A catastrophe theory view of accidental dwelling fire injuries

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Abstract

- Purpose

To apply catastrophe theory to the analysis of accidental dwelling fire injuries in terms of age band, gender, and contributory factors in order to inform fire prevention activities.

- Methodology

A case study in a UK Fire and Rescue service concerning analysis of the circumstances of accidental dwelling fire injuries, and the characteristics and behaviours associated with such utilising frequency analysis, percentages, ratios, and catastrophe theory modelling.

- Findings

Overall males were more likely to be injured in an accidental dwelling fire compared to females by a ratio of 1.68 to 1, and those in the age band 50 to 64 appeared to be the most at risk. 15.4% of the accidental dwelling fire injuries involved consumption of alcohol or drugs, and 5.9% involved falling asleep.

- Originality

The use of a catastrophe theory view to analyse the circumstances under which accidental dwelling fire injuries occurred using fire injury data from a UK fire and rescue service.

- Research implications

The circumstances of accidental dwelling fire injury can be analysed to identify patterns concerning when a catastrophic change relating to ordinary use of domestic objects results in an accidental dwelling fire injury.

- Practical implications

A catastrophe theory view can aid understanding of how ordinary use of domestic objects results in an accidental dwelling fire injury.

- Social implications

Since fire injuries have both a social and economic cost, understanding how such fire injuries occur can aid fire prevention through appropriately targeted fire prevention activities.

Key words: Catastrophe theory dwelling fire injury

1. Introduction

Previous research had indicated that there are a wide variety of factors associated with accidental dwelling fire injuries (Jennings, 2013; Dean et al, 2016; Higgins et al, 2013; Taylor et al 2012). In this article we examine the use of catastrophe theory to aid understanding of the factors associated with accidental dwelling fire injuries. In particular, we address accidental dwelling fire injuries using catastrophe theory to examine the normal factor (use of ignition sources such as cookers, heaters, smoker's materials, and candles) and splitting factor (time period over which such ignition sources are left unattended) that can be used to better understand accidental dwelling fire injury incidence.

Catastrophe theory (Zeeman, 1976) is a mathematical model for describing situations where gradually changing circumstances can produce sudden effects. These effects are termed catastrophic because the underlying continuity of the circumstances, for example simply using a cooking, heating, or other domestic appliance, smoker's materials, and candles, makes the sudden discontinuity of the effects (an accidental dwelling fire injury occurring) so unexpected. A small flame can turn into a dwelling fire in less than 30 seconds. It can take only minutes for smoke to fill a house or for it to be engulfed in flames (RG, 2022). Catastrophe theory has been used to model a variety of physical and sociological systems (Zeeman, 1976; Bonanno and Zeeman, 1988; Bunch, 2016), and in particular has been used for modelling in safety research (Guastello, 1989; Tong and Zhang, 2020; Wang, et al, 2017; Wang et al, 2021). Catastrophe theory was chosen for accidental dwelling fire injury modelling, since it is an approach that can model discontinuous change, in terms of modelling the circumstances when safe use of an ignition source such as a cooker or heating appliance can dramatically and unexpectedly change to an accidental dwelling fire and fire injury.

The originality of the research reported in this paper is the use of a catastrophe theory view of the circumstances under which accidental dwelling fire injuries occur relating to careless use of ignition sources such as cooking, heating, and other domestic appliances, smoker's materials and candles using fire injury data over a two year period from a UK fire and rescue service. The research gap that this research addresses is the gap between standard fire and rescue service statistical analyses of fire incidences and fire injuries and theoretical models (such as catastrophe theory) that can model the overall set of circumstances that can lead to an accidental dwelling fire injury.

2. Literature review

2.1 Accidental dwelling fire injury

In the UK in the majority of instances, an individual may use cooking, and other domestic appliances safely on a typically daily basis; may use heating appliances or other domestic appliances on a typically daily basis during colder weather; may use smoker's materials on a daily basis (if a smoker); and may typically use candles infrequently. In the vast majority of instances safe use of these will not result in an accidental dwelling fire injury. For fire injury prevention, the interest lies in the much smaller number of instances where careless use of ignition sources such as cooking, heating and other domestic appliances, smoker's materials, and candles results in an accidental dwelling fire injury (DWFR, 2022). There will be instances when an accidental dwelling fire is put out by the householder, or goes out by itself. A survey by the UK Ministry of Housing, Communities and Local Government (UKHCLG, 2018) in 2016-17 found that in the majority of dwellings where an accidental dwelling fire occurred, the fire was put out by a householder, or the fire went out by itself. Only a quarter (25%) of such accidental dwelling fires were put out by a fire and rescue service, implying that three quarters (75%) of accidental dwelling fires in the UK may never be reported to a fire and rescue service. In this article we are concerned with the accidental dwelling fires that were catastrophic in the sense that they could not, or were not brought under control by the householder, resulted in injury, and required the local fire and rescue service to be called out. Although no data is recorded regarding careless use of ignition sources when a local fire and rescue service is not called out when a fire is either put out by the householder, or goes out by itself, there is detailed data recorded regarding accidental dwelling fire injuries when a local fire and rescue service is called out, which can be used for modelling purposes. This is an important area for research given the social and economic costs of accidental dwelling fires and fire injuries both for individuals and for healthcare organisations such as the UK National Health Service. Further to their high casualty rates, fires impose considerable economic loss, including nearly USD 8.6 billion in the US in 2020 (Al-Hajj et al, 2023).

Previous research had indicated that carelessness can be a significant factor in accidental dwelling fire injuries (Harpur et al, 2014; Harpur et al, 2013; Holborn et al, 2003; Lambie et al, 2015; DFRS, 2022, CCUK, 2022). The main aspect of carelessness with regard to accidental dwelling fire injuries is typically leaving ignition sources such as cooking, heating, and other domestics appliances, smoker's materials, or candles unattended (Holborn et al, 2003; Xiong et al, 2017; Corcoran et al, 2016; Chhetri et al, 2018). Cooking fire injuries are typically one of the most common types of accidental dwelling fire injury (Taylor et al, 2023). When cooking with oil, firstly it will boil, then smoke, and then catch fire. It can take less than 30 seconds for smoking cooking oil to catch fire (BFC, 2022). In comparison, discarded smoker's materials may smoulder for hours before starting a fire (PC, 2022). The time that an ignition source is left unattended relates to the likelihood of an accidental dwelling fire starting, and associated factors can include distraction (CCC, 2022), falling asleep (CFRS, 2022, LFB, 2022), being under the influence of alcohol (Dean et al, 2018) or drugs (DSFRS, 2022; Taylor et al, 2022b), or a medical condition or illness affecting a householder (WMFS, 2022; LFB, 2022). In terms of applying analyses of accidental dwelling fire injuries in practice in terms of fire prevention, Runefors and Nilson (2021) stated the importance of matching the correct fire prevention measures to individuals depending upon sociodemographic risk factors in order to achieve maximal effectiveness,

2.2 Accidental dwelling fire injury modelling

Residential fires require further attention in order to develop fire risk theories, and to identify strong, reliable predictors to explain fire risk (Hossain and Smirnov, 2023). Accidental dwelling fire injury modelling has been undertaken using a variety of different approaches such as Markov chains, neural networks (Zheng et al, 2020), univariate and multiple regression modelling (Ghassempour et al, 2022), logistic regression modelling (Taylor et al, 2012), and community profile modelling (Higgins et al, 2013, Dean et al, 2016, Taylor et al, 2016). Typically the theory of epidemiologic transition is used in studies of fire incidence and injury. This approach focuses on the change in patterns of fire incidence and injury and on the interactions between these patterns and their demographic, economic and sociologic determinants and consequences (Jonsson et al, 2017; Perry et al, 2015). Various factors have been considered in previous accidental fire injury modelling research including socio-economic and demographic factors (Jonsson and Jaldell, 2020; Nilson, and Bonander, 2020; Hastie and Searle, 2016), householder behaviours (Hopkin, et al, 2019a; Thompson et al 2018), and housing type (Hopkin et al, 2019b).

2.3 Fire injury modelling using catastrophe theory

Catastrophe theory (Zeeman, 1976; Bonanno and Zeeman, 1988; Bunch, 2016) can provide mathematical models for circumstances that whilst gradually changing can suddenly produce significant (and potentially unexpected) effects. Effects such as an accidental fire injury may be described as catastrophic because simply using a domestic object and experiencing a sudden discontinuity such as an accidental dwelling fire injury occurring is so unexpected in the vast majority of instances in the use of domestic objects. Accidental dwelling fire injuries are relatively rare events within the population of a given area. Catastrophe theory has been used to model different types of non-domestic fires including dust-cloud fires (Zhikang, 2000), subway fire accidents (Lin et al, 2020), and compartment fires (Weng and Fan, 2001). In terms of domestic fires, catastrophe theory has been used to model specific aspects of fires, such as backdraft phenomenon in room fires (Weng and Fan, 2004).

Overall, although catastrophe theory has been used to model different types of non-domestic fires, there does not appear to have been use of catastrophe theory for examining the circumstances associated with domestic fire injuries. This is the originality of the research reported in this article, the use of a catastrophe theory view of the circumstances of accidental dwelling fire injuries in order to determine those circumstances most pertinent to the occurrence of such fire injuries.

3. Research method

3.1 Case study

A case study in Merseyside Fire and Rescue Service was undertaken using accidental dwelling fire injury data over the period 2019 to 2021. The data covered accidental dwelling fire injuries recorded by Merseyside Fire and Rescue Service when attending such fires. However, not all domestic fires may be reported to (and attended by) a fire and rescue service (Ghassempour at al, 2021). This allowed analysis of the circumstances of accidental dwelling fire injuries that resulted from careless use of different ignition sources, and the characteristics and behaviours associated with those injured in the fire incidents. Merseyside Fire and Rescue Service covers the mainly urban area of Merseyside within the North West region of England. Merseyside covers a geographical area of 645 km^2 and contains high-density urban areas, suburbs, and

semi-rural areas, has high levels of deprivation, and in 2020 had a population of 1,434,300 (Nomis, 2020).

This research examined the use of a catastrophe theory view of the circumstances when the careless use of ignition sources catastrophically changed from a situation that could be managed by a householder to an accidental dwelling fire that required the assistance of a local fire and rescue service and led to injury to the householder.

3.2 Catastrophe theory modelling

In order to develop a quantitative catastrophe theory view of accidental dwelling fire injuries there is a need to determine the quantitative aspects of careless use of ignition sources. This can be achieved via statistical modelling of accidental dwelling fire injuries over a period of time. From this can be determined the relevant aspects of careless use of ignition sources attributed to the different categories of ignition sources (cooking, heating and other domestic appliances, smoker's materials, candles, etc.) the ages and genders of those injured in the accidental dwelling fire, the circumstances and behaviours of those injured, and the resulting type of fire injury. In this manner is possible to quantitatively examine the nature of the generic splitting factor of ignition sources being left unattended in the catastrophe theory view.

Figure 1 shows the catastrophic jump to a fire incident requiring attendance by the local fire and rescue service resulting in injury relating to the increasing period of time over which ignition sources are left unattended.

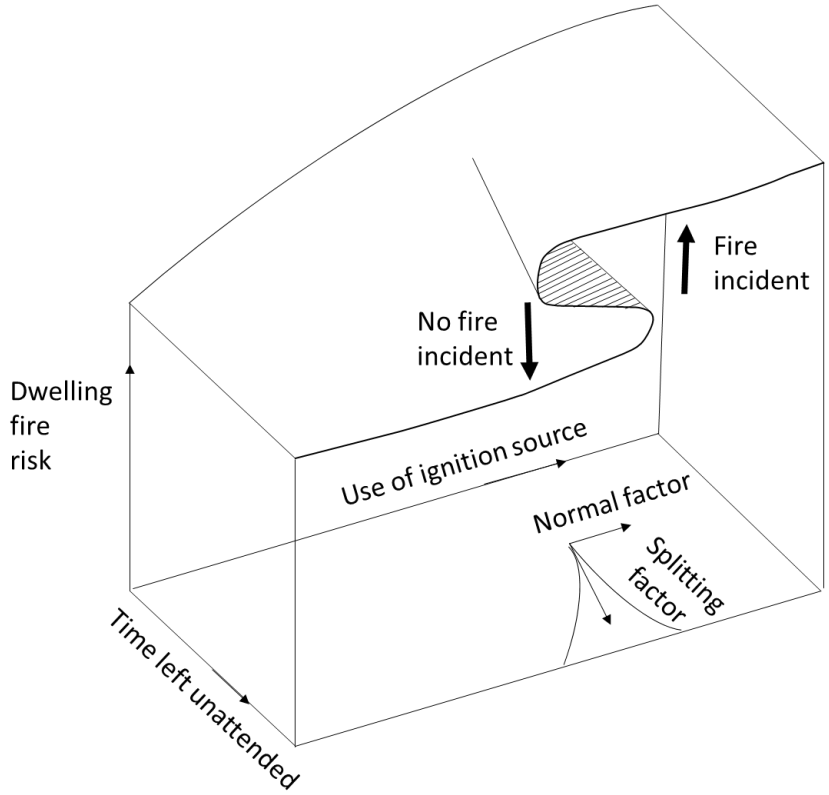

Figure 1. Catastrophe theory view of factors involved in accidental dwelling fire injuries.

In catastrophe theory terms, let a = variable concerned with the use of the ignition source, b = the time that the ignition source is left unattended, and u = dwelling fire risk level. A potential function V(a,b,u) is associated with the equilibrium surface (Zeeman, 1976) shown in Figure 1 with the equation $u^3 + au + b = 0$ where (a,b) (that is the use of the ignition source, and the time left unattended) are co-ordinates on what is termed the control space, and the vertical variable u (dwelling fire risk level) is what is termed the internal variable. The potential function V models the physical potential for a dwelling fire. The control (a,b) which varies the state (a,b,u) will jump from no fire incident to fire incident when it crosses the fold curve. The variable b, known as the splitting factor is the time left unattended. For a short time interval left unattended a fire incident would be unlikely to occur, however, the longer that the ignition source is left unattended there may be (or may not be) a catastrophic change to a fire incident. A fire incident would be dependent upon a number of factors associated with the variable a (the use of the ignition source), for example, the heat setting on the cooker, the nature of the cooking utensil used, and the oil or fat content of the food being cooked. For the same heat setting, and cooking utensil, and time period left unattended, a fire incident might occur if high oil or fat content foods were being cooked, but might not occur if low oil or fat content food were being cooked.

3.3 Analysis of dwelling fire injuries

Over the period studied 2019 to 2021, there were 169 accidental dwelling fire injuries in the area covered by Merseyside Fire and Rescue Service. The first step in the catastrophe theory modelling concerned modelling the factors involved in an accidental dwelling fire injury in terms of the use of ignition sources such as cooking, heating, and other domestic appliances, smoker's materials and candles, and the time period over which such were left unattended. Frequency analysis, ratios and percentages were utilised to analyse the ignition sources causing an accidental dwelling fire injury; the time of day of the fire injury; the age band of those injured; contributory factors; the type of fire injury; and the level of deprivation in the neighbourhood in which the fire injury occurred.

3.4 Research questions

The research questions posed were:

- How can catastrophe theory be used to model accidental dwelling fire injuries?

- What are the circumstances that lead to an accidental dwelling fire injury within a catastrophe theory model?

These are important research questions since accidental dwelling fire injuries have both a social and economic cost, and understanding the nature of how fire injuries occur can aid fire prevention through appropriately targeted fire prevention activities. The originality of the research reported in this paper is the statistical examination of the circumstances under which accidental dwelling fire injuries occur using a catastrophe theory approach. In particular, the use of catastrophe theory allows a deeper understanding the conditions under which safe use of domestic objects such as cookers, heaters and smoker's materials catastrophically changes to unsafe use resulting in a fire injury from a fire that either does not go out by itself or cannot be put out by the householders (UKHCLG, 2018) and thus requires attendance by the local fire and rescue service.

3.5 Catastrophe theory model of accidental dwelling fire injuries

In terms of analyzing the likelihood of a fire / no fire situation we can consider the likelihood distribution for different cooking, heating, other domestic appliance, smoking, and candle use cases. With increasing carelessness in terms of cooking, heating, other domestic appliance, smoking, and candle use relating to increasing time periods for which such were left unattended, a bimodal distribution might occur. With careful use of ignition sources such as cooking, heating, and other domestic appliances, smoker's materials, and candles there would not be an accidental dwelling fire. For the majority of the time, and the majority of individuals, this is the normal state of using such ignition sources. However, when careless use of such ignition sources goes beyond a certain level, the splitting factor (time left unattended) causes the fold curve to appear and the catastrophic effect of an accidental dwelling fire resulting in injury requiring attendance of the local fire and rescue service to occur. Carelessness of use could include forgetfulness in terms of leaving cooking unattended, (LFB, 2022), leaving clothing drying too close to heating appliances (DSFRSH, 2022, CHFRS, 2022), or leaving smoker's materials or candles unattended (NCC, 2022). Carelessness could also include clumsiness in terms of spilling or knocking over utensils containing flammable materials used in cooking, knocking over clothing left too close to a heating appliance, or dropping or knocking over smoker's materials or candles. By reducing the splitting factor (time left unattended) for example, turning down the cooking or heating setting in a timely manner (ESFRS, 2022), or extinguishing smoker's materials (LFBS, 2022) or candles (AFRS, 2022) in a timely manner the state of the system can be changed back to a no fire incident. Figure 2 shows the likelihood of fire and no fire situations arising with increased time period over which ignition sources are left unattended.

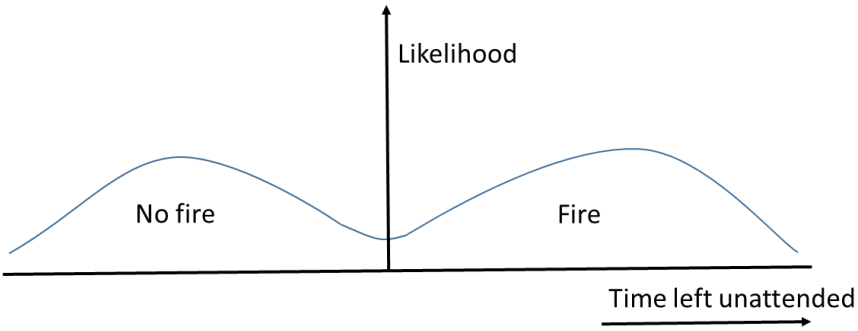

Figure 2. Likelihood distribution with increasing time that ignition sources are left unattended

Cooking foods with a high fat or oil content or using cooking oils and fats and leaving them unattended for a given time period might result in an accidental fire (smoking cooking oil can ignite in less than 30 seconds (BFC, 2022)), whereas cooking foods with low fat or oil content, or using only small amounts of cooking oils or fats and leaving them unattended for the same time period might typically not result in a fire. Candles left in stable and shielded candle holders away from flammable materials such as soft furnishings for a given time period might typically not result in a fire, whereas candles left in unstable and unshielded candle holders left close to flammable materials for the same time period might result in a fire (AFRS, 2022). The distance between drying clothing and a heating appliance, and the nature of the object on which the drying clothing was left could affect the likelihood of an accidental dwelling fire after a given time period of non-attendance (CHFRS, 2022). Appropriate use of ashtrays (or not) could

similarly affect the likelihood of an accidental dwelling fire caused by smoker's materials after a given period of non-attendance (LFBS, 2022).

4. Results

4.1 Circumstances of accidental dwelling fire injuries within a catastrophe theory model

In terms of the practical application of a catastrophe theory view of accidental dwelling fire injuries for fire prevention, it is necessary to understand the nature of the catastrophe fold curve in terms of statistical analysis of the circumstances associated with accidental dwelling fire injuries. Careless use of ignition sources in accidental dwelling fire injuries can be examined by statistical analysis of accidental dwelling fire injury data over a given time period. This can provide quantitative measures relating to careless use of ignition sources not in terms of individuals, but in terms of groups of individuals that have been involved in accidental dwelling fire injury who share common characteristics or behaviors over a period of time. There were 169 accidental dwelling fires injuries between 2019 and 2021 in the area studied.

In terms of the careless use of different types of ignition sources causing an accidental dwelling fire injury that was reported to the fire and rescue service studied over the time period studied:

Cooking appliances were involved in 39% of fire injuries.
Smoker's materials were involved in 14% of fires injuries.
Candles were involved in 11% of fire injuries.
Heating appliances were involved in 6% of fire injuries.
Other domestic appliances and other sources were involved in 30% of fire injuries.

Figure 3 indicated that carelessness when cooking was the most likely cause of an accidental dwelling fire injury. If using larger amounts of cooking oil, smoking cooking oil can ignite in less than 30 seconds (BFC, 2022), meaning that even a short period of non-attendance could result in a cooking fire and injury. In contrast, discarded smoker's materials may smoulder for hours before starting a fire (PC, 2022), meaning that a fire could start hours after the individual had gone to bed.

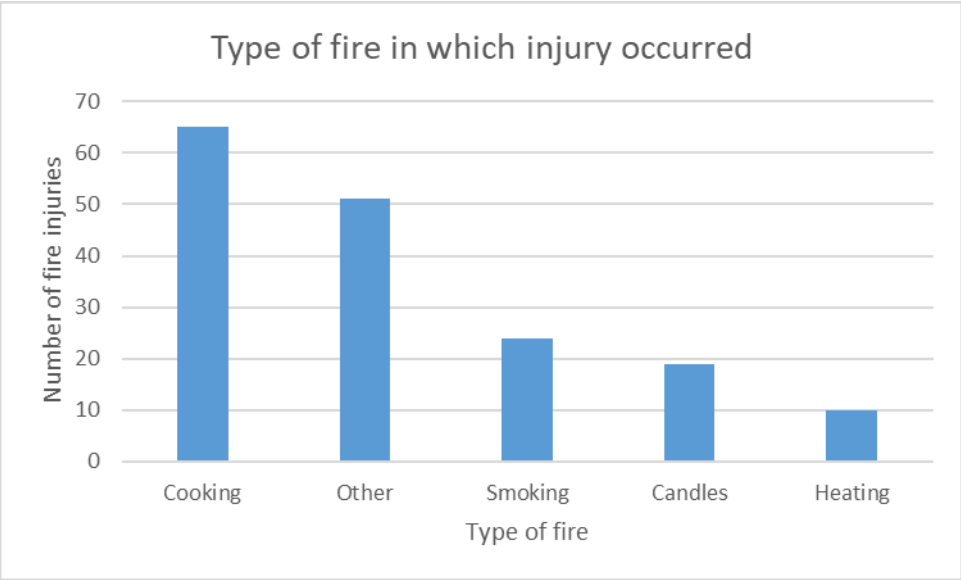

Figure 3. Ignition sources causing an accidental dwelling fire injury between 2019 to 2021 in the fire and rescue service studied

Figure 4 shows that the majority of accidental dwelling fire injuries occurred around meal times when a cooking device might be used (06:00 to 09:00; 12:00 to 14:00; and 17:00 to 20:00). Of the 14 fire injuries between 01:00 and 02:00 half were caused by a cooking device.

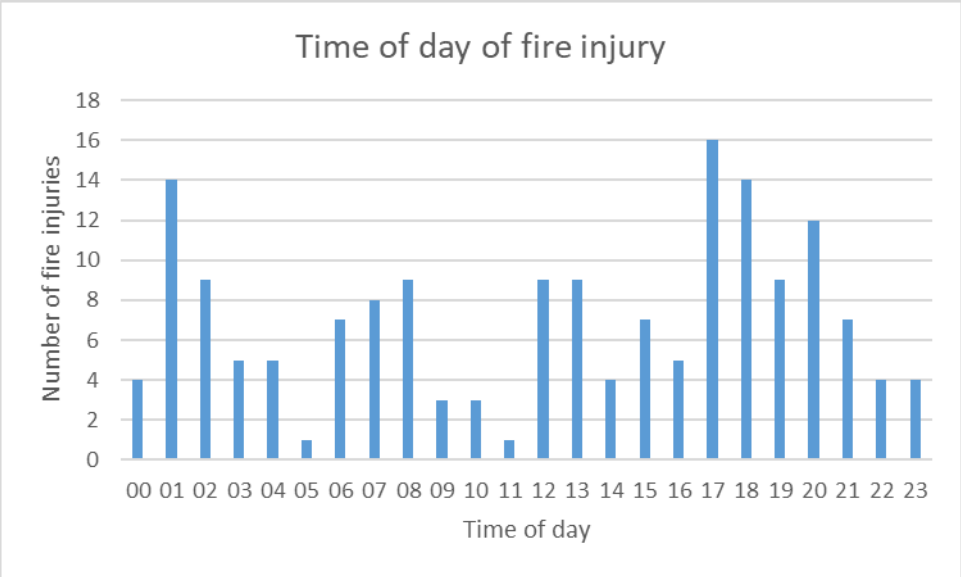

Figure 4. Time of day of accidental dwelling fire injuries 2019 to 2021 in the fire and rescue service studied.

In terms of the age of those injured in the accidental dwelling fire Figure 5 shows the distribution of the ages of those injured over the time period studied.

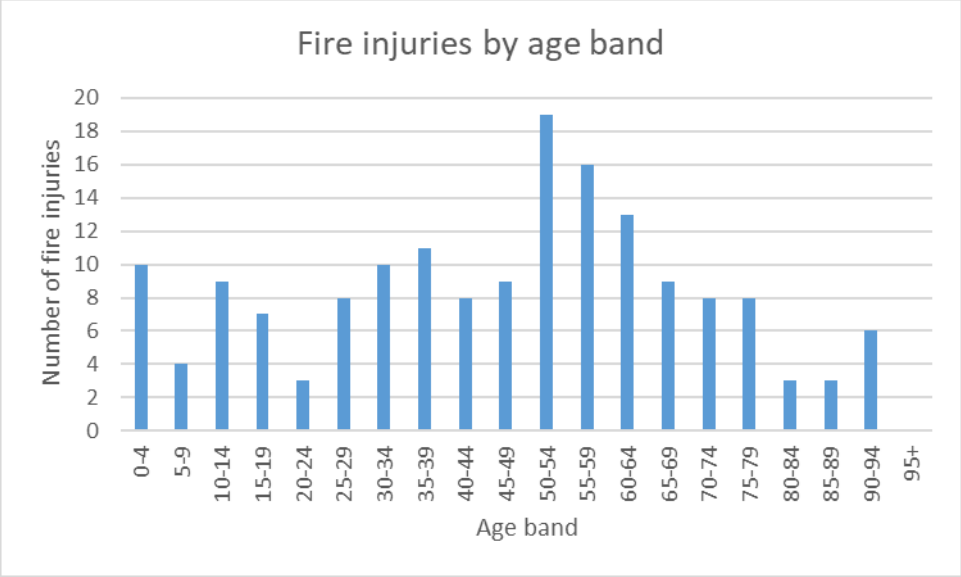

Figure 5. Ages of those injured in an accidental dwelling fire between 2019 to 2021 in the fire and rescue service studied.

Overall, it appeared that those in the 50 to 64 age band were at the greatest risk of an accidental dwelling fire injury. Over the time period studied it appeared that males were more likely to be injured in an accidental dwelling fire than females by a ratio of 1.68 to 1. There were 104 male fire injuries and 62 female fire injuries during the period studied.

In terms of the circumstances of accidental dwelling fire injuries over the period studied, 15.4% of the accidental dwelling fire injuries involved the consumption of alcohol or drugs, and 5.9% involved the individual falling asleep. The numbers of alcohol, drug, and tiredness related fire injuries during the period studied are shown in Figure 6

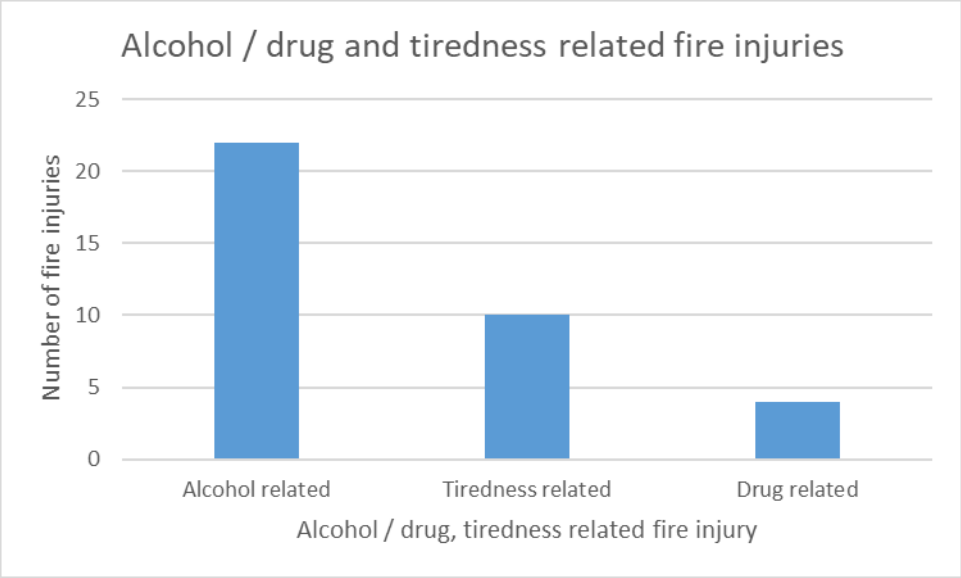

Figure 6. Alcohol, drug, and tiredness related fire injuries 2019 to 2021 in the fire and rescue service studied.

In terms of the type of injury sustained in the accidental dwelling fire, the majority of the injuries related to being overcome by smoke or toxic fumes as shown in Figure 7.

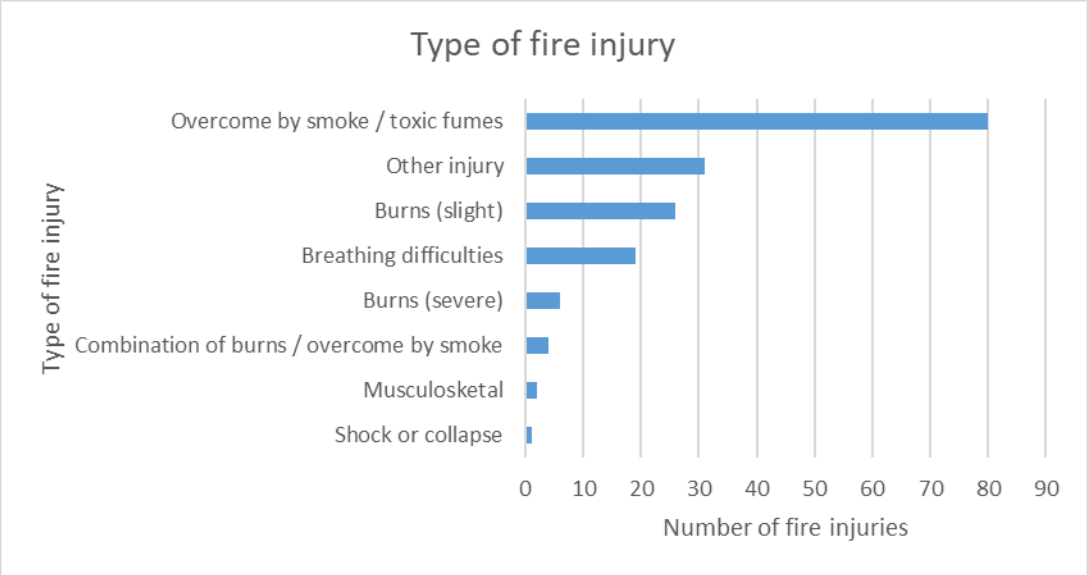

Figure 7. Types of accidental dwelling fire injuries 2019 to 2021 in the fire and rescue service studied

This would appear to indicate that in the majority of the accidental dwelling fire injuries over the period studied, the ignition source was left in an unattended state for a sufficient time period for the smoke or toxic fumes to build up to a level where being overcome by smoke or toxic fumes became the most common type of injury to the householders concerned (Taylor et al, 2022a).

Figure 8 shows that smoke/toxic fume inhalation injuries resulted mostly from use of cooking devices, followed by other domestic appliances and other sources, then candles, then heating devices, then smoker's materials.

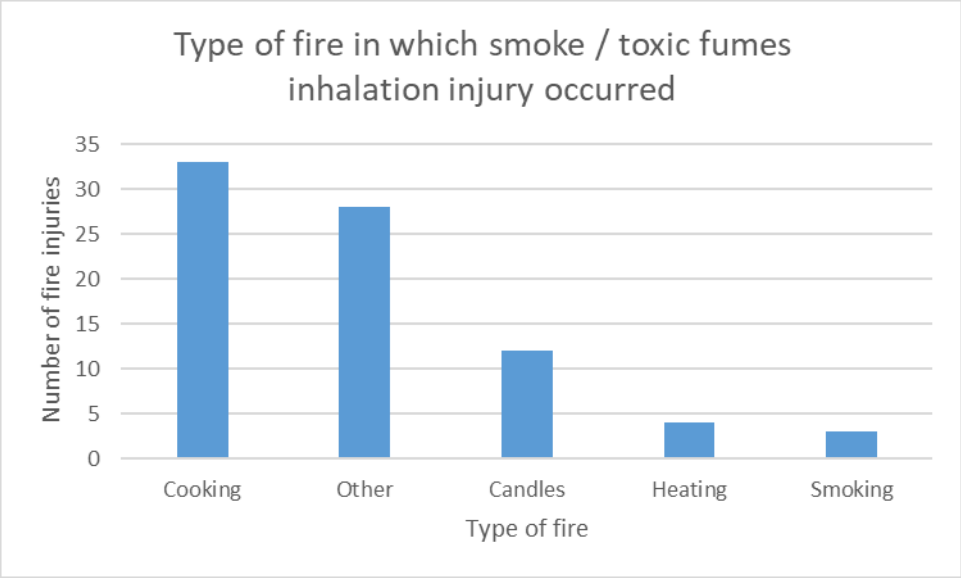

Figure 8. Type of fire in which smoke / toxic fumes inhalation injury occurred 2019 to 2021 in the fire and rescue service studied

Figure 9 shows the number of fire injuries per year in the different IMD deciles in the area studied. IMD decile 1 represents the most deprived areas, and IMD decile 10 represents the least deprived areas in England (IMD, 2023).

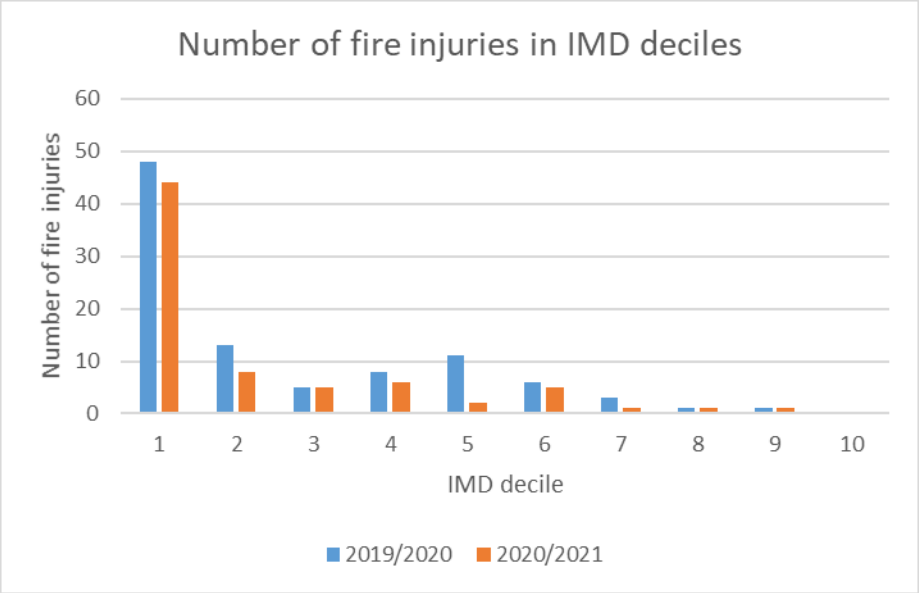

Figure 9. Number of fire injuries by year in IMD deciles

Figure 9 shows that there was a strong link between deprivation and accidental dwelling fire injury, with the majority of the fire injuries occurring in the most deprived neighbourhoods (IMD decile 1) within the area studied.

5. Discussion

The results from the research indicated that there are specific individual circumstances associated with each accidental dwelling fire injury, however, patterns exist in such circumstances in terms of:

- The different types of activity resulting in an accidental dwelling fire injury (Holborn et al, 2003, Chhetri et al, 2018) including cooking, smoking (Xiong et al, 2017), and candle use, with cooking being the most common activity resulting in fire injury (Taylor et al, 2023)

- The time of day when careless use of ignition sources may be more likely to result in an accidental dwelling fire injury, with the majority of accidental dwelling fire injuries occurring around meal times. In comparison, Holborn et al (2003) noted that the number of domestic fire instances was relatively evenly distributed over the course of the day.

- The age and gender of individuals that might be injured in an accidental dwelling fire, with males (Taylor et al, 2022a), and those in the 50 to 64 age band being most at risk of an accidental dwelling fire injury.

- The effects of alcohol / drug consumption and tiredness on the likelihood of an accidental dwelling fire injury, with roughly 15% of accidental dwelling fire injuries involving the consumption of alcohol or drugs, similar to studies in the UK by Dean et al (2018), and Taylor et al (2022b), and roughly 6% involving the individual falling asleep.

- The majority of accidental dwelling fire injuries occurred in neighbourhoods with a high level of deprivation, similar to other previous studies in the UK (Hastie and Searle, 2016, Taylor et al, 2022a), and Sweden (Jonsson and Jaldell, 2020; Nilson, and Bonander, 2020).

A catastrophe theory view of accidental dwelling fire injury considers the individual circumstances associated with fire injury in contrast to an epidemiological transition theory approach which focuses on changes in overall patterns of fire incidence and injury and the interactions between such patterns and their demographic, economic and sociologic characteristics. In practical terms, further understanding of the circumstances associated with accidental dwelling fire injuries and the characteristics of those likely to be injured in an accidental dwelling fire via a catastrophe theory model can support more targeted fire prevention activities.

6. Conclusions

The originality of the research reported in this paper is the use of a catastrophe theory view of the circumstances under which accidental dwelling fire injuries occur relating to careless use of ignition sources such as cooking, heating, and other domestic appliances, smoker's materials and candles utilising statistical analysis of fire injury data from Merseyside Fire and Rescue Service over a two year period. Although all age groups may exhibit careless behaviour with regard to ignition sources, those aged 50 to 64 appeared to have been more frequently involved in accidental dwelling fires. Overall males were more likely than females to be injured in an accidental dwelling fire by a ratio of 1.68 to 1. A significant proportion (15.4%) of the accidental dwelling fire injuries involved the consumption of alcohol or drugs as a contributory factor, and 5.9% involved the individual falling asleep. Using a catastrophe theory view combined with statistical analysis although the individual behaviour of a person resulting in an accidental dwelling fire injury cannot be modelled, it is possible to statistically model the overall circumstances and behaviour of different groups of individuals injured over time. In this manner it is possible to ascertain those groups that are more vulnerable to accidental dwelling fire injuries, and those circumstances and behaviours relating to careless use of ignition sources that are more likely to lead to such fire injuries in order to inform fire prevention strategies. A limitation of the research undertaken concerned the data available, since data was available only for those domestic fire injuries where the fire was attended by the fire and rescue service concerned.

In terms of practical fire prevention, this research addressed accidental dwelling fire injury prevention by providing a catastrophe theory model combined with statistical analysis of the circumstances associated with such fire injuries using data over a two year period from Merseyside Fire and Rescue Service. The results indicate that further fire prevention targeting in terms of guidance and advice to the public regarding the avoidance of cooking, smoking, and candle use when under the influence of alcohol or drugs over when overly tired is important. Furthermore, for any individual it is important to never leave cooking, smoker's materials, candles, or certain types of heating sources for drying clothing unattended for even short period of time. Smoke and toxic fumes inhalation were the main type of fire injury in the period studied, and these can build up to a dangerous level within a dwelling in just minutes, if the householder is unaware that a domestic fire has started from unattended use of an ignition source.

This research has demonstrated that the circumstances of accidental dwelling fire injury recorded by a fire and rescue service can be analysed over time to identify patterns to examine when a catastrophic change relating to ordinary use of domestic objects results in an accidental dwelling fire injury. It is hoped that the approach used may be of benefit to other fire and rescue services in terms of understanding the circumstances associated with accidental dwelling fire injuries, in particular in terms of the conditions under which an accidental dwelling fire may start and does not go out by itself or is able to be put out by a householder resulting in a fire injury. Future research could be used to apply a catastrophe model to accidental dwelling fire injuries over longer time periods, using fire injury data from multiple fire and rescue services, and further analyze differences in circumstances that may lead to a higher likelihood of fire injury.

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