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Original Article

Ambulance traffic accidents in Taiwan

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KEYWORDS

Ambulance traffic accident;
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 Emergency medical technician

Background/Purpose: Ambulance traffic accidents (ATAs) are the leading cause of occupation-related fatalities among emergency medical service (EMS) personnel. We aim to use the Taiwan national surveillance system to analyze the characteristics of ATAs and to assist EMS directors in developing policies governing ambulance operations.

Methods: A retrospective, cross-sectional and largely descriptive study was conducted using Taiwan national traffic accidents surveillance data from January 1, 2011 to October 31, 2016. **Results:** Among the 1,627,217 traffic accidents during the study period, 715 ATAs caused 8 deaths within 24 h and 1844 injured patients. On average, there was one ATA for every 8598 ambulance runs. Compared to overall traffic accidents, ATAs were 1.7 times more likely to result in death and 1.9 times more likely to have injured patients. Among the 715 ATAs, 8 (1.1%) ATAs were fatal and 707 (98.9%) were nonfatal. All 8 fatalities were associated with motorcycles. The urban areas were significantly higher than the rural areas in the annual number of ATAs (14.2 ± 7.3 [7.0–26.7] versus 3.1 ± 1.9 [0.5–8.4], $p = 0.013$), the number of ATA-associated fatalities per year (0.2 ± 0.2 [0.0–0.7] versus 0.1 ± 0.1 [0.0–0.2], $p = 0.022$), and the annual number of injured patients (who needed urgent hospital visits) in ATAs (19.4 ± 7.3 [10.5–30.9] versus 5.2 ± 3.8 [0.9–15.3], $p < 0.001$).

Conclusion: The ATA-associated fatality rate in Taiwan was high, and all fatalities were associated with motorcycles. ATAs in a highly motorcycle-populated area may require further

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investigation. An ambulance traffic accident reporting system should be built to provide EMS policy guidance for ATA reduction and outcome improvements.

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Introduction

Emergency medical service (EMS) personnel respond to medical emergencies and various types of disasters. Exposures to dangerous environments and hazardous processes inherent in these emergency responses could engender occupational injuries.¹ Ambulance traffic accidents (ATAs) are the leading cause of occupation-related fatalities and account for approximately 8% of nonfatal injuries among EMS personnel.^{1,2} The rate of motor vehicle incidents among EMS workers is almost 20 times higher than that among other workers.¹ ATAs involve more people and more injuries than incidents involving similar-sized vehicles.³ ATAs may delay the transportation of patients on the ambulance and lead to significant equipment repair expenses and manpower shortages.⁴ Ambulance drivers may face legal liability, and persons involved in ATAs could experience long-term psychological burdens.⁵

Occupational safety among EMS personnel, especially in Western countries, has been discussed in several studies; however, the ATA situation in Asian countries has rarely been reported.^{1,4,6–10} EMS systems in Asian countries are very different from the so-called Franco-German model and Anglo-American model, not only in the prehospital protocols but also in the cultural and socioeconomic aspects.^{11–14} In Asian cities, the response time of ambulance and the transport time from the scene to the hospital are usually much shorter than those in America or European countries.^{12,15} The dense population and narrow roads in Asian cities may also contribute to the high risk of incidents among ambulances.

Many Asians use motorcycles as their main mode of transportation.¹⁶ The motorcycle ownership rates in Asian countries are considerably high.^{16–18} In 2012, there were 1.5 persons per motorcycle in Taiwan, overwhelmingly exceeding the motorcycle density in the United Kingdom and the United States (47.4 and 118.7 persons per motorcycle, respectively).¹⁹ Traffic accidents involving motorcycles are 26 times more likely to have mortalities than those involving motor vehicles.²⁰ Hence ATAs in Asian countries, compared to those in Western countries, may have a distinct pattern. The goal of this study is to use the Taiwan national surveillance system to analyze the characteristics of ATAs and to assist EMS directors in objectively developing policies governing ambulance operations.

Methods

Study design and setting

This is a retrospective, cross-sectional and largely descriptive study using Taiwan national surveillance data on traffic accidents from January 1, 2011 to October 31, 2016.

Taiwan is located in East Asia. The population of Taiwan was estimated at 23.5 million in 2017, spread across a land area of 36,197 km², which makes the population density rank 17th in the world.²¹ There were 21.6 million vehicles in Taiwan, including 7.9 million motor vehicles and 13.7 million motorcycles. Half of Taiwan's adult population uses motorcycles as their primary mode of transportation.¹⁶ The use of helmets for motorcycle riders and passengers is mandated by law, which was enacted in 1997. The motor vehicles in Taiwan are driven on the right side of the road, with the drivers sitting in the left side of the vehicle.

The EMS system in Taiwan started in the 1960s. The public EMS system is fire-based, generally free of charge to users, and responds to prehospital emergencies. Interfacility patient transfers are usually carried out by private ambulances and are chargeable. As of 2017, there are 572 fire stations, 1188 ambulances and 14,033 emergency medical technicians (EMTs) in governmental fire departments, responsible for approximately 1.1 million ambulance runs annually.²² The average response time of ambulances in major cities is generally less than 5 min.^{12,14,21} During the deployment from the fire stations to the scenes, and during the transportation of patients from the scenes to the hospitals, the ambulances usually use sirens and flashing lights and are legally unrestrained to almost all traffic codes, such as speed limits or traffic-light controls.

The traffic accident data were obtained from the national surveillance system of the National Police Agency of Taiwan. Ground traffic accidents that had any fatalities within 24 h or any victims needing an urgent hospital visit were enrolled in the surveillance system; crashes of aircrafts or ferries were not enrolled. The surveillance system of traffic accidents contains data including the locations of the traffic accidents, the roadway information (such as the roadway type, the intersection type, the type of roadway surface, and any vision obstruction), the environment information (such as the weather, the light condition, the date, and the time of day), the driver information (such as gender, age, alcohol use, and driver license information), the parts of vehicles involved in the crash, vehicle types, and any use of protection devices.

An ATA was defined as a traffic accident in which at least one ambulance was physically involved. Fatal ATAs were defined as ATAs that had any fatality within 24 h. Nonfatal ATAs were defined as ATAs that did not have any fatality within 24 h but had at least one victim, other than the patients already on the ambulances, needing urgent hospital visits. The patients already on the ambulance prior to the traffic accident were not enrolled in the national surveillance system and thus were not included in our study. The surveillance system only follows up injured patients for 24 h; fatalities that occurred more than 24 h since the traffic accidents were not enrolled in the system.

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