



Unintentional residential fires caused by smoking-related materials: Who is at risk?



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ARTICLE INFO

Keywords:

Fire fatalities
Tobacco
Smoking-related materials
Risk factors
Coroner

ABSTRACT

Discarded cigarettes have been reported consistently as the leading cause of unintentional residential fire deaths; however, little is known about the risk factors of *unintentional residential fires caused by smoking-related materials* (i.e. smoking material fires, SMFs). Detailed data was coded from coronial files and this study focused on the 215 unintentional residential fires in the database which involved only single fatalities, with eighty-five of these being SMFs. This study is unique in using odds ratio (OR) analyses to investigate the size and relative importance of risk factors associated with SMFs. Seven out of 17 variables tested were significantly associated with SMFs compared to Non-SMFs, including being asleep (OR =15.37), bedroom/ lounge room being the room of fire origin (OR =10.29), alcohol intake (OR =3.42), psychotropic and sedative drugs intake (OR =3.35), mental illness (OR =3.18), being aged between 18 and 65 (OR =2.57), and being male (OR =1.81). Tests for mediation effect of alcohol intake and being asleep further clarify the nature of the relationship between age group and SMFs. Results revealed that individuals who had died in SMFs were more likely to present with multiple impairments compared to those who had died in non-SMFs. Further, significant associations between mental illness, psychotropic and sedative drug intake and the risk of SMFs were found. The comparative role of these risk factors provides an evidence-base for SMF prevention programs.

1. Introduction

Discarded cigarettes or other smoking-related materials have been consistently reported as a leading contributing factor to unintentional residential fire fatalities, injuries, and property damage [1,2]. In the U.S., from 2006 to 2010, smoking-related materials accounted for 8% of all reported fires, 22% of associated deaths, 9% of injuries and 5% of direct property damage [3], resulting in more deaths than any other type of residential fires. In Australia (excluding the Northern Territory) during the period from July 1996 to June 2004, when information regarding the cause of fire was available, smoking-related materials/equipment was the second leading cause of fatal residential fires (25%; 47/188) after heater/open fire/lamp (27%, 50/188) [4]. During the period from July 1999 to June 2006, when information was available, in 1823 cases that caused fire injuries, 6.3% (463/1823) were caused by cigarettes, 3.9% (287/1823) by lighters and another 3.1% (226/1823) by matches [5].

The important role of discarded cigarettes or other smoking-related materials in causing unintentional residential fires has been well documented, while little work has been done in identifying the

associated risk factors [3,6–11]. The existing studies are based mostly on two resources: fire incident databases developed by fire services and surveys on current smokers. The U. S. National Fire Protection Association (NFPA) provides comprehensive annual reports on the residential fires caused by smoking-related materials (SMFs) based on information collected from the National Fire Incident Reporting System [3,6]. These reports revealed that males, the very young, the elderly aged over 65, people with low socioeconomic status, individuals who was living alone, African Americans and Native Indians were generally at high risk in the U.S. smoking-material fire deaths. Most SMF fatalities occurred in winter, on the weekend, and in the late evening and early morning. The bedroom was the main room of fire origin for most fatal SMFs and being asleep was the primary factor. Despite its remarkable contribution, NFPA reports are predominantly descriptive and accordingly the relative importance of risk factors remains unknown.

There are also a growing number of studies that investigate SMFs through large scale surveys on current smokers' characteristics, risk behaviours, and reported fire incidents [7,12]. Such investigations often reveal a strong relationship between careless smoking behaviours

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(such as smoking in bed or leaving lit cigarettes unattended) and risks of SMFs. These studies however, rely heavily on participants' recall of their fire accidents and associated risky behaviours, it is possible that participants might seek to present themselves in a favourable manner [13].

Extending the existing literature, the main research question underpinning the current study is whether statistically significant associations exist between the factors revealed by previous research (i.e., age, sex, alcohol, mental illness, and physical illness) and SMF fatalities versus Non-SMF fatalities. Further, given that smoking combined with alcohol use exacerbates the risk of fires, fire injuries, and fire deaths [3,14], this study also aims to examine whether and how alcohol intake mediates and/ or moderates the relationships between risk factors and SMFs, an area that has not been investigated previously in fire research. Finally, this study aims to explore the role of impairment in SMFs via a comparison between Non-SMFs and SMFs involving single fatalities.

1.1. Definitions and selection criteria

For the purposes of this study, residential fire refers to a fire that occurred in a house, unit/apartment, mobile homes (i.e., campervan and caravan) or other residential dwelling (i.e., shed/garage). Backyard/ frontyard fires were included if they involved a structure such as a garage or shed. Confidence codes (i.e., definite, most likely, possible, and unknown) were used for a number of variables (i.e., ignition factors, behaviours, and the cause of death) to describe the degree of certainty regarding subjective judgements made by the coder. The confidence code of 'definite' is given when information is clearly stated or decided by forensic scientists, a key witness who was involved in the fire but did not die, or the victim who was still alive at some point following the fire and was able to give his/her account of events. Otherwise the judgement was coded as most likely, possible, or unknown.

Smoking-related materials were defined as cigarettes, other smoking-related materials, equipment or ignition sources (i.e., pipes, cigars, matches, battery powered e-cigarettes). However, fires that were caused by the ignition sources such as matches or lighters were included only when such equipment was used for the purpose of smoking, rather than other purposes such as lighting a fire or playing. In line with this criterion, fires caused by a child playing with ignition sources (i.e., lighters or matches) were not included as SMFs. Whether a fire was classified as SMF or Non-SMF was judged based on information collected for three variables: ignition factor, house appliances involved and form of heat. When an ignition factor was coded as 'discarded cigarettes or other smoking-related materials' and/ or form of heat was coded as 'heat from cigarette', with a confidence level being 'definitely' or 'most likely', the fire was classified as SMF otherwise, the fire was classified as Non-SMF. Fires with undetermined ignition factors were excluded from further analysis.

2. Methods

2.1. Sample

The data source is the ongoing Victoria University Fire Fatality Coronial Database (referred to below as *the Coroners' Database*) that currently collates fatal fire and fatality information across three Australian states: Victoria, New South Wales, and Queensland, from 1998 to 2008. Ethics approval was obtained by the Victoria University Human Research Ethics Committee (HRETH 09/163). This database was developed to record information about fatal fires and fatalities with the purpose of identifying risk factors to assist in the development of targeted prevention strategies. Included in the database is information about the fire, the environment, and the human behaviour implicated in each fire death. Scanned reports of coronial files were each

extensively coded using a specially developed manual (with over a 100 different variables) to compile available information quantitatively where possible. Each file may include reports from several sources such as police, the medical examiner, fire and arson investigators, and fire fighters. Witness statements about the event, and from family and friends who can provide relevant information about decedents are often also included. No results are reported for inter-coder reliability or the other indicators of coding quality.

In total, information regarding 492 fire fatalities had been entered in the SPSS database at the time of data analysis (files that have not been entered were mainly vehicle fire accidents). There were 33 fires involving multiple fatalities (totalling 80 fatalities; 24 fires ×2 fatalities, 4 fires ×3 fatalities, and 5 fires ×4 fatalities). Only three of these fires (involving 7 fatalities in total) were caused directly by discarded cigarettes. Fires involving multiple fatalities were not included in the analyses presented here in order to prevent artificial inflation of risk variables related to multiple death fires [15]. After the elimination of fires involving multiple fatalities, suicides and murders, non-residential premises or circumstances, suspicious, undetermined and deliberately lit fires (including arson), as well as fires caused by a child playing with ignition sources, information was available for 215 (43.7% of the total) unintentional residential single fatalities. Of the 215 fires, 39.5% (85/215) were caused by discarded cigarettes or smoking-related materials. It should be noted that, this study focused on the person who had died in the unintentional residential fires regardless of who caused fire.

2.2. Measures

'Unintentional residential fires/ fatalities' was the dummy dependent variable, with fires caused by smoking-related materials being coded as SMFs and those caused by other ignition factors (i.e., electrical failure) as Non-SMFs. In total, 17 factors were selected from previous research [11,16,17], including age, sex, being asleep, room of fire origin (RFO), alcohol, psychotropic and sedative drugs, mental illness, physical illness, pre-existing disability, property ownership, location at ignition, internal state of a building, outside condition of a building, living arrangement, smoke alarm presence, smoke alarm operation, and occupation. The classification of these variables were presented in the results section.

2.3. Statistical analyses

Binary logistic regression with the odds ratio (OR) was used to determine whether the variable examined was a significant risk factor for SMFs compared to Non-SMFs. The odds ratio analysis has been used widely to compare the relative odds of the occurrence of the outcome of interest (e.g. cancer), given exposure to the variable of interest (e.g. personal characteristic, aspect of medical history). The odds ratio can also be used to determine whether a particular exposure is a risk factor for a particular outcome, and to compare the magnitude of various risk factors for that outcome. The four steps of Baron and Kenny [18] and the Sobel test [19] were utilized to test whether alcohol intake mediates and/ or moderates relationships between risk factors and SMFs. Finally, the number of 'impairments' was compared between Non-SMFs and SMFs involving single fatalities.

3. Results

3.1. Characteristics of fatal unintentional residential fires (SMFs versus Non-SMFs)

In total, 215 unintentional residential fires involving single fatality were used for this study. Discarded cigarettes or other smoking-related materials (85/215, 39.5%) were the leading cause of fatal unintentional residential fires, followed by combustibles too close to heat (i.e., heater, candles; 50/215, 23.3%) and electrical failure (10%, 22/215). All 85

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