

SOCIOECONOMIC INEQUALITY AND ROAD TRAFFIC ACCIDENTS IN THAILAND: COMPARING CASES TREATED IN GOVERNMENT HOSPITALS INSIDE AND OUTSIDE OF BANGKOK

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Abstract. The study aims to report annual demographic characteristics and to compare the differences of socioeconomic inequality, type of motor vehicles, and seating relating to major bone injuries among hospitals in and outside Bangkok. Six public hospitals in Bangkok and six regional hospitals in the provinces were studied over a one year period (2008-2009). There were 3,650 cases: 3,596 injured patients and 54 deaths. Patients with a lower education level accounted for the largest number of cases, both in the provinces (46.3%) and Bangkok (17.1%). Their incomes were less than THB 10,000/yearly. Total number of motorcycle cases (3,360) was higher (11.6:1) than 290 cases of motor vehicles. Pickup cars were used more commonly. Riding a motorcycle was likely to be fatal. The front seat was the most common involvement. Passengers occupying the middle and rear seat of the motorcycle were involved in 16.0% and 1.0% cases, respectively. Long bone and joints were the most common injuries. The results strongly confirmed the striking contribution of motorcycles and pickups to road traffic accidents. People with a low educational level, in conjunction with low income, and in areas outside of Bangkok were more at risk. Specific education on road safety should be delivered, preferably in primary schools.

Keywords: road traffic accidents, socioeconomic inequality, educational level, seating position

INTRODUCTION

Road traffic accidents (RTA) are the most complex and dangerous incident due to the various forces of impact. Globally,

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this type of trauma is projected to be the third leading cause of death and disability which will increase by about 65% over the next 20 years (2020) (Ameratunga *et al*, 2006; Hazen and Ehiri, 2006; Mohan, 2008). Increases in number of motor vehicles and effects of gender, age, alcohol, seating positions, speed and various impact velocities have been well documented (Evans and Frick, 1988; Wick *et al*, 1998; Ichikawa, 2002; McGwin *et al*, 2003; Wang and Jiang, 2003; Ehiri *et al*, 2006; Eid and Abu-Zidan, 2007). Surprisingly, only a

few studies have focused on seating positions in motorcycles. Although risk factors for RTA around the world are nearly the same, there are large considerable differences among and within countries (Cirera *et al*, 2001; Ameratunga *et al*, 2006). Apart from geographic variation, similarities or dissimilarities of risk exposure within the countries can be explained by difference of socioeconomic status and various individual factors (Cubbin and Smith, 2002; Borrell *et al*, 2005). Lower social classes with less educated drivers are more likely to be exposed to traffic risk and may sustain more serious injuries (Swaddiwudhipong *et al*, 1998; Cubbin and Smith, 2002; Borrell *et al*, 2005; Lu *et al*, 2005; Babio and Daponte-Codina, 2006). In several reviews (Ameratunga *et al*, 2006; Russell *et al*, 2011), reduction of reported crash rates in developed countries have been proven successful by the enforcement of graduated driver licensing systems.

Like other nations, RTA in Thailand is among the leading cause of death in young populations despite the declaration of compulsory safety intervention. Although injury profiles on individual hospital basis and trauma registry databases have been reported (Swaddiwudhipong *et al* 1994; Böhning and Na Ayutha, 1997; Na Ayuthya and Böhning, 1997; Sintuvanich, 1997; Jirojwong *et al*, 2002; Ichikawa *et al*, 2003; Suriyawongpaisal and Kanchanasut, 2003; Kasantikul *et al*, 2005; Nakahara *et al*, 2005; Woratanarat *et al*, 2009) few have examined the potential differences among geographic areas and vulnerable road users by their educational levels (Swaddiwudhipong *et al*, 1994, 1998). Moreover, there are no Thai records to identify occupant seat positions that are specifically related to the severity of major bone and joint injuries. The authors have attempted to substantiate the ac-

tual problem of RTA by reporting annual demographic characteristics of injured patients and deaths by type of motor vehicles. Socioeconomic inequality and major bone injuries according to seating positions among government hospitals in and outside Bangkok were also evaluated.

MATERIALS AND METHODS

Thailand is divided into 75 provinces that are grouped into five regions (Ministry of Public Health, 2008). There are also two special governed districts: the capital city, Bangkok, and Pattaya City, of which Bangkok is at a provincial level and is thus often counted as the 76th province. Each province is divided into districts and the districts are further divided into sub-districts (*tambon*). The Ministry of Public Health has divided Thailand's 75 provinces into 19 regions. Each region has at least one regional hospital and several general and community hospitals. Regional hospitals have at least 350; almost all have in excess of 500 beds. General hospitals are categorized as Group I, which has less than 300 beds and Group II, with over 300 beds.

This cross sectional study was conducted over a one-year period (March 2008 - March 2009). The study proposal was reviewed and approved by the Institutional Ethics Board of Lerdsin Hospital, Department of Medical Services, Ministry of Public Health, Thailand (Ref N° 41/50; 22 March 2007-21 March 2009).

Initially, this study intended to include all regional hospitals (25 hospitals), and all university or teaching hospitals in Bangkok (BKK). Inclusion criteria included hospitals that had over 500 beds, with intensive monitoring and standard definitive treatment for admitted injured patients. Before study, formal letters were

sent to all hospitals meeting these criteria, and these were followed up by personal contact. Only 12 hospitals (6 in Bangkok and 6 in regional hospitals) voluntarily accepted to corporate. All included hospitals should provide specific nurse coordinators to complete case report form in the emergency room. Nurses were asked to follow exact steps in the guideline for crashes involved in the road traffic accident. Hospitals in Bangkok are all general hospitals under the Medical Services Department, Ministry of Public Health and two other hospitals.

The profile of collected information included demographic data: income ('unemployed'; 'low,' <THB 10,000; 'middle,' THB 10,000-20,000; and 'high,' >THB 20,000); educational level ('no school,' 'primary/secondary school,' 'high school/diploma,' and 'bachelor degree/post-graduate'). In addition, information was collected specific to RTA: type of motor vehicle ['4-wheel' (pick up, sedan, and truck/van), or '2-wheel']; 'driver' or 'passenger'; seating position in the vehicle ('front,' 'middle,' or 'rear'); and type of injury ('closed' or 'open'). Information about injuries included: anatomic diagnosis by site of major bone involvement, such as fractures of 'long bone' and 'joint,' 'skull,' 'chest/rib,' and 'spine.'

Information on injuries of each patient was obtained upon review of the medical record and from emergency personnel and relatives by trauma nurse coordinators. Data from the two groups of hospital (inside and outside Bangkok) were compared to evaluate the differences in demographics and other variables, particularly socioeconomic status (income), educational level, and occupant seating related to the pattern of major bone injuries.

Table 1
Total number of cases by age groups and gender, comparing Bangkok and provinces.

| Age (yrs) | Bangkok | | Province | |
|-----------|---------|--------|----------|--------|
| | Male | Female | Male | Female |
| 1-10 | 11 | 6 | 23 | 17 |
| 11-20 | 183 | 33 | 456 | 176 |
| 21-30 | 302 | 59 | 512 | 149 |
| 31-40 | 242 | 48 | 358 | 123 |
| 41-50 | 121 | 33 | 254 | 119 |
| 51-60 | 60 | 13 | 137 | 73 |
| >60 | 21 | 10 | 82 | 29 |
| Total | 940 | 202 | 1,822 | 686 |

Statistical analyses were performed using SPSS® (version 16; SPSS, Chicago, IL). Data were expressed as means; an independent *t*-test was used to compare means of continuous variables between groups. Pearson's chi-square test was used to analyze discrete data variables and to compare proportions ($p < 0.05$ was considered statistically significant).

RESULTS

During the one-year period, there were a total of 3,650 RTA, with 3,596 injured patients and 54 deaths. The overall number of cases and percentages with gender specific ages are shown in Table 1. Male cases (2,762) were greater (3.1:1) than female cases (888), with no difference between the average ages. Bangkok had a lower average age (32.12 yrs) than the provinces (32.84 yrs). Injury occurred irrespective of age group. The highest and the lowest were aged 21-30 years and 1-10 years, respectively. In all age groups, the percentage of men was higher than that of women (Table 1), and the provinces

Table 2
Number of cases in Bangkok and provinces by level of education.

| Hospital | Level of education | Male | Female | Total | |
|----------------|---------------------------------|---------------|-------------|--------------|------|
| | | | | <i>n</i> | % |
| Bangkok | No school | 30 | 10 | 40 | 1.1 |
| | Primary - Secondary school | 528 | 95 | 623 | 17.1 |
| | High school - Diploma | 289 | 73 | 362 | 9.9 |
| | Bachelor degree - Post graduate | 93 | 24 | 117 | 3.2 |
| | Total | 940 | 202 | 1,142 | 31.3 |
| Province | No school | 125 | 45 | 170 | 4.7 |
| | Primary - Secondary school | 1,229 | 460 | 1,689 | 46.3 |
| | High school - Diploma | 398 | 144 | 542 | 14.9 |
| | Bachelor degree - Post graduate | 70 | 37 | 107 | 2.9 |
| | Total | 1,822 | 686 | 2,508 | 68.7 |
| Over all cases | | 2,762 (76.7%) | 888 (24.3%) | 3,650 (100%) | |

Table 3
Distribution of income and level of education, comparing Bangkok and provinces, by gender.

| | 2 Wheels | | | 4 Wheels | | | All vehicles | | |
|-----------|----------|------|-------|----------|------|-------|--------------|------|-------|
| | <i>n</i> | % | Ratio | <i>n</i> | % | Ratio | <i>n</i> | % | Ratio |
| Driver | 2,787 | 83.0 | 4.9 | 118 | 46.7 | 1 | 2,905 | 79.6 | 3.9 |
| Passenger | 573 | 17.1 | 1 | 172 | 59.3 | 1.5 | 745 | 20.4 | 1 |
| Total | 3,360 | | | 290 | | | 3,650 | | |

had a greater number of cases compared to Bangkok.

Patients with a low educational level (primary/secondary school) accounted for the largest number of cases, both in the provinces and Bangkok (Table 2). In the provinces, this group of patients comprised nearly half of the cases, while in Bangkok the proportion was less than 20%. In all educational levels, the percentage of men was higher than that of women. Relative contribution of education to income was also detected as shown in Table 3. Those with low education had low incomes of less than THB 10,000/year.

In comparison between genders, the number of men in all classes of income was greater than the number of women. The total number of patients with low income in provinces was greater than in Bangkok.

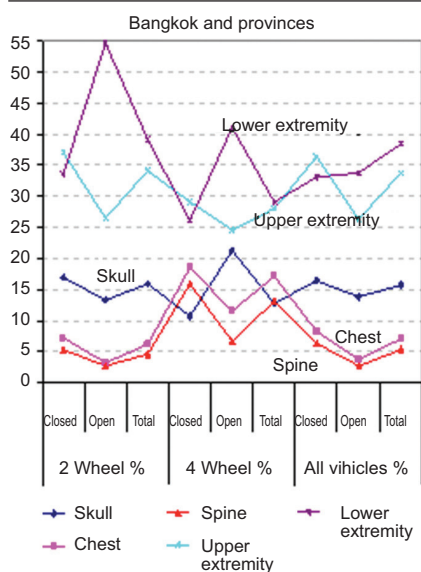
The total number of motorcycle cases (3,360) was higher (11.6:1) than motor vehicle cases (290) (Table 4). The mean age of motorcycle cases (31.46 years) was less than 4-wheel cases (36.7 years). In all kinds of motor vehicles, the number of patients in the provinces was greater than in Bangkok, and drivers were involved in nearly 80% of cases (79.6%). Of 2-wheel cases, drivers were injured more than

Table 4
Number and percent of drivers and passengers sustaining injuries by type of motor vehicle.

| | 2 Wheels | | | | 4 Wheels | | | | All vehicles | | | |
|-----------|----------|------|-------|-----|----------|------|-------|-----|--------------|------|-------|-----|
| | Injured | (%) | Death | (%) | Injured | (%) | Death | (%) | Injured | (%) | Death | (%) |
| Driver | 2,750 | 81.8 | 37 | 1.1 | 115 | 39.7 | 3 | 1.0 | 2,865 | 78.5 | 40 | 1.1 |
| Passenger | 562 | 16.7 | 11 | 0.3 | 169 | 58.3 | 3 | 1.0 | 731 | 20.0 | 14 | 0.4 |
| Total | 3,312 | 98.6 | 48 | 1.4 | 284 | 97.9 | 6 | 2.1 | 3,596 | 98.5 | 54 | 1.5 |

Table 5
Type of major bone injuries according to body region by type of vehicle.

| | 2 Wheels ^a | | | | 4 Wheels ^b | | | | All vehicles ^c | | | | |
|-----------------|-----------------------|---------------|-----------------|------------|-----------------------|--------------|--------------|------------|---------------------------|----------------|-----------------|------------|--|
| | Closed | Open | Total | Chi-square | Closed | Open | Total | Chi-square | Closed | Open | Total | Chi-square | |
| Skull | 443 (16.9) | 126 (13.3) | 569 (15.9) | 0.023 | 26 (10.6) | 13 (21.3) | 39 (12.7) | 0.163 | 469 (16.3) | 139 (13.8) | 608 (15.7) | 0.098 | |
| Chest | 188 (7.2) | 29 (3.1) | 217 (6.1) | 0.000 | 45 (18.4) | 7 (11.5) | 52 (17.0) | 0.240 | 233 (8.1) | 36 (3.6) | 269 (6.9) | 0.000 | |
| Spine | 140 (5.3) | 25 (2.6) | 165 (4.6) | 0.002 | 39 (15.9) | 1 (6.6) | 40 (13.1) | 0.000 | 179 (6.2) | 26 (2.6) | 205 (5.3) | 0.000 | |
| Upper extremity | 973 (37.0) | 250 (26.4) | 1,223 (34.2) | 0.000 | 71 (29.0) | 15 (24.6) | 86 (28.1) | 0.566 | 1,044 (36.4) | 265 (26.3) | 1,309 (33.7) | 0.000 | |
| Lower extremity | 883 (33.6) | 516 (54.6) | 1,399 (39.2) | 0.000 | 64 (26.1) | 25 (41.0) | 89 (29.1) | 0.006 | 947 (33.0) | 541 (33.7) | 1,488 (38.4) | 0.000 | |
| Total | 2,627 (100) | 946 (100) | 3,573 (100) | - | 245 (100) | 61 (100) | 306 (100) | - | 2,842 (100) | 1,007 (100) | 3,879 (100) | - | |



^a2 wheels vehicles are significantly associated with chest, spine, extremities but not skull injury;

^b4 wheels vehicles are significantly associated with spine and lower extremities injury;

^cAll vehicles are significantly associated with all major bone injuries except skull injury

passengers (4.9:1), while passengers in 4-wheel cases had greater involvement than drivers (1.5:1). The mean age of motorcycle drivers was 31.8 years old, while the motor vehicle drivers' average age was 36.47 years.

There were 54 fatalities: 6 cases from 4-wheel (mean age 31.87 years) and 48



Fig 1—Illegal motorcycle riding in Bangkok with more than 2-3 passengers riding without helmets.

cases (mean age 31.46 years) from 2-wheel vehicles (Table 4). The pickup was the most common 4-wheel vehicles used in the provinces (pickup: sedan: van = 125:67:14). In Bangkok, the sedan and pick-up were involved in nearly equal proportion (34:32). Concerning seating positions, the front seat of motorcycles had greater involvement (83.0%) than other types of motor vehicle (pick-up, 34.8%; sedan, 26.2%; and van, 4.5%). Middle and rear seats of a motorcycle were involved in 16.0% and 1.0% cases, respectively (Fig 1). The most dangerous position for the van was in the middle row.

As expected, long bone and joints were the most common injuries, accounting for 77.2% in Bangkok and 69.8% in the provinces. In all vehicles, lower extremity injuries (38.4%) occurred more often than the upper extremity (33.7%) (Table 5). The second most common was skull injury (15.7%). Two-wheel vehicles had a greater percent of bone and joint injuries (73.4%)

than four wheels (57.2%). Closed injuries were found more often than open injuries, with a ratio of 2.9: 1. The average sites of injury per crash incident of 2 wheels and 4 wheels were 2.57 and 2.61, respectively.

DISCUSSION

Like many developing countries, patterns of RTA injuries in Thailand are much more complex, with a variety of outcomes and disability (Böhning and Na Ayutha, 1997; Na Ayuthya and Böhning, 1997; Jirojwong *et al*, 2002; Kasantikul *et al*, 2005; Woratanarat *et al*, 2009). Not all injuries are treated in hospitals (Mahaisavariya, 2008). Generally, seriously injured patients are immediately transferred to the local provincial hospital. Some of the seriously injured patients would then be taken to a higher level facility or teaching center for further definite treatment in a big city such as Bangkok, Chiang Mai, Khon Kaen or Songkhla. Because of geographical, socioeconomic, and financial barriers, some victims, who do not require hospitalization, are treated by monks, Chinese medicine, or even stay helpless in their homes.

Since the promulgation of the Protection for Motor Vehicle Victims Act in 1992 (Protection for Motor Vehicle Victims Act BE 2535, 1992), road users who sustain an injury are protected by the Road Accident Victims Protection Company Limited (RVP). Moreover, the Thai population, particularly those who are unemployed,

the elderly, and children, are automatically insured by the National Health Security Act BE 2545 (AD 2002) (National Health Security Office, 2002). These two national health schemes intend not only to cover emergency support but also to facilitate all the comprehensive rehabilitation programs following sustained injury. Although the current report relies on secondary data from a relatively small number of hospitals, a greater numbers of patients treated in the provinces may substantiate the rationale for a national intervention. However, a more complete data set is needed to support the integration of its implementation across the Kingdom.

The current study has been the first attempt to compare data of patients treated inside and outside of Bangkok. The demographic figures and patterns of major bone injuries are for the most part consistent with other reports (Wick *et al*, 1998; Peng and Bongard, 1999; Cirera *et al*, 2001; Mathews *et al*, 2001; Eid *et al*, 2009; Lee *et al*, 2010). Though motorcycles are cheaper and more convenient, riders are taking high risks. As expected, riding a motorcycle was more likely to be fatal, with a ratio of 8:1 compared with those of 4-wheel motor vehicles.

The study also reflects the disparity in socioeconomic status between rural and urban areas. This contextual difference within the country is suggested to have a direct effect on health outcomes (Swaddiwudhipong *et al*, 1998; Cubbin and Smith, 2002; Borrell *et al*, 2005; Lu *et al*, 2005; BaBio and Daponte-Codina, 2006). Not surprisingly, it was found that young male cases were of low to very low education. These younger and poorer males sustained injuries with less awareness of their own safety. The majority of cases may not be able to afford to buy

a safer motor vehicle and devices. The findings of a higher percentage (nearly 80%) of injured drivers may also indicate lower standards of driving behavior and attitudes. In the literature, they were more likely to ride a motorcycle at night, with friends, in extreme moods, and with less sense of responsibility (Mathews *et al*, 2001; Babio and Daponte-Codina, 2006; Eaton *et al*, 2010).

Although various seating positions associated with fatality risk for relevant age groups in the motor vehicle crashes have been identified (Evans and Frick, 1988; Cirera *et al*, 2001; Ichikawa *et al*, 2002; McGwin *et al*, 2003; Lee *et al*, 2010), few have focused on the risk of injury for a rider as a passenger. The current study showed that the driver was involved in more than 80% of the cases, while motor vehicles and motorcycle passengers had nearly 60% and 20% share of traffic injuries, respectively. Of interest was the middle seat, which had a greater risk (16.0%) than the rear seat (1.0%). Usually, a driver is seated in the front seat or sandwiched between two passengers. This illegal seating, although underestimated, can be commonly found in most developing countries.

Although the current report suggested improvements in the distribution of trauma care services in the country, a significant gap in information is unavoidable, with the low percentage of data both from Bangkok, which contains the largest amount of either public or private hospitals, and only 6 regional hospitals from all the other 75 provinces. The reported figures can be biased by definition of the included cases, method of injury ascertainment, and data collection. The small number of deaths and injured patients could have been affected by selection bias as not all the dead-at-the-scene victims

would have been brought to the hospital. Another limitations concerned the response rate for regional hospitals (6/25 or 24%), despite personal follow-up, which was indicative of the difficulty in acquiring such data. Moreover, we observed that there was almost no data representative of the southern region.

In low- and middle-income countries (LMIC), injury can be a reflection of urbanization and economic growth, while reviews of reports and road safety research reflect country policy upon an understanding of the costs and obligation impact (Perel *et al*, 2007). Despite enormous improvements in the transportation infrastructure and services over the past decades, RTA problems, following its exponential development, is increasing in Thailand. Control of vulnerable road traffic users from various sectors requires special efforts. The public concern for safety issues should be established and implemented along with enforcement of traffic regulations.

This paper has illustrated the road traffic situation and socioeconomic disparity within the Kingdom. High risk-taking groups pertaining to RTA and areas outside of Bangkok were identified. Education focusing on road and vehicle safety should be delivered in primary schools. Attention on the personal costs of damage, grief, and suffering, as well as its legal expenses may contribute to a reduction of motor vehicle crash rates. Improving the pre-hospital trauma care system and appropriate management particularly for major bone injuries is another essential key for reducing morbidity and fatality on the road. A national computerized surveillance system should also be funded and processed. We hope that, the results of this study may stimulate the interest of both physicians and chief executive officers so

that effective prevention and standard definitive care can be better achieved with more comprehensive information. The authors do not intend to convey just a message, but to bring about changes, particularly on road safety in Thailand.

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