



RESEARCH ARTICLE

REVISED

Geographical characteristics and other factors associated with alcohol-related fatal fires in Ireland 2014 – 2021

[version 2; peer review: 1 approved, 1 approved with reservations]

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V2 First published: 10 Feb 2026, 9:15
<https://doi.org/10.12688/hrbopenres.14341.1>
Latest published: 16 Apr 2026, 9:15
<https://doi.org/10.12688/hrbopenres.14341.2>

Abstract

Introduction

Alcohol-related fatal fires represent a tragic but preventable death. Geographic features of these events can inform prevention campaigns and are important to consider in combination with other risk factors. This study aims to examine the factors associated with alcohol-related versus non-alcohol-related fatal fires, and to examine geographical characteristics of alcohol-related fatal fires in Ireland.

Method

Using Irish Coronal data, we looked at all 273 fire fatalities for the period 2014 to 2021, of which 112 (41.0%) had positive alcohol toxicology. Descriptive analyses were conducted followed by logistic regression and geospatial analyses to understand the characteristics of alcohol-related fatal fires.

Results

Compared to non-alcohol related fatal fires, the proportion of fatal fires that involved alcohol was higher among 35–49-year-olds (65.9%) smokers (54.7%) and those accompanied by friends (86.7%). In

Open Peer Review

Approval Status

1

2

version 2

(revision)

16 Apr 2026

version 1

10 Feb 2026

[view](#)[view](#)

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regression analyses, history of alcohol dependency was the only significant risk factor for a fatal fire being alcohol-related although this may be due to the modest sample size limiting statistical power rather than a true absence of association. Rural areas were over-represented in alcohol-related fatal fires, with an annual average 0.37 deaths per 100,000 people in rural areas for every 0.25 in urban areas. Alcohol-related fires that occurred in rural areas involved a longer travel time and distance to the nearest fire station but there was no significant association between alcohol-related fires and area-level deprivation.

Conclusions

People with a history of alcohol dependency suffer higher rates of alcohol-related vs non-alcohol-related fatal fires. These deaths are avoidable, and it is essential that alcohol use is acknowledged as a contributory risk factor and efforts be made to raise awareness and target at-risk individuals.

Keywords

Fire, alcohol-related mortality, socioeconomic deprivation, urban-rural location

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Competing interests: No competing interests were disclosed.

Grant information: The author(s) declared that no grants were involved in supporting this work.

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How to cite this article: Doyle A, Stevely AK, Lyons S *et al.* **Geographical characteristics and other factors associated with alcohol-related fatal fires in Ireland 2014 – 2021 [version 2; peer review: 1 approved, 1 approved with reservations]** HRB Open Research 2026, 9:15 <https://doi.org/10.12688/hrbopenres.14341.2>

First published: 10 Feb 2026, 9:15 <https://doi.org/10.12688/hrbopenres.14341.1>

REVISED Amendments from Version 1

Following peer review suggestions, this document has been edited to emphasise the small sample size and to clarify that all significant findings (or lack of) should be interpreted with this limitation in mind.

Furthermore, since only variables significant in the bivariate analyses were carried forward, we have added clarification that some theoretically important variables were excluded from the multivariable analyses.

Additional sensitivity analyses was undertaken to determine if the significant association between fire fatalities and alcohol dependence persisted after adjusting for level of BAC, and for fatal incidents involving more than one fatality (i.e., incident based rather than individual based analyses).

Additional methodological detail has been added for the geospatial analysis, including the settings used and an additional reference for the fire station location data source.

The methodology has been updated to clarify the use of complete case analysis.

Additional edits have been made to clarify that, although fatal fires occur more frequently in rural than urban areas, this difference is not statistically significant. We have further clarified that the absence of incidents in affluent areas should be interpreted with caution, as it is unclear whether this reflects a true lack of fatalities or other underlying factors.

Any further responses from the reviewers can be found at the end of the article

1. Introduction

Alcohol use is the tenth leading risk factor for both deaths and disability-adjusted life years globally.¹ Over 5% of all deaths annually are attributable to alcohol and its use is associated with alcohol dependence and alcohol-related liver disease, along with health conditions including cardiovascular disease and cancer.² As well as health conditions, alcohol use is commonly linked with traumatic incidents such as road traffic collisions, suicides, drownings, and homicide.²⁻⁵ Alcohol is also a risk factor for residential fire fatalities and existing global evidence indicates that up to one-half of those who died in fire incidents had been drinking prior to the event.⁶⁻¹⁵ Fortunately, despite more than 20,000 emergency fire service callouts annually in Ireland, fatalities are relatively rare.¹⁶ An analysis of alcohol-related hospitalisations that also involved fire/burn injuries found an average of 927 of such cases annually.¹⁷

Although declining, alcohol use remains high in Ireland at 9.9 litres of pure alcohol per adult (aged 15 years or greater) in 2023.² Of potential concern is the notable shift to drinking at home as opposed to drinking in licensed premises, a trend that has been especially pronounced since the COVID-19 pandemic and exacerbated by the cost-of-living crisis in Ireland. This pattern is also reflected elsewhere.¹⁸⁻²² Drinking at home, and especially solitary drinking, is linked to heavier drinking and a higher risk of alcohol-related problems.^{23,24} High blood alcohol concentration (BAC) levels are likely to reduce mobility, coordination, and sensory responses, affecting the ability to respond to escape or potentially extinguish a fire.^{6,25}

Alcohol can leave a person more vulnerable to residential fire incidents as otherwise normal behaviours may become hazardous while intoxicated, such as cooking or smoking and then falling asleep, as well as disorientation and drowsiness resulting in a slower response or reduced awareness of smoke or an alarm sounding.²⁶⁻²⁸ In addition to behavioural risk factors, previous research examining fatal fire incidents has indicated that geographic, individual, and building characteristics, are associated with higher likelihood of residential fire mortality.^{7,9-12,29-37}

Fatal fires involving alcohol have not been examined in detail in Ireland nor have the geographical characteristics of such events. Studies in other jurisdictions have examined alcohol-related fire fatalities^{6,10,32} but the use of coronial data for such is less common.^{38,39} Considering the high level of alcohol use in Ireland, the growing shift to drinking at home, and the prevalence of alcohol involved in fatal fires in Ireland, this exploratory study sought to examine the factors associated with alcohol-related fatal fires, including in comparison to non-alcohol-related fatal fires. It uses geocoded data to conduct a spatial analysis of the location of fatal fires, examining urban-rural location, area of deprivation, the distance and travel time to the nearest fire station. The findings will support fire prevention initiatives, in particular to inform campaigns to reduce alcohol-related fires.

2. Methods

2.1 Data source and population

Details of all fatal fires that occur in Ireland which are reported to the coroner are collected through the National Drug-Related Deaths Index (NDRDI), regardless of whether alcohol or other drugs are involved. The NDRDI is managed by

the Health Research Board (HRB) in Ireland where a team of HRB medical researchers collect data on all fire-related fatalities from multiple sources of data contained in coroners' files, including postmortem findings, toxicology results, witness testimonials, forensic reports, medical records, and incident reports completed by An Garda Síochána (Irish police service) and/or fires services. Further details on the NDRDI methodology can be found elsewhere.⁴⁰

All closed inquests into fire fatalities in Ireland during the period 2014 – 2021 were included in this study (n=273), of which 112 (41.0%) had positive alcohol toxicology. For each fire fatality, socio-demographic details were collected and where available, other potential risk factors including history of drug and/or alcohol dependency or misuse, history of mental ill-health, and details about the cause of death. Information on the circumstances surrounding the events of the fatal fire and potential contributory risk factors are recorded, including the location and where it started, the time of the fire, pre-fire behaviour, cause of fire, whether others were present, smoking status, mobility status, and if fire safety equipment (smoke alarms/detectors, fire extinguishers etc.) was in place.

To examine the geographical characteristics of alcohol-related fatal fires, the Eircode (a unique address identifier) of the location of each fire was mapped using Google maps. For each incident, the distance (in kilometres) and estimated travel time from the nearest fire station were derived using the default settings in Google maps.⁴¹ Calculations were based on the 'fastest route' setting, with the time of day standardised to daytime, outside of peak traffic hours, rather than adjusted to the actual time at which the fire occurred. The rate per 100,000 of the population of each county was then calculated, and using the Pobal HP deprivation Index, the location the fatal fire occurred was assigned a deprivation score. The Pobal HP Deprivation Index, developed by Haase and Pratschke in 2017, uses Census data to determine relative scores of disadvantage or affluence for Ireland's 18,488 Small Areas.⁴² Small Areas correspond to between 80 and 120 dwellings. A score is given to the area based on a national average of 0 and ranging from –35 (being the most deprived) to +35 (being the most affluent). For the purposes of this study, these data are presented in eight categories from most deprived to most affluent.

All supplementary tables associated with this study are available in Open Science Framework (OSF) repository at the following link: <https://osf.io/hqbzr>.⁶⁰

2.2 Statistical analysis

To examine the prevalence of alcohol involvement in fatal fires, we first present descriptive analyses of toxicology results detailing the BAC levels and presence of other drugs detected. A geospatial analysis was completed using Google maps to explore the geographical characteristics of alcohol-related fatal fires, including the urban-rural location, the deprivation score of the location, the travel distance and time to the nearest fire station. The rate of alcohol-related fatal fires per 100,000 of the population of each county was also calculated (and of the urban-rural population of each county) (Supplementary Table 2).

The characteristics of alcohol-related fatal fires for the period 2014 – 2021 were then compared with the characteristics of fatal fires where alcohol was not involved using cross-tabulation and statistical significance was assessed using Pearson χ^2 tests. Statistical significance was evaluated at a $p < 0.05$.

Due to the modest sample size of fatal fires, only variables identified as being statistically significant in the bivariate analysis were then selected to include in a multivariate logistic regression model as predictors of whether fatal fires were alcohol related. Missing data were handled using complete-case analysis. The multivariable model included 71 such cases. No imputation methods were applied. We report the estimated odds ratios (ORs) and 95% confidence intervals (CI). For the regression analyses, a p-value of less than 0.05 was considered to indicate statistical significance. Data analysis was conducted using Stata SE Version 17.1 (Stata Corporation, College Station, TX, USA) for Windows.

3. Results

3.1 Alcohol-related fatal fires

During the study period, 2014–2021 inclusive, 273 people died in 255 fire incidents in Ireland who were reported to the coroner and recorded by the NDRDI. Alcohol was detected on the antemortem or postmortem examination of 112 people, representing 41.0% of all fatal fires. According to hospitalisation data, these deaths represent 3.9% of all admissions associated with alcohol related burn or fire injuries during the study period, indicating that such cases are comparatively rare.¹⁷ Based on Census population estimates for Ireland, the mean annual fatal alcohol-related fire mortality rate was 0.29 per 100,000 population, ranging from 0.54 in 2014 to 0.08 in 2021.⁴³

Table 1. Blood alcohol concentration (BAC) recorded on toxicology of fatal fires, mg per 100 mL.

Blood alcohol concentration	Number of fatal fires	Proportion of alcohol-related fatal fires (%)	Proportion of all fatal fires (%)
Alcohol not present	161	n/a	59.0
Present/trace (<10 mL)	11	9.8	4.0
10 – 49 mg/100 mL	6	5.4	2.2
50 – 99 mg/100 mL	7	6.3	2.6
100 – 149 mg/100 mL	12	10.7	4.4
150 – 199 mg/100 mL	26	23.2	9.5
200 – 249 mg/100 mL	18	16.1	6.6
250+ mg/100 mL	32	28.6	11.7

3.1.1 Blood alcohol concentration

The BAC levels detected in the toxicology results ranged from ‘present’ or ‘trace’, to levels indicating severe intoxication (Table 1). Of all fatal fires, over one in ten individuals had a BAC reading of 250 mg/100 mL or higher (11.7%) or over one-quarter of alcohol-related fire fatalities (28.6%). Ireland’s legal drink-driving limit is 50 mg/100mL and 84.8% of the sample exceeded or met this threshold.

3.1.2 Toxicology findings

Alcohol was the only drug detected on 47.8% of alcohol-related fires’ toxicology results. A further 14.3% had one other substance detected, and 38.4% had 2+ other substances detected. The most common additional substances detected were antidepressants and benzodiazepines (Table 2).

3.2 Geographical characteristics of alcohol-related fatal fires

3.2.1 Urban-rural variation of alcohol-related fatal fires

Fatal fire incidents were more common in rural areas, and this rural pattern was also evident in alcohol-related fires. According to the Irish Census, an average of 36.9% of the population resided in rural areas during the study period yet rural areas accounted for 47.3% of all alcohol-related fatal fires.^{43,44} Urban areas accounted for 63.1% of the population and 52.7% of alcohol-related fatal fires (Figure 1 and Supplementary Table 3). However, this association was not statistically significant ($p=0.703$).

Table 2. Substances detected on toxicology of those with positive blood alcohol concentration (BAC) toxicology (n=112).

Substance detected on toxicology	Number of alcohol-related fatal fires	Proportion of alcohol-related fatal fires (%)
Alcohol	112	100.0
Antidepressants	31	27.7
Benzodiazepines	31	27.7
Other medication	25	22.3
Other hypnotic or sedatives including Z-drugs	13	11.6
Anticonvulsant drugs	11	9.8
Codeine	5	4.5
Other - 26 substances	26	23.2

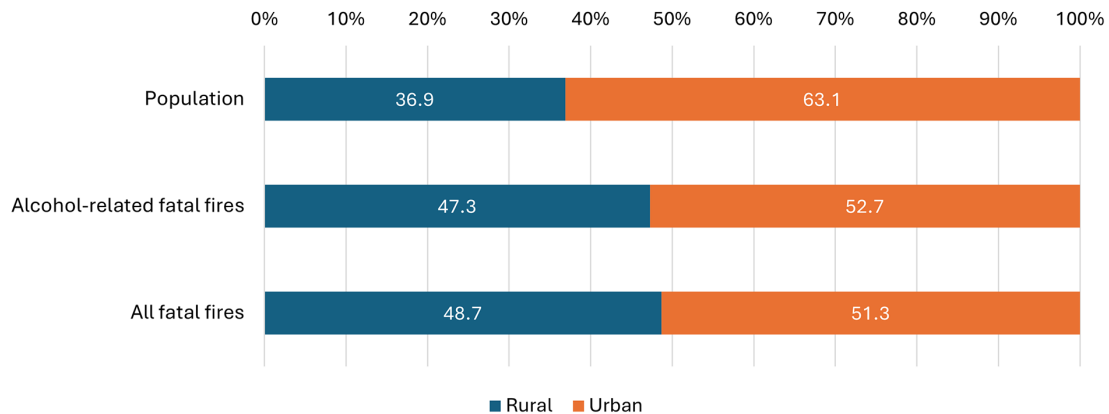


Figure 1. Urban-rural distribution of the Irish population and the location of alcohol-related fatal fires.

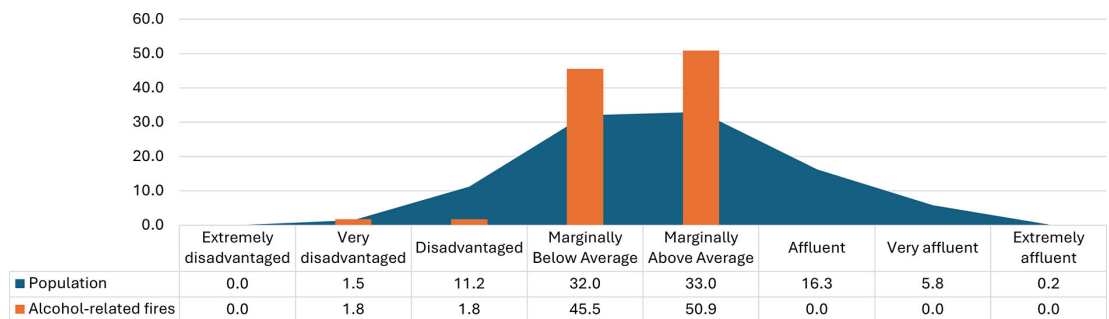


Figure 2. Rate of alcohol-related fatal fires by deprivation octile.

3.2.2 Area-based socioeconomic status of alcohol-related fatal fires

Figure 2 shows the percentage of the population, and that of alcohol-related fire mortalities, by socioeconomic deprivation classification, according to the HP Pobal deprivation index.⁴² During the study period, 44.7% of the population lived in disadvantaged or marginally below average areas and 49.1% of alcohol-related fatal fires occurred in these areas.⁴⁵ Although two in every five of the Irish population live in affluent areas (affluent, very affluent, or extremely affluent), no alcohol-related fatal fires occurred in these areas.

3.2.3 Distance and travel time from nearest fire station to alcohol-related fatal fire location

Distance from nearest fire station to alcohol-related fatal fire location

The mean distance from the nearest emergency response fire station to the location of the alcohol-related fatal fire was seven kilometres (ranging from 200 meters to 28 kilometres). Alcohol-related fatal fires that occurred in rural areas were significantly more likely to be greater distances from the nearest fire station. Over three-quarters of rural alcohol-related fatal fires were five kilometres or greater from the nearest fire station (77.4%) whereas urban alcohol-related fatal fires were more likely to be less than five kilometres from the nearest fire station (64.4%) (p<0.001) (Supplementary Table 4). There was no significant association between distance and level of deprivation of the location the fatal fire occurred (p=0.254) (Supplementary Table 5).

Travel time from nearest fire station to alcohol-related fatal fire location

The mean travel time from the nearest fire station to the location of the alcohol-related fatal fire was 10.5 minutes; the quickest journey time was 2 minutes, the longest was 35 minutes. There was no significant association between travel time and area of deprivation (p=0.690). Predictably, urban alcohol-related fatal fires had considerably less travel time from the nearest fire station (less than 5 minutes) (62.7%) compared to rural alcohol-related fatal fires (37.3%) (p<0.001) (Supplementary Table 4). There was no significant association between travel time and level of deprivation of the location the fatal fire occurred (p=0.180) (Supplementary Table 5).

3.3 Factors associated with alcohol-related fatal fires

3.3.1 Characteristics of alcohol-related fire fatalities

An examination of the characteristics of alcohol-related fire fatalities revealed that they were more likely to be male (69.6%) and older (Detailed results are provided in Supplementary Table 1 available in Open Science Framework (OSF) repository at the following link: <https://osf.io/hqbzr>). More than one-half were single (53.6%). Where the information was known, two-thirds (67.0%) of those who died were alone at the time of the fire, 42.0% were known to be smokers, 21.4% had a history of mental health problems, and 30.4% had a history of alcohol dependency. In addition, 14.3% were reported to have mobility issues including use of a walking stick/frame, wheelchair or were ‘otherwise immobile’.

The majority of alcohol-related fatal fires occurred in private residential premises (88.4%). The leading areas of fire origin reported were the sitting/living room (25.0%), and bedroom (23.2%). Likely due to extensive damage because of the fire, the information relating to fire safety equipment was limited but it was known that fire safety equipment was present in 22.3% of the premises of alcohol-related fires. Saturdays (21.4%), and the months of March and December (13.4% respectively) represented more alcohol-related fatal fires.

3.3.2 Alcohol-related fatal fires versus non-alcohol-related fatal fires

Supplementary Table 1 compares the characteristics of alcohol-related fatal fires to fatal fire incidents where alcohol was not involved to identify features that may be specific to alcohol-related fatal fires. Although fire fatalities overall were more common among older people, fire fatalities in the 35–49 years age group were significantly more likely to involve alcohol (65.9%) (p<0.001). Alcohol-related fires were more likely among smokers (p=0.001), those with a history of alcohol dependency (p<0.001), and those whose employment status was ‘other’ (p=0.002). Alcohol-related fatal fires were more likely when friends were present at the time of the incident (p<0.001).

3.3.3 Regression analysis

Table 3 provides the findings from a logistic regression carried out to assess the effect of the independent variables most strongly associated with alcohol-related fatal fires, with a p-value of <0.05 from Supplementary Table 1. History of alcohol dependency was a significant predictor of a fatal fire being alcohol-related (OR=4.109, 95% CI: 1.118, 15.106, p=0.033). Sensitivity analysis using a higher BAC threshold (≥ 50 mg/100 mL) found the findings remained significant for history of alcohol dependency even after removing the low level cases (p=0.042). A further sensitivity analysis with clustered standard errors found the significant finding remained (p=0.024). However, it should be noted that given the

Table 3. Logistic regression of risk factors associated with the likelihood of a fatal fire being alcohol-related.

Characteristics	Odds ratio	95% confidence interval (lower)	95% confidence interval (upper)	p-value
Age group				
0–34	REF			
35–49	2.052	0.134	31.326	p=0.605
50–64	1.172	0.085	16.100	p=0.905
65–84	1.468	0.096	22.568	p=0.783
85+	3.851	0.154	96.239	p=0.412
Smoker				
No	REF			
Yes	1.183	0.219	6.402	p=0.845
Employment status				
Employed/working	REF			
Unemployed	0.965	0.101	9.242	p=0.975
Home duties	0.157	0.006	4.207	p=0.270
Retired/unable to work due to disability	0.253	0.030	2.120	p=0.205
Other	0.158	0.013	1.893	p=0.145

Table 3. *Continued*

Characteristics	Odds ratio	95% confidence interval (lower)	95% confidence interval (upper)	p-value
Company at time of incident				
Alone	REF			
Friends	0.714	0.049	10.421	p=0.806
Family/partner	0.230	0.035	1.518	p=0.127
Other	0.280	0.034	2.311	p=0.237
Mobility issues				
No	REF			
Yes	1.983	0.442	8.885	p=0.371
History of alcohol dependency				
No	REF			
Yes	4.109	1.118	15.106	p=0.033

wide confidence intervals reflecting the limited sample size, reduced statistical power may have constrained the detection of effects for other variables.

4. Discussion

This is the first study in Ireland to examine alcohol and its role in fire fatalities. The results presented here indicate that alcohol is a key risk factor for fatal residential fires. We found a strong positive association between having a history of alcohol dependency and the likelihood of a fatal fire being alcohol-related which remained significant when analysis was limited to those with a BAC above the legal drink-drive limit (50 mg/100 mL). This finding should be considered along with other contextual factors to provide a more comprehensive understanding of the risk factors associated with alcohol-related fatal fires such as smoking, mobility issues, older age, being alone and other external risk factors. We restricted the multivariable model to variables that were statistically significant at $p > 0.05$ in the bivariate analyses, due to the small sample size. It is important to note that this approach resulted in the exclusion of several variables that have strong theoretical relevance (e.g. sex and history of mental health problems).

Our study found that over three-quarters of alcohol-related fire fatalities were alone at the time of the incident (67.0%), a key risk factor identified in several other studies examining residential fires.^{7,10,14,39} Being alone at the time of the fire is an obvious risk factor due to the vulnerability of not having immediate assistance to detect, and escape from a fire, risky behaviours may also be more likely when drinking alone as others are not around to advise against or prevent such activities.

Smokers were at a higher risk of alcohol-related fires (54.7%) compared to fires where alcohol was not involved and previous studies have noted the risk of drinking alcohol and falling asleep while smoking as a common cause of residential fires.^{32,46,47} Where known, of the alcohol-related fires, smoking materials and cooking appliances were noted as contributory factors to fire ignition, suggesting that smoking and/or cooking while under the influence of alcohol poses a genuine risk. The practice of cooking while intoxicated is recognised as a risk factor for fire accidents in the home, including fatal injuries.^{11,48,49} Given the notable shift to off-trade alcohol sales, drinking at home has become commonplace and this should be considered in the context of these findings.

There is limited prior evidence on the geographical characteristics of alcohol-related fire fatalities although previous research has identified rural areas as being a risk factor for fatal residential fires in general.^{33,34,38,50} Our study also reflected this rural pattern, although the higher representation of rural cases was not statistically significant. Those living in rural areas are potentially at a greater risk likely due to the decreased likelihood of a fire being witnessed and subsequently reported, the higher likelihood of older homes that may be exempt from the same building regulations that newbuilds are, and the travel distances from fire services. We found that travel time to the incident from the nearest fire station was significantly longer when the fire occurred in a rural area. Other geographical characteristics associated with fatal fires identified in the literature indicate a higher prevalence in areas of deprivation.^{10,31,32,37,51–54} There are several explanations why those living in areas that are considered more deprived may be at higher risk of residential fires, including poor quality housing, the use of standalone heaters to avoid the expense of heating oil etc., lack of fire safety equipment, or older properties with fewer building regulations compliance.^{12,52} However, area of deprivation was not a significant predictor of a fatal fire being alcohol-related in this study, consistent with findings from a US study.⁵²

This study has several strengths. The role of alcohol in fatal fires has not been considered in Ireland to date. Examining these incidents through a geographical lens, using precise location data, allowed a greater insight into the areas at highest risk of alcohol-related fires which may provide a novel approach to informing more focussed fire prevention initiatives. The toxicology reports permit a greater insight into the substances used by the individual before their death, including their level of alcohol use and whether other substances were consumed which may have further increased their risk of harm.

The small sample of alcohol-related fatal fires was a limitation of our analysis. Missing or unknown/not recorded data was also an issue. Due to the nature of fire incidents, damage or obliteration of evidence is commonplace, therefore there were several variables where the information was not obtained, especially in relation to the cause or source of the fire. Furthermore, as many of the fatalities were alone at the time of the incident, witness testimonials were not available to provide further information. The absence of alcohol related fatal fires in affluent areas should be interpreted with caution. It is not clear from the available data which suppressed cell counts less than five, whether this reflects a true lack of such incidents in more affluent communities, or whether it is simply a consequence of the overall rarity of fatal fires in these areas. This lower incidence may itself stem from factors such as better housing quality or greater availability of fire safety equipment, rather than any factor specifically related to alcohol.

The analysis presented here considered the travel time from the nearest fire station to the location of the fatal fire, however it is not known if this was the fire station that despatched the fire engine to attend the scene or whether one was dispatched at all. Furthermore, travel times presented here did not consider whether routes were congested or restricted. It was also unknown at what stage fire services were alerted to the scene, i.e. the fire may have been well progressed by the time they were notified and therefore travel time may not be relevant. It should also be noted that some fires lead to more than one fatality, and the characteristics of these fires will therefore have greater representation in our data.

Drinking at home may pose additional risks due to larger measures being poured and consumed, as well as drinking for longer periods of time. This in turn may lead to riskier behaviours such as cooking while intoxicated and less care when tending to open fires. The evidence presented here is an important step in ensuring that alcohol use is considered when planning fire safety campaigns and the use data in this study is used to promote policy and practice. Alcohol use alone is not the leading risk factor for fatal fires but when combined with the other risk factors identified, increases the risk of accidental fires and potentially death.

Several recommendations can be proposed based on the findings of this study to help prevent alcohol increasing the risk of fire fatalities. These include provision of specialist alarms (e.g. louder and/or visual alarms, sprinkler systems, etc.) in the homes of those known to be alcohol dependent; targeted prevention campaigns at those living in older homes that precede the building regulations required of newer builds; implementation of rotating advice on labelling on alcohol products to include the risk of fire when cooking while intoxicated; urging family members, neighbours and friends to identify those in their community at greater risk and discourage hoarding, the use of candles, chip pans, and open fires, when drinking; and finally, to include alcohol as a risk factor in annual fire safety week.

Further research is required to deepen our understanding of alcohol-related fatal fires. Due to limited information about the presence of fire safety equipment, there is still more to be learned about their effectiveness in this study and further research to examine their use in non-fatal fires is warranted. Examining in greater detail, non-fatal fire hospitalisations where alcohol had been consumed, may identify protective factors for surviving residential fires.

However, knowing who is at an increased risk, and the geographical characteristics of fatal fires will inform policy development. Furthermore, in publicising the risk associated with alcohol use and fatal fires widely, public awareness will increase, encouraging preventative behaviours as well as potentially reducing hazardous drinking patterns. The findings can also provide advocacy groups with further evidence of the harms associated with alcohol use. This study allows a greater understanding of fatal fires and how alcohol represents a risk factor in such incidents which is rarely included when discussing alcohol-related harms more generally. These findings can also be used to inform alcohol-specific policies such as understanding the impact of the Public Health (Alcohol) Act, 2018, as well as contributing to a health impact assessment, recommended in consideration of proposed legislation to increase alcohol availability, the Intoxicating Liquor Bill, 2024 and the Sale of Alcohol Bill, 2021.^{55–58}

5. Conclusion

Over two in every five of those who died in a fire in Ireland had been drinking prior to the incident indicating that alcohol is a key risk factor for fire accidents and mortality, which is not often recognised. Alcohol-related fire fatalities are more common in rural areas and among those who are alcohol dependent. Fire prevention and safety efforts should seek to mitigate the impact of alcohol on increasing the risk of fatal fires.

Ethical approval statement

The information in this study is obtained from the National Drug-Related Deaths Index (NDRDI). Ethical approval for the data collection, and subsequent use (including analysis and publications) was received from Health Research Board ethics committee (no longer in operation), formerly located at Health Research Board, 73 Lower Baggot Street, Dublin 2, and from ethics committees covering each individual acute hospital providing hospitalisation data. Any changes to the remit of the NDRDI have been approved by the Irish College of GPs Research Ethics Committee (ICGP), Irish College of GPs, 15 Hogan Place, Dublin 2, D02 DK23. Approval for the use of Central Treatment List data was obtained from the Methadone Prescribing Protocol Implementation Committee. All work was carried out in accordance with International Epidemiological Association/European Epidemiology Group guideline document.⁵⁹

This study does not have an ethics approval reference number because it was approved prior to the introduction of formal numbering systems. At that time, the ethics committee issued confirmation letters rather than assigning approval codes. The original confirmation letter documenting the committee's approval is available and can be provided upon request.

As the data used in this study are anonymised mortality data and no direct interaction with participants, informed consent was not possible.

Data availability statement

The data used in this study are not publicly available due to ethical and legal restrictions. The dataset comprises individual-level information on deaths, including potentially identifying variables and highly sensitive personal data relating to health status, cause and circumstances of death. Even where direct identifiers are removed, there remains a risk of re-identification, particularly in rare cases or small populations. Access to the data is therefore restricted under the terms of ethical approval and applicable data protection legislation. The data may only be accessed by authorised researchers for approved purposes and cannot be shared or disseminated in an open repository. Requests for access to aggregated or non-disclosive summary outputs may be considered, subject to disclosure control review and the permissions of the data controller.

To apply for access to the NDRDI dataset, requests should be made using the application form available on the HRB website <https://www.hrb.ie/data-collections-evidence/about-drug-and-alcohol-deaths/> and sent to NDRDI@hrb.ie for consideration.

Extended data

Open Science Framework (OSF). Geographical characteristics and other factors associated with alcohol-related fatal fires in Ireland 2014 – 2021. <https://osf.io/hqbzr>.⁶⁰

This project contains the following extended data:

- *Supplementary Table 1* (Demographic information of fire fatalities, alcohol-related and non-alcohol-related.)
- *Supplementary Table 2* (Mean annual rate of alcohol-related fatal fires per 100,000 of county population, and mean annual rate per 100,000 of urban and rural population of each county of alcohol-related fatal fires, 2014 – 2021.)
- *Supplementary Table 3* (Geographical characteristics of alcohol-related fatal fires, 2014 – 2021.)
- *Supplementary Table 4* (Distance and travel time between nearest fire station and location of alcohol-related fatal fires, urban and rural areas.)
- *Supplementary Table 5* (Distance and travel time between nearest fire station and location of alcohol-related fatal fires, by deprivation status.)

Data are available under the terms of the [Creative Commons Attribution 4.0 International \(CC BY 4.0\) licence](https://creativecommons.org/licenses/by/4.0/).

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Current Peer Review Status: ? ✓

Version 1

Reviewer Report 19 March 2026

<https://doi.org/10.21956/hrbopenres.15793.r53656>

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Thank you for the opportunity to review this fascinating study. As an investigator into alcohol-related harms, particularly the nexus of alcohol use and liver injury, I was aware of many of the other negative consequences on health of excessive alcohol use including motor vehicle accidents, accidents at work and domestic violence. I had not come across death due domestic fires before. Following reading Ms. DoYLES paper, I will add it to the list.

Ms. Doyle and her co-authors appropriately to demonstrate the importance of local social infrastructure and culture to their analysis of the data under review. While the number of fatalities is not high, the conclusions are plausible. A considerable proportion of Irish persons dying in a domestic fire have a positive blood alcohol, and many have high levels. Persons with a history of alcohol use disorder, who are living (and presumably drinking) alone and/or living in rural areas are at greatest risk. Of these issues, only a history of AUD was independently associated with mortality, however. Interestingly, the degree of social deprivation was not associated with mortality and alcohol use.

My only suggestion to the authors would be to include a comment on the non-fatal outcome of many fires. Extrapolating from their data, it would be interesting to capture the morbidity associated with domestic fires in Ireland in the same period. I would hypothesize that alcohol consumption was also associated in fires which resulted in at least one involved person required admission to hospital. Such an expansion of the dataset would provide further context about the social and personal toll of drinking in relation to domestic fires.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: I am a clinical hepatologist with an interest in alcohol-associated liver disease and liver transplantation. I am funded by the NIH to participate in multi center studies of selection for and outcome of liver transplantation in persons with liver failure and short intervals of sobriety.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 09 March 2026

<https://doi.org/10.21956/hrbopenres.15793.r53660>

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Summary

This paper examines alcohol involvement in fatal fires in Ireland between 2014 and 2021 using coronial data from the National Drug-Related Deaths Index. The authors present descriptive analyses of toxicological findings, a geospatial analysis of fire locations by urban-rural classification, deprivation status, and proximity to fire stations, and a multivariable logistic regression identifying predictors of a fatal fire being alcohol-related. This is a valuable and timely contribution to an underexplored area; to our knowledge it is the first study of its kind in Ireland. The use of detailed coronial data with individual-level toxicology is a particular strength, and the findings have clear relevance for fire prevention policy. The comments below are intended to support the authors in strengthening methodological transparency and the precision of a small number of interpretive claims, and we hope they are taken in that spirit.

Presentation and literature

The manuscript is clearly written and well referenced. One minor suggestion: the abstract and discussion describe history of alcohol dependency as "the only significant risk factor" in the regression. Given the wide confidence intervals for other variables in Table 3, which reflect the modest sample size rather than a meaningful absence of association, it may be worth adding a brief qualifier to acknowledge that limited statistical power may have precluded detection of effects for other variables. This would help readers avoid interpreting non-significance as evidence of no association.

Technical soundness

Definition of alcohol-related. Table 1 indicates that the alcohol-related category includes cases with BAC recorded as "present/trace (<10 mg/100 mL)." It would be helpful to briefly justify this inclusive definition, as the contribution of trace alcohol to fire risk in these cases is uncertain. A short sensitivity analysis using a higher threshold (e.g. ≥ 50 mg/100 mL) would reassure readers that the main findings, including the headline 41% prevalence, are robust to this definitional choice.

Statistical independence. The paper notes that some fires involved more than one fatality. It would be helpful to report the number of unique fire incidents alongside the number of individual fatalities. The authors may also wish to consider a sensitivity analysis excluding multi-fatality incidents, or at minimum acknowledge that clustering within incidents may affect the independence assumption of the regression model.

Variable selection for regression. The decision to restrict the multivariable model to variables significant at $p < 0.05$ in bivariate analyses is understandable given the sample size, and the authors acknowledge this as a limitation. It may be worth noting specifically whether any variables with strong theoretical relevance (such history of mental health problems) were excluded on this basis, so readers can assess the potential impact on the findings.

Reproducibility

The geospatial workflow is described as mapping Eircodes "using Google Maps." A brief additional description of how the nearest fire station was identified and what routing settings were used for distance and travel time would make this analysis more readily replicable by others.

The appendix helpfully provides "not known/not recorded" categories for several variables. It would further strengthen the paper to include a short summary of missingness across key variables, and to state the analytic sample size for the each analysis explicitly. Given the extent of

missingness and cell suppression across some variables, it is currently difficult to determine how many cases were included in the multivariable model.

Statistical interpretation

Three points on interpretation for the authors to consider. First, and most importantly, Supplementary Table 1 shows that the urban-rural distribution does not differ significantly between alcohol-related and non-alcohol-related fatal fires ($p=0.703$). This makes it difficult to sustain the claim that rural over-representation is a finding specific to alcohol involvement, and we would encourage the authors to revisit the framing of this result in both the results and discussion sections. It may be more accurate to characterise the rural pattern as a feature of fatal fires generally in Ireland, with alcohol-related fires reflecting that broader distribution rather than showing a distinct geographical signal.

Second, the finding that no alcohol-related fatal fires occurred in affluent areas is noteworthy, but should be interpreted cautiously. With relatively few cases overall and cell suppression limiting what can be observed in Supplementary Table 3, it is difficult to determine whether the apparent zero in affluent areas reflects a genuine absence of alcohol-related fire risk in those populations, or simply the general scarcity of fatal fires in more affluent areas; which may itself reflect factors such as housing quality or fire safety equipment rather than anything specific to alcohol. A brief note acknowledging these interpretive constraints would be a helpful addition for readers.

Third, Figure 1 shows that 48.7% of all fatal fires occurred in rural areas, which is very similar to the 47.3% figure for alcohol-related fires specifically, consistent with the non-significant bivariate result noted above.

Minor points

The paper would benefit from a brief comment on whether the COVID-19 years (2020–2021) show any distinct pattern, given the well-documented shifts in drinking behaviour and home time during that period that the authors themselves reference in the introduction.

Overall, this paper meaningfully contributes to understanding alcohol involvement in fatal fires in Ireland and is valuable for harm prevention planning. Some minor clarifications and sensitivity checks would enhance the transparency of the methods, strengthen confidence in the findings, and improve interpretability for policy and practice audiences.

Keegan W. Lawrence & MSc & James M. Clay, PhD

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

No

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Alcohol epidemiology, alcohol and health, alcohol policy, and the determinants of alcohol use.

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.
