

Lightning injuries in Colombia. From lack of awareness to prevention

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Abstract—Lightning injuries and deaths occur most often in individuals during recreational activities or who work outside. Colombia is one of the countries in the world with a much higher density of lightning than many other areas. Although the geographical, regional, temporal and seasonal variation of the frequency of lightning is known in Colombia, the basic epidemiological characteristics of lightning injuries are unknown. This paper presents a review about the first approach to the problem of lightning injuries in Colombia, which may allow the effective design and implementation of prevention programs.

Index Terms— Lightning injury, injury prevention, Colombia.

I. INTRODUCTION

As most traumatic injuries, lightning injuries are preventable [1, 2]. The prevention of injuries includes vigilance and data collection, analysis, and identification of populations under risk or related factors, creation of actions, and finally, the assessment of the latter [3]. All the above aims to reduce the incidence of injury and death that such involve. Colombia is one of the countries in the world with a much higher density of lightning than many other areas [4]. Because of the unknown number of injured and dead due to this cause in our country, the high complexity in the care of lightning injuries and mainly neurological sequela, the need and obligation to conduct epidemiological studies was observed in order to establish baseline data for the design, development, and implementation of prevention programs that impact on mortality and sequela of patients with lightning injuries.

II. TRAUMA AND PREVENTION

Lightning injuries should be classified as trauma, which is defined as the exposure to some source of energy (mechanical, electrical, thermal, radiation or chemical) in an intensity exceeding the tolerance level of the host. Trauma is also used to describe the damage caused by the lack of essential elements such as oxygen in drowning or lack of heat in hypothermia [5].

Traumatic injuries are highly preventable. An important task of all staff working on decreasing the magnitude of the effect of lightning, is the need to discourage the use of the term "accident", which refers to an event that is unpredictable and therefore inevitable [3]. We need to demystify these events as those generated by fate, divine punishment, or

chance, where you cannot do anything to avoid them. The vast majority of trauma are predictable and therefore preventable

The WHO promotes injury prevention and control as a cost-effective mechanism to decrease sequela, the number of deaths, and usually, the burden of disease [6]. There are activities to be performed in 3 different levels, depending on the moment in time they are made, using a conceptual model in injury prevention and response strategies [7, 8], as follows:

- a. Prevention of trauma, with activities made in order to prevent or reduce the likelihood of occurrence.
- b. Activities that minimize physical trauma caused by physical agents.
- c. Activities to reduce physical and emotional harm of the injury through the optimization of emergency systems and health care systems.

Each of these three activities described above correspond to the so-called primary, secondary and tertiary prevention [9].

III. PUBLIC HEALTH APPROACH TO PREVENT INJURIES

In Colombia, in 2011, an academic initiative was created with the purpose of establishing national epidemiological information about these type of injuries, which is the first of the 4 steps of the public health approach regarding injury prevention [10], which are the following:

- a. Surveillance and data collection on the extent of the problem.
- b. Identifying risk factors (causes and variables related to the event).
- c. Developing and evaluating actions (evidence).
- d. Implementing effective actions.

The collection of data that is necessary for the analysis must be free, as much possible, of bias that significantly change the validity of the results. Conducting a study on lightning deaths in Colombia was determined due to the lack of information on the extent and impact on health which is produced by lightning in the Colombian population; however, deaths are only the tip of the iceberg and the number of non-fatal injuries is a medical issue affecting both the patients and their families [11], and which can be 10 times higher than the number of dead [12]; so far, it remains unknown.

IV. THE LIGHTNING DEATHS STUDY IN COLOMBIA

This is the first nationwide study of epidemiological nature about lightning deaths in Colombia [13], and the 3th in Latin

America [14, 15]. Official vital statistics were collected from death certificates by the National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística—DANE), using ICD-10 codes for lightning deaths (X330 to X339 and T750). In Colombia, all “accidental deaths” are evaluated by officials of the National Institute of Legal Medicine and Forensic Sciences who complete death certificates after conducting autopsies

A total of 757 lightning-related deaths were identified in 10 years. The dead ranged in age from 3 days to 81 years old (mean of 32 years old) 80.3% were males, 12% were children (14 years old and under). The crude mortality rate varies from 0 to 7.69 per million per year among the departments, and the overall annual lightning death rate in Colombia is 1.78 per million per year. (Fig 1).

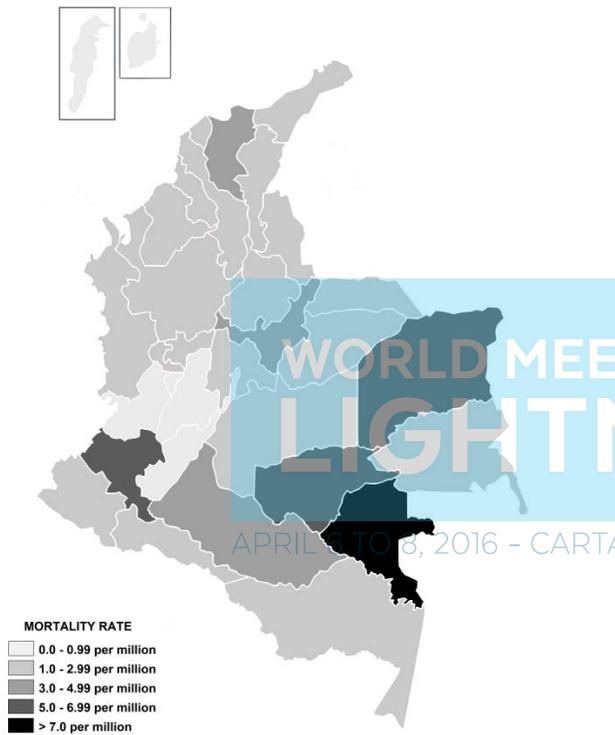


Fig. 1. Topographic distribution of lightning mortality rates by departments in Colombia.

With regard to the place where the fatalities occurred, the largest number was at home, with 268 cases (34.5%), followed by the workplace (20.1%), and Public roads (12.9%). In 592 deaths (78.2 %), there was no documentation of medical care being administered. And only 4.6% died in the health institution.

The number of fatalities (absolute frequency) was more frequent in the most populous departments (Antioquia, Cauca, Santander, Bolivar, Cordoba), while the death rate per million (relative frequency) was greater in less-populated and rural areas (Vaupes, Cauca, Vichada, Guaviare and Caqueta).

V. POTENTIAL ACTIONS TO BE IMPLEMENTED

In order to diminish the impact of lightning on the health of Colombians and following the WHO methodology and recommendations, we can suggest some action plans for the coming years.

Concerning the prevention of injuries and according to our study findings, mass media messages that alert people to seek safe haven when facing storms must be sent, similar to those of the campaign “when thunder roars go indoors” should be considered [16]. These campaigns must be oriented according to the target audience because in large urban areas audiovisual media including regional channels may be used, whereas in scattered rural areas, the use of radio stations may be the best option. It is also important to bring improvements in housing construction and the generation of protection systems to prevent damage to people living in them [17-18], since nearly 35% of deaths occur at home.

Regarding tertiary prevention, after the lightning strike, there are several things to be discussed. First, the most common cause of death in a lightning victim is cardiopulmonary arrest, manifested as asystole and respiratory standstill [19, 20]. Although the heart sometimes spontaneously resumes to an organized rhythm [21], respiratory arrest may persist and hypoxia may induce secondary hypoxic cardiac arrest [22,23]. In high-risk areas, residents must have the ability to recognize the absence of signs of life and start basic CPR (Basic Life Support) [24, 25].

Although improvements in emergency care systems are always feasible, regional topographic features, distances between towns, and the very high number of deaths in remote rural areas (62.2%), make the initial impact on the survival of the injured to depend primarily on the companion or witness who performs the CPR in a properly and timely manner [26, 27].

In addition, the general public should know that transient loss of consciousness and paralysis may occur. There is an event called Keraunoparalysis, which is characterized by a flaccid paralysis accompanied by vasomotor changes, which may last several hours [12]. Keraunoparalysis may explain why previously healthy individuals cannot escape when their homes are in fire, as it happened in the case of multiple victims in an indigenous community in Sierra Nevada de Santa Marta in October 2014. This is important so that communities in general can recognize fire hazards and help remove those disabled injured from the site of danger.

In regards to tertiary prevention and answering the question "What lightning research issues should be given special attention to in the coming years?", in the medical side it is important to generate and evaluate possible treatments to prevent or reduce neurological damage, which is the main sequela of those injured by lightning. This is a big field to work on.

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