Epidemiology of dwelling fires in England 2010-2023

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Highlights

- The number of dwelling fires has been reducing steadily year by year since 2010 and dwelling fires accounted for less than 5% of all incidents attended by English FRSs in 2022
- 14.68% of dwelling fires recorded involving at least one fire-related fatality or casualty
- Injuries or fatalities were most likely to occur in dwelling fires during the night, in properties with a single occupant, occupants of pensionable age (>65 years old) and when the initial fire spread from the items first ignited.
- Non-functional fire alarm due to battery issue increases the risk of fatality or casualty in dwelling fire.
- Human behaviour with the highest relative risk of being a fatality or casualty in dwelling fire is lack of attention when handling hot objects or naked flame.

Abstract:

Despite the number of dwelling fires having decreased around 4% over the past decade, this incident type is still the leading source of fire-related fatality and casualty in the UK.

This study reviews the prevalence of a range of risk factors in dwelling fires, their individual effects on casualties and fatalities, and explores the associations between different risk factors in incidents with at least one fire-related fatality or casualty from dwelling fires in England.

Method: This is a retrospective cohort secondary analysis of all dwelling fires in England attended by any of the 44 English Fire Rescue Services recorded on the Home Office Incident Record System between 1st April 2010 and 31st March 2023. Bivariate analysis and multivariable logistic regression analysis were used to explore the relationship between risk factors recorded and the incidence of at least one fire-related fatality or casualty in dwelling fires.

Findings: Fatalities or casualties were most likely to occur in dwelling fires at night (OR: 1.78, $p<0.001$; adjusted OR: 1.80, $p<0.001$), in properties with single occupancy (OR: 1.60, $p<0.001$; adjusted OR: 1.25, $p<0.001$) and occupant(s) of pensionable age (OR: 1.57, $p<0.001$; adjusted OR: 1.54, $p<0.001$) and when the extent of fire spread beyond the initial item ignited on arrival (OR: 2.34, $p<0.001$; adjusted OR: 2.53, $p< 0.001$). The human behaviour associated with the highest relative risks of involving a fatality or casualty was identified as lack of attention when handling hot objects or naked fire (OR: 5.12, $p<0.001$; adjusted OR 4.40, $p<0.001$).

Conclusion: This study provides valuable insight on the epidemiology of dwelling fire in England and will support fire prevention efforts of FRS including development a targeted approach for home fire safety visits. These findings will enable targeting of households at elevated risk of experiencing a dwelling fire and particularly those at increased risk of fatality or casualty due to dwelling fire. It will also support the refinement of fire prevention messages to raise awareness of the highest risk factors of injuries and fatalities in dwelling fires.

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1 Introduction

Fires are potentially devastating events and can result in emotional distress, physical injuries, deaths and significant damage to properties. Nearly 74% of fire-related injuries and over 80% of fire-related fatalities worldwide [1] are caused by dwelling fires. Dwelling fires account for a significant proportion of the incidents attended by UK Fire and Rescue Services (FRS) [2] and are the leading sources of fire-related fatality or casualty in the UK [3].

Despite the number of dwelling fires having decreased by approximately 4% over the past decade [4], they continue to cause significant harm and remain a public health concern worldwide [4,5]. In addition to the human costs of dwelling fires, there is an economic and social burden associated with the anticipation, consequences and response to dwelling fires [4,6].

Previous research across the world found that injuries and deaths are closely related to a range of fire-related, environmental and personal factors [7,8,9,10,11] as well as individual behaviours [9,11,12]. However, the evidence around the relative effect of each factor on the risk of being a fatality or casualty in dwelling fire remains limited.

Turner et al. published a systematic review in 2017 which indicated that: higher numbers of residents, male residents, children under the age of 5 years, non-working households, smoking, low income, non-privately owned properties, apartments and buildings in poor condition were associated with increased risk of fire incidents, injuries and fatalities; Living alone and households with older residents were both associated with increased risk of fire injury though households with older residents were significantly less likely to experience a house fire in the first place [13]. However, due to the

heterogeneity of the published literature, they concluded that it was not appropriate to conduct a meta-analysis and instead used a best evidence synthesis. [13].

Prevention has been recognised as the key to lower rates of fires in high-income countries and reducing the harms associated with dwelling fires [14]. Home Fire Safety Visits (HFSVs) were introduced by fire and rescue services across the world in the early 2000s and previous reviews indicated that they are effective interventions to prevent residential fires and reduce fire-related injuries and fatalities [15,16,17]. Williams et al. reported that Home Fire Safety Checks in England were associated with 13,670 fewer fires and 888 fewer non-fatal casualties per year [15] while Sund et al. reported that home fire safety checks by on-duty fire fighters reduced fire and developed fires by up to 8% per year in Southern Sweden [16]. Tannous reported that 94% of respondents stated that a home fire safety visit by Fire and Rescue New South Wales in Australia was helpful [17].

Home Fire Safety visits were one of the foci of UKFRS prevention work to prevent fire, reduce fire fatalities and serious injuries in the residential setting. The National Fire Chief Council (NFCC) has launched a Person Centred Framework guidance [18] which recommends UKFRS to adopt the eight core components for the Home Fire Safety Visits programme in the UK. This article will provide an extended analysis of potential factors influencing fatalities and casualties in dwelling fires in England to inform future development of Home Fire Safety Visits.

2 Methods

2.1 Study design

This is a retrospective cohort secondary analysis of the Home Office Fire Statistics obtained from the Home Office Incident Report System (IRS).

In contrast to the existing Home Office quarterly routine fire statistics report, the primary objective of this paper is to review the prevalence of a range of risk factors in dwelling fires as described by Turner et al. [13] and the NFCC eight core components of HFSV [18], their individual effects on casualties and fatalities, and explore the associations between different risk factors in incidents with at least one fire-related fatality or casualty from dwelling fires in England to inform the development of home fire safety visit programme in FRS in the UK.

All dwelling fires in England attended by all 44 English Fire Rescue Services recorded on the IRS between 1st April 2010 and 31st March 2023 were included in this secondary analysis.

The IRS is a national data collection system administered by the Home Office [19]. It is part of the FRS Improvement Programme and the Home Office produces reports on the national statistics on fires, casualties, false alarms and non-fire incidents attended by the FRS in England annually [20]. Due to the confidentially and accuracy considerations, the Home Office concluded that is not possible to publish all incident level data publicly.

The dataset used for this secondary analysis was chosen because it is the most recent and the only dwelling fire dataset in England which contains incident level data. It was published by the Home Office on the 27th July 2023 and it is available on the Home Office Fire Statistics webpage [21].

The variable available in the dwelling fires dataset is defined as "*Whether the incident involved a fatality or casualty*" [22]. Additionally, this aggregation of injuries and fatalities into a single outcome variable may limit the ability to distinguish specific risk factors associated with severe injuries and fatalities. The incident level dataset does not distinguish between incidents with single and multiple casualties/fatalities.

It is worth noting that not all the risk factors of interest as described in the systematic review by Turner et. al. [13] and the NFCC Person Centred Framework [18] are available in the IRS or were publicly available due to the risk of identification individuals involved. This study is therefore limited to the risk factors in Table 1 for both bivariate and multivariate analysis.

Table 1: Risk factors related to fatalities or casualties of dwelling fire included in the analysis

Time of day
Day of the week
Causes of Fire
Types of Properties
Location of initial fire
Initial Fire Size
Presence of Older People
Presence of Children
Single Occupancy
Delays in discovery/call
Fire alarm responses

The secondary objective of this paper is to explore the availability of data related to the eight core components in the NFCC Person Centred Approach to Home Fire Safety Visits Programme from the existing routine incident level reporting system.

2.2 Statistical Analysis

Statistical analysis was completed using Stata version 14.0 (College Station, Texas.)

Bivariate analysis was performed by comparing factors listed by the involvement of at least one fire-related fatality or casualty. Chi Square statistics were used to test the relationship between the primary outcome (i.e. incident with/without at least one or more fatality or casualty) between categorical and binary variables and p-value was presented to quantify the statistical significance and the likelihood of the observed odd ratios being due to chance.

Multivariable logistic regression analysis was used to explore the relationship between involvement of at least one fire-related fatality or casualty and factors in table 1 with adjustments as covariates. The result were presented as odds ratio to identify the association between each factor and a dwelling fire involving a fatality or casualty , compared to the odds of the outcome in the designated base variable for each covariate.

3 Findings and discussion

This study presents the first review and report on the epidemiology of dwelling fires in England utilising data from the Home Office IRS system, marking a pivotal step towards enhancing fire prevention and response strategies. By shedding light on the characteristics of dwelling fires, the prevalence of associated risks factors and their relationships with the risk of fatality or casualty in

dwelling fires, this research provides valuable insights for the UK Fire and Rescue Services to support the development of their prevention and operational strategies.

3.1 Number of dwelling fires and proportion of incidents with at least one fatality or casualty

There were 23,138,231 dwellings in England in 2021 [20]. The number of dwelling fires has been reducing steadily year by year since 2010 (Figure 1) and dwelling fires accounted for less than 5% of all incidents attended by English FRSs in 2022[1]. This decreasing trend of dwelling fires in England is similar to US and other European Countries [1,4].

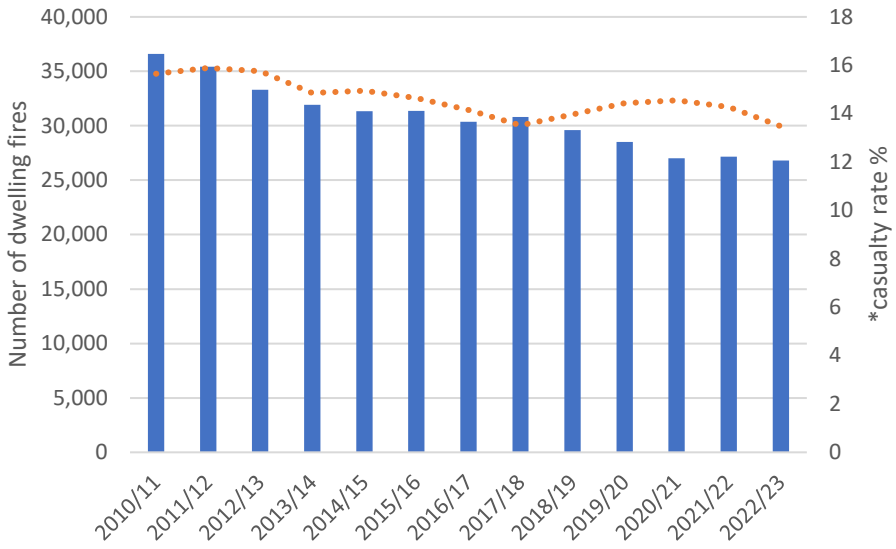

Figure 1: Number of dwelling fires and casualty rate attended by English FRS between 2010/11 and 2022/23

**casualty rate is calculated by the number of dwelling fire with involved at least one fatality/casualty divided by the total number of dwelling fire within the same time period*

The 44 English FRSs attended a total of 400,236 dwelling fire between 1st April 2010 and 31st March 2023. This equates to an estimated risk of dwelling fire in England between 2010-2023 of 1.33 incidents

per 1000 dwellings per year which is nearly half the incidence rate (2.60 incidents per 1000 dwellings per year) in the USA [4] and comparable to a number of European Countries (the Netherlands 0.90 incidents per 1000 dwelling per year; Hungary 1.56 incidents per 1000 dwellings per year; Belgium 1.62 incidents per 1000 dwellings per year) [1].

58,758 reported incidents of dwelling fire (14.68%) were recorded as involving at least one fire-related fatality or casualty 318,270 (85.23%) were recorded as no fire-related fatality or casualty. This equates to an estimated risk of dwelling fire-related fatality/casualty in England between 2010-2023 of 0.20 incidents per 1000 dwellings per year.

3.2 Incidence of dwelling fire and the proportion of incidents with at least one fatality or casualty by type of properties

Type of property was recorded in the 370,389 incidents. The majority of dwelling fires occurred in houses (66.6%), followed by flats (27.6%) and in bungalows (5.8%). The proportion of incidents with at least one fatality or casualty in different types of properties varies (Table 2).

Table 2: Dwelling Fires by type of properties

Type of property	Incidents with fatality/casualty		Total number of incidents	% incidents with at least one fatality/casualty	p-value *
	Yes	No			
Bungalow	4,295	17,358	21,653	19.8%	>0.001
House	34,085	212,415	246,500	13.8%	
Low Rise Flats (1-3 floors)	11,040	55,507	66,547	16.6%	
Medium Rise Flats (4-9 floors)	3,048	21,917	24,965	12.2%	
High Rise Flats (>10 floors)	1,536	9,188	10,724	14.3%	

*p-value calculated using Chi Square statistics

Using the "type of accommodation" information from the ONS Census data[23], the estimated risk of dwelling fire in houses (including bungalows) in England between 2010-2023 is 1.08 incidents per 1000 houses per year and the estimated risk of a dwelling fire in houses (including bungalow) including at least one fatality or casualty is 0.15 incidents per 1000 houses per year. Similarly, the estimated risk of dwelling fire in flats (all types) in England between 2010-2023 is 1.97 incidents per 1000 flats per year and the estimated risk of dwelling fire in flats (all types) including at least one fatality/casualty is 0.30 incidents per 1000 flats per year.

Table 3: Annual dwelling fire rate by type of properties

Type of properties	**Annual dwelling fire rate**	**Annual dwelling fire rate with ≥1 fatality/casualty**
House (including bungalow)	1.08 per 1000 properties	0.15 per 1000 properties
Flats	1.97 per 1000 properties	0.30 per 1000 properties

Our finding echoes previous literature summarised in the systematic review by Turner et. al. [13] which reported there is low level evidence that single family properties (houses) are less likely to experience a house fire incident compared to flats and other types of property; and properties with higher numbers of stories/ floors or those considered 'over-crowded' were associated with an increased risk of fire incidents.

The data on incidence rates of different types of properties will support UKFRS to review their current approach to Home Fire Safety Visits, the existing Pre-determined Attendance (PDA) protocol [24] and operational risk assessment to high-rise/flats. This will ensure effective deployment of resources as the incidence rate of dwelling fire in flats is nearly double that in houses. The use of targeted approach can optimise resource deployment, ensuring that areas with a higher density of flat/ high-rise buildings receive the appropriate level of resources to deliver both prevention and firefighting activities.

3.3 Incidence of dwelling fire and the proportion of incidents with at least one fatality or casualty by occupancy

320,562 reported incidents contained occupancy information and they are reported as "occupancy type" variable in the data published by the Home Office [21]. Specific occupancy sub-type information were extracted from the "occupancy type" variable to allow additional analyses on the effects of single occupancy, presence of child or pensionable age (>65 years old) occupants on the risk of having casualty/fatality in dwelling fires.

53.7% fires occurred in a dwelling with single occupancy, 33.5% occurred in a household with at least one child and 25.7% occurred in a household with one or more occupants of pensionable age. The proportion of incidents with at least one fatality or casualty with different occupancies is summarised in Table 4.

The bivariate analysis showed single occupancy and presence of pensionable age (>65 years old) occupant increase the rate of having fatality or casualty in dwelling fires, this aligns with findings from previous studies [25,26,27] while also contrasting with other prior studies [13, 26]. Additionally, the analysis showed that households with at least one child had a lower rate of having fatality or casualty in dwelling fires.

Further analysis for these characteristics is part of the multivariate analysis and reported in section 3.4 of this paper.

Table 4: Dwelling fire by occupancy sub-types

Occupancy sub-type	**Incidents with fatality/casualty**		**Total number of incidents**	**% incidents with at least 1 fatality/casualty**	**p-value****
	Yes	**No**			
Single Occupant	30,748	141,332	172,080	17.9%	<0.001

Multiple Occupants	17,738	130,744	148,482	11.9%	
Household with at least one child	11,509	95,748	107,257	10.7%	<0.001
Household without child	36,977	176,328	213,305	17.3%	
Household with 1 or more occupants in pensionable age	16,254	66,261	82,515	19.7%	<0.001
Household without occupants in pensionable age	32,232	205,815	238,047	13.5%	

** p-value is calculated by Chi Square statistics

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189

190 3.4 Multivariate analysis to explore factors linked to increased risk of fatality or
191 casualty in dwelling fires in England

192 Utilising epidemiological information gathered from this study to identify households at high risk of
193 experiencing a fire and those most at-risk and vulnerable to injuries or fatalities, the UKFRS and the
194 NFCC can target their prevention efforts to effectively reach and support those communities which are
195 most in need. It is reassuring that the risk factors identified by this study align with the NFCC Person-
196 Centred Approach to the Home Fire Safety Visit [18] where similar risk factors were identified as
197 increased risk of being a casualty in dwelling fires.

198

199 The crude and adjusted odds ratios of risk factors linked to increased risk of fatality or casualty in
200 dwellings fires in England are summarised in Table 7. It is worth noting the IRS has limited data and
201 not all risk factors were recorded in all incidents.

202

203 3.4.1 Fire/ Incident characteristics
204

Dwelling fires occurring in the night (from midnight to 0600hrs) are 78% more likely to result in fatality or casualty compared to dwelling fires occurring in the afternoon (midday to 1800hrs). Additionally, dwelling fires occurring at the weekends have a 7% increase in the risk of causing injuries or fatalities and the increase in risk reduced to 3% if adjusted for other risk factors.

The risks of injuries or fatalities is highest at night (OR: 1.78, p:<0.001; aOR 1.80, p<0.001), this could be because properties are more likely to be occupied at night, though sleep could influence a delay in discovery (as delay to discovery linked to a small rise in the risk of injuries).

Unsurprisingly, the risks of injuries or fatalities increase significantly if the initial fire on FRS arrival has spread beyond the item first ignited, this aligned with findings from Hasofer et al. [7] who concluded that "the extent of fire" is one of the fire-related factors with the greatest impact on injuries and fatalities.

3.4.2 Individual characteristics

Dwelling fires occurring in households with one or more occupants of pensionable age resulted in increased risk of fatality/casualty (OR: 1.57, p<0.001; aOR: 1.54, p<0.001); this is similar to previous studies which indicated that older people are at greater risk of fatality or casualty in dwelling fires [8,10,11,12,13,26,27,28]. It is also worth noting that Thompson et. al. [12,27,28] suggested that older people with age-related health conditions may have restricted abilities to identify fire risks, detect early signs of fire and to move away from fire to a place of safety, which all contribute towards the

increased probability of injuries and fatalities in older people. Ghassempour et al. [8] reported that older people had four-fold increase in the risk of dying in residential fire.

Dwelling fires in households with children had a lower risk of fatality or casualty (OR: 0.51, $p<0.001$; aOR: 0.78, $p<0.001$). This finding differs from previous non-UK findings from DiGuiseppi and others which suggest injury rates were higher in 0-4 years old [28,29,30]. This is likely due to the different classification of children in the two datasets. Our data classified children as any individual less than 18 years old whereas DiGuiseppi et al subcategorised children aged 0-4 years. Istre et. al. [30] reported that fireplay, such as play with matches or lighters in younger children was associated with increased fire risk.

Lone occupants in dwelling fires are more likely to incur injuries or fatalities. Fires that occurred in single occupancy dwellings are 60% more likely to be linked to fatality or casualty, this statistically significant increase in the risk of fatality or casualty remained at 25% when adjusted for other risk factors (Time of day, day of the week, dwelling type, occupancy information, poor fire alarm response, discovery time, discovery to call time, causes of fire, location of the fire started and initial fire size). This finding is consistent with numerous previous studies [11,12,27,31] however, Xiong et al. pointed out that lone occupancy status by itself might not provide adequate information about the social context at the time of a residential fire as a person living alone may have visitor with them which means they were not alone at the time of a fire, or vice versa [25].

3.4.3 Environmental factors (including built characteristics)

Although the annual incidence rates of dwelling fires by the number of properties are higher in flats, bungalows have the highest relative risks for involving a fatality or casualty in dwelling fires while

incidents occurring in Medium rise flats (4-9 floors) were least likely to link to fatality or casualty (OR: 0.56, p<0.001; aOR: 0.73, p<0.001).

This finding could be an artefact because only a relatively small number of bungalows were involved in dwelling fires. Using the housing stock data of England in 2017, the estimated annual dwelling fire rates are 0.76 incidents per bungalow, 1.86 incidents per house and 1.61 per flat during the study period. This aligned with previous finding from Turner et. al. [13] which concluded that single family properties are less likely to experience a dwelling fire. It is also possible that there is a systematic difference in occupancy status in bungalows with a higher proportion of both "single occupancy" and "one of more occupants in pensionable age" which both independently increase the risk of injuries or fatalities in dwelling fires.

The kitchen is the most common location where dwelling fires started (Table 5). It represented over half (53.3%) of the locations of fire initially started in our data. This is most likely associated with cooking. However, the risk of having a fatality or casualty were higher if the dwelling fire started in the bedroom (OR: 1.87 p<0.001 ; AOR: 1.82, p<0.001) and living area (OR: 1.40, p<0.001; aOR: 1.45, p<0.001) while fires started in the bathroom (OR: 0.77, p<0.001; aOR: 0.88, p=0.003) and other areas (OR: 0.50, p<0.001; aOR: 0.63, p<0.001) had a lower risk of having a fatality or casualty compared to those started in the kitchen. The relatively higher risk of having a fatality or casualty where dwelling fires started in bedroom and living areas was also reported in previous studies [7,25,26] and this was determined by Hasofer et al. as being due to "activity at the time of fire".[7].

Table 5: The type of room/compartment the dwelling fire started in

Location of initial fire	Incidents with fatality/casualty		Total number of incidents	% incidents with at least 1 fatality/casualty	p-value**
	Yes	No			
Bedroom	9028	28126	37154	24.3	<0.001
Kitchen	29912	171072	200984	14.9	
Living area	9046	39149	48195	18.8	
Bathroom	1035	7743	8778	11.8	
Others	5854	63442	69296	8.4	

3.4.4 Human Behaviours

Human behaviours are among the factors linked with the highest relative risks of having fatality or casualty in the study.

Fire alarms were present in over seven out of ten of the dwelling fires in England. However, alarms were not always activated or raised an alarm. Reasons why fire alarms were not activated or did not raise an alarm included defective/missing battery (1%), faulty systems (0.8%), fire in an area not covered by the alarm system (2.5%), and occupants did not respond (1.4%). [21]

Table 6: Smoke/fire alarm activations in dwelling fires

Smoke/fire alarm activation	Incidents with fatality/casualty		Total number of incidents	% incidents with at least 1 fatality/casualty	p-value**
	Yes	No			
Alarm Absent	12,406	94,629	107,035	11.6%	<0.001
Alarm Present and raise the alarm	26,048	125,435	151,483	17.2%	
Alarm Present but did not operate	8,994	64,801	73,795	12.2%	
Alarm Present but did not raise alarm	7,689	33,405	41,094	18.7%	

** p-value is calculated by Chi Square statistics

Compared to dwelling fires with a functional fire alarm, incidents with a defective fire alarm linked to battery issues increased the risk of having a fatality or casualty (OR: 1.40, p<0.001; aOR: 1.34, p<0.001).

The presence of other human factors such as occupants did not respond, other acts preventing alarms from operating were also linked to an increased risk of having a fatality or casualty (OR: 1.22, p<0.001; aOR: 1.06, p=0.017). However, it is worth noting that human behaviours (including battery issues) significantly influenced the operation and the effectiveness of fire alarms and linked to increased risk of having a fatality or casualty. Focusing on human behaviours related to fire alarms continues to be a key aspect of HFSVs by UKFRS [18].

The lack of attention (OR: 5.12, p<0.001; aOR 4.40, p<0.001) and lack of care (OR:2.38, p<0.001; aOR:1.85, p<0.001) when handling hot objects or naked fire are the two greatest risk factors for injuries or fatalities in dwelling fires. Similar to the fire start location discussed in the earlier section, this is likely linked to the activity at the time of fire and the proximity of individual involved to the source of fire when they started as described by Hasofer and colleagues[7].

Unsurprisingly, both delays in discovery (>5 minutes) and delays in call (>5 minutes) were associated with an increased risk of injuries or fatalities. Delays in calls to Fire and Rescue Services related to a higher risk (OR: 1.50, p<0.001; aOR: 1.42 p<0.001) compared to delays in the discovery of the fires (OR: 1.22, p<0.001; aOR:1.06 p<0.001).

307

308 *Table 7: Crude and Adjusted odds ratios for dwelling fire involving one or more fatality/casualty*

Characteristics	Crude ORs	95% CI	p-value	Adjusted* ORs (n=235,941)	95% CI	p-value
Time of day (n=400,236)						
Afternoon	1			1		
Morning	1.11	1.08-1.14	<0.001	1.13	1.08-1.17	<0.001
Evening	1.17	1.14-1.20	<0.001	1.24	1.20-1.27	<0.001
Night	1.78	1.73-1.82	<0.001	1.80	1.74-1.87	<0.001
Day of the week (n=400,236)						
Weekday	1					
Weekend	1.07	1.05-1.09	<0.001	1.03	1.00-1.05	0.041
Dwelling Type (n=370,389)						
Bungalow	1					
House	0.65	0.63-0.67	<0.001	0.83	0.80-0.87	<0.001
Low Rise Flats	0.80	0.77-0.84	<0.001	0.91	0.86-0.96	<0.001
Medium Rise Flats	0.56	0.53-0.59	<0.001	0.73	0.69-0.78	<0.001
High Rise Flats	0.68	0.63-0.72	<0.001	1.00	0.92-1.09	0.976
Occupancy sub-type (n=320,562)						
Single Occupancy	1.60	1.57-1.64	<0.001	1.25	1.22-1.29	<0.001
Household with at least 1 Child	0.57	0.56-0.59	<0.001	0.78	0.76-0.80	<0.001
One or more occupants in pensionable age	1.57	1.53-1.60	<0.001	1.54	1.50-1.59	<0.001
Poor Alarm Response (n= 382,151)						
Alarm raised	1			1		
Battery Issues	1.40	1.33-1.47	<0.001	1.34	1.27-1.44	<0.001
System Issues	0.44	0.43-0.46	<0.001	0.67	0.64-0.70	<0.001
No Alarm	0.63	0.62-0.65	<0.001	0.79	0.77-0.81	<0.001

Other Human factors	1.22	1.18-1.27	<0.001	1.06	1.01-1.12	0.017
Discovery time (n=372,116)						
>5mins	1.22	1.12-1.24	<0.001	1.06	1.03-1.09	<0.001
Discovery to call time (n=387,584)						
>5mins	1.50	1.46-1.54	<0.001	1.42	1.36-1.47	<0.001
Causes of fire (n=357,424)						
Faulty Equipment	1			1		
Lack of attention	5.12	4.94-5.31	<0.001	4.40	4.19-4.62	<0.001
Lack of care	2.38	2.31-2.45	<0.001	1.85	1.79-1.92	<0.001
Misuse of equipment	1.60	1.56-1.65	<0.001	1.66	1.59-1.73	<0.001
Deliberate	1.75	1.70-1.82	<0.001	1.84	1.75-1.93	<0.001
Location of fire started (n=400,236)						
Kitchen	1			1		
Bedroom	1.84	1.80-1.89	<0.001	1.62	1.56-1.70	<0.001
Living area	1.40	1.37-1.44	<0.001	1.45	1.39-1.51	<0.001
Bathroom	0.77	0.72-0.82	<0.001	0.88	0.80-0.96	0.003
Others	0.50	0.49-0.51	<0.001	0.63	0.61-0.66	<0.001
Initial Fire Size (n=400,235)						
No Fire Damage	1			1		
Limited to item first ignited	0.80	0.78-0.82	<0.001	0.86	0.83-0.89	<0.001
Spread from the item first ignited	2.34	2.29-2.39	<0.001	2.53	2.45-2.61	<0.001

*Logistic regression model is adjusted for Time of day, Day of the week, Dwelling Type Occupancy sub-type, Reason for poor alarm response, Discovery time, Discovery to call time, Causes of fire, Location of fire started and Initial Fire Size

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4 Limitations

Despite the significance of this study, several limitations must be acknowledged. Firstly, the primary source of incident-level data is from on-scene fire crew reports via the IRS. Even though the Home Office applies quality assurance checks on data received, it still relies on individual fire commander judgement to complete the report which may introduce the potential for bias. Variations in reporting practices and data collection methods across different UKFRS may impact the accuracy and reliability of the epidemiological findings.

The historical nature of the data means that emerging risks, such as those posed by charging of lithium batteries which are commonly use in e-bike and e-scooter [32], are not reflected in this study as new categories of risk have not yet been developed in the IRS. As technology and societal trends evolve, the landscape of fire risks continues to change, necessitating ongoing surveillance and adaptation of prevention strategies.

The absence of information regarding previous interactions with UKFRS, the properties involved and the health status of the occupants in dwelling fires represents a notable gap in the dataset. Understanding whether a property has been previously attended for a fire or has undergone Home Fire Safety Visit could provide valuable information for assessing the effectiveness of past interventions and informing future prevention efforts. Having knowledge of individuals involved in the dwelling fire could support the other components of the Person-Centred Approach to Home Fire Safety Visit [18]

by testing some of the assumptions on the associations between existing health conditions (such as mental health diagnosis) and incidents of fire [25,33,34] .

The dataset used in this study reports at an incident level which does not distinguish between incidents with single and multiple casualties/fatalities. Additionally, the aggregation of injuries and fatalities into a single outcome variable limits the ability to distinguish specific risk factors associated with severe injuries and fatalities. A more nuanced analysis that distinguishes between the severity and nature of injuries and incidents with multiple casualties/fatalities could facilitate the identification of targeted prevention measures aimed at reducing the most severe consequences of dwelling fires.

5 Recommendations

Building on the insights gathered from this study, several recommendations can be proposed to enhance fire prevention and response efforts. Firstly, fire and rescue services should utilise epidemiological data to develop a targeted approach for home fire safety visits, with a particular focus on reaching households at elevated risk of experiencing a dwelling fire (i.e. flats) and individuals most susceptible to injuries or fatalities (namely people who live alone or older people). By tailoring prevention initiatives to target these higher risk populations, the effectiveness and impact of fire prevention efforts can be maximised. This can be achieved by improving access to the list of vulnerable people who are at a higher risk of injuries or fatalities from the local authorities and health departments.

Secondly, fire and rescue services should consider how they can use these epidemiological findings to refine of their public fire prevention messages to raise awareness of high risk factors for injuries and fatalities in dwelling fire. This should include highlighting the risk of injuries/fatalities is highest at night

and the importance of closing bedroom doors to slow the spread of smoke and fire if a fire occurs; the importance of paying attention during cooking and the use of naked flame as well as the importance of regularly testing their fire alarm.

Lastly, as IRS does not collect data from all the eight components of the NFCC person-centre approach to Home Fire safety visit; this should be rectified to allow full evaluation of the framework. Further research should explore how to collate these factors and how various risk factors associated with the severity of injuries and fatalities by accessing a more granular level of incident data. Additionally, incorporating emerging risks, such as E-scooters, and individual victims' existing health conditions into the analysis, and integrating information on previous prevention activities at the location level could enhance the comprehensiveness and relevance of epidemiological studies in guiding evidence-based fire safety and prevention strategies.

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