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Review Article

Burn injuries in rural India: a comprehensive review of epidemiology, risk factors and preventive strategies

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ABSTRACT

In India, burns rank as the second leading cause of unintentional injuries. Few studies have examined the trend of burn injuries in rural India. Managing burn injuries poses a significant challenge in the country, which has the highest rate of female fatalities worldwide from flame burns. Burns can occur anywhere; however, they are more prevalent in rural areas, impacting the impoverished. The most frequent type is flame burns, with kerosene and flammable clothing worn by women being the factors involved. The healthcare network's infrastructure is strong, but there is a significant shortage of resources. To achieve a positive transformation, it will be necessary to have more qualified individuals ready to serve in the rural regions. In many instances, burn patients face mistreatment in the community before reaching the healthcare facility. The community holds misconceptions about burn management that hinder effective management within the facility. On the other hand, the facility's preparedness poses a significant challenge. To maintain quality and consistency in burn care in rural India, it is essential to foster knowledge and awareness within the community regarding burn prevention and their involvement. In this way, timely availability of facilities will enhance community confidence, consequently saving thousands of lives from burn injuries in rural India.

Keywords: Burn injury, Rural India, National program, Prevention strategies

INTRODUCTION

India possesses an ancient culture that traditionally venerates fire as "Agnidev." When utilized carefully, it is highly beneficial to humanity; however, if misused, it can lead to catastrophes. Burn injuries are among the frequent medical emergencies treated in hospitals and represent a significant public health issue globally. The term burn injury is defined as a body lesion due to an external cause, either intentional (alleged homicidal or suicidal) or unintentional (accidental) resulting from sudden exposure to energy (mechanical, chemical, electrical, thermal, or radiant) generated by agent host interaction.[1]

In India, burn injuries rank just below motor vehicle accidents as a cause of trauma-related deaths.[2] Burns are responsible for a large economic, social and public health burden in low- and middle-income countries (LMICs). Due to the lack of a formal registry, it is challenging to determine the precise incidence of burn injuries in India. Indians experiences a significant number of burns with an unusually high mortality rate. In 2019, more than 23,000 fire-related deaths were estimated in India, which is about 20% of the global mortality burden. Additionally, 1.5

million DALYs were attributed to burns. The burden of burns among women (aged 15–49 years) in India is three times higher than that among men Most burns in India take place in rural regions, which are poorly equipped (and often lack the skills) to handle severe burns.[3,4] Hence in this review article we compiled all the information related to burn injuries in rural setting of India and tried to explore the problem burden, risk factors, and preventive measures including various national programs available for burn victims which will eventually guide the policymakers to come up with even better strategies in order to tackle this problem at grassroots level.

RURAL EPIDEMIOLOGY

Burden and risk factors of burn injury in rural India

Burns occur in various places, but are slightly more prevalent in rural regions. According to the 2011 census of India, the term "rural sector" refers to any area that satisfies the conditions such as a population under 5,000, a population density of fewer than 400 individuals per square kilometer, and over 25 percent of the male workforce involved in agriculture.[5] The root cause is the inadequate electricity supply, resulting in widespread reliance on kerosene lamps for illumination, which often tip over and spill kerosene, leading to frequent sources of flame burns.[6]

Owing to insufficient liquid petroleum gas availability in rural areas, biogas or wood as fuel needs to be supplemented with a quick-light kerosene stove. The design of the wick stove was launched along with safety regulations, yet women still experience burns while preparing food on the burner. Regrettably, there is a considerable lack of knowledge regarding fire extinguishing techniques and the first aid that should be provided. This results in severe burns, encompassing a significant proportion of full-thickness burns. Kerosene, a readily flammable liquid, is present in every household and, unfortunately, often plays a role in numerous intentional burn injuries.

Women in rural areas typically wear saris made from a polyester blend fabric that is very flammable. Even a lightweight cotton sari is just as combustible. This loose-fitting outfit ignites from the back without the wearer's awareness.

This is succeeded by a panic response when the individual flees for assistance, increasing oxygen to the flames. The panic response stems from widespread public misunderstanding of the proper methods for addressing a person on fire. Kids can suffer from burns because hot liquids such as water, milk, and food are stored at floor level. Farmers suffer many electrical burns during the active agriculture phase as they attempt to tap electricity directly from the mainline to pump water for their farms.[7] In India, research has indicated burn mortality rates as high as 64.5% community-focused, cross-sectional investigation conducted in the rural field practice region of Raja Rajeswari Medical College and Hospital, Bangalore, from January 2016 to January 2017 disclosed that the prevalence of burn injuries stood at 9.5%.[4,8]

Similarly, another community-based study by Bhardwaj et al in rural Bhopal reported a burn injury prevalence of 8.4%, contrasting with a study performed in a slum community in Delhi, which indicated a higher prevalence of 14.25%.[9,10] According to a study conducted to evaluate the pattern of household injuries in Punjab's rural areas, contact with heat and hot substances resulted in 13% of accident cases.[11] A research conducted in a rural area of central India revealed that young, married, illiterate Hindu women were more likely to sustain burns. Suicidal burns were more likely in women, but the majority of electric burn victims were men.[12]

GAPS AND CHALLENGES

Heath care network in India and access to healthcare

The World Health Organization (WHO) recognizes universal healthcare as a basic human right. Human resources for health (HRH) are essential for effective, high-quality healthcare systems that maintain and improve good health. Health systems must have adequate levels and fair distribution of human resources to guarantee that healthcare delivery is as efficient as possible.[13] Healthcare in rural regions includes primary health centers in small towns (Tehsil or taluka) or villages, a community health center at block level, a district hospital in the district town, and a referral medical college hospital in larger state cities. Ultimately, advanced facilities are providing specialized treatment in urban regions. This is the typical Indian healthcare delivery system. They focus more on delivering maternity and child care and initiatives for controlling tuberculosis, malaria, and AIDS. Trained workforce, such as doctors and specialty doctors, is low in rural and district areas, mainly because they do not find this an appealing option. Enhanced pay and working environments and the commitment to secure jobs for candidates from rural regions after serving three years for postgraduate chances might draw physicians to rural areas. District hospitals in district headquarters have surgeons and anesthesiologists; nonetheless, they encounter a major shortage of junior doctors, nurses, and paramedical health workers. Resources for the treatment of burn patients are unavailable. They are situated under a mosquito net at the back of the general wards and have exposed wounds. There are no guidelines for managing them.[7]

Globally, 57 nations face a shortage of personnel designated for essential healthcare. India is one of those.[14] The WHO suggests a ratio of 44.5 healthcare professionals, including doctors, nurses, and midwives, for every 10,000 people, while it is 20.6 %in India.[15] Nonetheless, the allocation of HRH across the states is inconsistent.[16] Significant differences exist between urban and rural regions in HRH, as urban areas boast a doctor

density that is four times that of rural areas. HRH's presence, allocation, and standard are essential for realizing universal health coverage (UHC) in lower-to-middle-income countries (LMICs) like India. India has only a few hundred surgeons and plastic surgeons dedicated to treating burn patients in burn centers, most concentrated in urban areas.[7] In many instances, no specialized burn surgeons are available, and general surgeons without formal burn care training treat burn victims improperly. Moreover, burn nursing is not widely recognized, complicating many patients' post excision surgery care.6 Resuscitation is often delayed due to long travel distances and inadequate transport facilities, with limited ambulance or pre-hospital services available for burn related emergencies in the rural regions. Despite a reported annual increase in funding for burn care in many low- and middle-income countries (LMICs) and improvements to existing burn centers, burn management remains particularly deficient in rural regions. Physiotherapy is commonly provided by patients' family members rather than trained personnel.[17,18] Even with national efforts to improve burn care, there is still a significant disparity in the ratio of burn patients to available beds, with a 700:1 ratio in India compared to 14:1 in the USA. The shortage of qualified specialists and available centers leads to delays in treatment and transfer, resulting in higher morbidity and mortality rates among these burn patients in India.[4] More than 1 billion citizens of India for 75.1% of the population, reside within a two-hour journey to a bur facility. Nonetheless, numerous centers do not have the essential ICU and skin bank services necessary for contemporary burn care. Merely 221.9 million individuals, representing 15.9% of the population, can reach a burn center that has both an ICU and a skin bank within a two-hour.[19]

Believe in traditional practices

Typical methods for treating burns employed by individuals residing in rural areas include raw eggs, decayed sections of banana trees, consistently immersing the injuries, and using ice to reduce the temperature of the burnt area. These communities also use methods for burn injuries such as applying mud, toothpaste, onion paste, raw potato mash, coconut oil, kerosene oil, or a blend of lime water and coconut oil, even cow dung. They also utilize various herbal remedies composed of leaves from herbal plants, such as a combination of sesame oil and wax, the juice of 'Kapila' leaves, and even a blend made by boiling milk to prevent scar formation. Applying heat to burn wounds is considered helpful in lowering the community's infection risk.[20] For treatment, they initially rely on the Local faith healer or homeopathy or Ayurveda practices (Kabiraj). Still, afterward, if the patient's condition does not improve, they are referred to a qualified physician. Prior studies have shown that for a child's burn, about 60% of parents turn to unqualified healthcare providers. At the same time, those in higher income brackets and with higher education prefer qualified service providers.[21] The management of a serious burn wound is lengthy, painful, and costlier than addressing other types of injuries. In low-income nations, burn injuries are viewed as complex health issues since the medical assistance required demands specialized personnel and costly technologies that are often not easily accessible. Burns lead to extended hospitalizations, lasting disabilities, and emotional strain while also imposing a financial burden on families by hindering their members' capacity to work.[22]

STRATEGIES FOR IMPROVING BURN CARE IN RURAL AREAS

Community awareness

As stated by Keswani in 1986, "The difficulty of burns in India is not in effectively treating a fully burned patient, but in completely preventing all injuries".[23] Setting the burn incidence on a declining trend requires not only the adoption of evidence-based and cost-effective treatment protocols but also raising public awareness about their roles and responsibilities in preventing and managing burn injury. The priority for educating rural populations should be the message about extinguishing fires by stopping, dropping, and rolling, and then cooling the burn with tap water. They should provide educational resources on fire safety and first aid, focusing on the primary cause of burns, i.e., kerosene flame burns. These may consist of flip charts, posters, and audio-visual streaming through Visual aids in the health centers in local languages. Stressing on the preventing strategies. The intended audience should include both children and adults, regardless of gender.

Messages and advertisements regarding burn prevention should be broadcast regularly on radio and TV during peak viewing times. These campaigns should inform individuals about how to prevent accidents by following specific strategies during cooking and handling fire and electric equipment, and they must also clearly demonstrate the actions to be taken in case of an accident.[17]

Burn prevention needs to be a national initiative crafted with empathy, foresight, and attention to promoting changes in harmful cultural behaviors. Education should incorporate recommendations for certain safe lifestyle strategies for the average Indian. This will encourage significant research to ensure their environment is secure. In a study from Nagpur regarding electrical burn injuries, it was found that most of the victims did not have adequate knowledge of electrical burn injuries. They acknowledged that their actions would have been different if they had access to the information beforehand.[24]

Preventive strategies should focus on altering harmful cultural practices with sensitivity, and integrating fire safety and first aid education into school curriculum and antenatal care programs can increase awareness among children and expectant mothers. Village markets provide an opportunity for public health outreach and education. Additionally, collaborative training programs for healthcare providers in burn management would

significantly improve care. Let's examine our neighboring nations, such as Bangladesh. Their rural burn patterns are likewise connected to cooking at ground level outside the home, and the hot ashes from cooking are often left without cooling down. Kids in this zone unknowingly burn their feet by stepping on hot ashes. Mashreky et al from the Center for Injury Prevention and Research in Dhaka examined this issue impacting many children. They suggested a prevention strategy that effectively shields rural children from hot ashes by constructing a temporary barrier around the cooking area.[21] They assisted homemakers in the morning when accidents frequently occurred by offering monitored childcare. This has demonstrated a significant decrease in burns in the studied area.

Government initiatives

In the developed world, effective burn care is achievable through government involvement, universal health insurance coverage, legislation such as the right to health, and a strong public awareness of safety. The main strategies for Burn care consist of creating physical facilities and staffing for Burn treatment throughout all three levels of the healthcare delivery system through inter-agency cooperation and public-private partnerships. This will be achieved by providing material resources and capacity-building programs to enhance accessibility, equity, and universal coverage. Quality control and supervision will be implemented to ensure the maintenance of standards. Additionally, the Government has initiated the "National Programme for Prevention, Management, and Rehabilitation of Burn Injuries (NPPMRBI)," an extensive effort to enhance the prevention, care, and rehabilitation services for burn injuries.[25] In 2017, a new National Health Policy (NHP) was established with the expressed goal of gradually advancing towards Universal Health Coverage (UHC). The NHP initiated a significant strategic change in public health care, connecting the private sector with public health objectives, and consequently broadening the government's role from merely being a provider to becoming a purchaser. The later introduction of the Ayushman Bharat initiative in 2018 reinforced this strategy by launching a significant publicly funded health insurance program, the Pradhan Mantri Jan Arogya Yojana (PMJAY). In the evolving environment of health-care services in India, there exists a chance for revitalized health policy initiatives regarding burns management.

By having proper knowledge of prevention and administering the right first aid, the occurrence of severe non intentional burns can be diminished, and the seriousness of burns will also be reduced. There ought to be explicit protocols for handling minor burns locally and transferring others to an appropriate burn treatment center for individuals who are still hurt. Moving goods from distant villages and tribal regions can pose significant difficulties, and it can take them several days to arrive near a facility, assuming they receive proper guidance. The government of India has introduced a solar-powered lamp named Kiran, a safer alternative to conventional kerosene lamps. This cost-effective solar lighting solution provides up to 8 hours of illumination on a full battery, reducing the risks associated with kerosene use.

Management guidelines in burns

In hospital settings

The primary approaches for burn care involve supplying physical facilities and personnel for burn treatment across all three tiers of the health delivery system via inter-agency collaboration and public-private partnerships. This will be accomplished by providing material resources and capacity-building initiatives to ensure easy access, fairness, and universal coverage. Quality management and monitoring will be conducted to guarantee the preservation of standards.

According to National programme for prevention of burn injuries, for effective burn injury management at all three levels of the healthcare delivery system, there will be specific additional requirements. For primary level, the available space will be utilized for different activities, and the current personnel (like ANMs, nurses, and dressers) will be informed and trained in burn first aid. For district level, a compact burn unit with 4-6 beds will be established in district hospitals. The current operation theater and additional facilities will be used but will be enhanced by supplying essential equipment like a vital parameter monitor, skin graft mesher, Humby’s knife, and portable light, along with some consumables. Each district will receive one advanced life support ambulance along with personnel. In tertiary level capacity building will occur in areas without current facilities, or enhancement will take place where facilities exist by adding further infrastructure and manpower. A burn unit featuring 12 beds will be established, which will include an ICU with 4 beds. The current operation theatre and additional facilities will be used, but enhancements will be made by supplying essential equipment like ventilators, vital sign monitors, skin graft meshers, Humby’s knives, portable lights, and dermatomes, among others. A mechanism for a National Burn case registry will be established using MIS in the country, spanning from sub centre > PHC > CHC > district administration > state > centre. This information will be extremely helpful for future strategy planning related to prevention, burn management, necessary behavioral or cultural changes, and safety regulations, aimed at decreasing burn incidents and enhancing burn care across the country.[25]

Minor surface burns not located in sensitive body parts can be treated locally. Superficial partial thickness burns (which are identified by a pink and moist appearance, blanching with pressure in unaffected nearby areas, and eliciting pain and sensitivity) that leave the face, hands, perineum, feet, or circumferential limb parts (critical area burns) unharmed, and where the inhalational injury is not

suspected, are deemed very small burns if they cover <10% total body surface area (TBSA) in adults and <5% in children; therefore, they can be treated at the local hospital. Each burn in infants must be directed to a specialized center for initial assessment. A training program needs to be created so these staff members can become familiar with handling such injuries and encourage them to pursue training. This will prevent the deformities that arise after burns, which presently make up most reconstructive endeavors and affect the quality of life for a burn survivor. Full-thickness burns that may involve inhalation, situated in vital areas and alongside other injuries or existing conditions, surpassing 5% in infants, 10% in children, and 15% in adults, necessitate a referral to a burn care center for admission.[7]

In community settings

Multi-strategy, community-oriented initiatives are extensively advocated for lowering injury rates. It has been suggested that sustained reduction in injury rates observed at the population scale necessitate the application of injury prevention measures within multi-strategy, multifaceted community programs, incorporating a blend of both social and physical environmental interventions within community-led efforts. The community-oriented method is defined by a collective ownership of the injury issue and its resolution between experts and community members, along with mutual accountability for identifying suitable interventions.[26] A research by MacKay et al assessed "Project Burn Prevention", an educational initiative involving schools and media. The two years long intervention was carried out via three platforms: mass media (television, radio, newspaper, educational institutions and community groups. The educational advice included information on first aid for burns and contact burns. The recommendations focused on alterations in behavior and the environment, incorporating safety items like fire-resistant clothing.[27] Proper management of burn injuries locally is essential. This includes providing first aid for burns, emphasizing the importance of promptly visiting a healthcare center after a burn injury, addressing the shortage of trained staff experienced in burn treatment, creating specialized spaces for treating burn patients, and ensuring access to necessary medications and supplies. Rural communities often worsen injuries by providing inadequate care; they depend on local traditional healers and usually pursue medical facilities only after a significant period has elapsed. Once the patient arrives at the healthcare facility, the waiting period and inadequate treatment of the burn will hinder its management, thus complicating the care provided by doctors and nurses at district and sub-district health centers. Moreover, they have insufficient training, resources, and essential medications to address burn injuries. The first hour of a burn is called the 'golden hour'; efficient emergency response in this time can save lives, reduce burn severity, and decrease hospital duration. Burns creates a significant economic and social strain on the patient and their families. The prevention and management of burn injuries, alongside appropriate immediate care for burn victims in the community, can lessen this burden.[21,22]

Increasing awareness among the general public regarding proper first-aid techniques and burn treatment and the necessity for trained personnel, vital medications, and effective logistics in healthcare facilities is crucial for managing burn injuries. Altering the viewpoint and methods regarding prompt burn injury treatment in the community is vital. Educating doctors and nurses on managing severe burns would lower the obstacles to treating burn injuries at government health facilities in India at the district and sub-district levels.

CONCLUSION

Timely and precise first-aid in the community, as well as treatment in a medical facility, is essential for individuals suffering from burns. These will be vital in preventing disabilities resulting from burn injuries and will save both time and money for the patients and their loved ones. Rural communities must know and acknowledge the significance of quickly getting people with burn injuries to a medical facility. Burn patients must be treated exclusively in medical facilities. Healthcare facilities need the right tools, medicines, and logistics, and both physicians and nurses should be educated in burn care. When burn patients obtain timely and suitable care at medical facilities, the levels of disability, morbidity, and mortality will decrease. A strong referral system is crucial in district and sub-district institutions. However, people with severe burns and those facing complications will always require referral to specialized facilities for adequate care. A research initiative can be established in rural areas to investigate the impact of awareness and pre-hospital first aid on decreasing morbidity caused by burn injuries.

The Indian Ministry of Health and Family Welfare can play a crucial role by establishing and implementing guidelines, training healthcare professionals, coordinating logistics, and modifying facility infrastructure to guarantee effective treatment for burn injury patients. There is a scarcity of research in the literature available for practitioners to establish an evidence-base about the efficacy of community-based injury prevention programs aimed at preventing burns and scalds in rural community settings. Practitioners must enact effective community-based intervention programs grounded in research that identifies successful methods to minimize burns and scalds among populations in study environments. There is an evident necessity to steer future research towards generating evidence from diverse community settings to realize overall enhancements in injuries related to burns and scalds. Thorough and methodologically sound assessments that incorporate quality metrics for injury results and a modern community control within the study framework should be anticipated for any new initiatives launched. It is essential to establish a framework for addressing the issue of burns injuries in rural populations from a preventive viewpoint. Additionally, a collection of

evidence-based strategies should be integrated to develop program guidelines that can be implemented (with local modifications) in rural communities around the globe.

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