



Full length article

Road traffic injuries among children and adolescents in Singapore – Who is at greatest risk?



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ABSTRACT

Introduction: Pediatric road traffic injuries remain a significant cause of death and disability in many countries in Asia, despite the implementation of road traffic safety laws. We aim to describe the injuries, the use of restraints among road users, and risk factors associated with severe injuries for children in Singapore.

Methods: We performed a retrospective chart review of road traffic injuries presenting to the only two pediatric tertiary care hospitals in Singapore, from January 2012 to April 2016. We included children <16 years old presenting to the emergency departments within 24 h after injury (pedestrian, bicycle, motorcycle, motor vehicle). We calculated the frequencies for specific injury mechanisms, injury severity scores (ISS), and in-hospital outcomes of severe injuries (death, urgent resuscitation and emergent surgery). We performed a multivariate logistic regression to determine risk factors associated with severe injury.

Results: There were 2468 patients during the study period. The mean age was 7.9 years (SD 4.7); 60.1% of road injuries involved motor vehicle occupants (1483/2468). Most bicyclist/motorcyclists were not wearing helmets (70.0%, 245/350) and 51.1% of motor vehicle passengers (758/1483) were not restrained. Compared to motor vehicle passengers, pedestrians (adjusted OR 2.38, 95% CI 1.41–3.99), bicyclists (adjusted OR 2.12, 95% CI 1.04–4.32) and motorcyclists (adjusted OR 6.09, 95% CI 2.04–18.24) were more likely to sustain severe injuries.

Conclusion: Child pedestrians, bicyclists and motorcyclists are especially vulnerable for severe injuries. Further injury prevention efforts must focus on the enforcement of legislation to protect these high-risk groups.

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1. Introduction

Road traffic injuries remain a global epidemic and an urgent public health priority due to the magnitude of morbidity and mortality internationally (Hyder et al., 2016; Toroyan et al., 2013). Compared to countries like the United States (U.S.) (Sauber-Schatz et al., 2016) and some countries in Europe (Gijzen et al., 2014; Parkkari et al., 2013) where the mortality rate from road traffic injuries has decreased over time, these injury rates have remained stable or increased in other regions of the world, including some parts of Asia (Karkee and Lee, 2016; Razzak et al., 2013; Liu et al., 2014). Specifically, in the Western Pacific and South East Asia World

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Health Organization (WHO) regions, road traffic death rates are higher at 18.5 per 100,000 population compared to 16.1 per 100,000 in the U.S (Toroyan et al., 2013). As Asia encompasses a large area, which includes many different countries with varying traffic patterns and population densities, more specific knowledge of road traffic injuries in individual countries is necessary to implement injury prevention measures. The lack of specific country based knowledge about road traffic injuries is due to inadequate surveillance in many countries in Asia, where national trauma databases are being newly established.

Many countries in Asia, including Singapore, face rapid urbanization, with evolving infrastructure and safety practices that influence the trends of road traffic injuries. Singapore is a highly urbanized country with traffic laws mandating restraint use for motor vehicle users, motorcyclists and bicyclists (Singapore Statutes, 2016); however, a previous study has suggested significant non-compliance in the use of restraints despite these laws (Chong et al., 2016). Increased knowledge about those at risk for road traffic injuries will help inform a multi-pronged public health approach to reduce these injuries, including improvements in road infrastructure, socio-economic factors as well as stronger legislation and enforcement (Brubacher et al., 2016).

Children are a special risk group in road traffic injuries, and their risk factors for serious pediatric road trauma are multi-factorial (Mitchell et al., 2015). Young children rely on their adult caregivers to make sure they are appropriately restrained in child safety seats when they travel in motor vehicles (AAP Updates Recommendation on Car Seats, 2016). As pedestrians, their smaller body mass increases their risk for injury as they are less visible to a motorist, and are more likely to sustain injuries to multiple organs (Schaller et al., 2012; Thorén et al., 2012). Due to their developmental level, they are also at higher risk for unsafe pedestrian behaviors, such as darting onto the street after a ball (Schieber and Vegega, 2002). The objectives of this study are to describe: (1) the pediatric road traffic injuries presenting to the only two tertiary care pediatric hospitals in Singapore, (2) the use of restraints among various pediatric road users, and (3) the risk of different road users associated with severe injuries resulting in death, need for surgical intervention and emergency resuscitation.

2. Material and methods

2.1. Design and setting

This is a retrospective chart review of children evaluated in the emergency departments (EDs) of the only two tertiary care pediatric hospitals in Singapore from January 2012 to April 2016. We utilized data from both trauma registries, which are accredited by the Association for the Advancement of Automotive Medicine (AAAM). For this trauma registry, the attending emergency physician prospectively completes mandatory data fields on a structured data collection form during the patient encounter. These data are then verified and entered into the trauma registry by the trauma coordinators. The institutional review boards of both institutions approved this study.

2.2. Inclusion and exclusion criteria

We included children and adolescents <16 years old who presented within 24 h after a road traffic injury to the EDs of either hospital. This included children involved in a motor vehicle crash (MVC) as well as pedestrians, bicyclists, or motorcyclists involved in a crash with a motor vehicle. Patients transferred from neighboring countries were excluded.

2.3. Outcomes

The primary outcome was severe injuries, which was defined as the following: death, need for emergent surgery, and need for urgent resuscitation (defined as any trauma code activation, need for cardiopulmonary resuscitation (CPR), intubation, chest tube insertion, and/or blood product resuscitation). Trauma code activation at our hospitals occurs in the event of traumatic cardiopulmonary arrest or severe physiological compromise, a pediatric trauma score of 8 or less, major chest or abdominal trauma, or penetrating wounds. Secondary outcomes included the length of intensive care unit (ICU) and overall hospital stay.

2.4. Variables

Demographic characteristics (age, sex, ethnicity) of the patients were collected. We followed the International Classification of External Causes of Injury (ICECI) classification (National Institute for Public Health and the Environment, 2016) and collected the following variables describing all road traffic injuries: the location where the injury occurred, the type of injured road user (motor vehicle occupant, pedestrian, bicyclist, motorcyclist), position within the vehicle (if applicable), and the use of restraints (child safety seats, helmets). We categorized the injuries into groups by injury severity score (ISS). Children were divided into the following age categories: <1 year, 1–<2 years, 2–<6 years, 6–<10 years and 10 or more years old. From the trauma registry we collected the following data on hospitalized patients only: presenting Glasgow Coma Scale (GCS) score, injuries sustained, ED intervention for airway and circulatory stabilization, and computed tomography (CT) findings. These data on physical examination and outcomes are not routinely captured in the trauma registry among patients with mild injuries (ISS <9) who are discharged home, and hence were not collected.

2.5. Statistical analysis

Continuous variables were presented using mean (with standard deviation, SD) or median (with interquartile ranges, IQR), depending on normality of the data. Categorical data were presented with frequencies and percentages. Univariate and multivariate logistic regression modeling was performed for the primary outcomes as stated above with odds ratios (OR) and 95% confidence intervals (CI) reported. In the multivariable model, we adjusted for age, sex, and year of injury. All statistical analysis was performed using IBM SPSS Statistics Version 19.0 (SPSS Inc, Chicago).

3. Results

There were a total of 2468 children and adolescents with road traffic injuries presenting to the two EDs during the study period. The mean age was 7.9 years (SD 4.7) (Table 1). Most of the road injuries involved motor vehicle occupants (60.1%) followed by pedestrians (25.7%). The majority of the children had minor injuries, presenting with an ISS of <9 (95.9%).

Among the 1483 motor vehicle occupants, there was a high proportion of children presenting with no restraint used, which was highest in the infant group (65.7%, 92/140) followed by children aged 1–<2 years old (61.5%, 67/109) (Table 2). Of the children 0–<10 years old, 18.5% motor vehicle occupants (196/1057) were sitting in the front seat. For bicycle and motorcycle users, nearly all of the children <10 years old were not secured in bicycle seats or were not donning helmets.

For the 590 patients who were hospitalized, 90.5% of the road traffic injuries occurred on the major roadways. The majority of children sustained soft tissue injuries (67.1%), extremity injuries (17.8%), or head injuries (10.8%) (Table 3). The total number of road

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