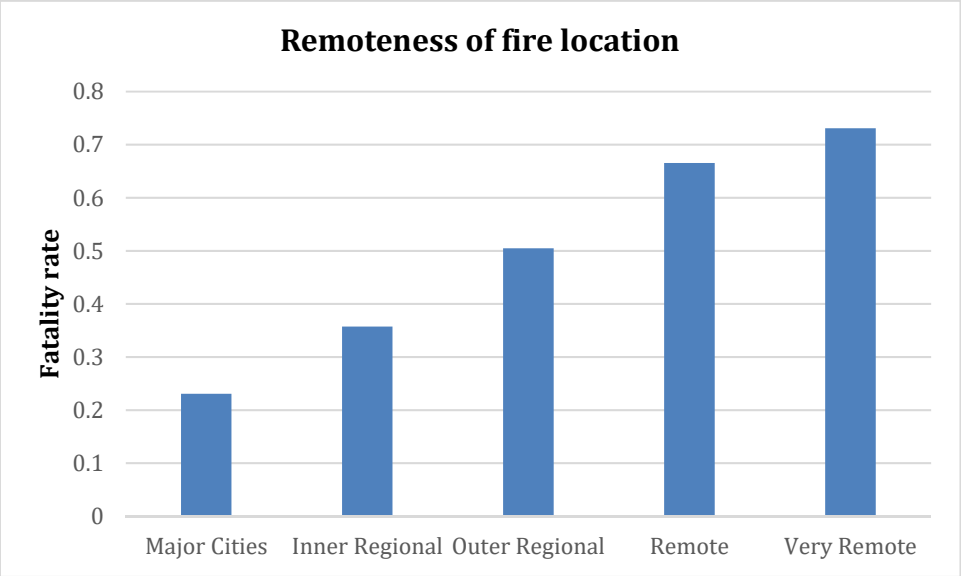

FIGURE 15: FATALITY RATES PER 100,000 POPULATION BY REMOTENESS OF FIRE INCIDENT, FY 2004 TO FY 2017

1. THE UNKNOWNS AND THOSE WITH NO USUAL ADDRESS HAVE NOT BEEN INCLUDED FOR GREATER CLARITY: THUS THE TOTAL IN THIS FIGURE IS 894.

2: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Intent

In the database, three fields were used to determine whether the death was unintentional or not, while ensuring that each case entered still conformed to the parameters described in the Methods section (Definitions/ inclusion criteria, pp.24-26) earlier, as a preventable residential fire death.

1. Intent to self-harm: this information was not known for 53 out of 900 cases. It was determined that, in 1.5% of known cases (n=13), there was an intent to self-harm.
2. Intent to set the fire: this information was not known for 55 out of 900 cases. It was determined that, in 2.7% of known cases (n=23), there was an intent to set the fire.
3. Victim of intentional act: information was not known for 18 out of 900 cases. It was determined that, in 0.6% of known cases (n=5), there was an intent by a person other than the decedent to set the fire.

Behaviour: stayed inside or left residence

Whether the decedent had safely left the residence but had then returned was not known for 139 out of 900 cases. In the majority of cases (83.2%, n=633), the decedent had *stayed inside residence*, in 2.1% of cases (n=16) the decedent had *safely left residence but then returned*. This was further analysed against age, However, no trends were apparent.

Behaviour: response to the incident

Information on the decedent's response to the fire incident was not known for 31.9% (n=287) of cases. In almost half (48.8%, n=299) of the remaining 614 cases, the decedent had taken *no/ limited action*, in 19.9% (n=122) of cases the decedent had *attempted to escape* and in 9.5% (n=58) of cases the decedent had *possibly attempted to escape* (Figure 16). In 7.0% (n=43) of cases, the decedent had *attempted to fight the fire*.

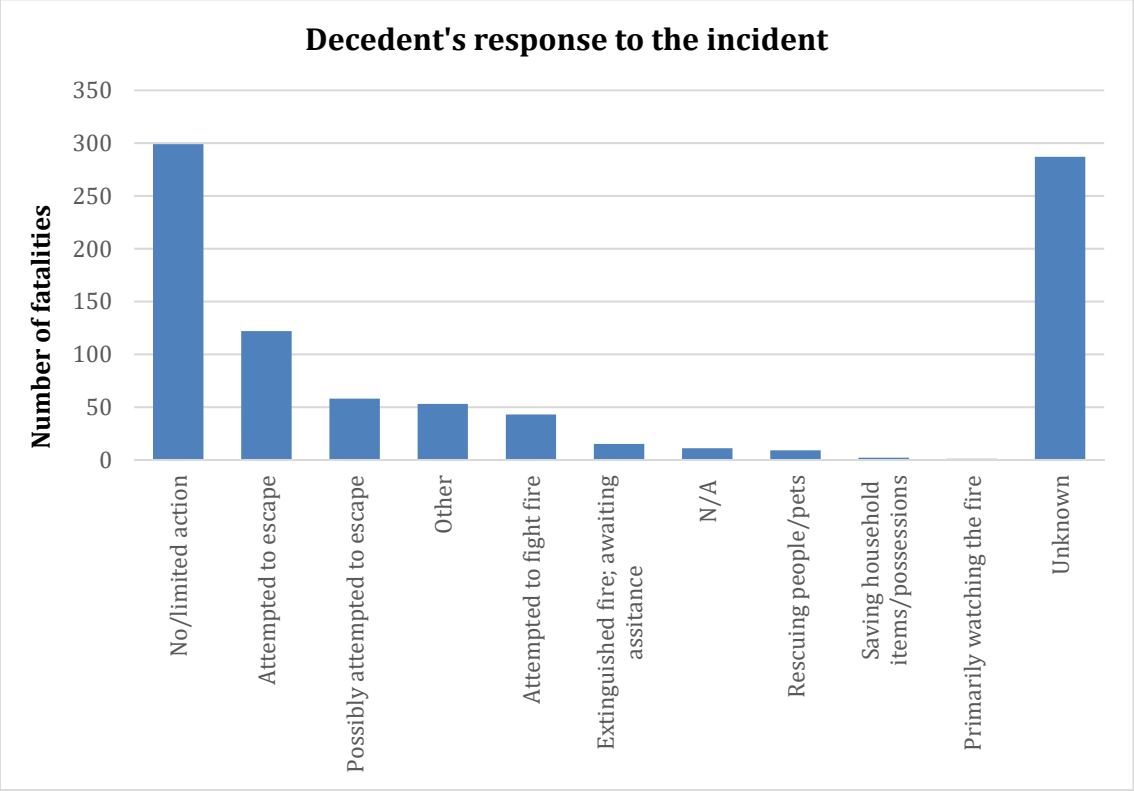

FIGURE 16: FATALITIES BY DECEDENT RESPONSE, FY 2004 TO FY2017
1: "PRIMARILY WATCHING THE FIRE" DOES NOT INCLUDE WATCHING WHILST WAITING FOR RESCUE ETC.

CASE STUDY 3

Victoria, 2014

Mr A was 24 years old. He arrived in Australia in 2001 on a refugee visa and settled in Melbourne in 2014 in a two bedroom public housing unit occupied by his sister and her children. Mr A's sister had constructed a gazebo in a common garden area shared with another unit. Mr A used this as his bedroom. Several complaints were made to the public housing authority regarding the gazebo but Mr A's sister advised the agency that the gazebo was only used for storage.

On the eve of the fire, the decedent had been drinking with his friend since approximately 4:30 pm. His friend went to sleep earlier that night. His sister last saw Mr A at 3 am, when he was awake but intoxicated. At 4 am Mr A's friend and sister awoke discovering the gazebo on fire. Mr A's body was located by firefighters in the fire affected area.

Fire investigators concluded that the fire started due to a lit cigarette making contact with a couch inside the gazebo. The fire spread very quickly to the remainder of the contents due to the abundance of highly flammable material. The extent of Mr Sulieman's intoxication was found to have prevented him from waking during the fire.

Discussion: *This case highlights the combined risk associated with alcohol and smoking. It also provides an example of a fatality that occurred in makeshift accommodation that did not have fire protection measures such as a smoke alarm.*

THE RESIDENCE

Type of residential structure

The type of residential structure in which the fire incident occurred was unknown in only six (0.7%) cases. The majority of residential structures in which a fatal fire occurred were *free-standing houses/ villas* (67.1%, n=600). The next most common structure were low-rise *units/ apartments* (17.0%, n=152). Five or less fatalities occurred in high-rise (over 25m high) *units/ apartments*, *other residential facility (e.g., dormitory)* and *tents*.

Property tenure

In most cases, the property tenure was unknown (57.7%, n=519). For the majority of known cases it was *owner occupied* (53.0%, n=202), then *private rental* (18.1%, n=69) and *supported accommodation* (10.5%, n=40). *Transient visitors* made up (7.6%, n=29) of cases, and *social housing* (5.8%, n=22), with smaller numbers for other categories including squatting, short-term commercial/ residential (e.g., Airbnb) and other.

CASE STUDY 4

New South Wales, 2012

Ms B was a 21 year-old university student, who died when she fell several metres from the window ledge of her fifth floor apartment after she became trapped by a fire that was furiously burning. Her friend, who had also been trapped in the apartment by the fire, also fell but survived with terrible injuries.

The Coroner found that the fire was likely to have been ignited by a cigarette discarded by one of Ms B's housemates on the balcony of the apartment. Upon discovering the fire, the housemate first attempted to douse it, but was driven back by the smoke and flames. He exited the apartment leaving both the balcony door and the apartment door open. Leaving the doors open, combined with the windy conditions and the design of the building, created a wind tunnel effect that led to the fire rapidly reaching flashover within the apartment. Ms B and her friend became trapped in a bedroom and they either jumped or fell from the bedroom window while attempting to escape the fire.

The Coroner found that there were significant fire safety issues in the design of the apartment building and with its fire safety systems. For example, the Coroner found that the building contained an "atrium" which did not comply with fire safety measures set out in the building code. The building also arguably had an effective height of over 25 metres, but did not have sprinklers. The Coroner found that on the part of the building developer and other interested parties, there was a culture of compliance rather than on reducing risk with regard to fire safety.

Discussion: *This case illustrates a potentially emerging risk in the form of fire fatalities in residential apartment buildings that have inadequate fire protection measures. The Coroner made a number of recommendations directed towards the New South Wales Government and the Australian Building Codes Board (amongst others) to amend and improve fire safety legislation and regulation in apartment buildings.*

Relationship between residents

There were 139 cases (15.4% of the total) for which no information was available on this field. Of the remaining cases, the largest number lived *alone* (44.5%, n= 339). Another 32.1% (n=244) lived *with other family* and 14.7% (n=112) lived *with partner*. Figure 17 illustrates this.

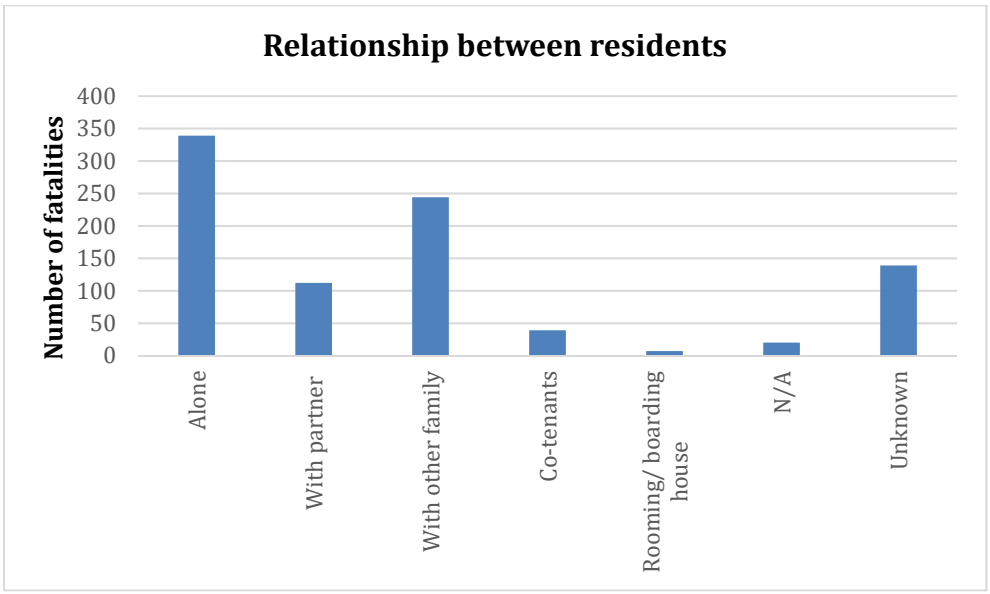

FIGURE 17: FATALITIES BY RELATIONSHIP BETWEEN RESIDENTS, FY 2004 TO FY 2017

1: "WITH PARTNER" REFERS TO THE DECEDENT LIVING SOLELY WITH THEIR PARTNER, "WITH OTHER FAMILY" REFERS TO THE DECEDENT LIVING EITHER WITH A MEMBER OR MEMBERS OF THEIR FAMILY NOT THEIR PARTNER, OR WITH A COMBINATION OF PARTNER PLUS ONE OR MORE OTHER FAMILY MEMBERS.

2: A "BOARDING HOUSE" OR ROOMING HOUSE IS WHERE THE OCCUPANTS DO NOT KNOW EACH OTHER (AS OPPOSED TO A "SHARED HOUSE").

Smoke alarms

Data was collected from coronial records about smoke alarms relating to three cascading questions: Was a smoke alarm present? Was the smoke alarm working? Was it a specialist smoke alarm?

In 65.9% (n=593) of cases, this information was not known. Of the remaining cases, *N/A* was chosen when a fire occurred in a location where it would not be reasonably expected that a smoke alarm would be located or activated such as where a fire occurred outside the residence. This was the case for a further 49 (16.0%) cases. Of the remaining 258 known cases, 69.0% (n=178) did have a smoke alarm present, 31.0% (n=80) did not (Figure 18).

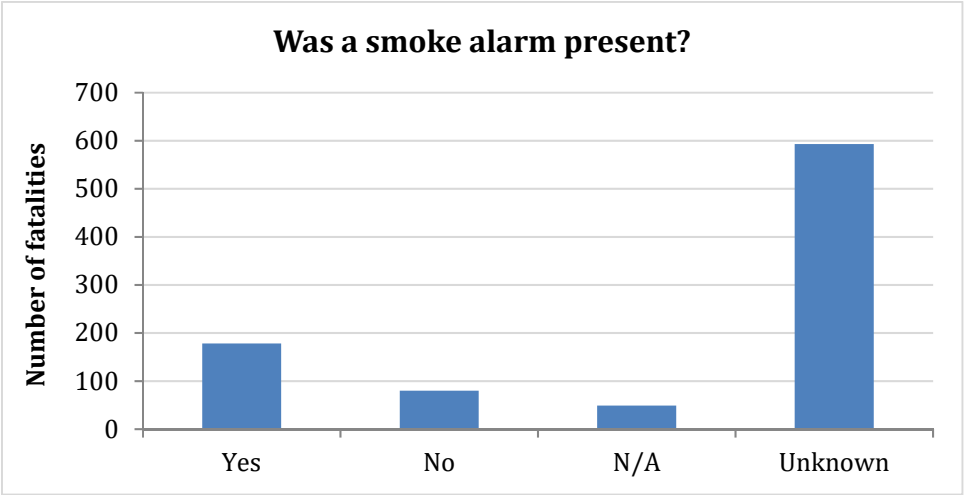

FIGURE 18: FATALITIES BY PRESENCE OF SMOKE ALARM, FY 2004 TO FY 2017

Whether the smoke alarm was working was not known in 66.4% (n=598) of cases. Of the remaining cases, *N/A* applied to a further 160 cases. Of the remaining 142 known cases, 73.2% (n=104) of cases did have a working smoke alarm, 26.8% (n=38) of cases did not (Figure 19).

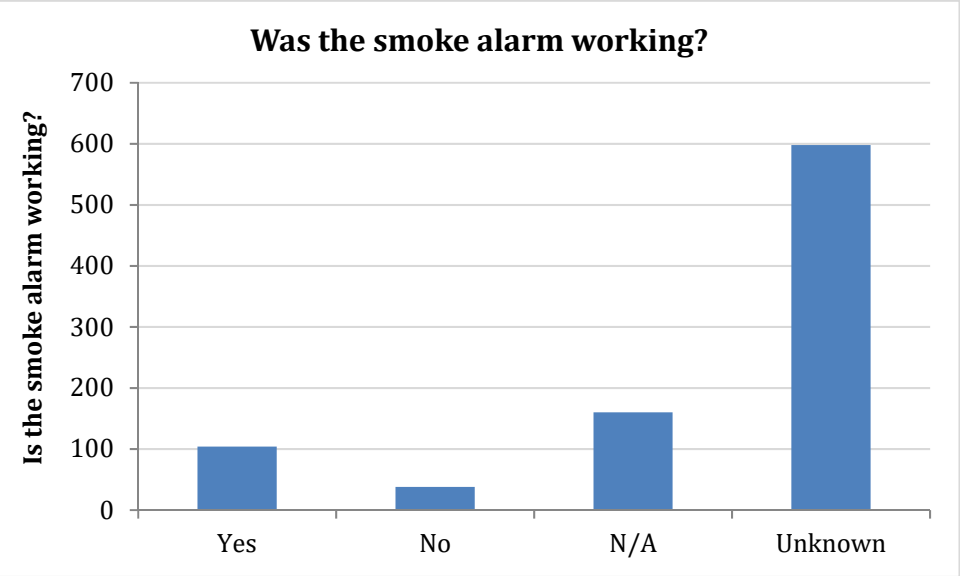

FIGURE 19: FATALITIES BY FUNCTIONALITY OF SMOKE ALARM, FY 2004 TO FY 2017

A test was run between "Smoke alarm present" and "Smoker?" to see if there was a relationship between those who smoke and the issue of no smoke alarm present. The test found no association between whether there was a smoke alarm present and whether the decedent was a smoker.

In 58.0% (n=522) of cases, whether a specialist smoke alarm was present and working or not was not known. Of the remaining cases, *N/A* applied to a further 340 cases. Of the remaining 38 known cases, there were no known cases of a specialist alarm being present and working, 100.0% (n=38) of cases did not have a specialist smoke alarm present.

THE PEOPLE

Gender

The majority of fatalities (64.3%, n=579) were males. Females made up 35.7% (n=321) of fatalities. The male:female ratio was 1.8 (i.e., 1.8 male fatalities for every female fatality).

Contingency table testing (see Method section, p.30) was used to analyse whether *gender* was related to a range of factors. The following relationships were found:

- *Relationship between residents* (significant (0.5%)). More than expected males lived alone and less lived with partner or with other family. Conversely, less than expected females lived alone and more lived with partner or with other family.

- *Toxicology* (highly significant (0.5%)). More than expected males and less than expected females had alcohol detected
- *Requires support to live at home* (highly significant (0.1%)). Less than expected males and more than expected females required support to live at home.

No significant relationship was found between gender and *cause of death*, *time of day*, *decedent's response*, *intent to self-harm*, *set fire* or *harm another person*, *presence of smoke alarm* or a *working smoke alarm*, *employment status*, *and decedent a smoker.*

Age

By 5 year age classes, the *0-4* year age group had the highest number of deaths (7.8%, n=70) followed by the *65-69* (7.4%, n=67) and *75-79* (7.4%, n=67) groups. Each age group from *40-44* through to *85-89* had more than 50 deaths.

Figure 20 illustrates the fatality rate in five year age brackets (up to ages >74). This shows that compared to the average (shown as "all ages" in the figure), the 0-4 age group and all ages ≥65 are over-represented. Age groups from 45-64 are just above the average.

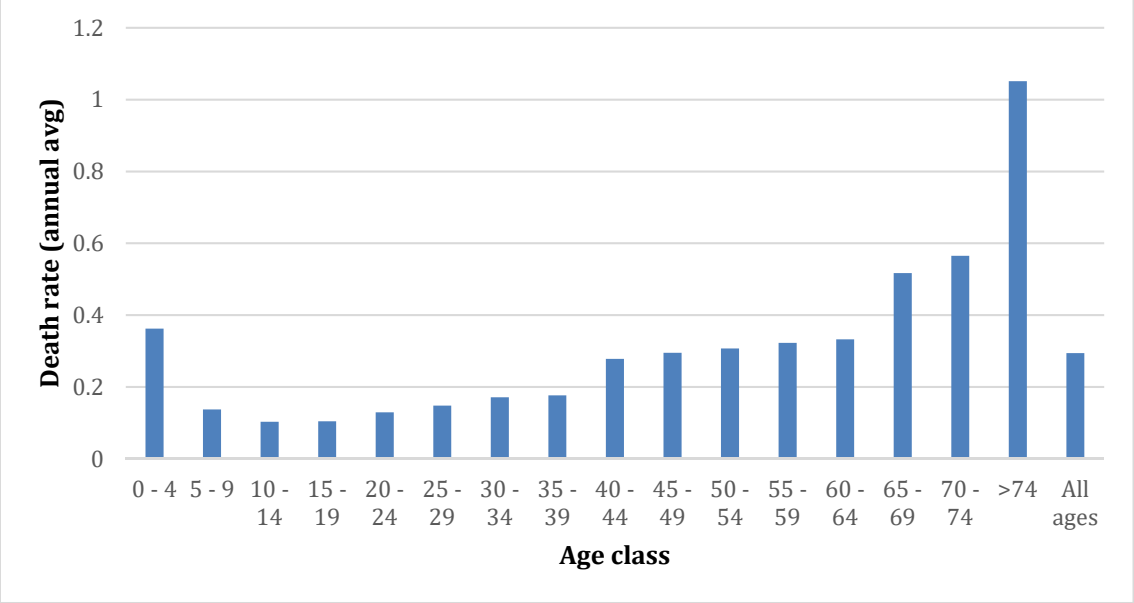

FIGURE 20: FATALITY RATES BY AGE GROUPS, FY 2004 TO 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

2. THE FATALITY RATE WAS CALCULATED USING THE ABS POPULATION ESTIMATES FOR EACH YEAR OF RECORD AND AVERAGING.

3. THE AGE GROUPINGS FOLLOW THOSE OF THE ABS DATA WHICH, FOR THIS DATASET, PROVIDES 5-YEAR AGE GROUPS ONLY UP TO 75: THUS, THE SPIKE ON >74 MAY BE MISLEADINGLY HIGH.

CASE STUDY 5

Tasmania, 2015

Mr B was 81 years of age and in generally good physical health but a year earlier he was diagnosed with vascular dementia. Mr B lived mostly independently and was given care by his children and grandson. Although he was prone to confusion, his family had not observed him undertaking actions that would put him at risk of harm.

On the night of the fire, Mr B lit a fire in the wood heater in his lounge room. Mr B's grandson left the premises late in the evening, leaving Mr B home alone. At 4.25 am a neighbour called the fire service, who were on scene in approximately FIVE minutes and were confronted with a house fire in an advanced stage. Once firefighters contained the fire, they entered the residence and located Mr B deceased in the kitchen.

Fire investigators found that the source of the fire was most likely from a smouldering log that had been placed on the floor of the lounge next to the wood heater. The Coroner concluded that Mr B tended to the wood heater while he was alone in the house before going to bed. He removed a log of wood from the heater and placed it on the floor. He was either unaware that it was still smouldering or gave no thought to the fact. The log eventually ignited the surrounding area. Evidence indicated that Mr B awoke and attempted to fight the fire before being overcome by smoke and gases from the fire, causing his death.

The Coroner speculated that Mr B's increasingly confused state of mind contributed to him placing the smouldering log on the floor, and found that mental impairment and being alone in a house are factors that greatly reduced the likelihood of responding appropriately to an activating smoke alarm when asleep.

Discussion: *This case provides an example of the occurrence of multiple risk factors including older age, dementia, living alone and misuse of heating equipment. At a population level, some risk factors are likely to increase in the future, such as ageing population, an increase in the numbers of people suffering dementia, and an increase in people living alone (particularly older people living at home alone for longer).*

The research team conducted further analysis of data relating to the 0-4, 5-19, 20-64 and ≥65 age brackets. Given the project's ethical requirement to report age data by a minimum of 5 year age classes, these age segmentations most closely correspond to how fire agencies have typically "segmented" fire safety interventions. The segmentations can be described as young children (and their families) (0-4), school fire safety education (5-19), broad population (20-64) and older people (65+).

Table 12 shows the fatality rates for the 0-4, 5-19, 20-64 and ≥65 age brackets. There were higher fatality rates amongst 0-4 age group and the over 65 age group.

Age group	Total	Fatality rate
0-4	70	0.36
5-19	67	0.11
20-64	433	0.23
≥65	330	0.77
Total	900	

TABLE 12: THE NUMBERS OF DEATHS AND FATALITY RATES PER 100,000 POPULATION FOR AGE GROUPS 0-4, 5-19, 20-64 AND ≥65, FY 2004 TO FY 2017

1: THE FATALITY RATE RATIO IS BASED ON AN AVERAGE OF THE ABS ESTIMATED RESIDENT POPULATION FIGURES FOR EACH YEAR OF RECORD.

2: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

Figure 21 provides a picture of fatality rates over time by looking at the broader age brackets of 0-4, 5-19, 20-64 and ≥65.

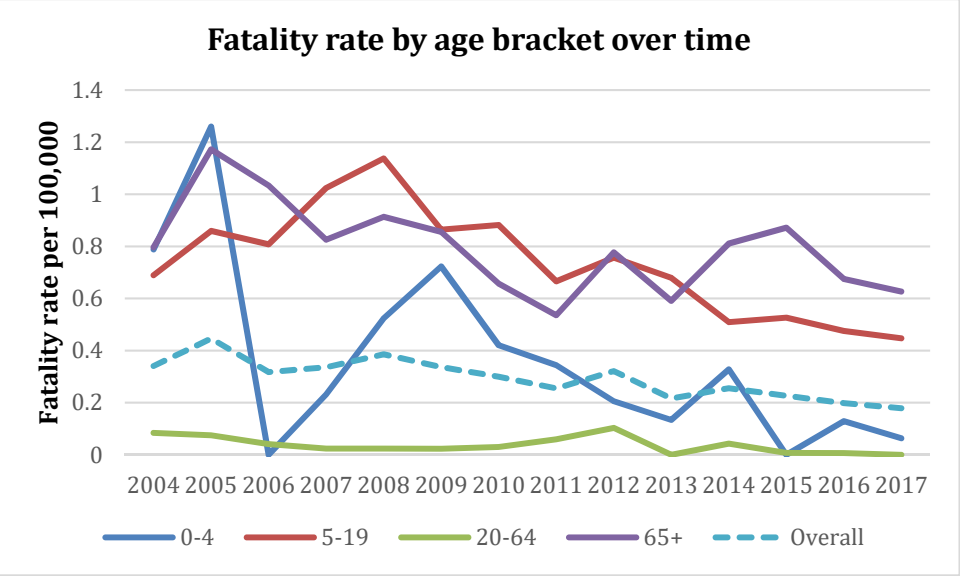

FIGURE 21: FATALITY RATE PER 100,000 POPULATION BY AGE BRACKETS, FY 2004 TO 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS POPULATION ESTIMATES FOR EACH YEAR OF RECORD.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

The 0-4, 5-19, 20-64 and ≥65 age brackets were also analysed for socio-economic advantage/ disadvantage, using the ABS SEIFA-IRSAD index (described on pp.31-32). Table 13 shows that almost half (48.6%, n=34) of the 0-4 age bracket were located in the top 10% of greatest socio-economic disadvantage (IRSAD percentile 1-10), with 87.2% of fatalities in the 0-4 age bracket located in the top 40% of areas of greatest disadvantage. The other age brackets also had the highest proportions of deaths in the most disadvantaged locations (IRSAD percentiles 1-10): 42.8% (n=22) for the 5-19 bracket, 21.7% (n=94) for 20-64 and 20.0% (n=66) for ≥65.

There appears to be a strong relationship to socio-economic disadvantage across all of the age cohorts, with the least strong relationship in the over 65 age bracket.

	Age brackets and % of age brackets									
IRSAD percentile	**0-4**		**5-19**		**20-64**		**≥65**		**Total**	
1-10	34	48.6%	22	32.8%	94	21.7%	66	20.0%	216	24.0%
11-20	9	12.9%	11	16.4%	71	16.4%	48	14.5%	139	15.4%
21-30	12	17.1%	8	11.9%	53	12.2%	35	10.6%	108	12.0%
31-40	6	8.6%	5	7.5%	48	11.1%	31	9.4%	90	10.0%
41-50	<5	N/A	8	11.9%	43	9.9%	36	10.9%	91	10.1%
51-60		0.0%	7	10.4%	43	9.9%	30	9.1%	80	8.9%
61-70	<5	N/A	<5	N/A	28	6.5%	25	7.6%	56	6.2%
71-80	<5	N/A	<5	N/A	22	5.1%	23	7.0%	48	5.3%
81-90	<5	N/A	<5	N/A	19	4.4%	18	5.5%	39	4.3%
91-100	<5	N/A	<5	N/A	12	2.8%	18	5.5%	33	3.7%
Total	70	100%	67	100%	433	100%	330	100%	900	100%

TABLE 13: NUMBERS AND PERCENTAGES OF FATALITIES BY , FY 2004 TO FY 2017

1: THE FATALITY RATE RATIO IS BASED ON AN AVERAGE OF THE ABS ESTIMATED RESIDENT POPULATION FIGURES FOR EACH YEAR OF RECORD.

2: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

Contingency table testing (see Method section, p.30) was used to analyse whether *age* was associated with a range of other variables. The aim was to identify which variables occurred together with specific age groups significantly more (or less) than would be expected under an assumption of independence between the two variables. The following relationships were found:

- *Relationship between residents* (highly significant (0.1%)). For those decedents who lived alone, more than expected were aged *40-54*, *55-74* and *≥75.*
- *Toxicology* (highly significant (0.1%)) For people aged 55 and older, less than expected had alcohol, other drugs or a combination detected. The *55-74* age group had a greater number of cases where both alcohol and medications were detected. For people aged 40-54, a greater number than expected had detectable quantities of other drugs, alcohol or a combination of medications, alcohol plus other drugs in their blood. For people aged 20-39, a greater number than expected had detectable quantities of other drugs or a combination of either alcohol plus other drugs or medications plus other drugs in their blood.
- *Decedent a smoker* (highly significant (0.1%)). For people in age classes *20-39, 40-54* and *55-74,* less than expected were not smokers.

- *Requires support to live at home* (highly significant (0.1%). More than expected decedents aged *55-74* and *≥75* required support to live at home.
- *Time of day* (significant (1%). For people aged *≥75,* significantly less than expected decedents died from *12-4am* and significantly more than expected died from *8am-12pm* and *4-8pm.* For people aged *0-4*, significantly more than expected died from *12-4pm.*
- *Working smoke alarm* (significant (5%). Significantly more than expected decedents in the 55-74 and ≥75 age groups had a working smoke alarm.

Other variables where a significant relationship was found, but where sample sizes of categories were too small to be confident of the result included: *cause of death, decedent's response,* and *intent to set fire* or *harm another person.* No significant relationship was found for *intent to self-harm, presence of smoke alarm* and *employment status.*

Analysis using Random Forest supervised machine learning (ML) was performed on the *≥65* age group data (n=328, 36.4% of the total sample). This process uses an algorithm to identify the difference between the decedents in the *≥65* cohort compared to the remaining decedents in the database. (See Appendix 4 for more information.) This analysis found that 67% of known cases in the *≥65 years of age* group had a positive toxicology report, whilst it was 73% for *<65 years of age*. It also found that only 11% of known cases in the *≥65 years of age* had no disabilities (40% for all people under *65 years of age*).

ML analysis using clustering uses a partitioning algorithm to group-like observations into clusters (See Appendix 4 for more information). The partitioning-around-medoids algorithm using four clusters – one of the most efficient numbers for this dataset – identified that living status, toxicology and gender were predictors for the *≥65 years of age* group. Australian male decedents in residential fires had a higher number of physical disabilities than females. Males typically lived with family.

ML analysis clustering using 12 clusters for people aged ≥65 years identified some trends of factors that were commonly found together for this age cohort. These results are shown in Table 14.

	Factor								
Cluster	**Male**	**Female**	**Lived alone**	**Lived with family**	**Positive toxicology**	**Negative toxicology**	**Physical disability**	**Mental health condition**	**Smoker**
1	X		X		X		X		X
2	X			X					
3	X			X	X				X
4			X		X			X	X
5			X		X				X
6		X	X		X			X	
7	X					X	X		
8	X		X				X		
9	X		X		X		X		
10		X		X	X			X	
11				X	X				
12	X			X		X	X		

TABLE 14: RESULTS OF MACHINE LEARNING USING CLUSTERING ANALYSIS

Gender and age

Figure 22 shows that males have been over-represented in fatalities across many of the age groups.

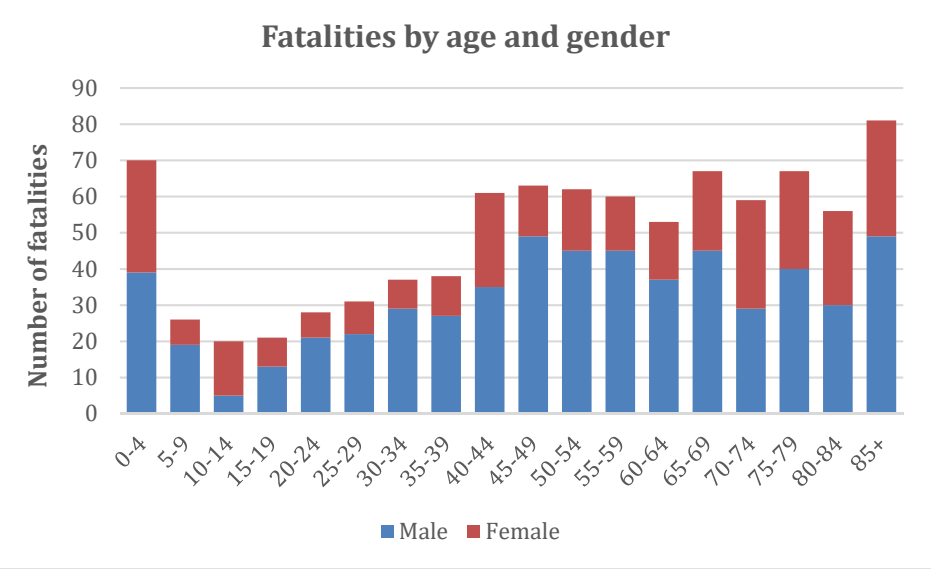

FIGURE 22: FATALITIES BY AGE GROUPS AND GENDER, FY 2004 TO FY 2017

1. 5-YEAR COHORTS ABOVE 80-84 NOT SHOWN SEPARATELY AS SOME WERE <5.

The male:female death ratio across five-year age groups is illustrated in Table 15. The ratio shows the number of males who have died for each female fatality.

Age group	Male	Female	Total	% total	Male:female death ratio
0-4	39	31	70	7.8%	1.3
5-9	19	7	26	2.9%	2.7
10-14	5	15	20	2.2%	0.3
15-19	13	8	21	2.3%	1.6
20-24	21	7	28	3.1%	3.0
25-29	22	9	31	3.4%	2.4
30-34	29	8	37	4.1%	3.6
35-39	27	11	38	4.2%	2.5
40-44	35	26	61	6.8%	1.3
45-49	49	14	63	7.0%	3.5
50-54	45	17	62	6.9%	2.6
55-59	45	15	60	6.7%	3.0
60-64	37	16	53	5.9%	2.3
65-69	45	22	67	7.4%	2.0
70-74	29	30	59	6.6%	1.0
75-79	40	27	67	7.4%	1.5
80-84	30	26	56	6.2%	1.2
85-89	36	18	54	6.0%	2.0
90-94	11	10	21	2.3%	1.1
≥95	<5	<5	6	0.4%	0.3
Total	**579**	**321**	**900**	**100.0%**	**1.8**

TABLE 15: THE MALE:FEMALE DEATH RATIOS

1: THE FATALITY RATE RATIO IS BASED ON 2016 CENSUS FIGURES.

2: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

3. USING THE ABS 2016 CENSUS FIGURES, WE WERE UNABLE TO OBTAIN FATALITY RATES FOR SEPARATE AGE GROUPS FOR 85 AND OVER: THE MALE:FEMALE FATALITY RATE RATIO FOR THE COMBINED ≥85 AGE GROUP IS 2.6.

Figure 23 illustrates fatality rates by age and gender. This shows that the majority of age groups are dominated by male fatalities, with the exception of the *10-14* and the *70-74* age groups.

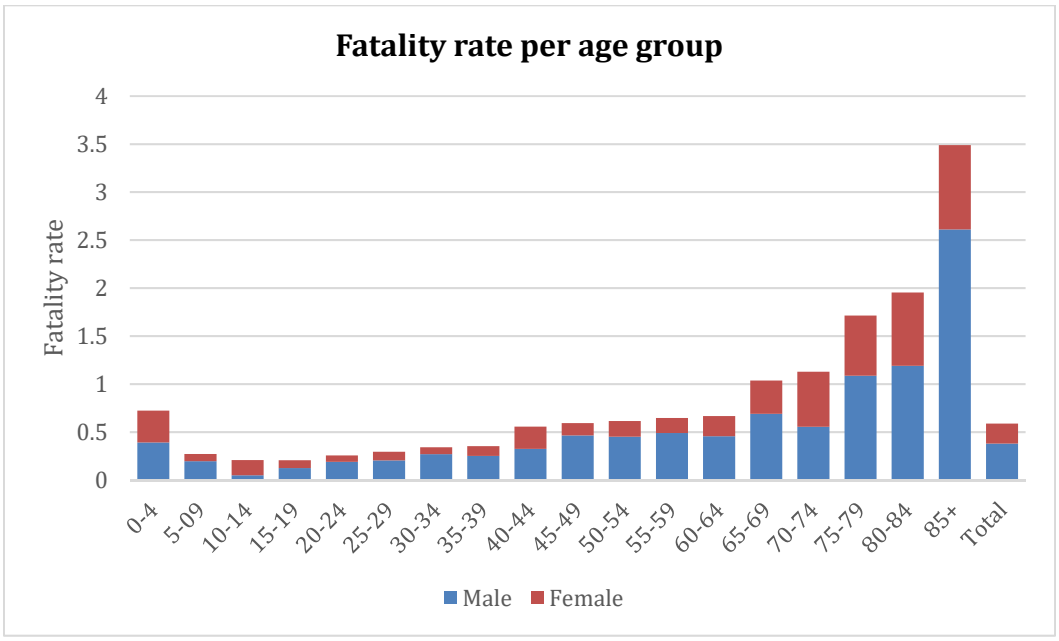

FIGURE 23: FATALITY RATES PER 100,000 POPULATION BY AGE GROUPS AND GENDER, FY 2004 TO FY 2017

1. THE FATALITY RATE WAS CALCULATED USING THE ABS POPULATION ESTIMATES FOR EACH YEAR OF RECORD.
2. ABS POPULATION ESTIMATES FOR THESE AGE-GENDER SPLITS END AT ≥85 YEARS, SO ALL THE FATALITY DATA FROM THERE ONWARDS WAS COMBINED INTO A SINGLE CATEGORY, *≥85*.

The age brackets of 0-4, 5-19, 20-64 and ≥65 were analysed against disability and toxicology to investigate the extent that these variables co-occur with male gender. The percentages of *males* in each of the toxicology categories of *alcohol*, *medication*, *other drugs* and *N/A* (nil) were compared to the total record. This analysis showed that a larger percentage of males than females in the 5-19 age group had a positive toxicology reading for alcohol or medication (or both). A larger percentage of males than females in the ≥65 age group were showed positive for alcohol, and a larger percentage of females than males in the 20-64 and ≥65 age groups showed positive for medication.

The disability categories of *any physical disability* and *any mental health condition* were similarly analysed for the difference between the percentages of *males vs. males plus females*. This analysis found that, in terms of *physical disability*, there was a greater percentage of males than females in the 20-64 age group and a much greater percentage of males than females in the ≥65 age group. In terms of *mental health condition*, there was a greater percentage of females than males in the 20-64 age group and a much greater percentage of females than males in the ≥65 age group.

Indigenous identification

In 22.7% of cases (n=204) the data was not known for this category. The vast majority of known cases (91.8%, n=639) were identified as *not Aboriginal/ Torres Strait Islander* (TSI) (Figure 24). Of the remaining categories, 8.2% (n=57) identified as *Aboriginal, TSI or both*.

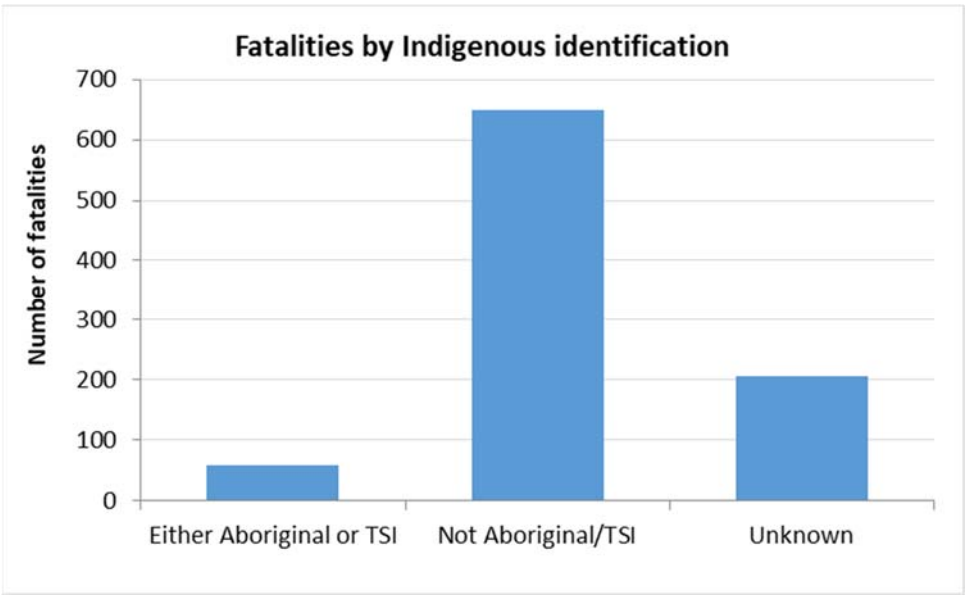

FIGURE 24: FATALITIES BY INDIGENOUS IDENTIFICATION, FY 2004 TO FY 2017

Analysis using Random Forest supervised ML found that Aboriginal/ TSI people comprised 12% of fatalities under 65 years of age and 3% of people over 65 years.

Country of birth

The country of birth was known for 70.6% (n=636) of cases. Of those, in 78.5% (n=499) of cases the country of birth was *Australia* and, in 21.5% (n=137) of cases, other countries, as per Figure 25.

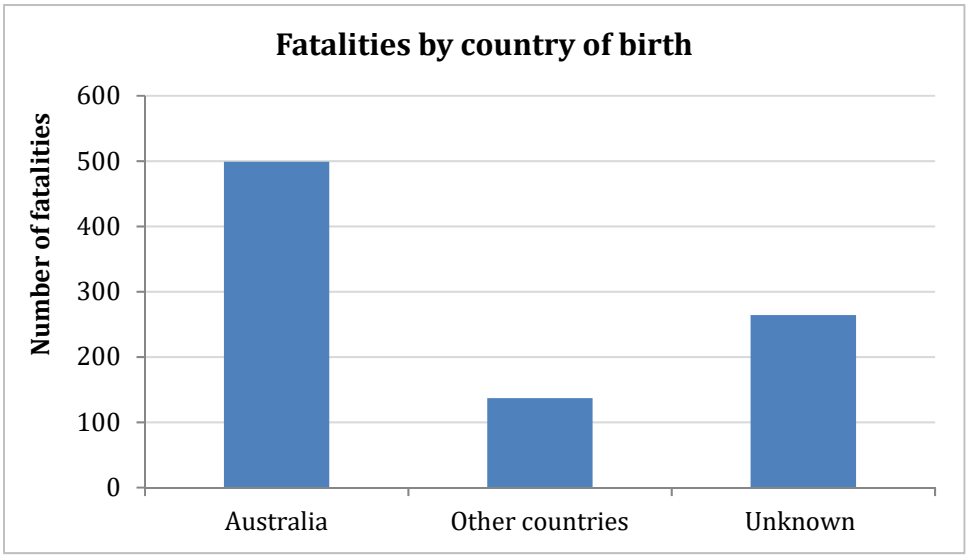

FIGURE 25: FATALITIES BY COUNTRY OF BIRTH, FY 2004 TO FY 2017

The most common countries of birth other than Australia were the *United Kingdom* (24), *New Zealand* (n=18), Greece (n=6), Poland (n=6), India (n=5) and Hungary (n=5). There were a total of 67 countries of birth other than Australia.

The majority of decedents for whom this field was known (other than those born in Australia) were born in European countries.

For just over a third of cases (35.7%, n=321), the period of residence in Australia was not known or not recorded. Of the cases remaining, the largest number had resided in Australia for *>50 years* (42.8%, n=248), and another 24.9% (n=144) for *30-49 years* (see Figure 26).

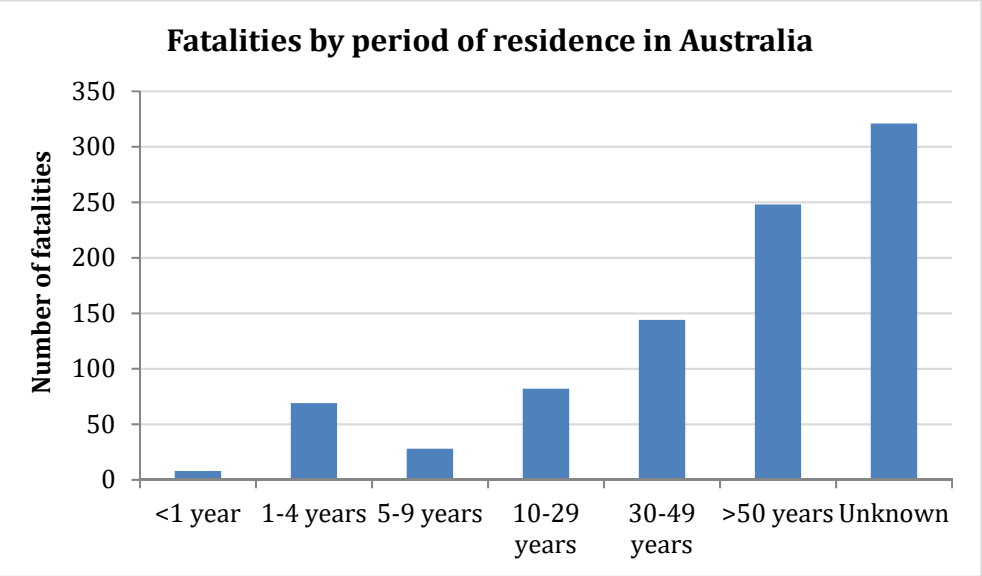

FIGURE 26: FATALITIES BY PERIOD OF RESIDENCE IN AUSTRALIA, FY 2004 TO FY 2017

Primary employment status

The employment status of 11.4% (n=103) of cases was unknown. Of the remaining cases, the majority of those who died in a preventable residential fire were *retired* (31.7%, n=370), on the *aged pension* (28.7%, n=335) or both. (This field allowed for more than one answer.) The next most common occupations were *unemployed* (12.1%, n=141) and *full-time work* (10.1%, n=118).

This field allowed multiple responses, hence, there were 1168 responses from the 800 cases for which this field was known. Of the cases where more than one response was selected, the vast majority of responses (91.4%, n=328) had both the *retired* and the *aged pension* fields selected. The next most common grouping of multiple employment status was being *retired* and on the *disability pension* (6.7%, n=24). The latter four fields had less than five responses. The total of those commonly at home (retired, on the aged or disability pension, unemployed, stay-at-home parents, part-time workers or, children not at school, etc.) was 84.2%.

Socio-economic index analysis

The data were analysed in terms of socio-economics by using the ABS SEIFA Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) data products (refer to pp.31-32 and Appendix 3 for further information). Figure 27 gives the results for Australia as a whole.

It can be seen that most fatalities have occurred in locations where there is relatively greater socio-economic disadvantage. There is a gradual lessening of numbers of fatalities in locations of greater socio-economic advantage.

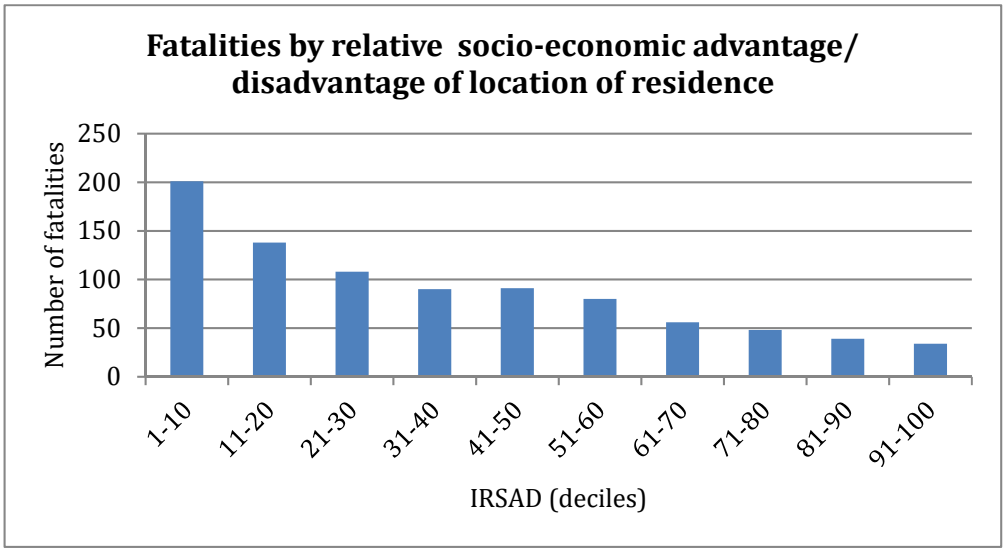

FIGURE 27: FATALITIES BY SOCIO-ECONOMIC CONDITION (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004 TO FY 2017

1. THE X AXIS IS MEASURED IN 10-PERCENTILE UNITS, STARTING FROM DECILE 1-10, EQUIVALENT TO THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO PERCENTILE 91-100, EQUIVALENT TO THE GREATEST SOCIO-ECONOMICALLY ADVANTAGED LOCATIONS.

Proximity of death to usual place of residence

The address of the usual place of residence of the decedent was mapped against the address of the fire incident. In the vast majority of cases (92.8%, n=831), the decedent died at their place of residence. In 64 cases (7.2%) they did not. Table 16 relates the distance (in kilometres) between the addresses of residence and of incidence.

Distance (km)	Number of deaths
0	831
1-9	27
10-29	11
30-99	6
100-499	15
500-1999	3
2000-9999	2

TABLE 16: PROXIMITY OF FIRE INCIDENTS TO THE USUAL RESIDENCE OF THE DECEDENT, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

2. FOR FIVE OF THE CASES, AT LEAST ONE OF THE RESIDENTIAL OR INCIDENT ADDRESSES WAS NOT KNOWN, HENCE THIS TABLE CONTAINS 895 CASES.

Toxicology

Toxicology refers to the presence of alcohol, medications or other drugs in the decedent's blood. These results are reported in pathology reports that form part of many cases in the NICS database. In the current study, the presence or absence of alcohol was recorded. No data was recorded relating to the level of alcohol in the bloodstream. The presence of medications was included only when there was no doubt that the medications had been taken before the fire incident and were not a result of medical treatment due to injuries sustained in the fire incident. No information was recorded relating to the type of medication, or other information such as whether it was prescribed or whether it was likely to have caused impairment. Other drugs refers to the presence of illicit drugs such as cannabis, amphetamines and cocaine. No information was recorded relating to the specific drug or whether it was likely to have caused impairment.

A total of 157 cases out of the possible 900 (17.4%) were unknown for this field. Of those known cases, there were a total of 332 responses indicating the presence of *medications* (34.4% of known responses) and 315 responses indicating the presence of *alcohol* (32.7% of known responses). Another 101 responses indicated the presence of *other drugs* (10.5% of known responses). Some 22.4% (n=216) of cases indicated the presence of neither alcohol, medication nor other drugs.

Multiple responses were allowed for the *toxicology* field, this gave a total of 1121 responses from 743 cases where this field was known. *Alcohol*, *medication* plus *other drugs* were all present in 24 of the cases. Another 171 cases had two of the three variables present, with the most common being *alcohol* + *medication* (110 cases). Figure 28 illustrates the results.

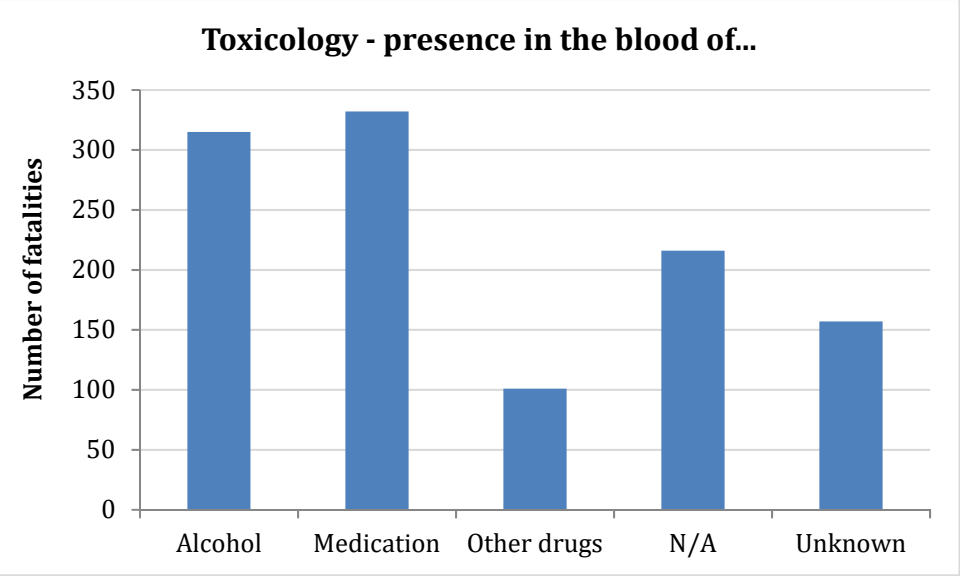

FIGURE 28: FATALITIES BY TOXICOLOGY, FY 2004 TO FY 2017

1: AS MULTIPLE RESPONSES WERE ALLOWED FOR THIS CODING FIELD, THERE ARE A TOTAL OF 1121 RESPONSES FROM 900 CASES.

Smoker

This data was not known for 472 out of 900 (52.4%) cases. For those known cases, 65.4% (n=280) were smokers and 11.0% (n=47) were non-smokers. A further 23.6% (n=101) were classed as *N/A* – that is, young children. Figure 29 illustrates the results.

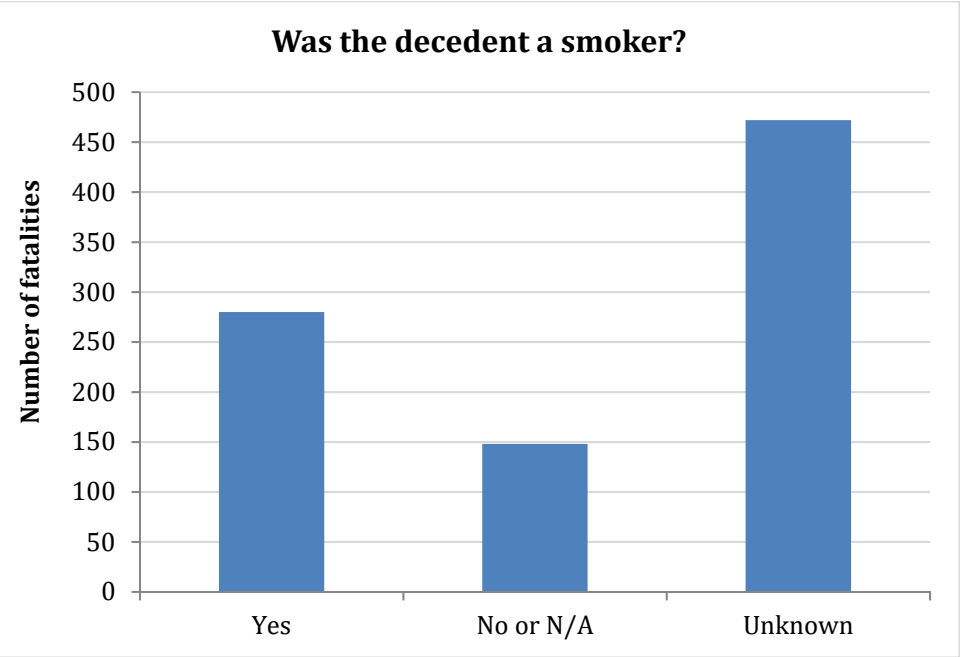

FIGURE 29: FATALITIES BY HABIT OF SMOKING, FY 2004 TO FY 2017

The data were investigated in terms of year of fire incident. There is no particular trend apparent through time of smokers being fire victims.

Disabilities

Multiple responses were allowed for this field. Whether the decedent had a disability was not known for 220 (24.0%) out of 900 cases. Of the 680 known cases, 38.2% (n=260) had *no disability present*. Of the 420 cases where disability was known to be present, 147 cases had multiple responses (therefore there were 1096 responses in total from the 680 known cases). One case had five disability types, seven cases had four disability types, 28 cases had three disability types and 111 cases had two disability types. Common combinations were *physical* plus *mental health* (68 cases), and *physical* plus *neurological* (43 cases). The most common disability was *physical (e.g., mobility, heart disease, asthma etc.)* (46.2%, n=285), followed by *mental health* (27.8%, n=171) and *neurological (e.g., dementia)* (9.7%, n=60).

Analysis using contingency table testing (see Method section, p.30) was used to discern whether *disability* was related to:

- *Time of day* – a highly significant (0.5%) relationship was found, with less than expected decedents with a disability were killed between the hours

of midnight to 8 am and significantly more between the hours of 8 am – noon.

- *Working smoke alarm* – a highly significant (0.5%) relationship was found, with more than expected decedents with a disability had a working smoke alarm.
- *Toxicology* – a highly significant (0.5%) relationship was found, with less than expected decedents with a disability having alcohol and a combination of alcohol plus other drugs detected, and more than expected having medication and a combination of alcohol plus medication detected.

No significant relationship was found between disability and *decedent's response* (action) or *presence of smoke alarm*.

Aids and equipment

Whether the decedent used aids and/ or equipment was not known for 535 (59.4%) out of 900 cases. Multiple responses were allowed for this field, and so there were a total of 943 responses for the 365 known cases. Of these 365 known cases, 279 (76.4%) used no aids/ equipment. Of the 86 cases where some form of aids/ equipment was known to be used there were 129 responses. Those most common were *crutches/ walking stick/ walking frame* (33.3%, n=43), *wheelchair/ scooter/ stroller* (15.5%, n=20) and *oxygen concentrators and oxygen gas* (12.4%, n=16). Further details are in Table 17.

Type of Aid/ equipment	Aids and equipment	Deaths	Percentage
Mobility	Bed backrest and bed raise	<5	N/A
	Alternative positional and postural seating supports	<5	N/A
	Standing equipment	<5	N/A
	Hoist/mechanical lifter	<5	N/A
	Crutches/walking stick/walking frame	46	33.3%
	Wheelchair/scooter/stroller (and wheelchair push mitt)	21	15.5%
	Total of Mobility	**70**	**54.3%**
Medical aids	Pressure management (bed)	<5	N/A
	Ventilator/CPAP appliance/respiratory mask and accessories	<5	N/A
	Medical dressings	<5	N/A
	Catheters	6	4.7%
	Oxygen concentrators and oxygen gas	16	12.4%
	Nebuliser	<5	N/A
	Total of Medical aids	**26**	**20.2%**
	Other	8	6.2%
	N/A	280	
	Unknown	544	

TABLE 17: AIDS/ EQUIPMENT USED BY DECEDENTS, FY 2004 TO FY 2017 – BY NUMBER AND PERCENTAGE OF THOSE WHO USED SOME FORM OF AIDS/ EQUIPMENT

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

2. 36 OTHER CATEGORIES OF AIDS AND EQUIPMENT WERE CODED FOR BUT HAVE NOT BEEN INCLUDED IN TABLE 14 AS NO DECEDENTS WERE RECORDED AS USING THEM.

Multiple responses were present in 23 cases: one case had six aids, two cases had five aids, one case had four aids, three cases had three aids and 16 cases had 2 aids. The most common combination of aids/ equipment was *crutches/ walking stick/ walking frame* plus *wheelchair/ scooter/ stroller* (five cases).

Services/ support received

Table 18 provides data on whether the decedent had been previously assessed by and/ or was receiving services, support and/ or intervention from government or other funded services. This data was not known for 479 (53.2%) out of 900 cases.

For those cases that were known, 34.4% (n=145) cases were not in receipt of services, support and/or intervention from government or other funded services. The remaining 276 cases were in receipt of a total of 398 funded services (multiple responses were allowed for this field, giving a total of 1022 responses from the 276 cases for which this data was known). Of these, 33.7% (n=134) were classed as *unknown but likely* – that is, although no specific services were mentioned in the reports attached to the case, there was sufficient information given to imply, that the decedent was probably receiving some form of support due to their circumstance. The next highest category was *informal – friends/ family/ neighbours, etc.* (16.1%, n=64) and then the *other* category, which included private support agencies (11.8%, n=47).

"Public housing" was the next most common support service the decedent was in receipt of (7.8%, n=31), followed by "adult mental health service" (5.3%, n=21), "acute health (in facility) – mental health, social work, occupational therapy, hospital in the home, post-acute care services" (4.8%, n=19), "community nursing service" (3.3%, n=13) and "community housing" (2.8%, n=11).

Seventy-six cases had multiple responses: four cases had six sources of services, support and/ or intervention, three cases had five sources, three cases had four sources, nine cases had three sources and 57 cases had two sources. There were no obvious patterns in common combinations.

Previously assessed by and/ or receiving services support and/ or intervention from…	Number of decedents	Percentage of decedents [1]
Aged and Disability Services	<5	N/A
Aged Care Assessment Team (ACAT) or Aged Care Assessment Service (ACAS)	<5	N/A
Home & Community Care or Home & Community Care Home Maintenance (HACC) - Commonwealth	<5	N/A
Packaged Care Level 1 - Commonwealth	<5	N/A
Community Aged Care Package (CACP) - Commonwealth	5	1.3%
Packaged Care Level 2- Commonwealth	0	0.0%
Extended Aged Care At Home (EACH) - Commonwealth	<5	N/A
Packaged Care Level 3- Commonwealth	<5	N/A
Extended Aged Care At Home Dementia (EACH D) - Commonwealth	0	0.0%
Packaged Care Level 4- Commonwealth	<5	N/A
Veterans Home Care and Veterans Home Care Home Care Maintenance or Aids and Equipment Program - Commonwealth Department of Veterans Affairs	<5	N/A
Acute health (in facility) – mental health, social work, occupational therapy, Hospital in the Home, post-acute care services	19	4.8%
Sub-Acute/ Rehabilitation Health - Social Work, Occupational Therapy	7	1.8%
Aged Persons Mental Health Service or Aged Persons Assessment Team Mental Health	<5	N/A
Adult Mental Health Service	21	5.3%
Child and Adolescent Mental Health Service	<5	N/A
Public Housing	31	7.8%
Community Housing	11	2.8%
Community Nursing Service	13	3.3%
Child Protection Service	9	2.3%
Children Youth and Family Service	6	1.5%
Personal Alarm Provider	9	2.3%
Individual Disability Support Package or Program	<5	N/A
National Disability Insurance Scheme or National Disability Insurance Agency	0	0.0%
Other	47	11.8%
Financial administration/ guardianship	<5	N/A
Informal – friends/ family/ neighbours etc.	64	16.1%
Unknown but likely (e.g., high level of disability implied, could not remove self from fire)	134	33.7%
N/A	145	
Unknown	479	

TABLE 18: GOVERNMENT OR OTHER SUPPORT/ SERVICES RECEIVED BY DECEDENTS, FY 2004 TO FY 2017

1: THE PERCENTAGE HAS BEEN CALCULATED WITH THE INCLUSION OF NEITHER THE UNKNOWNS NOR THE N/As. THE N/As REPRESENT THOSE DECEDENTS FOR WHOM IT WAS KNOWN THEY WERE NOT RECEIVING ANY FORM OF SERVICES, SUPPORT OR INTERVENTION.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

3: ALL FIGURES LESS THAN 5 HAVE BEEN DENOTED "<5", AS PART OF OUR AGREEMENT IN RELATION TO ACCESSING NCIS CASES.

Ability to live at home

Figure 30 gives the results of the question, "Did the decedent require assistance/ support to live at home?" This information was not known for a total of 378 (42.0%) out of the 900 cases examined.

Of the remainder, the majority of decedents (75.7%, n=395) did not require assistance or support to live at home, 24.3% (n=127) did.

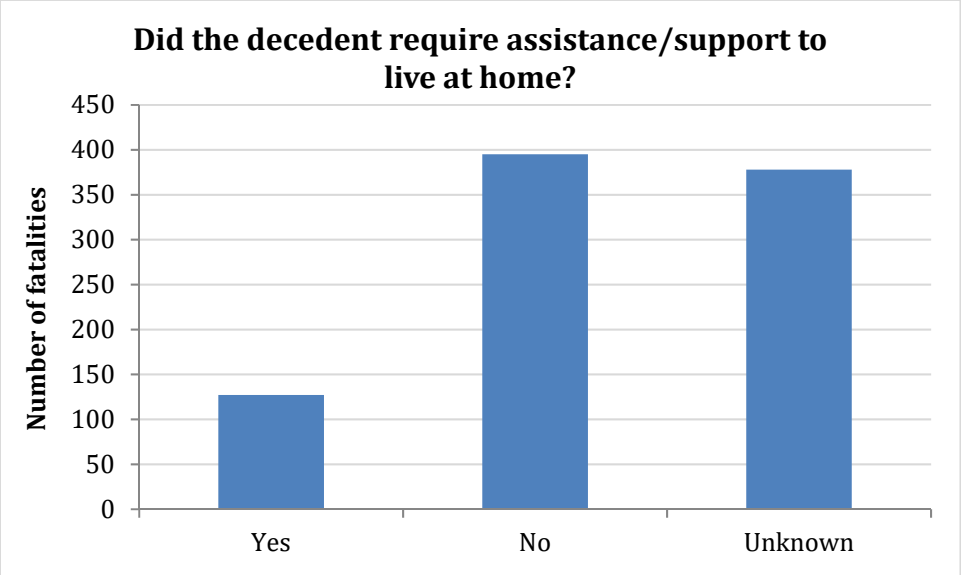

FIGURE 30: TOTAL DEATHS BY WHETHER THE DECEDENT REQUIRED SUPPORT/ ASSISTANCE TO LIVE AT HOME, FY 2004 TO FY 2017

Other high-risk fire behaviours

A range of behaviours (apart from those already analysed in this section) may increase the risk of residential fire resulting in a fatality. This can include hoarding, which can impede the safe evacuation of building occupants, or ad hoc/ unconventional heating, lighting and/ or cooking practices. It can also include extreme fire risk behavior, such as a history of fire-lighting. In this section in particular, the recording of these risks was dependent on the researcher being able to identify from the NCIS data that a high-risk fire behaviour was present. The figures below are likely to be an under-representation.

Data on other high-risk fire behaviour on the part of the decedents was not known for 353 (39.2%) out of the 900 cases. Of the remainder, 44.2% (n=242) did not exhibit any high-risk fire behaviours.

Multiple responses were possible for this field so, for the remaining 305 cases, a total of 352 responses were given. The single high-risk fire behaviours amongst the majority of decedents were *fireplay* (7.2%, n=43), *extreme fire risk behaviour* (7.2%, n=43) and *use of candles* (7.1%, n=42). *Hoarding* and/ or *squalor* were behaviours identified in 59 cases (8.2%), with 26 recorded as *hoarding*, eight as *squalor* and 15 as *hoarding with squalor*.

Some examples of *other* are a previous history of smoking in bed; unsafe disposal of cigarette butts; unsafe cigarette lighting practices or of smoking in the vicinity of oxygen concentrator apparatus; unsafe storage of LPG cylinders, gunpowder or explosives; overcrowded living conditions; reclusiveness; and the improper usage, handling, carriage or storage of accelerants such as petrol or kerosene. Of the 37 cases having multiple responses, one case had six behaviours, four cases had three behaviours and 32 cases had two behaviours. There were no obvious patterns in common combinations of behaviours.

Coronial recommendations

Data on recommendations made by the Coroner was not known in 12.2% of (n=110) cases and, in another 35.6% of (n=320) cases, no inquest was carried out. Table 20 sets out the results for the remaining 470 cases. No recommendations were made in 64.3% of (n=364) cases. Comments on matters of public safety were made in 10.8% of (n=61) cases. The current policy/ practice framework was endorsed in 5.1% of (n=29) cases and endorsed, but a gap identified, in a further 5.1% of (n=29) cases. Reviews were recommended of the current policy/ practice framework in 4.1% of (n=22) cases and of the current regulation/ legislation in 4.6% of (n=26) cases Table 19).

Coronial recommendation	Number of responses	Percentage of responses
Endorse current policy/ practice framework	29	5.1%
Endorse current policy and identify a gap in practice	29	5.1%
Recommend review of current policy/ practice framework	23	4.1%
Endorse current regulation/ legislation	<5	N/A
Endorse current regulation/ legislation and identify a gap in practice	14	2.5%
Recommend review of current regulation/ legislation	26	4.6%
Recommend legal action	0	0.0%
No recommendation	364	64.3%
Comment regarding a matter of public safety	61	10.8%
No recommendation but other comment, note etc	12	2.1%
Endorse a previous coronial recommendation	<5	N/A
Other	0	0.0%

TABLE 19: CORONIAL RECOMMENDATIONS MADE, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

2. MORE THAN ONE RESPONSE WAS ALLOWED IN THIS CODING FIELD, THUS THERE WERE A TOTAL OF 566 RESPONSES, RATHER THAN 470.

Data on the person/ body to whom any coronial recommendations were directed was not known in 12.4% of (n=112) cases and, in another 77.6% of (n=698) cases, either no inquest was carried out or, if it was, no recommendation was made. Table 20 sets out the results for the remaining 90 cases. Recommendations were directed to *fire services* in 24.5% of (n=46) cases and to *State government agencies/ departments* in 21.8% of (n=41) cases. In 14.9% of (n=28) cases, recommendations were directed to *standards associations or regulatory bodies* and to *individuals*. in a further 5.1% of (n=29) cases. Reviews were recommended of the current policy/ practice framework in 4.1% of (n=22) cases and of the current regulation/ legislation in 4.6% of (n=26) cases.

Coronial recommendation	Number of responses	Percentage of responses
Individual	28	14.9%
Private business	12	6.4%
Not for profit or community agency	5	2.7%
State government agency/ department	41	21.8%
Commonwealth government agency/ department	13	6.9%
Fire service	46	24.5%
Standards associations or regulatory bodies	28	14.9%
National council or peak body	<5	N/A
Other	12	6.4%

TABLE 20: CORONIAL RECOMMENDATIONS DIRECTED TO, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS AUSTRALIA IN THE FOLLOWING PROPORTIONS: 23% IN FY 2017, 8% IN FY 2016 & 7% IN FY 2015.

2. MORE THAN ONE RESPONSE WAS ALLOWED IN THIS CODING FIELD, THUS THERE WERE A TOTAL OF 188 RESPONSES, RATHER THAN 90.

CASE STUDY 6

Victoria, 2008

Ms C was 73 years of age and lived alone. She was profoundly deaf, mute and unable to walk. She was confined to her bed, on the first floor of her two-storey home. Ms C received in-home care via a Community Aged Care Package. She had previously refused to move to the ground floor.

Ms C was a heavy smoker and evidence of cigarette burns in her bedding had been previously identified by in-home care workers. Care workers attempted to provide smoke alarms on numerous occasions but Ms C refused their installation. She had undergone several cognitive assessments and was found competent to make decisions relating to her safety.

The fire service was alerted to the fire by several Triple Zero calls. Upon arrival minutes later, the fire service found the top floor and roof of the home was alight. Ms C's remains were discovered directly underneath her bed and bedroom, where a hole in the floor had burnt through. This indicated that Ms C was unable to move at the time of the fire. The fire was found to have started in the bedroom and the cause of fire was found to be the ignition of a combustible material such as the mattress or bedding. The exact cause of ignition could not be determined, but the likely cause was a smouldering cigarette.

Discussion: *Ms C was considered to be competent to make decisions relating to her safety, and had refused to consent to steps to increase her fire safety such as having smoke alarms installed. However, residential smoke alarms are mandatory. This case highlights that there is uncertainty over the extent to which in-home care providers and others with a duty of care are responsible for identifying and reducing fire risks.*

This case also illustrates the risk of fire from smoking and in particular, smoking in bed. The Coroner noted that, despite the introduction of reduced fire risk cigarettes in 2010, ignition of combustible materials from a lit cigarette is still possible. The Coroner asked fire services to consider whether the provision of flame retardant bedding for at-risk older people may be an effective intervention.

DISCUSSION

MORTALITY STATISTICS

This study found that at least 900 people have died in preventable residential fires in Australia from July 2003 to June 2017, averaging approximately 64 deaths per year or more than one preventable residential fire death every week. Between 2003 and 2017 there was no clear declining trend in fire fatalities.

The majority of deaths occur in single fatality incidents. These incidents do not receive a lot of media attention and, it could be argued, are business as usual for fire services. Historically, fire services from most jurisdictions have only collected a limited amount of data about fatal fires, particularly regarding the person and the circumstances that may have contributed to a preventable fire resulting in their death.

Fire services, individuals and other stakeholders can and should do more to reduce the rate of residential fire fatalities further towards zero. Interventions to reduce the risk of residential fire for those most at risk of dying need to encompass both technological and human-centred approaches. Developing evidence-based interventions that are informed by ongoing focus and analysis of fatality data is an approach that has been successful in other sectors such as water safety and road safety as well as internationally in residential fire safety.

The results from this study highlight that the conceptualisation of fire fatality risk is complex. The presence of a single risk factor on its own is unlikely to significantly increase a person's risk of dying in a residential fire. Rather, it is the co-occurrence of a range of risk factors surrounding the person, their behaviours, their residential environment and other external factors that is likely to impact their overall level of risk of having a fire that results in their death.

The overall findings from this study broadly align with findings from a range of previous Australian and international studies into residential fire fatalities. These findings are summarised in Table 21.

FIRE INCIDENT DETAILS

This study found that the most common characteristics of residential fires that are fatal include that they occur most commonly between hours of 8pm-8am and particularly from midnight-4am and they occur most commonly during the Australian winter months. They start most commonly in the living room/ lounge or bedroom and they are most commonly caused by cigarettes or similar smoking materials. Fatal residential fires are not necessarily large or severe fires, with approximately half of fires burning one room or less of the structure.

Factor	This study	AFAC, 2005 Aust	AFAC, 2005 NZ	QFRA, 1998	Other (Australia and internationally)
Annual average death toll	64	56			
Highest national annual fatality rate	0.46	0.41	0.70		
Cause of death: smoke inhalation	44.8%	43%			
Cause of death: burns	31.0%	23%			
Time of day: 0-4am	31.0%	21.3%			
Time of day: 8pm-8am	64.3%	49.3%	78.1%		69% Aust. (Aufiero *et al*, 2011)
Month of incident: Jun-Aug	34.7%	35.9%			
Cause of fire: cigarettes	26.7%	25%		30%	25% Europe (Fire Serv Acad, 2017), 22% USA (NFPA, 2014)
Cause of fire: heaters	11.1%			12.2%	
Cause of fire: heaters, open fires, lamps	23.7%	27%			
Cause of fire: electrical faults	10.9%	23%		8.1%	
Male fatalities	64.3%	60%	61.9%	59%	62.6% NZ (Miller, 2005)
0-4 years age group fatalities	7.8%	8%	16%	13%	18% USA (NFPA, 2014)
≥65 years age group fatalities	36.7%	22%	22%	27%	26% NZ (Miller, 2005), 31% USA (NFPA, 2014)
Indigenous identification	8.2%	6%			
Employment: retired/ age pension	31.7/28.7%	28%			
Building type: free-standing house	67.1%	80%			
Building type: flat (any height)	17.6%	6%			
Property tenure: owner occupied	53.0%	76%			
Property tenure: private rental	18.1%	13%			
Property tenure: public rental	5.8%	11%			
Lived: alone	44.5%				75% (Bruck *et al*, 2011)
Smoke alarm present	69.0%	45%		65%	
Smoke alarm working	73.2%	69%			37% NZ (Miller, 2005)
Toxicology: alcohol	32.7%	21%			58% (Bruck *et al*, 2011)
Formal services/ support received	22.4%				25% elderly, N Ireland (Harpur *et al*, 2014)
High-risk behaviour: hoarding	6.9%				19% (Aufiero *et al*, 2011)

TABLE 21: COMPARISON OF CURRENT STUDY RESULTS WITH THOSE OF OTHER STUDIES

1: THE FY 2017 FIGURE IS AN UNDER-REPRESENTATION BY APPROX. 23%.

2: NO COMPARISONS WERE AVAILABLE FOR SOME OF OUR CODING FIELDS, AND FOR SOME CATEGORIES WITHIN CODING FIELDS.

THE RESIDENCE

Housing type, tenure and location

Free-standing houses/ villas were the housing types where the majority of fatal fires occurred (67.1%) but, when compared to housing data, stand-alone houses may be underrepresented, as they comprise 78.4% of all housing stock in Australia. Similarly, owner occupiers were the most commonly identified property tenure (53%), but owner occupiers account for approximately 67% of all property tenures in Australia (ABS, 2017). This indicates that other tenure types, such as private and public rentals, may be over-represented in fire fatalities.

Geographically, most fatal residential fires occurred in major cities, but there was over-representation of deaths in regional and remote areas. The analysis of the fatality data in relation to areas of relative socio-economic advantage and disadvantage (IRSAD) (refer to pp.31-32 and Appendix 3) shows that most fatalities occurred in locations where there is relatively greater socio-economic disadvantage.

Smoke alarms

Smoke alarms are the most important residential fire safety device. They provide a reliable and inexpensive early warning in residential fires and a working smoke alarm significantly reduces the risk of death from residential fire. Smoke alarms should be viewed as a fire fatality prevention device. They are required by law in residential properties in all Australian jurisdictions.

For this study, the data on smoke alarms was collected from the narrative parts of the NCIS database, generally from the police report or the Coroner's findings. In a large majority of cases (65.9%), this information was not known. Sometimes the presence of a smoke alarm cannot be known due to the extent of fire damage of a building. However, the extent that the presence of a smoke alarm was noted is low considering their importance, and considering that the absence of a smoke alarm may have had an impact on the fatality outcome (e.g., by providing an earlier warning to the fire victim.) Where a smoke alarm was mentioned, it was often incidental to the overall narrative: for example, a mention in the police report that neighbours were alerted to the fire by a smoke alarm.

Of the 258 cases where smoke alarm presence was noted, 69.0% (n=178) did have a smoke alarm present. Of these, the smoke alarm was noted as working in only 104 of cases. The noting of smoke alarm presence is likely to be overstated, given the large quantum of missing data.

It is critically important for fire services to gather accurate data relating to smoke alarms. Fire services need to increase their focus on understanding the extent of smoke alarm coverage in fires that result in a fatality. In addition to informing the development of evidence based fire service interventions, this information should be proactively provided to coroners to inform their consideration of fire fatality cases.

THE PEOPLE

Single variable analysis from the current research found that those most at risk of dying in a preventable residential fire included:

- Older people – people aged ≥65 represent 36.4% of total fatalities
- Young children aged 0-4 – 7.8% of all fatalities
- People who had a disability (61.8%)
- Aboriginal/ Torres Strait Islander people (over-represented by a factor of 2.5)
- People who smoked – 65.4% of known decedents were smokers
- Males – 64.3% of all fatalities (M:F death ratio of 1.8) and particularly those age over 45
- People who lived in the most socially and financially disadvantaged locations
- People who lived alone (44.5%)
- People who had medications (34.4%) or alcohol (32.7%) present in their blood.

The presence of a single risk factor on its own is unlikely to significantly increase a person's risk of dying in a residential fire. Rather, it is the co-occurrence of a range of risk factors that ramp up the risk. Significant risk groups and trends relating to those groups are discussed further below.

Older people

By age cohort, people aged ≥65 are the group most at risk of dying in a residential fire. In the ≥65 cohort, the fatality rate increases with age: older age groups are more at risk. Older people are over-represented in data relating to people dying from burn injuries and people dying one month or more after the fire incident. This may indicate that older people die more often in fires that would be survivable by others.

The data indicates that the other factors that increase risk in older people include smoking, having a disability, the presence in their blood of alcohol and/ or medications, living alone and requiring support to live at home. Where these factors are present in combination, an older person's risk may increase significantly due to an increased chance of ignition (e.g., from smoking materials) and/ or a decreased ability to respond to and escape from the fire (e.g., due to decreased mobility or the effects of alcohol or some medications). Amongst older males, the presence of alcohol and physical disability appeared to be particular factors that increase risk.

The presence of a working smoke alarm may, in some cases, not provide early enough warning to enable older people escape from a fire. This is an area that needs more research, but it indicates that there may be efficacy in fire services and other stakeholders focusing on increasing the uptake of specialist smoke alarms appropriate to the needs of older people. These can include smoke alarms linked to personal alarms or smoke alarms for people who are deaf or hard of hearing.

The future fire fatality risk for older people is likely to be on an increasing trajectory. This is due to a range of demographic trends and government policy settings that may converge and co-occur in different ways in various geographic locations and amongst various population sub-groups. Some of the key factors include population ageing, increased numbers of people living independently or with limited care in their own homes for longer and an increase in the number of older people suffering from dementia.

My Aged Care, funded through the Federal Department of Health, is the main entry point to the aged care system in Australia. The scheme specifically supports older people to live in their own home through access to Home Care Packages.[2] Home Care Packages aim to respond to the preferences of older people and their families to remain in their home where possible, rather than move into an aged care facility. However, this could increase fire risk as older people may increasingly live at home while experiencing significant declines over time in their physical health, mobility, mental health and cognitive abilities.

Dementia describes the symptoms of a group of illnesses which cause a progressive decline in a person's functioning, including loss of memory, intellect, rationality, social skills and physical functioning. Dementia has become the second leading cause of death in Australia. It is the leading cause of death amongst females. Dementia is the single greatest cause of disability in older people. In 2019, an estimated 447,115 people in Australia live with dementia. This is expected to increase to 589,807 by 2028 and 1,076,129 by 2058.[3]

Fire safety interventions that aim to partner with providers of home care services for older people, and leverage their access and expertise, may be an effective way to reduce fire fatality risk. An example of this approach is a partnership between Australian fire services and AFAC with the Vocational Educational and Training sector to develop and embed units of competency in home fire safety into national qualifications for community care and health industry workers. Home care workers who have completed these units of competency can assess and take actions to reduce the residential fire risk of their clients, without necessarily needing fire services to intervene.[4]

This is a relatively new approach for fire services and is one that faces challenges to develop expertise and viable and sustainable interventions. It is an area that requires significant work and investment to build connections between sectors, and to develop evidence around effective intervention strategies.

Young children

In the study, children aged 0-4 had the largest number of deaths of any 5 year age range. The cause of fire was more often lighters or matches (n=31), which may indicate that a significant number of fires were lit by children during fire-play. The link to social and financial disadvantage was particularly significant in

[2] https://agedcare.health.gov.au/programs/my-aged-care (Accessed 28/7/2019)
[3] https://www.dementia.org.au/statistics (Accessed 28/7/2019)
[4] https://www.afac.com.au/initiative/bhfs (Accessed 28/7/2019)

this cohort, with almost half (48.6%, n=34) of deaths in the 0-4 age bracket occurring in locations in the top 10% of greatest socio-economic disadvantage, and 87.2% in the top 40% of areas of greatest disadvantage.

Fire safety interventions for this cohort need to be focused on increasing the basic home fire safety of families with young children, particularly in areas of social and financial disadvantage. Basic fire safety interventions include removing access to lighters, matches and other ignition sources and increasing the use of smoke alarms and home escape plans. Fire services and other stakeholders may consider interventions that partner with other services, such as maternal and child health services, to identify and access those most at risk.

People with a disability

In Australia, 4.3 million people (18.3%) live with a disability. Of these, 78.5% live with a physical disability and 21.5 % live with mental and behavioural disorders. Disability is strongly correlated with age, with 50.7% of older people living with disability.[5]

Within the fire fatality data collected for this study, despite there being a large number of unknown returns for this category, 46.7% (n=420) of decedents were identified as having at least one disability present. Within this there were a significant number of cases with multiple disabilities. Physical disabilities comprised 46.2% of disabilities identified, while mental health and neurological disorders made up 27.8% and 9.7% of disabilities identified. This indicates that people with a disability are likely to be over-represented in the fire fatality data. Mental and neurological disorders may also be a risk factor for residential fire fatality.

The data suggests that people with a disability more often died between the hours of 8am-12pm. This contrasts with the overall data, where fatal fires more often occurred during sleeping hours. This may indicate that, for people with a disability, their disability rather than being asleep may have contributed to their inability to safely escape the fire. Similarly, people with a disability more often had a working smoke alarm. This is an area that needs more research, but it indicates that there may be efficacy in fire services and other stakeholders focusing on increasing the uptake of specialist smoke alarms appropriate to the needs of people with a disability. These can include smoke alarms linked to personal alarms or smoke alarms for people who are deaf or hard of hearing.

The National Disability Insurance Scheme (NDIS), funded through the Federal Department of Health, provides support for people with disability.[6] The NDIS provides people under the age of 65 who have a permanent and significant disability with support needed to live an ordinary life. Similar to the case with older people, fire safety interventions that aim to partner with providers of NDIS services to people with disabilities, and leverage their access and expertise,

5 https://www.abs.gov.au/ausstats/abs@.nsf/0/C258C88A7AA5A87ECA2568A9001393E8?Opendocument (Accessed 28/7/19)

6 https://agedcare.health.gov.au/programs/younger-people-in-aged-care/about-the-national-disability-insurance-scheme-ndis (Accessed 28/7/19)

may be an effective way to reduce fire fatality risk. It is an area that requires significant work and investment to build connections between sectors, and to develop evidence around effective intervention strategies.

Aboriginal/ Torres Strait Islanders (TSI)

In the residential fire fatality data, 8.2% (n=57) of people were identified as *Aboriginal, TSI or both*. Approximately 3.3% of the Australian population identify as Aboriginal or TSI (ABS, 2019a), meaning that this cohort is over-represented in the data by a factor of 2.5. Analysis using Random Forest supervised ML found that Aboriginal/ TSI people comprised 12% of fatalities under 65 years of age and 3% of people over 65 years. This skew is likely a reflection of the younger age structure of the overall Aboriginal and TSI population.

Geographically, the analysis of data at a State and Territory level (Appendix 5) shows that Aboriginal and TSI fatalities are over-represented, particularly in jurisdictions with a higher proportion of indigenous people.

Some 20.3% of the Aboriginal/ TSI population live in outer regional areas and 18.6% live in remote or very remote areas (compared to 8% and 1.5% of the non-indigenous population) (ABS, 2019a). Although no specific analysis was done on this, it is likely that Aboriginal/ TSI people make up a significant proportion of fatalities in these locations.

Fire services and other stakeholders may consider how partnership approaches with indigenous-focused health and service providers, particularly in regional and remote areas, could be leveraged to reduce Aboriginal and TSI fatalities.

Smoking

The data indicates that smokers are over-represented by a large extent in residential fire fatalities. Of cases where the smoking status of the decedent was known (n=428), 65.4% of people were smokers. During the study period, smoking rates in Australia decreased significantly. In 2004/5, 23.3% of the Australians were smokers. By 2014/15 this had decreased to 15.5%.[7] The data does not reflect any decline in the number of smokers who died over the course of the study period. It is unclear why this is the case. It may be related to disadvantage, with Heart Foundation statistics noting that smoking is more prevalent in areas of greatest disadvantage, amongst the unemployed and in regional and remote areas. This is an area where further research may be useful.

Smoking materials are a major cause of ignition of fatal residential fires. For those cases where the fire cause was known, over a quarter (26.7%, n=161) were caused by *smoking materials*, with just over a third of those (n=56) relating to smoking in bed. There was a strong link between smoking materials as the cause of fire, and the residence being located in a relatively disadvantaged

[7] https://www.heartfoundation.org.au/about-us/what-we-do/heart-disease-in-australia/smoking-statistics (accessed 19/06/2019)

area, with 49% of fires caused by smoking materials occurring in the top 25% of most disadvantaged locations. There is no particular declining trend apparent for *smoking materials* as a cause of fires when looking at the full period. Males were also over-represented in fatalities where the cause was *smoking materials* (73.1%), and was a major cause of death of people under 65 years of age.

Fire services and other stakeholders may consider if there is efficacy in pursuing smoking fire safety messaging in partnership with public health campaigns that aim to reduce the smoking rates in Australia.

Males

Males comprised the majority of fatalities (64.3%, n=579). There were 1.8 male fatalities for every female fatality. Other common factors for male fire fatalities included alcohol, living alone and disability. The ABS notes that living alone appears to be linked with social disadvantage among middle-aged men.[8] Fire services and other stakeholders must consider the efficacy of interventions that specifically target men. The findings from this study suggest that being male is a risk only in association with a range of other factors, such as age and smoking.

RECOMMENDATIONS

Fire services and other stakeholders may consider the following recommendations to reduce the incidence of preventable residential fire fatalities in Australia:

- Develop a national residential fire strategy with an overall aim of reducing preventable fire deaths towards zero
- Develop an annual fire fatality report that sources fire and fatality data from fire services and use this data to drive evidence-based policy and practice
- Update residential fire fatality data sourced from NCIS, optimally every three years
- Consider how fire services could more pro-actively provide information and data to inform coroners, particularly around aspects of fire risk, prevention and smoke alarms
- Develop and evaluate partnership approaches to residential fire safety with other sectors such as providers of NDIS and My Aged Care services, maternal and child health services, Aboriginal services and others
- Extend the uptake of the Basic Home Fire Safety Training Materials as a unit of competency in a wider range of qualifications and sectors that provide services in the homes of people at increased risk from fire
- Consider how older people and people with a disability can more easily access fire safety devices appropriate to their needs, including specialised smoke alarms and residential sprinkler systems.

[8] https://aifs.gov.au/publications/demographics-living-alone (accessed 19/06/2019)

FURTHER RESEARCH

Future fire fatality studies

This study shows that data available in the NCIS is a rich source of information regarding residential fire fatalities in Australia. The development of the *Preventable Residential Fire Fatality Database* establishes a basis for future studies. There are relatively long lead times for cases to become "closed" and available within the NCIS, on average around 12-18 months after an incident. The ethics requirements to access to the NCIS data are also significant, and data collection requires significant time and expertise. It is therefore recommended that updating of residential fire fatality data sourced from NCIS should optimally occur every three years.

Other data sources

In other sectors such as water safety and road safety, the ongoing collection, analysis and reporting of fatality data is a key driver of evidence-based policy and practice. Fire services and other stakeholders may consider other methods to collect and analyse fatality data on an annual basis. One possibility is to work with and support fire investigation departments within fire agencies to expand the data they collect during the course of investigations of fatal fires and to share and analyse it via AFAC. This is a possibility that would require significant commitment and work from fire agencies in all jurisdictions to achieve. It would also be important to ensure that consistent data is collected and reported ethically.

Other potential areas for further research

This study has highlighted a number of areas of potential further research related to preventable residential fire fatality and fire fatality, injury and occurrence more generally. These include:

- Understanding the extent to which residential fire victims were receiving government funded support services, particularly services provided to people in their home, such as in-home care
- National collection and analysis of data relating to residential fire injury to better understand who is at most risk of injury and any differences with those most at risk of fatality
- Developing a deeper understanding of risks relating to older people, young children and smokers
- Understanding the extent to which specialist smoke alarms and other technological interventions appropriate to the needs of older people, people with a disability and other people at risk may reduce risk
- Developing partnership models between fire services and other sectors, including the trialling and evaluation of interventions targeted at people most at risk of dying in residential fires.

CONCLUSION

Preventable residential fire fatalities in Australia remain a significant public health problem, with an average of 64 fatalities each year. That equates to approximately the same number of deaths as occurred during the Black Saturday bushfires (173) every three years. Deaths from residential fires have significant social, economic and emotional impacts on individuals, families, communities and also on the firefighters and other emergency service workers who attend these tragic incidents.

For the first time in over 14 years this study provides evidence around the extent of preventable residential fire fatalities in Australia, those people most at risk and the details of fire incidents and residences where fatal fires have occurred. It provides a set of data that fire services and other stakeholders can use to develop evidence-based policy and practice to reduce the occurrence of fatal residential fires.

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APPENDIX 1: NCIS DATA

CASES AVAILABLE FOR VIEWING – BY FINANCIAL YEAR AND JURISDICTION

This appendix lists metadata given by NCIS in relation to the number of coronial cases available for viewing in its database. Table A1-1 reproduces Table 4 (p. 33) and lists the total of national (Australian) cases available for viewing, for the past four financial years. The last year of record utilised in the current study was FY 2017. It can be seen that for this year, 77% of the total 17,726 cases were closed and, thus, available for viewing. The figures for the two years previous to that, 92% and 93%, show a much more complete listing and these percentages improve further back in the record.

Financial year	% closed	% open	Total cases
2014-2015	93	7	18966
2015-2016	92	8	19251
2016-2017	77	23	19100
2017-2018	53	47	17726

TABLE A1-1: NCIS CASES AVAILABLE FOR VIEWING, FY 2015 TO FY 2018

AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J BRYAN)

Tables A1-2 to A1-5 list the Australian cases available for viewing, sorted by jurisdiction (and including the national total), for FY 2015 through to FY 2018. Of importance here is that, for the FY 2017 (Table A1-4), only 45% of cases were available for viewing for Victoria. For NSW the Figure is 82% - the next lowest percentage but a much more representative sample available. However, in the two years previous to that, NSW had only 87% and 89% of cases available for viewing (in FY 2016 and 2015 respectively), yet the Figure was over 90% for all other jurisdictions.

Jurisdictions	% closed	% open	Total cases
NSW	89	11	5123
VIC	92	8	5728
QLD	94	6	2585
SA	98	2	2290
WA	99	1	2191
TAS	98	2	476
NT	100	0	281
ACT	98	2	292
Total	**93**	**7**	**18966**

TABLE A1-2: NCIS CASES AVAILABLE FOR VIEWING BY JURISDICTION, FY 2015

AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J BRYAN)

Jurisdictions	% closed	% open	Total cases
NSW	87	13	5107
VIC	93	7	5859
QLD	92	8	2577
SA	96	4	2430
WA	98	2	2211
TAS	94	6	506
NT	99	1	274
ACT	92	8	287
Total	**92**	**8**	**19251**

TABLE A1-3: NCIS CASES AVAILABLE FOR VIEWING BY JURISDICTION, FY 2016 AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J BRYAN)

Jurisdictions	% closed	% open	Total cases
NSW	82	18	5277
VIC	45	55	5052
QLD	90	10	2702
SA	94	6	2538
WA	95	5	2423
TAS	82	18	519
NT	94	6	290
ACT	89	11	299
Total	**77**	**23**	**19100**

TABLE A1-4: NCIS CASES AVAILABLE FOR VIEWING BY JURISDICTION, FY 2017 AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J BRYAN)

Jurisdictions	% closed	% open	Total cases
NSW	70	30	5386
VIC	3	97	4383
QLD	82	18	1927
SA	65	35	2596
WA	62	38	2274
TAS	59	41	536
NT	78	22	308
ACT	85	15	316
Total	**53**	**47**	**17726**

TABLE A1-5: NCIS CASES AVAILABLE FOR VIEWING BY JURISDICTION, FY 2018 AFTER NCIS DATA, GIVEN 6 FEBRUARY 2019 (PERS. COMM., J BRYAN)

APPENDIX 2: CODING TABLES

The coding tables listed below are those used to enter data into the Preventable Residential Fire Fatalities Database from data gleaned from the NCIS. They were compiled through discussion with the chief project end-users (Julie Harris and Geoff Kaandorp of the MFB) and the research team (Lucinda Coates and Andrew Gissing, RF) and based on similar ABS tables where feasible. Some valuable advice was input by Nick Nickolopoulis (NSW Fire & Rescue).

A primary link key (a number from 1) links the Preventable Residential Fire Fatalities Database (PRFFD) with an Excel spreadsheet containing identifying data to be utilised solely for matching data with approved government departments and to be viewed solely by those persons approved by JHREC, CCOV RC and WACEC.

INCIDENT TIME DATA

Table A2-1: the *approximate hour of* fire *incident* coded for the hour when fire started/ was at its height as far as could be determined. This corresponds to Table 1 of the PRFFD.

Code	Approximate hour of incident
1	00:00-00:59
2	01:00-01:59
3	02:00-2:59
4	3:00-3:59
5	4:00-4:59
	etc
999	Unknown

Table A2-1: Approximate hour of incident

Table A2-2: the *year of incident* coded for the year of the fire incident leading to the death/ s. This corresponds to Table 5 of the PRFFD. Note: usually this result was the same as that of the year of death, sometimes it was not.

Code	Year of incident
2002	2002
2003	2003
2004	2004
2005	2005
2006	2006
	etc
999	Unknown

Table A2-2: Year of incident

Table A2-3: the *month of incident* coded for the month of the fire incident leading to the death/ s. This corresponds to Table 6 of the PRFFD. Note: sometimes this result was the same as that of the month of death, sometimes it was not.

Code	Month of incident
1	January
2	February
3	March
4	April
5	May
6	June
7	July
8	August
9	September
10	October
11	November
12	December
999	Unknown

Table A2-3: Month of incident

DATE OF DEATH

Table A2-4: the *year of death* coded for the year of death resulting from the fire incident. This corresponds to Table 2 of the PRFFD. Note: usually this result was the same as that of the year of incident, sometimes it was not.

Code	Year of death
2002	2002
2003	2003
2004	2004
2005	2005
	etc
999	Unknown

Table A2-4: Year of death

Table A2-5: the *month of death* coded for the month of death resulting from the fire incident. This corresponds to Table 3 of the PRFFD. Note: usually this result was the same as that of the month of incident, sometimes it was not.

Code	Month of death
1	January
2	February
3	March
4	April
5	May
6	June
7	July
8	August

Code	Month of death
9	September
10	October
11	November
12	December
999	Unknown

Table A2-5: Month of death

FIRE INCIDENT LOCATION DATA

Table A2-6: the *jurisdiction of incident* coded for the state or territory of Australia in which the incident occurred. This corresponds to Table 8 of the PRFFD. Note: the jurisdiction, suburb and street address of both the incident location and the usual residential address of the decedent was stored in a separate location accessible only to approved RF researchers.

Code	Jurisdiction of incident
1	NSW
2	VIC
3	QLD
4	SA
5	WA
6	TAS
7	NT
8	ACT
999	Unknown

Table A2-6: Jurisdiction of incident

Table A2-7: the *suburb of incident* coded for the suburb in which the incident occurred. This corresponds to Table 9 of the PRFFD. Note: the jurisdiction, suburb and street address of both the incident location and the usual residential address of the decedent was stored in a separate location accessible only to approved RF researchers. The suburb was coded once it was known exactly what suburbs to include.

Code	Suburb of incident
1	Ashgrove
2	Bellbowrie
3	Cooma
4	Dorrigo
	etc
999	Unknown

Table A2-7: Suburb of incident

Table A2-8: the *remoteness of incident location* coded for the Australian Bureau of Statistics' (ABS) Remoteness Area (RA) structure utilised by NCIS from the Australian Statistical Geography Standard (ASGS), as NCIS doesn't utilise the SOS ASGS structure (where urban and rural is defined on basis of population size). Rather, RA is based on relative access to services. RAs are based on the Accessibility/Remoteness Index of Australia (ARIA+), an index supplied to ABS by University of Adelaide as a one kilometre grid covering all of Australia.

Each grid point is allocated a value which is based on the measurement of road distances to service centres. The ASGS Statistical Area Level 1 (SA1) are then overlaid onto the grid and an average score is calculated based upon the grid points that are contained within each SA1. The resulting average score determines which remoteness category is allocated to each SA1 (ABS, 2016a). This coding table corresponds to Table 10 of the PRFFD.

Code	Location	ABS Section of State Structure of the ASGS
1	Major cities of Australia	0 to 0.2
2	Inner regional Australia	greater than 0.2 and less than or equal to 2.4
3	Outer regional Australia	greater than 2.4 and less than or equal to 5.92
4	Remote Australia	greater than 5.92 and less than or equal to 10.53
5	Very remote Australia	greater than 10.53
9	No usual address	
999	Unknown	

Table A2-8: Remoteness of incident location

DEMOGRAPHIC DATA

Table A2-9: the coding table for the gender of the decedent was taken from that used by ABS. This corresponds to Table 11 of the PRFFD.

Code	Sex
1	Male
2	Female
3	Other
999	Unknown

Table A2-9: Sex of decedent

Age ranges (Table A2-10) were used to denote the age of the decedent rather than actual age, in order to satisfy NCIS requirements. Five-year age ranges were chosen as the best balance of protecting the identity of the decedents and satisfying the needs of the end-users (i.e., to be able to identify important vulnerable groups such as the 0-4s or the over 65s). The coding table for the gender of the decedent was taken from that used by ABS, although sometimes ABS uses 10-year groupings, or groups some of the older age groups together (e.g., over 85s). This coding table corresponds to Table 12 of the PRFFD.

Code	10-yr age range
1	0-4
2	5-9
3	10-14
4	15-19
5	20-24
6	25-29
7	30-34
8	35-39
9	40-44
10	45-49
11	50-54

Code	10-yr age range
12	55-59
13	60-64
14	65-69
15	70-74
16	75-79
17	80-84
18	85-89
19	90-94
20	95-99
21	≥99
999	Unknown

Table A2-10: Age category of decedent

Table A2-11: the primary *employment status* at time of death is the main occupation of the decedent. The ABS Labour Force Survey defines part-time employed persons as those who usually work <35 hours per week and full-time employed persons as those who usually work 35 hours or more per week. This coding table corresponds to Table 13 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

Code	Employment status
1	Full-time (35 or more hours per week)
2	Part-time (less than 35 hours per week)
3	Student
4	Unemployed
5	Retired
6	Stay at home parent
7	On aged pension, etc
8	On disability pension, etc
9	Other
888	N/A (e.g., child not yet at school)
999	Unknown

Table A2-11: Employment status of decedent

Table A2-12 refers to the *country of birth* of the decedent. This coding table corresponds to Table 14 of the PRFFD.

Code	Country of birth
1	Australia
2	New Zealand
3	China
4	India
5	Greece
6	Pacific Islands…
7	North America etc
999	Unknown

Table A2-12: Country of birth

Table A2-13: the *visa status* of the decedent was coded for but not utilised as there was insufficient data to support it. This coding table corresponds to Table 38 of the PRFFD.

Code	Visa status at time of death
1	Australian resident/ national
2	International visa holder - student
3	International visa holder – working holiday
4	International visa holder – not student/ working holiday
5	International visa holder – type unknown
6	Other
888	N/A
999	Unknown

Table A2-13: Visa status at time of death

Table A2-14: the *period of residence in Australia* of the decedent coded for the number of years the decedent had been in Australia at the time of the fire incident. This coding table corresponds to Table 15 of the PRFFD. Note: "98" on the NCIS summary sheet meant the decedent had lived in Australia all their life and so their age was used to populate this field.

Code	Period of residence in Australia
1	< 1 year
2	1-4 years
3	5-9 years
4	10-29 years
5	30-49 years
6	> 50 years
999	Unknown

Table A2-14: Age category of decedent

Table A2-15: *indigenous identification* coded for whether the decedent identified as Aboriginal, Torres Strait Islander (TSI) or both. There was also a category for Maori but, as the project's focus was Australia not New Zealand, this aspect was not analysed. This coding table corresponds to Table 16 of the PRFFD.

Code	Indigenous identification (AUS)/ Ethnicity (NZ)
1	Aboriginal
2	TSI
3	Maori
4	Not Aboriginal/ TSI
5	Both Aboriginal/ TSI
999	Unknown

Table A2-15: Indigenous identification

Table A2-16: whether the decedent spoke a language other than English at home was coded for but not utilised as there was insufficient data to support it. This coding table corresponds to Table 17 of the PRFFD.

Code	Speaks language other than English at home?
1	No, English only
2	Yes, spoke a language other than English at home
999	Unknown

Table A2-16: Did the decedent speak a language other than English at home? [

SOCIO-ECONOMIC, RISK FACTOR AND RISK BEHAVIOUR DATA

Table A2-17 coded for if the decedent had been previously assessed by and/ or was receiving services, support and/ or intervention from government or other funded services. Code 28 was used when a high level disability was identified but not specified in the reports – e.g., if the fire was in one room, the decedent in another yet could not escape. This coding table corresponds to Table 18 of the PRFFD. This was a multi-select table: >1 response could be selected.

Code	Government funded service
1	Aged and Disability Services
2	Aged Care Assessment Team (ACAT) or Aged Care Assessment Service (ACAS)
3	Home & Community Care or Home & Community Care Home Maintenance (HACC) - Commonwealth
4	Packaged Care Level 1 - Commonwealth
5	Community Aged Care Package (CACP) - Commonwealth
6	Packaged Care Level 2- Commonwealth
7	Extended Aged Care At Home (EACH) - Commonwealth
8	Packaged Care Level 3- Commonwealth
9	Extended Aged Care At Home Dementia (EACH D) - Commonwealth
10	Packaged Care Level 4- Commonwealth
11	Veterans Home Care and Veterans Home Care Home Care Maintenance or Aids and Equipment Program - Commonwealth Department of Veterans Affairs
12	Acute health (in facility) – mental health, social work, occupational therapy, Hospital in the Home, post-acute care services
13	Sub-Acute/ Rehabilitation Health - Social Work, Occupational Therapy
14	Aged Persons Mental Health Service or Aged Persons Assessment Team Mental Health
15	Adult Mental Health Service
16	Child and Adolescent Mental Health Service
17	Public Housing
18	Community Housing
19	Community Nursing Service
20	Child Protection Service
21	Children Youth and Family Service
22	Personal Alarm Provider
23	Individual Disability Support Package or Program
24	National Disability Insurance Scheme or National Disability Insurance Agency
25	Other
26	Financial administration/ guardianship
27	Informal – friends/ family/ neighbours etc
28	Unknown but likely (e.g., high level of disability implied, couldn't remove self from fire)
888	N/A
999	Unknown

Table A2-17: Previously assessed by and/ or receiving services, support and/ or intervention from government or other funded services

Table A2-18: *disability type* coded for whether the decedent was identified as having a disability – either directly mentioned in a report or identified by the researcher and, if so, the type of disability. The format of this table is taken from the Australian Institute of Health and Welfare. This coding table corresponds to Table 20 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

Code	Disability type including age-related
1	No disability
2	Intellectual
3	Specific learning/Attention Deficit Disorder
4	Autism
5	Developmental delay
6	Physical (e.g., mobility, heart disease, asthma etc)
7	Acquired brain injury
8	Neurological (e.g., dementia)
9	Deaf-blind
10	Vision
11	Hearing
12	Speech
13	Mental health
14	Other
888	N/A
999	Unknown

Table A2-18: Disability type (including age-related)

Table A2-19: *aids and equipment* coded for whether the decedent was identified as having any types of aids and/ or equipment that would signify having some form of disability – again, either directly mentioned in a report or identified by the researcher and, if so, the type of aids or equipment used. The format of this table is taken from the Australian Institute of Health and Welfare (AIHW, 2003). This coding table corresponds to Table 21 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

	Code	Aids and equipment
Self-care/Personal	1	Beds/bed table/mattresses
	2	Shower hose/hand shower
	3	Bath and shower seating
	4	Commode
	5	Toilet support, frames and steps
	6	Continence aids/drainage bags and bottles
	7	Safety helmets
Mobility	8	Bed backrest and bed raise
	9	Alternative positional and postural seating supports
	10	Standing equipment
	11	Hoist/mechanical lifter
	12	Crutches/walking stick/walking frame
	13	Wheelchair/scooter/stroller (and wheelchair push mitt)

	Code	Aids and equipment
	14	Portable ramps
Communication	15	Communication board
	16	Communication cards
	17	Communication/ chat book
	18	Electronic communication device scheme
	19	Eye-pointing frame
	20	Box scanner
	21	Memory/message box with voice input
	22	Computer interface/access
	23	Alternative keyboards
	24	Communication output device with(out) voice
	25	Electrolarynx
	26	Voice amplifier and other electronic voice aids
	27	Cochlear Implant Speech Processor
	28	Hearing aids
Medical aids	29	Pressure management (bed)
	30	Ventilator/CPAP appliance/respiratory mask and accessories
	31	Humidifier
	32	Medical dressings
	33	Catheters
	34	Tracheostomy tubes and dressings
	35	Oxygen concentrators and oxygen gas
	36	Continuous positive airway pressure
	37	Tube feeding equipment
	38	Glucometer
	39	Nebuliser
Orthoses	40	Cervical, cervical thoracic, thoracic lumbar sacral, lumbar sacral & spinal orthoses
	41	Lower limb orthosis
	42	Upper limb orthosis
	43	Pressure management garment
	44	Footwear (for deformation or chronic ulceration)
Prostheses	45	Wigs
	46	Mammary prosthesis
	47	Optical prosthesis
Home Modifications	48	Bathroom, toilet, kitchen and laundry modifications
	49	Bidet toilet attachment
	50	Door fittings and widening
	51	Hand-held showers
	52	Hand-rails and grips
	53	Keypad, swipe-card or lockbox entry
	54	Power outlets and switches
	55	Non-slip paint for ramps
	556	Safety flooring
	57	Ramps/step modifications

	Code	Aids and equipment
	58	Thermostats
	59	Other
	888	N/A
	999	Unknown

Table A2-19: Aids and equipment

Table A2-20: *requires support/ assistance to live at home* is whether the decedent was able to live at home independently or whether they required some support or assistance – again, either directly mentioned in a report or identified by the researcher. This coding table corresponds to Table 22 of the PRFFD.

Code	Requires support/ assistance to live at home
1	Yes
2	No
888	N/A
999	Unknown

Table A2-20: Requires support/ assistance to live at home

Table A2-21: toxicology (*presence in blood of* alcohol, medication and/ or other drugs) coded for whether any of the above toxins were either detected in the decedent's blood analysis (in the toxicology report) or were mentioned in any of the other attached reports and identified by the researcher. This coding table corresponds to Table 23 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

Code	Presence in blood of:
1	Alcohol
2	Medication
3	Other drugs
888	N/A
999	Unknown

Table A2-21: Toxicology (presence in blood of alcohol, medication and/ or other drugs)

Table A2-22: *smoker?* is whether the decedent was a smoker. This coding table corresponds to Table 24 of the PRFFD. Use "unknown" (code 999) was used if the decedent was aged 11 years or older and it was unknown if they were a smoker. For those aged 10 years or under, it was assumed they were a non-smoker.

Code	Smoker?
1	Yes
2	No
888	N/A
999	Unknown

Table A2-22: Smoker?

Table A2-23: *other high-risk fire behaviours* coded for whether the decedent had any additional habits that put them at an increased risk of dying in a residential fire. This coding table corresponds to Table 25 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

Code	Other high-risk fire behaviours
1	Fire play
2	Use of candles
3	*Ad-hoc*/ unconventional cooking practices
4	*Ad-hoc*/ unconventional heating practices
5	*Ad-hoc*/ unconventional lighting practices
6	Misuse of power boards/ other electrical devices
7	Hoarding
8	Hoarding with squalor
9	Squalor
10	Security measures e.g., locked doors/ security shutters
11	None in this instance
12	Other
13	Extreme fire risk behaviour (i.e., irrational e.g., history of fire lighting)
999	Unknown

Table A2-23: Other high-risk fire behaviours

RESIDENCE/ SMOKE ALARM DATA

Table A2-24: *type of structure* coded for the type of building the decedent was in when the fire occurred. This coding table corresponds to Table 26 of the PRFFD. The structure type was mapped to the agreed ABCB building classifications (ABCB, 2015) as per Amanda Leck's (AFAC) suggestion.

Code	Type of structure	
1	Free-standing house/ villa	Class 1a
2	Duplex/ townhouse	Class 1a
3	Unit/ apartment (below or equal to 25m in height)	Class 2
4	Unit/ apartment (above 25m in height)	Class 2
5	Other residential facility (dorms, etc)	Class 3
6	Granny flat/ other secondary free-standing structure as part of a main structure	Class 1a SOU
7	Shed/ garage	Class 10
8	Caravan/ campervan/ mobile home/ cabin/ moveable unit	Moveable dwelling
9	Tent	Moveable dwelling
10	Other	Other
999	Unknown	Unknown

Table A2-24: Type of structure

Table A2-25: *property tenure* coded for the tenure type the decedent had with respect to the building where the fire occurred. It corresponds to PRFFD Table 27.

Code	Property tenure
1	Owner occupied
2	Private rental
3	Public rental (e.g., Dept Housing)
4	Supported accommodation (group housing, support from a few hours a week to 24-hours a day)
5	Squatting
6	Short-term commercial/ residential (e.g., farmstay, homestay, air b'n'b)
7	Transient visitor (e.g., relative or friend house-sitting, couch surfer)
999	Unknown

Table A2-25: Property tenure

Table A2-26: *relationship between residents* coded for who the decedent was living with. This coding table corresponds to Table 28 of the PRFFD.

Code	Relationship between residents: decedent was living…
1	Alone
2	With partner
3	With other family
4	With friends/ some other link
5	With co- tenants – not known if shared or boarding house
6	With co- tenants – shared house (know each other)
7	With co- tenants – rooming/ boarding house (don't know each other)
888	N/A
999	unknown

Table A2-26: Relationship between residents

Table A2-27: whether a smoke alarm was present or not corresponds to Table 29 of the PRFFD. If *yes* (smoke alarm present), tables A2-28 and A2-29 were completed to the best of the available knowledge; if *no* (no smoke alarm present), code 888 (N/A: not applicable) was selected.

Code	Smoke alarm present?
1	Yes
2	No
888	N/A
999	Unknown/ data not collected/ undetermined

Table A2-27: Smoke alarm/s present?

Table A2-28 relates to whether a smoke alarm that was present was working or not. This coding table corresponds to Table 40 of the PRFFD.

Code	Smoke alarm working?
1	Yes
2	No
888	N/A
999	Unknown

Table A2-28: Smoke alarm/s working?

Table A2-29 relates to whether at least one of the smoke alarms was a specialist type, and working or not. This coding table corresponds to Table 39 of the PRFFD. As mentioned previously, an example of a specialist smoke alarm for a person with a hearing disability is one that might: go to a personal alarm or have a flashing light in a visible area or a vibrating alarm underneath the bedroom pillow etc. If the decedent was not disabled (e.g., not deaf or blind) then code 888 (N/A: not applicable) was selected.

Code	Specialist smoke alarm?
1	Yes
2	No
888	N/A
999	Unknown/ data not collected/ undetermined

Table A2-29: Is at least one of the smoke alarms a specialist type, and working?

EVENT PHYSICAL CHARACTERISTICS DATA

Table A2-30: *location of ignition point* coded for the location of where the fire started – that is, what room it started in. This coding table corresponds to Table 30 of the PRFFD. This was a multi-select table – that is, more than one response could be selected.

Code	Location of ignition point
1	Bedroom
2	Bathroom
3	Kitchen
4	Living room, lounge
5	Laundry
6	Foyer
7	Below ground Level
8	Wall space
9	Roof space
10	Level below decedent's room
11	Garage
12	Outhouse
13	Shed
14	Other
888	N/A
999	Unknown

Table A2-30: Location of ignition point

Table A2-31: *fire severity* coded for how much of the house was burnt. N/A is selected if this field is not applicable to the case – e.g., if it was solely the decedent's clothing which caught fire or if the incident occurred outside the house. This coding table corresponds to Table 31 of the PRFFD.

Code	Fire Severity
1	Minimal damage to home
2	At least 1 room burnt
3	Major repairs required for liveability
4	House destroyed
5	>1 house/ unit destroyed
6	N/A (e.g., decedent's clothing caught fire, incident occurred outside [but near] house)
999	Severity unknown

Table A2-31: Fire severity

Table A2-32: *cause of fire* refers to what started the fire– that is, what was the primary cause of ignition. This coding table corresponds to Table 32 of the PRFFD.

Code	Cause of Fire
1	Heater or similar
2	Open fire/ flames
3	Cigarette or similar and smoking in bed
4	Cigarette or similar
5	Electrical fault
6	Operating equipment failure (includes someone incorrectly using the equipment)
7	Misuse of electrical equipment
8	Explosion (explosives. Do NOT use in place of 1 cause of fire: e.g., for gas leak/ cooker incident)
9	Kitchen fire/ cooking materials
10	Candles, lamp or similar
11	Other (e.g., accident)
12	Lighter/ matches
13	Gas leak
999	Unknown

Table A2-32: Cause of fire

CIRCUMSTANCES OF DEATH DATA

Table A2-33: *decedent stayed inside or left residence* coded for whether, on discovery of the fire, the decedent stayed inside the residence, safely left the residence and then returned, or carried out some other response behavior. N/A was selected when, for example, the incident occurred outside the house, and thus the decedent was already outside. This coding table corresponds to Table 41 of the PRFFD.

Code	Decedent stayed inside or left residence
1	Stayed inside residence
2	Safely left residence but then returned
3	Other (e.g., left residence but not safely i.e., died)
888	N/A (e.g., incident occurred outside [but near] house)
999	Unknown

Table A2-33: Decedent stayed inside or left residence

Table A2-34: *decedent's activity/ behaviour at time of incident* coded for what activity or behavior the decedent undertook, on discovery of the fire. N/A was selected when, for example, the incident occurred outside the house, or none of the other fields were appropriate. This coding table corresponds to Table 33 of the PRFFD.

Code	Decedent's activity/ behaviour at time of incident
1	No/ limited action
2	Attempted to escape – trapped at door
3	Attempted to escape – trapped by clutter
4	Attempted to escape – limited/ ineffectual (e.g., under bed, in closet)
5	Possibly attempted to escape
6	Attempted to fight fire
7	Extinguished fire, awaiting assistance
8	Did not extinguish fire, awaiting assistance
9	Rescuing people
10	Rescuing pets
11	Saving household items/ possessions
12	Primarily watching the fire (i.e., not watching whilst waiting for rescue etc)
13	Other
888	N/A
999	Unknown

Table A2-34: Decedent's activity/ behaviour at time of incident

Table A2-35: *cause of death* coded for the medical cause of death of the decedent, as specified by the Coroner or in the autopsy report and in the NCIS summary sheet. This coding table corresponds to Table 34 of the PRFFD.

Code	Cause of Death
1	Smoke inhalation (includes carbon monoxide and also where inhalation causes death on top of existing illness, e.g., emphysema, ischaemic heart disease, etc)
2	Burns
3	Medical complications (of burns)
4	Cardiac arrest (heart attack)
5	Injury – crush (e.g., wall or house collapse)
6	Injury - other
7	Indirectly caused by the fire
8	Natural causes
9	Burns and inhalation
11	Effects of fire (exact cause of death unknown)
12	Other
999	Unknown

Table A2-35: Cause of death

1. Note: there is no code 10 in this table.

Table A2-36: *number killed in fire* refers to the total number of decedents killed in the one fire incident. This coding table corresponds to Table 35 of the PRFFD.

Code	Number killed in fire
1	1
2	2
3	3
4	4
5	5-9
6	>10
999	Unknown

Table A2-36: Number killed in fire

Table A2-37: *intent to self-harm* refers to whether the decedent intended to harm themselves – i.e., whether they realized what the consequences of their actions might be. Such a person may well have set the fire with another purpose in mind, and the fire "got away from them" or simply not had the mental capacity to understand that setting the fire could harm themselves. Deciding whether to include such cases as these or not required finding sufficient positive evidence in the reports attached to the case to understand that, for example, the decedent did not have the mental capacity to understand the consequences of their actions AND that the decedent was in some form of consultation with an appropriate agency, either in-house or in, for example, a hospital. This coding table corresponds to Table 42 of the PRFFD.

Code	Intent to self harm
1	Yes
2	No
999	Unknown

Table A2-37: Intent to self-harm?

Table A2-38: *intent to set fire* refers to whether the decedent intended to set the fire – i.e., whether they realized what the consequences of their actions might be. Such a person may well have set the fire because they did not have the mental capacity to understand that setting the fire could harm themselves or others – e.g., they may have had a mental health condition. Deciding whether to include such cases as these or not required finding sufficient positive evidence in the reports attached to the case to understand that, for example, the decedent did not have the mental capacity to understand the consequences of their actions AND that, if the decedent had a mental health condition, the decedent was in some form of consultation with an appropriate agency, either in-house or in, for example, a hospital. No was selected if the person who set the fire was a very young child, as it was assumed that they would not have understood that, e.g., fireplay could lead to a fire. This coding table corresponds to Table 43 of the PRFFD.

Code	Intent to set fire
1	Yes
2	No
999	Unknown

Table A2-38: Intent to set fire?

Table A2-39: *victim of intentional act* refers to whether the decedent intended to harm another person – i.e., whether they realized what the consequences of their actions might be. Such a person may have simply not had the mental capacity to understand that setting the fire could harm another person. Deciding whether to include such cases as these or not required finding sufficient positive evidence in the reports attached to the case to understand that, for example, the decedent did not have the mental capacity to understand the consequences of their actions AND that the decedent was in some form of consultation with an appropriate agency, either in-house or in, for example, a hospital. This coding table corresponds to Table 44 of the PRFFD.

Code	Victim of intentional act
1	Yes
2	No
999	Unknown

Table A2-39: Victim of intentional act?

INQUEST REPORT DATA

Table A2-40: *Coroners' recommendations* refers to the type of recommendations made by the Coroner in the coronial findings report attached to the case. If no Coroner's report was available, code 999 (unknown) was selected in this table and in Table A2-41. If the report was available but no clear recommendation was given, code 8 (no recommendation) was selected for this table and code 888 (N/A) was selected for Table A2-41. This coding table corresponds to Table 36 of the PRFFD.

Code	Coroners' recommendations
1	Endorse current policy/practice framework
2	Endorse current policy and identify a gap in practice
3	Recommend review of current policy/practice framework
4	Endorse current regulation/legislation
5	Endorse current regulation/legislation and identify a gap in practice
6	Recommend review of current regulation/legislation
7	Recommend legal action
8	No recommendation
9	Comment re matter of public safety
10	No recommendation but other comment, note etc
11	Endorse a previous coronial recommendation
12	Other
888	N/A
999	Unknown

Table A2-40: Coroners' recommendations

Table A2-41: *Coroners' recommendations directed to* codes for the type of agency to which the recommendations made by the Coroner were directed. If no Coroner's report was available, code 999 (unknown) was selected in this table. If the report was available but no clear recommendation was given, code 888 (N/A) was selected. If a named agency was both a State government agency/ department and a regulatory body, code 7 (standards associations or regulatory bodies) was selected. This coding table corresponds to Table 37 of the PRFFD.

Code	Coroners' recommendations directed to:
1	Individual
2	Private business
3	Not for profit or community agency
4	State government agency/ department
5	Commonwealth government agency/ department
6	Fire service
7	Standards associations or regulatory bodies
8	National council or peak body
9	Other
888	N/A
999	Unknown

Table A2-41: Coroners' recommendations directed to…

APPENDIX 3: DEFINITIONS/ GLOSSARY

This glossary is also contained at the back of the *Preventable residential fire fatalities database user guide*. The main references used were AIDR, 2019; AIMS, 2017 (*in* AIDR, 2019); OED, 2019 (*in* AIDR, 2019) and UNISDR, 2017.

24/ 7 care – qualified personal care staff or a registered nurse is available and actively supervising residents to ensure their comfort, health and safety is looked after day and night.

Accelerant – any substance (such as oil, gasoline, etc) that is applied to a fuel-bed to expedite the burning process (AIDR, 2019).

Accident – a sudden event in which harm is caused to people, property or the built or natural environment (AIDR, 2019).

Acquired brain injury (ABI) – the result of damage to the brain that may occur at any time during life. An ABI can cause many different problems for the person affected. It is different from an intellectual disability or a mental illness (Health Direct, 2018).

AFAC – the Australasian Fire and Emergency Service Authorities Council is the body representing urban fire, rural fire and land management agencies and state and territory emergency services within Australia and New Zealand having a responsibility for the protection of life and property from fire and other emergencies (AIMS, 2017).

Affected – people who are affected, either directly or indirectly, by a hazardous event. Directly affected are those who have suffered injury, illness or other health effects or who were evacuated, displaced, relocated or have suffered direct damage to their livelihoods, economic, physical, social, cultural and environmental assets. Indirectly affected are those who have suffered consequences, other than or in addition to direct effects, over time, due to disruption or changes in economy, critical infrastructure, basic services, commerce or work, or social, health and psychological consequences. Affected people may experience short-term or long-term consequences to their lives, livelihoods or health and to their economic, physical, social, cultural and environmental assets. In addition, people who are missing or dead may be considered as directly affected (UNISDR, 2017).

Algorithm – a method, function, or series of instructions used to generate a machine learning model. Examples include linear regression, decision trees, support vector machines, and neural networks.

ArcGIS – this is a geo-spatial software tool that is used for working with maps and geographic information. The tool allows users to view, analyse, compile, discover and share spatial data. The maps and geographic information can be used and managed within various applications in the software.

Area of origin – general location where the fire started (AIDR, 2019).

Arson – the deliberate setting of a fire where the intent of the person responsible was to cause harm or destruction to life or property (AIDR, 2019).

Assumption of independence – the assumption of independence is used for T Tests, in ANOVA tests, and in several other statistical tests. It is essential in order to obtain results from a sample that reflect what one would find in a population. Even the smallest dependence in your data can turn into heavily biased results (which may be undetectable) if you violate this assumption.

At-risk – exposed to harm or danger.

Attention deficit disorder/ specific learning – any of a range of behavioural disorders occurring primarily in children, including such symptoms as poor concentration, hyperactivity and learning difficulties.

Attribute – a quality (e.g., colour, size, weight) describing an observation: for example, the column headers in a table. In this report, the term category is often used in the sense ">65 age category": i.e., similar to a subset of an attribute.

Australian Institute for Disaster Resilience – (AIDR) is an agency which works with government, communities, NGOs, not-for-profits, research organisations, education partners and the private sector to enhance disaster resilience in Australia.

Australasian Fire Authorities Council – now known as Australasian Fire and Emergency Service Authorities Council (see AFAC).

Autism – a developmental disorder of variable severity that is characterized by difficulty in social interaction and communication and by restricted or repetitive patterns of thought and behaviour.

Autopsy report – a report of the results from a post-mortem examination to discover the cause of death or the extent of disease.

Binary – a nominal type of datum with only two classes (e.g., Yes/ No).

Blood alcohol concentration (BAC) – a measure of the alcohol present in the blood stream. A BAC reading of 0.05% means that there is 0.05g of alcohol in every 100ml of blood.

Categorical (or *nominal*) – features having a discrete set of possible values. For example, consider a categorical feature named 'ethnicity', which has a discrete set of three possible values: Aboriginal, Torres Strait Islander, New Zealander. By representing ethnicity style as categorical data, the model can learn the separate decedents of Aboriginal, Torres Strait Islander, New Zealander ethnicity with other attributes.

Catheter – a flexible tube inserted through a narrow opening into a body cavity, particularly the bladder, for removing fluid.

Cell – a table cell which stores information for a specified row and column.

"Closed" case – that is, a coronial case no longer under investigation: available for viewing by approved NCIS users only.

Clustering – the most common form of unsupervised learning. Clustering works by comparing the normalized distances of each predictor and grouping the like observations into 'k' clusters.

Commode – a portable toilet.

Community – a group with a commonality of association and generally defined by location, shared experience, or function. A social group which has a number of things in common, such as shared experience, locality, culture, heritage, language, ethnicity, pastimes, occupation, workplace, etc (AIDR, 2019).

Confidence interval – a statistical measure of the confidence or trust one can place in the results of an analysis.

CPAP (continuous positive airway pressure) **appliance** – a device which moves air down the throat during sleep to keep the airways open.

Decedent – a deceased person.

Decision node – a variable included on an influence diagram or decision tree that is under the control of the decision maker. It is usually represented visually as a square or rectangle.

Decision tree – a tree-like model of decisions and their possible consequences.

Degree of association – how closely objects are connected.

De-identified – the identity of someone or something is withheld

Deliberate fire – a fire resulting from a person placing burning material to cause ignition. The intent of the person may have been to cause harm or destruction to life or property (arson-criminal offence) or to modify fuels and/or vegetation for land management purposes (summary offence). See also Arson (AIDR, 2019).

Dementia – a chronic or persistent disorder of the mental processes caused by brain disease or injury and marked by memory disorders, personality changes, and impaired reasoning.

Demographics – statistical data relating to the structure of populations and particular groups within it.

Deprivation (index) – a statistical measure of the level of socio-economic deprivation in an area.

Deprivation Index Decile (NZ) – a New Zealand statistical measure of socio-economic deprivation.

Developmental delay – the condition of a child being less developed mentally or physically than normal for its age.

Disability – resulting from the interaction between persons with physical, mental, intellectual or sensory impairments and barriers of attitude and the environment that prevent their full and effective participation in society on an equal basis with others (TSP).

Distance – a measure of how far objects are from one another.

Electrolarynx – a voice restoration device used to create clearer speech for people who have lost their voice box.

Ensemble – a merger of the predictions of multiple models. An ensemble can be created *via* one or more of the following: different initializations, different hyperparameters or different overall structure. Deep and wide models are a kind of ensemble. In the case of the machine learning section of this report, the ensemble is the grouping of multiple decision trees.

Event – an incident or situation, which occurs in a particular place during a particular interval of time (AIDR, 2019).

Exemplar – a person or thing serving as a typical example or appropriate model.

Explosion – sudden release of large amounts of energy in a destructive manner; a result of powders, mists, or gasses undergoing instantaneous ignition, or liquids or solids undergoing sudden decomposition, or a pressurised vessel undergoing over-pressure rupture with such force as to generate tremendous heat, cause severe structural damage, occasionally generating a shock wave, and propelling shrapnel (AIDR, 2019).

Exposure – the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest (UNISDR, 2017).

Fatality (or death) rate – the number of fatalities seen in relation to the background population. For example, Victoria had its greatest fatality rate in 2008, when the fatality rate was 0.57: that means, there were 0.57 fatalities for every 100,000 people living in Victoria in 2008.

Field – see *attribute*, above. In connection with the machine learning section of this report, the term field has been used to refer to selections from the initial database tables, whereas *categories* has been used to refer to the specific created 'columns' for the machine learning.

Fire – the chemical reaction between fuel, oxygen and heat. Heat is necessary to start the reaction and once ignited, fire produces its own heat and becomes self-supporting (AIDR, 2019).

Fireplay – experimenting with fire i.e., lighting matches.

Fire risk – processes, occurrences or actions that increase the likelihood of fires occurring (AIDR, 2019).

Fire-setting behaviour – fire-setting is a complex pattern of behaviour in which a child or adolescent starts fires, either accidentally or intentionally. Factors in classifying fire setting include intentionality, damage caused, frequency, and interest in fire vs. actually starting fires.

Fire-setting has a variety of contexts and causes, and may be an aspect of the clinical presentation of other psychological disorders such as conduct disorder. (Brosbe & Waguespack, 2011)

Government or other funded programs and services – any project, service or activity provided by the government or other body that assists individuals in areas such as health, general welfare, mental well-being and education.

Gower distance – a distance measure that can be used to calculate distance between two entities whose attributes have a mix of categorical and numerical values.

Glucometer – a medical device used to measure the approximate level of glucose in the blood.

Haddon Matrix - a commonly used paradigm in the injury prevention field. The matrix looks at factors related to personal attributes, vector or agent attributes and environmental attributes; before, during and after an injury or death.

Hazard – a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin (UNISDR, 2017).

Health – the state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (AIDR, 2019).

Hoarding – a persistent difficulty to part with items which results in an excessive accumulation of items, regardless of their value (Mayo Clinic, 2019).

Humidifier – a device used to keep the air in a room moist.

Ignition – the beginning of flame production or smouldering combustion; the starting of a fire (AIDR, 2019).

Ignition point – the location (point) at which the initial flame was produced. Please note: this definition is specific to this report and not that of, e.g., the AIDR (2019) definition.

Income elasticity – the degree to which a demand or supply is sensitive to changes in price or income.

Indigeneity – the fact of originating or occurring naturally in a particular place.

Intellectual disability/ impairment – a disability which usually occurs during the developmental stage of life (i.e., before the age of 18) and is characterized by below-average intellectual functioning (an IQ of 70 or under) and at least two deficits in adaptive behavior (daily living) such as communication, self-care, home living, social skills, self-direction, leisure and work or learning. An intellectual disability/ impairment may be caused by a genetic condition, problems during pregnancy and birth, health problems or illness, environmental factors and/ or through the use of drugs/ alcohol (IDRS, 2009).

Interval- scaled data – scaled numerical values.

Interval type predictor – features having numerical values.

IRSAD – the Index of Relative Socio-economic Advantage and Disadvantage is an ABS statistical measure of socio-economic conditions within defined areas – see Methods section, pp. 31-32.

Jurisdiction – a term signifying a state and/ or territory of Australia.

Machine learning – a category of algorithm that allows software applications to become more accurate in predicting outcomes without being explicitly programmed. The basic premise of machine learning is to build algorithms that can receive input data and use statistical analysis to predict an output while updating outputs as new data becomes available.

Matrix (matrices) – a rectangular mathematical array of numerical values.

Mean decrease accuracy –used to determine the importance of a particular variable. It is a measure of how the accuracy in a Random Forest analysis decreases when that particular variable is excluded. If there is a big decrease, then that variable was very important in the analysis.

Mean decrease gini – a measure of how purely/ cleanly a variable splits/ separates the data at a node. E.g., how well a variable splits the fruit (data) so that all the oranges are on one side and all the apples are on the other side.

Mechanism of injury – the manner in which a physical injury occurred (e.g., fall from a height, ground-level fall, high- or low-speed motor vehicle accident, ejection from a vehicle, vehicle rollover). The MOI is used to estimate the forces involved in trauma and, thus, the potential severity for wounding, fractures, and internal organ damage that a patient may suffer as a result of the injury.

Mental health condition – disorders that affect mood, thinking and behaviour. Examples include depression, anxiety disorders, schizophrenia, post-traumatic stress disorder, eating disorders and addictive behaviours. These behaviours become a condition when ongoing signs and symptoms cause frequent stress and affect a person's ability to function. Many people have mental health concerns from time to time. But a mental health concern becomes a mental illness when ongoing signs and symptoms cause frequent stress and affect your ability to function.

Metric – a standard for measuring or evaluating something, especially one that uses figures or statistics.

Mobile homes – a large caravan or prefabricated structure that is situated in one particular place and used as permanent living accommodation.

Mortality – 1) death, especially on a large scale: e.g., 'the causes of mortality among infants and young children'; 2) the number of deaths in a given area or period, or from a particular cause: e.g., 'post-operative mortality was 90 per cent for some operations'.

Nebuliser – a device for producing a fine spray of liquid, used for inhaling a medicinal drug.

Neurological – relating to the anatomy, functions, and organic disorders of nerves and the nervous system.

Node – a point in the decision tree where there is a split of the data.

Nominal (*categorical*) – with respect to predictors, these are where the categories of a predictor are classes (classifiers) rather than values (having a way to assign/ classify relative value/ distance). See also *categorical*.

Normalization (of data) – for fatality rates, the raw numbers of fatalities are normalized by viewing the fatality numbers against a background population of the particular group of interest – see Method section, p. 31. In general, multiplying an item of data by a factor that makes the norm, or some associated quantity, to a desired value (usually 1).

"Open" case – that is, a coronial case still under investigation and thus not available for viewing.

Orthoses – a brace, splint or other artificial external device serving to support the limbs or spine or to prevent or assist relative movement.

Other drugs – illicit drugs and/ or drugs not personally prescribed by the decedent's doctor.

Overfitting – a condition where a statistical model begins to describe the random error in the data rather than the relationships between variables.

Over-representation/ over-represented – where a population forms a disproportionately large percentage; having representatives in a proportion higher than the average.

Oxygen concentrator – a medical device that concentrates oxygen from the air and stores it in a cylinder, which is administered to the individual by means of a mask or pipe to the nasal passage (Medequip, 2017).

Partitioning-around-medoids (PAM) – a clustering algorithm that can handle custom distance matrices and select an exemplar for each cluster (useful for nominal data).

Percentile data – this is a measure used in the IRSAD socio-economic data product. Numerical data can be sorted in increasing or decreasing order, the percentile is the value at a particular rank. For example, if a house is valued for its net worth and is in the 95th percentile, a common interpretation is that only 5% of remaining houses valued ranked higher than it.

Physical disability – an illness that affects parts of a person's physical body as opposed to the mind: e.g., mobility, diabetes, cancer, heart disease or asthma.

Predictor variables –attributes/ categories/ fields used in machine learning to build the model to predict the "target".

Principle component analysis – a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principal components.

Pre-existing health condition – any ailment, illness, or condition where, in the opinion of a medical adviser, the signs or symptoms of that illness, ailment or condition existed at any time prior to the fire incident.

Preventable residential fire fatalities – see p. 24-26 (Method section, main report).

Prosthesis – an artificial body part, such as a limb, a heart or a breast implant.

Psychological – of, affecting, or arising in the mind; related to the mental and emotional state of a person.

Random Forest – a supervised machine learning approach to data analysis. The algorithm constructs an ensemble of decision trees using random subsets of data and variables, reducing overfitting (variance) and hence reducing the total error.

Residential Risk Referrals – the referral of a person who is at-risk – due to emotional, mental and/ or physical issues and/ or lifestyle, e.g., living in squalor – to care services.

Risk factors – any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury (WHO, 2019).

Risk reduction – a selective application of appropriate techniques and management principles to reduce either likelihood of an occurrence or its consequences, or both (AIDR, 2019).

SA1 – Statistical Areas Level 1 are geographical areas within the Australian Statistical Geography Standard, and are generally the smallest areal unit for the release of census data, having a population of between 200 and 800 people (ABS, 2016b).

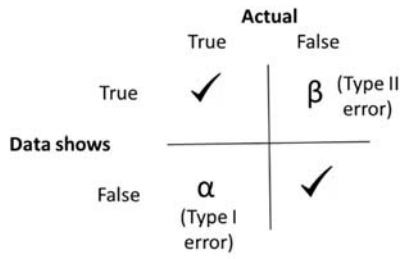
SEIFA data product – the Socio-Economic Indexes for Areas (SEIFA) is an ABS product that enables the assessment of the welfare of Australian communities – see pp. 31-32.

Self-harm/ self-harming – deliberate injury to oneself, typically as a manifestation of a psychological or mental health disorder.

Self-immolation – the action of setting fire to oneself, especially as a form of protest or sacrifice.

Sensory impairments – impairment of the function of one or more of the senses i.e., touch, taste, smell.

Significance – the likelihood that a relationship between two or more variables is caused by something other than chance. A statistical hypothesis test tests a hypothesis about a population based on a sample of data. The diagram below shows the situations that may arise from this process, depending on whether the hypothesis is true or false in the population, and whether the data shows the hypothesis to be true or false.



Clearly, if the hypothesis is true in the population, and we accept the hypothesis based on the data, we have a correct decision (top left-hand quadrant). Likewise, if the hypothesis is false in the population, and we reject the hypothesis based on the data, we have a correct decision (bottom right hand quadrant). Now if the hypothesis is true in the population, and we reject the hypothesis based on the data, we are making an error – this is called a type I error. The probability of a type I error – rejecting the hypothesis when it is true - is represented by "a". This is the significance level of the test. The second error, accepting a hypothesis when it is false, is called a type II error, and has probability "β".

Generally, a significance level of less than 5% is accepted as being small enough to allow us to say that the hypothesis has been proven. We say the test is significant. Smaller values of "a" imply that we can be even more certain that data has supported the hypothesis. So if "a" is less than 1% we can say that the test is highly significant.

Silhouette width – a metric useful in clustering to determine the optimal number of clusters. It is a measure of how similar an object is to its own cluster compared to other clusters.

Smoke alarms – a self-contained, single or multi-stationed fire-protection device that automatically detects and gives a warning of the presence of smoke.

Smoke detectors – smoke-sensing devices that operate as an interconnected system and are sometimes monitored remotely.

Smoking materials – products used to smoke tobacco or other drugs. i.e., cigarette, cigar, pipes.

Socio-demographic – social characteristics of a population. i.e., age, gender, ethnicity, location, employment status.

Socio-economic factors – relating to or concerned with the relationship between social and economic factors in society.

Squalor – the state of being extremely dirty and unpleasant.

Squatting – unlawfully occupying an uninhabited building or settling on a piece of land.

Subset – in this report: a set where each element is a member of another set.

Tenure – the conditions under which land or buildings are held or occupied.

Toxicology report – a result of tests conducted post-mortem to identify and quantify potential toxins in the body which include prescription medications, other drugs and alcohol.

Tracheostomy tube – a breathing tube inserted into an incision in a person's windpipe.

Trends – a general direction in which something is developing or changing.

Type classification – process of organizing data by relevant categories so that it may be used and protected more efficiently.

Under-representation/ under-represented – having representatives in a proportion lower than the average.

Variables – any characteristic, number, or quantity that can be measured or counted.

Ventilator – a machine used for people who need aid to/ cannot breathe, that moves air into and out of the lungs to assist with breathing (also referred to as a respirator).

Victim – A person directly affected by a disaster. A person who is killed (AIDR, 2019).

Victimology – the study of why certain people are victims or crime or accidents, in this case, residential fires.

Vulnerability – The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNISDR, 2017).

Weight – a coefficient for a feature in a model. A number (weight) is assigned to each data object that reflects its relative importance.

APPENDIX 4: MACHINE LEARNING ANALYSIS

By utilising machine learning it is possible to consider a number of different variables at the one time.

DATA

The fields from the Preventable Residential Fire Fatalities Database (PRFF Database: see the PRFF Database Users' Guide for more data) were subset into a table with 21 predictors. These predictors were selected after statistical analysis had been performed, choosing those with the most likeliness to impact who is most likely to die during a residential fire.

The coding fields were the same as those from the database and the coding tables (see Appendix 2). The 21 predictors are listed in Table A4-1. The tables mentioned are those utilised in the PRFF Database and also those of the coding tables.

Variable	Description
Age category (Age)	As per the PRFF Database table - consisted of 5-year age categories from 1: *0-4* to 21: ≥99. There were no unknown values, and it was interpreted as an interval type predictor. This was later used to classify a *greater than or equal to 65 years of age* (hereafter called ≥65) sub-category.
Remoteness Area (RA)	An interval type predictor, from 1-5, with 1 being *major city* and 5 being *remote*. The six unknown entries were assigned to *major city*.
Gender (Sex)	A binary (nominal) predictor, with 1 being *male* and 2 being *female*.
Employment status (Emp)	Taken from Table 13 (Employment status), but was modified to indicate the amount of time spent away from home. This was an interval type predictor, with 1 being *full-time*, 2 being *part-time + student* and 3 being *other* (retired/ pensioner, unemployed etc). The 103 unknown entries were assigned to category 3. This predictor was created in order to capture the measure of how long away from home (e.g., at work) the decedent was.
Retired/ pension (RP)	Also from Table 13: a nominal predictor, with 1 being *retired + pension*, 2 being *other*, 3 being the 103 *unknown*. This predictor was created in order to focus solely on the retired/ pension category.
Country of birth (Born)	Taken from Table 14, this has been grouped into seven areas/ continents in order to better capture any trends: 1 being *Australia*, 2 *Oceania*, 3 *Asia*, 4 *Europe*, 5 *North America*, 6 *South America* and 7 *Africa*). Those *unknown* cases were set to U. This is a nominal type of predictor. This first series of born in groupings was created to see if any specific continents (including Australia), were more at risk.
Born in Australia (BnAa)	Also from Table 14 and a nominal predictor. The data were grouped into just three categories, with 1 being *Australia*, 2 being *other*, and U being *unknown*. This second series of groupings was created in order to determine whether there was any significance in the country of birth being Australia as opposed to being born anywhere overseas.
Period of residence in Australia (Res)	An interval predictor with categories the same as for Table 15. The 323 *unknown* cases were set to category 6.
Indigenous identification (Ind)	A nominal predictor, with categories 1 being *not indigenous/ TSI* and 2 being *other*. The 207 *unknown* were set to U.
English only spoken at home (Eng)	A nominal predictor with categories similar to Table 17 but with 1 being *English*, 2 being *other* and U being the 493 *unknown* cases.
Government funded service (Gov)	A nominal predictor, with 1 being *Has assistance* (categories 1 to 28 from Table 18), 2 being *No* and the 478 *unknown* set to U.
Disability type (Dis)	A nominal predictor from Table 20 with 1 being *no disability*, 2 being *mental health condition*, 3 being *physical disability*, 4 being *both mental and physical disability* and with the 311 *unknown* or *N/A* cases set to U. These groupings were created in order to capture whether having a mental as opposed to a physical, as well as either having a disability or not, were important variables.
Number of disabilities (NumDis)	Also from Table 20: an interval predictor, with the number of recorded disabilities ranging from 0-5. *Unknown* cases were set to 0. This second series of groupings was created in order to ensure that any variations relating to the number of disabilities a decedent had were captured.
Aids and equipment (Eq)	An interval predictor, with the numbers of aids and equipment utilised by the decedents summed from Table 21 and categorized from 0-6 and the 544 *unknown* cases set to 0.

Variable	Description
Requires assistance at home (Assist)	The categories were taken directly from Table 22. This was a nominal predictor with 1 being *Yes*, 2 being *No* and the 535 *unknown* set to U.
Toxicology (Tox)	A nominal predictor, The categories were taken from Table 23 but categorized as 1 if either medications, alcohol or other drugs, or any combination, were present, else 2 if nil were present. The 157 *unknown* cases were set to U.
Smoker (Smo)	A nominal predictor from Table 24 with 1 being *Yes*, 2 being *No* and the 578 *unknown* cases set to U.
Other high-risk fire behaviours (HiRisk)	A nominal predictor, with 1 being *Yes* (i.e., if any, or any combination of, the behaviours listed from 1-13 in Table 25 were selected), 2 being *No* and U being the 361 *unknown* cases.
Property tenure (Prop)	A nominal predictor from Table 27 with the categories as per that table and the 531 *unknown* cases set to U.
Living alone (Alone)	A nominal predictor from Table 28 with 1 being *living alone*, 2 being *other* and U being the 159 *unknown* cases.
Living with (LivWith)	A nominal predictor, again from Table 28, with 1 being *Alone*, 2 being *friends/ etc*, 3 being *family* and U being *unknown*.

TABLE A4-1: DESCRIPTION OF THE PREDICTORS (VARIABLES) TAKEN FROM THE CODING TABLES

Table A4-2 sets out the characteristics of the 21 data fields chosen. Columns 3 to 8 (Age to Eq) present the interval type predictors, with the minimum, mean and maximum values, and the first, median and third probability quantiles. Columns 9 to 23 present the counts in each category for the nominal predictors.

	ID	Age	RA	Emp	Res	NumDis	Eq	Sex	RP	Born	BnAa	Ind	Eng	Gov	Dis	Assist	Tox	Smo	HiRisk	Prop	Alone	LivWith
Min	8	1	1	1	1	0	0	1:579	1:366	1:499	1:499	1:636	1:382	1:279	1:167	1:129	1:528	1:287	1:306	U:520	1:343	1:343
1Q	236.8	7	1	3	5	0	0	2:321	2:434	U:264	2:137	2:60	2:27	2:145	2:204	2:244	2:215	2:47	2:241	1:203	2:404	2:46
Median	466.5	11	1	3	6	1	0		3:100	4:70	U:264	U:204	U:476	U:476	3:193	U:527	U:157	U:566	U:353	2:68	U:153	3:358
Mean	487.1	10.85	1.736	2.624	5.218	0.78	0.14			2:28					4:25					4:39		U:153
3Q	691.2	15	2	3	6	1	0			3:23					U:311					7:29		
Max	1170	21	5	3	6	5	6			Other:16										Other:41		

TABLE A4-2: DATA FIELDS AND CHARACTERISTICS

MACHINE LEARNING MODELS

A range of machine learning approaches was undertaken to get insightful information and correlations not immediately visible from the data. As the records were concerned only with fatalities, there was no target for supervised learning approaches. As a result, most analyses used an unsupervised approach to group the data together to see trends. Also, specific focus was wanted for the ≥65 *year* category.

Random Forest

Random Forest is a supervised machine learning (ML) approach. It is probably the most popular ML algorithm as it provides good predictions, low overfitting and easy interpretability. The algorithm works by building an ensemble of decision trees by randomly sampling the data and the predictors at each decision node.

As Random Forest is a supervised learning approach, a target was needed. As the ≥65 *year* category was of interest, the target was set to decedents that were aged ≥65 *years*. Hence, the algorithm was essentially finding the difference between the decedents in this cohort compared to the remaining decedents in the Preventable Residential Fire Fatalities Database. The Random Forest is of type classification, with 20 predictors and 900 decedents. The class error rates are presented in Table A4-3.

	0	1	Class.error
0	516	54	0.09473684
1	40	290	0.12121212

TABLE A4-3: RANDOM FOREST CLASS ERROR RATES.

The eight most important predictors (or variables) are listed in Table A4-4. The mean decrease accuracy is used to determine importance. It is a measure of how the accuracy decreases when that variable is excluded. Also listed is the mean decrease gini, which is a measure of how pure a variable splits the data at a node.

Variable	Mean Decrease Accuracy	Mean Decrease Gini
Retired_or_Pension	92.1555267	153.305681
Period_of_residence_in_Australia	53.1050701	49.148459
Employment_status	27.2175325	16.958931
Toxicology	16.9103611	15.386939
Country_of_birth	15.5538681	14.677307
Disability_type	13.0243946	8.243910
Born_Australia	12.8223089	22.976098
Indigenous_identification	11.6510326	8.059178

TABLE A4-4: RANDOM FOREST TOP EIGHT MOST IMPORTANT PREDICTORS OF "≥65", AND THE MEAN DECREASE GINI

Clustering (PAM)

Clustering is the most common form of unsupervised learning. Clustering works by comparing the normalised distances of each predictor and grouping the like observations into 'k' clusters. Typically, the biggest limiting factor in this approach is choosing the number of clusters as there is no exact solution, but there are a variety of metrics that can be used to help with such decisions. In

this work the silhouette width was used (see Figure A4-5). For our data, however, the biggest limiting factor was that most of the predictors were classifiers (nominal predictors) which don't have a way to compare distance. To overcome this, the Gower distance was used to assign distances and weights to nominal predictors. For the clustering algorithm, partitioning around medoids (PAM) was chosen for its ability to handle custom distance matrices and to select an exemplar for each cluster (useful for nominal data).

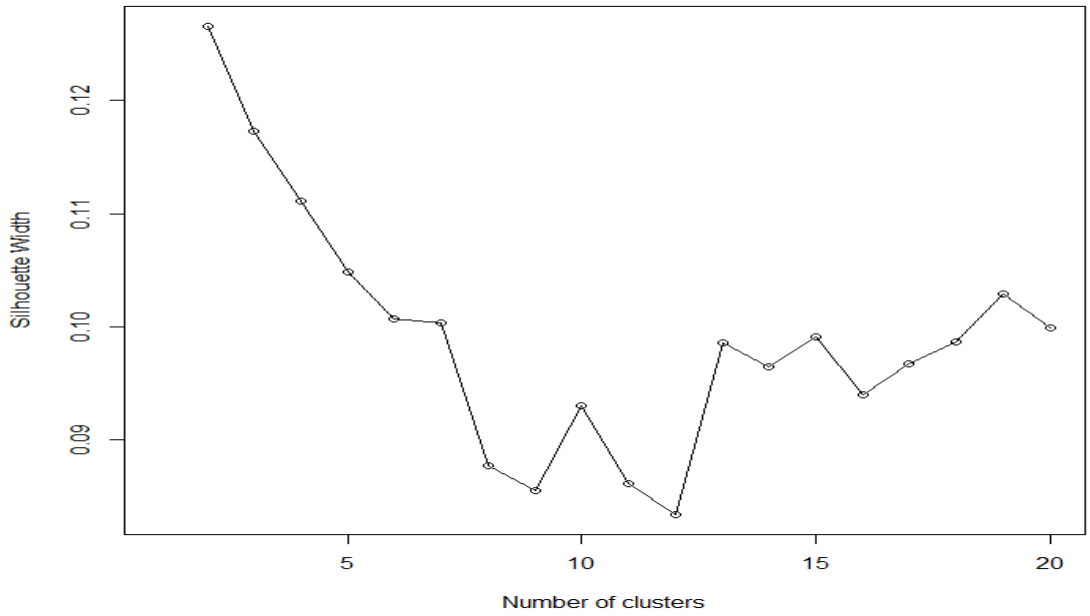


FIGURE A4-5: THE SILHOUETTE WIDTH TO DETERMINE THE OPTIMAL NUMBER OF CLUSTERS.

≥65 years

A few different selections of 'k' and the predictors were performed to get a more whole interpretation of the data. Tables A4-6 to A4-9 show k=4.

Age	RA	Sex	Emp	Res	Born	BnAa	Res	Ind	Eng	Gov	Dis	NumDis	Eq	Assist	Tox	Smo	HiRisk	Prop	Alone	LivWith
14	1	1:61	1	1:80	U:57	1:10	5	1:61	1:8	1:28	1:10	0	0	1:14	1:50	1:50	1:31	U:50	1:77	1:77
15	1	2:31	3	2:6	4:20	2:25	6	2:3	2:5	2:5	2:21	1	0	2:21	2:1	2:1	2:39	1:22	2:8	2:3
16	1		3	3:6	1:10	U:57	6	U:28	U:28	U:59	3:44	1	0	U:57	U:41	U:41	U:22	3:6	U:7	3:5
16.4	1.6		2.9		3:4		5.9				4:4	1.1	0.2					2:5		U:7
18	2		3		7:1		6				U:13	2	0					4:5		
21	5		3				6					4	2					7:3		
																		(O):1		

TABLE A4-6: CLUSTER 1 (C1)

Age	RA	Sex	Emp	Res	Born	BnAa	Res	Ind	Eng	Gov	Dis	NumDis	Eq	Assist	Tox	Smo	HiRisk	Prop	Alone	LivWith
14	1	1:55	1	1:89	U:69	1:8	4	1:59	1:5	1:27	1:10	0	0	1:8	1:39	1:13	1:24	U:64	1:10	1:10
15	1	2:42	3	2:2	4:12	2:20	6	2:2	2:6	2:2	2:20	0	0	2:13	2:32	2:4	2:23	1:16	2:70	2:9
16	1		3	3:6	1:8	U:69	6	U:36	U:86	U:68	3:20	0	0	U:76	U:26	U:80	U:50	4:4	U:17	3:61
16.1	1.4		3.0		2:4		5.9				4:1	0.6	0.2					2:4		U:17
17	2		3		3:3		6				U:46	1	0					7:3		
20	5		3		7:1		6					4	4					6:3		
																		(O):3		

TABLE A4-7: CLUSTER 2 (C2)

Age	RA	Sex	Emp	Res	Born	BnAa	Res	Ind	Eng	Gov	Dis	NumDis	Eq	Assist	Tox	Smo	HiRisk	Prop	Alone	LivWith
14	1	1:19	1	1:58	1:49	1:49	5	1:55	1:46	1:44	1:3	0	0	1:10	1:35	1:39	1:20	U:34	1:43	1:43
15	1	2:42	3	2:2	4:5	2:9	6	2:2	2:2	2:4	2:21	1	0	2:10	2:14	2:2	2:15	1:13	2:4	2:1
16	1		3	3:1	U:3	U:3	6	U:4	U:13	U:13	3:27	1	0	U:41	U:12	U:20	U:26	2:6	U:14	3:3
16.3	1.9		3.0		2:1		6.0				4:1	1.4	0.4					4:4		U:14
18	3		3		5:1		6				U:9	2	1					7:3		
20	5		3		6:1		6					3	6					3:1		
					(O):2															

TABLE A4-8: CLUSTER 3 (C3)

Age	RA	Sex	Emp	Res	Born	BnAa	Res	Ind	Eng	Gov	Dis	NumDis	Eq	Assist	Tox	Smo	HiRisk	Prop	Alone	LivWith
14	1	1:58	1	1:71	1:69	1:69	5	1:75	1:69	1:19	1:2	0	0	1:13	1:49	1:23	1:23	U:43	1:10	1:10
14	1	2:22	3	2:5	4:9	2:11	6	2:0	2:0	2:2	2:16	0	0	2:39	2:17	2:3	2:17	1:27	2:57	2:7
16	1		3	3:4	5:1	U:0	6	U:5	U:11	U:59	3:31	1	0	U:28	U:14	U:54	U:40	2:5	U:13	3:50
15.9	1.8		3.0		7:1		6.0				4:3	1.0	0.3					4:2		U:13
17	2		3				6				U:28	1	0					3:1		
21	5		3				6					3	3					6:1		
																		(O):1		

TABLE A4-9: CLUSTER 4 (C4)

The second trial split the ≥*65 years* into 13 clusters. Table A4-10 outlines the significance of each cluster. Highlighting in: green/red denotes significantly Y/N, colours denote significant categories, yellow denotes unknown and blank denotes nothing of significance was found.

	AC	R	G	ES	RP	CB	BA	PRA	II	EO	GFS	DT	ND	AE	RA	T	S	OHR	PT	A	LW
C1			M			A	Y	6	N	Y	Y	P				Y	Y			Y	A
C2			M	R	Y															N	F
C3			M	R	Y	A	Y	6	N	Y					N	Y		Y		N	F
C4		<				E	N		N		Y	M			N	Y	Y			Y	A
C5				R										0	Y	Y	Y	N		Y	A
C6			F	R	Y	A	Y	6	N		Y	M		≥		Y					
C7			M					6	N			P				N					
C8			M					6				P								Y	A
C9			M	R		E	N		N			P				Y			1	Y	A
C10		<	F					6			Y	M		≥		Y		N		N	F
C11		<		R	Y	E	N		N							Y		N		N	F
C12				R		A	Y		N	Y											
C13			M			A			N	Y		P				N			1	N	F

TABLE A4-10: THE SIGNIFICANCE OF EACH OF 13 CLUSTERS

GREEN/RED = SIGNIFICANTLY Y/N, COLOURS = SIGNIFICANT CATEGORIES, YELLOW = UNKNOWN, BLANK = NOTHING IMPORTANT

A third trial was performed that removed some predictors that duplicated similar information (e.g., country born and born in Australia). The results were similar to the other results. For k = 3 it was mainly separated into three categories:

- C1: Unknown country of birth
- C2: Australian, male (physical disability, lived alone)
- C3: Australian, female (mental health condition, other high risk behavior)

The process of removing unknowns was attempted: however, this only left 12 observations for the ≥*65 years* as opposed to 328 observations.

GENERAL COMMENTS

The most valuable result appears to be from the second PAM trial (the 13 classes). It is interesting how *male* and *female* categories are often divided, as well as *disability type*, *toxicology* and *living arrangements*. Also surprising is the picking out of Europeans (*country of birth*) and the large number of *smokers*. See the results and discussion sections for the detail of the results.

APPENDIX 5: JURISDICTIONAL ANALYSIS

NOTE: Due to NCIS requirements, graphs/ figures showing any bars/ categories at values of <5 could not be displayed. This impacts mainly on those jurisdictions with relatively fewer fatalities.

VICTORIA

NOTE: the FY17 results for Victoria could be an under-estimation as 55% of all coronial cases were not available for examination. This figure was 7% for FY16 and 8% for FY15.

Key statistics

- Second highest number of deaths amongst Australian jurisdictions (254)
- Annual fatality rates from 0.08 to 0.44 per 100,000: generally above the national average
- Male:female death ratio 2.3 but ≥5.0 for *25-34*, *45-54* and *55-64* age groups
- Fatality rates highest amongst *75-84* (M: F) and ≥*85* (M) groups
- 58.9% of deaths from *8pm-8am*
- The months when most deaths occurred: *July* and *August*
- Most deaths occurred in *major cities*, but *remote areas* are over-represented
- *Smoking materials* the most common cause of fatal fires
- Slight over-representation of *indigenous* deaths
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived alone*
- Smoke alarm present in most known cases, of which most were working
- 41.1% of deaths occurred in the top 25% of areas of greatest socio-economic disadvantage (IRSAD percentiles of ≤25).

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 254 deaths have occurred in 233 preventable residential fires in Victoria: an average of 18.1 deaths per year. For comparison, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note that, for FY 1997, no data was available for Victoria and the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records). Tables 6 and 7 (pp. 37 and 40) show the numbers of fatalities and fatality rates per 100,000 of the population of Victoria. These results are shown in Figures 48 (numbers of fatalities) and 49 (fatality rates per 100,000 population of Victoria). There is a slight downward trend throughout the FY2004-2017 period of record shown on Figure A5-1: however, the fact that a substantial number of cases were not available for viewing in more recent years must be taken into account.

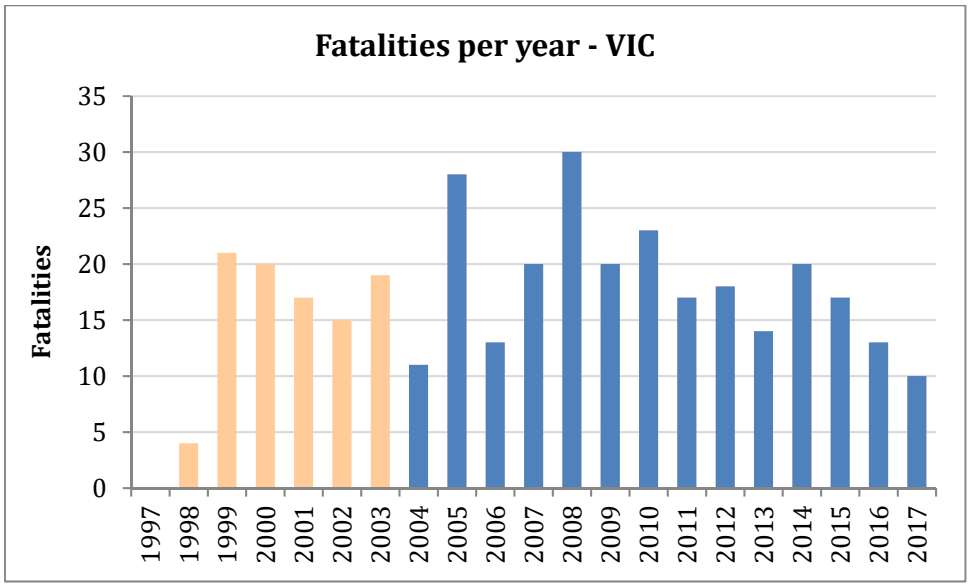


FIGURE A5-1: TOTAL FATALITIES ACROSS VICTORIA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

3: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 1997 DATA WAS NOT AVAILABLE FOR VICTORIA.

4: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Fatality rates

The trend of the fatality rate shows a more marked downward trend (Figure A5-2), although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. In general, Victoria sits just above the national average fatality rate.

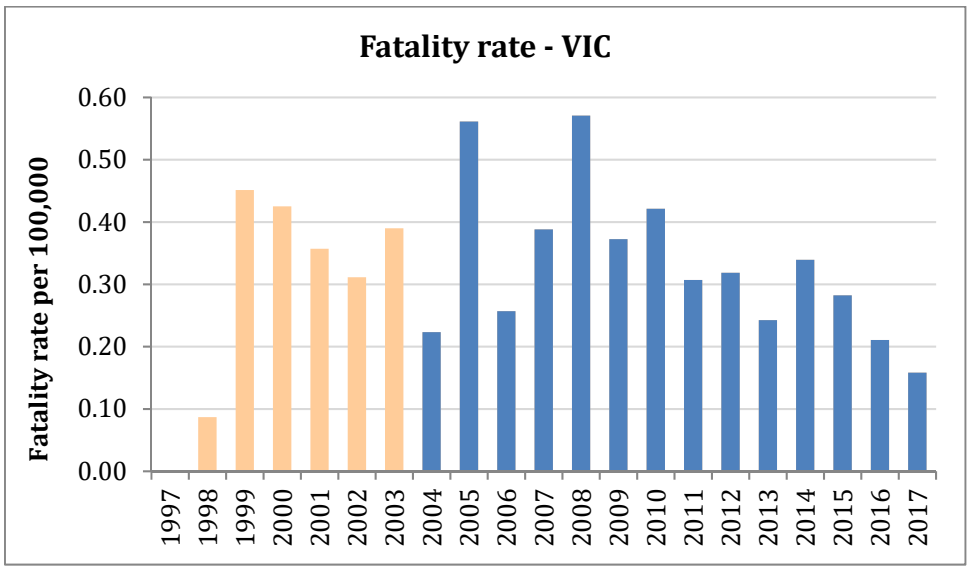


FIGURE A5-2: FATALITY RATE PER 100,000 POPULATION FOR VICTORIA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

3: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 1997 DATA WAS NOT AVAILABLE.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

The vast majority (85.5%, n=218) of deaths in Victoria have occurred in single-fatality fires. Just 8.7% (n=22) occurred in double-fatality fire incidents, there were three incidents of triple- or quadruple-fatality fires and one fire killed over four people. That is, there were 16 multiple fatality fires which killed 37 people.

Fire incident details

Cause of fire

The cause of the fire was not known for 94 (37% of) cases. Of the remaining 160 cases, the majority (28.2%, n=45) were caused by *smoking materials*, within this, 11.9% (n=19) of deaths were associated with *smoking in bed* (Figure 57). A further 11.9% (n=19) were caused by an *electrical fault*, and 10.0% (n=16) by *candles, lamps or similar*.

Time of day

The time of day (to the nearest hour) of the fire was not known for 57 (22.4% of) cases. Of the remaining 197 cases, the majority (28.4%, n=56) occurred between the hours of midnight and 4am (Figure A5-3). Very similar numbers of deaths occurred between the hours of 12pm to 4pm (afternoon), 4am to 8am (early morning) and 8pm to 12am (night) (18.3%, 15.7% and 14.7% of deaths respectively). A total of 58.9% (n=116) died between the "sleeping hours" of 8pm to 8am.

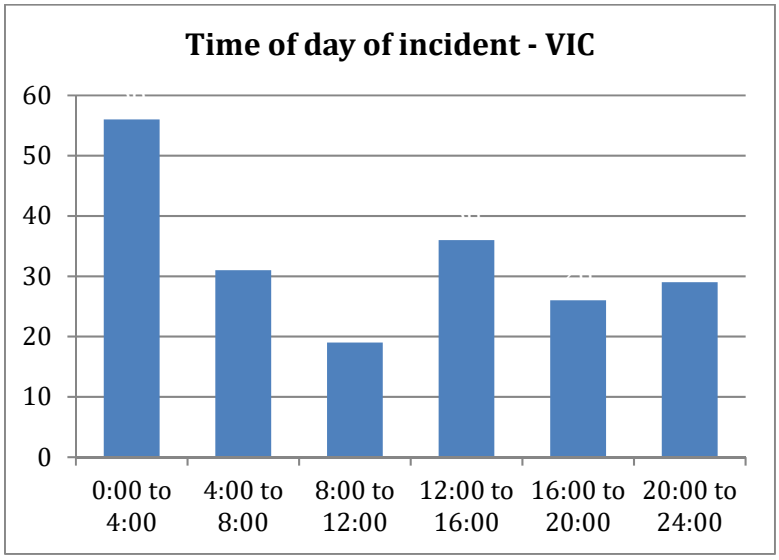


FIGURE A5-3: FATALITIES BY TIME OF DAY OF FIRE INCIDENT, VICTORIA, FY 2004 TO FY 2017

Month of incident

The majority of deaths occurred in August (15.4%, n=39) and July (13.4%, n=34), as shown in Figure A5-4: the Australian winter season when the use of heaters is more prevalent.

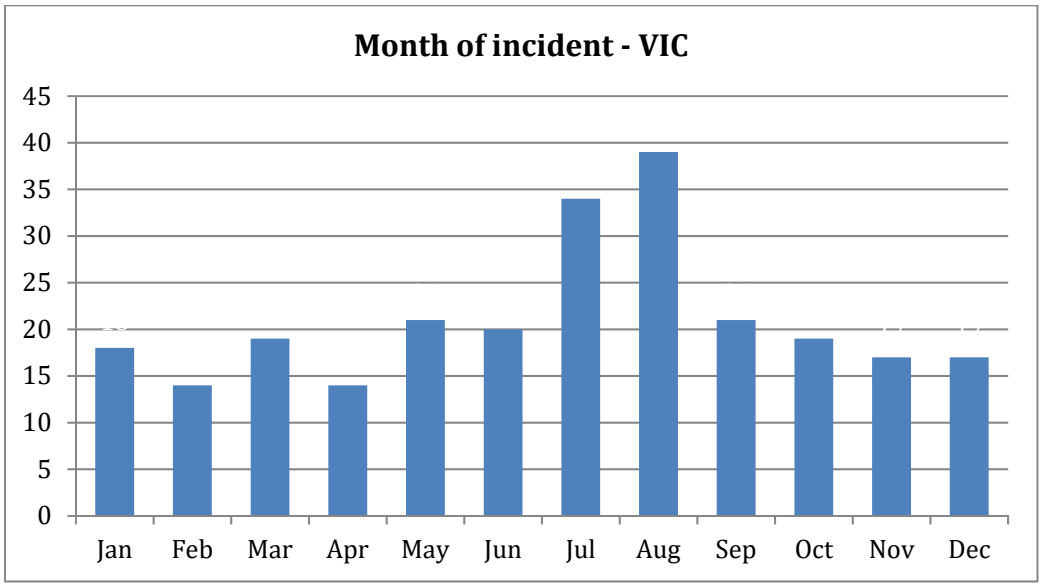


FIGURE 5A-4: FATALITIES BY MONTH OF INCIDENT, VICTORIA, FY 2004 TO FY 2017

1. JANUARY STARTS AT "12–1 O'CLOCK" AND THE FOLLOWING MONTHS RUN CLOCKWISE.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For Victoria this field was known for all but three cases. Figure A5-5 illustrates that the majority of deaths (56.6%, n=142) occurred in *major cities*. A further 29.9% (n=75) occurred in *inner regional areas*.

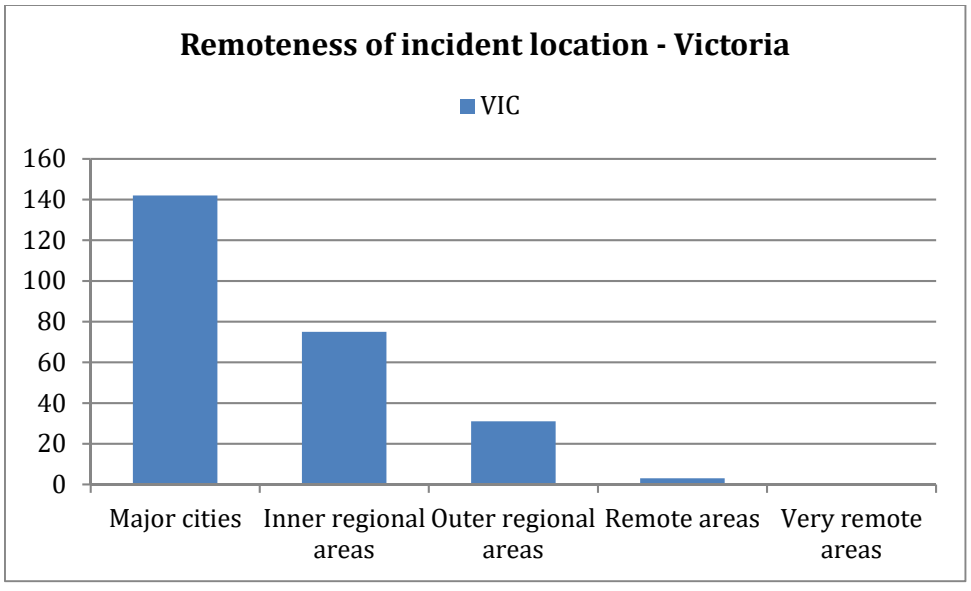


FIGURE A5-5: FATALITIES BY REMOTENESS OF LOCATION, VICTORIA, FY 2004 TO FY 2017

Further analysis was carried out on the RA data from Victoria, NSW and QLD in relation to fatality rates. The population data for each RA within these states was taken into account in order to determine the relative vulnerabilities of people living in these areas to fatal residential fires. Table A5-1 shows the data for Victoria.

It should be noted that all of the RA fatality rates are high relative to, say, the age-gender fatality rates because the RA rate is relative to, for example, Victorian *remote areas* whereas, in the age-gender calculations, the rate was calculated relative to the national value. *Remote areas* of Victoria are over-represented amongst fire fatalities, having a fatality rate of 7.01 per 100,000 of that population: however, the actual numbers of fatalities are extremely low, so this must be viewed with some caution.

Remoteness Area	Fatalities	Percentage	Fatality rates per 100,000
Major cities	142	56.6	0.22
Inner regional areas	75	29.9	0.48
Outer regional areas	31	12.4	0.91
Remote areas	<5	N/A	7.01
Very remote areas	0	0.0	-
Unknown	<5	N/A	
Total	254	100.0	

TABLE A5-1: FATALITY RATES PER 100,000 POPULATION BY REMOTENESS OF LOCATION, VICTORIA, FY 2004 TO FY 2017

1. THE FATALITY RATE WAS CALCULATED USING THE ABS CENSUS FIGURE FOR 2016 BUT, AS THE TIME PERIOD COVERS 14 YEARS (FY2004 TO 2017), IT CAN ONLY BE AN APPROXIMATION OF THE FATALITY RATES. THEREFORE, THESE FATALITY RATES SHOULD NOT BE USED IN COMPARISON WITH FATALITY RATES FOR ANY OTHER CAUSES OF DEATHS UNLESS CALCULATED USING THE SAME METHOD.
2. PERCENTAGES SHOWN ARE THOSE FOR KNOWN CASES ONLY.
3. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

The residence

Type of structure

The type of structure was known for all 254 Victorian decedents. The majority of decedents (68.5%, n=174) were in a *free-standing house/ villa*, 7.9% (n=42) were in a *unit/ apartment (below or equal 25m)*. A further 4.7% (n=12) were in a *caravan/ campervan/ mobile home/ cabin* and 3.9% (n=10) in a *granny flat/ other secondary structure*.

Property tenure

The property tenure was unknown for 50.4% (n=126) of Victorian decedents. Of the known cases, the majority (55.5%, n=71) of residences were *owner occupied*. A further 14.8% (n=19) were *private rental*, and 11.7% (15) each were: *supported accommodation (e.g., group housing etc)* and *transient visitor (e.g., relative or friend)*. A small number were *public rental (e.g., Dept Housing)* and *squatting* – 3.1% and 2.3% respectively.

Relationship between residents

The relationship between the residents at the decedent's residence was known for 241 of the 254 Victorian decedents. Figure A5-6 shows that, of known cases, 49.8% (n=120) of decedents lived *alone*, 28.6% (n=69) lived *with other family* and 10.4% lived *with a partner*.

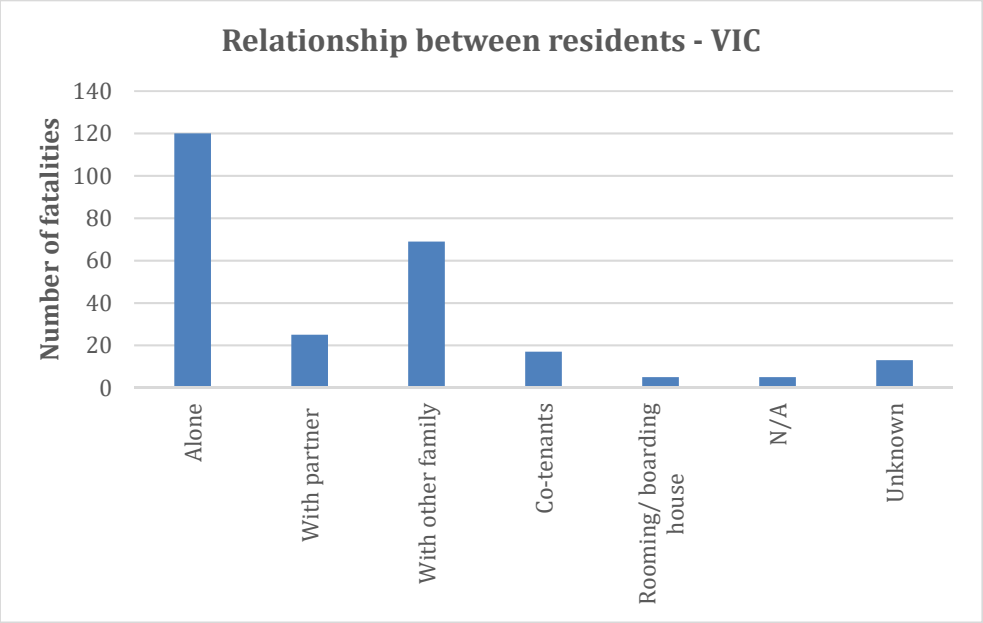


FIGURE A5-6: FATALITIES BY RELATIONSHIP BETWEEN RESIDENTS, VICTORIA, FY 2004 TO FY 2017

Smoke alarms

Whether a smoke alarm was present or not was not known for 62.2% (n=158) of Victorian cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence. This was the case for a further 19 (19.8% of) cases. Of the remaining 77 known cases, a smoke alarm was present in 66.2% (n=51) of the cases and was not in 33.8% of (n=26) cases, as shown in Table A5-2 and Figure A5-7 (the latter showing the data for NSW and Queensland in addition to that from Victoria).

Figure A5-7 shows the large number of cases for which this information was unknown. In one third of known cases for Victoria, there was no smoke alarm present.

Smoke alarm present?	Fatalities	Percentage
Yes	51	66.2
No	26	33.8
N/A	19	
Unknown	158	
Total	254	100

TABLE A5-2: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, VICTORIA, FY 2004 TO FY 2017

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

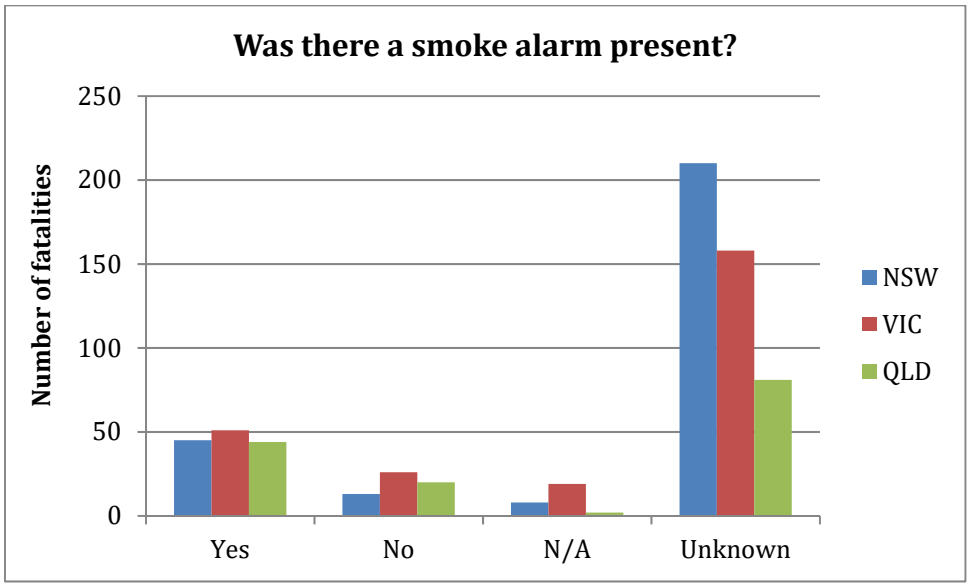


FIGURE A5-7: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, NSW, VICTORIA AND QLD, FY 2004 TO FY 2017

Whether any smoke alarm present was working or not was not known for 67.3% (n=171) of Victorian cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence, or if it was known that there was no smoke alarm present. This was the case for a further 47 (56.6% of) cases. Of the remaining 36 known cases, a smoke alarm was present and working in 83.3% (n=30) of the cases and was not in 16.7% of (n=6) cases, as shown in Table A5-3 and Figure A5-8 (the latter showing the data for NSW and QLD in addition to that from Victoria).

Figure A5-8 shows the large number of cases for which this information was unknown. In the majority of cases for Victoria for which this was known, there was a smoke alarm present and working. NSW and Victoria show very similar results in this regard.

Smoke alarm present and working?	Fatalities	Percentage
Yes	30	83.3
No	6	16.7
N/A	47	
Unknown	171	
Total	254	100

TABLE A5-3: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, VICTORIA, FY 2004 TO FY 2017

2. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

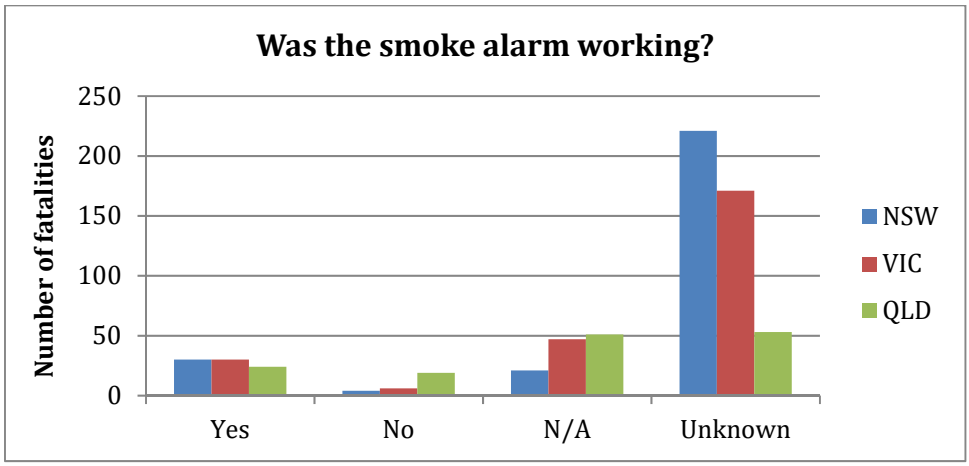


FIGURE A5-8: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, NSW, VICTORIA AND QLD, FY 2004 TO FY 2017

The people

Gender

The overall male:female death ratio is 2.3 (i.e., 2.3 males have died to every one female). Another way of saying this is that, of the 254 Victorian fatalities, almost 70% of them were male and 30% female.

Age

Figure A5-9 shows that the highest numbers of fatalities have occurred evenly amongst the 35-44 to 85+ age groups, ranging from 13.8% of the total deaths (n=35) in the 75-84 group to 11.8% (n=30) in the 85+ group.

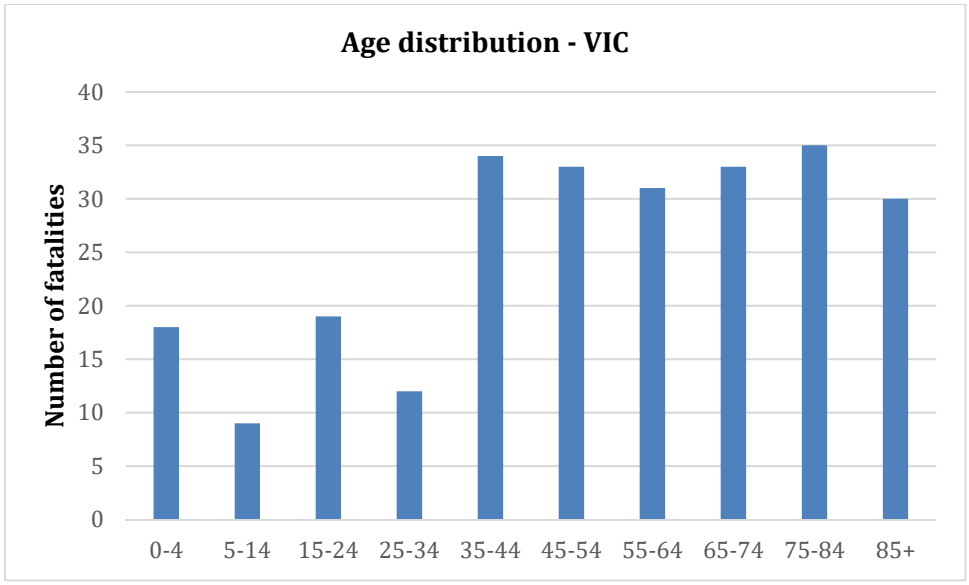


FIGURE A5-9: FATALITIES BY AGE, VIC, FY 2004 TO FY 2017

Table A5-4 and Figure A5-10 show that numbers of decedents were distributed fairly equally across the 10-year age groups from 35-44 to ≥85 (n=30–35). The least fatalities occurred within the 5-14 year age group. Of note is the relatively high numbers of male decedents within the 45-54 and 55-64 age groups.

Age group	Male	M %	Female	F %	Total	T %	M:F Death Ratio
0-4	<15	N/A	<5	N/A	18	7.1%	3.5
5-14	<10	N/A	<5	N/A	9	3.5%	3.5
15-24	14	7.9%	5	6.5%	19	7.5%	2.8
25-34	<15	N/A	<5	N/A	12	4.7%	5.0
35-44	24	13.6%	10	13.0%	34	13.4%	2.4
45-54	28	15.8%	5	6.5%	33	13.0%	5.6
55-64	26	14.7%	5	6.5%	31	12.2%	5.2
65-74	19	10.7%	14	18.2%	33	13.0%	1.4
75-84	16	9.0%	19	24.7%	35	13.8%	0.8
≥85	19	10.7%	11	14.3%	30	11.8%	1.7
Total	**177**	**100%**	**77**	**100%**	**254**	**100.0%**	**2.3**

TABLE A5-4: FATALITIES IN VICTORIA BY AGE AND GENDER, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS VICTORIA IN THE FOLLOWING PROPORTIONS: 55% IN FY 2017, 7% IN FY 2016 & 8% IN FY 2015.

2. ALL FIGURES LESS THAN 5 HAVE BEEN DENOTED "<5", AS PART OF OUR AGREEMENT IN RELATION TO ACCESSING NCIS CASES.

Gender and age

Males are over-represented throughout most age groups, with the 75-84 age group the only age group where more females than males have died (Table A5-4). In Figure A5-10, Victorian population figures are used to calculate fatality rates. Males and females in the 75-84 age group are over-represented (fatality rates of 1.62 and 1.55). They are also both over-represented in the ≥85 group (fatality rates of 2.13 and 0.74 respectively), although there are relatively few males of ≥85 in the general population. There is little difference in fatality rates amongst males in the 45-54, 55-64 and 65-74 age groups (0.84, 0.88 and 0.88). There is also a similarly high fatality rate amongst males aged 0-4 (0.54).

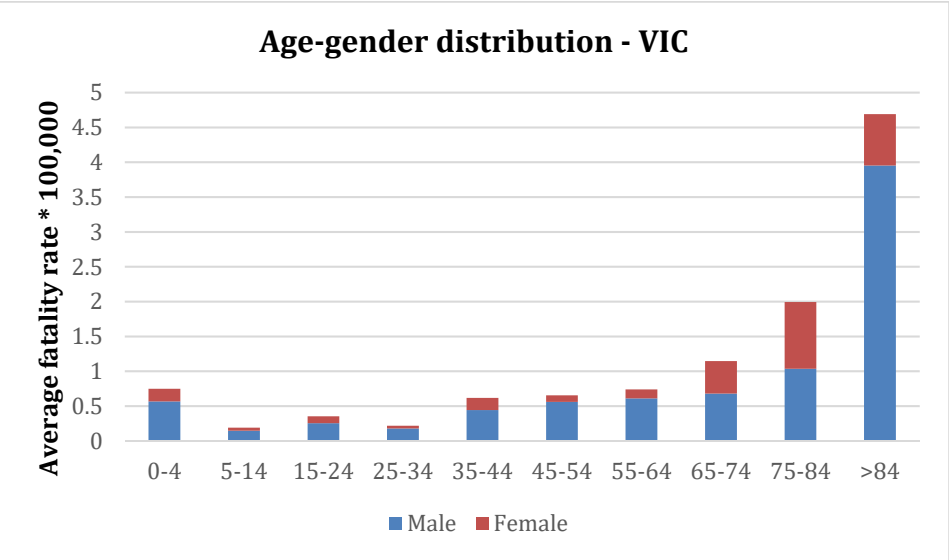


FIGURE A5-10: FATALITY RATES PER 100,000 POPULATION BY AGE AND GENDER, VICTORIA, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of 41.3% (n=105) of Victorian cases was not known. Of the remainder, 98.7% (n=147) did not identify as Aboriginal/ TSI, 1.3% did.

Country of birth

The most common countries of birth of decedents from Victoria, after Australia, were Greece and India, followed by Hungary, New Zealand and the United Kingdom, and then Egypt. The greatest number of such decedents were born in European countries. Fire victims originated from a total of 24 countries outside of Australia.

Primary employment status

The primary employment status was known for 90.6% (n=230) of the 256 decedents. Sixty percent (n=138) of decedents were retired/ age pensioners, 15.2% (n=35) were employed full time and 12.2% (n=28) were unemployed. A further 8.7% (n=20) were N/A – this category often referred to children under school age.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For Victoria, 41.1% (n=101) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%) (Figure A5-11). However, the highest fatality occurrences show a fairly wide spread across the following 5-percentile units (not shown): the 21-26 percentile (10.2%, n=25), 6-11 percentile (9.8%, n=24), 41-46 percentile (9.3%, n=23), 11-16 percentile (8.9%, n=22) and 51-56 percentile (7.3%, n=18).

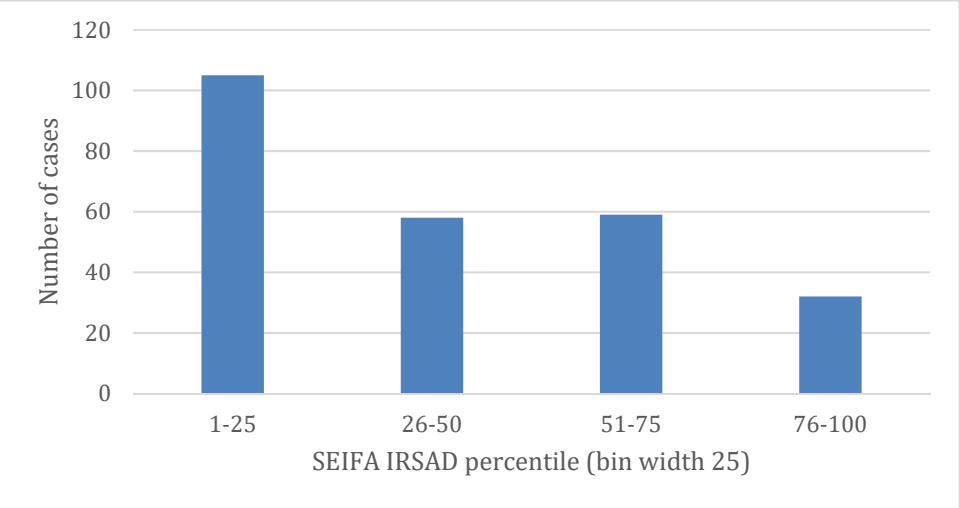


FIGURE A5-11: FATALITIES BY SOCIO-ECONOMIC CONDITION, VIC (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004-2017

1. THE X AXIS IS MEASURED IN 25-PERCENTILE UNITS, STARTING FROM 1-25: THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO 76-100: THE LEAST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS.

Ability to live at home

The ability of the decedent to live at home was not known for 35.8% (n=91) of cases. Of the remaining 163 cases, 24.5% (n=40) *required support to live at home*, 75.5% (n=123) did not.

NEW SOUTH WALES

NOTE: the FY17 results for NSW could be an under-estimation as 18% of all coronial cases were not available for examination. This figure was 13% for FY16 and 11% for FY15.

Key statistics

- Highest number of deaths amongst Australian jurisdictions (276)
- Annual fatality rates from 0.17 to 0.43 per 100,000: generally just below the national average
- Majority of deaths amongst *65-74* and *75-84* age groups
- Male:female death ratio 1.9 but ≥4.0 for *15-24* and *45-54* age groups
- Fatality rates highest amongst *65-74*, *75-84* (especially M) and *≥85* groups
- 64.4% of deaths from *8pm-8am*
- The month when most deaths occurred: *September*
- Most deaths occurred in *major cities*, *very remote areas* over-represented
- *Smoking materials* the most common cause of fatal fires
- Over-representation of *indigenous* deaths by a factor of 2
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived alone* or *with other family*
- Most deaths occurred in areas of greater socio-economic disadvantage (51.6% in IRSAD percentiles of ≤25).

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 276 deaths have occurred in 251 preventable residential fires in New South Wales (NSW): an average of 19.7 deaths per year. In addition, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note: the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records.) Tables 6 and 7 (pp. 37 and 40) show the numbers of fatalities and fatality rates per 100,000 of the population of NSW.

These results are shown in Figures A5-12 (numbers of fatalities) and A5-13 (fatality rates per 100,000 population of NSW).

A slight downward trend throughout the FY2004-2017 period of record shown on Figure A5-12 may be at least partially due to a substantial number of Coroner's cases in more recent years that have not been closed and are therefore not part of the record.

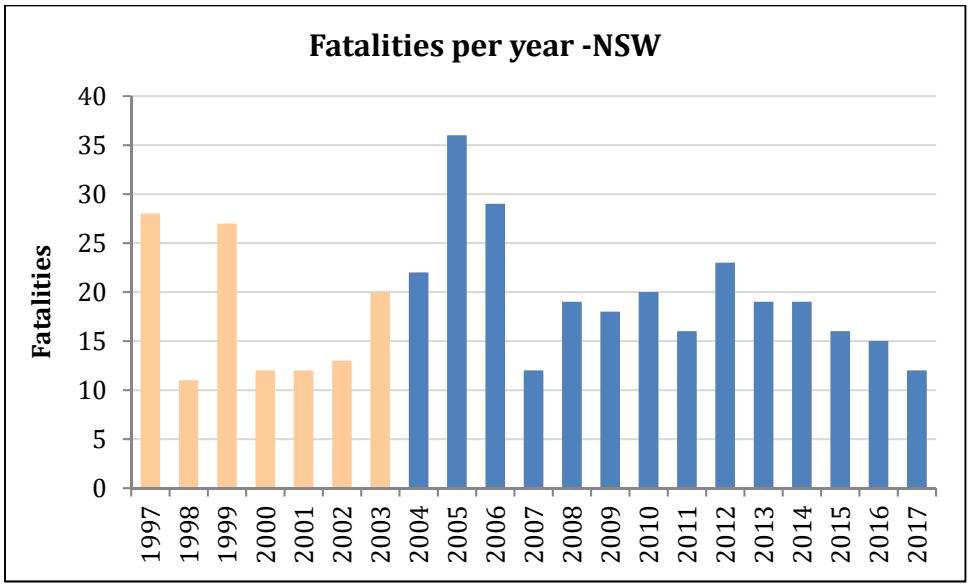


FIGURE A5-12: TOTAL FATALITIES ACROSS NSW, FY 1997 TO FY 2017, SHOWING TREND LINE

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY.

3: THE FY 2017 FIGURE IS AN UNDER-REPRESENTATION BY APPROX. 18%, FY16 BY 13% AND FY15 BY 11%.

4: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Fatality rates

The fatality rate (Figure A5-13) shows a more marked downward trend, although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. In general, NSW sits just below the national average fatality rate.

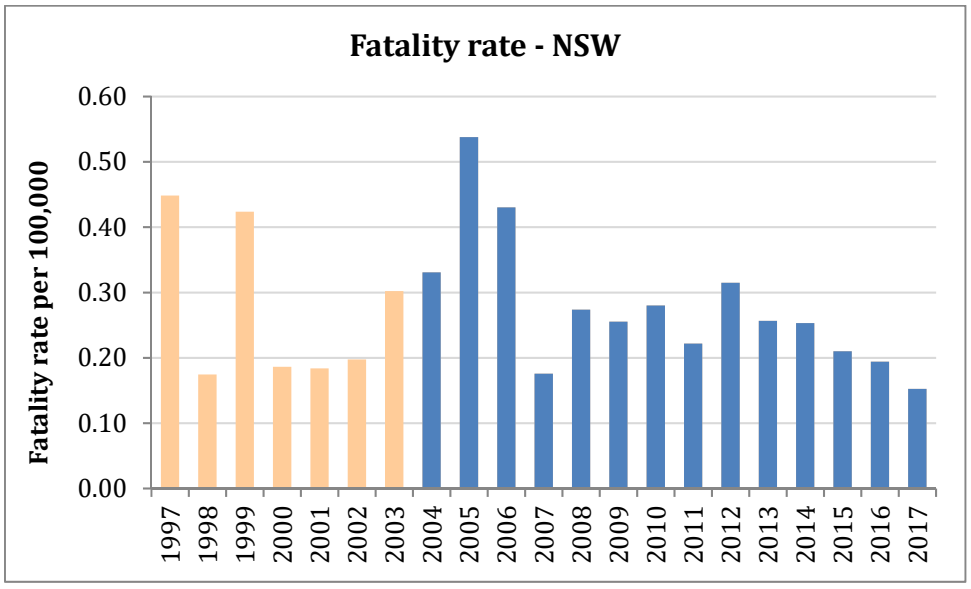


FIGURE A5-13: FATALITY RATE PER 100,000 POPULATION FOR NSW, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS NSW IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 13% IN FY 2016 & 11% IN FY 2015.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

The vast majority (84.8%, n=234) of deaths in NSW have occurred in single-fatality fires. A further 8.7% (n=22) occurred in double-fatality fires and there were five incidents of triple- or quadruple-fatality fires. There were 17 multiple fatality fires which killed 42 people.

Fire incident details

Cause of fire

The cause of the fire was not known for 85 (30.8% of) cases. Of the remaining 191 cases, *smoking materials* were the primary cause of the fire in 23.6% (n=45) of cases. Within this result, 17.3% (n=33) were caused by a cigarette or similar and 6.3% (n=12) were caused by smoking in bed. Equal numbers (15.7%, n=30) were killed in fires caused by a *heater or similar* and *kitchen fire/ cooking materials*.

Time of day

The time of day (to the nearest hour) of the fire was not known for 77 (27.9% of) cases. Of the remaining 199 cases, 30.7% (n=61) occurred between the hours of midnight and 4am, followed by early morning (4-8am: 15.1%, n=43) (Figure A5-14). The next most common time periods for deaths to occur were between the hours of 4-8pm (early afternoon: 15.6%, n=31) and 8pm to 12am (night: 12.1%, n=24). A total of 64.3% (n=128) died between the "sleeping hours" of 8pm to 8am.

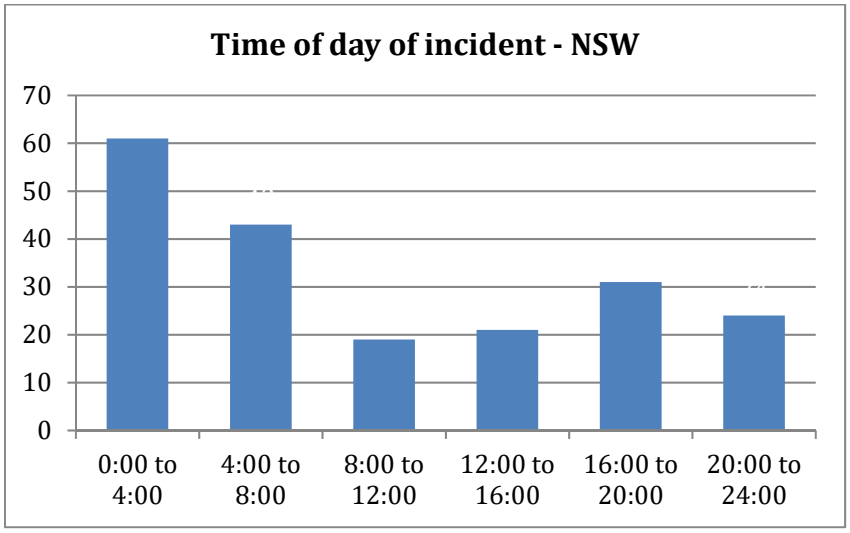


FIGURE A5-14: FATALITIES BY TIME OF DAY OF FIRE INCIDENT, NSW, FY 2004 TO FY 2017

Month of incident

The majority of deaths occurred in *September* (12.3%, n=34), as shown in Figure A5-15, followed by a fairly even spread across the Australian winter months of *June* (10.1%, n=28), *July* (9.8%, n=27) and *August* (10.9%, n=30) and also the late spring/ early summer months of *November* and *December* (each 10.1%, n=28).

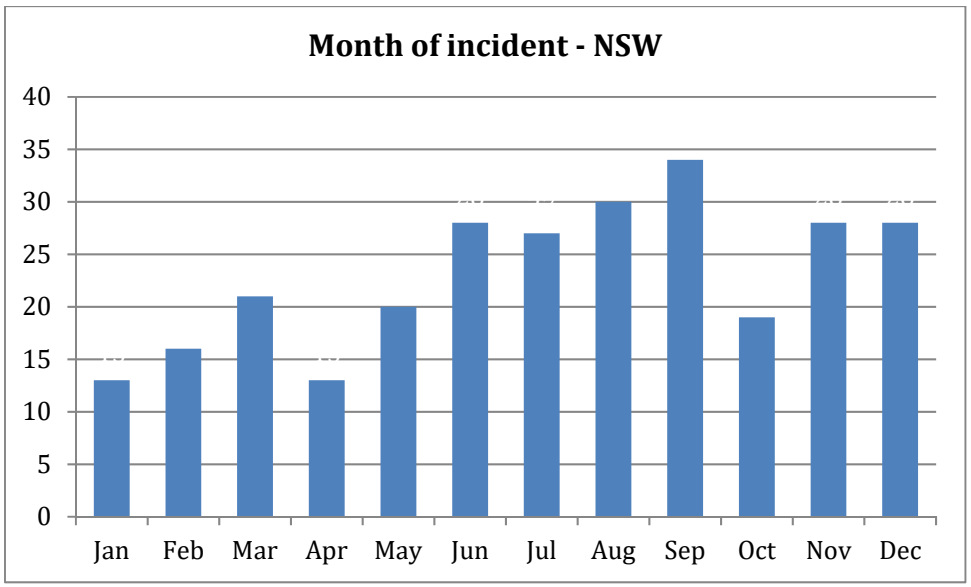


FIGURE A5-15: FATALITIES BY MONTH OF INCIDENT, NSW, FY 2004 TO FY 2017

JANUARY STARTS AT "12–1 O'CLOCK" AND THE FOLLOWING MONTHS RUN CLOCKWISE.

Remoteness of deaths

The Remoteness Area structure (RA) (described on p.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For NSW this field was known for all cases. The majority of deaths (66.3%, n=183) occurred in *major cities*. A further 19.9% (n=55) occurred in *inner regional areas*.

Further analysis was carried out on the RA data from Victoria, NSW and QLD in relation to fatality rates. The population data for each RA within these states was taken into account in order to determine the relative vulnerabilities of people living in these areas to fatal residential fires. Table A5-5 shows the data for NSW.

It should be noted that all of the RA fatality rates are high relative to, say, the age-gender fatality rates because the RA rate is relative to, e.g., NSW *remote areas* whereas, in the age-gender calculations, the rate was calculated relative to the national value. Even though the actual numbers of fatalities of those who lived in the more remote areas of NSW are low, *very remote areas* are over-represented amongst fire fatalities, with a fatality rate of 3.78 per 100,000 of that population. To a lesser extent, *remote areas* are also over-represented, having a fatality rate of 0.73 per 100,000 of that population. However, the numbers of fatalities are extremely low, so these results must be viewed with caution.

Remoteness Area	Fatalities	Percentage	Fatality rates
Major cities	183	66.3	0.23
Inner regional areas	55	19.9	0.28
Outer regional areas	32	11.6	0.53
Remote areas	<5	N/A	0.73
Very remote areas	<5	N/A	3.78
Total	276	100.0	

TABLE A5-5: FATALITY RATES BY REMOTENESS OF LOCATION, NSW, FY 2004 TO FY 2017

1. THE FATALITY RATE WAS CALCULATED USING THE ABS CENSUS FIGURE FOR 2016 BUT, AS THE TIME PERIOD COVERS 14 YEARS (FY2004 TO 2017), IT CAN ONLY BE AN APPROXIMATION OF THE FATALITY RATES. THEREFORE, THESE FATALITY RATES SHOULD NOT BE USED IN COMPARISON WITH FATALITY RATES FOR ANY OTHER CAUSES OF DEATHS UNLESS CALCULATED USING THE SAME METHOD.
2. PERCENTAGES SHOWN ARE THOSE FOR KNOWN CASES ONLY.
3. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS NSW IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 13% IN FY 2016 & 11% IN FY 2015.

The residence

Type of structure

The type of structure was known for 275 of the 276 NSW decedents. The majority of decedents (68.5%, n=174) were in a *free-standing house/ villa*, 7.9% (n=42) were in a *unit/ apartment (below or equal 25m)*. A further 4.7% (n=12) were in a *caravan/ campervan/ mobile home/ cabin* and 3.9% (n=10) in a *granny flat/ other secondary structure*.

Property tenure

The property tenure was not known for 70.3% (n=194) of NSW decedents. Of the remainder, the majority (46.3%, n=38) of residences were *owner occupied*, 19.5% were *private rental* and 17.1% (n=14) were *supported accommodation (e.g., group housing etc)*. Another 7.3% (n=6) were *public rental (e.g., Dept Housing)*.

Relationship between residents

The relationship between the residents at the decedent's residence was not known for 22.8% (n=63) of NSW decedents. Of the remainder, almost half (45.7%, n=95) of decedents lived *alone*, 36.5% (n=76) lived *with other family* and 13.9% (n=29) lived *with a partner*.

Smoke alarms

Whether a smoke alarm was present or not was not known for 76.1% (n=210) of NSW cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence. This was the case for a further 8 (2.3% of) cases. Of the remaining 58 known cases, a smoke alarm was present in 77.6% (n=45) of the cases and was not in 22.4% of (n=13) cases, as shown in Table A5-6 and Figure A5-7 (the latter showing the data for NSW and Queensland in addition to that from Victoria).

What is immediately apparent from Figure A5-7 is the large number of cases for which this information was unknown.

Figure A5-7 shows the large number of cases for which this information was unknown. In almost a quarter of known cases for NSW, there was no smoke alarm present.

Smoke alarm present?	Fatalities	Percentage
Yes	45	77.6
No	13	22.4
N/A	8	
Unknown	210	
Total	276	100

TABLE A5-6: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, NSW, FY 2004 TO FY 2017

1: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS NSW IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 13% IN FY 2016 & 11% IN FY 2015.

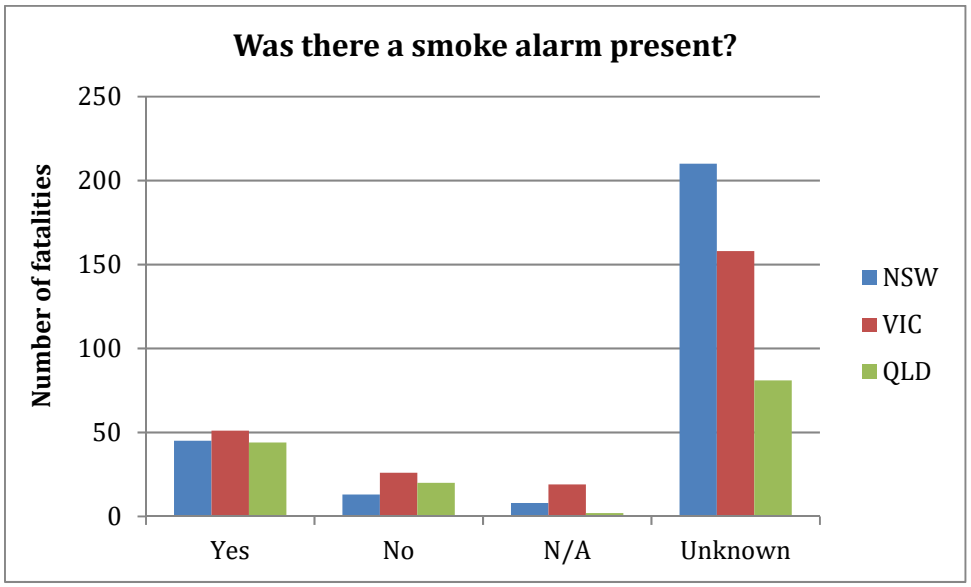


FIGURE A5-7: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, NSW, VICTORIA AND QLD, FY 2004 TO FY 2017

Whether any smoke alarm present was working or not was not known for 80.1% (n=221) of NSW cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence, or if it was known that there was no smoke alarm present. This was the case for a further 21 (38.2% of) cases. Of the remaining 34 known cases, a smoke alarm was present and working in 88.2% (n=30) of the cases and was not in 11.8% of cases, as shown in Table A5-6 and Figure A5-8 (the latter showing the data for Victoria and Queensland in addition to that from NSW).

Figure A5-8 shows the very large number of cases for which this information was unknown. In the majority of cases for NSW for which this was known, there was a smoke alarm present and working. NSW and Victoria show very similar results in this regard.

Smoke alarm present and working?	Fatalities	Percentage
Yes	30	88.2
No	<5	N/A
N/A	21	
Unknown	221	
Total	276	100

TABLE A5-7: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, NSW, FY 2004 TO FY 2017

1: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS NSW IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 13% IN FY 2016 & 11% IN FY 2015.

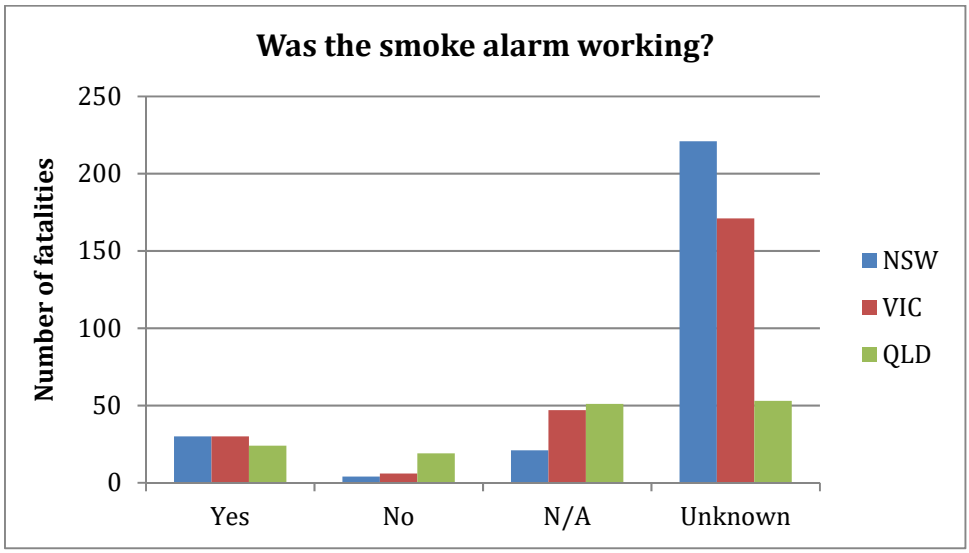


FIGURE A5-8: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, NSW, VICTORIA AND QLD, FY 2004 TO FY 2017

The people

Gender

The overall male:female ratio is 1.9 (i.e., 1.9 males have died to every one female). Another way of saying this is that 66% of fatalities were male and 34% were female.

Age

Figure A5-15 shows that most fatalities have occurred amongst the 75-84 (17.4%, n=48) followed by the 65-74 (16.3%, n=45) age groups.

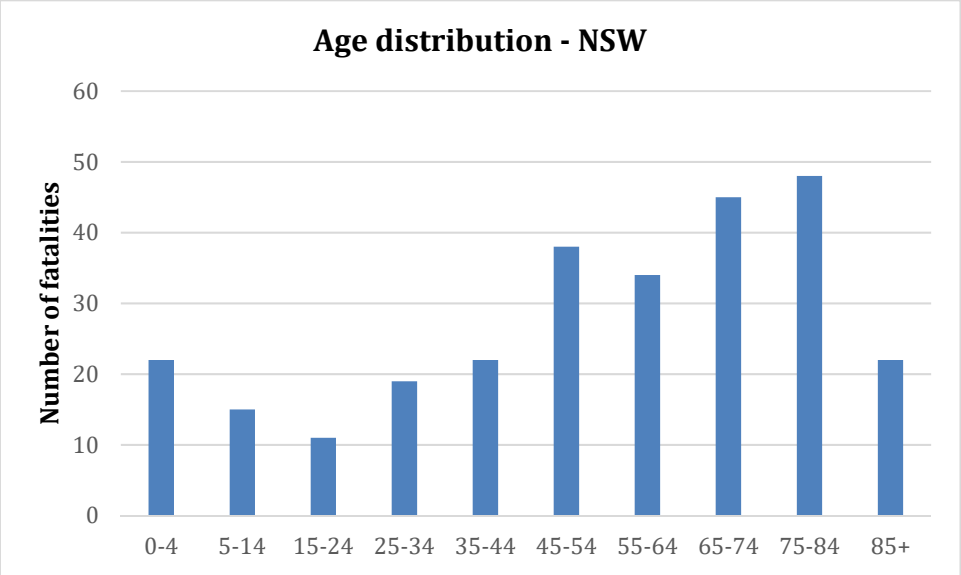


FIGURE A5-15: FATALITIES BY AGE, NSW, FY 2004 TO FY 2017

Table A5-8 and Figure A5-16 show that the greatest numbers of decedents have been within the *65-74* and *75-84* age groups. The least fatalities occurred within the *15-24* and then the *5-14* year age groups. There are a relatively high number of *male* decedents within the *45-54* age group.

Age group	Male	M %	Female	F %	Total	T %	M:F Death Ratio
0-4	13	7.2%	9	9.5%	22	8.0%	1.4
5-14	10	5.5%	5	5.3%	15	5.4%	2.0
15-24	<10	N/A	<5	N/A	11	4.0%	4.5
25-34	14	7.7%	5	5.3%	19	6.9%	2.8
35-44	13	7.2%	9	9.5%	22	8.0%	1.4
45-54	33	18.2%	5	5.3%	38	13.8%	6.6
55-64	23	12.7%	11	11.6%	34	12.3%	2.1
65-74	27	14.9%	18	18.9%	45	16.3%	1.5
75-84	31	17.1%	17	17.9%	48	17.4%	1.8
≥85	8	4.4%	14	14.7%	22	8.0%	0.6
Total	**181**	**100%**	**95**	**100%**	**276**	**100.0%**	**1.9**

TABLE A5-8: FATALITIES IN NSW BY AGE AND GENDER, FY 2004 TO FY 2017

1. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS NSW IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 13% IN FY 2016 & 11% IN FY 2015.

2. ALL FIGURES LESS THAN 5 HAVE BEEN DENOTED "<5", AS PART OF OUR AGREEMENT IN RELATION TO ACCESSING NCIS CASES.

Gender and age

The male:female ratio varies from a maximum of 6.6 and 4.5 within the *45-54* and *15-24* age groups respectively to a minimum of 0.6 within the *≥85* age group – the only age group where more *females* than males have died (Table A5-8).

Figure A5-16 shows the age and gender distribution in terms of fatality rates per 100,000 population. *Males* of *45 -54* years and over still show as over-represented, with fatality rates above 0.75. *Males* in the *75-84* group show a very high fatality rate: 3.13 – however, this may well be an outlier due to the relatively small population of males of that age in NSW. *Females* of older age groups (*65-74* years and over) also show higher fatality rates, of 0.80 and above.

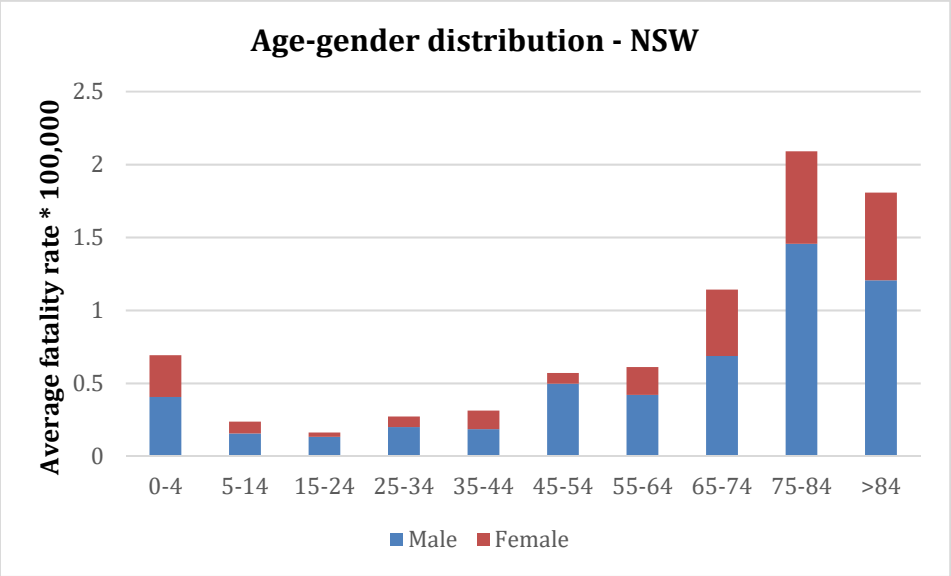


FIGURE A5-16: FATALITY RATES PER 100,000 POPULATION BY AGE AND GENDER, NSW, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of 10.5% (n=29) of NSW cases was not known. Of the remainder, 93.5% (n=231) of them did not identify as *either Aboriginal/ TSI*, 6.5% (n=16) did.

Country of birth

The most common countries of birth of decedents from NSW, after *Australia*, were the *United Kingdom*, followed by *South Korea* and *Poland*, then *Yugoslavia*. The next most common countries of birth were *China*, *Greece*, *Hungary* and *Lebanon*. The highest number of decedents born elsewhere than Australia were born in European countries. Fire victims originated from a total of 20 countries outside of Australia.

Primary employment status

The primary employment status was known for 90.9% (n=251) of the 276 NSW decedents. Some 48.2% (n=121) were *retired, pensioner*, 22.7% (n=57) were *unemployed* and 16.7% (n=42) were *employed full time*. A further 6.0% (n=15) (not shown on Figure 76) were *N/A* – this category generally referred to children under school age – and 5.6% (n=14) were students.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For NSW, 51.6% (n=142) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%)(Figure A5-17). There is a gradual lessening of numbers of fatalities, in general, in locations of lesser socio-economic disadvantage.

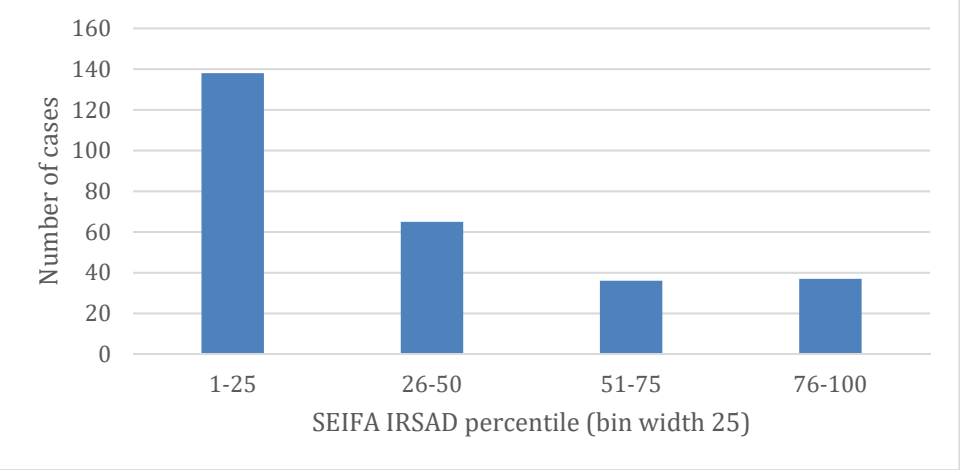


FIGURE A5-17: FATALITIES BY SOCIO-ECONOMIC CONDITION, NSW (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004-2017

1. THE X AXIS IS MEASURED IN 25-PERCENTILE UNITS, STARTING FROM 1-25: THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO 76-100: THE LEAST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS.

Ability to live at home

The ability of the decedent to live at home was not known for 54.3% (n=150) of cases. Of the remaining 126 cases, 28.6% (n=36) *required support to live at home*, 71.4% (n=90) did not.

QUEENSLAND

NOTE: the FY17 results for Queensland could be an under-estimation as 10% of all coronial cases were not available for examination. This figure was 8% for FY16 and 6% for FY15.

Key statistics

- Total of 147 deaths
- Second lowest jurisdictional fatality rate (0.22 per 100,000)
- Annual fatality rates from 0.11 to 0.46 per 100,000: generally just below the national average
- Highest number of multiple-fatality deaths amongst the jurisdictions
- Male:female death ratio 1.3 – lower than for most other jurisdictions
- Fatality rates highest amongst *75-84* and *≥85* (M) groups
- *72.6%* of deaths from *8pm-8am*
- The month when most deaths occurred: *August*
- Most deaths occurred in *major cities*, *remote* and *very remote areas* are over-represented
- *Smoking materials* the most common cause of fatal fires
- Under-representation of *indigenous* deaths by a factor of 1.6
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived with other family* – note the latter is different to the case for Victoria and NSW
- Smoke alarm present in most known cases, of which most were working
- Most deaths occurred in areas of greater socio-economic disadvantage (53.1% in IRSAD percentiles of ≤25).

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 147 deaths have occurred in 115 preventable residential fires in QLD: an average of 10.5 deaths per year. In addition, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note: the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records). Tables 6 and 7 (pp. 37 and 40) show the numbers of fatalities and fatality rates per 100,000 of the population of Queensland.

These results are shown in Figures A5-18 (numbers of fatalities) and A5-19 (fatality rates per 100,000 population of Queensland).

There is a slight downward trend throughout the FY2004-2017 period of record shown on Figure A5-18: however, the fact that a substantial number of cases were not available for viewing in more recent years must be taken into account.

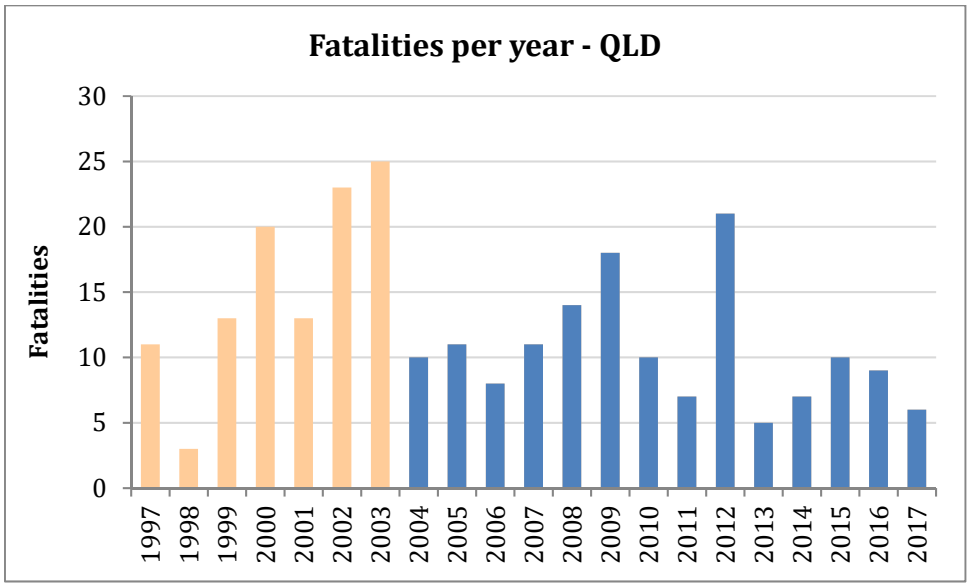


FIGURE A5-18: TOTAL FATALITIES ACROSS QUEENSLAND, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

4: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Fatality rates

The fatality rate shows a slightly more marked downward trend (Figure A5-19), although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. Queensland sits generally below the national average fatality rate.

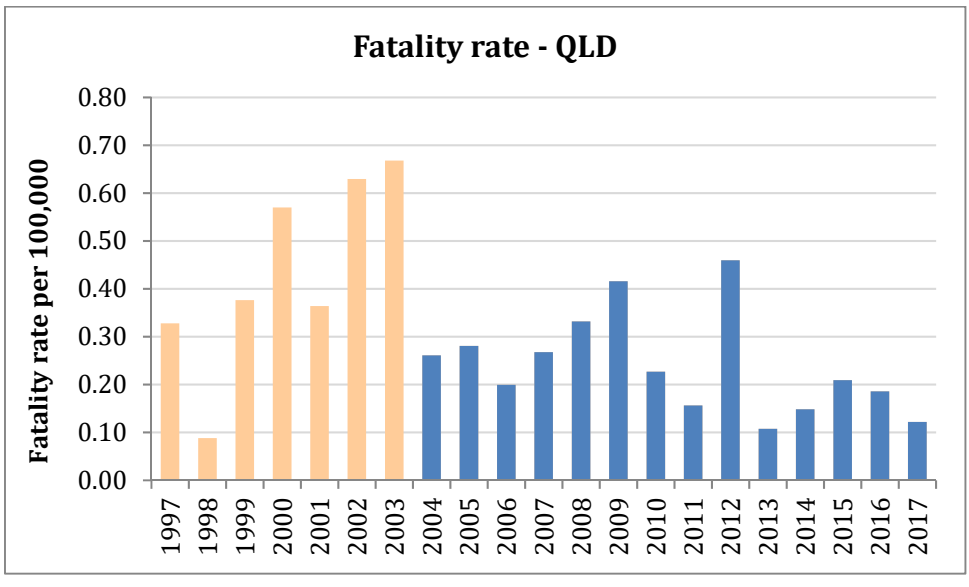


FIGURE A5-19: FATALITY RATE PER 100,000 POPULATION FOR QUEENSLAND, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

The majority (66.0%, n=97) of deaths in Queensland occurred in single-fatality fires. A further 19.0% (n=20) occurred in double-fatality fire incidents and there were three incidents of triple- and quadruple-fatality fires. One fire killed >4 people. In total, there were 18 multiple fatality fires which killed 50 people – 34.0% of the fatalities in Queensland.

Fire incident details

Cause of fire

The cause of the fire was not known for 53 (36.1% of) cases. Of the remaining 94 cases, *smoking materials* were the primary cause of the fire in a total of 25.1% (n=33) fatalities. Within this result, 20.2% (n=19) were caused by a cigarette or similar, and 14.9% (n=14) were caused by smoking in bed (Figure 87). A further 16.0% (n=15) were caused by *lighter/matches*, and 10.6% (n=10) by *heater or similar*.

Time of day

The time of day (to the nearest hour) of the fire was not known for 23 (15.6% of) cases. Of the remaining 124 cases, 35.4% (n=44) occurred between the hours of midnight and 4am (middle of the night) (Figure A5-20). Another 25 (20.1%) occurred between the hours of 4am to 8am (early morning) and 21 (16.9%) between 8pm to 12am (night). A total of 72.6% (n=90) died between the "sleeping hours" of 8pm to 8am.

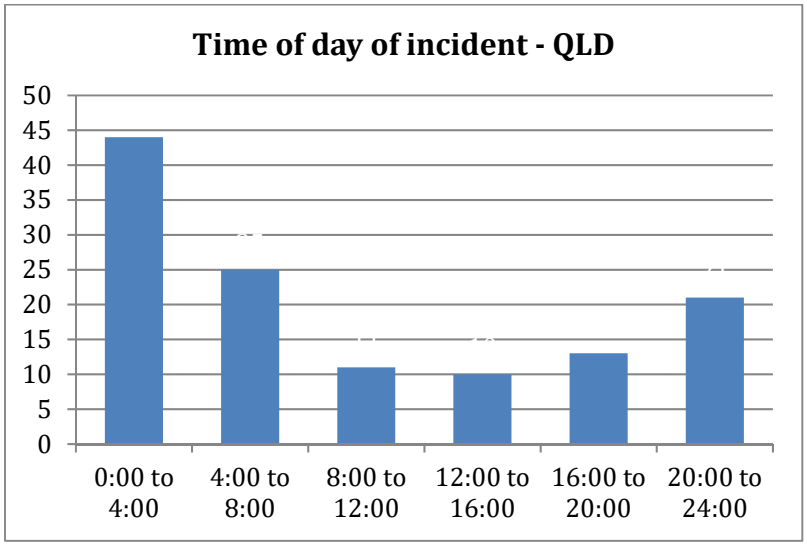


FIGURE A5-20: FATALITIES BY TIME OF DAY OF FIRE INCIDENT, QUEENSLAND, FY 2004 TO FY 2017

Month of incident

The majority of deaths occurred in *August* (23.8%, n=35) and *September* (13.6%, n=20).

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For Queensland this field was known for all cases.

Figure A5-21 illustrates that 44.9% (n=66) of deaths occurred in *major cities*. A further 27.9% (n=41) occurred in *inner regional areas*.

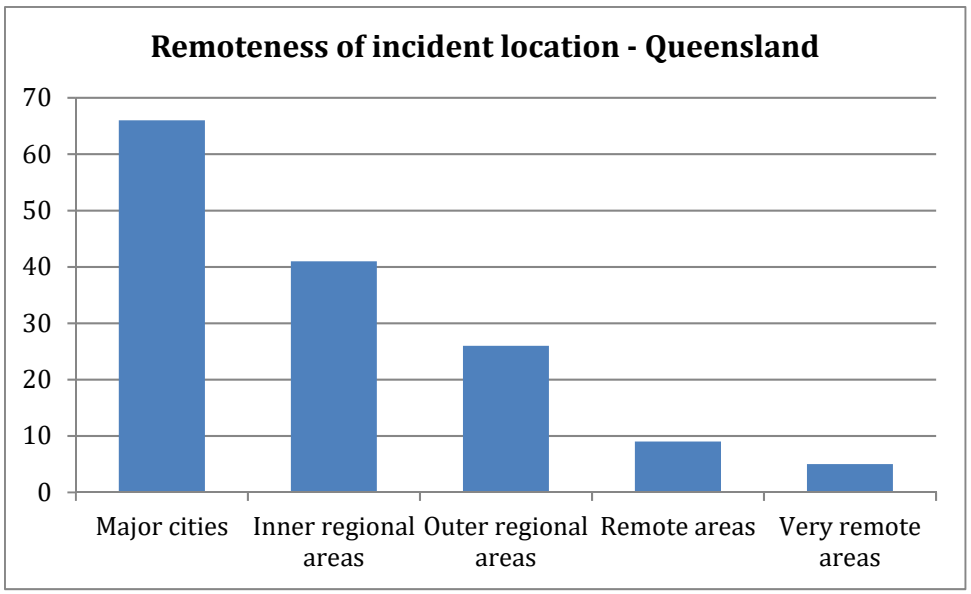


FIGURE A5-21: FATALITIES BY REMOTENESS OF LOCATION, QUEENSLAND, FY 2004 TO FY 2017

Further analysis was carried out on the RA data from Victoria, NSW and Queensland in relation to fatality rates. The population data for each RA within these states was taken into account in order to determine the relative vulnerabilities of people living in these areas to fatal residential fires. Table A5-9 shows the data for Queensland. It should be noted that all of the RA fatality rates are high relative to, say, the age-gender fatality rates because the RA rate is relative to, for example, Queensland *remote areas* whereas, in the age-gender calculations, the rate was calculated relative to the national value.

Even though the actual numbers of fatalities of those who lived in remote areas are low, *remote areas* and *very remote areas* of Queensland are over-represented amongst fire fatalities, having fatality rates of 0.90 and 0.68 per 100,000 of those populations respectively. However, the actual numbers of fatalities are extremely low, so these results must be viewed with caution.

Remoteness Area	Fatalities	Percentage	Fatality rates
Major cities	66	44.9	0.16
Inner regional areas	41	27.9	0.31
Outer regional areas	26	17.7	0.28
Remote areas	9	6.1	0.90
Very remote areas	5	3.4	0.68
Total	147	100.0	

TABLE A5-9: FATALITY RATES BY REMOTENESS OF LOCATION, QUEENSLAND, FY 2004 TO FY 2017

1. THE FATALITY RATE WAS CALCULATED USING THE ABS CENSUS FIGURE FOR 2016 BUT, AS THE TIME PERIOD COVERS 14 YEARS (FY2004 TO 2017), IT CAN ONLY BE AN APPROXIMATION OF THE FATALITY RATES. THEREFORE, THESE FATALITY RATES SHOULD NOT BE USED IN COMPARISON WITH FATALITY RATES FOR ANY OTHER CAUSES OF DEATHS UNLESS CALCULATED USING THE SAME METHOD.
2. PERCENTAGES SHOWN ARE THOSE FOR KNOWN CASES ONLY.
3. THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

The residence

Type of structure

The type of structure was known for all but two of the Queensland decedents. The majority of decedents (79.3%, n=115) were in a *free-standing house or villa*, 8.3% (n=12) were in a *unit/ apartment (below or equal 25m)*. A further 6.2% (n=9) of decedents were in the vicinity of a *shed/ garage*.

Property tenure

The property tenure was unknown for 58.5% (n=86) of Queensland decedents. Of the known cases, the majority (55.7%, n=34) of residences were *owner occupied*. A further 26.2% (n=16) were *private rental* further 6.6% were *transient visitors*.

Relationship between residents

The relationship between the residents at the decedent's residence was known for 126 of the 147 Queensland decedents. Of known cases, 43.7% (n=55) of decedents lived *with other family*, 28.6% (n=36) lived *alone* and 20.6% (n= 26) lived *with partner*. These figures differ from Victoria and NSW, where living alone was most common.

Smoke alarms

Whether a smoke alarm was present or not was not known for 55.1% (n=81) of Queensland cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence. This was the case for a further 3.0% of cases. Of the remaining 64 known cases, a smoke alarm was present in 68.8% (n=44) of the cases and was not in 31.2% of (n=20) cases, as shown in Table A5-10 and Figure A5-7 (the latter showing the data for NSW and Victoria in addition to that from Queensland).

Figure A5-7 shows the large number of cases for which this information was unknown. In almost one third of known cases for Queensland, there was no smoke alarm present.

Smoke alarm present?	Fatalities	Percentage
Yes	44	68.8
No	20	31.2
N/A	<5	
Unknown	81	
Total	147	100

TABLE A5-10: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, QUEENSLAND, FY 2004 TO FY 2017

1: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

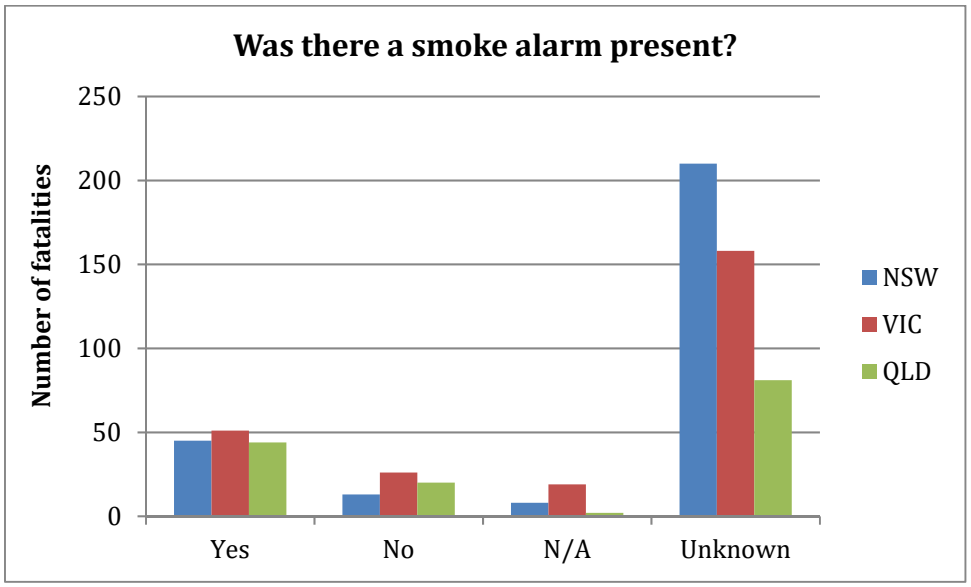


FIGURE A5-7: FATALITIES BY THE PRESENCE/ ABSENCE OF A SMOKE ALARM, NSW, VICTORIA AND QUEENSLAND, FY 2004 TO FY 2017

Whether any smoke alarm present was working or not was not known for 36.1% (n=53) of Queensland cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence, or if it was known that there was no smoke alarm present. This was the case for a further 51 (54.3% of) cases. Of the remaining 36 known cases, a smoke alarm was present and working in 55.8% (n=24) of the cases and was not in 44.2% of (n=19) cases, as shown in Table A5-11 and Figure A5-8 (the latter showing the data for NSW and Victoria in addition to that from Queensland).

Figure 65 shows that, unlike NSW and Victoria, Queensland has only a moderate amount of cases for which the presence/ absence of a working smoke alarm was not known. A difference of concern is that smoke alarms were present and working in only just over half of those cases known.

Smoke alarm present and working?	Fatalities	Percentage
Yes	24	55.8
No	19	44.2
N/A	51	
Unknown	53	
Total	147	100

TABLE A5-11: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, QUEENSLAND, FY 2004 TO FY 2017

1: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

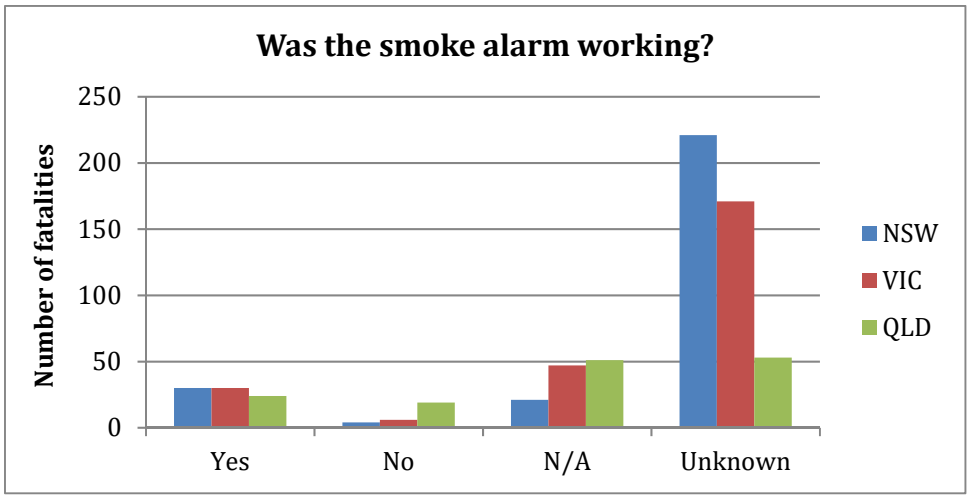


FIGURE A5-7: FATALITIES BY THE PRESENCE/ ABSENCE OF A WORKING SMOKE ALARM, NSW, VIC AND QLD, FY 2004 TO FY 2017

The people

Gender

The overall male:female death ratio is 1.3 (i.e., 1.3 males have died to every one female in Queensland). That is, 56% of fatalities were male and 44% were female.

Age

Figure A5-21 shows the fatalities have a fairly even spread across all age groups. Most fatalities have occurred amongst the 55-64 (12.9%, n=19) followed by the 35-44 (16.3%, n=17), 45-54 (10.9%, n=16) and 75-84 (10.9%, n=16) age groups.

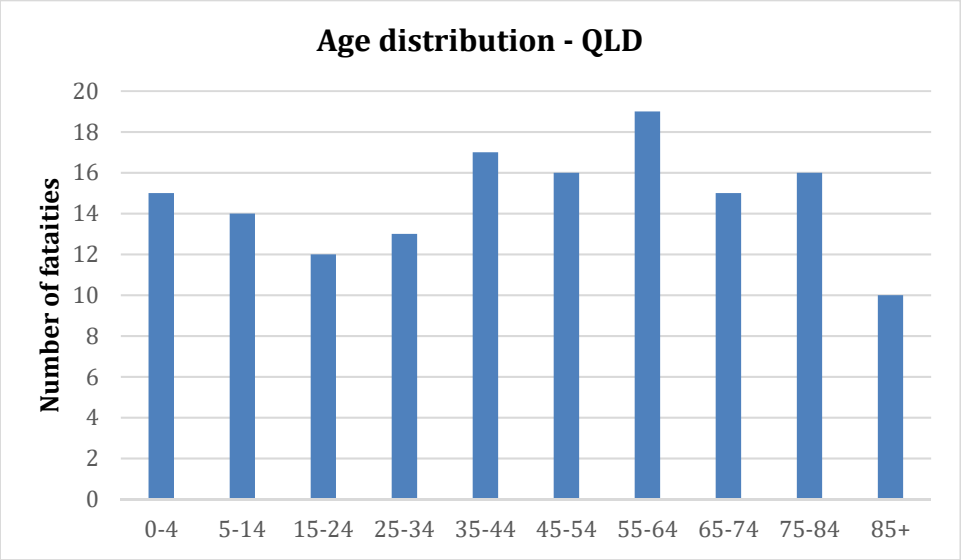


FIGURE A5-21: FATALITIES BY AGE, QUEENSLAND, FY 2004 TO FY 2017

Table A5-12 and Figure A5-22 show that fatalities were distributed equally across age groups. The least fatalities occurred in the *≥85*, *15-24* and *25-34* age groups. There are a relatively high number of *male* decedents in the *55-64* age group.

Age group	Male	M %	Female	F %	Total	T %	M:F Death Ratio
0-4	6	7.3%	9	13.8%	15	10.2%	0.7
5-14	<5	N/A	<15	N/A	14	9.5%	0.4
15-24	6	7.3%	6	9.2%	12	8.2%	1.0
25-34	<10	N/A	<5	N/A	13	8.8%	2.3
35-44	7	8.5%	10	15.4%	17	11.6%	0.7
45-54	9	11.0%	7	10.8%	16	10.9%	1.3
55-64	13	15.9%	6	9.2%	19	12.9%	2.2
65-74	9	11.0%	6	9.2%	15	10.2%	1.5
75-84	9	11.0%	7	10.8%	16	10.9%	1.3
≥85	10	12.2%	0	0.0%	10	6.8%	-
Total	82	**100%**	65	**100%**	147	**100.0%**	1.3

TABLE A5-12: FATALITIES IN QUEENSLAND BY AGE AND GENDER, FY 2004 TO FY 2017

1: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS QLD IN THE FOLLOWING PROPORTIONS: 10% IN FY 2017, 8% IN FY 2016 & 6% IN FY 2015.

2. ALL FIGURES LESS THAN 5 HAVE BEEN DENOTED "<5", AS PART OF OUR AGREEMENT IN RELATION TO ACCESSING NCIS CASES.

Gender and age

In terms of the male:female death ratio, there is an even spread of male and female fatalities across all age groups. The exception is the *≥85* age group, which had no female fatalities: differing from most other jurisdictions. Most age groups have more female than male fatalities (*0-4*, *5-14*, *35-44*) or equal numbers (*15-24*). Those with twice as many *male* as *female* are *25-34* (death ratio of 2.3) and *55-64* (2.2) age groups (Table 31).

Calculation of Queensland fatality rates show (Figure A5-22) that males in the *75-84* and ≥*85* age groups are over-represented (fatality rates of 0.91 and 1.12 per 100,000 respectively). However, the populations of older males are relatively small (e.g., at the 2016 census in Queensland there were an estimated 70,658 males and 87,478 females in the 75-84 age group – ABS, 2016). There is a relatively high fatality rate amongst *males* in the *55-64* and *65-74* age groups (0.44 and 0.42 respectively). There is a high fatality rate amongst *females* aged *75-84* (0.57), and relatively high fatality rates amongst *females* aged *0-4* (0.27) and *5-14* (0.32).

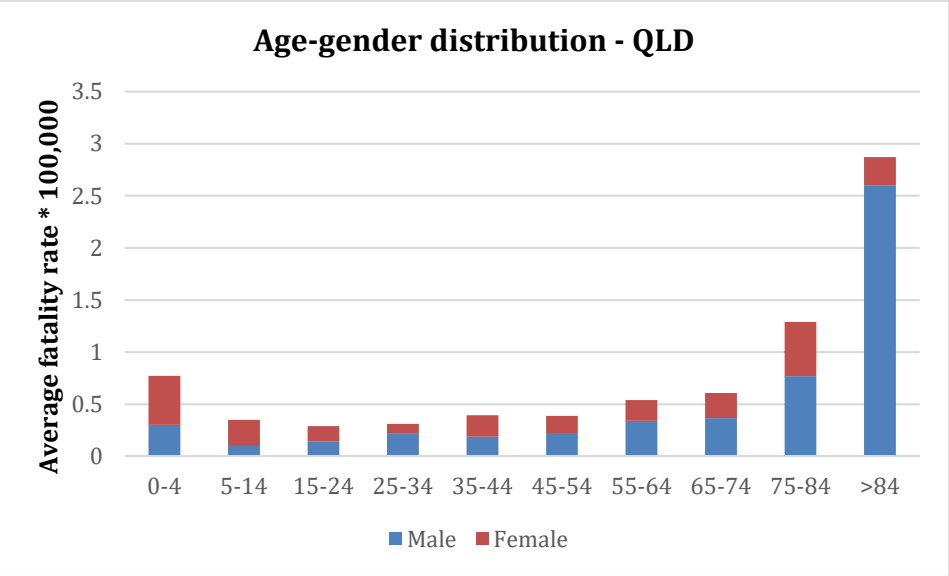


FIGURE A5-22: FATALITY RATES BY AGE AND GENDER, QUEENSLAND, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of 9.5% (n=13) of the Queensland cases was not known. Of the remainder, 92.5% (n=124) of them did not identify as *either Aboriginal/ TSI*, 7.5% (n=10) did.

Country of birth

The next most common countries of birth of decedents from Queensland, after *Australia*, were the *United Kingdom* (mainly England) and *New Zealand*, followed by *Tonga* and *Sweden*. The greatest number of such decedents were born in European countries. Fire victims originated from a total of 12 countries outside of Australia.

Primary employment status

The primary employment status was known for 81.6% (n=120) of the 147 decedents. The majority of decedents for which this datum was known (48.3%, n=58) were *retired, pensioner*, 19.2% (n=23) were *unemployed* and 11.7% (n=14) were *employed full time*. A further 10.0% (n=12) (not shown on Figure 90) were *N/A* – this category generally referred to children under school age – and 10.0% (n=12) were *students*.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For Queensland, 53.1% (n=76) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%) (Figure A5-23). There is a gradual lessening of numbers of fatalities, in general, in locations of lesser socio-economic disadvantage.

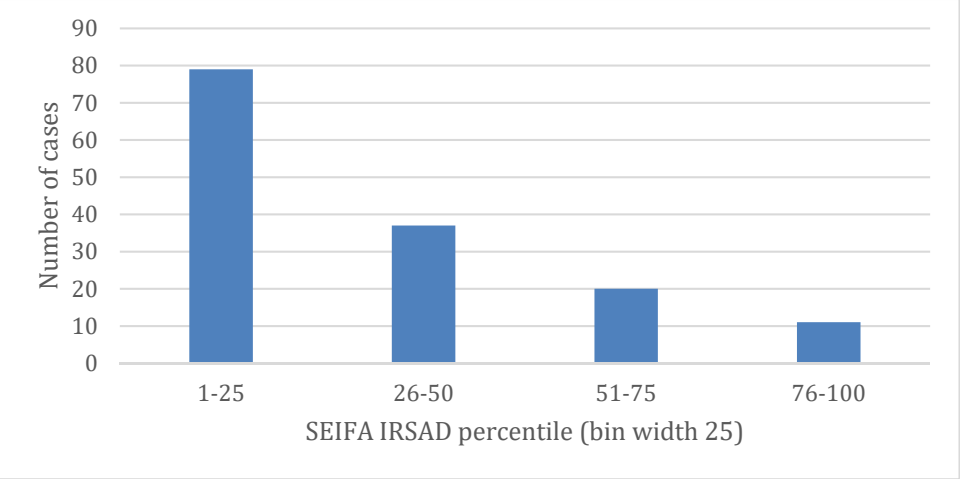


FIGURE A5-23: FATALITIES BY SOCIO-ECONOMIC CONDITION, QLD (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004-2017

1. THE X AXIS IS MEASURED IN 25-PERCENTILE UNITS, STARTING FROM 1-25: THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO 76-100: THE LEAST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS.

Ability to live at home

The ability of the decedent to live at home was not known for 29.3% (n=43) of cases. Of the remaining 104 cases, 16.3% (n=17) *required support to live at home*, 83.7% (n=87) did not.

SOUTH AUSTRALIA

NOTE: the FY17 results for South Australia could be an under-estimation as 6% of all coronial cases were not available for examination. This figure was 4% for FY16 and 2% for FY15.

Key statistics

- Total of 78 deaths
- Annual fatality rates range from 0.07 to 0.40 per 100,000: This is close to the national average
- Majority of deaths occurred amongst the *35-44* to *≥85* age groups
- Male:female death ratio 1.7 but ≥2.5 for *25-34* and *45-54* age groups
- Fatality rates highest amongst *75-84* and *≥85* (M) groups
- *75.7%* of deaths from *8pm-8am*
- The months when most deaths occurred: *July* and *August*
- *Smoking materials* the most common cause of fatal fires
- Over-representation of *indigenous* deaths by a factor of 7.6
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived alone* or *with partner*
- More deaths occurred in areas of greater socio-economic disadvantage (44.2% in IRSAD percentiles of ≤25)

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 78 deaths have occurred in 78 preventable residential fires in South Australia: an average of 5.6 deaths per year. In addition, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note that, for FY 1997-1998 and 2002-2003, no data was available for South Australia and the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records). Tables 6 and 7 (pp. 37 and 40) show the numbers of fatalities and fatality rates per 100,000 of the population of South Australia.

No figure could be reproduced here from the numbers of fatalities due to NCIS requirements as some annual fatality numbers were <5. There is a slight downward trend throughout the FY2004-2017 period of record: however, the fact that a substantial number of cases were not available for viewing in more recent years must be taken into account.

Fatality rates

Figure A5-24 shows the fatality rates per 100,000 population of South Australia. The trend of the fatality rate shows, similarly, a slight downward trend, although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. South Australia sits fairly close to the national average fatality rate, with some early period excursions above it.

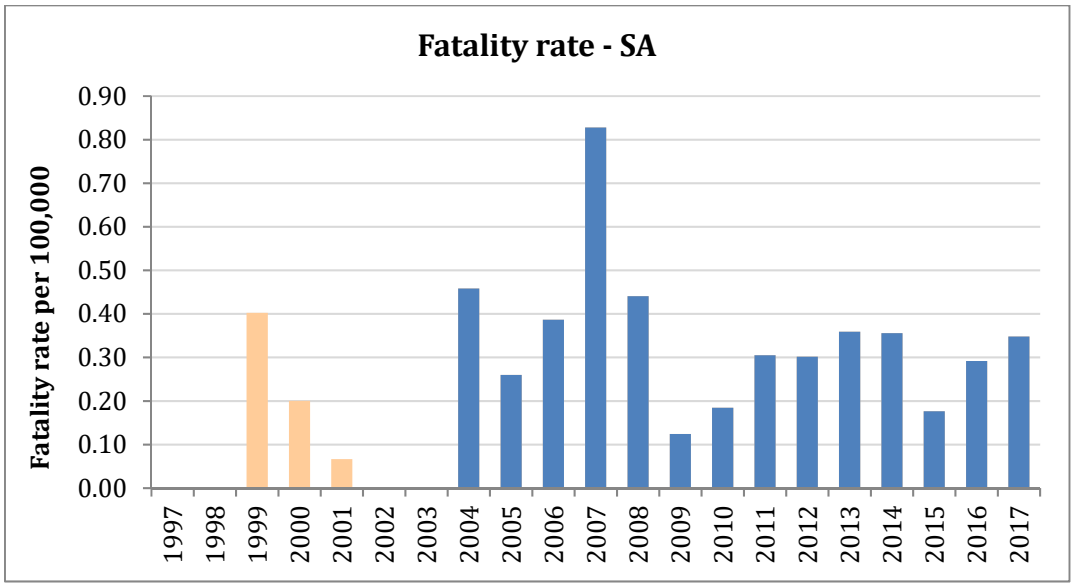


FIGURE A5-24: FATALITY RATE PER 100,000 POPULATION FOR SA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 1997-1998 AND 2002-2003 DATA WAS NOT AVAILABLE FOR SOUTH AUSTRALIA.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS SA IN THE FOLLOWING PROPORTIONS: 6% IN FY 2017, 4% IN FY 2016 & 2% IN FY 2015.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

In all 78 (100% of) cases, the deaths have occurred in single-fatality fires.

Fire incident details

Cause of fire

The cause of the fire was not known for 29 (21.2% of) cases. Of the remaining 49 cases, *smoking materials* were the primary cause of the fire in 22.4% of cases. Within this, 18.4% (n=9) were caused by a *cigarette or similar* and another 4.1% were caused by *smoking in bed*. The second major cause of fatal fires in South Australia was *other (e.g., accident)* (16.3%, n=8).

Time of day

The time of day (to the nearest hour) of the fire was not known for 41 (52.6% of) cases. Of the remaining 37 cases, most (37.8%, n=14) occurred between the hours of midnight and 4am. Very similar numbers of deaths occurred between the hours of 8pm to 12am (night), 4am to 8am (early morning) 4pm to 8pm (early evening) (21.6%, 16.2% and 16.2% of deaths respectively). A total of 75.7% (n=28) died between the "sleeping hours" of 8pm to 8am.

Month of incident

The majority of deaths occurred in *July* (17.9%, n=12), *April* (14.1%, n=11) and *May* (11.5%, n=9) – Australian autumn-winter months – but the numbers were fairly well spread out across the spectrum of the seasons.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For South Australia this field was known for all 78 cases. The majority of deaths (61.5%, n=48) occurred in *major cities*. A further 16.7% (n=13) occurred in *outer regional areas* and 12.8% (n=10) occurred in *inner regional areas*.

The residence

Type of structure

The type of structure was known for 97.4 (n=76) of the 78 South Australian decedents. Figure 104 shows that the majority of decedents (73.7%, n=56) were in a *free-standing house* or villa. A further 11.8% (n=9) were in a *unit/ apartment (below or equal 25m) in* height, and 9.2% (n=7) were in a *caravan/ campervan/ mobile home/ cabin*.

Property tenure

The property tenure was not known for 87.2% (n=68) of the South Australian decedents. Of the ten known, 70.0% (n=7) of residences were *owner occupied*. Less than five fatalities occurred in properties where the tenure was *private rental*, *public rental* and *transient visitor*. Due to the very small numbers of fatalities known for this datum, these numbers cannot be used to determine any trends.

Relationship between residents

The relationship between the residents at the decedent's residence was not known for 44.9% (n=35) of South Australian decedents. Figure A5-25 shows that, of the remaining 43 cases, 41.9% (n=18) of decedents lived *alone*, 34.9% (n=15) lived *with partner* and 23.3% (n=10) lived *with other family*.

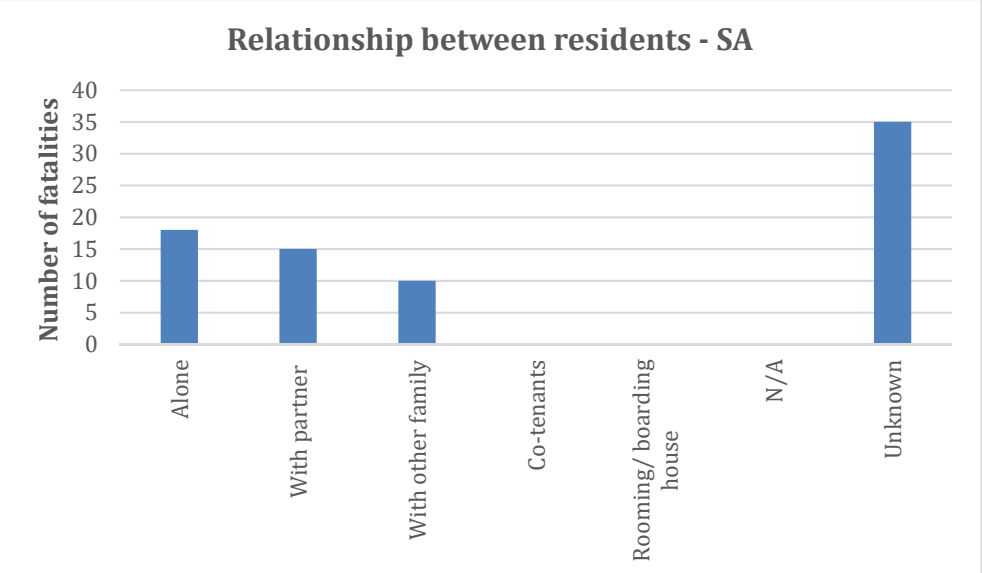


FIGURE A5-25: FATALITIES BY RELATIONSHIP BETWEEN RESIDENTS, SOUTH AUSTRALIA, FY 2004 TO FY 2017

Smoke alarms

Whether a smoke alarm was present or not was not known for 85.9% (n=67) of South Australian cases. A smoke alarm was present in the majority of known and relevant cases – but the number of known cases was very low.

Whether any smoke alarm present was working or not was not known for 87.2% (n=68) of South Australian cases. In the majority of known and relevant cases for South Australia, there was a smoke alarm present and working – but the number of known cases was very low.

The people

Gender

The overall male:female death ratio is 1.7 (i.e., 1.7 males have died to every one female in South Australia). Another way of saying this is that 63% of fatalities were male and 37% were female.

Age

Most decedents were in the *45-54* age group (19.2%, n=15), followed by the *65-74* (17.9%, n=14) then the *75-84* (15.4%, n=12) age groups. The least fatalities occurred within the *15-24* and *5-14* year age groups.

Gender and age

There were relatively high numbers of male decedents within the *45-54* age group. Those groups with the highest male:female death ratios are the *25-34* (ratio of 3.0) and the *45-54* (ratio of 2.8) age groups.

Figure A5-26 shows South Australian fatality rates by age and gender. Males in the *75-84* and *≥85* age groups are over-represented (fatality rates of 0.71 and 0.56 per 100,000 respectively) – although the populations of older males are relatively small (e.g., at the 2016 census in South Australia there were an estimated 70,658 males yet 87,478 females in the 75-84 age group – ABS, 2016). There is a relatively high fatality rate amongst *males* in the *45-54* and *65-74* age groups (0.33 and 0.37 respectively). There is a high fatality rate amongst *females* aged *75-84* (0.41) and *65-74* (0.27).

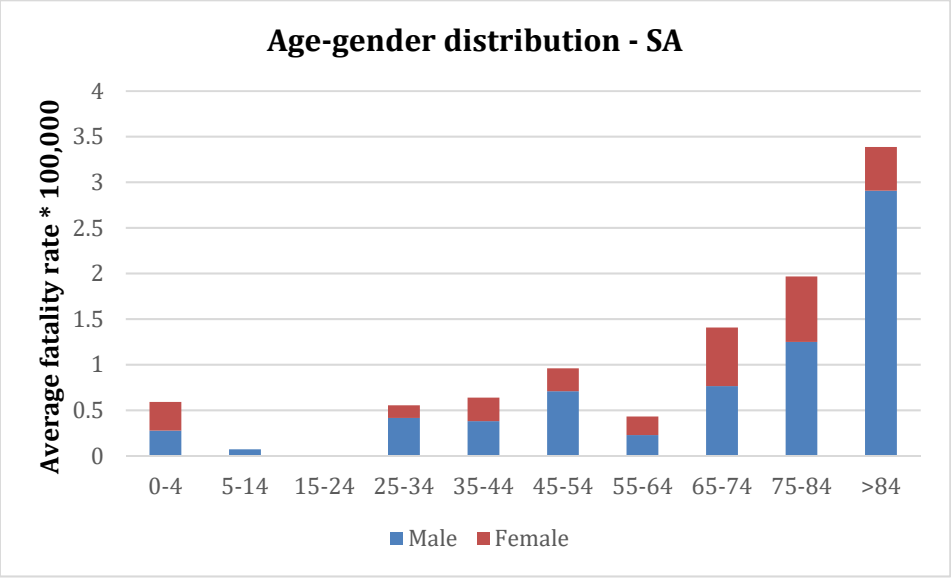


FIGURE A5-26: FATALITY RATES BY AGE AND GENDER, SOUTH AUSTRALIA, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of 73.1% (n=57) of the South Australia cases was not known. Of the remainder, 81.0% (n=17) of them did not identify as *either Aboriginal/ TSI*, 19.0% (n=<5) did.

Country of birth

The most common countries of birth of decedents from South Australia after *Australia* were the *United Kingdom*, the United States of America (*USA*) and *Vietnam* (n=<5 for each country). Fire victims originated from a total of three countries outside of Australia.

Primary employment status

The primary employment status was known for 87.2% (n=68) of the 78 decedents. Most of the decedents for which this datum was known (47.1%, n=32) were *retired/ age pensioners*, 20.6% (n=14) were *employed full time* and 7.4% (n=5) were *unemployed*. A further 17.6% (n=12) were *N/A* – this category generally referred to children under school age.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For South Australia, 44.2% (n=34) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%)(Figure A5-27). However, the highest fatality occurrences show a fairly wide spread across the following 5-percentile units (not shown): the 1-6 percentile (16.9%, n=13), 21-26 and 31-36 percentiles (each 7.8%, n=8) and 36-41 and 56-61 percentiles (each 9.3%, n=6).

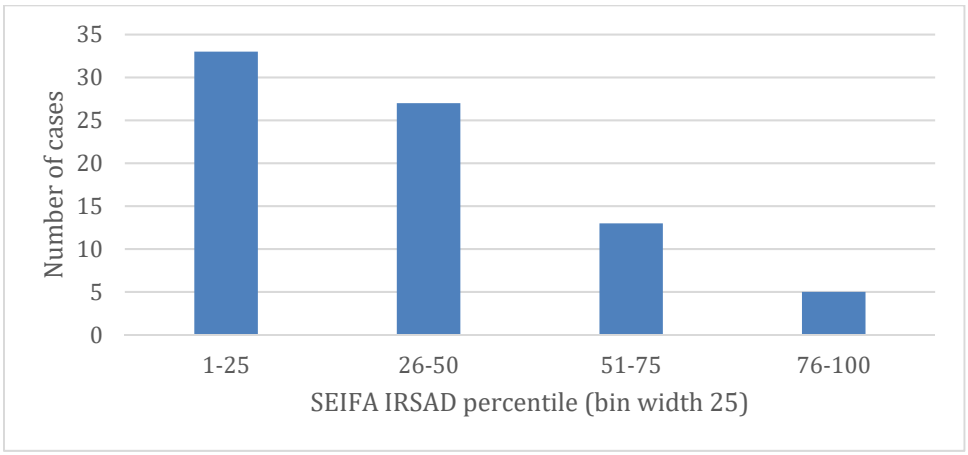


FIGURE A5-27: FATALITIES BY SOCIO-ECONOMIC CONDITION, SA (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004-2017

1. THE X AXIS IS MEASURED IN 25-PERCENTILE UNITS, STARTING FROM 1-25: THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO 76-100: THE LEAST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS.

Ability to live at home

The ability of the decedent to live at home was not known for 85.7% (n=60) of cases. Of the remaining 18 cases, 27.8% (n=5) required support to live at home, 72.2% (n=13) did not.

WESTERN AUSTRALIA

NOTE: the FY17 results for Western Australia could be an under-estimation as 5% of all coronial cases were not available for examination. This figure was 2% for FY16 and 1% for FY15.

Key statistics

- Total of 88 deaths
- Annual fatality rates from 0.05 to 0.54 per 100,000: close to the national average
- Most deaths amongst the *45-54*, *55-64* and *65-74* age groups
- Male:female death ratio 2.4 but ≥4.0 for *25-34* and *35-44* age groups and 1.0 for *5-14* and *75-84* age groups
- Fatality rates highest in the ≥*85* group and also amongst *45-54* to *75-84* groups (M all groups, F two oldest groups)
- 56.1% of deaths from *8pm-8am*
- The months when most deaths occurred: *July* and *August*
- Most deaths occurred in *major cities*
- *Smoking materials* the most common cause of fatal fires
- Over-representation of *indigenous* deaths by a factor of 4
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were free-*standing houses*, *owner-occupied* and in which the decedent *lived alone*
- More deaths occurred in areas of greater socio-economic disadvantage (39.5% in IRSAD percentiles of ≤25)

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 88 deaths have occurred in 83 preventable residential fires in Western Australia: an average of 6.3 deaths per year. Figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note that, for FY 1997-1999, no data was available for Western Australia and the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records). Tables 6 and 7 (pp. 37 and 40) show the numbers of fatalities and fatality rates per 100,000 of the population of Western Australia.

No figure could be reproduced here from the numbers of fatalities due to NCIS requirements as some annual fatality numbers were <5. There is a slight downward trend throughout the FY2004-2017 period of record: however, the fact that some cases were not available for viewing in more recent years must be taken into account.

Fatality rates

Figure A5-28 shows fatality rates per 100,000 population of Western Australia. The fatality rate shows a more marked downward trend, although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. Western Australia sits fairly close to the national average fatality rate.

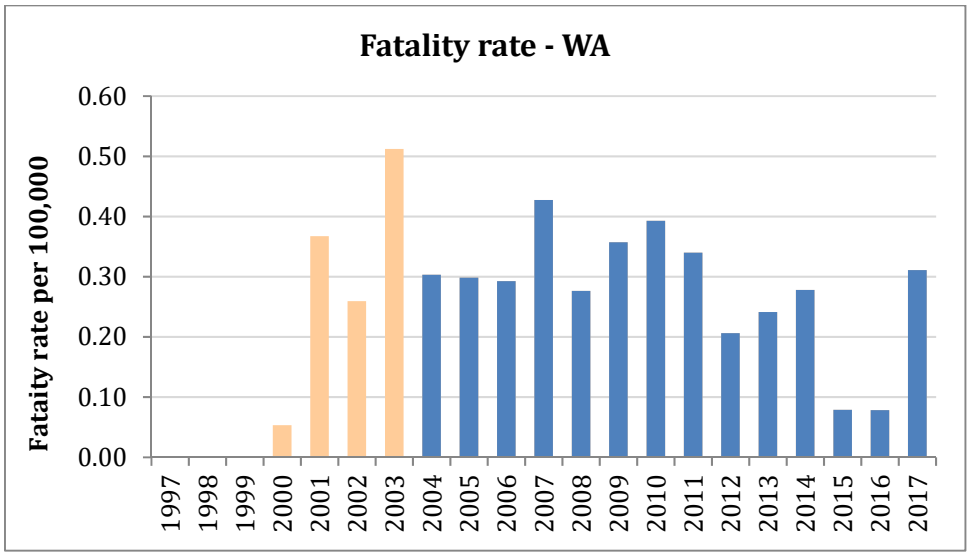


FIGURE A5-28: FATALITY RATE PER 100,000 POPULATION FOR WESTERN AUSTRALIA, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 1997-1999 DATA WAS NOT AVAILABLE FOR WESTERN AUSTRALIA.

3: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS WA IN THE FOLLOWING PROPORTIONS: 5% IN FY 2017, 2% IN FY 2016 & 1% IN FY 2015.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

The majority (89.8%, n=79) of deaths occurred in single-fatality fires. Double- and triple-fatality fires killed a total of nine people.

Fire incident details

Cause of fire

The cause of the fire was not known for 30 (34.1% of) Western Australia cases. Of the remaining 58 cases, *smoking materials* were the primary cause of the fire in a total of 29.3% (n=17) of cases. Within this, 19.0% (n=11) were caused by a *cigarette or similar* and 10.3% (n=6) were caused by *smoking in bed*. A further 12.1% (n=7) were caused by a *kitchen fire/ cooking materials*, and 8.6% (n=5) by *candles, lamps or similar*.

Time of day

The time of day of the fire was not known for 22 (25.0% of) cases. Of the remaining 66 cases, 22.7% (n=15) occurred between the hours of midnight and 4am (Figure A5-29). Very similar numbers of deaths occurred between the hours of 4am to 8am (early morning), 8am-12pm (morning), 4pm-8pm (afternoon) and 8pm to 12am (night) (18.2%, 16.7%, 18.2% and 15.2% of deaths respectively). A total of 56.1% (n=37) died between the "sleeping hours" of 8pm to 8am.

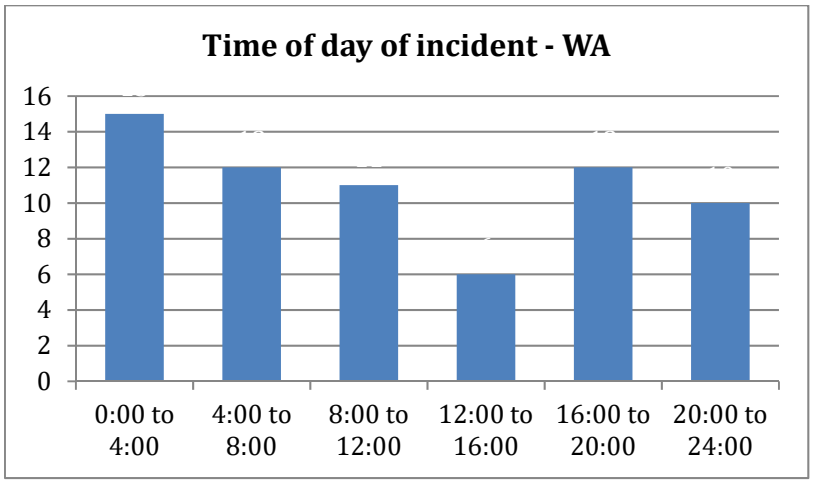


FIGURE A5-29: FATALITIES BY TIME OF DAY OF FIRE INCIDENT, WESTERN AUSTRALIA, FY 2004 TO FY 2017

Month of incident

The majority of deaths occurred in *August* (15.9%, n=14) followed by *July* (14.8%, n=13) – Australian winter months – with a fairly even spread across most of the remaining months.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For Western Australia this field was known for all but one case. The majority of deaths (54.0%, n=47) occurred in *major cities*. A further 21.8% (n=19) occurred in *outer regional areas* and 13.8% (n=12) occurred in *inner regional areas*.

The residence

Type of structure

The type of structure was known for all of the 88 Western Australian decedents. The majority of decedents (48.9%, n=43) were in a *free-standing house/ villa*. A further 27.3% (n=24) were in a *unit/ apartment (below or equal 25m)*.

Property tenure

The property tenure was unknown for 34.1% (n=30) of Western Australian decedents. Of the known cases, the majority (56.9%, n=33) were *owner occupied*. The second most common category (15.5%, n=9) was *private rental*, A further 10.3% (6) were in *supported accommodation (e.g., group housing etc)*, 8.6% (n=5) were in *short-term commercial/ residential (e.g., homestay, airBnB)* and 6.9% were *transient visitor (e.g., relative or friend)*.

Relationship between residents

The relationship between the residents at the decedent's residence was known for 96.6% (n=85) of the 88 Western Australian decedents. Of known cases, 56.5% (n=48) of decedents lived *alone*, 24.7% (n=21) lived *with other family* and 9.4% (n=8) lived *with a partner*.

Smoke alarms

Whether a smoke alarm was present or not was not known for 58.0% (n=51) of Western Australian cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence. This was the case for a further 10 (27.1% of) cases. Of the remaining 27 known cases, a smoke alarm was present in 55.6% (n=15) of the cases and was not in 44.4% of (n=12) cases.

Whether any smoke alarm present was working or not was not known for 59.1% (n=52) of Western Australian cases. Of the remaining cases, N/A was chosen where an operational smoke alarm would have made no difference to the outcome: that is, for example, if the fire incident occurred outside the residence, or if it was known that there was no smoke alarm present. This was the case for a further 22 (61.1% of) cases. In the majority of the remaining 14 known cases for Western Australia, there was a smoke alarm present and working.

The people

Gender

The overall male:female death ratio is 2.4 (i.e., 2.4 males have died to every one female in Western Australia). Another way of saying this is that 70% of fatalities were male and 30% were female.

Age

The numbers of decedents were distributed mainly across the *45-54*, *55-64* and *65-74* age groups. The least fatalities occurred within the *5-14* year age group.

Gender and age

There were a relatively high number of *male* decedents within the *45-54* and *55-64* age groups. The highest male:female death ratio was amongst the *35-44* (male:female death ratio of 7.0) age group, followed by *25-34* (ratio of 4.0) then *55-64* (2.4) and *45-54* (2.4).

Fatality rates for the Western Australian population show, in Figure A5-30, that *males* in the *≥85* age group are over-represented (fatality rate of 0.67 per 100,000), although the populations of older males are relatively small (e.g., at the 2016 census in Western Australia there were an estimated 63,698 males and 105,770 females in the ≥85 age group – ABS, 2016). There are relatively high fatality rates amongst *males* in the *45-54*, *55-64*, *65-74* and *75-84* age groups (0.36, 0.34, 0.37 and 0.30 respectively). There are high fatality rates amongst *females* aged *65-74* and *75-84* (0.27 and 0.24 respectively).

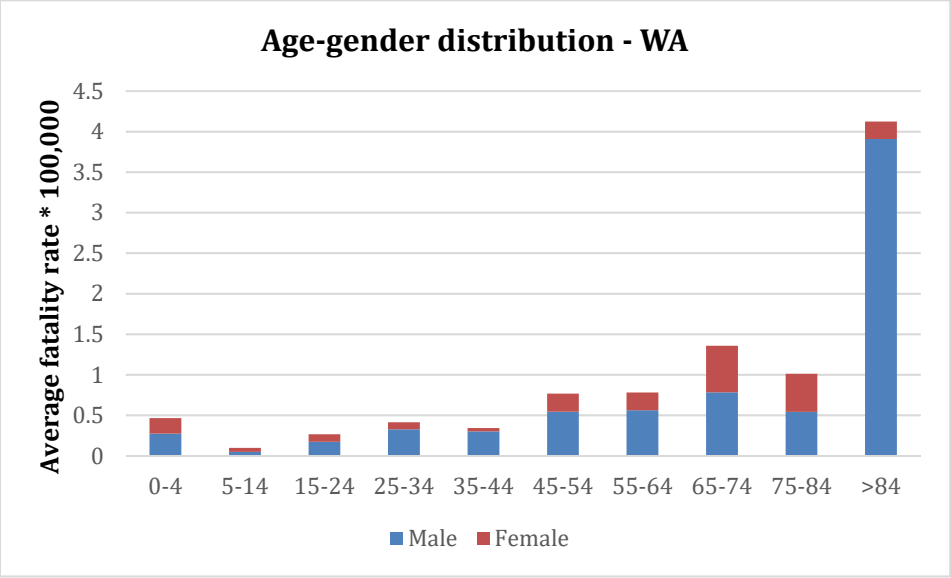


FIGURE A5-30: FATALITY RATES BY AGE AND GENDER, WESTERN AUSTRALIA, FY 2004 TO FY 2017

1: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of all of the Western Australian cases was known: 85.2% (n=75) of them did not identify as *either Aboriginal/ TSI*, 14.8% (n=13) did.

Country of birth

After *Australia*, the next most common countries of birth of decedents from Western Australia were *New Zealand* (n=7), followed by the *United Kingdom*, *Germany* and *Vietnam*. Fire victims originated from a total of 17 countries outside of Australia.

Primary employment status

The primary employment status was known for 90.1% (n=80) of the 88 decedents. Figure A5-31 shows that 46.3% (n=37) were retired/ *pensioner*, 20.0% (n=16) were *unemployed* and 10.0% (n=8) were *employed full time*. A further 17.5% (n=14) (not shown on Figure A5-31) were *N/A* – this category generally referred to children under school age.

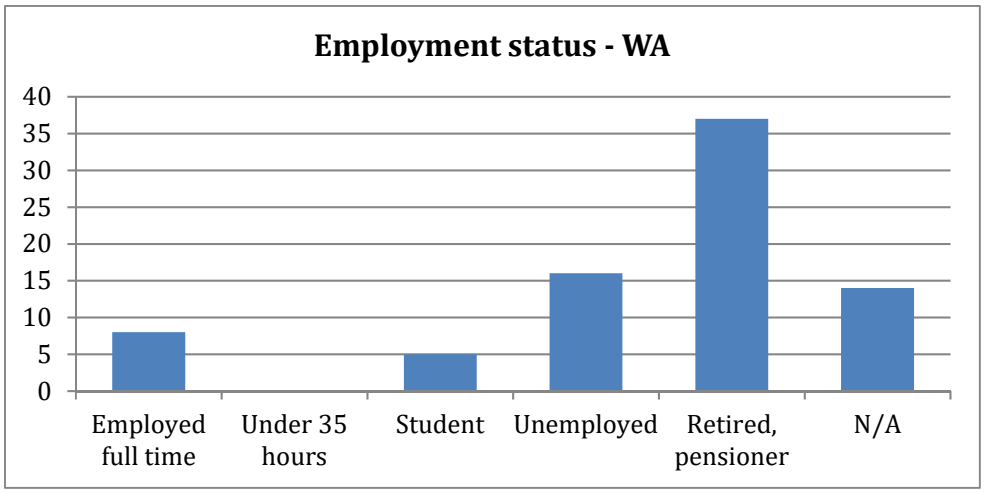


FIGURE A5-31: FATALITIES BY PRIMARY EMPLOYMENT STATUS, WESTERN AUSTRALIA, FY 2004 TO FY 2017

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For Western Australia, 39.5% (n=32) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%)(Figure A5-32). There is a gradual lessening of numbers of fatalities, in general, in locations of lesser socio-economic disadvantage. However, the highest fatality occurrences show a fairly wide spread across the following 5-percentile units (not shown): 6-11 percentile (16.0%, n=13), 51-56 percentile (12.3%, n=10) and 36-41 percentile (8.6%, n=7).

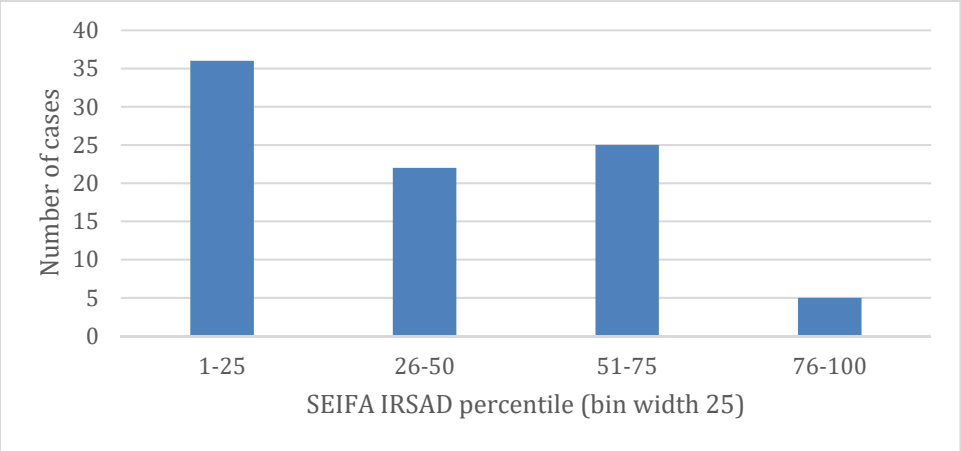


FIGURE A5-32: FATALITIES BY SOCIO-ECONOMIC CONDITION, WA (BY SEIFA IRSAD, AFTER ABS, 2016A & 2016B), FY 2004-2017

1. THE X AXIS IS MEASURED IN 25-PERCENTILE UNITS, STARTING FROM 1-25: THE GREATEST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS, TO 76-100: THE LEAST SOCIO-ECONOMICALLY DISADVANTAGED LOCATIONS.

Ability to live at home

The ability of the decedent to live at home was not known for 25.0% (n=22) of cases. Of the remaining 66 cases, 18.2% (n=12) *required support to live at home*, 81.8% (n=54) did not.

TASMANIA

NOTE: the FY17 results for Tasmania could be an under-estimation as 18% of all coronial cases were not available for examination. This figure was 6% for FY16 and 2% for FY15. The total fatality numbers for Tasmania were not large: caution must be observed in extrapolating any trends from this data.

Key statistics

- Total of 33 deaths
- Second highest jurisdictional fatality rate (0.46 per 100,000)
- Annual fatality rates from 0.21 to 2.32 per 100,000: generally just above the national average
- Most deaths evenly spread, mainly amongst *5-14*, *35-44*, *55-64* and *75-84*
- Male:female death ratio 1.8 but, differing from most other jurisdictions, more age groups ≤1.0: 0-4, 5-14, *15-24* and *35-44*
- Fatality rates highest amongst *75-84* (M) and ≥*85* (M) groups
- 84.4% of deaths from *8pm-8am*
- The months when most deaths occurred: *May* and *July*
- Most deaths occurred in *inner* and *outer regional areas*
- *Smoking materials* the most common cause of fatal fires then, differing from other jurisdictions, *electrical fault*
- Under-representation of *indigenous* deaths
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived alone*
- Most deaths occurred in areas of greater socio-economic disadvantage (70.3% in IRSAD percentiles of ≤25)

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 33 deaths have occurred in 30 preventable residential fires in Tasmania: an average of 2.4 deaths per year. In addition, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note that, for FY 2003, no data was available for Tasmania and the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records). Table 7 (p. 40) shows the fatality rates per 100,000 of the population of Tasmania.

No figure could be reproduced here from the numbers of fatalities due to NCIS requirements as some annual fatality numbers were <5. There is a downward trend throughout the FY2004-2017 period of record: however, the fact that a substantial number of cases were not available for viewing in more recent years must be taken into account.

Fatality rates

Figure A5-33 shows fatality rates per 100,000 population of Tasmania. The fatality rate shows a similarly downward slope, although the caveat of fewer cases available for viewing in the most recent years still needs to be applied.

The Tasmanian fatality rate is generally above the national average fatality rate in the early and middle period of the record, with several points well above it, but then fairly close to it for the most recent period of the record.

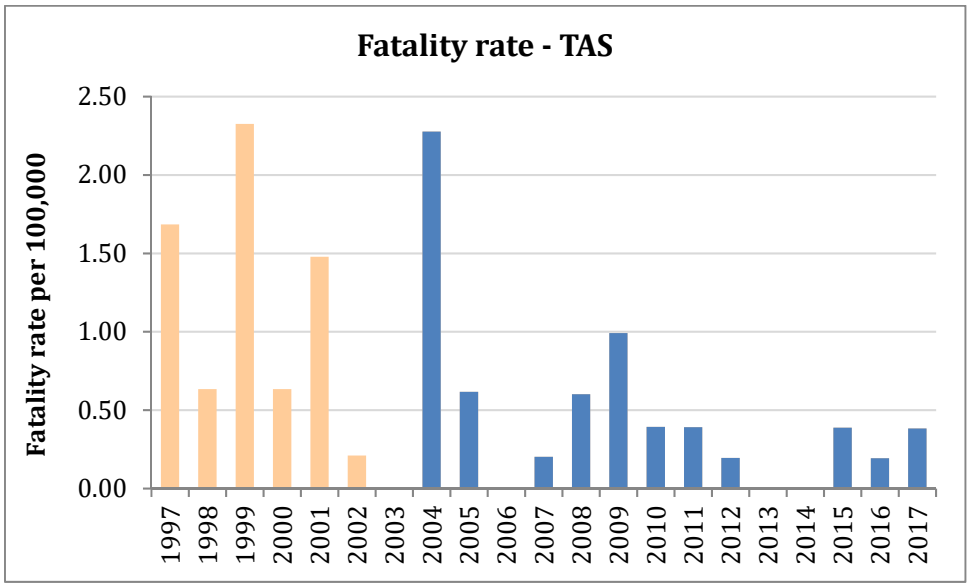


FIGURE A5-33: FATALITY RATE PER 100,000 POPULATION FOR N, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 2003 DATA WAS NOT AVAILABLE FOR TAS.

3: CAUTION IS REQUIRED WHEN OBSERVING TRENDS: THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS TAS IN THE FOLLOWING PROPORTIONS: 18% IN FY 2017, 6% IN FY 2016 & 2% IN FY 2015, AND TOTAL FATALITY NUMBERS FOR TAS WERE NOT LARGE.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

Most (88.9%, n=29) deaths occurred in single-fatality fires.

Fire incident details

Cause of fire

The cause of the fire was not known for 10 (30.3% of) cases. Of the remaining 23 cases, *smoking materials* were the primary cause of the fire in a total of 30.4% of cases. Within that, 21.7% were caused by a *cigarette or similar* and 8.7% were caused by *smoking in bed*. Some 26.1% (n=6) were caused by an *electrical fault* and a further 17.4% were caused by *lighter/ matches*.

Time of day

The time of day (to the nearest hour) of the fire was known for all but one Tasmanian case. Of the 32 known cases, the majority (50.0%, n=16) occurred between the hours of midnight and 4am.

The second most common time was from 8pm to 12am (night) (25%, n=8), followed by 4pm to 8pm (evening) (12.5%). A total of 84.4% (n=27) died between the "sleeping hours" of 8pm to 8am.

Month of incident

Most deaths occurred in *May* (18.2%, n=6) and *July* (15.2%, n=5): the Australian winter when the use of heaters is more prevalent. However, very few fatalities occurred in *June*, the middle winter month: also, the remaining fatalities were distributed fairly widely throughout the year.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For Tasmania this field was known for all cases. Most deaths (48.5%, n=16) occurred in *inner regional areas*. A further 45.5% (n=15) occurred in *outer regional areas*.

The residence

Type of structure

The type of structure was known for all 33 Tasmanian decedents. The majority of decedents (87.9%, n=29) were in a *free-standing house/ villa*. A further 9.1% were in a *unit/ apartment (below or equal 25m)*, and 3.0% were in a *caravan/ campervan/ mobile home/ cabin*.

Property tenure

The property tenure was known for 72.7% (n=24) of Tasmanian decedents. Of the known cases, the majority (62.5%, n=15) were *owner occupied*. A further 20.8% (n=5) were *private rental*. A small number (<5) were *transient visitor (e.g., relative or friend)* or *short-term commercial/ residential (e.g., homestay, airBnB)*.

Relationship between residents

The relationship between the residents at the decedent's residence was known for 90.9% (n=30) of Tasmanian decedents. Of those known, 53.3% (n=16) of decedents lived *alone* and 30.0% lived *with other family*.

Smoke alarms

Whether a smoke alarm was present or not was not known for 51.5% (n=17) of Tasmanian cases. Of the remaining 16 known cases, a smoke alarm was present in the majority of the cases.

Whether any smoke alarm present was working or not was not known for 72.7% (n=24) of Tasmanian cases. Of the remaining known and relevant cases, a smoke alarm was present and working in just under 50% of cases – but the number of known cases was very low.

The people

Gender

The overall male:female death ratio in Tasmania is 1.8 (i.e., 1.8 males have died to every one female). Another way of saying this is that 64% of fatalities were male and 36% were female.

Age

In Tasmania, most fatalities occurred within the *35-44*, *5-14*, *55-64* and *75-84* age groups. The least fatalities occurred within the *15-24* (0 fatalities) and *0-4* year age groups.

Gender and age

Of note is the *male* only decedents within the *25-34*, *55-64* and *65-74* age groups, and the high proportion of *female* fatalities in the *5-14* age group.

Tasmania differs from most of the other jurisdictions in that more age groups have more *female* fatalities than *males* (*0-4*, *5-14*, *35-44*) or equal numbers (*15-24*). Those groups with twice as many *male* fatalities as females are the *25-34* (male:female death ratio of 2.3) and the *55-64* (ratio of 2.2) age groups (Table 38).

Fatality rates for the Tasmanian population show, in Figure A5-34, that *males* in the *75-84* and ≥*85* age groups are over-represented (fatality rates of 5.32 and 3.18 per 100,000 respectively). The populations of older males are fairly similar to those of older females (e.g., at the 2016 census in Tasmania there were an estimated 5374 males and 6617 females in the 75-84 age group – ABS, 2016). The highest fatality rate amongst *females* is within the *5-14* age group (1.89).

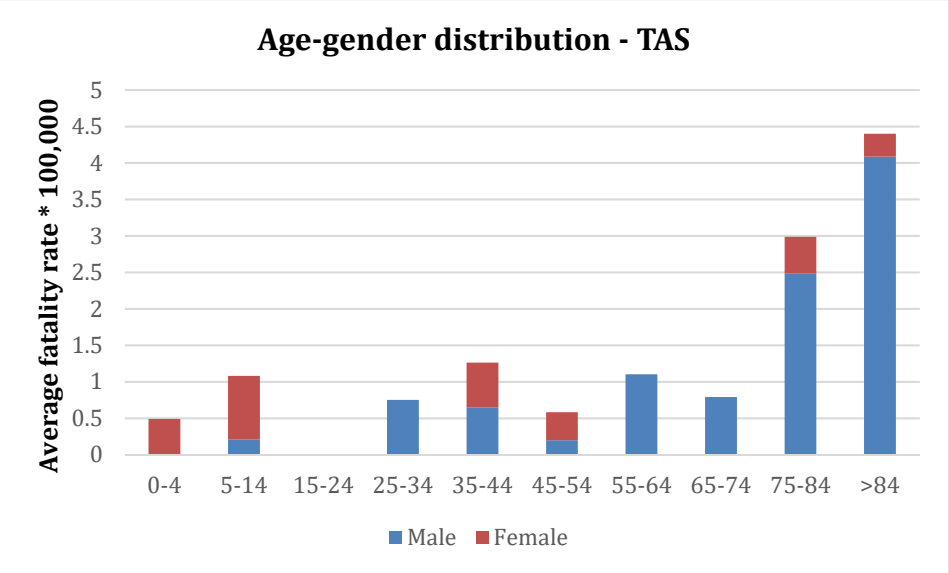


FIGURE A5-34: FATALITIES BY AGE AND GENDER, TAS, FY 2004 TO FY 2017

1. CAUTION IS REQUIRED WHEN OBSERVING TRENDS: TOTAL FATALITY NUMBERS FOR TAS WERE NOT LARGE

2: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of all of the Tasmanian cases was known: 100.0% (n=33) of them identified as *neither Aboriginal/ nor TSI*.

Country of birth

The most common countries of birth of decedents from Tasmania after *Australia* were the *United Kingdom*, the *Netherlands* and *South Africa* (all n=<5). Fire victims originated from a total of three countries outside of Australia.

Primary employment status

The primary employment status was known for 90.9% (n=30) of the 33 Tasmanian decedents. Of the known cases, most (53.3%, n=16) were *retired, pensioner*. The next most common categories were *unemployed* followed by *employed full time* (16.7% and 13.3% respectively). A further 13.3% were N/A – this category generally referred to children under school age.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For Tasmania, 70.3% (n=26) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%). There is a gradual lessening of numbers of fatalities, in general, in locations of lesser socio-economic disadvantage.

Ability to live at home

The ability of the decedent to live at home was not known for 18.2% (n=6) of Tasmanian cases. Of the remaining 27 cases, 29.6% (n=8) *required support to live at home*, 70.4% (n=19) did not.

NORTHERN TERRITORY

NOTE: the FY17 results for the Northern Territory could be an under-estimation as 6% of all coronial cases were not available for examination. This figure was 1% for FY16. The total fatality numbers for the Northern Territory were not large: caution must be observed in extrapolating any trends from this data.

Key statistics

- Second fewest deaths amongst Australian jurisdictions (17)
- Highest jurisdictional fatality rate (0.53 deaths per 100,000)
- Annual fatality rates from 0.00 to 1.46 per 100,000: well above the national average
- Deaths evenly spread across the age groups, but highest number in the 0-4 group
- Male:female death ratio 0.3 – very different from the other jurisdictions
- Fatality rates highest amongst *65-74* (F) and *≥85* (F) groups
- 31.3% occurred from *8pm-8am* and, differing from other jurisdictions, the 4-hour period with most deaths was *12-4pm* then by *4-8pm* (not 0-4am)
- The month when most deaths occurred: *May*
- Most deaths occurred in *outer regional areas*
- *Smoking materials* the most common cause of fatal fires
- Over-representation of *indigenous* deaths by a factor of 2.4
- Most common employment status: *retired/ age pensioner*
- Deaths mainly occurred in residences that were *free-standing* houses and, differing from other jurisdictions, in *supported* accommodation and in which decedent *lived with partner* or *family*
- Most deaths occurred in areas of greater socio-economic disadvantage (50.0% in IRSAD percentiles of ≤25)

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least 17 deaths occurred in 14 preventable residential fires in the Northern Territory: an average of 1.2 deaths per year. Table 7 (p. 40) shows the fatality rates per 100,000 of the population of the Northern Territory.

No figure could be reproduced here from the numbers of fatalities due to NCIS requirements as some annual fatality numbers were <5. There is a slight downward trend throughout the FY2004-2017 period of record: however, the fact that some cases were not available for viewing in more recent years must be taken into account.

Fatality rates

Figure A5-35 shows fatality rates per 100,000 population of the Northern Territory. The fatality rate shows a similar slight downward trend, although the caveat of fewer cases available for viewing in the most recent years still needs to be applied. In many of the study period years, the Northern Territory fatality rate was well above the national average fatality rate.

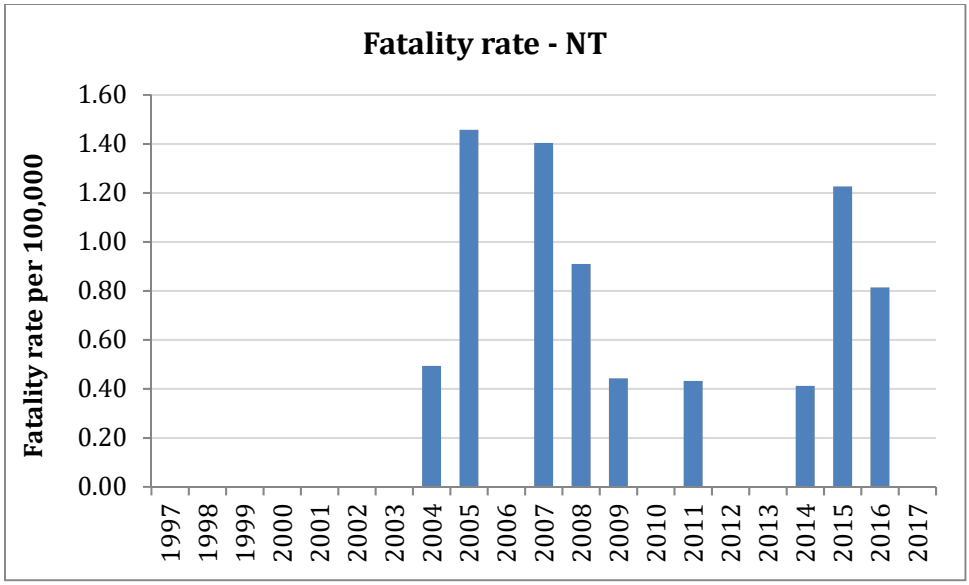


FIGURE A5-35: FATALITY RATE PER 100,000 POPULATION FOR NT, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY. NOTE THAT FY 1997-2003 DATA WAS NOT AVAILABLE.

3: CAUTION IS REQUIRED WHEN OBSERVING TRENDS: TOTAL FATALITY NUMBERS FOR NT WERE NOT LARGE AND THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS THE NT IN THE FOLLOWING PROPORTIONS: 6% IN FY 2017 & 1% IN FY 2016.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

5: TREND LINE SHOWN IS FOR THE CURRENT FY 2004-2017 PERIOD OF STUDY ONLY.

Multiple fatality fires

The majority (70.6%, n=12) of Northern Territory deaths have occurred in single-fatality fires. There were two incidents of multiple fatality fires.

Fire incident details

Cause of fire

The cause of the fire was not known for four (23.5% of) cases. Of the remaining 13 cases, the highest proportion (38.5%) were caused by an *electrical fault* and 30.8% by *lighter/ matches* (Figure 138). In very few cases were cigarettes the primary cause of the fire.

Time of day

The time of day (to the nearest hour) of the fire was known for all but one case. Of these 16 cases, equal numbers (31.3%, n=5) occurred between the hours of 12pm to 4pm (afternoon) and 4pm to 8pm (early evening). A total of 31.3% (n=5) died between the "sleeping hours" of 8pm to 8am.

Month of incident

The highest proportion of deaths occurred in *May* (23.5%), followed by *June*, *July* and *November* (17.6% each): the Australian winter season when the use of heaters is more prevalent.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables) was used to determine whether the fire incident occurred in an urban or a rural location. For the Northern Territory this field was known for all but one case. The majority of deaths (43.8%, n=7) occurred in *outer regional areas*. The remaining deaths were split between *remote areas* and *very remote areas*. No fatalities occurred in *major cities* or *inner regional areas*.

The residence

Type of structure

The type of structure was known for all 17 Northern Territory fire deaths. The highest proportion of decedents (47.1%, n=8) were in a *free-standing house/ villa* and 17.6% were in a *unit/ apartment (below or equal 25m)*. Another 29.4% (n=5) decedents were in an *other* type of structure: this included cases of being very close to but not in the house: e.g., within a vehicle or adjacent to a campfire.

Property tenure

The property tenure was known for 70.6% (n=12) of Northern Territory decedents. Of the known cases, the majority (66.7%, n=8) of residences were in *supported accommodation (e.g., group housing etc)*. The remaining few decedents were distributed fairly evenly across the property tenure categories of *private rental*, *owner occupied* and *public rental (e.g., Dept Housing)*.

Relationship between residents

The relationship between the residents at the decedent's residence was known for all 17 Northern Territory decedents but the categories were not applicable to 23.5% decedents. Figure 143 shows that, of the remainder, 38.5% (n=5) of decedents lived *with a partner*, 30.8% lived *with other family* and 23.1% lived

Smoke alarms

Whether a smoke alarm was present or not was not known for 35.3% (n=6) of Northern Territory cases. Of known relevant cases, a smoke alarm was present in 50% of the cases.

Whether any smoke alarm present was working or not was not known for 35.3% (n=6) of Northern Territory cases. Of the remaining known and relevant cases, a smoke alarm was present and working in 67.7% of the cases.

The people

Gender

The overall male:female death ratio is 0.3 (i.e., 0.3 males have died to every one female). Another way of saying this is that 24% of fatalities were male and 76% were female.

Age

The decedents were distributed fairly widely across all age groups. The most fatalities occurred within the *0-4* age group, the least within the *5-14*, *15-24* and *≥85* age groups (0 fatalities).

Gender and age

There were relatively high numbers of *female* decedents throughout the record. Most other jurisdictions (save Queensland) had more male fatalities across most age groups. In the Northern Territory the age groups (*0-4*, *25-34*, *35-44*, *45-54*, *65-74* and *≥85)* have more *female* fatalities than *male*. In the latter four groups, all the fatalities were *female*.

When fatality rates for the Northern Territory are considered (Figure A5-36), *females* in the *≥85* and *65-74* age groups are over-represented (fatality rates of 11.88 and 6.62 per 100,000 respectively), although the populations of older people in the Northern Territory is relatively small. For example, at the 2016 census in the Northern Territory there were an estimated 601 females in the *≥85* age group (ABS, 2016).

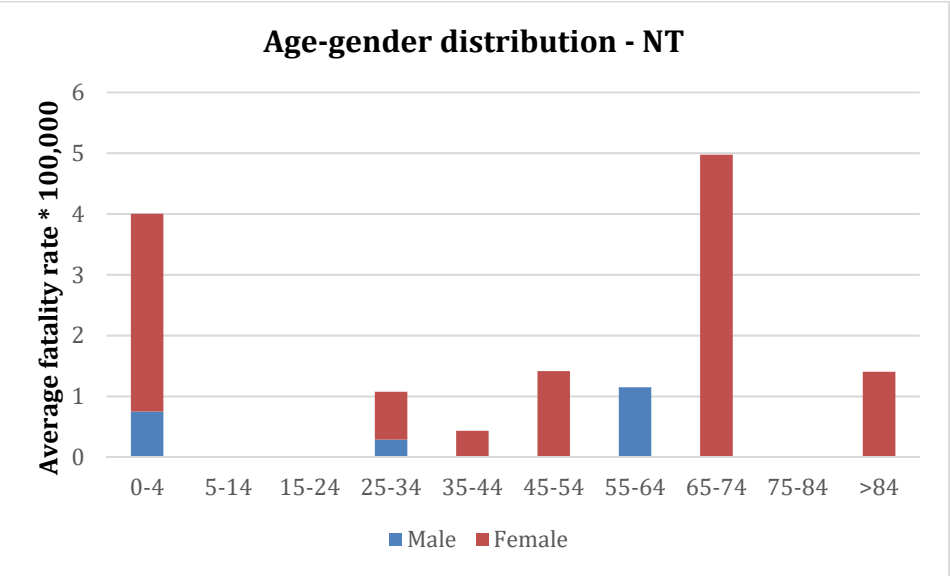


FIGURE A5-36: FATALITY RATES BY AGE AND GENDER, NT, FY 2004 TO FY 2017

1: CAUTION IS REQUIRED WHEN OBSERVING TRENDS: TOTAL FATALITY NUMBERS FOR NT WERE NOT LARGE.

2: THE FATALITY RATE WAS CALCULATED USING THE ABS ESTIMATED RESIDENT POPULATION FOR EACH OF THE YEARS IN QUESTION AND CALCULATING THE AVERAGE OF THIS OVER THE 14 YEARS (FY2004 TO 2017) OF RECORD.

Indigenous identification

The indigenous status of all Northern Territory decedents was known. Of these, 70.6% (n=12) identified as *either Aboriginal/ TSI*.

Country of birth

The highest proportion of decedents from the Northern Territory were born in Australia. Fire victims originated from a total of four countries outside of Australia.

Primary employment status

The primary employment status was known for 82.4% (n=14) of Northern Territory decedents. The highest proportion (42.9%, n=6) were *retired, pensioner*, with the next largest groups being *students*.

Socio-economic index

The data were analysed in terms of socio-economic disadvantage by using the ABS SEIFA and IRSAD data products. For the Northern Territory, 50.0% (n=7) of deaths occurred in the top 25% of areas of greatest economic disadvantage (IRSAD percentiles of ≤25%). There is a gradual lessening of numbers of fatalities, in general, in locations of lesser socio-economic disadvantage.

Ability to live at home

The ability of the decedent to live at home was not known for 29.4% (n=5) of cases. Of the remaining 12 cases, 41.7% (n=5) required support to live at home, 58.3% (n=7) did not.

AUSTRALIAN CAPITAL TERRITORY

NOTE: the FY17 results for the Australian Capital Territory (ACT) could be an under-estimation as 11% of all coronial cases were not available for examination. This figure was 8% for FY16 and 2% for FY15. The total fatality numbers for ACT were too small to allow detailed meaningful analysis to be carried out. The ethical requirements for this study also mean that any results <5 cannot be reported. Results for the ACT are confined to the *key statistics* summary and a few additional points. Caution must therefore be observed in extrapolating any trends from this data.

Key statistics

- fewest deaths amongst Australian jurisdictions (6)
- lowest jurisdictional fatality rate (0.11 per 100,000)
- annual fatality rates range from 0.00 to 0.32 per 100,000: well below the national average
- fatality rates highest amongst ≥*85* (F) group
- most deaths occurred from *8pm-8am*, differing from other jurisdictions the 4-hour period with most deaths was *8pm-12am* (as opposed to 04am)
- all deaths occurred in *major cities*
- *heaters* the most common cause of fatal fires: none caused by *smoking materials* – differing from other jurisdictions
- most common employment status: *retired/ age pensioner*
- deaths mainly occurred in residences that were *free-standing houses*, *owner-occupied* and in which the decedent *lived alone*
- all deaths occurred in areas of greater socio-economic advantage (100.0% in IRSAD percentiles of ≥50) – very different from other jurisdictions

Mortality statistics

Number of deaths

In the 14 years from July 2003 to June 2017, at least six deaths have occurred in six preventable residential fires in ACT: an average of 0.4 deaths per year. In addition, the figures from the AFAC 2005 study were added to the current data for the time period FY 1997-2003 (note: the methodology was significantly different to the current study as data was sourced from fire services, not from coronial records) Table 7 (p. 40) shows the fatality rates per 100,000 of the population of ACT.

Fatality rates

The fatality rates per 100,000 population of ACT are shown in Figure A5-37. The ACT fatality numbers were too low for any trends to be stated. However, ACT sits well below the national average fatality rate.

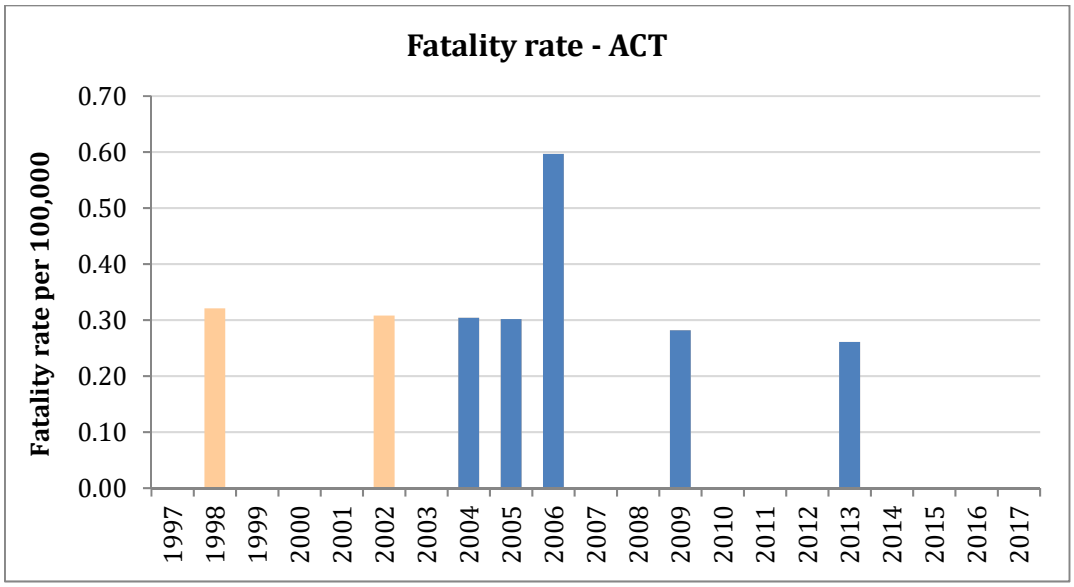


FIGURE A5-37: FATALITY RATE PER 100,000 POPULATION FOR ACT, FY 1997 TO FY 2017

1: THE FINANCIAL YEAR (FY: E.G., 1997 IS THE FY 1 JULY 1996 TO 30 JUNE 1997) OF THE FIRE INCIDENT IS DISPLAYED, NOT NECESSARILY THAT OF THE FIRE DEATH.

2: FIGURES FROM FY 1997-2003 ARE FROM THE AFAC 2005 STUDY.

3: CAUTION IS REQUIRED WHEN OBSERVING TRENDS: TOTAL FATALITY NUMBERS FOR ACT WERE NOT LARGE AND THE FIGURES MAY BE AN UNDER-ESTIMATION AS THE DATA EXCLUDES RECORDS ACROSS THE ACT IN THE FOLLOWING PROPORTIONS: 11% IN FY 2017, 8% IN FY 2016 & 2% IN FY 2015.

4: FATALITY RATES WERE CALCULATED BY USE OF THE ABS POPULATION ESTIMATES FOR JUNE OF EACH YEAR IN QUESTION.

Multiple fatality fires

In all six cases in the ACT, the deaths occurred in single-fatality fires.

Fire incident details

Time of day

The time of day (to the nearest hour) of the fire was known for all six ACT cases. They were spaced throughout the hours of the day, although most occurred between the "sleeping hours" of 8pm to 8am.

Month of incident

The majority of deaths occurred in the Australian summer season.

Remoteness of deaths

The Remoteness Area structure (RA) (described on pp.50-51 and table A2-8 of Appendix 2: Coding tables), used to determine whether the fire incident occurred in an urban or a rural location, was not reported on for the ACT as this field was not relevant due to the small size of this jurisdiction.

The residence

Smoke alarms

Of known ACT cases, a smoke alarm was present and working in 50% of known and relevant cases – but the number of known cases was very low.

The people

Gender and age

The majority of decedents were *male*. The ages were spread out across the 15-24 to the ≥85 groups. The total fatality numbers for ACT were too small to allow further meaningful analysis to be carried out.

Indigenous identification

The indigenous status of all six ACT decedents was known: 100.0% of them identified as *neither Aboriginal/ nor TSI*.

Country of birth

Other than those born in Australia, the only country listed as being the country of birth for ACT decedents was New Zealand.

Socio-economic index

The data were analysed in terms of socio-economics by using the ABS SEIFA and IRSAD data products. The situation in the ACT differs from all other Australian jurisdictions in that most fatalities have occurred in locations where there is lesser socio-economic disadvantage and no deaths have occurred in the top 50% of areas of greatest economic disadvantage (IRSAD percentiles of ≤50%). This may be due to the overall relative advantage of ACT, combined with the low number of deaths.