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AN OBSERVATION STUDY OF DEATH OCCURRED FROM ELECTROCUTION IN RURAL AREAS IN LUCKNOW, UP

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Abstract

Introduction: Direct electrical shock can cause electrocution, which can cause burns or organ failure. Contact with live parts, power lines, machinery, and ignorance are common causes. Safety awareness, especially in rural regions, is needed because electrical burns kill. In emerging nations, poor infrastructure and education increase danger. Electrocution in remote areas requires analysis for personalised prevention, infrastructure improvement, resource allocation, and healthcare access, addressing this multifaceted public health issue.

Aim and objectives: This study examines electrocution deaths in rural Lucknow, Uttar Pradesh. The goal is to understand these situations and establish prevention measures.

Method: A retrospective study from October 2018 to September 2019examined 50 cases of electrical burn deaths at the Forensic and Toxicology Department, Hind Institute of Medical Sciences, Mau, Sitapur,Lucknow, (U.P.). The research delved into epidemiological and medico-legal aspects using data from autopsy reports, hospital files, and investigative reports. Factors studied included age, gender, shock type, body part affected, accident location, and potential risk factors. Inclusion criteria covered consenting adults with complete data, while exclusion criteria involved inconsistent information or uncooperative guardians. Researchers, including university students and trained investigators, evaluated data daily.

Result: Table 1 shows that 76% of 50 instances were accidents, highlighting unintended deaths. Table 2 shows that 60% of cases contain entry burn marks, illustrating burn injury patterns. Table 4 shows that electrical wires (24%) and stoves (18%) cause electrocutions, emphasising the need for electrical safety awareness. The gendered dataset in Figure 1 shows 78% male incidences, requiring more examination. Warmer months have more occurrences, as shown in Figure 2. Upper extremity injuries account for 61% of injuries (Figure 3).

Conclusion: The study concludes that there is more males who was affected with electrocution and eventually died and there is more work-related electrocution.

Keywords: electrocution, rural areas, burn injury, death

Introduction

Electrocution epitomizes a grave consequence arising from direct exposure to an electrical shock. This perilous occurrence emerges when an individual encounters an electrically charged source, be it a live wire or an electrical device, thereby allowing the surge of electric current through their body. Its repercussions span a spectrum of injuries, ranging from severe burns to cardiac arrest, neurological impairment, and even organ failure [1,2].

Electrical injuries, a prevalent form of physical trauma, stem from diverse sources like lightning strikes, low or high-voltage incidents, often carrying substantial risks to health and life. Typically accidental, these incidents are frequently avoidable. The aftermath of such injuries, if not immediately fatal, can lead to widespread tissue or organ dysfunction. Among the four primary classifications of electrical injuries, each possesses distinct characteristics. Flash injuries, triggered by an arc flash, typically cause surface-level burns, with no penetration of electrical current beyond the skin. Flame injuries arise when an arc flash sets ablaze an individual's attire, where electrical current may or may not pass through the skin. Lightning injuries involve intense but fleeting high-voltage electrical energy surging through an individual's entire body. True electrical injuries entail a person inadvertently becoming part of an electrical circuit, often identifiable by entry and exit points where the current passed through [1].

Electrocution, the fatal outcome stemming from the introduction of electrical current to the human body, arises from diverse triggers. Foremost among these is direct contact with live electrical components like wiring, apparatus, and illumination fixtures. Incidents also occur due to inadvertent contact with overhead power lines, charged metallic objects, industrial machinery, powered tools, and portable lighting sources. Furthermore, the occurrence of electrical injuries

can be attributed to phenomena like arc flashes or blasts. Factors such as negligence, improper equipment handling or maintenance, and impairment due to substances contribute significantly to the incidence of electrocution [3,4].

Electrical burns, a significant contributor to fatalities, annually affect a considerable number of individuals in Iran due to technical issues, equipment failures, and unauthorized power use. Examining incidents worldwide pinpointed that 37% of injuries resulted from proximity to electricity lines and unauthorized construction near medium- and low-voltage lines, predominantly among individuals with an average age of 35. These revelations underscore the critical need for fostering a safety-conscious culture, particularly among professionals working with electricity, construction workers, and schoolchildren, to substantially diminish such incidents [5].

The prevalence of fatal burns, largely impacting low and middle-income countries like India, highlights a significant public health challenge. In Lucknow, India it was found that a substantial number of burn-related deaths, predominantly among females in the 10 to 49 age group. Suicidal incidents comprised a notable portion, alongside accidental and homicidal cases, with a majority showcasing extensive body surface area affected. Mortality within a week was high, primarily due to complications such as septicaemia and pneumonia, emphasizing the critical need for targeted preventive measures and education programs, especially within domestic environments, to mitigate the magnitude of these incidents [6].

Electrocution poses a substantial risk in rural regions, especially within developing nations, attributed to inadequate infrastructure, safety lapses, and limited awareness. Research reveals that these incidents often unfold outside domestic settings, notably in locations like farms or workplaces, predominantly impacting males. Remarkably, upper extremities emerge as the primary contact site. Urgent efforts in rural education focusing on the proper handling and precautions concerning electrical equipment are imperative to curtail these incidents and safeguard communities from harm [7-11].

Insufficient safety precautions in rural environments heighten the risk of electrocution, showcasing higher mortality rates compared to urban areas. Factors like deficient infrastructure, inadequate grounding, and limited awareness about electrical safety notably contribute to this heightened risk. Prioritizing safety in rural settings demands meticulous attention, emphasizing the correct setup and upkeep of electrical systems, widespread education on electrical safety, and fostering awareness about the perils of electrocution [9,12].

Exploring electrocution fatalities in rural areas holds pivotal significance on multiple fronts: Firstly, it allows for targeted prevention strategies by unveiling specific risk factors, especially vital for educating farmers and those handling electrically powered machinery. This insight aids in implementing tailored safety measures to avert such accidents. Secondly, delving into these deaths unveils the state of electrical infrastructure in rural regions, spotlighting areas needing improvement—be it grounding systems, equipment maintenance, or safety protocol enforcement. Moreover, this study informs policymakers about the healthcare burden stemming from these incidents, guiding resource allocation towards emergency services, professional training, and necessary medical facilities. Lastly, the impact on public health in rural areas becomes clearer, urging for improved healthcare access, emergency response systems, and enhanced trauma care to address the implications of these fatalities effectively [7,13,14].

Unravelling the root causes pivotal for preventing electrocution stands as a linchpin in advocating electrical safety and curbing fatalities. Pinpointing and rectifying these causes pave the way for tailored preventive actions, shielding individuals from such perilous incidents. Factors encompassing breakdowns in sociotechnical systems, inadequacies in safety training programs, and unsafe behaviors serve as substantial contributors to electrical fatalities. Moreover, identified elements like work-related accidents, contact with electrical cables, and seasonal fluctuations in electrocution fatalities further underscore the multifaceted nature of these risks. By comprehending these intricacies, the groundwork can be laid for devising and enacting targeted safety measures to mitigate the pervasive risks associated with electrocution [15,16].

Method

Research Design

An observational retrospective study was conducted fromOctober 2018to September 2019on burn deaths at Forensic and Toxicology Department,Hind Institute of Medical Sciences, Mau,Sitapur,Lucknow, (U.P.). These 50 electrical cases serve as the material for this study. To understand more clearly the dynamics surrounding these deaths, the epidemiological characteristics and medico-legal aspects of 50 people who died from electrocution were thoroughly investigated. Retrospective data were collected from university autopsy reports, hospital case files, attorney general's investigation reports, and investigators' police investigation reports. Age, gender, type of electric shock, distribution of body parts, place and season of accident, contact information, length of hospitalization until death, presence or absence of multiple injuries due to fall from height, mode of death, age of victim. Nationality and potential risk factors for fatal injuries are all determining factors. They were university students and trained investigators. At the end of each workday, the researcher and investigator evaluated the data collection process.

Inclusion and Exclusion

Inclusion Criteria

- Both genders of patients.
- Adults who were above the age of 18.

- Cases whose data was completely stored.
- Cases whose samples were effectively obtained
- The cases for whose the respectively guardian gave consent for analysis of their information and sample.

Exclusion Criteria

- Cases whose cause of death is not consistent
- Cases whose relatives or guardian did not cooperate with the authors of this study
- Cases whose detailed information is not available or seemed to be inconsistent

Statistical analysis

The study has used SPSS 25 for effective statistical analysis. The continuous data has been written in mean ± standard deviation while the discrete data has been presented as frequency and its respective percentage. The study as employed ANOVA as the statistical tool for its analysis. The level of significance was considered to be $P<0.05$. The collected data were thoroughly cleaned and entered into an MS-Excel spreadsheet for data analysis. Among these methods, the main methods were transcription, careful examination of primary data, content analysis and interpretation of content. In this study, percentages were used to analyze the variables.

Ethical approval

The relatives and the guardians of the samples were explained about the process of the study and the consent was obtained from each of them. The study process has been approved by the Ethical Committee of the concerned hospital.

Result

Table 1 displays the distribution of the manner of death in a sample of 50 cases. The majority, 76.00%, resulted from accidents, demonstrating a high prevalence of unintentional fatalities. Suicides account for 22.00% of cases, representing a considerable but smaller proportion. Homicides are quite infrequent, accounting only 2.00% of the total instances. The data reveals the major significance of accidents as the leading cause of death in this group, underlining the importance of preventive efforts. Understanding these numbers aids in prioritizing activities and resources for public safety and health projects.

Table 1: The manner of death in the 50 cases.

Manner of death	N (%)
Accidents	38 (76.00%)
Suicides	11 (22.00%)
Homicides	1 (2.00%)
Total	50 (100%)

Table 2 shows 50 cases' burn marks. Most (60.00%) have entry burn marks, indicating a single site of contact or injury. In 30.00% of cases, the burn damaged both entry and exit locations, suggesting a more complex or penetrating injury. Burn marks were absent in 10% of instances. This data shows how burn injuries vary, revealing patterns that may benefit forensic analysis or medical investigations.

Table 2: Type of burn marks

Type of Burn mark	N (%)
Entry	30 (60.00%)
Entry & exit	15 (30.00%)
Not observed	5 (10.00%)
Total	50 (100%)

Table 3 shows a variety of accident types that caused injuries in 50 cases. Workplace accidents account for 54.0% of instances, highlighting their importance. At 20.0%, household accidents highlight the importance of domestic surroundings in harm. Other accidents (18.0%) show external forces cause injuries. Unexpectedly, 8.0% of instances involve no accidents. Safety actions in businesses and residences must be targeted to reduce accident risk, as this breakdown shows.

Table 3: Cases according to manner of accident

Type of accident	N (%)
Work accident	27 (54.0%)
Household accident	10 (20.0%)
Other accident	9 (18.0%)
No accidents	4 (8.0%)
Total accidents	50 (100%)

Table 4 shows the materials involved in 50 electrocution incidents, revealing electrical injury causes. Electrical cables (24.0%) and stoves (18.0%) are major contributors, indicating their risk. Other major sources include electrical cable (16.0%) and bathroom water heater (10.0%). The data emphasises electrical safety across household equipment due to the variety of materials used. This analysis helps identify high-risk goods and informs electrocution prevention efforts, boosting public safety and awareness.

Table 4: Type of material causing electrocution

Type of material	N (%)
Electrical wire	8 (16.0%)
Electrical cable	12 (24.0%)
Water heater in the bathroom	5 (10.0%)
Washing machine	6 (12.0%)
Electrical stove	9 (18.0%)
Electrical outlet	4 (8.0%)
Dynamo	2 (4.0%)
Transfer	3 (6.0%)
Refrigerator	1 (2.0%)
Total	50 (100%)

Figure 1 shows that 22% of cases are female and 78% are male (p=0.041), which implies that there is significantly more number of males as compared to females. The dataset appears to be gendered, with males experiencing the event more often. The majority of cases involving men may point to employment or behavioural habits that increase their risk of the incident. Further investigation is needed to identify the causes of this gender discrepancy and guide targeted preventive strategies or interventions that address each gender group's individual risks in the reported cases.

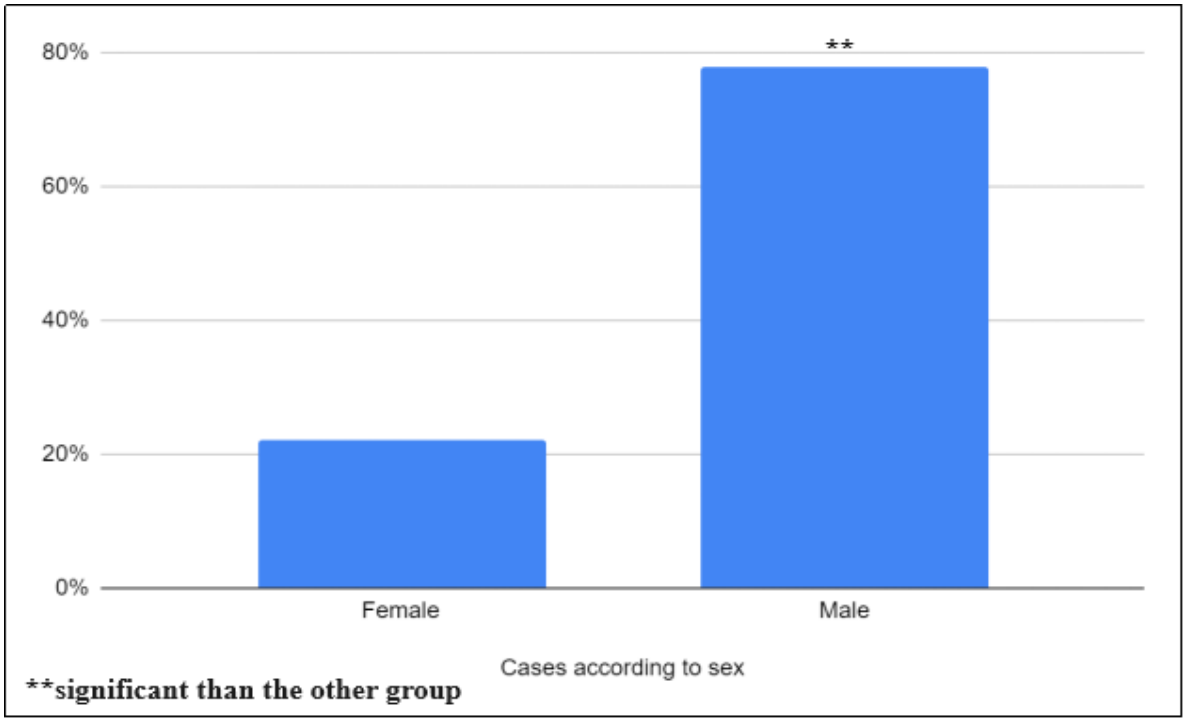

Figure 1: Cases according to sex

Figure 2 shows a seasonal pattern in instances. Most instances (39% overall) occurred from July to September. Following this, April to June had 33%, indicating a warmer-month concentration of events. Winter months January–March and October–December had lower rates at 9% and 19%, respectively. This season-wise distribution implies a link between warmer weather and a higher occurrence of the phenomena, emphasising the need for increased awareness and prevention during these months. Further research may reveal the causes of seasonal fluctuation.

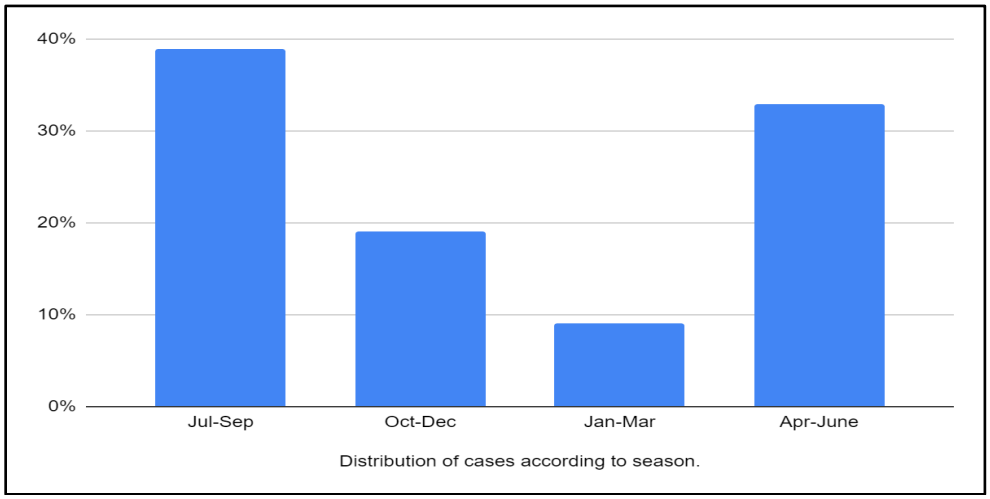

Figure 2: Distribution of cases according to season

Figure 3 demonstrates a 61% concentration of lesion localization in the "Upper Extremity" among victims. This shows that most instances involved arm and shoulder injuries. Regional vulnerability varied by body part, with 17% in "Chest" and 11% in "Lower Extremity". Lowest percentages were 6% and 5% for "Head & Neck" and "Abdomen". Upper extremity injuries are common, suggesting that accidents may involve activities or conditions that put the arms at danger.

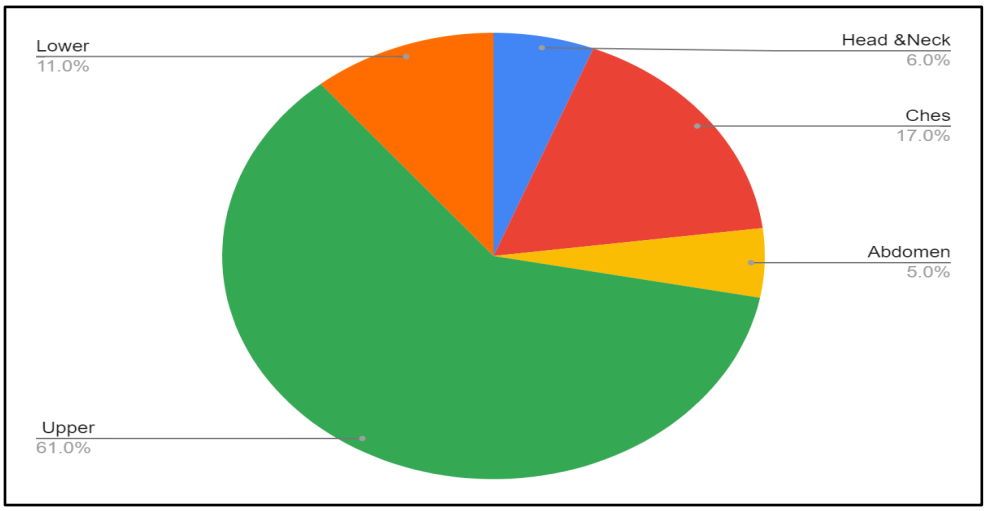

Figure 3: Lesion localization of victims

Discussion

A retrospective investigation by Mukherjee et al. (2015) spanning a decade, from July 2004 to June 2014, scrutinized cases of electrocution-related deaths in the Mortuary of Pravara Rural Hospital, Loni, situated in Western Maharashtra. These cases, representing about 2.31% of all autopsies, solely comprised accidental deaths. Among the 53 fatalities examined, individuals aged 2 to 67 years were affected, predominantly males within the 11 to 30-year bracket, accounting for 79.25% of victims. Notably, during the monsoon season, there was a surge in electrocution-related deaths, constituting 49.06%. The upper extremities featured as the primary contact site in 75.47% of cases, while 9.43% displayed no electrical burn marks. A striking observation was that 50 cases were brought in deceased, with only three deaths occurring within the hospital premises. A noteworthy conclusion emerged, highlighting that a majority of fatalities transpired in non-domestic rural settings, notably on farms, underscoring the urgency of educating farmers on the safe handling and precautions concerning electrically powered equipment [7].

Electrical injuries, a significant contributor to burn-related fatalities and health issues, were investigated by comparing mortality data from two extensive community-based health and injury surveys in Bangladesh, conducted thirteen years apart by Shawon et al. (2019). The surveys, encompassing 819,429 individuals in 2003 and 299,216 in 2016, utilized verbal autopsy methods to ascertain electrocution deaths over the preceding year. Results revealed a surge in electrocution death rates from 1.7 to 4.3 per 100,000 between

2003 and 2016, notably affecting individuals aged 18 to 59 across both years. The comparison demonstrated increased death rates across all age groups, particularly pronounced in rural areas, notably spiking in 2015. Workplaces emerged as the primary setting for fatal events, with males experiencing a doubled mortality rate compared to females [9].

Indian agriculture engages a staggering 225 million workers across 140 million hectares, with a notable reliance on traditional methods despite the significant presence of farm machinery—149 million units in operation. Amidst this landscape, concerns arise over the toil, traumatic accidents, and injuries prevalent in crop production activities. This assessment by Nag et al. (2004) delves into human energy expenditure in these activities, scrutinizing job severity, tools, and machinery to pave the way for ergonomic interventions. Notably, while farm mechanization predominates in northern India, accidents are more prevalent in the southern villages. Tractor incidents, comprising overturning and falls, top the list at 27.7%, followed by thresher (14.6%), sprayer/duster (12.2%), sugarcane crusher (8.1%), and chaff cutter (7.8%) accidents, predominantly leading to fatal outcomes, with an estimated annual fatality rate of 22 per 100,000 farmers. Meanwhile, hand tools contribute to 8% of accidents, primarily non-fatal. Regulatory inadequacies and shortcomings in machinery monitoring contribute to the high accident rate, notably evident in the prevalence of thresher accidents in southern India. The local fabrication of implements often lacks adherence to safety standards due to technical limitations among artisans [17].

Electrocution fatalities in India stem from diverse factors: Primarily, a lack of awareness and education about electrical safety practices leads to many deaths, where people remain unaware of live wire dangers and faulty equipment risks. Furthermore, poor infrastructure maintenance, notably in rural areas, results in exposed wires and faulty grounding. Industries like construction, agriculture, and electrical maintenance pose heightened risks due to occupational exposure to electrical hazards. Additionally, unsafe practices like unauthorized connections and using substandard electrical products amplify the threat. Weak enforcement of safety regulations exacerbates these risks. To counter these challenges, bolstered public awareness campaigns, enhanced infrastructure, stringent safety regulations, and robust enforcement mechanisms are vital to curtail electrocution incidents in India [18-21].

Electrocution fatalities, prevalent in both rural and urban settings, stem from distinct factors. Rural areas face risks due to deficient electrical infrastructure—poor grounding, faulty wiring, and substandard equipment—coupled with a lack of awareness regarding electrical safety practices. Conversely, urban locales grapple with higher population density and increased electricity accessibility, leading to hazards like overcrowding, improper installations, and illicit connections. Moreover, urban settings harbor a higher propensity for unsafe behaviors, including equipment tampering and electricity theft, augmenting the risk of electrical accidents [14,22].

Effective strategies to curb electrocution fatalities encompass several key avenues. First and foremost, strict adherence to safe work protocols in electrical occupations stands paramount, mitigating hazards and reducing fatalities resulting from heightened exposures to electrical risks during routine work activities. Addressing contributors to fatalities in electrical trades—spanning accident details, location, union status, project specifics, costs, human factors, and injury sources—is crucial for a comprehensive preventive approach. Additionally, upholding federal safety regulations and standards for electrical products, notably household cords, becomes pivotal to avert electrocution risks, especially among children. Combining these approaches—embracing safe practices, comprehensive training, and stringent regulations—proffers a robust framework poised to significantly diminish electrocution-related deaths [23,24].

Conclusion

The study concludes that there is more males who was affected with electrocution and eventually died and there is more work-related electrocution. Again the study has concluded that the upper part of the body is more affected as compared to the other parts.

This study calculated that Most of the deaths were due to accidents, and 12 of these were suicides. This is in contrast to studies conducted in the West, where the suicide rate was 2/3. Among them, the main victims were 26 men. More than 39 people died due to the monsoon. Most deaths are sudden or immediate. India's death rate is strikingly similar to that of Bulgaria, Canada and other parts of the world. There have been no reported deaths from bathtubs or hair dryers. More than 59% of the fatal accidents occurred in workplaces. This shows that most of the deaths were preventable due to the lack of basic knowledge of the dangers of electric shock on the part of the people working in the company. Data on electrocution deaths can illustrate the scale of the electrocution problem at the national level and help to compare potential risks in different situations. Further investigation revealed contact with overhead power lines, contact with exposed conductors, inadequate personal protective equipment, nonexistent lockout/tagout procedures, and contact with other live conductors required when working around conductors. It is necessary to focus on more detailed information about risks such as electric shock, handling electrical equipment, etc.

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