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Patient and injury characteristics associated with road traffic mortality in general hospitals in southern Thailand

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Abstract

Background: Road traffic injuries are a major public health burden in developing countries. Thailand has the highest fatality rate from road traffic injuries in southeast Asia so that prevention of unintentional injuries is important.
Objective: To identify patient and injury characteristics associated with road traffic mortality in the southern provinces of Thailand.
Methods: Data on a total of 78,862 road traffic injuries recorded by the general hospitals in 5 southern provinces of Thailand, during 2008–2013, were obtained from the Office of Disease Prevention and Control. Chi-squared test was used to determine the association between patient/injury characteristics and road traffic mortality, and logistic regression was used to identify the strength of associations.
Results: In this study, road traffic mortality was found to be 1.8% of all injuries. Most of the deaths occurred in males (61.7%), who were aged 25–44 years (35.8%), being drivers (68.6%), using motorcycle (78.4%), and not wearing a helmet (61.0%). Road traffic mortality was higher among males, older age people, those who were not wearing a helmet or not fastening a seat belt, pedestrians and when people crashed with or by motor car, with wound being penetrating or blunt with penetrating, and when they were having head or neck, chest, or abdominal or pelvic cavity injuries.
Conclusion: Policies and measures for reducing road traffic mortality should focus on males and older aged persons, use of safety devices, and occurrence of multiple injuries.

Keywords: accidents; traffic; mortality; wounds and injuries

More than 1.25 million road traffic injuries occur globally each year with huge impacts on health and development of countries, but they could be partly preventable [1]. Approximately 50% of the world's injury-related morbidity and mortality occur in teenagers and young adults aged between 15 and 44 years [2–4]. The low- and middle-income countries are the hardest hit, with double the fatality rates of high-income countries and accounting for 90% of global road traffic deaths [1].

High traffic mortality rate is common in the southeast Asian countries. Annually, it is estimated that there are approximately 316,000 traffic death cases in southeast Asia, accounting for 25% of the global deaths from traffic accidents [5].

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In southeast Asia, Thailand had the highest rate, 36.2 per 100,000 population fatality rate from road traffic injuries in 2013, while the average rate was 17.0 per 100,000 population in this region [5].

Several factors are associated with traffic mortality, including demographic factors and injury characteristics [6–9]. The traffic injury mortalities occur among males by two-thirds more than among females, for cases aged under 40 years and being motorcyclists [10, 11]. In low-income countries, 45% of the traffic mortalities are pedestrians, whereas the corresponding figure is 29% in middle-income and 18% in high-income countries [12]. Mostly, the mechanism of injuries is blunt [13]. Moreover, mortality from traffic accidents is higher during holidays, for example, during New Year or Thai New Year holidays (locally known as Songkran holidays) [7].

The proper use of a motorcycle helmet can reduce the risk of death by almost 40% and the risk of severe injury by over 70% [1]. Several studies had also shown that the epidemiological characteristics and injury profiles are related to road traffic mortality [8, 14–16]. Head or body injuries are the most common cause of traffic accident-induced mortality worldwide [17–21].

The road traffic injuries remain a major public health problem in Thailand. However, there was no national system for collecting traffic injury data before 1990, so that information for setting up the proper policies to prevent and solve injury problems was lacking. Therefore, the Epidemiology Division of the Thai Ministry of Public Health designed an injury surveillance (IS) system in 1992 to set up a proper data collection system. After that, all the injury cases seeking care at an emergency department (ED) were recorded, and the data are collected from 5 sentinel hospitals in 4 regions and in Bangkok, starting from 1995. This was expanded gradually and voluntarily to 22 hospitals in 2001 and became the National Injury Surveillance System (NISS), which includes only severe injury cases, and expanded to 29 sentinel hospitals in 2004 [22]. A large injury data have been produced. A cohort study on predictors of injury mortality in Thailand focusing on non-transport injuries reported that southern residents had higher injury mortality compared to other regions [23]. This study aimed to identify patient demographic factors and characteristics of injuries associated with road traffic mortality. Results from this study can be used as baseline data for policy makers and other stakeholders on the management and prevention of mortality from traffic injuries in the hospital.

Methods

Data on traffic injuries were obtained from IS database between 2008 and 2013, from the Office of Disease Prevention and Control (ODPC). These data are hospital-based data collected from general hospitals of 5 provinces in upper southern Thailand. Data were collected by using an IS form. Patient and injury characteristics were obtained by interviewing patients or bystanders, performed by nurses. Information on demographic factors of patients including age and gender, and injury characteristics including road user type, type of vehicle, safety device use, pattern of crash, mechanism of injury, body region of injury, and survival status after receiving treatment were extracted from the database. Patients could have died at any stages before, during or after treatment in the ED or the inpatient department (IPD). There were 78,862 cases of traffic injuries included in this study. Data were cleaned to eliminate the errors of coding and recording before performing data analyses. Age group was classified as below 15, 15–24, 25–44, and 45 years and older. Road user type was grouped as drivers, passengers, pedestrians, and unknown. Type of vehicle was categorized as motorcycle, motor car, pedestrian, others, and unknown. Fastening seat belt or helmet was grouped as yes, no, and unknown. Pattern of road traffic crash was categorized as crashed with or by a motorcycle, crashed with or by motor car, crashed with or by others, and unknown. Mechanism of injuries was grouped as blunt, penetrating, or blunt with penetrating, and unknown. Body region of injuries was categorized as head or neck, facial, chest, abdominal or pelvic cavity, extremities or pelvic girdles, external injuries, and unknown.

Descriptive statistics were calculated for each variable. In this study, the determinants consist of patient demographic factors and injury characteristics. The outcome is road traffic mortality. Chi-squared test was used to find the association between determinants and outcome. Logistic regression analysis was performed to identify the strength of association between determinants and outcome. P-value of <0.05 was used to define statistical significance. Adjusted odds ratios (aORs) together with their 95% confidence intervals (95% CIs) were used to describe the independent association between predictors and outcome. R program was used for data management and statistical analysis [24].

Results

Road traffic injuries were equally distributed by year, except for the year 2008 with the lowest percentage (9.1%). The majority of injuries occurred in males (61.7%). Patients aged 25–44 years had the highest percentage of road traffic injuries (35.8%) followed by age groups 15–24 years (30.2%), and 45 years or older (19.2%), respectively. The majority of road user types were drivers (68.6%) and motorcyclists (78.4%). There were 61.0% of injury cases who did not wear a helmet. The major pattern of road traffic crash was crashing with or by motor car, accounting for 24.2%, followed by crashed with or by motorcycle for 21.7%. The typical mechanism of injuries was blunt, accounting for 88.8%. About 45.7% of injuries by body region were external injuries. There were 1.8% of patients who died from traffic injuries as summarized in **Table 1**.

Table 2 summarizes the associations between road traffic mortality and independent variables based on chi-squared test. To eliminate the collinearity between the variables, type of road users, type of vehicle, and safety device use were combined to create a new variable called road user–vehicle type–safety device use. The results showed that three-fourths of road traffic deaths occurred in males (75.3%). The predominance of deaths occurred in the age group from 25 to 44 years, accounting for 44%. About 37.6% of deaths were drivers or passengers using motorcycle and not wearing helmet, whereas 9.9% of deaths were drivers or passengers using motor car and not fastening the seat belt. Most of the deaths were by crash by motor car, accounting for 42.4%. The major mechanism of injury among the death cases was blunt (82.2%). There were 45.8% of deaths from head or neck injuries. Results from chi-squared test show that gender, age group, road user–vehicle type–safety device use, pattern of traffic crash, mechanism of injuries, and body region of injuries were significantly associated with road traffic mortality ($P < 0.001$) as summarized in **Table 2**.

Table 3 summarizes the association between demographic factors and injury characteristics with road traffic mortality from multivariate analysis. The results showed that gender, age group, road user–vehicle type–safety device use, pattern of road traffic crash, mechanism of injuries, and body region of injuries were statistically significantly associated with road traffic mortality. Males were more likely to die from road traffic injury than females by 1.66 times. Road traffic mortality significantly increased with age. Patients aged 15–24, 25–44, and 45 years and older were more likely to die by 1.95, 2.83, and 2.82 times than patients aged less than 15 years. Driver or passenger using motorcycle and not wearing helmet, driver or passenger using motor car not fastening seat belt and pedestrian had higher morality than driver or passenger using motorcycle and wearing a helmet by 2.08, 3.37, and 5.65 times, respectively. Those with penetrating or blunt and penetrating injuries were more likely to die by 1.55 times than those with only blunt injuries. Those who crashed or were crashed by motor car had higher mortality than those who crashed or

Table 1. The distribution of demographic factors and injury characteristics in relation to road traffic mortality

Patient and injury characteristics	Number (N = 78,862)	Percent (%)
Year of injuries		
2008	7,184	9.1
2009	14,962	19.0
2010	14,504	18.4
2011	14,486	18.3
2012	13,863	17.6
2013	13,863	17.6
Gender		
Male	48,691	61.7
Female	30,171	38.3
Age groups		
<15 years	11,695	14.8
15–24 years	23,824	30.2
25–44 years	28,208	35.8
≥45	15,135	19.2
Type of road users		
Driver	54,121	68.6
Passenger	19,302	24.5
Pedestrian	2,777	3.5
Unknown	2,662	3.4
Type of vehicles		
Motorcycle	61,832	78.4
Motor car	7,746	9.8
Pedestrian	2,777	3.5
Other	3,935	5.0
Unknown	2,572	3.3
Used a helmet or fastened seat belt		
Not wearing a helmet	48,063	61.0
Wearing a helmet	10,471	13.3
Not fastening a seat belt	6,705	8.5
Fastening a seat belt	1,034	1.3
Pedestrian	2,777	3.5
Unknown	9,812	12.4
Pattern of road traffic crash		
Crash with or by motorcycle	17,075	21.7
Crash with or by motor car	19,119	24.2
Crash with or by others	8,544	10.8
Unknown	34,124	43.3
Mechanism of injuries		
Blunt	69,997	88.8
Penetrating or blunt and penetrating	7,232	9.2
Unknown	1,633	2.0
Body Region of injuries		
Head or neck	11,388	14.4
Facial	2,808	3.6
Chest	1,308	1.7
Abdominal or pelvic cavity	1,980	2.5
Extremities or pelvic girdles	18,986	24.1
External injuries	36,070	45.7
Unknown	6,322	8.0
The status of injured patients		
Died	1,431	1.8
Survived	77,431	98.2

Table 2. The association between factors and road traffic mortality from chi-square test

Patient and injury characteristics	Road Traffic Injuries		*P*
	Death 1,431	Survival 77,431	
Gender			<0.001
Female	354 (24.7)	29,817 (38.5)	
Male	1,077 (75.3)	47,614 (61.5)	
Age-group			<0.001
< 15 years	104 (7.3)	11,591 (15.0)	
15–24 years	329 (23.0)	23,495 (30.3)	
25–44 years	630 (44.0)	27,578 (35.6)	
≥ 45 years	368 (25.7)	14,767 (19.1)	
Road user and vehicle type in each safety device			<0.001
D/P using motorcycle not wearing a helmet	538 (37.6)	46,719 (60.3)	
D/P using motorcycle wearing a helmet	57 (4.0)	10,319 (13.3)	
D/P using motor car not fasten seat belt	142 (9.9)	6,338 (8.2)	
D/P using motor car fasten seat belt	10 (0.7)	1,005 (1.3)	
Pedestrians	100 (7.0)	2677 (3.5)	
Others and unknown	584 (40.8)	10,373 (13.4)	
Pattern of road traffic crash			<0.001
Crash with or by motorcycle	300 (21.0)	16,775 (21.7)	
Crash with or by motor car	607 (42.4)	18,512 (23.9)	
Crash with or by others	159 (11.1)	8,385 (10.8)	
Unknown	365 (25.5)	33,759 (43.6)	
Mechanism of injuries			<0.001
Blunt	1,177 (82.2)	68,820 (88.9)	
Penetrating or blunt and penetrating	206 (14.4)	7,026 (9.1)	
Unknown	48 (3.4)	1,585 (2.0)	
Body region of injuries			<0.001
Head or neck	655 (45.8)	10,733 (13.9)	
Facial	29 (2.0)	2,779 (3.6)	
Chest	51 (3.6)	1,257 (1.6)	
Abdominal or pelvic cavity	69 (4.8)	1,911 (2.5)	
Extremities or pelvic girdles	146 (10.2)	18,840 (24.3)	
External injuries	272 (19.0)	35,798 (46.2)	
Unknown	209 (14.6)	6,113 (7.9)	

Note: D/P refers to driver or passenger

were crashed by motorcycle by 2.02 times. Having head or neck, chest and abdominal or pelvic cavity injuries induced higher mortality than injuries to extremities or pelvic girdles by 6.96, 4.21, and 4.16 times, respectively, as summarized in **Table 3**.

Discussion

This current study assessed the road traffic mortality and its determinants from general hospitals in southern Thailand. Road traffic accident mortality in general hospital records was found to be 1.8% of all injuries. Gender, age group, road user–vehicle type–safety device use, pattern of road traffic crash, mechanism of injuries and body region of injuries were significantly associated with road traffic mortality.

Our study data had fairly low rate of road traffic mortality when compared to other countries, such as 2.2% from trauma referral in hospitals of Tanzania [25], 4.9% from trauma center care hospital in Libya [26], and 7.7% from a teaching hospital in Kenya [6]. This low rate of mortality might be because the severe cases from traffic accidents who were admitted to general hospitals tended to be referred to tertiary hospitals, due to the lack of advanced medical equipment, treatment, and specialists.

In this study, about three-fourths of road traffic mortalities were males. Similar results were found in studies conducted in Ghana by Der et al. [27] and in Vietnam by Ngo et al. [21].

Table 3. Factors associated with road traffic mortality from multivariate analysis

Variable	Crude odds ratio (95%CI)	Adjusted odds ratio (95% CI)	*P*
Gender			
Female	1	1	
Male	1.90 (1.69–2.15)	1.66 (1.46–1.88)	<0.001
Age-group			
< 15 years	1	1	
15–24 years	1.56 (1.25–1.95)	1.95 (1.55–2.45)	< 0.001
25–44 years	2.55 (2.07–3.14)	2.83 (2.28–3.50)	< 0.001
≥ 45 years	2.78 (2.23–3.46)	2.82 (2.26–3.54)	< 0.001
Road user and vehicle type in each safety device			
D/P using motorcycle not wearing a helmet	2.08 (1.59–2.74)	2.08 (1.58–2.75)	< 0.001
D/P using motorcycle wearing a helmet	1	1	
D/P using motor car not fasten seat belt	4.06 (2.98–5.52)	3.37 (2.47–4.61)	< 0.001
D/P using motor car fasten seat belt	1.80 (0.92–3.54)	1.34 (0.68–2.65)	0.396
Pedestrians	6.76 (4.87–9.39)	5.65 (4.03–7.91)	< 0.001
Others and unknown	10.19 (7.76–13.39)	9.44 (7.15–12.47)	< 0.001
Pattern of road traffic crash			
Crash with or by motorcycle	1	1	
Crash with or by motor car	1.83 (1.59–2.11)	2.02 (1.75–2.34)	< 0.001
Crash with or by others	1.06 (0.87–1.29)	1.05 (0.86–1.28)	0.657
Unknown	0.60 (0.52–0.71)	0.60 (0.51–0.71)	< 0.001
Mechanism of injuries			
Blunt	1	1	
Penetrating or blunt and penetrating	1.71 (1.48–1.99)	1.55 (1.32–1.81)	< 0.001
Unknown	1.77 (1.32–2.37)	1.05 (0.77–1.42)	0.768
Body Region of injuries			
Head or neck	7.87 (6.57–9.44)	6.96 (5.79–8.63)	< 0.001
Facial	1.35 (0.90–2.01)	1.32 (0.88–1.98)	0.173
Chest	5.24 (3.79–7.24)	4.21 (3.02–5.86)	< 0.001
Abdominal or pelvic cavity	4.66 (3.49–6.23)	4.16 (3.10–5.59)	< 0.001
Extremities or pelvic girdles	1	1	
External injuries	0.98 (0.80–1.20)	1.12 (0.91–1.37)	0.289
Unknown	4.41 (3.56–5.46)	3.95 (3.18–4.91)	< 0.001

Moreover, this finding is in agreement with the results of several studies [28, 29]. This might be due to more frequent driving, having driving risk behaviors, and more exposure to driving occupations. The risk of road traffic mortality increased with age. The result matches the findings from several studies [30–34]. This result may be explained by the deterioration in health with aging. Even minor injuries can bring serious health problems, require long time of recovery, and increase the risk of death for elderly persons [33, 34].

Pedestrians had elevated risk of mortality. Our finding is consistent with the findings of several prior studies [35–38]. The possible reasons for higher mortality among pedestrians might be more severe impacts, such as pedestrians crashed from back, crashed at high speed or by drink driver, and crashed directly by the vehicle without any protection. Not wearing a helmet or fastening a seat belt gave higher risk of mortality. This finding supports many other studies [1, 4, 7, 39]. Wearing helmet or fastening seat belt can protect against injuries and mortality from accident efficiently. It has been shown that the use of safety helmets and fastening seat belts is a most effective way to reduce mortality and morbidity from traffic injuries [1]. It seems possible that either further education about the benefits of fastening seat belt or helmet use for drivers and passengers or seat belt or helmet laws applied to more drivers or passenger might increase these safe behaviors. In Thailand, helmet was used by more than 25% of motorcycle drivers between 2005 and 2009 [11], but in this current study only in southern Thailand in 2008–2013 it is shown that the helmet use was less frequent (13.3%). Government should rigorously enforce laws on using injury-protective devices.

Mortality when crashed with or crashed by motor car was significantly higher than crashed with or crashed by motorcycle. This is supported by studies conducted in Iran, USA, and

Albania [28, 40–41]. The probability of mortality in the event of a crash with motor car is elevated, but the main road users in this study were motorcycle users. Driving at a high speed is common among car drivers, and this also increases the chances of getting in an accident. Accidents from high-speed driving, drowsiness, fatigue, and driver health status result in severe injuries and mortality [42, 43].

Mortality from penetrating or blunt and penetrating was higher than from blunt trauma only. This is because penetrating injuries can be seen from external bleeding, while blunt injuries cannot be evaluated for bleeding from external appearance. The mechanism of blunt and penetrating affects both internal and external organs, thereby tending to have higher severity of injury. Our current study contrasts with other studies that have reported blunt injuries only as the majority in mortality cases, in Iran, USA, and Egypt [13, 44, 45].

Head or neck injuries had higher mortality than injuries to extremities or pelvic girdles. High mortality from head injuries was reported in previous studies, such as in Kenya, Laos, Vietnam, Libya, and China [6, 19, 21, 26, 46]. This might be due to most drivers and passengers not wearing helmets, despite their use being required by law. In addition, this current study revealed that chest and abdomen or pelvic cavity injuries also had high mortality, because the single vital organ injuries of patients are too serious to be recovered.

There are some limitations to this current study. Some information of patients was not recorded, and there were missing data in almost all the variables. However, the largest percentage of missing data was in the unknown status of fastening seat belt or using helmet. The data used in this study were secondary data and might contain some errors that cannot be detected. Some information related to treatment and the status of patients after discharging from the hospital was not recorded.

Conclusion

Any policies and measures set up by the authorities to reduce mortality from road traffic injuries should emphasize males, older aged people, pedestrians, not wearing helmet or fastening seat belt, being crashed with or by motor car, having blunt and penetrated as the mechanism of injury, and having head or neck, chest, or abdominal or pelvic cavity injuries.

Author contributions. All the authors contributed substantially to the conception and design of this study and acquisition of data and analyzed and interpreted the data. Sunee Kraonual and Sampurna Kakchapati drafted the manuscript. Apiradee Lim and Attachai Ueranantasun contributed substantially to its critical revision. All the authors approved the final version submitted for publication and take responsibility for the statements made in the published article.

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Conflict of interest statement. The authors have completed and submitted the International Committee of Medical Journal Editors Uniform Disclosure Form for Potential Conflicts of Interest. None of the authors disclose any conflict of interest.

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