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RESEARCH ARTICLE

THE DISTRIBUTION AND CHARACTERISTICS OF LIGHTNING INJURIES AMONG RESIDENTS IN A RURAL AREA IN SRI LANKA.

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Abstract

Background: Lightning occurs most commonly in the tropical countries, yet due to under-reporting of data, both developed and developing countries didn't aware the actual problem. Thus, proper reporting and management of the victims related to lighting are crucial.
Aim and Objective: To describe the distribution and characteristics of the lightning-related lifetime injuries among residents in a rural area in Sri Lanka
Methods: We conducted a cross-sectional survey among 510 residents in the Medical Officer of Health area, Kiriella. Among them, we selected residents who reported the lightning-related lifetime injuries and interviewed them using an interviewer-administered questionnaire.
Results: The lightning-related lifetime injuries were 18 (3.6%). Among the victims, 12 (66.7%) were males, and 6 (33.3%) were females. Most (n=13, 72.2%) were 18 to 45 years of age, when injured to lightning. Eight (44.4%) lightning strikes happened during the period from 2004 to 2013, and most of the lightning-related injuries were reported from noon to evening (n=10, 55.6%). The most (n=9, 50.0%) affected body part was the head. Males were 1.34 times increased risk for lightning compared to females (Relative risk 1.34, 95% confidence interval 0.51-3.50). Further, residents of age 18 to 45 years were highly vulnerable to lightning (Relative risk 3.07, 95% confidence interval 1.11-8.49).
Conclusions: Lightning-related injuries are more common among younger males in the selected rural area in Sri Lanka. Therefore it is recommended to conduct awareness programmes on preventive measures among at-risk population and to introduce protective measures at residences to mitigate the loss and damage.

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Introduction:-

Lightning is a public health problem worldwide (Biswas et al., 2016). Approximately, 24,000 deaths occur due to lightning every year in the world, and the injuries reported ten times higher than the deaths (United Nations Educational Scientific and Cultural Organization, 2018). Out of of lightning-related fatalities and the injuries approximately 70% are in the tropical regions attributed to high population density, labour-intensive outdoor occupations including agriculture, fishing and construction of high rising buildings, modes of transportation, low literacy rate and poverty (Holle, 2016: Illiyas et al., 2014). Accordingly, Malawi reported the highest annual death rate related to lightning as 84 per million populations from 2007 to 2010 (Holle, 2016). Further, India reported 1,755 deaths per year representing the highest deaths related to the lightning across the world (Illiyas et al., 2014). Bangladesh reported an overall incidence of lightning injuries as 19.9 per 100,000 people based on the data in 2003 (Biswas et al., 2016). Moreover, being an island in the tropical region, Sri Lanka is highly vulnerable to lightning in certain areas of the country such as Western coastal belt and South-Western slope of the mid-country hills, indicating that lightning is more common in the districts of Gampaha, Ratnapura and Kalutara (Ministry of Disaster Management, n.d.). Furthermore, reported lightning injuries were low throughout the past years in the country, however, there were two reported peaks in 1995 and 2007 with 24 and 35 injuries respectively (Disaster Information and Management System, 2014).

The actual number of lightning-related deaths and injuries are higher than the reported figures due to unavailability of data recording and monitoring system in most of the countries (Biswas et al., 2016). However, the reported number of deaths and injuries related to lightning are decreasing over the years both in developed and developing countries due to improvement in the weather forecast, increase availability and accessibility to emergency treatment facilities and lesser outdoor occupations (Elsom & Webb, 2017: López & Holle, 1998: Selvi & Rajapandian, 2016). Further, males affected to lightning due to increased outdoor recreational and work-related activities compared to females (Biswas et al., 2016: López & Holle, 1998). Moreover, people working at outdoors such as farmers and workers in the construction sites are highly vulnerable to lightning strikes (Forster et al., 2013: Selvi & Rajapandian, 2016). Shelter under a tall tree or isolated shed, working in the open field or water environment are identified as risk environments for lightning strikes (Muehlberge et al., 2001).

Lightning may cause mild injuries to sudden deaths. Several studies described the ‘rule of thumb’ as 10% of patients die due to lightning strikes, while the rest 90% survive with life-long disabilities due to brain injury or nerve damage (López et al., 1993). It can cause damages due to direct hit, touch voltage or step voltage, which is determined by the combination of factors such as risk environment, activities carried out by the victim at the time of lightning and the available protective measures, thus the number of lightning injuries could be different to each country (Selvi & Rajapandian, 2016). Therefore, identification of distribution and characteristics of lightning injuries in a rural area in Sri Lanka are more important to reduce the damage and target the health promotion to the at-risk population. Further, identification of socio-demographic characteristics of the affected people will help in developing precautionary measures since awareness, and proper planning is essential to improve safety. Further, to improve the emergency service facilities, it is essential to identify the common acute effects face by Sri Lankans due to lightning. Thus, this study aims to describe the distribution and characteristics of lightning injuries among residents in a rural area in Sri Lanka.

Methods:-

A cross-sectional study was conducted during September 2014 in 17 randomly selected ‘Grama Niladari’ divisions in Medical Officer of Health (MOH) area Kiriella in Ratnapura district in Sri Lanka. Multi-stage cluster sampling method was used to select 510 households. The current study is part of this larger study, and detailed methodology has been described elsewhere (Kalubowila et al., 2018). The principal investigator visited 18 residences of lightning incidents and conducted the questionnaire survey. The questionnaire consisted of socio-demographic characteristics of the victims at the time of incident, the year and the time of the injury, activity carried out by the victim at the time of lightning, details of the affected body part, treatment received or not and the treatment provider. It was designed following a thorough literature survey of studies conducted in both developed and developing countries and discussion with a panel of experts including the public health specialists and experts in the Department of Meteorology, Sri Lanka. Subsequently, it was assessed for face, content and consensual validity. Ethics clearance was obtained from the Ethics Review Committee, Faculty of Medicine, University of Colombo, Sri Lanka. The data were collected retrospectively from the study participants and before the interview; the informed written consent was obtained.

Data analysis was carried out using the Statistical Package for Social Sciences (SPSS) software version 21. The lifetime injuries, the age of the victim at the time of the incident, the place, year and the time when the injury occurred, the details of the injury were determined and presented as frequency distributions. Relative risk (RR) was calculated for age and gender, and 95% confidence intervals (CIs) were computed.

Results:-

Out of 18 (3.6%) lifetime lightning-related injuries, no one has witnessed the lightning strikes twice. Of them, 12 (66.7%) were males, and 6 (33.3%) were females. Thirteen residents (72.2%) were 18 to 45 years of age, when they hit by lightning strikes and the mean age of the victim was 39.5 (SD ±10.3) years. Most (n=12, 66.7%) residents worked related to outdoor occupations such as plucking tea leaves (n=5), construction sites (n=3) and paddy cultivation (n=4), when they witnessed to lightning. The majority educated below the GCE (O/L) (n=14, 77.8%).

Out of all victims, eight (n=8, 44.4%) had multiple injuries. The age of 18 to 45 years were highly vulnerable to lightning compared to the age group of above 45 years (RR 3.07, 95% CI 1.11-8.49). Similarly, males were at risk with a 1.34 times increased risk compared with females (RR 1.34, 95% CI 0.51-3.50).

Discussion:-

Average of 40 human deaths is reported every year (Premalal & Kumarasinghe, 2015) in Sri Lanka, however, due to unavailability of data related to lifetime lightning injuries, the comparison of data related to this study is impossible.

The most (72.2%, n=13) affected age group was between 18 to 45 years and males with low educational level. In Sri Lanka, economically active age group is defined as 15 years and above, therefore 18 to 45 years age group could be the most vulnerable age group to indoor and outdoor injuries (Department of Census and Statistics, 2016). Similarly males were engaged in more outdoor related occupations that made them more vulnerable to lightning. Two developing countries reported similarly high figures among 31-50 years age group (Ahmad et al., 2013: Shrigiriwar et al., 2014). In the same way, males were at increased risk to lightning-related injuries in developed countries (82.0%) and in Bangladesh (n=98, 60.1%) (Biswas et al., 2016: Cooper & Ab Kadir, 2010).

Considering the occupation of the study participants females plucking tea leaves, construction workers and farmers were affected more (n=12, 66.7%) due to lightning in the present study. This may be due to the fact that the employees working out-door being the tallest objects in the open fields. Due to lack of awareness and knowledge on precautionary measures for lightning strikes and for daily wages, the rural communities in Sri Lanka continue their work at outdoors even during the lightning (Premalal & Kumarasinghe, 2013). Correspondingly, students (31.2%), agricultural workers (17.9%) and housewives (14.5%) were the main victims of lightning injury in a study conducted in Bangladesh (Biswas et al., 2016).

Lightning injuries have been identified as one of the natural disasters in Sri Lanka with increase intensity in last years (Ministry of Disaster Management, n.d). Due to climate change, the increase trend of lightning strikes could be seen mainly in the tropical countries, thus further studies need to clearly understand the magnitude of the recent upsurge (Price & Rind, 1994). Similarly, the most lightning-related injuries were occurred in the evening (55.5%, n=10) or night (27.8%, n=5) in the present study, which were correlated with the previous studies and could be due to heavy rain mostly experiencing in the evening and night in tropical countries (Biswas et al., 2016: Aslar et al., 2001: Ahmad et al., 2010). By contrast, a decline in lightning fatalities in recent decades has been reported from developed countries (Gatewood & Zane, 2004: Gomes et al., 2006). The advancement of the treatment, educate the public on preventive measures, improving facilities in weather forecast and improving the availability of lightning protection equipment such as earthing system and lightning rods could be the identified reasons for the reduction of lightning casualties (Pincus et al., 2015).

Lightning strikes increase in certain outdoor environments such as open areas, tall objects and wet environments. In the present study, most incidences (66.7%, n=12) occurred at outdoors. Similarly, studies done in Switzerland and Florida reported the higher incidence at outdoors (Pfortmueller et al, 2012: Gomes et al., 2006). There is a habit especially among villagers, looking shelter under trees during showers with lightning, which lead to increase the risk. Therefore knowledge on protective behaviours should be improved among at-risk communities.

All lightning related adverse effects are preventable. However, the outcomes due to lightning strikes may be different due to the intensity of the lightning flashes and the activites carried out by the victim at the time of lightning. Accordingly, the skull is a common contact point for direct hits, which correlates with the findings of the present study. In contrast, the leg was the most frequent site injured due to lightning in Bangladesh, where the most people working in open fields at the time of lightning strikes and they are more prone to be affected by step voltage (Biswas et al., 2016: Selvi & Rajapandian, 2016).

Similar to the present study the majority (83.1%) sought treatment from a doctor or traditional healer in the study conducted in Bangladesh (Biswas et al., 2016). Therefore these two studies highlight that the majority of the lightning victims were presented to the health care practitioners. Thus, data were recored at first contact eventhough they were not disseminated or reported subsequently. Hence introducing data reporting system at regionl, district or national level is realistic.

Conclusions and Recommendations:-

Lightning has become a public health problem over the last years in the selected rural area that requires prompt action. Similarly, male gender and the age group between 18 to 45 years were the most vulnerable groups for lightning. The direct hits by lightning are frequent in the selected area. Conducting awareness programmes on lightning to improve preventive measures and strengthening lightning protective measures at residences with grounded plumbing, electric conducting materials, improved fire resistance and lightning rods, can reduce the lightning risk. A multi-stakeholder involvement is necessary to identify possible and effective solutions for preventing injuries due to lightning. Moreover, improve awareness of medical treatment in rural communities in an emergency, as well as a comprehensive reporting system is needed for future preventive action.

Author Declarations

Conflicts of interests:

The authors declare that they have no competing interests.

Ethics approval and consent to participate:

Ethics clearance was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Colombo, Sri Lanka. Written authorization was obtained from the Regional Director of Health Services (RDHS) Ratnapura and Kiriella MOH, and informed written consent from the participants.

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Author contribution:

All authors were involved in conceptualizing and interpretation of data. The principal investigator was involved in data collection and drafting the manuscript. All authors revised it critically for intellectual content and gave final approval.

Table 1:-Distribution of lightning injuries according to the year and time of occurrance, place of injury and activity carried out by the victim at the time of lightning strike

Characteristics	Number(n=18)	Percentage
Year of occurrence		
1974-1983	02	11.1
1984-1993	03	16.7
1994-2003	05	27.8
2004-2013	08	44.4
Time when the injury occurred		
Midnight-6 am	01	5.5

6 am – 12 noon	10	55.6
12 noon – 6 pm	05	27.8
6 pm -midnight	02	11.1
Place of injury		
Outdoors	14	77.8
Indoors	04	22.2
Activities carried out by the victim at the time of lightning strike		
Working in the field	12	66.7
Watching television inside the house	04	22.2
Entertaining outdoor sport activities	02	11.1

Table 2:-Body part injured due to lightning strike, treatment sought and the treatment provider

Characteristics	Number	Percentage
Body part injured (n=18)		
Head	09	50.0
Hand	08	44.5
Abdomen	01	5.5
Treatment sought (n=18)		
Yes	15	83.2
No	03	16.8
Treatment provider (n=15)		
Traditional healers	10	66.7
General practitioner	03	20.0
Medical practitioner at the hospital	02	13.3

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