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Injuries due to fireworks use: A surveillance data analysis in Colombia, 2008–2013

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ABSTRACT

Purpose: To describe the injuries due to fireworks use in Colombia during the period 2008–2013 and to identify factors associated with hospitalization and death due to this cause.
Methods: A descriptive study from surveillance data was carried out. Incidence rates and relative risks were calculated. The incidence rate trend was modeled with a joint point regression model. Multivariate logistical models were implemented to identify the associated factors with hospitalization and mortality due to firework injuries.
Results: A total of 6585 people were reported to be injured by fireworks during the 2008–2013 period. An upward trend in the incidence rate during this period was observed, with an annual percentage of change of 28% (95% CI 27.7–28.3) during 2008–2011 and 3.5% (95% CI 3.0–3.9) during 2011–2013. The factors associated with hospitalization were injury occurrence at the workplace (odds ratio (OR) 2.62, 95% CI 1.97–3.47), storage (OR 2.40, 95% CI 1.54–3.73), transport (OR 1.63, 95% CI 1.20–2.21), multiple trauma (OR 1.49, 95% CI 1.31–1.70), and injury occurrence at home (OR 1.26, 95% CI 1.07–1.50). The factors associated with mortality were storage (OR 19.52, 95% CI 4.62–82.44), transport (OR 13.37, 95% CI 3.29–54.3), injury occurrence at the workplace (OR 4.88, 95% CI 1.69–14.13), and ethnicity (OR 3.37, 95% CI 1.12–10.12).
Conclusion: These results provided information for revising the public policies and intersectorial interventions to reduce the avoidable burden due to firework injuries at all times and not just during the high injury occurrence season.

1. Introduction

Fireworks are used worldwide as they are an integral part of various national and local celebrations that have strong cultural roots [1]. Although there are a variety of festivals in which it is customary to use fireworks, the use of fireworks increases during celebrations of Christmas and New Year's Eve, religious holidays, and national and regional festivals. Combustion, deflagration, and detonation produced by fireworks can cause significant injuries to firework manufacturers and users, particularly children [2]. Risks associated with fireworks are not only limited to public and private settings, but also to places where they are manufactured, transported,

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stored, and sold [3]. Young people are the most frequently affected by firework injuries as a result of their increased use. In addition, they are part of a population group that displays greater risk behaviors because they are not experts in using fireworks, which increases the concerns and challenges [4].

Fireworks can be manufactured by hand or machine. In developing countries, handmade production of fireworks occurs under highly unsafe employment conditions, generally involving many individuals and families working in precarious infrastructure, distribution, and sale conditions. Additionally, both wholesalers and retailers of raw materials and finished products have a direct relationship with the consumer and the manufacturer and are responsible for the delivery of the products for consumption [5]. Moreover, there are vendors who often deal in camouflaged sales, either hiding fireworks in sites where fruits, shoes, or others are sold or selling them without minimum security conditions, and in sales of foreign pyrotechnic products that have not undergone quality control and are sold at very low prices (Personal communication from Bogotá Health Secretary official, 4th March, 2014). Such products are validated by the consumers who accept or reject the product [5].

Fireworks are the cause of various injuries such as burns, contusions, lacerations, amputations, and injuries due to foreign bodies [6], and can even cause death [7]. Although the risk of injury due to firework exposure is recognized and recommendations limiting or prohibiting their sale and use are implemented, the injuries continue to occur [2,8–12]. To address this problem, different measures have been taken. These include prohibition of private use of fireworks, conducting public events managed by experts, strong and permanent educational campaigns aimed at changing youth behaviors related to firework used, articulation between different public and private sectors, and alternative labor sources for handmade firework manufacturers.

Globally, the burden of firework injuries shows a wide variation, fluctuating between 2.8 and 99 injuries per 100,000. The figures depend on the year's season during which celebrations such as holidays, religious, sport events, and politician meetings occur and the type of fireworks used [12–16]. For instance, in 2014 in United States, 10,500 firework injuries and 11 non-occupational deaths occurred [17]; in Philippines for the same year, the number of firework-related injuries was 840 [18]; in China, between 2007 and 2011 during the spring festival, 734 people suffered from firework injuries [19]. Firework injuries affect mainly the population comprising people younger than 25 years old and men [7,15–20]. Case fatality rate varies between 0 and 3.6% [15,17,19]. In Colombia, a study performed in Pasto city reported an incidence of 8.25 per 100,000 during December 2005 and January 2006 [21], the most affected of the population being those under 15 years old and men [21–23].

In Colombia, despite the efforts of national and local governments to regulate the manufacture and use of fireworks, it has been observed that the use of fireworks increases during Christmas and New Year celebrations. This is the season when there is a greater chance of being injured. Moreover, not many studies on this subject are published, and the published ones are based on the intense surveillance for those seasons. Given these facts, the aim of this study was to describe the characteristics of people with firework injuries in Colombia during the period of 2008–2013 and to identify factors associated with hospitalization and death to recognize elements for understanding the phenomenon and to guide control measures.

2. Methods

2.1. Study design

A descriptive analysis was conducted to determine the characteristics of persons injured by fireworks in Colombia during the 2008–2013 period from the data reported to the Colombian national surveillance system. To investigate the factors associated with hospitalization and death due to firework injuries, two models of logistic regression were adjusted.

2.2. Information sources

The information was obtained from the notification database on firework injuries at the National Surveillance System in Public Health (*Sivigila* in Spanish) in the Colombian National Institute of Health [24,25]. Population data for rate estimation were obtained from population projections in the 2008–2013 period from the National Statistics Institute (*Departamento Administrativo Nacional de Estadísticas-DANE*) [26]. Both these sources are the official information data sources in Colombia, with national coverage.

2.3. Descriptive and trend analyses

Frequency distributions for qualitative measures of central tendency and dispersion for quantitative variables were used. Incidence rates and rate ratios were estimated with their respective 95% confidence intervals. The trend of incidence rate was modeled by regression analysis of inflection points (Joinpoint, Poisson). Statistical significance was set at 5%.

2.4. Independent variables

The variables considered in the bivariate and multivariable analysis were year of notification, date of injury, municipality of occurrence, area of occurrence (urban/rural), gender, education level, ethnicity, socioeconomic status (SES), type of injury, circumstances of the injury, and type of pyrotechnic product. All this information was collected from the notification form and sent on a weekly basis to the National Health Institute. The database was cleaned by identifying repeated or duplicate cases and mis-codification of variables. The notification process of the *Sivigila* included a very complete data cleaning process with validation rules that considered the variable code, date of consultation, epidemiological week, identification type, identification number, primary data generating units, and information units and emphasized the assessment of repeated and duplicate cases.

2.5. Dependent variable

For the model adjustment (bivariate and multivariable), the dependent variables were two dichotomous health outcomes:

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