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Epidemiological Characteristics of Traffic and Non-traffic Injuries and Quality of Emergency Medical Services in Southern Thailand

Patcharee Prommoon, M.N.S.[1], Thanom Phibalsak, M.N.S.[1], Janya Netwachirakul, B.N.S.[1], Mayuree Mekthat, M.Sc.[1], Walailuk Jitpiboon, M.Sc.[2], Rassamee Sangthong, M.D., Ph.D.[2,3]

[1]Emergency Department, Hatyai Hospital, Hat Yai, Songkhla 90110, Thailand.

[2]Epidemiology Unit, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

[3]Research Unit for Kids and Youth Development, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

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Abstract:

Objective: This study aimed to report the situation of injuries and emergency medical services in southern Thailand.

Material and Methods: Data from the Injury Surveillance system of a Level 1 Trauma Center Hospital in lower southern Thailand during 2012-2016 were extracted. Trends in epidemiological characteristics of both traffic and non-traffic injuries and emergency medical services were described. Logistic regression was used for the analysis.

Results: The number of patients admitted to emergency departments due to traffic and non-traffic injuries was stable over the five-year period (n=102, 840). Traffic injuries involving motorcycles and falls were the two leading causes of injury. Most were adults aged 19-60 years (62.5%). The most common risky behaviors were driving a motor vehicle without wearing a seatbelt (81.9%) and riding a motorcycle without wearing a helmet (71.7%). Alcohol and drug use were relatively low but significantly increased the odds of sustaining a severe/critical injury. Significant predictors of severe/critical non-traffic injury included drowning [odds ratio (OR)=29.7, 95% confidence interval (CI)=11.9-74.7], self-harm/suicide (OR=12.6, 95% CI=9.2-17.3), and bites/stings from poisonous animals (OR=8.1, 95% CI=6.1-10.8). The use of Emergency Medical Services (EMS) was low but increased over time. The main challenge was delivering appropriate EMS for different levels of injury. The percentage of health care staff who performed advanced life support appropriately for critically injured patients ranged from 95.5% to 100.0% while for severely injured patients, ranged from 93.9% to 100.0%.

Contact: Rassamee Sangthong, M.D., Ph.D.
Epidemiology Unit, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
Research Unit for Kids and Youth Development, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
E-mail: rassamee.s@psu.ac.th

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Conclusion: Traffic and non-traffic injuries were high and the use of EMS was still low in southern Thailand.

Keywords: emergency medical service, injury surveillance system, non-traffic, traffic

Introduction

Premature deaths among people aged 15-29 years are mainly caused by road traffic injuries while other injuries, such as suicide and drowning, are among the top ten globally.[1] Road fatality rates in Thailand were estimated to be as high as 36.2 per 100,000 population in 2013, the second highest rate in the world.[2,3] The Thai government, led by the Bureau of Non-Communicable Diseases, aims to reduce the traffic fatality rate to below 10 per 100,000 population in 2020.[4] The rate of deliberate self-harm and suicide in Thailand increased from 7.9 in 2003 to 12.9 per 100,000 population in 2016.[1,5,6] Similarly, drowning has become the leading cause of death among people aged <15 years.[4] In South Korea, suicide ranks number one as the cause of death amongst adolescents. In Eastern Ethiopia, it is injuries due to conflict and road traffic accidents.[7,8] Effective interventions and policies to prevent injuries and good pre-hospital services are urgently needed.

Thailand's Injury Surveillance database was developed by the Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health in 1993[9] with the aim to monitor the situation and improve prevention pre-hospital care at the local and national levels. The Injury Surveillance database can be used to assess and monitor injuries and the quality of pre-hospital services. As part of a level 1 Trauma Center in southern Thailand, we examined the epidemiological characteristics of traffic and non-traffic injuries and the quality of the pre-hospital care to understand the current situation.

Material and Methods

A retrospective cohort study was conducted using data from the Injury Surveillance database of a Level 1 Trauma Center Hospital, Ministry of Public Health in the lower southern region of Thailand. The database contains a total of 133 variables including transport method to the hospital, pre-hospital care, demographic data, type(s) of injury, risk behaviors, vital clinical data on arrival, and diagnosis on discharge.[9] Injuries sustained between 2012 and 2016 were included in this study.

Transport to hospital was recorded as by oneself, others, or via the emergency medical service (EMS). The EMS was classified into three levels[10] based on the competence of health personnel and facilities available in the vehicle. For the "Advanced Life Support" level, the healthcare worker must be a doctor or nurse who has completed appropriate training and be qualified to maintain airway, control bleeding, give fluid replacement and/or medical injections, stabilize fractures, immobilize the cervical spine and transfer a critical patient safely. Health workers at the "Basic Life Support" level must have completed 110 hours of training, be able to stop bleeding, give appropriate oral medications, transfer a patient safely and assist in childbirth. A "First Responder" is anyone who has completed 40 hours of first aid training and knows how to transfer a patient safely.

Injury and external causes of injury were defined by the International Classification of Diseases, 10th edition (ICD-10) chapters 19 and 20, respectively.[11,12] Injuries were defined broadly into traffic and non-traffic types. Risk behaviors at the time of sustaining the injury included alcohol and substance use, not wearing a seatbelt while driving (or travelling in) a vehicle, not wearing a helmet while riding a motorcycle, and mobile phone use. Severity of injury was measured by the Emergency Severity Index (ESI) Version 4 which categorizes from very mild (1) to critical (5).[13] Only the last two years (2015-2016) of data on ESI were available for analysis.

The data were recorded by a well-trained triage nurse from all injured patients who visited the emergency unit. A hospital data analyst then coded and entered the data into a Microsoft Access database.

Ethical considerations

This study obtained approval from the Ethics Board Committee, Faculty of Medicine, Prince of Songkla University (No. 60-341-19-9).

Statistical analysis

The R program was used for all statistical analysis.[14] Descriptive statistics were used to examine the epidemiological nature of the individual characteristics, magnitudes and types of injuries, time of injury, and trends over the five-year period including during the special New Year and Songkran festival holidays. Use of EMS was also examined and its quality assessed based on severity of the patient's injuries and appropriateness of services delivered. Severe injuries were defined as ESI ≥3 and factors associated with severe injury were analyzed using multivariate logistic regression separately for motorcycle and motor vehicle accidents and for non-traffic injuries. Two-sided p-values were used and significance was set at <0.05.

Insufficient pre-hospital care was defined for patients who were severely or critically injured and did not receive appropriate service, such as airway maintenance, bleeding control, immobilization of cervical spine, splint/slap use or fluid replacement. Excessive pre-hospital care was defined for patients who were mildly or moderately injured and received any of the above-mentioned services unnecessarily.

Results

Epidemiological characteristics of the injuries

Victims

A total of 102,840 patients were admitted to emergency departments as a result of injuries received during 1 January 2012–31 December 2016. Table 1 shows the baseline characteristics of the study patients. Males outnumbered females by a ratio of 1.6:1. Most patients were aged 19-60 years while about one-third were children or adolescents. The highest work category was laborers (31.5%), followed by unemployed (22.5%) and students (19.1%). The most common risk behavior was not wearing a seatbelt among motor vehicle drivers (81.9%) followed by not wearing a helmet among motorcyclists (71.7%). Driving under the influence of alcohol (9.8%) and/or other drugs (0.4%) was less common.

Table 1 Characteristics of injured patients admitted to a Level 1 Trauma Center Hospital in southern Thailand, 2012-2016 (n=102,840)

Characteristic	Number	%
Gender		
Male	63,151	61.4
Female	39,689	38.6
Age group (years)		
0-6	9,632	9.4
7-18	20,361	19.8
19-60	64,299	62.5
>60	8,548	8.3
Occupation		
None (children <5 years old)	8,279	8.1
Student	19,690	19.1
Unemployed	23,144	22.5
Laborer	32,373	31.5
Government officer	7,140	6.9
Businessperson	3,595	3.5
Farmer	4,047	3.9
Others	4,572	4.5
Risky behaviors		
Not wearing seatbelt† (n=2,957)	2,421	81.9
Not wearing helmet‡ (n=34,132)	24,478	71.7
Alcohol use (n=100,192)	9,776	9.8
Other drugs use (n=100,257)	399	0.4
Mobile phone use (n=100,853)	30	<0.1

† Among motor vehicle drivers. ‡Among motorcycle riders.

Magnitude, trend, types of injuries and use of emergency medical services

As shown in Table 2, the numbers of admissions due to injuries were consistent across the five-year period. Non-traffic injuries were more common than traffic injuries. Injuries involving motorcycles were the most common traffic injury followed by injuries involving private vehicles such as pick-up trucks, cars, and bicycles. Injuries involving public transport vehicles such as buses and taxis were rare. The most common causes of non-traffic injuries were collisions, falls, body assaults, and animal bites. Self-harm and suicide, poisoning, and drowning were uncommon. The overall utilization of the emergency medical services was 24.2% and the rate increased each year. Use of the service among patients with traffic injuries was substantially higher than that of patients with non-traffic injuries.

Time of injury

As shown in Figure 1, the distributions of the time of injury for both traffic and non-traffic injuries were bimodal, with peaks occurring between 06:00-8:00 and between 17:00-18:00 for traffic injuries and between 12:00-13:00 and between 17:00-18:00 for non-traffic injuries.

Table 2 Types of injuries and use of emergency medical services by year, 2012-2016

Type of injury	2012	2013	2014	2015	2016
All injuries	20,090 (19.5)	20,045 (19.5)	20,526 (20.0)	21,436 (20.8)	20,743 (20.2)
Traffic (type of vehicle)	n=8,662	n=8,262	n=8,172	n=8,571	n=8,315
Motorcycle	7,211 (83.2)	6,996 (84.7)	6,929 (84.8)	7,208 (84.1)	7,023 (84.5)
Pick-up truck	379 (4.4)	372 (4.5)	321 (3.9)	371 (4.3)	374 (4.5)
Bicycle/tricycle	290 (3.3)	266 (3.2)	291 (3.6)	391 (4.6)	303 (3.6)
Private car	189 (2.2)	156 (1.9)	188 (2.3)	159 (1.9)	211 (2.5)
Truck/caravan	52 (0.6)	45 (0.5)	38 (0.5)	41 (0.5)	34 (0.4)
Minibus/bus/taxi	35 (0.4)	34 (0.4)	30 (0.4)	24 (0.3)	43 (0.5)
Van	45 (0.5)	21 (0.3)	37 (0.5)	36 (0.4)	26 (0.3)
Others	461 (5.3)	372 (4.5)	338 (4.1)	341 (4.0)	301 (3.6)
EMS use	2,853 (32.9)	2,864 (34.7)	2,975 (36.4)	3,481 (40.6)	3,466 (41.7)
Non-traffic	n=11,428	n=11,783	n=12,354	n=12,865	n=12,428
Collision	4,460 (39.0)	4,548 (38.6)	4,432 (35.9)	4,535 (35.3)	4,335 (34.9)
Fall	3,174 (27.8)	3,269 (27.7)	3,639 (29.5)	3,761 (29.2)	3,934 (31.7)
Physical assault	1,525 (13.3)	1,526 (13.0)	1,635 (13.2)	1,700 (13.2)	1,492 (12.0)
Animal attack	839 (7.3)	1102 (9.4)	1,312 (10.6)	1,451 (11.3)	1,377 (11.1)
Self-harm	334 (2.9)	298 (2.5)	270 (2.2)	263 (2.0)	236 (1.9)
Poisoning	318 (2.8)	289 (2.5)	326 (2.6)	329 (2.6)	290 (2.3)
Drowning	22 (0.2)	15 (0.1)	22 (0.2)	16 (0.1)	18 (0.1)
Others	756 (6.6)	736 (6.2)	718 (5.8)	810 (6.3)	746 (6.0)
EMS use	918 (8.0)	938 (8.0)	941 (7.6)	1,173 (9.1)	1,272 (10.2)

Numbers in the table are frequency (%)
EMS=emergency medical services

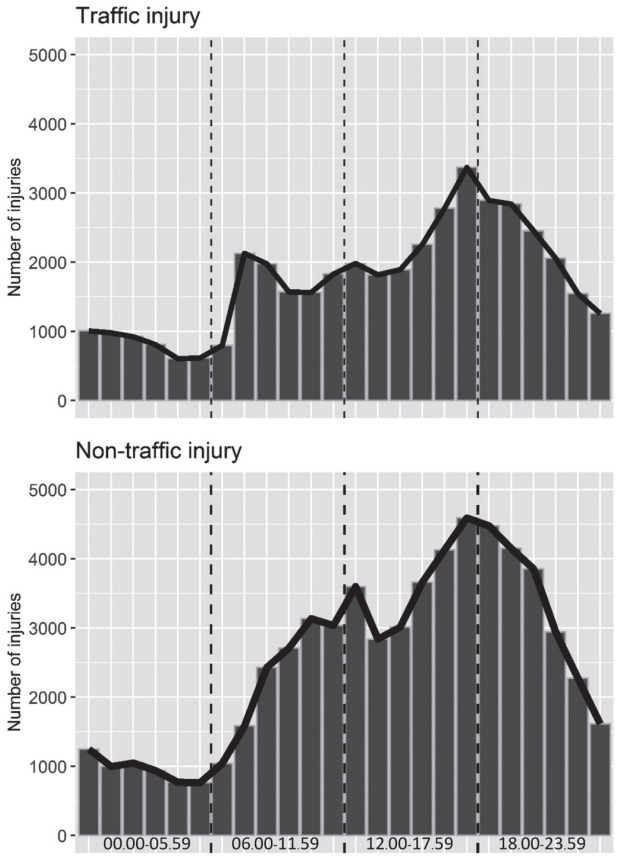

Figure 1 Distribution of time of injury by injury type

Critical period of injuries during the New Year and Thai Traditional New Year holidays

Figure 2 shows the number of injuries occurring per day during the international and Thai traditional (Songkran) New Year holiday festivals, periods of relatively higher injuries compared to other times of the year. During the international New Year period, the highest numbers of admissions due to traffic and non-traffic injuries occurred on New Year's Eve and New Year's day, respectively. During the Songkran festival, the highest number of admissions due to injuries occurred on April 13, Songkran day.

Associated factors of severe injury

Table 3 shows the factors associated with severe injury for persons injured from motorcycle accidents, motor vehicle accidents, and non-traffic injuries. Among those involved in motorcycle accidents, males [odds ratio (OR)=1.6, 95% confidence interval (CI)=1.3-1.9] and those aged more than 60 years (OR=2.3, 95% CI: 1.5-3.5) were more likely to have severe injuries as were those who did not wear a helmet (OR=2.8), used alcohol (OR=3.1) or other drugs (OR=4.9), and did not use the EMS (OR=2.7). The only significant risk factor for severe injury among those involved in motor vehicle accidents was not wearing a seatbelt (OR=2.2, 95% CI: 1.0-4.8). For non-traffic injuries, males were more likely to have a severe injury (OR=2.3, 95% CI: 2.0-2.6) as were those aged >60 years (OR=2.0), and those who used alcohol (OR=1.6) or other drugs (OR=3.0). Non-use of the EMS was associated with not having severe injuries (OR=0.7, 95% CI: 0.6-0.8). Compared to injuries caused by animals, drowning (OR=29.7), self-harm (OR=12.6), and poisoning (OR=8.1) were significantly more likely to cause severe injuries.

Coverage and quality of pre-hospital care by EMS

Overall, 24.2% of patients received pre-hospital care by EMS. Among these, Basic Life Support (57.1%) was the most common service followed by First Responder (38.3%) and Advanced Life Support (4.6%). Table 4 shows the appropriateness of EMS by severity of injury. Less than half of all patients received appropriate EMS services with one-third receiving an insufficient level of care and one-fifth receiving an excessive level of care. Additional analysis revealed that the fatality rate was highest (78.6%) among patients who received insufficient pre-hospital care compared to 21.4% among those who received appropriate

care. Among those who were critically or severely injured, 92.9% received an insufficient level of care while 63.4% of those whose injury was mild or very mild received an excessive level of care.

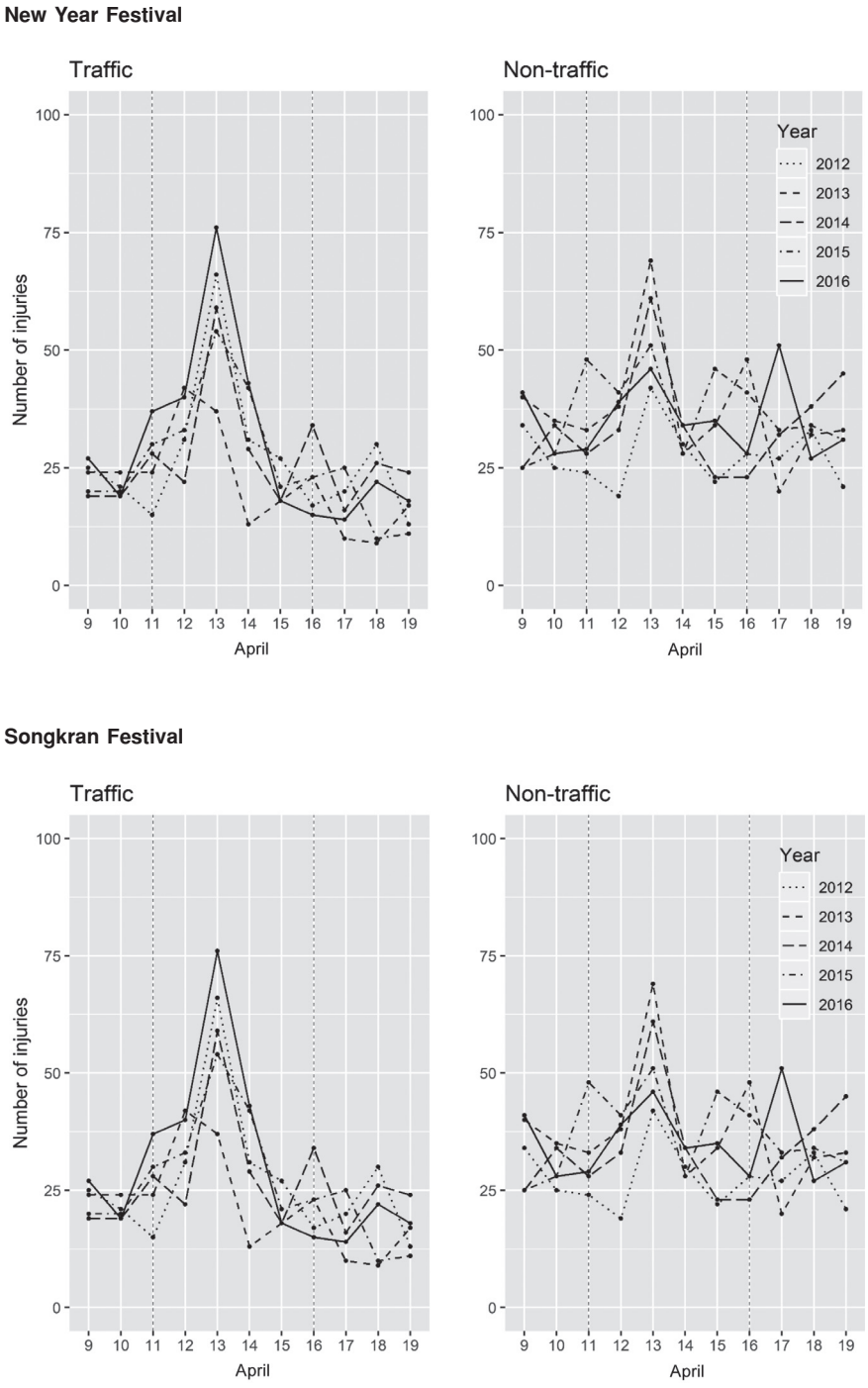

Figure 2 Number of injuries per day during the New Year's and Songkran festivals, 2012–2016

Table 3 Associated factors for severe/critical injury by type of injury

Factor	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Motorcycle accidents (n=12,738)			
Gender (Ref.=Female)			<0.001
Male	2.1 (1.8, 2.4)	1.6 (1.3, 1.9)	
Age (years) (Ref.=0–6)			<0.001
7–18	0.7 (0.5, 1.0)	0.8 (0.6, 1.2)	
19–60	0.9 (0.6, 1.3)	1.0 (0.7, 1.4)	
>60	2.1 (1.4, 3.1)	2.3 (1.5, 3.5)	
Time of injury (hr) (Ref.=06:00–11:59)			<0.001
00:00–05:59	1.1 (0.9, 1.4)	0.5 (0.4, 0.7)	
12:00–17:59	1.1 (0.9, 1.3)	1.1 (0.9, 1.3)	
18:00–23:59	1.2 (1.0, 1.4)	0.8 (0.6, 1.0)	
Not wearing helmet	2.9 (2.4, 3.5)	2.8 (2.3, 3.4)	<0.001
Alcohol use	3.2 (2.7, 3.7)	3.1 (2.6, 3.7)	<0.001
Drug use	5.9 (2.7, 13.1)	4.9 (2.1, 11.6)	<0.001
No EMS use	2.6 (2.3, 3.1)	2.7 (2.3, 3.2)	
Automobile accidents (n=307)			
Gender (Ref.=Female)			0.987
Male	1.0 (0.5, 1.8)	1.0 (0.5, 1.9)	
Age (years) (Ref.=0–6)			0.739
7–18	1.1 (0.2, 7.2)	1.3 (0.2, 8.2)	
19–60	1.3 (0.3, 6.0)	1.6 (0.3, 8.0)	
>60	0.7 (0.1, 5.7)	0.8 (0.1, 7.0)	
Time of injury (hr) (Ref.=06:00–11:59)			0.291
00:00–05:59	0.6 (0.2, 1.4)	0.4 (0.1, 1.1)	
12:00–17:59	0.8 (0.3, 1.8)	0.8 (0.3, 1.9)	
18:00–23:59	1.0 (0.4, 2.3)	0.9 (0.4, 2.2)	
Not wearing seatbelt	1.8 (0.9, 3.8)	2.2 (1.0, 4.8)	0.032
Alcohol use	0.9 (0.5, 1.9)	1.5 (0.6, 3.8)	0.381
No EMS use	1.7 (0.9, 3.2)	1.9 (1.0, 3.6)	0.060
Non-traffic injuries (n=23,737)			
Gender (Ref.=Female)			<0.001
Male	1.7 (1.5, 1.9)	2.3 (2.0, 2.6)	
Age (years) (Ref.=0–6)			<0.001
7–18	1.3 (1.1, 1.7)	1.0 (0.8, 1.3)	
19–60	1.9 (1.5, 2.3)	1.2 (1.0, 1.5)	
>60	2.1 (1.6, 2.6)	2.0 (1.6, 2.6)	
Time of injury (hr) (Ref.=06:00–11:59)			0.002
00:00–05:59	1.6 (1.3, 1.9)	0.9 (0.7, 1.1)	
12:00–17:59	1.1 (0.9, 1.2)	1.1 (0.9, 1.3)	
18:00–23:59	1.0 (0.9, 1.2)	0.8 (0.7, 1.0)	
Type of injury (Ref.=Animal attack)			<0.001
Accident	0.5 (0.4, 0.7)	0.4 (0.3, 0.5)	
Fall	1.3 (1.1, 1.7)	1.1 (0.9, 1.4)	
Assault	3.4 (2.7, 4.3)	2.8 (2.2, 3.5)	
Self-harm	17.0 (12.8, 22.6)	12.6 (9.2, 17.3)	
Poisoning†	8.7 (6.6, 11.5)	8.1 (6.1, 10.8)	
Drowning	29.8 (12.4, 71.9)	29.7 (11.9, 74.7)	
Others	2.2 (1.7, 3.0)	1.8 (1.3, 2.3)	
Alcohol use	3.2 (2.7, 3.8)	1.6 (1.3, 2.0)	<0.001
Drug use	14.9 (10.6, 20.8)	3.0 (2.0, 4.6)	<0.001
No EMS use	0.4 (0.4, 0.5)	0.7 (0.6, 0.8)	<0.001

OR=odds ratio, CI=confidence interval, EMS=emergency medical services, Ref=reference group
†Includes snake bites and eating poisonous plants.

Table 4 Appropriateness of emergency medical services by severity of injury

Severity of injury	Number	Appropriateness of services, n (%)		
		Insufficient	Appropriate	Excessive
All	9,029	2,862 (31.7)	4,101 (45.4)	2,066 (22.9)
Severe to critical	772	717 (92.9)	55 (7.1)	–
Moderate	5,253	2,145 (40.8)	2,947 (56.1)	161 (3.1)
Mild to very mild	3,004	–	1,099 (36.6)	1,905 (63.4)

Not applicable

Table 5 Percentage of services appropriately delivered to patients with critical and severe injuries by emergency medical services level (n=772)

EMS level	Number	Appropriate service, n (%)				
		Airway maintenance	Bleeding control	Immobilization of cervical-spine	Splint/slab	Fluid replacement†
Critical injury						
Advanced life support	22	22 (100.0)	22 (100.0)	22 (100.0)	22 (100.0)	21 (95.5)
Basic life support	104	78 (75.0)	96 (92.3)	93 (89.4)	92 (88.5)	–
First responder	77	55 (71.4)	71 (92.2)	68 (88.3)	70 (90.9)	–
Severe injury						
Advanced life support	33	33 (100.0)	31 (93.9)	32 (97.0)	31 (93.9)	32 (97.0)
Basic life support	295	227 (93.9)	283 (95.9)	276 (93.6)	289 (98.0)	–
First responder	241	217 (90.0)	229 (95.0)	225 (93.4)	238 (98.8)	–

†Assessment of fluid replacement was omitted for basic life support and first responder levels.
EMS=emergency medical services

Table 5 shows the quality of services delivered to patients with severe and critical injuries by EMS level. The appropriate service for those requiring advanced life support was given to all critically injured patients except for fluid replacement (95.5%) but between 93.9% and 100.0% of severely injured patients. For critically injured patients requiring basic life support, the quality of services delivered ranged from 75.0% to 92.3% and for severely injured patients the rate ranged from 93.9% to 98.0%.

Discussion

The study revealed dual problems of traffic and non-traffic injuries representing the burden of disability and death in youth and adults in the study areas. Motorcycle injuries and falls were the leading causes of injury requiring hospital care. Although drowning self-harm, and poisoning were comparatively less common, these types of injuries significantly increased the likelihood of a severe/critical injury.

For traffic injuries, 63.9% were contributed by road users.[15] In 1979 Thailand legislated the Road Traffic Act. B.E. 2522[15] requiring motorcycle helmets and front-seat seatbelts to reduce the severity of traffic injuries. However, this study found a high rate of injuries in which motor vehicle drivers or passengers were not wearing their seatbelts (81.9%) or motorcycle riders who were not wearing a helmet (71.7%). A national report in (2018) found that 79.9% of motorcycle riders did not wear a helmet, with the highest

percentages of non-use among 15-19 years old and young adults.[4] The poor compliance to this road safety practice has led to traffic fatality rates of 19.2% and 12.9% among populations aged 15-19 and 20-24 years, respectively.[4] Public awareness, public education, and law enforcement should thus be further improved.

Alcohol and drug use among accident victims were relatively low in this study but should not be neglected. The low numbers reported may be due to declining trends of regular drinkers and increasing numbers of Muslims residing in this region.[16,17] Drunk driving and driving under the influence of a controlled substance contributed to 6.9% and <0.1% of all road traffic accidents, respectively.[15] Our study found that alcohol and drug use substantially increased the likelihood of severe injury, especially among victims of motorcycle accidents and other non-traffic injuries, a result consistent with national reports.[4]

The peak time of injury was during the late afternoon and evening, a result consistent with reports at the regional and national levels.[4] This finding could suggest more human resources should be allocated during these high-risk periods. In Thailand, road safety interventions are increased during the New Year's and Songkran holiday periods. Our study reported a high or even higher incidence of non-traffic injuries during those two periods which calls for interventions to be increased or enhanced.

The utilization of pre-hospital care increased over time and the rate was higher for traffic injuries compared to non-traffic injuries. However, the EMS utilization rate (24.2%) was still substantially lower than the minimum expected rate of 60.0%.[18] EMS often encounter challenges in delivering the appropriate level of service to reach a high quality of pre-hospital care. A study from Iraq reported that good pre-hospital care could reduce mortality rates by 13.0%.[19] Thus, training of EMS personnel and assessment for qualification should be improved.

Strengths and weakness

As part of a Level 1 Trauma Center and a Center for EMS provision in southern Thailand, our database was large enough to provide insights on the epidemiological nature of injuries and the quality of EMS care in the southern part of Thailand. We were aware of data quality, a common problem in secondary data analysis. Thus, we carefully cleaned and verified the data to ensure reliability. Data on sensitive issues such as risky behaviors, mobile phone use, and alcohol and other drug use might be underestimated; however, we could report some significant adverse impacts. The findings from the descriptive statistics limited causal inferences being made. For example, we found that non-use of EMS was associated with a high mortality rate.

Conclusion

The situation of both traffic and non-traffic preventable injuries is still critical in Thailand and urgently needs special attention. The study identified much room for improvement needed in the EMS services. Other prevention strategies in addition to service plans and legislation should be considered. Without improved interventions, the national goal will be difficult to reach, not only by 2020, but sustained long-term.

Conflicts of Interest

None

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