



Socio-demographic predictors of residential fire and unwillingness to call the fire service in New South Wales

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ABSTRACT

In most industrialised countries, the majority of fire-related deaths and injuries occur in the home. Australia has implemented fire prevention programs and strategies, including the use of smoke alarms, to minimise this burden. The number of reported house fires has declined over the past decade. However, there is a growing recognition that unreported fires are important in the estimation of total fire hazards and their associated injuries. This current study used data from the 2014 New South Wales (NSW) Population Health Survey, a yearly telephone survey, consisting of 14,732 survey respondents. Univariate and multiple binary logistic regression models were conducted to examine predictors of residential fire and (un)willingness to call the fire service in the event of a residential fire. The proportion of respondents who experienced residential fires in NSW was 10% (95% confidence interval [CI]: 9.3, 10.8). The proportion of respondents who were willing to call the fire service was 3.1% (95% CI: 2.7%, 3.6%) and that of respondents unwilling to call was 6.9% (95% CI: 6.3%, 7.6%). Multivariate analyses revealed that respondents spoke another language in addition to English were significantly less likely to have experienced a home fire (odds ratio [OR] = 0.46; 95% CI: 0.32, 0.65, $p < 0.001$) and significantly less likely to call the fire service (OR = 0.34; 95% CI: 0.21, 0.54, $p < 0.001$), compared with those who only spoke English at home. The results in this study will inform Fire & Rescue NSW's ongoing development of appropriate interventions and awareness-raising programs about residential fire prevention.

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1. Introduction

In most industrialised countries, the majority of fire-related deaths and injuries occur in the home (World Health Organisation, 2011; TriData Division, 2009; TriData Division, 2008; TriData Division, 2007; Haynes, 2015). Globally, fire prevention programs that promote the use of smoke alarms are among the leading strategies adopted to minimise this burden (World Health Organisation, 2011; Haynes, 2015; Ahrens, 2013; Senate Legal and Constitutional Affairs Committee, 2016). Australia is among the countries that have implemented strategies and best practices in fire prevention programs. Prevention programs are in place at state and national levels including the passage of legislation that requires one or more functioning smoke alarms in every home (TriData Division, 2008; Senate Legal and Constitutional Affairs Committee, 2016). Yet residential fires remain a significant public health problem in the country. Across NSW, available records reveal that residential fires account for an estimated 94% of all fire-related

deaths (Fire and Rescue New South Wales, 2016) and more than half of these may have been prevented if the homes had working smoke alarms and perhaps a practised home escape plan in place (Ahrens, 2013; Fire and Rescue New South Wales, 2015a). Between 2010 and 2015, there were 23,766 residential fires in NSW, with 115 deaths and 3311 injuries (Fire and Rescue New South Wales, 2015b).

The importance of functional smoke alarms in homes, as a key prevention strategy, cannot be overemphasised. The extant literature reveals that most home fire-related injuries and deaths result from smoke inhalation and toxic fumes rather than burns (NSW Fire Brigades, 2009; Ahrens, 2009; Atiyeh et al., 2009; Edelman, 2007; Hsiung et al., 2007; Harpur et al., 2013). International research has established that the majority of residential fires and associated injuries are preventable, and that the use of functional smoke alarms is a crucial and inexpensive prevention method (Haynes, 2015; Ahrens, 2009; Ballesteros and Kresnow, 2007; Parmer et al., 2006; Tannous et al., 2016; Chubb, 2003; Thomas and Bruck, 2015). Studies in Australia have found that occupants in homes without smoke alarms face more than five times the risk of fire-related injury or death compared to homes with smoke alarms (Parmer et al., 2006; Tannous et al., 2016; Wright, 2013). While there is compelling international and Australian

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evidence that demonstrates that functional smoke alarms are an effective house fire prevention strategy, house fires and fire-related deaths and injuries still occur, and may even go unrecorded (Tannous et al., 2016; Wright, 2013; Ballesteros et al., 2005; Frattaroli et al., 2012). In NSW, the annual fire death rate was 2.9 deaths per million people in 2015 (22 deaths) with a three year average of 4.0 deaths per million people between 2013 and 2015 (Productivity Commission, 2016). Yet, due to limited data in Australia, this decline only represents cases when the fire service (Fire & Rescue NSW (FRNSW)) attended the residential fire. Any residential fire incidents where the fire brigade did not attend, and which may have resulted in injuries or fatalities, were not included in FRNSW's reported statistics on incidents, injuries or fatalities (Senate Legal and Constitutional Affairs Committee, 2016; Barnett, 2008; Flora et al., 1977).

Information and statistics on fires incidents, such as that collected by FRNSW, are entered into the Australian Incident Reporting System (AIRS). However, as noted above, this data may only be inclusive of fires reported to the fire brigade and may not include small fires, such as kitchen fires, that were suppressed by individuals, even if property damage or injury was involved. AIRS does also collect data from a range of different organisations in Australian states and territories including emergency services, hospitals and insurance companies (Senate Legal and Constitutional Affairs Committee, 2016; Fire and Rescue New South Wales, 2015b). While this additional data may contain associated information about incidents that were not reported to fire services, it has been noted in Australia that it is likely to be incomplete.

Regarding unreported fires, the 2015 Australian Senate's inquiry into the use of smoke alarms in the prevention of smoke and fire-related deaths noted that there was a "paucity of data on unreported fires" ((Senate Legal and Constitutional Affairs Committee, 2016):16). In its submission to the Senate inquiry, FNSW stated that statistics on fires that are unreported, and therefore unattended, or that had been reported to another agency, such as the NSW Rural Fire Service, do not exist. In addition, there is no data on people with fire-related injuries that do not seek medical attention or property damage that is not reported to any general insurance company (Senate Legal and Constitutional Affairs Committee, 2016; Fire and Rescue New South Wales, 2015b).

These unreported fires are important to note in the estimation of total fire hazards as they could have developed into potentially dangerous fires if they had not been detected or controlled early (Butry and Thomas, 2012). These fires may or may not have involved insurance claims and therefore insurance company data. In addition, they may or may not have involved injuries that involved emergency department presentation and therefore hospital data (Flora et al., 1977). To capture this additional information, some jurisdictions are now using surveys asking households if they have had a fire in the recent past and whether they had reported the incident or contacted the fire brigade (Haynes, 2015; Flora et al., 1977; Greene and Andres, 2009).

In the United States (US), the Consumer Product Safety Commission (CPSC) conducted national telephone probability sample surveys of unreported (and non-fire department attended) residential fires in 1974, 1984, and 2004–05. All three surveys demonstrated that the majority of fire incidents in residential homes were not attended by the fire department (Chubb, 2003; Greene and Andres, 2009). In the 2004–05 study, the rate of unreported fires in the US was determined at 6.3 fires per 100 households with the combined estimate of unreported and reported fires at 6.6 per 100 households (Greene and Andres, 2009). The total number of fires, both attended and unattended, was determined to have not decreased over the 20 years since the 1984 survey. However, the earlier warnings of incidents provided by smoke alarms may have resulted in residents extinguishing fires before they got out of control and required fire department assistance (Chubb, 2003; Greene and Andres, 2009). The small size of fires and the early warning system via smoke alarm have been identified by researchers as reasons for the higher rates of unattended fires and self-management by

residents (Ahrens, 2013; Chubb, 2003; Greene and Andres, 2009). People may feel confident in dealing with small fires without needing tools or special knowledge. In addition, smoke alarms alert householders before the fire gets too big to handle (Chubb, 2003).

The number of fires in the US requiring fire service intervention has been estimated at one in 25 (Chubb, 2003). In New Zealand, around one in ten fires require fire service intervention while the rest are managed by residents (Chubb, 2003). To the best of our knowledge there is no study that examines trends for under-reported and unattended home fires leading to deaths in NSW. In the report by the Australian Senate (2016) on the use of smoke alarms to prevent smoke and fire-related deaths, the authors recommended that Australian governments consider establishing a national residential fire reporting and recording mechanism to capture statistics of currently unreported residential fire incidents (Senate Legal and Constitutional Affairs Committee, 2016).

This study seeks to address some of these gaps in data and knowledge by examining factors related to individuals' unwillingness to call the fire brigade. The study used data from the annual NSW Population Health Survey on households' (un)willingness to call the fire brigade and report residential fire incidents. The objective of the study is to identify socio-demographic and other factors associated with individuals' unwillingness to call their local fire service.

The findings from this study should be useful to fire services, other incident response agencies and policymakers in understanding the behaviour of households following residential fire incidents. The findings could also inform the review and design of intervention and management strategies aimed at reduction in fire incidents and associated injuries and fatalities.

1.1. Ethical consideration

The data set used in this study was sourced from the NSW Population Health Survey, the methods and questions of which were approved by the NSW Population Health and Health Services Ethics Committee.

2. Methods

2.1. Data source

The data examined in this study was extracted from the NSW Population Health Survey (2014). The NSW Population Health Survey is an annual cross-sectional computer-assisted telephone survey, stratified by geographical regions. The target population is all residents of the state of NSW, through the use of overlapping dual-frame design, with three types of phone use: landline only, mobile only and dual-phone users (people with a mobile phone living in a household with a landline phone). Participants were selected through either the landline or mobile phone number sampling frames (Barr et al., 2014). The survey has a yearly target of 1500 persons in each of the state's 15 area health services and a total sample of about 15,000 persons a year (Barr et al., 2008a). The dataset analysed for this study consisted of 14,732 survey respondents. It comprised self-reported information about respondents' socio-demographic characteristics, including household size, respondent's age, gender, level of education, employment status, income, ethnicity, socioeconomic status and smoker status. The sample, including the demographic profile of the weighted survey population, was comparable with the Australian population, and is described in detail elsewhere (Barr et al., 2008b). Of those people contacted to participate, about 65% completed a full interview and thus form part of the dataset (Centre for Epidemiology and Research, 2010). In the 2014 survey, additional questions were asked of households about fire incidents. These were "Have you ever experienced an unintentional or accidental fire in your home?"; and "Was the fire brigade called to put out the fire?"

2.2. Study variables

2.2.1. Dependent variables

The dependent variables for the current study were *experienced residential fire* and *unwillingness to call the fire service*. These dependent variables took a binary form, such that *experienced residential fire* and *unwillingness to call the fire service* was categorised as 1 and *otherwise* categorised as 0. The dependent variables were examined against all potential confounding variables and the results are shown in Fig. 1.

2.2.2. Confounding variables

Fig. 1 presents all potential confounding variables based on information available in the NSW health survey datasets. These variables were classified into four distinct groups: demographic characteristics, type of smoke alarm and fire risk, private health insurance and smoking status factors.

2.3. Statistical analysis

The prevalence of *experienced residential fire* and *unwillingness to call the fire service* were described by conducting a frequency tabulation of

all potential risk factors included in the study. Survey logistic regression that adjusts for postcode and sampling weights was used. Univariate and multivariable analyses were used to examine factors associated with the outcome variable.

As part of the multivariable analyses, a four-stage modelling scheme was performed by following a similar conceptual framework to that described in Fig. 1. First, demographic characteristics were entered into the baseline model to assess their relationship with the dependent variables. A manually processed stepwise backwards elimination was performed, and variables that were significant at 5% significance level were retained in the model. Second stage, type of smoke alarm variable were examined with the demographic and demographic characteristics that were significantly associated with *experienced residential fire* and *unwillingness to call the fire service*, and those variables with p -values < 0.05 were retained.

In the third stage, *private health insurance* was investigated with the demographic and socioeconomic characteristics factors associated with the study outcomes were retained. A similar procedure was used for smoking status factors in the fourth stage as before, those variables with p -values < 0.05 were retained. All analyses were conducted using “SVY” commands in STATA version 14.1 (STATA Corporation, College

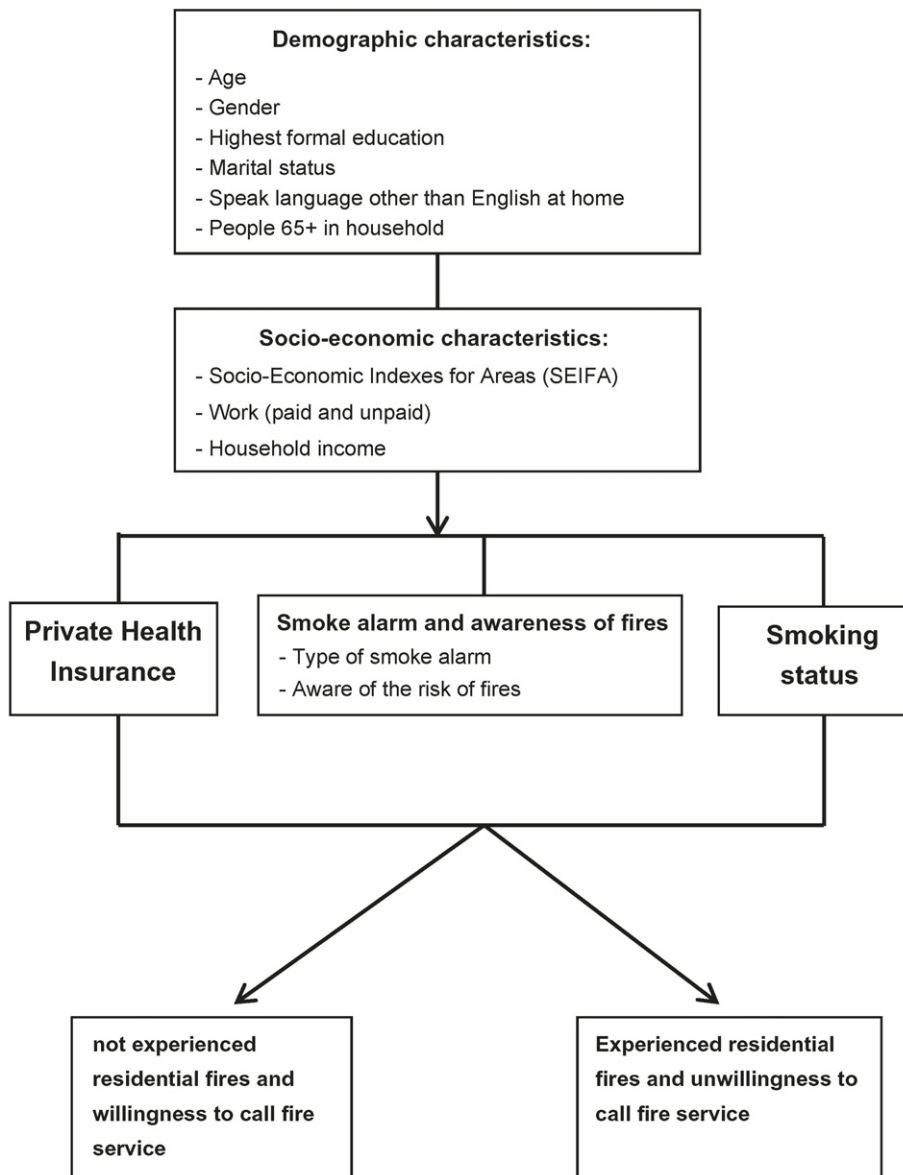


Fig. 1. Conceptual framework of factors influencing residential fire and unwillingness to call fire service.

Station, TX, US) to adjust for the cluster sampling survey design and sampling weights.

3. Results

Table 1 presents characteristics of the participants. Age groups of the participants ranged between “<16” and “75 or older”. While most of the participants belonged to the 25–34 years age group (14.3%), the

Table 1
Characteristics of the respondents (n = 14,732).

Characteristic	n*	n	%*
Age in categories (n = 14,731)			
<16 years	1,451,882	2045	19.3
16–24	902,949	965	12.0
25–34	1,073,898	1153	14.3
35–44	1,022,954	1303	13.6
45–54	1,016,880	1948	13.5
55–64	869,621	2750	11.6
65–74	653,646	2706	8.7
75 +	519,792	1861	6.9
Gender			
Male	3,730,260	6312	49.7
Female	3,781,515	8420	50.3
Highest formal qualification (n = 12,520)			
University degree/equivalent	2,231,169	3978	29.7
TAFE certificate/Diploma	1,397,133	3040	18.6
High school certificate	985,616	1781	13.1
School certificate	978,560	2633	13.0
Others	399,878	1088	5.3
Work (paid or unpaid) (n = 12,650)			
No	2,297,459	6201	30.6
Yes	3,739,810	6449	49.8
Household income (before tax) (n = 10,758)			
<\$20 k	953,512	2502	12.7
\$20–40 k	843,566	1684	11.2
\$40–60 k	771,517	1422	10.3
\$60–80 k	2,700,676	4254	36.0
>\$80 k	453,071	896	6.0
Marital status (n = 14,664)			
Married	4,282,091	8159	57.0
Widowed	349,146	1560	4.6
separated/divorced	795,187	2036	10.6
Never married	2,050,494	2909	27.3
Speak language other than English (n = 14,262)			
No	5,530,352	12,329	73.6
Yes	1,595,314	1933	21.2
Number of people 65 + in household (n = 14,732)			
No	1,143,775	4486	15.2
Yes	6,367,999	10,246	84.8
Socioeconomic disadvantage quintile (n = 14,725)			
least disadvantaged	1,548,537	2095	20.6
2nd quintile	1,541,875	2543	20.5
3rd quintile	1,582,087	3148	21.1
4th quintile	1,416,448	3643	18.9
Most disadvantaged	1,418,880	3296	18.9
Private Health Insurance (n = 14,619)			
Yes	4,339,055	8506	57.8
No	3,087,466	6113	41.1
Type of smoke alarm (n = 14,224)			
Battery	4,415,796	9003	58.8
Hard wired	1,292,222	2527	17.2
Both	1,033,013	2008	13.8
None	358,784	686	4.8
Aware of the risk of fires (n = 14,224)			
<5min	4,415,796	9003	58.8
6–10 min	1,292,222	2527	17.2
11–15 min	1,033,013	2008	13.8
>15min	358,784	686	4.8
Smoking status (n = 12,677)			
Smoke daily	696,619	1322	9.3
Smoke occasional	246,976	380	3.3
Doesn't smoke now but use to	1,407,707	3590	18.7
Tried out	650,237	1252	8.7
Never	3,052,753	6133	40.6

n* = weighted total; n = unweighted total; %* = weighted percentage.

smallest percentage was in the “75 or older” group (6.9%). Male and female respondents were almost equally represented (49.7% and 50.3% respectively). For 48.3% of those surveyed had above average levels of education with 29.7% had a university degree or its equivalent. The highest level of formal education was at year 10 or below for 18.3% of respondents. Not surprisingly, there were more participants in paid employment than unemployed, and while 36.0% of those in paid employment earned between \$60,000 and \$80,000, only 6.0% of participants earned more than \$80,000. Fifty-seven percent of participants were married and 27.3% had never married. From the survey respondents, 21.2% spoke a language other than English. Most participants (84.8%) had people aged 65 years or older in their households.

Only 4.8% of participants did not have any type of smoke alarm installed in their homes. While a majority of participants (58.8%) would take less than 5 min to assess the risks of the likelihood of a home fire, 4.8% of them would take >15 min to identify that risk. Many of those interviewed (40.8%) had never smoked, while 9.3% smoked daily. Fig. 2 presents the proportions of the NSW population who had experienced residential fires, and who were willing to call the fire service or who were unwilling to call the fire service. While 10% (95% CI: 9.3,10.8) of the surveyed population had experienced residential fires, of these people, 3.1% (95% CI: 2.7,3.6) did call the fire service and 6.9% (95% CI: 6.3,7.6) were unwilling to call the fire service (Fig. 2).

Table 2 shows the unadjusted odds ratios (OR) of participants who experienced a home fire but did not call the fire service. Females were found to be significantly more likely to experience a home fire (OR = 1.19; 95% CI: 1.00, 1.41, p = 0.045) and also significantly more likely to call the fire service (OR = 1.30; 95% CI: 1.06, 1.59, p = 0.013). Participants who spoke another language in addition to English were significantly less likely to have experienced a home fire (OR = 0.42; 95% CI: 0.30, 0.52, p = 0.001) and also significantly less likely to call the fire service (OR = 0.35; 95% CI: 0.25, 0.49, p < 0.001). Participants who used both battery and hardwired smoke alarms were significantly more likely to have experienced a home fire (OR = 1.62; 95% CI: 1.29, 2.10, p = 0.001) and significantly more likely to call the fire service (OR = 1.60; 95% CI: 1.22, 2.08, p = 0.001). Higher household income (\$A80,000 and over) were significantly less likely to experience a home fire (OR = 0.58; 95% CI: 0.39, 0.88, p = 0.010) and also significantly less likely to call the fire service (OR = 0.56; 95% CI: 0.35, 0.90, p = 0.015).

Table 3 is a summary of the factors that posed risk to experiencing a home fire. Compared with those who spoke another language in addition to English at home, participants who spoke English only at home were less likely to experience a home fire (OR = 0.46; 95% CI: 0.32, 0.65, p = 0.001). Participants who used both battery and hardwired smoke alarms were more likely (OR = 1.51; 95% CI: 1.14, 2.00, p = 0.004) to experience a home fire. Ex-smokers were significantly more likely to experience a home fire (OR = 1.67; 95% CI: 1.20, 2.34, p = 0.003) for those participants who tried out and OR = 1.38; 95% CI:

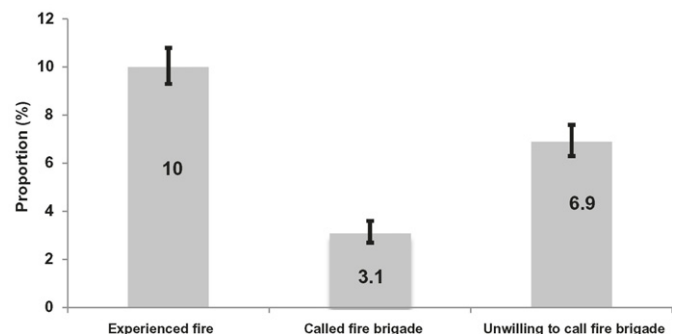


Fig. 2. Proportion of NSW population who experienced residential fires, willing to call fire service and unwilling to call fire service.

Table 2
Occurrence of a residential fire without calling the Fire Service: Unadjusted odd ratios.

Characteristic	Experienced fire OR [95% CI] ^a	Did not call fire brigade OR [95% CI] ^a
Age in categories		
<16 years	1.00	1.00
16–24	0.75 [0.52,1.07]	0.68 [0.44,1.05]
25–34	0.58 [0.39,0.85]	0.61 [0.39,0.96]
35–44	0.99 [0.71,1.36]	0.90 [0.61,1.32]
45–54	1.18 [0.88,1.60]	1.15 [0.81,1.63]
55–64	1.31 [0.99,1.75]	1.16 [0.84,1.61]
65–74	0.97 [0.72,1.30]	0.96 [0.68,1.35]
75+	0.77 [0.54,1.09]	0.70 [0.45,1.08]
Gender		
Male	1.00	1.00
Female	1.19 [1.00,1.41]	1.30 [1.06,1.59]
Highest formal qualification		
University degree/equivalent	1.00	1.00
TAFE certificate/Diploma	1.25 [0.99,1.57]	1.22 [0.93,1.61]
High school certificate	0.92 [0.69,1.24]	0.82 [0.57,1.18]
School certificate	1.09 [0.84,1.43]	0.98 [0.71,1.35]
Others	1.09 [0.74,1.59]	0.94 [0.58,1.52]
Work (paid or unpaid)		
No	1.00	1.00
Yes	1.18 [0.98,1.41]	1.29 [1.03,1.61]
Household income (before tax)		
<\$20 k	1.00	1.00
\$20–40 k	0.78 [0.56,1.10]	0.72 [0.47,1.10]
\$40–60 k	0.89 [0.64,1.24]	1.04 [0.71,1.53]
\$60–80 k	0.76 [0.59,0.99]	0.76 [0.56,1.04]
>\$80 k	0.58 [0.39,0.88]	0.56 [0.35,0.90]
Marital status		
Married	1.00	1.00
Widowed	1.28 [0.93,1.77]	1.18 [0.78,1.79]
separated/divorced	1.38 [1.08,1.77]	1.26 [0.94,1.69]
Never married	1.11 [0.90,1.38]	1.11 [0.86,1.43]
Speak language other than English		
No	1.00	1.00
Yes	0.40 [0.30,0.52]	0.35 [0.25,0.49]
Number of people 65+ in household		
No	1.00	1.00
Yes	1.11 [0.92,1.34]	1.13 [0.90,1.42]
Socioeconomic disadvantage quintile		
Least disadvantaged	1.00	1.00
2nd quintile	1.14 [0.86,1.51]	1.27 [0.91,1.79]
3rd quintile	1.08 [0.81,1.44]	1.18 [0.84,1.66]
4th quintile	1.16 [0.89,1.53]	1.14 [0.81,1.59]
Most disadvantaged	1.18 [0.88,1.58]	1.25 [0.88,1.77]
Private Health Insurance		
Yes	1.00	1.00
No	1.14 [0.96,1.36]	1.06 [0.86,1.3]
Type of smoke alarm		
Battery	1.00	1.00
Hard wired	1.02 [0.80,1.28]	1.01 [0.76,1.34]
Both	1.62 [1.29,2.03]	1.60 [1.22,2.08]
None	1.06 [0.72,1.58]	1.09 [0.67,1.77]
Aware of the risk of fires		
<5 min	1.00	1.00
6–10 min	1.02 [0.80,1.28]	1.01 [0.76,1.34]
11–15 min	1.62 [1.29,2.03]	1.60 [1.22,2.08]
>15mins	1.06 [0.72,1.58]	1.09 [0.67,1.77]
Smoking status		
Smoke daily	1.00	1.00
Smoke occasional	0.93 [0.53,1.62]	1.06 [0.55,2.04]
Doesn't smoke now but use to	1.25 [0.93,1.69]	1.20 [0.84,1.71]
Tried out	1.39 [0.97,2.00]	1.58 [1.03,2.42]
Never	0.81 [0.62,1.08]	0.86 [0.62,1.20]

^a Note: 95% confidence intervals (CI) that include 1.00 indicate a non-significant result.

1.07, 1.77, $p = 0.013$ for those participants who does not smoke but use to smoke before].

Table 4 presents the risk factors for participants' unwillingness to call the fire service. Participants who spoke another language in addition to English at home were significantly less likely to call the fire service (OR = 0.34; 95% CI: 0.21, 0.54, $p < 0.001$) compared to those who spoke English only at home. Average and higher household incomes

were 40% and 38%, respectively significantly less likely to experienced residential fires (OR = 0.72; 95% CI: 0.55, 0.93, $p = 0.013$ for average household income; OR = 0.60; 95% CI: 0.40, 0.91, $p = 0.017$ for higher household income).

Participants who used both battery and hardwired smoke alarms were risk factors to being unwilling to call the fire service (OR = 1.60; 95% CI: 1.15, 2.23, $p = 0.006$). Participants who had never smoked were also a risk to being unwilling to call the fire service (OR = 1.66; 95% CI: 1.12, 2.47, $p = 0.012$). Average and higher household incomes were significantly less likely to call fire the fire service than those with lower incomes (less than \$A20,000) (OR = 0.72, 95% CI: 0.55, 0.93, $p = 0.013$ for average household income; OR = 0.58, 95% CI: 0.36, 0.94, $p = 0.025$ for higher household income).

4. Discussion

The current analysis highlights notable differences between willingness and unwillingness to call the fire service in case of a residential fire, with 6.9% of the NSW population found to be unwilling to call the fire service. The household factors determined to be significantly associated with residential house fires and unwillingness to call the fire service are speaking only English, those who used both battery-operated and hardwired smoke alarms in their homes and those who had never smoked. In addition, females were significantly more likely to experience a residential fire and not show a willingness to call the fire service.

Univariate and bivariate analyses revealed that females, high household income (\$80,000 plus), having both battery and hardwired smoke alarms installed at home, and speaking a language other than English at home were significantly associated with *experienced residential fire* and *unwillingness to call the fire service*.

It is noteworthy that 10% of the NSW population experienced a residential fire with about one-third of these households being unwilling to call the fire service. These findings are consistent with a US study which showed that the majority (96%) of residential home fires were not attended by fire departments (Greene and Andres, 2009) and a New Zealand study, where about 90% of fires were managed by residents (Chubb, 2003). However, these findings could be attributed to the earlier warning of fire outbreak provided by smoke alarms, which may have resulted in residents extinguishing fires without the assistance of fire services (Chubb, 2003; Greene and Andres, 2009). The small size of fires and the early warning system provided by a smoke alarm have been identified in previous studies as reasons for the higher rates of unattended fires and self-management by residents (Ahrens, 2013; Chubb, 2003; Greene and Andres, 2009).

The current results indicate that, after adjusting for covariates, high household incomes (\$80,000 plus) were significantly associated with residential fires and unwillingness to call the fire service in case of a residential fire. This is contrary to a finding from a study conducted by Butry and Thomas (2012) which found that cities where fires tend to go unreported have lower average incomes than cities where fires do not tend to get reported. However, the findings are similar to those obtained by Greene and Andres (2009), who found that as income increases unreported fires or fire unattended by the fire brigade increase. This may be attributed to the fact that households with higher incomes are likely to have different types of fire safety equipment, such as interconnected smoke alarms (Ahrens, 2015), that would alert them early enough when the fire is still controllable.

The odds of experiencing a home fire were notably high among respondents who spoke only English at home while the odds of being unwilling to call the fire service during a home fire incident were significantly lower among respondents who spoke a language other than English at home. The different pattern of responses is not surprising given that previous research has indicated a relationship between safety concerns and cultural differences with respect to family protection among respondents that only spoke English at home and those who spoke other languages than English at home (Stevens et al., 2009).

Table 3
Risk factors associated with a residential fire.

Characteristic	Mo AOR [95% CI]	M1 AOR [95% CI]	M2 AOR [95% CI]	M3 AOR [95% CI]
Household income (before tax)				
<\$20 k	1.00	1.00	1.00	1.00
\$20–40 k	0.77 [0.55,1.09]	0.80 [0.57,1.13]	0.80 [0.56,1.13]	0.90 [0.62,1.29]
\$40–60 k	0.88 [0.63,1.23]	0.90 [0.64,1.26]	0.92 [0.66,1.30]	0.94 [0.65,1.37]
\$60–80 k	0.72* [0.55,0.93]	0.71* [0.55,0.93]	0.74* [0.57,0.98]	0.82 [0.61,1.11]
>\$80 k	0.60* [0.4,0.91]	0.64* [0.42,0.98]	0.67 [0.43,1.03]	0.83 [0.53,1.31]
Speak language other than English				
No	1.00	1.00	1.00	1.00
Yes	0.39** [0.28,0.53]	0.41** [0.3,0.56]	0.41** [0.30,0.56]	0.46** [0.32,0.65]
Type of smoke alarm				
Battery		1.00	1.00	1.00
Hard wired		0.93 [0.71,1.22]	0.94 [0.71,1.23]	0.99 [0.74,1.31]
Both		1.51** [1.18,1.94]	1.49** [1.16,1.92]	1.51** [1.14,2.00]
None		1.23 [0.78,1.94]	1.22 [0.77,1.93]	1.17 [0.72,1.90]
Private Health Insurance				
Yes			1.00	1.00
No			1.12 [0.9,1.39]	1.12 [0.88,1.42]
Smoking status				
Never				1.00
Tried out				1.67** [1.20,2.34]
Doesn't smoke now but use to				1.38* [1.07,1.77]
Smoke occasional				1.09 [0.59,2.03]
Smoke daily				1.15 [0.82,1.61]

Mo: adjusted for Age (continuous); Gender, Highest formal qualification; Work (paid or unpaid); Household income (before tax); Marital status; Speak language other than English and Socioeconomic Disadvantage quintile; M1 = Mo + Type of smoke alarm; M2 = M1 + Private Health Insurance; M3 = M2 + Smoking Status.

* $p < 0.05$.
** $p < 0.01$.

Respondents who installed both battery and hardwired smoke alarms at home were significantly more likely to experience a home fire and unwilling to call the fire service during a home fire. The plausible reasons for installing two alarms could be that multiple alarms, especially in homes with split living and sleeping areas, would be more likely to alert householders of a small fire and therefore save lives. In addition, all types of smoke alarms have limitations and no one type of smoke alarm can sense every kind of fire. A recent cluster randomised control trial conducted in NSW on a home fire safety checks program indicated that, compared to individuals in

the control cluster, individuals in the intervention cluster increased their use of battery or hardwired smoke alarm by 9% and 3% respectively (Tannous et al., 2016).

Respondents who smoked were more likely to experiencing a home fire and be unwilling to call the fire service during a home fire. This finding was supported by research conducted in the US which indicated that individuals who were involved in partial smoking (smoking in private lots) may increase their smoking behaviour inside these lots and therefore increase the likelihood of triggering smoking alarms (Wilson et al., 2014).

Table 4
Risk factors associated with unwillingness to call the Fire Service.

Characteristic	Mo AOR [95% CI]	M1 AOR [95% CI]	M2 AOR [95% CI]	M3 AOR [95% CI]
Household income (before tax)				
<\$20 k	1.00	1.00	1.00	1.00
\$20–40 k	0.71 [0.46,1.10]	0.73 [0.47,1.12]	0.74 [0.48,1.14]	0.84 [0.53,1.33]
\$40–60 k	1.04 [0.71,1.54]	1.05 [0.71,1.56]	1.08 [0.73,1.61]	1.18 [0.76,1.84]
\$60–80 k	0.72* [0.53,0.99]	0.71* [0.52,0.98]	0.75 [0.54,1.04]	0.90 [0.62,1.30]
>\$80 k	0.58* [0.36,0.94]	0.61* [0.38,0.99]	0.63 [0.39,1.04]	0.79 [0.46,1.34]
Speak language other than English				
No	1.00	1.00	1.00	1.00
Yes	0.32** [0.22,0.47]	0.33** [0.22,0.49]	0.33** [0.22,0.49]	0.34** [0.21,0.54]
Type of smoke alarm				
Battery		1.00	1.00	1.00
Hard wired		0.95 [0.70,1.30]	0.95 [0.69,1.30]	0.94 [0.66,1.33]
Both		1.55** [1.16,2.07]	1.56** [1.17,2.08]	1.60** [1.15,2.23]
None		1.31 [0.76,2.27]	1.33 [0.77,2.30]	1.34 [0.76,2.36]
Private Health Insurance				
Yes			1.00	1.00
No			1.09 [0.85,1.41]	1.03 [0.77,1.37]
Smoking status				
Never				1.00
Tried out				1.66* [1.12,2.47]
Doesn't smoke now but use to				1.27 [0.94,1.71]
Smoke occasional				0.98 [0.45,2.10]
Smoke daily				1.03 [0.70,1.54]

Mo: adjusted for Age (continuous); Gender, Highest formal qualification; Work (paid or unpaid); Household income (before tax); Marital status; Speak language other than English and Socioeconomic Disadvantage quintile; M1 = Mo + Type of smoke alarm; M2 = M1 + Private Health Insurance; M3 = M2 + Smoking Status.

* $p < 0.05$.
** $p < 0.01$.

Some limitations need to be considered when interpreting the results of this study. First, the cross-sectional nature of the design means this study captures only a snapshot view of these frequencies and no firm conclusions can be made regarding causes. Second, the findings are a baseline analysis and further studies can examine trends over time and consistency and the effect of some of the factors adjusted for, such as age (participants <16 years), could lead to underestimation or overestimation of our findings. Third, a number of confounding variables, such as the Kessler Psychological Distress Scale (K10), respondents' self-rated health and the Accessibility/Remoteness Index of Australia (ARIA), may influence factors associated with experiencing a home fire and not showing any willingness to call the fire service and these were not included in our analysis. Lastly, this study relies on self-reported data and this may be a source of measurement bias because participants may inaccurately recall information that was asked in the survey and teenagers may have different priorities of fire prevention and reporting than adults. Despite these limitations, a major strength of this study is the use of readily available data about people's home fire reporting attitudes and behaviours to inform knowledge and deepen understanding about home fire safety. The sampling method, appropriate adjustment for sampling weight, and the baseline data for monitoring trends over time are other important strengths of the survey. The regression estimates reported in this study did not shift significantly across the models which indicated that stage multivariate modelling approach adopted in this study eliminated any statistical bias that the usual multivariate modelling approach (adjusting for all potential confounding factors) would have introduced. The different models reported in this study will enable public health researchers and policy makers to determine the contribution of each potential confounder factors adjusted for and, to target sub-population at risk when demographic characteristics and other factors were adjusted for.

In conclusion, FRNSW, like all fire departments in Australia and globally, aims to improve the service it provides to benefit communities through ongoing assessments and monitoring of prevention measures and targeted responses. Household behaviour that indicates an unwillingness or inability to use services and/or adhere to fire prevention strategies are a worry and carry implications for service provision as well as research, policy and practices. Furthermore, as there are no data linkage studies connecting fire and rescue incident data, ambulance callouts, emergency department presentations, hospital admissions, general practitioners' visits or death registries, the exact number or residential fires and associated injuries or fatalities is unknown. In addition, government education and prevention policies using FRNSW incident data will be based on significantly lower numbers as determined by this study. This is an issue, as current government and industry discourse is on the strong requirements for fire safety imposed on existing and new dwellings and their impacts on development costs and pricing. We envisage that the results in this study will inform FRNSW's ongoing development of appropriate community-based interventions, and education and awareness programs on residential fire prevention especially among smokers, those who spoke another language in addition to English at home and those who used both battery and hardwired smoking alarms. We also hope that this study will deepen understanding about how household reporting attitudes affect residential fire safety interventions.

Author contributions

Kathy W. Tannous and Kingsley E. Agho conceptualised the study, performed the analyses, interpreted the results, and critically reviewed the manuscript for intellectual content. Both authors read and approved the final manuscript as submitted.

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Conflicts of interest

The authors declare no conflicts of interest.

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