

Paper

# Electrical Fatalities in Northern Ireland

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## SUMMARY

A review of autopsy reports in cases of electrocution in Northern Ireland revealed that there were 50 accidental electrocutions and 9 suicidal electrocutions over a 22 year period (1982 – 2003). No cases of homicidal electrocution were detected in this jurisdiction. Analysis of the cohort of accidental electrocutions showed that there was a clear skew towards young and middle-aged male adults with deaths occurring more frequently in the summer months. Almost 60% of individuals were engaged in occupational tasks when they were accidentally electrocuted. High and low voltage-related deaths occurred with similar frequency and electrical appliances were found to be responsible for approximately one third of accidental electrocutions. The potential hazards of electricity must continue to be stressed in public safety campaigns if these relatively uncommon but tragic deaths are to be prevented.

## INTRODUCTION

Given the widespread use of electricity, it is perhaps surprising that fatalities related to its use are not more common. Extensive legislation to ensure electrical safety, both in the home and at work, has almost certainly limited the potential for harm in developed countries. Nevertheless, it is estimated that about 1500 electrical-related deaths occur annually in the United States<sup>1</sup> with an average of one death occurring every day in the workplace<sup>2</sup>. Provisional data from The Royal Society for the Prevention of Accidents indicates that there were 27 deaths involving electric current in the United Kingdom in 2002<sup>3</sup>, however this figure probably represents an underestimate of the actual number killed. Electrocution ranks in the top five occupational killers in the United States<sup>2</sup>. Statistics from the National Institute of Occupational Safety and Health show that although the number of electrical incidents is relatively small, there is a disproportionate fatality rate<sup>4</sup>.

## MATERIALS & METHODS

This study examines electrical fatalities which occurred in Northern Ireland over a 22 year period (1982 – 2003) using retrospective review of autopsy reports at the Northern Ireland State Pathologist's Department. Pathologists at the department undertake post-mortem examinations in almost all cases of sudden unnatural death instructed by Coroners in the province.

The search term 'electrocution' was entered into the electronic register of the State Pathologist's Department. Following case ascertainment, the author reviewed the autopsy report

for each fatality and the relevant details were entered into a printed pro-forma.

The average annual incidence of accidental and suicidal deaths was calculated on the basis of historical population data for the study period, available from the Northern Ireland Statistics and Research Agency ([www.nisra.gov.uk](http://www.nisra.gov.uk)). The average population for the region during 1982 – 2003 inclusive was 1,625,682.

## RESULTS

Fifty-nine cases of electrocution were identified in Northern Ireland in a 22 year period from January 1, 1982 to December 31, 2003. It is common practise for the examining pathologist to enter his opinion as to the manner of death into the register. This had occurred in most instances; in any case the nature of the death was generally obvious from the circumstances described. Of the 59 deaths, 50 were accidental and 9 were suicides. No cases of homicide were encountered. The suicidal electrocutions were subject to separate analysis.

## ACCIDENTAL DEATHS

In most years there were two or three fatalities. In two years there were four deaths per annum and in four years there was only one death per annum. No cases were recorded in 1992 (figure 1). The average annual incidence of accidental electrocutions was 0.14 cases per 100,000 population per year. The victims of electrocution were overwhelmingly male (94%) with only three female fatalities encountered. There was a peak of cases in the summer months of the study period with nine deaths occurring in the month of July. Only one case occurred in the month of January (figure 2). The age range of the victims was 17 months to 80 years however there was a clear skew towards young and middle-aged adults (figure 3). The 17 month-old victim was the only young child identified in the cohort. This child was electrocuted by the live metal structure of a caravan, which had not been earthed. The oldest victim, an 80 year-old man, was in the process of recharging a car battery when he died. It would appear that he might have touched the live crocodile clips of the charging apparatus.

Fifty-eight percent of cases occurred outdoors, in various

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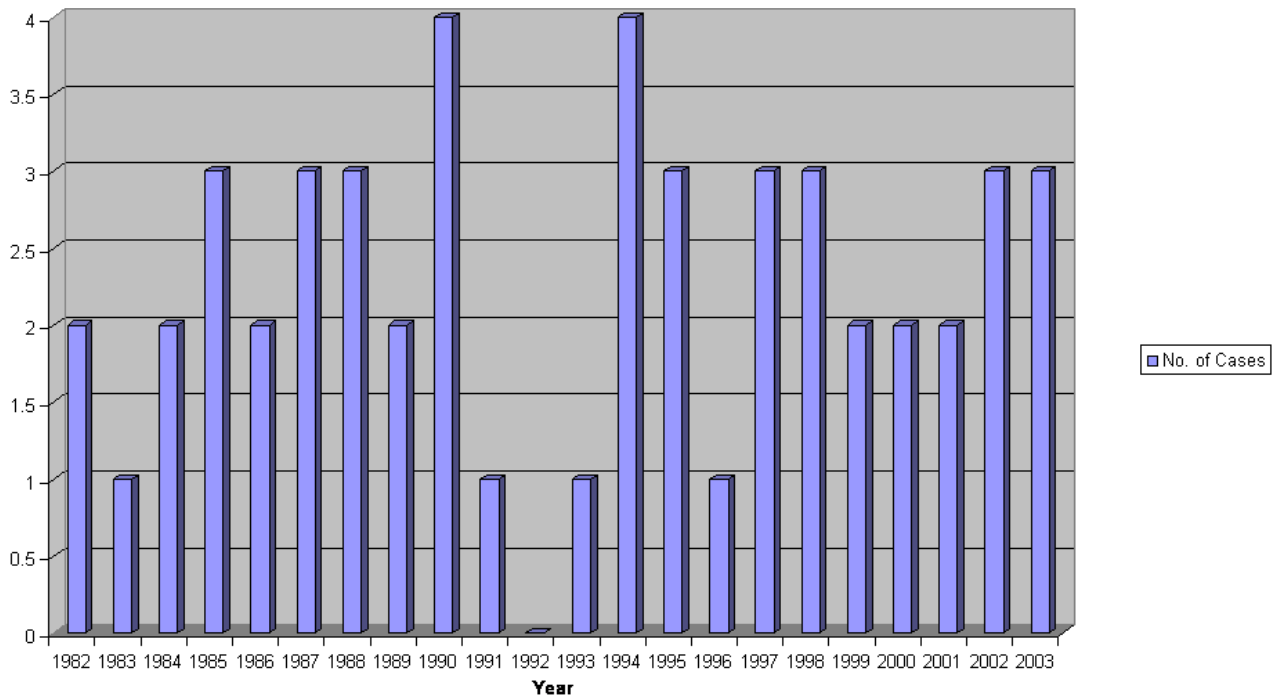


Fig 1. Fatal accidents per year

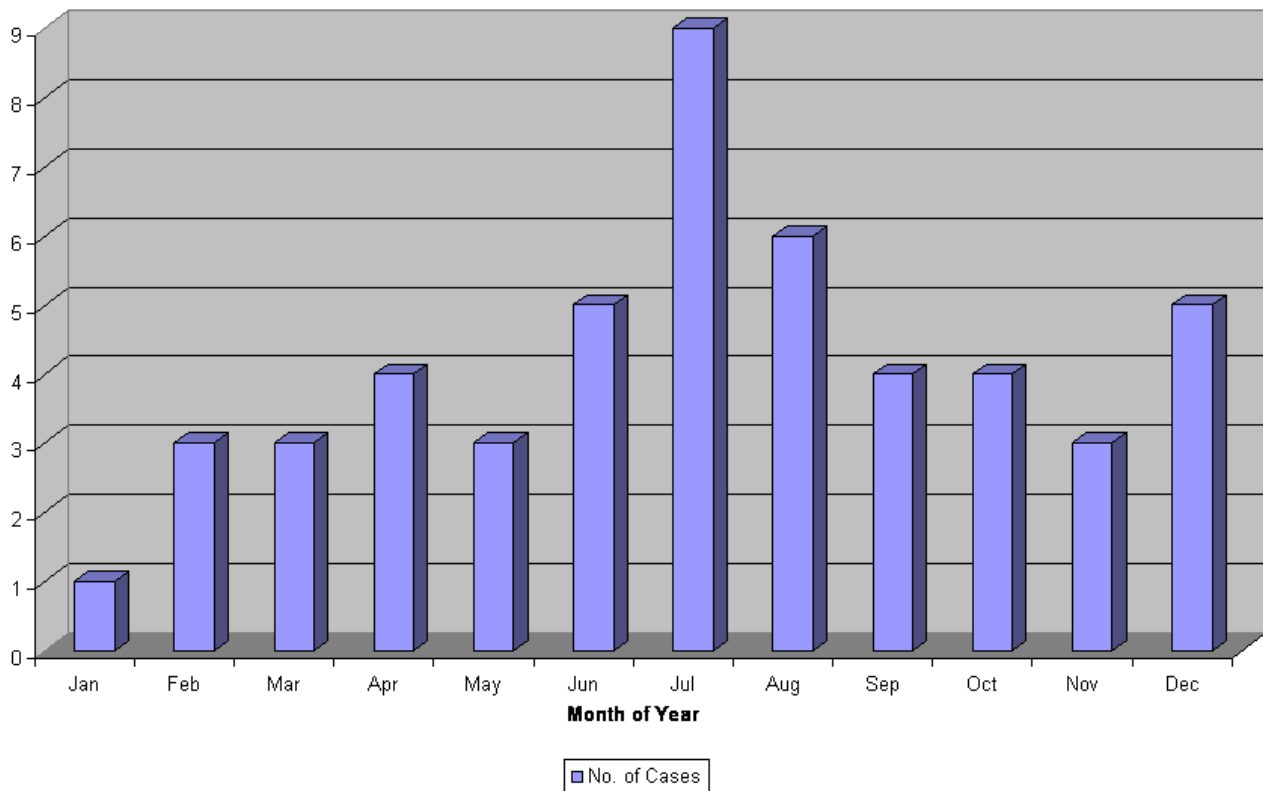


Fig 2. Case distribution by month

locations at home and in the workplace. Occupation-associated fatalities were identified in 58% of cases whilst 38% occurred in the domestic setting. In one case it was not clear whether the victim was engaged in DIY or occupational tasks. Another case was classified as para-occupational as the victim was a customer who was electrocuted at a business

premises (figure 4). There were six farming-related deaths: four of these involved an electrical appliance (two cases involving electric sheep-shears, one case involving a chainsaw and in another an electric heating lamp). In two of the farming deaths, electrified cattle wire was being manipulated when it appeared to make contact with overhead cables. Six

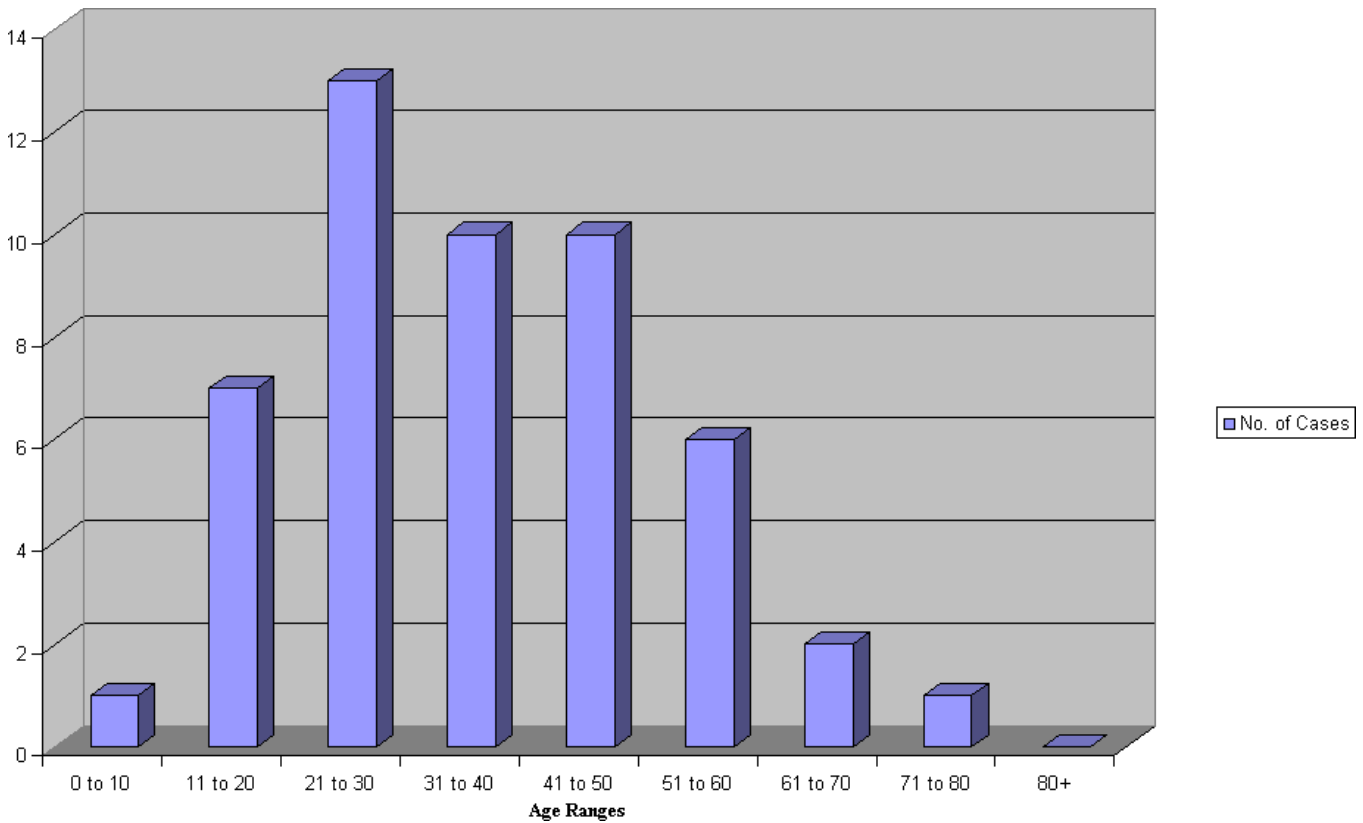


Fig 3. Age categories of accidental deaths

of the victims were electricians or electrical engineers; five of these deaths were clearly occupation-related. It would seem that in most instances, the electrician was not aware that the circuit was live, either through his own carelessness or due to that of others. One of the engineers failed to follow standard safety procedures and was electrocuted whilst working on high voltage wires.

The magnitude of the voltage involved was classified as high voltage (>1000 V) in 44% and low voltage (<1000 V) in 52% of cases. The voltage magnitude was not known or specified in 4% of cases (figure 5). Most of the high voltage cases (20 of 21) occurred in association with overhead cables whilst the individual was at work. These fatalities were sub-classified according to the object making contact with high-tension wires (table I). In several cases, there was no clear evidence that contact had been made with the overhead line and the possibility of arcing (dielectric breakdown) was considered.

Faulty electrical appliances were deemed responsible for electrocution in 32% of cases. The defective appliance varied with no one specific type of equipment emerging as a particular problem. Examples included white goods (cooker, washing machine and spin dryer), extension cables, power hoses and DIY equipment (drill, chain-saw, arc-welders), a television and video recorder, and a combined hand washing/ drying machine. A recurring finding was the presence of perished cable where exposed live wires had often been repaired with insulation tape. Some appliances were incorrectly wired at the plug with the earth wire loose or not connected and touching the live terminal.

Blood alcohol determinations were carried out in almost

every case. Two cases were positive and in these instances the deceased was at least moderately intoxicated at the time of death (247 and 206 mg of alcohol per 100 ml respectively). A drug screen was performed in only three of the fifty cases, revealing a cannabis metabolite in the blood of one individual.

Apart from electrical marks, no other serious injuries were encountered although resuscitation injuries and trivial ‘collapse’ marks were very common. None of the victims appeared to have suffered significant bony injury as a result of the electric shock.

TABLE I:

<b>Contact with overhead electricity cables (cases):</b>	
Directly with the body	1
Crane or Hoist	7
Tipper truck/ other vehicle	6
CB aerial	1
Wire fencing	2
Steel lamppost	1
Football post	1
Other (tree branch)	1
<b>Total</b>	<b>20</b>

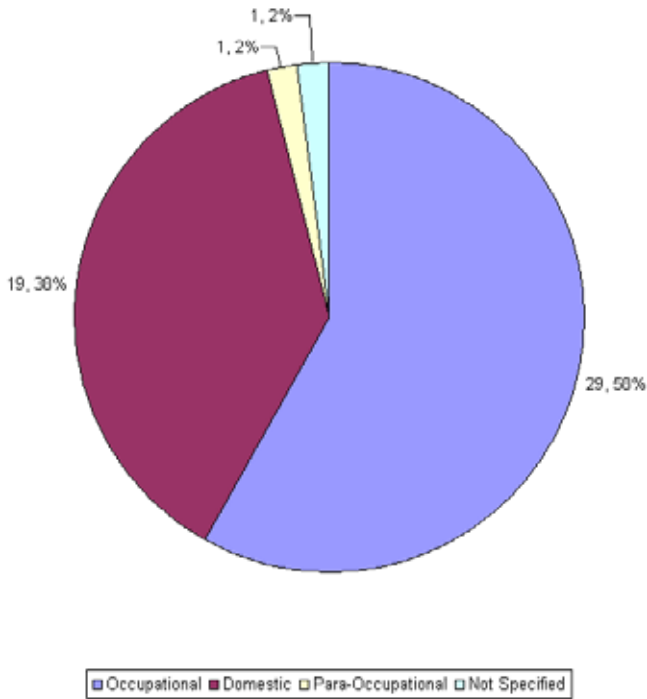


Fig 4. Nature of fatal accidental electrocutions

Recognisable electric marks were detected in 94% of cases and these commonly affected more than one site (figures 6 - 8).

### SUICIDAL ELECTROCUTIONS

The average annual incidence of suicidal electrocutions was 0.025 cases per 100,000 population per year. The victims ranged in age from 22 to 81 years old. Eight of the nine were male. All had used the domestic electricity supply, usually by removing the insulating sleeving of electrical flex so as to expose the wires. In six cases the exposed wires had been wound around both wrists; in two cases the wires had been attached to the chest in some way and one victim was found dead in the bath with an electric heater in the water. Eight of the deaths occurred at home in various rooms. One electrocution occurred in a hospital side room. This was the only case of delayed death following electrocution in either the accident or suicide group. He died from bronchopneumonia secondary to cerebral anoxia about three weeks after the electric shock. Electric marks were present in all cases except for the victim who died in the bath. Blood alcohol concentrations (BAC) were determined in eight cases and were positive in five of these. In three instances the victim was moderately intoxicated at the time of death but in two cases the BAC was less than 80 mg per 100 ml and had possibly accumulated in the post-mortem interval due to the effects of decomposition. In eight of the nine cases there was a documented history of depression and two victims had attempted suicide in the past (although neither had utilised electricity before). No psychotic illnesses were described in any of the victims. The only individual without a history of depression was the eldest of the group, a semi-retired electrician.

### DISCUSSION

The results of this study were broadly similar to those

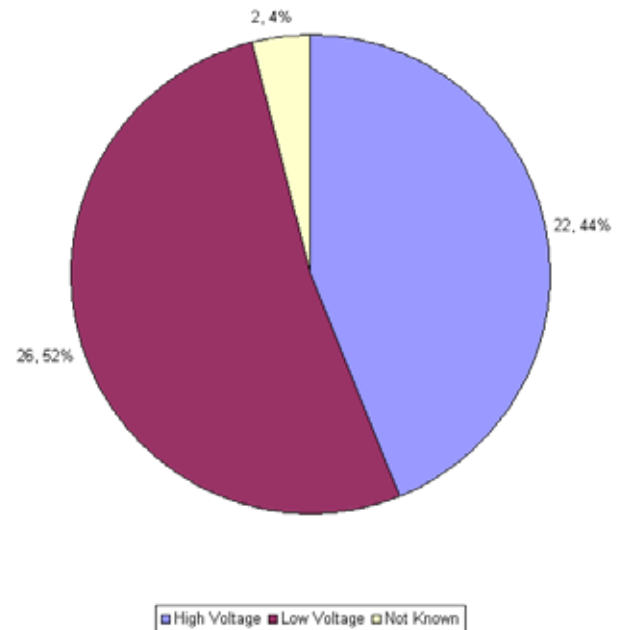


Fig 5. Type of voltage in fatal accidental electrocutions

previously published, showing that accidental deaths form the greatest proportion of cases<sup>5-8</sup>. In common with the published reports, suicides are relatively uncommon and homicides extremely rare. Overall case numbers were comparable with the Adelaide study<sup>5</sup> but significantly lower than the rate of fatal accidental electrocutions in Florida<sup>6</sup>. Electrocution is overwhelmingly seen in young and middle-aged males, probably a reflection of the fact that men are more commonly employed in industries at risk from electricity and are more likely to undertake home or garden improvement, or 'DIY'. Most studies have shown a preponderance of low-voltage related deaths, apart from one study from the Armed Forces Institute of Pathology in the United States<sup>7</sup>. This study was restricted to serving members of the armed forces. Published data reflects a higher incidence of fatal cases in the summer months, possibly as a result of increased humidity and the lower resistance of moist skin but other behavioural factors may be involved<sup>8</sup>.

Suicidal electrocutions are relatively rare<sup>9-11</sup>. Only two of two hundred and twenty victims in Florida had used electricity to commit suicide<sup>6</sup>. Twenty-eight deaths were attributed to suicide in Australia, representing 29% of the total number of electrocutions over a thirty-year period<sup>5</sup>. In the latter study, eight victims had committed suicide immersed in the bath and eleven had wrapped electrical wires around various parts of the body. In Northern Ireland, just one suicide had used the bath.

Like other forms of 'violent' suicide, this method showed a strong male bias. There was a history of depression in all but one case - surprisingly there was no definite indication of psychotic illness in any of the victims. Electrical timers were not used by any of the victims during the study period although they have been reported in the literature<sup>5</sup>. Interestingly, the risk to individuals discovering the dead body was highlighted in a number of instances when family members or medical personnel received a shock after touching



*Fig 6.* An electric mark at the base of the right thumb. The lesion consists of a ruptured blister with a scorched base and a bordering zone of hyperaemia.



*Fig 7.* An 'earthing' or 'grounding' lesion on the great toe of the right foot, indicating the point of exit of the electric current. This is the same case as illustrated in Figure 6 - an occupational fatality caused by contact with overhead power lines.

the body, although none of these secondary shocks were fatal. Diagnosis of electrocution was straightforward in most cases, the majority of victims sustaining typical electric marks subjacent to the live wires. The death in the bath showed no such signs however, due to the dispersion of electricity across the body surface.

It is perhaps surprising that electricity is not utilised more frequently as a means to commit suicide. It is almost universally available to most homes in the developed world and must be considered, like hanging, to have a high success rate. One possible explanation might be that many people have had an unpleasant experience with electricity, such as a painful shock, in the past. Another explanation may be that electrocution is inextricably linked to judicial execution, to 'death row' and to the notorious electric chair. The marked differences in suicidal electrocution cases in published literature from the United States, where judicial electrocution is still used and from other parts of the world where it is not, provides some supportive evidence for this



*Fig 8.* An extremely subtle electric mark on the index finger, highlighting the need for careful examination of individuals who have sustained an electric shock.

theory. The situation is somewhat analogous to the increase in suicidal hangings in Britain since the abolition of capital punishment<sup>12</sup>. One can only speculate as to the reasons why the nine individuals in this study had used electricity to commit suicide, as opposed to the thousands who had chosen hanging, poisoning, drowning or some other technique during this period. Only one victim, an electrician, could have been expected to have above-average knowledge of electric circuitry.

Homicidal electrocutions are vanishingly rare; none were detected in this jurisdiction during the study period. Sporadic case reports have appeared in the literature<sup>13</sup> and three cases were recounted by Saukko and Knight<sup>14</sup>. It has been suggested that the cited rates of homicidal electrocutions are possibly an underestimate of the true numbers as it may be difficult to distinguish the manner of death in certain circumstances, such as when the victim is found dead in the bath with an electrical appliance in the water<sup>5</sup>. This reinforces the importance of a thorough scene investigation in all cases.

### **DIELECTRIC BREAKDOWN**

The phenomenon of arcing or dielectric breakdown is well recognised as occurring. The higher the voltage, the greater distance over which arcing can take place. Chandrasiri described a fatal case where electrocution had occurred without the victim touching the live conductor<sup>15</sup>. In this instance it was found that there was about a one-metre gap between an aluminium staff, which the victim was holding, and overhead power lines. According to this author, when voltages are of the order of 33 000 V, the sparking gap could be as large as 50cm. The Northern Ireland study indicated that dielectric breakdown fatalities were considered in several cases.

The most extreme form of dielectric breakdown occurs with lightning strikes. Fatalities are extremely uncommon in temperate regions however a number of deaths occur each year in warmer climates such as in the Southern United States<sup>16</sup>. No lightning deaths were described in Northern Ireland during the study period however one case occurred in 2006. This involved a young man who was walking in

the Mountains of Mourne, County Down. His body was discovered at the top of Slieve Donard, the highest mountain in this region. A thunderstorm was reported that morning. At autopsy there were fairly extensive cutaneous burns as well as defects in his all-weather clothing, typical of those due to high-voltage electrocution. Classical Lichtenberg figures (arborescent marks) were not observed.

### CONCLUSIONS

Many of the accidental electrocutions occurring during the study period were readily preventable. Public safety organisations, government and industry must continue to promote electrical safety in the home and at work. Despite the readily available supply of electricity, suicidal electrocutions remain relatively rare.

The author has no conflict of interest.

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