Accident Analysis and Prevention 50 (2013) 667–677

Contents lists available at SciVerse ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

A structured autopsy-based audit of 370 firearm fatalities: Contribution to inform policy decisions and the probability of the injured arriving alive at a hospital and receiving definitive care

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ARTICLE INFO

Article history:
Received 14 August 2010
Received in revised form 16 June 2012
Accepted 18 June 2012

Keywords:
Violence
Death
Pre-hospital deaths
Firearm
Audit
Surveillance
Greece

ABSTRACT

The objectives of this autopsy-based audit of firearm-related fatalities were to acquire data to inform policy decisions and to assess the probability of the injured arriving alive at a hospital and receiving definitive care.

Evaluated variables: Demographics; co-morbidities; location and intention of the injury; toxicology; types of firearms; Abbreviated Injury Scale; Injury Severity Score (ISS); transfer means and time; and location of death.

Results: Of a total of 370 fatalities, 85.7% were male. The median age was 38 (9–95) years. Suicides (47%) and assaults (45.1%) were the most common underlying intentions.

The most seriously injured regions were the head (44.5%), thorax (25.7%), abdomen (10.7%), and spine (5.7%).

Of the 370 total subjects, 4.9% had an ISS < 16 and 59.5% had an ISS ≤ 74; both groups were classified as potentially preventable deaths.

The majority (84%) died at the scene, and only 9.8% left the emergency department alive for further treatment.

Multivariate analyses documented that postmortem ISS is an independent factor that predicts the probability of the injured reaching a hospital alive and receiving definitive care.

Individuals injured in greater Athens and those most seriously injured in the face, abdomen or spine had significantly greater chances of reaching a hospital alive and receiving definitive care, whereas those injured by a shotgun and the positive toxicology group were significantly less likely to.

In conclusion, this study provides data to inform policy decisions, calls for a surveillance network and establishes a baseline for estimating the probability regarding the location of firearm-related deaths.

1. Introduction

Violence can been divided by type into self-directed (as in suicide or self harm), collective (in acts of war or by gangs) and interpersonal (against a child, partner, elder, acquaintance or stranger) (Krug et al., 2002).

Each year, more than 1.5 million people lose their lives worldwide, and many more suffer non-fatal injuries, as a result of self-directed, collective or interpersonal violence, which can occur in different settings (Krug et al., 2002). In the 52 countries of the World Health Organization (WHO) European Region, approximately 164,000 deaths are due to self-inflicted injuries and approximately 73,000 deaths are the result of interpersonal violence annually (Sethi et al., 2006; Racioppi and Sethi, 2009). The incidence of violent deaths involving firearms varies from country to country with reported rates per 100,000 persons in 1997 in South Africa of 64.64, Brazil of 26.97, Jamaica of 18.72, the USA of 14.05, Estonia of 10.15, Sweden of 2.31, Greece of 1.87, Germany of 1.47, Spain of 1.01, and the United Kingdom of 0.53 (United Nations Council, 1997).

A worldwide report of 88,649 firearm-related deaths demonstrated that a higher mortality is attributed to firearms in high-income countries than in upper-middle-income countries (Krug et al., 1998). Countries with high firearm restrictions have also been reported to have lower firearm-related mortality than in countries where guns are available (The Members of the Violence

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http://dx.doi.org/10.1016/j.aap.2012.06.018

Prevention Task Force of the Eastern Association for the Surgery of Trauma, 1995). A Greek report suggests that violence in that country has increased over the last two decades (Hellenic Republic Ministry of Public Order Hellenic Police Headquarters Security and Order Brunch Public Security Division Analysis Unit, 2004).

A transition of firearm-related mortality from an epidemic to an endemic situation has also been observed in the USA and constitutes a difficult problem to solve (Christoffel, 2007). In addition to potentially avoidable loss of life, the destructive impact of violence is much more extensive when physical disabilities, post-traumatic psychological consequences for the survivors and economic costs are included (The Members of the Violence Prevention Task Force of the Eastern Association for the Surgery of Trauma, 1995; Miller and Cohen, 1997). Hence, the reduction of firearm-related mortality remains an important task worldwide.

In this effort, violence has been recognized to be often predictable and preventable (The Members of the Violence Prevention Task Force of the Eastern Association for the Surgery of Trauma, 1995; World Health Organization (WHO), 2004). However, public health authorities require accurate, timely and comprehensive surveillance data to prevent violent deaths (National Research Council, 2005). The collection of data and a comprehensive risk analysis allow for the development and implementation of multisectoral informed policies and effective interventions as has been previously recommended (Krug et al., 2002; Sethi et al., 2006).

However, major difficulties arise in obtaining valuable data. Autopsy possesses a strategic position and remains an important source of information in violent deaths. A large proportion of violent fatalities occur at the pre-hospital stage when an accurate diagnosis has not been determined. Hence, the need for certification of the cause of death and other legal reasons obligate the submission of fatalities to autopsy and toxicology examinations. In addition, omitting the pre-hospital trauma deaths from analyses may affect epidemiological data and injury severity estimations (Harviel et al., 1989; Hanzlick and Parrish, 1996; Riddick et al., 1998).

A structured autopsy-based audit of firearm fatalities was used in the present study. The study focuses on key components related to primary prevention and on identifying factors affecting the location of death in the previously described context of providing evidence to inform policy decisions to help institute changes where deficiencies are identified (Report of the Joint Working Party of the Royal College of Pathologists the Royal College of Physicians of London and the Royal College of Surgeons of England, 1991).

2. Methods

2.1. Objectives

The objectives of the present study were to acquire data to inform policy decisions for primary prevention and to identify factors affecting the probability of the injured arriving alive at a hospital and receiving definitive care.

2.2. Settings

The Athens Forensic Medical Department (in association with two more Forensic Medical Departments) serves the greater Athens region, the surrounding prefectures and islands outside Greater Athens, and occasionally other more remote regions of Greece.

2.3. Data acquisition

The data were obtained from the *Attica – Trauma Audit and Research Autopsy-Based Registry*. The registry was structured according to a predefined protocol and included all consecutive fatalities of all causes of trauma, excluding poisoning and drowning. All fatalities were submitted to a formal medico legal autopsy in the Athens Forensic Medical Department from January 1996 to February 2001. The processed data for all consecutive trauma deaths caused by firearms only were included in the present analysis.

2.4. Core variables

The following variables were extracted and evaluated from the registry: gender; age; ethnicity; co-morbidities; location of injury; intention of the injury; toxicology screening; mechanism of injury classified according to International Classification of Diseases injuries and causes of death, 9th Revision (ICD9) (World Health Organization (WHO), 1980); types of firearms used; distribution of all injuries according to AIS-90 anatomic regions; AIS-90 severity codes (Association for the Advancement of Automotive Medicine, 1990); postmortem Injury Severity Score (ISS) (Baker et al., 1974); time of discovery of the injured; transfer means and time to a definitive care facility; performed surgery; complications; and location at which the death occurred.

2.5. Classification of deaths according to ICD9

Deaths were classified according to the following ICD9 codes: 1. Firearm (E922, E955.0–E955.4, E970); 2. Assaults (E960–E969); 3. Self-inflicted (E950–E959); 4. Legal intervention (E970–E978); 5. Unintentional (E800–E869, E880–E929); and 6. Undetermined (E980–E989).

Classification of death as suicides or homicides was based on the autopsy findings and the phenomenology as assessed and reported for each fatality by the forensic examiners.

2.6. Diagnosis and classification of injuries by AIS-90 anatomic region and severity

To avoid subjective interpretation, the autopsy findings were used to extract the accurate description of all injuries of each subject that were consequently classified according to AIS-90 anatomic regions and AIS-90 severity codes and for the estimation of the postmortem ISS. Available hospital data were also incorporated.

The AIS-90 severity code of each injury varies from AIS1 (minor), AIS2 (moderate), AIS3 (serious), AIS4 (severe), AIS5 (critical) to AIS6 (maximum/unsalvageable). The AIS-90 anatomic region with the higher AIS-90 severity code, i.e., the most seriously injured anatomic region of each subject, was included in the stepwise logistic regression analyses. Subjects with equal AIS-90 codes in more than one AIS-90 anatomic region were reviewed and further classified by the first and second authors. The objective for the later classification was to identify the most severely injured AIS-90 anatomic region that had the potential to lead to death in a shorter period of time.

2.7. Severe injuries

Severely injured patients were defined as those with an ISS equal to or higher than 16.

2.8. Potentially preventable deaths

In this study, when the ISS of a subject was 75, the death was defined as not preventable/unsalvageable. Deaths were defined as potentially preventable/salvageable under optimal care when the subjects had an ISS equal to or less than 74 in the context of injuries that do not necessarily lead to death.