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An analysis of cooking fire injuries 2011 to 2022 in Merseyside UK

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ABSTRACT

In England, cooking fires are the most common type of accidental dwelling fire. In this article we examine cooking fire injuries over the period 2011 to 2022 in Merseyside in the North West region of England. Cooking fire injuries occurred at all times of day, however mainly such injuries occurred during evening meal time. Almost 30% of cooking fire injuries occurred overnight (between 10:00 p.m. and 7:00 a.m.). The risk of cooking fire injuries was present for all age groups, however this increased for those aged 75 and over, and increased further for those aged 85 and over. The greater the level of deprivation of an area, the higher the rate of cooking fire injuries. There was a strong correlation between the IMD decile (an English standard measure of deprivation) and the rate of cooking fire injuries per 100,000 population of 0.95. The use of a chip pan or deep fat fryer was associated with 35% of the cooking fire injuries over the period studied. The consumption of alcohol/drugs was a contributory factor in 17% of the cooking fire injuries over the time period studied.

1. Introduction

In England in 2021–2022 cooking appliances were responsible for 45% of accidental dwelling fires [1]. In the United States in 2021, fire departments responded to an estimated 170,000 home cooking fires. These cooking fires caused an estimated 135 deaths, 3,000 injuries and over \$494 million in property loss [2]. In the United States, cooking fires are the main cause of home fires and home fire injuries and unattended cooking is the leading factor in cooking fires and cooking fire casualties [3]. In European countries, cooking is identified as a common cause of fire, however, fatal residential fires are rarely caused by cooking [4]. Joint European Union fire statistics are not currently available, and fire statistics in many European countries are not publicly available [5].

Cooking methods and habits such as the use of larger amounts of fats or oils, and the cleanliness of cooking devices can affect the level of cooking fire risk [6,7]. In particular, cooking with large amounts of oil in a pan can increase the risk of a cooking fire [8]. UK fire and rescue services advocate only ever filling a pan one third full with oil, and recommend avoiding using traditional chip pans and using alternatives such as electric deep fat fryers which have a safety switch that cuts them off to stop them overheating and catching fire, or using other cooking methods instead [9–12].

Cooking fires can affect all age groups, however elderly people are at

the highest risk [13–15], and elderly people also account for more serious cooking fire injuries [16]. Contributory risk factors for cooking fire injury can include living alone, falling asleep [17], and consumption of alcohol [18]. There are both social and economic costs associated with accidental dwelling fire injuries [19]. In 2018, the estimated cost to the UK NHS for burns injuries was £20 million per year [20]. The estimated average NHS cost of burn care in 2020 was £16,924 per burn, ranging from £12,002 to £40,577 for a healed and unhealed wound, respectively [21]. Burns can be more likely to be fatal for elderly individuals [22]. Smoke inhalation injury can lead to respiratory complications in 73% of patients and acute respiratory distress syndrome (ARDS) in 20% of patients [22].

The research presented in this article concerns the detailed analysis of cooking fire injuries in Merseyside in the North West region of England during the period 2011 to 2022. Merseyside was chosen as the area for study as the authors had worked with Merseyside Fire and Rescue Service for a number of years previously. The period 2011 to 2022 was chosen since this provided the most up to date set of data over a reasonable time period for pattern and trend identification. In particular, the research examines cooking fire injury trends, the occurrence patterns of such injuries, the circumstances of such injuries, the demographics of those injured in cooking fires, and the contributory factors which may increase the likelihood of cooking fire injuries.

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2. Literature review

2.1. Cooking fire injuries

Typically, the majority of accidental dwelling fire injuries occur as a result of accidents involving cooking, smoking, the careless use of heating devices or candles [23]. Cooker top fires are typically the leading cause of injuries in cooking-related domestic fires [24]. Unattended cooking equipment was often the leading factor contributing to cooking fires in a study in Australia based upon analysis of 196 domestic fires [25]. Cooking fires can occur when combustibles (such as paper towels or tea towels) are placed too close to heat sources, through carelessness (such as spilling water into hot oil), or leaving cooking appliances on for too long or at too high a temperature leading to the burning of food, cooking oils or fats [25].

Some types of cooking activity, such as frying, broiling, and boiling, require continuous attention. Other types of cooking such as simmering, baking, or roasting, require at least regular attention by the householder. If a householder needed to leave the kitchen whilst cooking, it is important to take pans off the heat or turn them down to avoid fire risk [26]. In America between 2014 and 2018 two-thirds of home cooking fires began with the ignition of cooking materials, including food [3]. It is important to keep ovens, hobs and grills clean and in good working order. A build-up of fat and grease on cooking device surfaces can ignite a fire when cooking [26,27]. The placing of metallic objects in microwave ovens [6], the positioning of toasters near to curtains, and not emptying the toaster crumb tray regularly can also increase the risk of a cooking fire [7]. Placing flammable items (such as a tea towel) near a source of cooking heat such as a lit hob can also increase the risk of a cooking fire [27]. Cooking fires on kitchen hobs where the cooking layout is in proximity to an escape path may pose additional risk for householders based upon analysis of previous research [28,29]. Based upon experimental analysis, kitchen hob fires can be difficult to suppress, and without sufficient cooling, fires heated to auto-ignition that are suppressed can readily re-light, and can be particularly hazardous in terms of fire size and growth [30,31].

2.2. Cooking fire injury prevention

UK fire and rescue service provide guidance on the avoidance of cooking fires and associated injuries, and what to do when a cooking fire occurs [16,32,33]. Consumption of alcohol can be one of the main contributory factors to the likelihood of a cooking fire injury [34]. If an individual is very tired, has been drinking alcohol, or is taking medication that might make them drowsy, it would be safer not to risk cooking [35]. Recent increases in the cost of living may tempt individuals to utilise cheaper methods of cooking than a traditional oven [36]. Cooking fire risks may arise from bringing camping stoves or barbeques indoors [35]. This can not only increase risk of a cooking fire but also increase the risk of carbon monoxide poisoning [35].

Householders can utilise various forms of cooking fire prevention and suppression including stove guards [37], smoke alarms, fire blankets, and fire extinguishers [27]. For those with a hearing impairment, a smoke alarm which uses a strobe light and vibrating pads can be fitted. Elderly or mobility impaired individuals may not have the means nor the ability to reach smoke alarms, in such cases smoke alarm battery failure and unit replacement may be a factor in fire safety and fire prevention [38]. Smoke alarms may be less suitable for steamy, sometimes-smoky kitchens. As an alternative to a smoke alarm, a heat alarm can be installed that detects changes in temperature. Unlike smoke alarms, heat alarms would not typically be activated if for example, meat was seared, steam was generated from boiling, or toast was singed [35]. For elderly individuals who may experience memory problems, shut off devices can be fitted to stop the gas supply if the individual forgets to turn off the cooker. For those with more severe memory problems a special gas tap can be fitted that friends and family can turn off when they leave the

individual's home, known as a 'lockable cooker valve'. Such a device prevents cooking unless someone is with the individual with more severe memory problems [39].

Overall, although previous research has addressed fire injury prevention across the overall set of accidental dwelling fire types, there has been limited research specifically into cooking fire injury trends, patterns, circumstances, and risk factors.

3. Research method

Accidental dwelling fire injury data from the UK Fire Incident Recording System recorded by Merseyside Fire and Rescue Service during 2011–2022 and area deprivation data from the UK Office for National Statistics was analysed in order to answer the following research questions:

When do cooking fire injuries occur?

Who is most at risk of cooking fire injury?

What types of cooking activities are associated with cooking fire injuries?

What contributory factors are associated with cooking fire injuries?

These are important research questions since cooking fires are the most common type of accidental dwelling fires, and further insight into the nature and occurrence of cooking fire injuries can assist in enhancing fire injury prevention approaches. Cooking fire injuries in Merseyside were identified from the UK Fire Incident Recording System from the Ignition Source variable categories that related to cooking devices. The statistical analysis techniques used for the research included frequency analysis, correlational analysis, percentages, and ratios. The software used for the statistical analysis undertaken was Microsoft Excel.

Investigation of accidental dwelling fires and analyses of the characteristics of such fires and how they occur can provide information that may be useful for fire prevention [40]. The analysis conducted for the research reported was undertaken by examining the different circumstances recorded for cooking fire injuries, during the period 2011 to 2022 in Merseyside. The analysis included the overall patterns of accidental dwelling fire injuries, and cooking fire injuries over the period studied, and analyses of the distribution of cooking fire injuries by time of day, age band, sex, and level of deprivation. Also, the types of cooking activities associated with the recorded cooking fire injuries and contributory factors associated with the recorded cooking fire injuries were examined. The research approach adopted was to firstly examine the trend in cooking fire injuries in Merseyside over the period studied, and to compare this with the trend in overall accidental dwelling fires in Merseyside, and in England as a whole. Analysis of patterns in the time of day of cooking fire injuries was then undertaken, in order to understand when cooking fire injuries are more likely to occur. Analysis of cooking fire injuries by age band and sex was then undertaken, and this was contextualised by examining the rates per 100,000 population of cooking fire injuries in Merseyside amongst sexes and age bands. The relationship between deprivation and cooking fire injury was examined via the use of rates per 100,000 of population in the different IMD decile areas within Merseyside. IMD decile 1 represents the most deprived areas, and IMD decile 10 represents the least deprived areas in England [41]. Analysis was then undertaken of the most common types of cooking activity associated with cooking fire injuries over the period studied. Finally, contributory factors including alcohol/drug consumption and tiredness were examined in relation to cooking fire injuries over the period studied.

The originality of the research presented is the detailed analysis of cooking fire injuries recorded by an English fire and rescue service over the period 2011 to 2022 in terms of trends within such injuries, the occurrence of such injuries, those most at risk of such injuries, and the contributory factors which may increase the risk of such injuries.

4. Cooking fire injury analysis

4.1. Cooking fire injury occurrence

In England over the period 2011 to 2022 there were 82,073 non-fatal accidental dwelling fire injuries as shown in Fig. 1. There was a 32.7% decrease in the number of non-fatal accidental dwelling fire injuries over the period 2011 to 2022 in England.

In Merseyside between 2011 and 2022 there were 1041 non-fatal accidental dwelling fire injuries, distributed across the time period as shown in Fig. 2. There was a 47.9% decrease in the number of non-fatal accidental dwelling fire injuries in Merseyside over the period studied.

During 2011 to 2022 in Merseyside there were 523 non-fatal cooking fire injuries which constituted 50.24% of the non-fatal accidental dwelling fire injuries over the period studied. During the period 2011 to 2021 in Merseyside there were 11 fatalities due to cooking fires, which constituted 16.7% of the accidental dwelling fire fatalities during the period.

Cooking was the main activity associated with accidental dwelling fire injury over the period studied. Smoking was associated with 145 (13.93%) fire injuries over the period studied, candle use with 84 (8.07%) fire injuries, and heating appliance use with 61 (5.86%) fire injuries. There was a 55.7% decrease in the number of cooking fire injuries in Merseyside over the period studied.

In terms of the types of cooking fire injuries sustained by householders over the period studied, being overcome by gas, smoke and toxic fumes was the most common (44.36%) followed by breathing difficulties (17.97%), slight burns (10.90%), severe burns (3.63%), and combination of burns and overcome by gas/smoke (2.68%).

Of the 523 cooking fire injuries in total, 477 were classed as slight injuries, and 46 were classed as serious injuries. Of the 46 serious cooking fire injuries, 23 concerned being overcome by gas, smoke and toxic fumes, 17 were burns, 1 was a combination of burns and overcome by gas/smoke, 1 was breathing difficulties, and the remainder (4) were other injuries.

Cooking fire injuries occurred at all times of day over the period studied as shown in Fig. 3. Mainly such injuries occurred during evening meal time (5:00 p.m. to 8:00 p.m.). There were 203 (38.8%) cooking fire injuries during this time period. However, there were 153 (29.3%) cooking fire injuries overnight (between 10:00 p.m. and 7:00 a.m.).

4.2. Cooking fire injury demographics

Fig. 4 shows the cooking fire injuries per 100,000 population by age band and sex in Merseyside between 2011 and 2022. Cooking fire injuries were present for all age groups and sexes, however the rate of cooking fire injuries increased for those aged 75 and over, and increased further for those aged 85 and over.

Fig. 5 indicated that the rate of cooking fire injury in Merseyside was roughly similar for males and females (39.32 per 100,000 of male

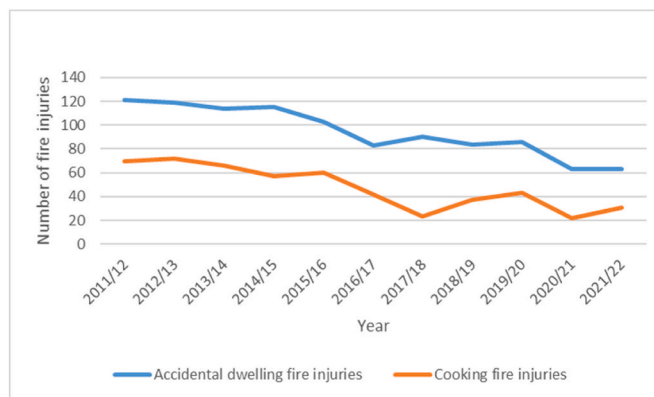


Fig. 2. Overall accidental dwelling fire injuries and cooking fire injuries in Merseyside 2011 to 2022.

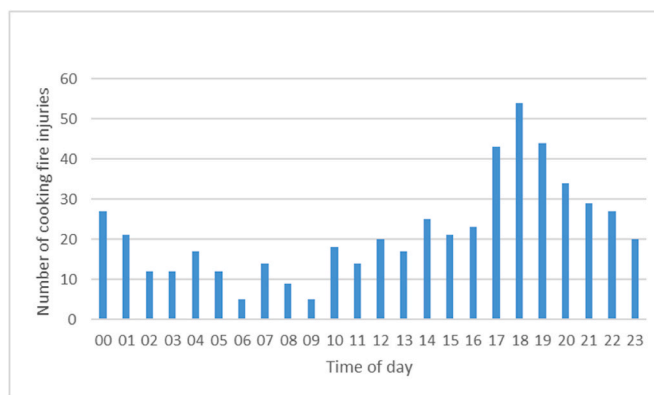


Fig. 3. Cooking fire injuries by time of day in Merseyside 2011 to 2022.

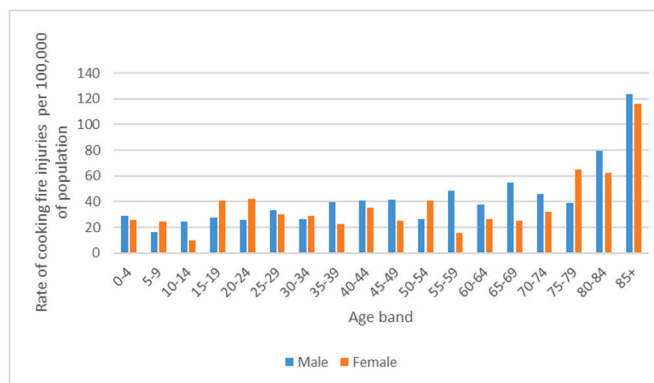


Fig. 4. Cooking fire injuries per 100,000 population by age band and sex in Merseyside 2011 to 2022.

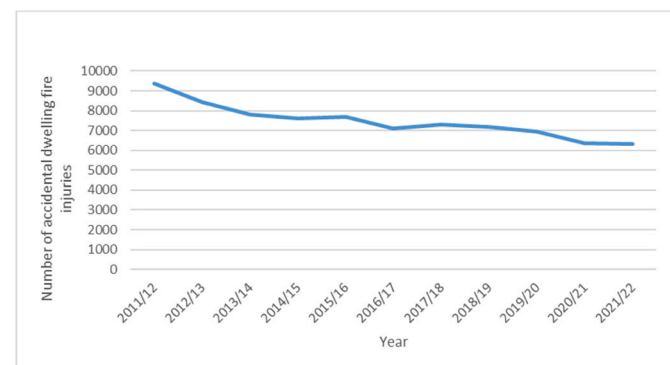


Fig. 1. Accidental dwelling fire injuries in England 2011 to 2022.

population compared to 33.72 per 100,000 of female population) over the period studied. The ratio of the rate of male cooking fire injuries to the rate of female cooking fire injuries was 1.17 to 1. The Chi-square value for the frequency analysis of male and female cooking fire injuries was 1.608 with a p-value of 0.205 meaning that the difference in the frequency of male and female cooking fire injuries was not statistically significant.

Fig. 6 shows that the greater the level of deprivation, the higher the rate of cooking fire injuries in Merseyside over the period studied. The number of injuries assigned to each IMD decile was determined by the address of the cooking fire incident being matched with the IMD rating for the area in which the address resides. The rate per 100,000 of

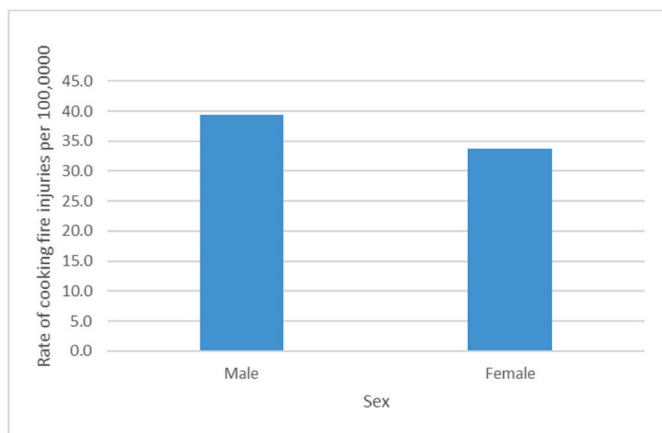


Fig. 5. Cooking fire injuries per 100,000 population in Merseyside 2011 to 2022 by sex.

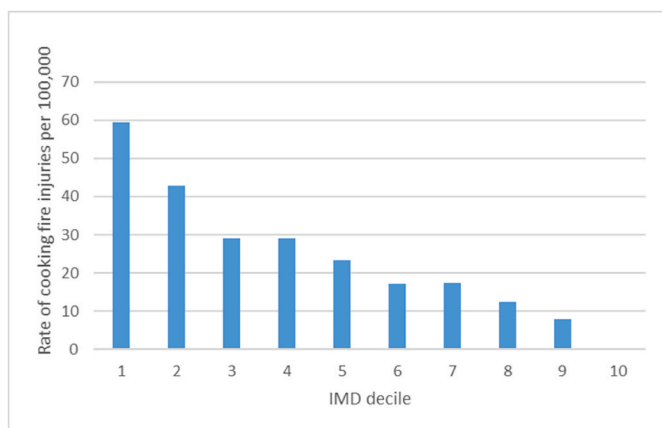


Fig. 6. Cooking fire injuries per 100,000 population in Merseyside 2011 to 2022 by IMD decile.

population living in an IMD decile was used in order to understand how deprivation related to fire injury rates. IMD deciles are calculated by ranking the 32,844 Lower Super Output Areas in England from most deprived to least deprived and dividing them into 10 equal groups [41]. IMD decile 1 represents the most deprived areas, and IMD decile 10 represents the least deprived areas. Lower Super Output Areas are geographic areas in England with a minimum population of 1000 and a mean population of 1500 [42]. There was a strong correlation between the IMD decile and the rate of cooking fire injuries per 100,000 population in Merseyside of 0.95 with a significance level of 0.009. Figs. 4 and 6 clearly indicate that cooking fire injuries are a societal problem and one related to age and deprivation, that is related to the vulnerable in the population.

4.3. Types of cooking activities associated with cooking fire injuries

Fig. 7 shows that the majority of the cooking fire injuries were associated with the use of a cooker, or chip pan, with smaller numbers of fire injuries associated with other cooking appliances such as ring/hot plate, grill/toaster or microwave oven. Fig. 7 shows the total number of each type of appliance that was involved in a cooking fire injury over the period studied.

The use of a chip pan or deep fat fryer was associated with 184 (35.18%) of the cooking fire injuries over the period studied. Chip pan or deep fat fryer cooking fire injuries occurred across all the different age bands during the study period. There was an overall decrease in the

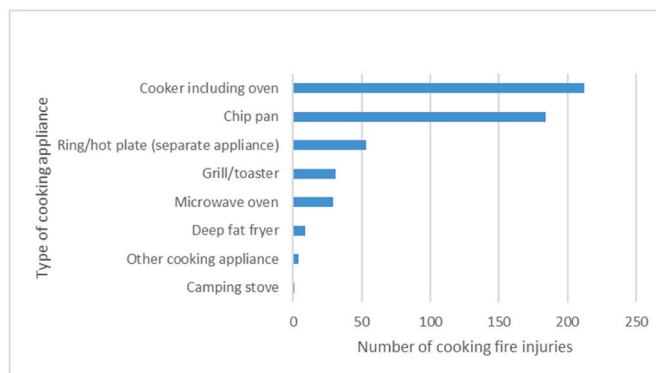


Fig. 7. Types of cooking appliances associated with cooking fire injuries in Merseyside 2011 to 2022.

numbers of chip pan/deep fat fryer fire injuries over the period studied as shown in Fig. 8. There were smoke alarms present at 412 (78.8%) of the cooking fire injury incidents over the period studied, and the smoke alarm was activated in 341 (82.8%) of these instances.

4.4. Cooking fire injury contributory factors

The main contributory factors associated with cooking fire injury over the period studied were the consumption of alcohol/drugs, and tiredness as shown in Fig. 9. Males were more likely to have been affected by alcohol/drugs in relation to a cooking fire injury than females by a ratio of 2 to 1 in terms of actual numbers of injuries (60 male alcohol/drugs related cooking fire injuries to 30 female alcohol/drugs related cooking fire injuries). The percentage of the overall number of cooking fire injuries in which alcohol/drugs was a contributory factor was 17.2% over the time period studied.

Cooking fire injuries associated with alcohol/drug consumption occurred at all times of day over the period studied. Mainly alcohol/drug related cooking fire injuries occurred overnight (between 10:00 p.m. and 7:00 a.m.) (45.56%) or during evening meal time (5:00 p.m. to 8:00 p.m.) (16.67%). In addition to the above contributory factors associated with cooking fire injuries, there were 57 male cooking fire injuries and 37 female cooking fire injuries (giving a ratio of 1.54 to 1) associated with householders attempting to fight the cooking fire over the period studied.

Fig. 10 shows the cooking fire injuries sustained attempting to fight the cooking fire by sex per 100,000 population in Merseyside during 2011–2022. In terms of the recording of circumstances (including contributory factors) of cooking fire injuries over the period studied, only one main circumstance was recorded per fire injury. Overall, it

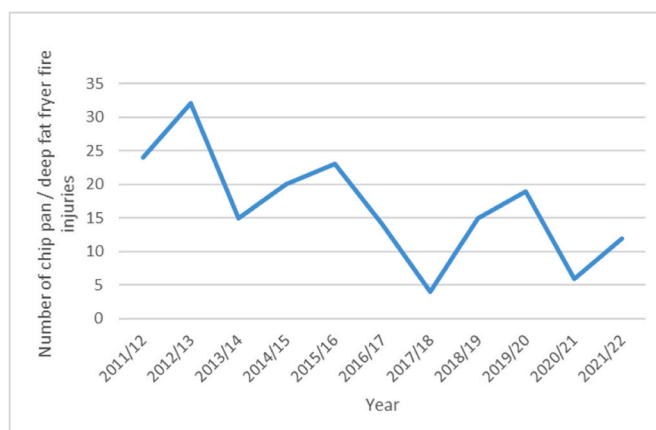


Fig. 8. Chip pan/deep fat fryer fire injuries in Merseyside 2011 to 2022.

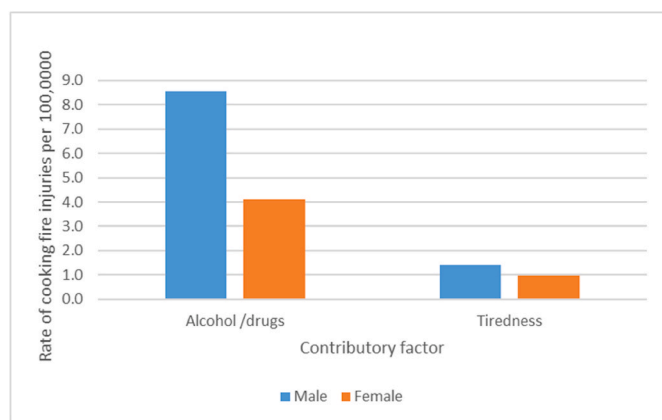


Fig. 9. Cooking fire injuries per 100,000 population in Merseyside 2011 to 2022 by contributory factor.

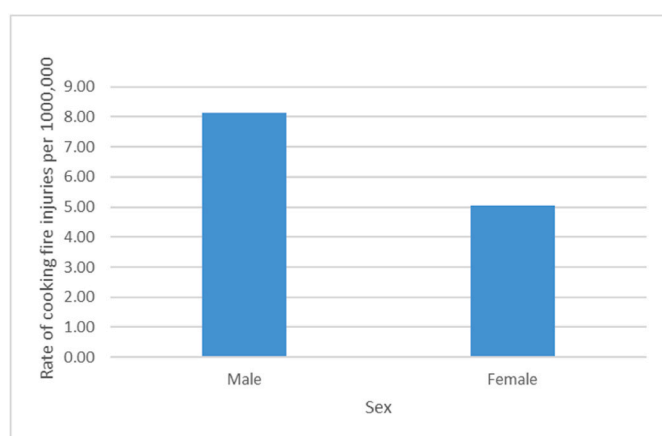


Fig. 10. Cooking fire injuries sustained attempting to fight the fire by sex per 100,000 population in Merseyside 2011 to 2022.

appeared that riskier behaviours such as alcohol consumption whilst cooking, and attempting to fight the fire were more likely for males than females, which might contribute to the slightly higher rate of cooking fire injuries for males than females over the period studied.

5. Limitations

A limitation of the research undertaken was the potential generalizability of the analysis to other fire and rescue services, as Merseyside contains some of the most deprived areas in England. Another limitation of the research was that the fire and rescue service concerned could only record cooking fire injuries when they were called to attend. If a householder in Merseyside was injured in a cooking fire, and the fire and rescue service was not called to attend, for example, if the fire was extinguished by a householder, then such a cooking fire injury would not be recorded in the Fire Incidence Recording System. A further limitation concerned the lack of data regarding whether the injured person was the sole inhabitant of the property. Not having this kind of data can impact the fire safety messaging that a fire and rescue service can provide to the public.

The research was further limited in terms of the analysis being based solely upon the available data, when there may be other aspects that could be the reason for the differences observed. For example the findings that cooking fires are more frequent among males, and that males also tend to be more frequent in terms of alcohol consumption relating to cooking fire injury may have underlying factors. Similarly there might be underlying factors in the finding that males appeared more likely to

fight a cooking fire compared to females, with or without alcohol consumption. The concern is related to just looking at the statistics available, when there can be problems with confounders, that is underlying factors that are not included but may be the governing ones. For example, living alone, which was not available in the recorded data might be an important factor in terms of who might fight a cooking fire in a household containing more than one person, or with regard to cooking fire injury relating to alcohol consumption, as not all the residents in a household might have consumed alcohol.

6. Conclusion

The implications of the research results for fire injury prevention include the higher level of cooking fire risk for those aged 75 and over and the higher rate of cooking fire injuries in areas with higher levels of deprivation, which can assist in the targeting of cooking fire prevention initiatives. In addition, it is important to strengthen fire prevention messages relating to cooking activities, especially in relation to the use of chip pans. This is particularly important for those aged 75 and over, since it is this age group that is most at risk of cooking fire injury. With regard to the benefit and effectiveness of providing fire prevention information to the elderly, this can only be assessed over time. Merseyside Fire and Rescue Service had targeted fire prevention to the elderly over the period studied and the overall rate of accidental dwelling fire injuries amongst this group had decreased. Furthermore, fire prevention messages for householders regarding consumption of alcohol before or during cooking, or not cooking when overly tired are important in order to reduce the risk of a cooking fire injury.

Overall, it appeared that the number of non-fatal cooking fire injuries in Merseyside decreased over the period studied by 55.7%, compared to a 47.9% decrease in the overall number of non-fatal accidental dwelling fire injuries in Merseyside. The decrease in the overall number of non-fatal accidental dwelling fire injuries in England over the same period was 32.7%. This would appear to indicate that Merseyside Fire and Rescue Service had effective fire prevention strategies in place over the period studied. Evening meal time (between 5:00 p.m. to 8:00 p.m.) had the largest incidence of cooking fire injuries over the period studied, however, 29.3% of cooking fire injuries occurred overnight (between 10:00 p.m. and 7:00 a.m.) when tiredness may have been a contributory factor. In terms of further targeting fire prevention with regards to cooking fires and associated injuries, the over 75s, those more likely to consume alcohol, and those living in higher levels of deprivation appeared to be the groups most at risk of domestic cooking fire injury. Overall riskier behaviours such as alcohol consumption whilst cooking, and attempting to fight the fire were more likely for males than females, which might have contributed to the slightly higher rate of cooking fire injuries for males than females over the period studied.

The research presented provides an initial study of cooking fires injuries, and further future studies could be conducted in order to determine if the reported trends and patterns of cooking fire injuries are generalisable, which could aid the identification of the most significant factors on a wider basis. It is hoped that the results of this research may be of use to other fire and rescue services in terms of informing fire prevention and fire injury prevention activities with regard to cooking fires, which are typically the most common type of accidental dwelling fire.

Statement and declaration

Ethical approval was not required for the research reported in this article since no personal data was involved. There was no funding allocated for this research. There was no conflict of interest regarding the research. The data used is available upon request.

Author statement

The authors have no competing interests to declare.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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