

An exploration of alcohol related fire incidences

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Abstract

In this paper we examine an operational research project concerning the analysis of the characteristics of alcohol related fire instances attended by a UK Fire and Rescue Service in the North West region of England and the development of a geographical information system for fire prevention support. The research project examined the circumstances of alcohol related fires, their geographical distribution and the socio-economic characteristics of such fire incidences within the region studied, and also involved the design and implementation of a geographical information system for supporting prevention of such fires. Overall, it was found that cooking fires involving 'harmful' or 'hazardous' levels of alcohol consumption were most likely to be found amongst younger urban residents living in high levels of deprivation, students living in city centre locations and young families with high benefit need within the region studied.

Key words: fire risk geographical information system

Introduction

Complex socio-economic environments can be difficult to analyse in order to develop appropriate public sector information systems for management information purposes (Amaeci and Counsell, 2013; Fahey et al, 2004). Fire prevention information systems are an example of such systems that aim to provide appropriate management information for fire prevention activities that must operate in a complex socio-economic environment. The research discussed in this paper examines an operational research project concerning the development of a fire prevention support system that involved statistical and spatial analysis of alcohol related fire incidence data which was incorporated into a geographical information system to support alcohol related fire prevention activities. The research project was conducted over a twelve month period during 2014 / 2015 with a fire and rescue service in the North West region of England. The area covered by the fire and rescue service included urban areas with high levels of deprivation and rural and semi-rural areas with high levels of affluence.

The relationship between alcohol and unintentional fire incidences was chosen for examination by the fire and rescue service concerned because alcohol had been identified as a factor in a significant proportion of such fires, and the North West region of England in which the fire and rescue service studied is based has some of the highest alcohol consumption levels in the UK. The research project examined the views of the stakeholders within the fire and rescue service associated with alcohol related fires in order to inform the analytical approach to be adopted, as well as examining how to conduct spatial analysis of alcohol related fires, and how to develop a geographical information system to support the prevention of such fires. Initially the research project examined the stakeholders' perspectives with regard to alcohol related fire incidence prevention, the environment in which fire prevention operates, and the potential sources of data for examining alcohol related fire incidences. The knowledge gained from the discussions and interviews with the stakeholders was then used to explore the factors associated with alcohol related accidental dwelling fires, and to inform statistical and spatial analysis of alcohol related fire incidence data, in order to identify social groups and geographical areas at the highest risk of alcohol related fires within the region studied. The analyses of alcohol related fire risk were incorporated into a geographical information system for fire prevention support.

Finally, fire prevention strategies within the fire and rescue service studied were developed to support more targeted alcohol related fire prevention activities, based upon the information provided by the statistical and spatial analyses enabled via the geographical information system.

The originality of the research reported in this paper is the statistical and spatial analysis of alcohol related fire data that was incorporated into a geographical information system to support fire prevention activities for alcohol related dwelling fires. In particular, the research included analysis of patterns of alcohol related fires based upon reported accidental dwelling fire incidences and also included analysis of alcohol consumption patterns and socio-economic groupings associated with alcohol related fire risk in order to inform more targeted fire prevention strategies. The new knowledge presented in this paper concerns the more detailed analysis of the nature of alcohol related fire incidences, in particular, how alcohol related fire risk differs between different community groups, the relationship between alcohol related and cooking related fire incidences, and how such information can be provided for alcohol related fire prevention through a geographical information system. This is an important area of research given the budget reductions affecting UK fire and rescue services that necessitate more targeted fire prevention activities.

Literature review

Alcohol related fire incidences

A number of studies have been undertaken into the factors associated with unintentional dwelling fires. Some factors concern socio-demographics, for example being elderly, disabled or living alone. However, other factors relate to the behavior of individuals that might put the individual at risk of fire, for example alcohol consumption and smoking. This paper examines the effects of alcohol consumption upon fire risk. Leth et al. (1998) undertook a study of fatalities in dwelling fires in the municipality of Copenhagen in Denmark that identified smoking combined with alcohol intoxication as significant factors associated with residential dwelling fire fatalities. Waterhouse (2010) found a strong correlation between fire deaths and smoking and /or alcohol consumption in a study of fire related deaths in Alberta, Canada. Jordan et al. (1999) in a study of house fire fatalities in Eastern Scotland identified alcohol intoxication, and social deprivation as significant factors in residential dwelling fire incidents. Zhang et al (2006) in a study in Australia, commented that alcohol and smoking are amongst factors influencing the prevalence of fires in the family home. Baker et al (2013) defined those with addictions to drugs and / or alcohol as belonging to the profile of individuals most at risk of dwelling fires in Leicestershire in the UK. Clark et al (2014) commented that certain social conditions may promote alcohol use that can increase fire risk. Overall it appeared that a variety of studies of factors associated with unintentional dwelling fires had identified alcohol consumption as a potential contributory factor to such fires.

Bruck and Thomas (2010), Thomas and Bruck (2010) and Ahrens (2008) commented that alcohol consumption can reduce the occupants awareness of the presence of a fire, for example, the awareness that a smoke alarm has been activated. These studies indicated that alcohol consumption might not just contribute to the likelihood of a fire, but might also significantly impact the risk of injury or fatality to the individual from the fire due to reduced awareness of the presence of a fire.

Harper et al (2013) commented that numerous studies have shown the important role that alcohol consumption plays in fatal dwelling fires. Overall a number of researchers had identified alcohol as being part of a set of factors associated with unintentional dwelling fires and fire fatalities. For example, Holborn et al (2003) undertook a detailed study of unintentional dwelling fire fatalities in London, UK, and identified smoking, alcohol, old age, disability, illness, living alone, and social deprivation as factors in such fatalities. However, there appeared to be little, if any research specifically examining alcohol related fire incidences. This research reported in this paper specifically examines the effects of alcohol consumption upon fire risk.

Factors associated with alcohol related fire incidences

In most contemporary western societies there is growing concern about rising levels of alcohol consumption, particularly by young people (Valentine et al, 2010). In England during 2012-13, there were an estimated 1,008,850 hospital admissions related to alcohol consumption where an alcohol-related disease, injury or condition was the primary reason for hospital admission or a secondary diagnosis (HSCIC, 2015). Over 24% of people in England consume alcohol in a way that's harmful or potentially harmful to their health and wellbeing (NHS Alcohol Misuse, 2015). There are numerous support avenues for individuals seeking help with alcohol consumption problems (NHS Alcohol Support, 2015; Wilson et al, 2011). UK alcohol consumption statistics highlight that amongst some sections of the UK population alcohol consumption is increasing, and given the link with unintentional dwelling fires, is thereby of increasing concern as a potential fire risk factor.

The London Fire Brigade, UK highlighted the fire dangers of alcohol consumption (LFB, 2015), in particular that the risk of accidents, especially in the kitchen, is greater after alcohol is consumed; that alcohol consumption near to naked flames such as candles should be avoided; and overall that many fire deaths including alcohol as a contributing factor involve people who may live alone or have alcohol problems. Howland and Hingson (1987) commented that there is substantial, although not definitive, evidence that alcohol plays a role in the etiology of fire and burns injuries and deaths. Cleveland Fire Brigade, UK (CFB, 2015) stated that alcohol related fires are typically caused by people drinking alcohol and then falling asleep whilst cooking or smoking. Ballard et al (1991) and Runyan et al (1992) commented upon the association of alcohol consumption with regard to residential fire injuries. In particular, alcohol intoxication can also cause drowsiness and can make an individual less alert to the signs of fire. When the fire is discovered, the alcohol can heighten feelings of disorientation, making it difficult for the individual to escape. Overall these studies indicated that alcohol may either cause carelessness that could result in a fire, or reduce the ability of an individual to escape from a dwelling fire.

Fire prevention approaches

The Home Fire Safety Check (HFSC, 2015) initiative was first implemented in the UK in 1999. A home fire safety check identifies potential fire risks within a home, informs the householder what to do in order to reduce or prevent these risks, creates an escape plan in case a fire does break out, and ensures that the household has working smoke alarms. Some households may qualify for free smoke alarms to be fitted within the home as part of the home fire safety check.

Bjorndal et al (2012) commented that operations research has played a role in fire prevention activities. However, this has mainly been in the area of forest fires, rather than residential

dwelling fires. Crawford (2005) commented that it is important to continually reassess and adjust fire prevention activities undertaken by fire and rescue services in order to provide a long term solution for the reduction of fire injuries, fire deaths, and property damage. Fire prevention initiatives may typically be targeted to those geographical areas, individuals, and social groups perceived as having a higher risk of fire occurrence (Diekman, 2010). Existing approaches to fire prevention adopted by fire and rescue services typically involve the spatial analysis of fire incidence combined with measures of social deprivation (O'Grady, 2014).

Doughty and Orton (2014) suggested that telecare (the remote care of elderly and disabled individuals typically using sensors around the home to detect possible problems), could be used to manage fire risk in the homes of older and vulnerable people (including those with a history of substance abuse). Bruck et al (2011) commented that the risk of fire death for alcohol-affected people who are capable of being alerted and escaping the property may be reduced if they can be alerted more quickly and effectively via a suitable smoke alarm.

Overall the literature review indicated that alcohol consumption can be a significant factor in unintentional dwelling fires. The research reported in this paper focuses upon how alcohol consumption may contribute towards the likelihood of unintentional dwelling fires. Analysis of alcohol related fires was undertaken in order to inform future fire prevention strategies that could reduce the number of alcohol related fires. This should then hopefully reduce the number of associated fire injuries and fatalities.

Research method

The research reported in this paper concerned a facilitated operational research approach (Franco and Montibeller, 2010) whereby the researchers worked not only as analysts but also as facilitators to the organisation concerned. That is the researchers were actively involved in analysing alcohol related fire incidences in order to inform fire prevention strategies within the fire and rescue service studied. Two of the researchers worked at a local university whilst the other three researchers worked at the fire and rescue service concerned. The research project involved statistical and spatial analysis of geo-coded data to examine the quantitative characteristics of alcohol related fire incidences in order to develop a geographical information system to provide information to support alcohol related fire prevention approaches in practice, and to develop strategies to support the prevention of such fires.

The research methodology involved:

- The identification of appropriate data sources for analysis of alcohol related fire risk
- The identification of appropriate analytical methods
- Incorporating the analyses in organizational geographic information systems
- Examination of the use of such analyses and information provision for fire prevention activities.

The research questions posed by this research were:

- How can alcohol related fire incidences be analysed?

- What factors are associated with alcohol related fire incidences?
- How can alcohol related fires be prevented?

These operational research questions are important since harmful levels of alcohol consumption are becoming increasingly common in the UK, and this is increasing the risk of alcohol related fire incidences, injuries and fatalities. In addition this is occurring in an environment of decreasing fire and rescue service budgets, meaning that there are decreasing resources available to address the increasing risk of alcohol related fire incidence.

Data collection

The examination of the characteristics of alcohol related fire instances from accidental dwelling fire records was based upon a facilitated operational research approach and was initiated via interviews with stakeholders from the fire and rescue service studied including three information analysts, two community fire prevention officers and two fire officers. This was a process of inquiry and learning during which the different viewpoints of the stakeholders concerned were discussed, in order to develop an overall view of the nature of alcohol related fire incidence, and approaches to preventing such fires. In addition, a variety of data sources were utilised from the fire and rescue service (for example, accidental dwelling fire records) studied and partner organisations (including NHS trusts, and a centre for public health) in order to obtain appropriate geo-coded data for statistical and spatial analysis of alcohol related fire instances and fire risk within the region studied.

A limitation of the data available for analysis was that only limited data regarding the individuals involved in a fire is typically recorded in accidental dwelling fire records. For each accidental dwelling fire in the UK, the cause of the fire is identified by a fire officer. However, although part of the data recorded covers whether alcohol consumption was suspected as a contributory factor in an accidental dwelling fire, often this data might not be recorded or entered simply as 'unknown'. Details of the individuals involved in a fire might typically only be recorded for those injured or killed in an accidental dwelling fire. In addition, other data used in the research such as alcohol consumption levels was only available at the output area (OA, 2015) level of geography or above. Individual household data, or individual resident data was simply not available. Finally, the number of fire incidents and the factors associated with fire incidences are not static. The demographics of populations in an area change over time, and in particular in the UK, significant reductions in fire and rescue service budgets over the last few years have impacted upon the fire prevention resources available.

The researchers undertook interviews and meetings with the relevant staff in the fire and rescue service studied typically once per week for approximately one hour. The interview and meeting notes were content analyzed by identifying themes within the texts. For example, themes such as: how understanding the factors associated with alcohol related dwelling fires, and how spatial and statistical analysis of alcohol related dwelling fire data could inform fire risk management for such types of fires. This approach allowed an understanding of the nature of alcohol related dwelling fires from a stakeholder perspective. The specific findings established from the interviews and meetings with the fire and rescue service personnel were the necessity of analysis of alcohol consumption (based upon appropriate alcohol consumption bandings) and fire incidence on an appropriate geographic scale, that of output areas (OA, 2015) and also the necessity of analysis by community profiles (Higgins et al, 2015). Community profiling was the technique used in the fire and rescue service studied to determine the characteristics of

the different community groups within the region covered by the fire and rescue service (CALG, 2012). The data used to determine community profile groups was only available at the output area (OA, 2015) level of detail. Each output area within the region covered by the fire and rescue service could then be identified as being associated with one of the community groups. The community profiling approach has been used in other sectors (e.g. marketing via MOSAIC classifications (MOSAIC, 2015) for some time. However, the community profiling approach was a novel development for UK fire and rescue services (CALG, 2012). The generic MOSAIC classification was considered for use by the fire and rescue service studied, however the development of a more specific set of community profiles was deemed to be required. The geo-coded accidental dwelling fire records data obtained from the fire and rescue service, and other relevant data obtained from NHS trusts and the local centre for public health allowed a quantitative statistical and spatial perspective of alcohol related fire incidence and fire risk.

Data analysis

A statistical and spatial analysis approach was used to analyse alcohol related accidental dwelling fire incidence and injuries using geo-coded data in order to understand and identify patterns and associations within the alcohol related fire incidences within the region studied. Meetings and discussions with relevant staff within the fire and rescue service studied identified the need for more targeted fire prevention activities, which formed the conceptual basis of the bandings for alcohol risk levels that would need to be incorporated into the geographic information system for alcohol related fire prevention support. A number of map based analyses were produced for alcohol consumption and fire incidence, fire injuries and fire fatalities, of which Figure 1 (Map illustrating areas with a prevalence of 'harmful' or 'hazardous alcohol consumption and injuries in accidental dwelling fires) is one example. The other GIS maps included areas with a prevalence of 'harmful' or 'hazardous alcohol consumption and fire fatalities in accidental dwelling fires, areas with a prevalence of 'harmful' or 'hazardous alcohol consumption with smoking prevalence and fire injuries in accidental dwelling fires, and areas with a prevalence of 'harmful' or 'hazardous alcohol consumption with smoking prevalence and fire fatalities in accidental dwelling fires. The GIS maps that included smoking prevalence as well as 'harmful' or 'hazardous alcohol consumption were required since a number of previous studies had linked alcohol related fire risks with smoking (Leth et al, 1998; Waterhouse (2010); CFB, 2015; Ballard et al, 1991).

The map based analyses (spatial analyses) visually presented output areas (OA, 2015) with a 'harmful' or 'hazardous' level of alcohol consumption overlaid with the actual location of fire injuries (Figure 1) and also the actual location of fire deaths, as well as the output areas with a 'harmful' or 'hazardous' level of alcohol consumption and smoking prevalence overlaid with actual locations of fire injuries and fire deaths. This enabled a visual presentation of the frequency with which fire injuries and deaths occurred in areas with either 'harmful' or 'hazardous' levels of alcohol consumption. These demonstrated that the majority of fire injuries and deaths occurred in output areas with 'harmful' or 'hazardous' level of alcohol consumption. Given that for a significant proportion of fire incidents the presence or absence of alcohol consumption as a contributory factor was either not known or not recorded, the map based analyses demonstrated that residents living in output areas with 'harmful' or 'hazardous' levels of alcohol consumption were at greater risk than output areas with a moderate or low level of alcohol consumption. Although the scope for ecological fallacy cannot be removed due to the limitations of the data available, overall it appeared that areas with 'harmful' or 'hazardous' levels of alcohol consumption did have a higher risk of fire injury or death.

The statistical and spatial analysis involved analysis of the proportion of alcohol related accidental dwelling fires and associated fire injuries within the region studied over the period 2010 / 2011 to 2014 / 2015, and the types of fire associated with alcohol consumption (mainly cooking and smoking materials fires). In addition, given that for a significant proportion of the fire incidents, the presence of alcohol as a contributory factor was either not known or not recorded, an analysis of potential alcohol related fire risk was produced by matching different categories of alcohol consumption (non-drinkers, moderate, hazardous and harmful) defined by the centre for public health with the output areas (OA, 2015) within the region. An output area is a geographical area classification defined by the UK Office for National Statistics which contains a minimum of 40 households and 100 residents. In order to assess the statistical and spatial patterns associated with alcohol consumption in relation to fire risk, the number of dwelling fire incidents and fire injuries were examined for each output area. Finally, in order to provide insight into the socio-economic characteristics associated with alcohol related fire incidences, a customer insight community profiling classification developed by the fire and rescue service (based upon a k-means cluster analysis of socio-economic data) for the output areas in the region (Higgins et al, 2013) was compared with the alcohol consumption rates and the distribution of dwelling fire injuries across the output areas within the region. The customer insight community profiling classification developed by the fire and rescue service consisted of the following 10 categories (Higgins et al, 2013):

1. Wealthy over 50 population living in semi-rural locations
2. Older retirees
3. Middle income residents living in privately owned properties
4. Average income older residents
5. Students living in city centre locations
6. Young families
7. Young families with high benefit need
8. Residents living in social housing with high need for benefits
9. Transient population living in poor quality housing
10. Younger, urban population living in high levels of deprivation

Given the limitations of the data available and the use of percentages and geo-spatial visual analyses of the patterns of alcohol related fire injuries and deaths, the use of tests of significance was not relevant to this research. The geographical information system based upon the statistical and spatial analysis of alcohol related fire incidence was developed using the MAPINFO (MAPINFO, 2015) geographical information system software development tool, the MAPBASIC programming language, and the Microsoft SQL Server Database Management System.

Overall the facilitated operational research approach (Franco and Montibeller, 2010) was beneficial as it allowed an in depth exploration of the development of a management geographical information systems for alcohol related fire prevention support. The approach also supported an understanding of the perspectives of the different stakeholders in alcohol related fire incidences and a statistical and spatial analysis of relevant geo-coded data to understand and identify patterns and relationships in alcohol related fire incidences and fire risk. The main drawback to the case study approach utilized was potential limitations on the generalizability of the findings to other fire and rescue services.

Research Results

Analysing alcohol related fire incidences

The interviews and discussions with staff within the fire and rescue service studied enabled an understanding of the stakeholder perspectives with regard to alcohol related fire incidences, and assisted in identifying potential sources of geo-coded data concerning alcohol related fire incidences. For example, the utilization of accidental dwelling fire records, alcohol consumption data, and community profiles by geographic areas. The interviews and discussions with the relevant staff identified the need for a system to provide information for activities associated with increasing awareness of alcohol related fire risks and reducing such risks by analysis of fire incident, socio-economic, geo-coded data to achieve a reduction in alcohol related fire incidence within the constraints of the geo-coded data available for analysis.

A quantitative analysis of alcohol fire related incidences data was undertaken via statistical and spatial analysis of fire and rescue service accidental dwelling fire data for the region and the use of a customer insight community profiling classification based upon k-means cluster analysis of population socio-economic characteristics developed by the fire and rescue service studied (Higgins et al, 2013) to examine which of the customer insight community profiles had the most statistically significant levels of alcohol related fire injuries and fatalities within the region studied.

Factors associated with alcohol related fire incidences

Analysis of alcohol related fire incidences indicated that alcohol was involved in roughly one in ten fire incidences during the period studied. However, typically alcohol consumption appeared to be just a contributory factor to the fire, with cooking appliances and smoking materials being the most common form of ignition source involved with alcohol related fires.

In the period 2010 / 2011 to 2014 / 2015 out of 5737 accidental dwelling fires attended by the fire and rescue service studied, 556 were fires where impairment due to suspected alcohol consumption was a contributory factor in the fire. Of the 556 alcohol related fires, 433 involved a cooking appliance as the ignition source and 89 involved smoking materials as the ignition source. This appeared to indicate that just under 10% of the accidental dwelling fires in the region during the period studied were recorded as involving alcohol consumption, and that the majority of these (78%) also involved cooking activities, and 16% also involved smoking materials.

In the period 2010 / 2011 to 2014 / 2015 in the region studied there were 110 accidental dwelling fire injuries that involved alcohol as a contributory factor out of a total of 644 injuries. Thus it appeared that roughly 17% of accidental dwelling fire injuries could be attributed in part to alcohol consumption over the period studied. The numbers of alcohol related accidental dwelling fires and associated injuries occurring during the period studied in the region are shown in Table 1.

	2010 / 2011	2011 / 2012	2012 / 2013	2013 / 2014	2014 / 2015
Alcohol related fires	126	136	98	99	97
Alcohol related fire injuries	21	28	19	17	25

Table 1. Alcohol related fires and associated injuries during the period 2010 / 2011 to 2014 / 2015 in the region studied.

Out of the 5737 accidental dwelling fires attended in the region and period studied, there were 995 fires where the presence or absence of alcohol consumption as a contributory factor was either not known or not recorded (the other 4186 fire incidents recorded no alcohol consumption as being involved). Since there was a significant proportion of accidental dwelling fires where alcohol consumption as a contributory factor was either not known or not recorded, it was deemed useful by the fire and rescue service staff involved to analyse fire incidents compared to recorded alcohol consumption statistics within the region, to ascertain what risk level patterns might be present with regard to alcohol related fire risk at the output area (OA, 2015) level of geography.

The discussions and interviews with staff within the fire and rescue service studied identified the need to analyse patterns of alcohol consumption within the region, the need to analyse alcohol related fire risk, and the need to reduce alcohol related fire incidence through improved information provision. Data concerning alcohol consumption patterns in the region was provided by the local centre for public health in order to gain an understanding of alcohol consumption within the region. In the region studied alcohol consumption patterns were classified into four main groups:

- Non-drinkers (individuals never, or very occasionally, consuming alcohol)
- Moderate drinkers (males consuming less than 22 units of alcohol per week, females consuming less than 15 units of alcohol per week)
- Hazardous drinkers (males consuming between 22 and 50 units of alcohol per week, females consuming between 15 and 35 units of alcohol per week)
- Harmful drinkers (males consuming over 50 units of alcohol per week, females consuming over 35 units of alcohol per week)

The alcohol consumption categories were matched with every Output Area (OA, 2015) within the region studied. Output Areas (OAs) were created for UK Census data, specifically for the output of census estimates. The Output Area is the lowest geographical level at which census estimates are provided by the UK Office for National Statistics (Chainey, 2013). The minimum Output Area size is 40 households and 100 residents. The alcohol consumption categories were also matched with the ten Community Profiles used by the fire and rescue service studied for customer insight (Higgins et al, 2013, CALG, 2012)).

Matching the alcohol consumption categories prevalent in the different Output Areas (OA, 2015) within the region with cooking fire incidents indicated that roughly 35% of cooking fires occurred in areas with a prevalence of 'harmful' alcohol consumption, 29% of cooking fires occurred in areas with a prevalence of 'hazardous' alcohol consumption, 13% of cooking fires occurred in areas with a prevalence of 'moderate' alcohol consumption, and 23% of cooking fires occurred in areas with a prevalence of 'non-drinkers'. This analysis would suggest that residents in areas with a prevalence of 'harmful' levels of alcohol consumption may be at greatest risk of accidental cooking fires (Figure 1). From the geographical distribution of cooking fire incidences across the different output areas (OA, 2015) each of which had an associated level of alcohol consumption, it was apparent that overall areas with higher levels of alcohol consumption had higher levels of cooking fires. Of the 556 alcohol related fires 433 involved a cooking appliance as the ignition source, which would appear to indicate that in areas with higher levels of alcohol consumption, the higher likelihood of cooking whilst under

the influence of alcohol (associated with generally higher levels of alcohol consumption) presents a real risk. Since the presence of alcohol as a contributory factor cannot always easily be established for each given fire incidence, a clear causal link between typical alcohol consumption levels and number of fires is not really possible. However, given that 77% of cooking fires occurred in areas where alcohol consumption is prevalent, this does present a case for such a link.

When the alcohol consumption categories prevalent in the different Output Areas within the region studied were matched against accidental fire injury and fatality data it was found that roughly 20% of accidental dwelling fire injuries were within areas with a prevalence of 'harmful' alcohol consumption and a further 21% of injuries were within areas with a prevalence of 'hazardous' alcohol consumption. In addition roughly 15% of accidental dwelling fire fatalities were within areas with a prevalence of 'harmful' alcohol consumption and a further 26% of fatalities were within areas with a prevalence of 'hazardous' alcohol consumption. This would suggest that 'harmful' or 'hazardous' alcohol consumption levels can potentially be a contributory factor to the risk of injury or fatality in an accidental dwelling fire (Figure 1).

Comparison of prevalent alcohol consumption levels across the region with the ten Customer Insight Community Profiles (Higgins et al, 2013) in use at the fire and rescue service studied indicated that cooking fires within Output Areas with a prevalence of 'harmful' or 'hazardous' alcohol consumption levels were most likely to be found within three community profile groups (groups 5, 7, and 10). Across the region studied, roughly 86% of cooking fire incidents occurred within these three groups:

- Group 5 (Students living in city centre locations) accounted for 17% of cooking fire incidents
- Group 7 (Young families with high benefit need) accounted for 14% of cooking fire incidents
- Group 10 (Younger, urban population living in high levels of deprivation) accounted for 55% of cooking fire incidents

The analyses of alcohol related fire incidence and alcohol consumption data indicated that there are not necessarily clear correlation / causation patterns between alcohol consumption and fire incidence, and that it is important not to lapse into ecological fallacy whereby statistical data is interpreted to infer the nature of individual's fire risk behaviours from the group to which those individuals belong. Rather the results of the analyses indicate that individuals in general are at risk of fire from alcohol related behaviours, and that individuals from certain socio-economic groups are more likely to be at risk of fire from alcohol related behaviours, since 86% of cooking fire incidents occurred in areas corresponding to just three socio-economic groups, all with high levels of alcohol consumption, and 78% of alcohol related fires involved cooking activities. It would be useful for the future to conduct similar analyses within the geographical areas covered by other fire and rescue services to assess whether similar incidence of alcohol related fires occur with similar frequency in the socio-economic groups identified by this research.

Overall the results of the research reported in this paper indicated that alcohol consumption is a contributory factor in a significant proportion of fires within the region studied. The alcohol consumption appears to affect an individual's likelihood of accidentally starting a fire due to inappropriate use of cooking facilities or smoker's materials, and may impair the ability to

escape the fire. Alcohol related fires appear to be more common amongst certain socio-economic groups that typically appear to have higher levels of alcohol consumption. Thus in answer to the research question “What factors are associated with alcohol related fire incidences”, the main factors appear to be the community group to which a given individual or household belongs (community groups were the main analytical tool used by the fire and rescue service studied to analyse fire incidence patterns), the likelihood of cooking whilst under the influence of alcohol (associated with the level of alcohol consumption in a given area) since of the 566 alcohol related fires 433 (78%) involved a cooking appliance as the ignition source, and the likelihood of smoking whilst under the influence of alcohol (associated with the level of alcohol consumption in a given area) since of the 566 alcohol related fires 89 (16%) involved smoking materials as the ignition source.

Alcohol related fire incidence prevention

The analyses undertaken regarding alcohol related fires indicated that such fires form a significant proportion of unintentional dwelling fires. In terms of preventing such fires it was therefore important to understand which different groups of individuals are more likely to be at risk of such fires.

The spatial and statistical analysis of alcohol related fire incidences allowed the identification of those communities and geographical areas at highest risk of alcohol related fire incidences. Analysis of the alcohol consumption data revealed that high levels of alcohol consumption mainly occurred in three of the ten Customer Insight Community Profiles utilised by the fire and rescue service studied (Higgins et al, 2013), namely younger urban residents living in high levels of deprivation, students living in city centre locations and young families with high benefit need. In particular, accidental cooking fires involving ‘harmful’ or ‘hazardous’ levels of alcohol consumption were most likely to occur within these three groups. Households in these communities and geographical areas would be targeted by the fire and rescue service as part of the Home Fire Safety Check (HFSC, 2015) initiative for prevention of accidental dwelling fires.

The statistical and spatial analysis of alcohol related fire incidence distribution was graphically presented in the form of a set of colour coded maps from the geographical information system that was developed, where the colour of each output area within the region indicated the risk level of alcohol related dwelling fires. In addition the geographical information system provided lists of addresses for the households within the different output areas for use by fire prevention officers undertaking the targeted home fire safety checks. In answer to the research question “How can alcohol related fires be prevented?” overall this research indicated that analysis of the incidence of alcohol related fires in terms of community groups can provide a basis for understanding what type of individual or household might be at a higher risk of alcohol related fires, and geographical information systems can be used to inform fire prevention resource allocation with regard to the geographic distribution of such. As part of the home fire safety check initiative (HFSC, 2015) individuals are advised not to drink alcohol whilst cooking, and referrals to NHS alcohol management services could be made as appropriate.

The high incidence of accidental cooking fires related to high levels of alcohol consumption amongst these three groups implied that it would be useful to develop communications or campaigns to target individuals within these groups. The fire and rescue service studied was considering developing bespoke communication packs for each community profile group based on the main fire risks present for each group. However, the significant budget reductions

applied to the fire and rescue service studied were such that from 2015 onwards, the number of home fire safety checks that could be carried out was drastically reduced.

Conclusions

In this paper we have examined how the statistical and spatial analysis of alcohol related fire incidence data, alcohol consumption patterns data, and socio-economic groupings data was used to develop a geographical information system for supporting fire prevention of alcohol related dwelling fires. Discussions and meetings with relevant staff within the fire and rescue service studied identified the need to analyse alcohol consumption patterns and alcohol related fire risk. In order to achieve this, sources of geo-coded data that could be used to analyse the nature and geographical distribution of alcohol related fire incidences, and the socio-economic characteristics of individuals and communities associated with alcohol related fire risk were identified.

The statistical and spatial analyses undertaken allowed an identification of the social groups and geographical areas at highest risk of alcohol related fire incidence within the region studied. Analysis of alcohol consumption level data and cooking fire incidence data appeared to indicate a relationship between accidental cooking fire incidents and geographical areas with a prevalence of 'harmful' or 'hazardous' levels of alcohol consumption. Overall there also appeared to be a relationship between 'harmful' and 'hazardous' levels of alcohol consumption and injuries and fatalities in accidental dwelling fires within the region studied.

Finally, it appeared that high levels of alcohol consumption occurred mainly in just three of the ten Customer Insight Community Profiles utilised by the fire and rescue service studied. In particular, it was found that cooking fires involving 'harmful' or 'hazardous' levels of alcohol consumption were most likely to be found amongst younger urban residents living in high levels of deprivation, students living in city centre locations and young families with high benefit need.

The fire prevention activities undertaken by the fire and rescue service studied for alcohol related fires mainly concerned the use of targeted home fire safety checks in households identified as being at higher risk of alcohol related fires. The analysis undertaken through the research reported in this paper supported the development of communications and campaigns to target individuals within socio-economic groups most at risk of alcohol related fires. The fire and rescue service was considering developing bespoke communication packs for each community profile group based on the main fire risks present for each group. However, the significant budget reductions applied to the fire and rescue service studied drastically reduced the number of home fire safety checks that could be carried out.

Overall the research presented in this paper develops the theoretical understanding of fire and fire risks in terms of the contribution that alcohol can play in fire incidence. Through identification of particular socio-economic groups that have a higher likelihood of alcohol related fires, this research assists in understanding the risks affecting different community groups in practice.

References

Amaechi, A., Counsell, S. (2013) Towards an Approach for a Conceptual System Design, *Systems Research and Behavioral Science*, 30, 6, 780 - 793.

Ahrens, M. (2008) Home smoke alarms: The data as context for decision, *Fire Technology*, 44, 313-327.

Baker, J., Bouchlaghem, D., Emmitt, S. (2013) Categorisation of fire safety management: Results of a Delphi Panel, *Fire Safety Journal*, 59, 37 - 46.

Ballard, J., Koepsell, T., Rivara, F. (1991) Association of smoking and alcohol drinking with residential fire injuries, *American Journal of Epidemiology*, 135, 1, 26 - 34.

Bjorndal, T., Herrero, I., Newman, A., Romero, C., Weintraub, A. (2012) Operations research in the natural resource industry, *International Transactions in Operational Research*, 19, 1, 39 - 62.

Bruck, D., Thomas, I. (2010) Interactions between human behaviour and technology: implications for fire safety science, *Fire Technology*, 46, 769-787.

Bruck, D., Ball, M., Thomas, I. (2011) Fire Fatality and Alcohol Intake: Analysis of Key Risk Factors, *Journal of Studies on Alcohol and Drugs*, 72, 5, 731 – 736.

CALG (2012) UK Department of Communities and Local Government, Customer Led Transformation Programme Case study: Merseyside Fire and Rescue Service 41/58 http://www.local.gov.uk/c/document_library/get_file?uuid=670e4b6c-876a-40f9-a69a-ca918b667030&groupId=10180
(accessed 27 November 2015)

CFB (2015) Cleveland Fire Brigade, UK, Alcohol Safety, <http://www.clevelandfire.gov.uk/safety/alcohol-safety/>
(accessed 27 November 2015)

Chainey, S. (2012) Using the vulnerable localities index to identify priority areas for targeting fire safety services, *Fire Safety Journal*, 62, 30 - 36.

Crawford, B. (2005) Reducing fire risk for the poor, *Fire Engineering*, 58, 1, 83 - 88.

Clarke, A., Smith, J., Conroy, C. (2014) Domestic fire risk: a narrative review of social science literature and implications for further research, *Journal of Risk Research*, DOI: 10.1080/13669877.2014.913660

Diekman, S. (2010) A qualitative evaluation of fire safety education programs for older adults, *Health Promotion Practice*, 11, 2, 216 - 225.

Doughty, K., Orton, M. (2014) AT and telecare to manage fire risks in the homes of older and vulnerable people, *Journal of Assistive Technologies*, 8, 1, 35 - 43.

Fahey, D., Carson, E., Cramp, D. (2004) Applying systems modelling to public health, *Systems Research and Behavioral Science*, 21, 6, 635 - 649.

Franco, L, Montibeller, G. (2010) Facilitated modelling in operational research, *European Journal of Operational Research*, 205, 3, 489 - 500.

Harper, A., Boyce, K., McConnell, N. (2013) An investigation into the circumstances surrounding fatal dwelling fires involving very young children, *Fire Safety Journal*, 61, 72 - 82.

HFSC (2015) Home Fire Safety Check, available at <http://www.fireservice.co.uk/safety/hfsc> (accessed 27 November 2015)

Higgins, E., Taylor, M., Jones, M., Lisboa, P. (2013) Understanding community fire risk – A spatial model for targeting fire prevention activities, *Fire Safety Journal*, 62, 20 - 29

Holborn, P., Nolan, P., Golt, J. (2003) An analysis of fatal unintentional dwelling fires investigated by London Fire Brigade between 1996 and 2000, *Fire Safety Journal*, 38, 1 - 42.

Howland, J., Hingson, R. (1987) Alcohol as a risk factor for injuries or death due to fires and burns: a review of the literature, *Public Health Reports*, 102, 5, 475 - 483.

HSCIC (2015) Health and Social Care Information Centre, Statistics on Alcohol - England, 2014, <http://www.hscic.gov.uk/catalogue/PUB14184> (accessed 27 November 2015)

Jordan, L., Squires, T., Busuttill, A. (1999) Incidence trends in house fire fatalities in Eastern Scotland, *Journal of Clinical Forensic Medicine*, 6, 233 -237.

Leth, P., Gregersen, M., Sabroe, M. (1998) Fatal residential fire accidents in the municipality of Copenhagen, 1991 – 1996, *Preventative Medicine*, 27, 444 - 451.

LFB (2015) London Fire Brigade, UK, The fire dangers of alcohol, <http://www.london-fire.gov.uk/FeatureFireRiskAndAlcohol.asp> (accessed 27 November 2015)

MAPINFO (2015) MAPINFO, <http://www.mapinfo.com/> (accessed 27 November 2015)

MOSAIC (2015) Mosaic UK Consumer and Demographic Data, Experian <http://www.experian.co.uk/marketing-services/products/mosaic-uk.html> (accessed 27 November 2015)

NHS Alcohol Misuse (2015) NHS Choices, Alcohol Misuse, <http://www.nhs.uk/conditions/Alcohol-misuse/Pages/Introduction.aspx> (accessed 27 November 2015)

NHS Alcohol Support (2015) NHS Choices, Alcohol Support, <http://www.nhs.uk/Livewell/alcohol/Pages/Alcoholsupport.aspx> (accessed 27 November 2015)

OA (2015) Output Area, UK Office for National Statistics, <http://www.neighbourhood.statistics.gov.uk> (accessed 27 November 2015)

O’Grady, N. (2014) Securing Circulation Through Mobility: Milieu and Emergency Response in the British Fire and Rescue Service, *Mobilities*, 9, 4, 512 - 527.

Runyan, C., Bangdiwala, S., Linzer, M., Sacks, J., Butts, J. (1992) Risk factors for fatal residential fires, *The New England Journal of Medicine*, 327, 12, 859 - 863.

Thomas, I., Bruck, D. (2010) Awakening of sleeping people: A decade of research, *Fire Technology*, 46, 743 – 761.

Valentine, G., Holloway, S., Jayne, M. (2010) Generational patterns of alcohol consumption: Continuity and change, *Health and Place*, 16, 5, 916-925.

Waterhouse, K. (2010) A Review of Fire-Related Deaths in Alberta, *Canadian Society of Forensic Science Journal*, 43, 4, 171-180.

Wilson, G., Lock, C., Heather, N., Cassidy, P., Christie, M., Kaner, E. (2011) Intervention against Excessive Alcohol Consumption in Primary Health Care: A Survey of GPs' Attitudes and Practices in England 10 Years On, *Alcohol and Alcoholism*, 46, 5, 570-577.

Zhang, G., Lee A., Lee, H., Clinton, M. (2006) Fire safety among the elderly in Western Australia, *Fire Safety Journal*, 41, 57-61.

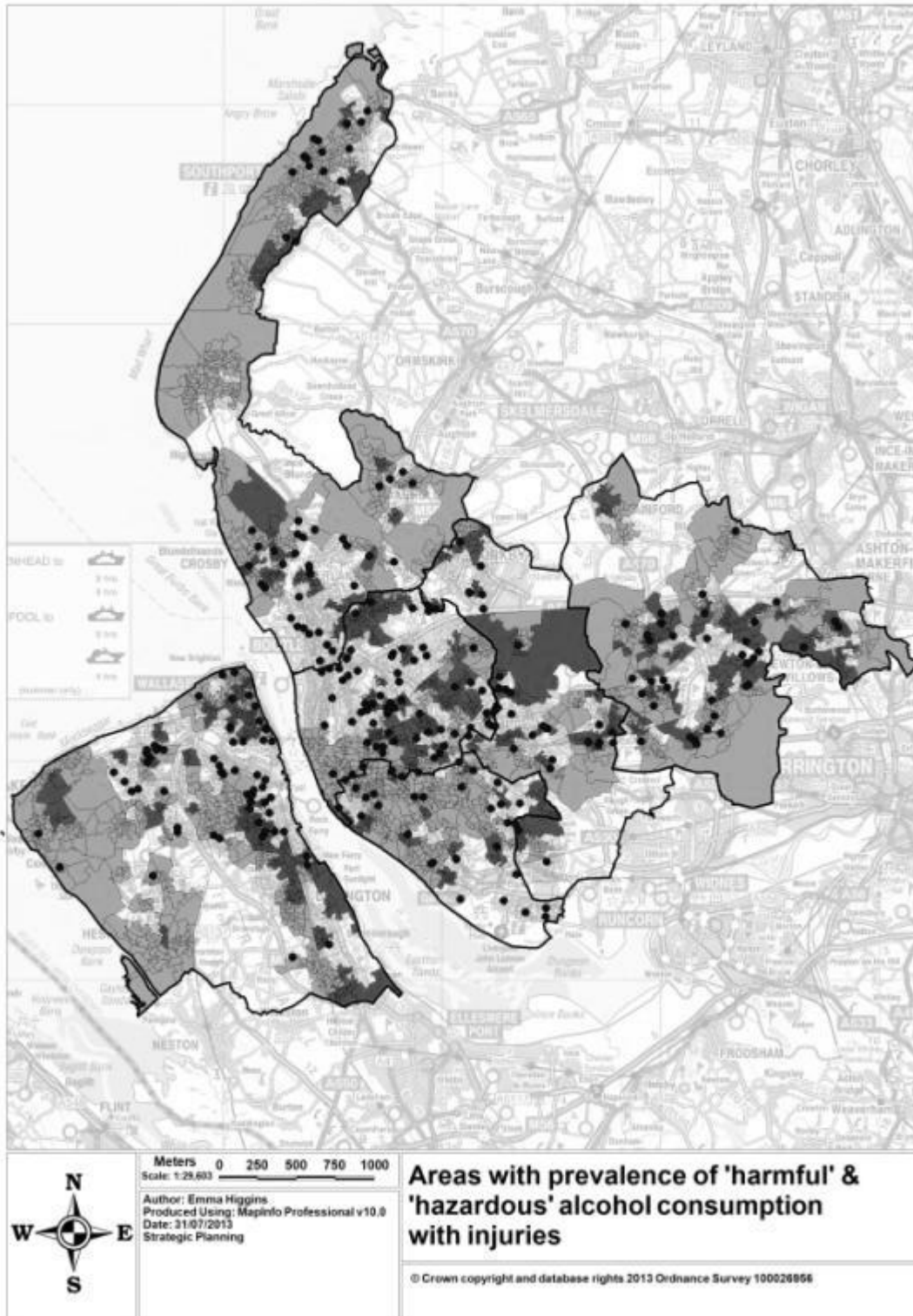


Figure 1 - Map illustrating areas with a prevalence of 'harmful' or 'hazardous' alcohol consumption and injuries in accidental dwelling fires