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# ROAD SAFETY ANALYSIS IN THAILAND AND OTHER ASIAN COUNTRIES: URGENT ACTIONS FOR THAILAND

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**ABSTRACT:** One of the most important prerequisites to achieving challenging sustainable development goals (SDG) on road safety is to comprehend the interrelationship of constituents related to road safety such as road traffic fatalities (RTFs), population, income levels, registered vehicles, law enforcement and others. A comprehensive review and critical analysis of road safety status in Thailand and other Asian countries were completed. It was found that RTFs per 100,000 people had no correlation with GNI per capita, while RTFs per 1,000 vehicles revealed reasonable correlations with the number of registered vehicles per 1,000 people. As the number of registered vehicles per 1,000 people increased, the RTFs per 1,000 vehicles decreased. The main cause of RTFs in Thailand and several Asian countries were 2/3-wheelers. As the proportion of 2/3- wheelers in Asian countries increased, the percentages of RTFs caused by 2/3-wheelers were enhanced. When the GNIs of any Asian country increased, the performances of the national road safety law enforcement were generally improved. Based on RTFs per 100,000 people, Thailand was one of the most dangerous road transport countries on earth. Finally, when the various main causes of road accidents in Thailand were identified, urgent road safety actions were proposed accordingly.

*Keywords: Road traffic fatalities, Fatalities per vehicle, Fatalities per population, Asian countries, Road safety action plans*

## 1. INTRODUCTION

In 2013, more than 1,250,000 people were killed in road accidents, and several million suffered serious injuries and became disabled. Road accidents were ranked as the 9th main contributor to global road fatalities. The total costs of global road accidents were estimated at approximately 3 percent of gross domestic product (GDP) [1]. The United Nations Development Programme (UNDP) recently released 17 sustainable development goals (SDGs) associated with 169 targets to create a balance among economic, societal and environmental constituents for sustainable development and to encourage suitable courses of actions in the future [2]. One of the SDGs closely associated with global road safety issues is SDG 3: "Ensure healthy lives and promote well-being for all at all ages" with Target 3.6: "By 2020, halve the number of global deaths and injuries from road traffic accidents" [2]. This SDG and its associated target were established to promote and stimulate every country to undertake appropriate policies, plans, and actions to suppress the global road safety crisis.

Based on the WHO global road safety status report published in 2013 [1], the number of road traffic fatalities (RTFs) in Thailand was 24,237. Based on the estimated RTFs per 100,000 people, Thailand was ranked 2nd (36.2) in the world [1] and, therefore, one of the most dangerous road transport countries on earth. According to the UN decade of action for road safety [4], Thailand set up the challenging target of 10.0 RTFs per 100,000 people in 2020. One of the most important elements of achieving such a challenging target is to understand the relationships among RTFs, population, income levels, the numbers of registered vehicles, vehicle fleet composition, road safety laws and their adoption and enforcement and others. A comprehensive literature review and critical analysis of various road safety elements in Thailand and Asian countries are highly important.

At the strategic level, low-income countries have encountered greater road safety risk than high-income countries [5]. The risk of RTFs (RTFs per 100,000 people) declines as income levels (GNI per capita) increase [6]. As vehicle ownership increases, RTFs per vehicle decreases [7]. Klungboonkrong and Faiboun [8] noted that in AEC countries, RTFs per 100,000 people revealed no correlation with gross national income (GNI) per capita. However, the RTFs per 1,000 vehicles showed a reasonable correlation with both GNI per capita and a number of vehicles per 1,000 people. Jacop et al. [9] and Mohan [10] noted that analyzed

RTF data were commonly underreported. Therefore, the WHO [11] recently proposed to resolve this problem by readjusting RTF data to the 30-day period after the accidents occurred. The main objectives of this research are as follows: (i) to analyze the relationship between RTF rates and RTF risk, motorization and income levels among the 43 Asian countries; (ii) to examine the relationship between vehicle composition and proportion of RTFs by road user types among those Asian countries; (iii) to analyze the levels of enforcement of national road safety laws among the Asian countries; and finally (iv) to review and analyze the current road safety status of Thailand to identify the main causes of the road safety crisis and to suggest urgent road safety actions.

## 2. ROAD TRAFFIC FATALITIES PER POPULATION

Based on [1], RTFs and other information of the 43 Asian countries were analyzed and compared. Some of the key findings are described below. As shown in Figure 1, both reported and estimated RTFs per 100,000 people in 2013 revealed no correlation with GNI per capita. Similar results were also found in [8] [10] [12] [13]. Thailand showed the greatest discrepancy between the reported and the estimated RTFs per 100,000 people. As shown in Figure 1, although some Asian countries (e.g., Thailand (TH), Jordan (JO), Iran (IR), and China (CN)) had similar GNI per capita, the RTFs per 100,000 people were considerably different. In addition, the estimated RTFs per 100,000 people for some Asian countries (e.g., CN and TH) were much greater than the reported ones. This situation clearly reflects the existence of critical road safety database problems in these Asian countries.

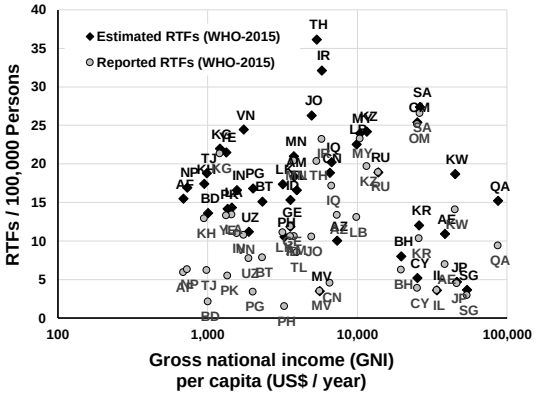


Fig. 1 The relationship between RTFs per 100,000 people and GNI per capita [1]

## 3. ROAD TRAFFIC FATALITIES PER VEHICLE

As shown in Figure 2, the estimated RTFs per 1,000 registered vehicles showed reasonable correlation with the number of vehicles per 1,000 people. The greater the number of vehicles owned (motorization), the lower the reported and estimated RTFs per 1,000 vehicles. Similar findings could be noticed in [8] [10] [12] [13]. This result means that as the number of vehicles per 1,000 people of each country increases, the RTFs per 1,000 vehicles decreased. In addition, it has been realized that motorization rates grew much faster than those of RTFs. In addition, as the number of vehicles per 1,000 people increased, the discrepancy between the reported and estimated RTFs per 1,000 vehicles of these Asian countries considerably decreased.

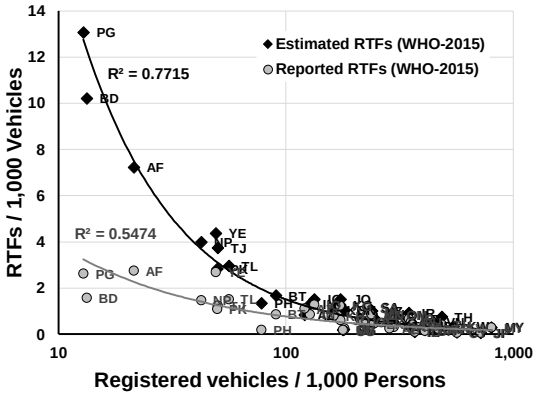


Fig. 2 The relationship between RTFs per 1,000 vehicles and vehicles per 1,000 people [1]

## 4. VEHICLE COMPOSITIONS AND PROPORTION OF RTFS BY ROAD USER TYPES

As shown in Figure 3, the vehicle compositions were arranged from top to bottom according to low to high GNI per capita. As the GNI per capita increased, the vehicle proportions of the 2- and 3-wheelers declined, and those of cars and 4-wheeled vehicles, in contrast, were enhanced. For low- and medium-income Asian countries, 2- and 3-wheeled vehicles were the dominant mode of the total road fleets. Based on the RTFs by road user types, 2/3-wheeled vehicles were the main contributor to RTFs. As shown in Figure 4, when the fleet composition of 2/3-wheeled vehicles increased, the proportion of RTFs caused by such vehicles was generally increased. In Figure 4, some Asian countries (e.g., Cambodia (KH), Indonesia (ID) and Maldives (MV)) had similar 2/3-wheeler compositions, but their proportion of RTFs caused by 2/3-wheelers was dramatically distinct.

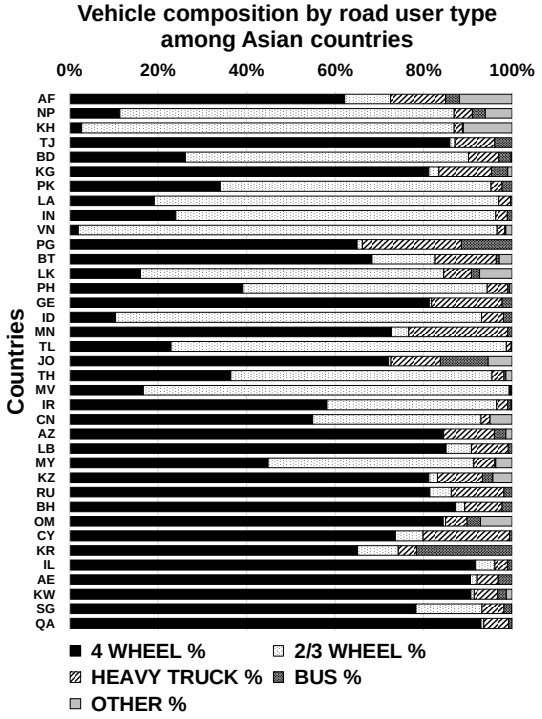


Fig. 3 Vehicle composition by road user types among Asian countries [1]

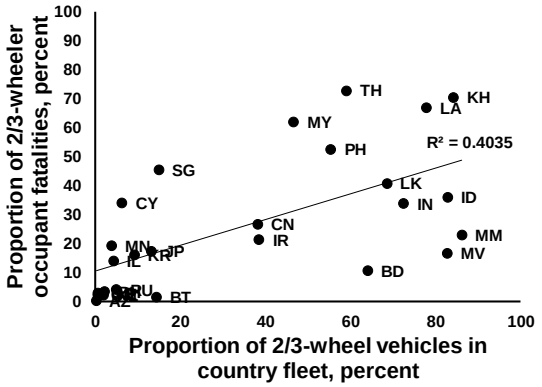


Fig. 4 Proportion of 2/3-wheeler fatalities vs. proportion of 2/3-wheeled vehicles in-country fleet [1]

## 5. THE ADOPTION AND ENFORCEMENT OF NATIONAL ROAD SAFETY LAWS

Based on the WHO report [1], the rating scores adopted to assess the performances of road safety laws enforcement ranged from 1 (inefficient) to 10 (highest efficiency). The analytic hierarchy process (AHP) [14] was then applied to extract and synthesize the knowledge and expertise of seven selected road safety experts in Thailand about the relative importance of each of the five national road safety law enforcements. It is assumed that the relative weights of the five national road safety laws in all Asian countries are equal. Consequently, the composite law enforcement scores (CLES) can be derived from $CLESi = \sum_{j=1}^{n} w_j \times LES_{ij}$, where $w_j$ = relative weight of law enforcement criterion j and $LES_{ij}$ = law enforcement score ranging from 1 to 10 for criterion j of an Asian country i. Hence, $w_1$ = 0.480; $w_2$ = 0.332; $w_3$ = 0.104; $w_4$ = 0.064; and $w_5$ = 0.020; for i = 1 (speed limit law), 2 (drinking and driving law), 3 (motorcycle helmet law), 4 (seat belt law) and 5 (child restraint law). All individual and group expert judgments were consistent, with all computed consistency ratios less than 0.1 [14]. As shown in Figure 5, when the GNI per capita increased, the composite laws enforcement scores (CLESi) also increased. This result means that as GNI per capita increased, the combined performances of enforcement of all five road safety laws were generally improved. This situation occurred because the attitude and awareness of the people regarding road safety and the government budgets of road safety authorities were also enhanced as a result of the increase in GNI per capita.

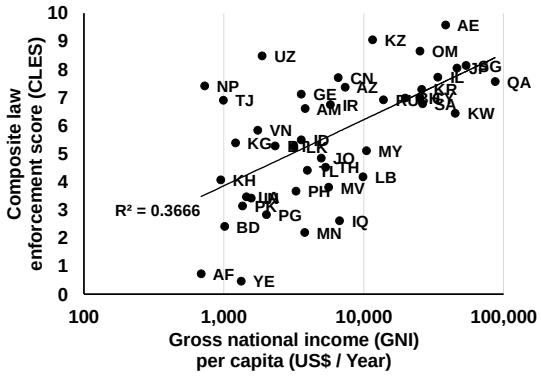


Fig. 5 Relationship between the composite law enforcement scores (CLES) vs. GNI per capita among Asian countries

## 6. ROAD SAFETY STATUS OF THAILAND

The road safety status of Thailand was reviewed from various sources and summarized below. The description is organized according to the 5 road safety pillars [4].

### 6.1 Road safety management

• As illustrated in Figure 7, each individual trend of the RTFs per 100,000 people estimated from the National Police Bureau (NPB) and the Road Accident Victim Protection Company of Thailand (RAVPCT) and recently from the Ministry of Public Health (MPH) database systems was uniquely distinct. Hence, the quality of RTF database systems derived from these three sources in Thailand was questionable. The MPH recently

completed a comprehensive study based on the systematic and scientific combination of the 3 RTFs database sources including the NPB, MPH, and RAVPCT [15]. The main objective of the study was to estimate the most scientific and systematic RTFs based on the NPB, MPH, and RAVPCT database systems in Thailand. Some RTF data screening and manipulating approaches were needed to eliminate repeated RTF counts [15]. The best estimate of RTFs in Thailand from these 3 database sources during 2011 and 2016 were much greater than the formally reported RTFs. Consequently, the development of a systematic and integrated road safety database system for Thailand is crucially needed. It should be noted that the RTFs per 100,000 people estimated from the 3 database sources were generally less than but close to the WHO estimations [1] [3] [15]. The future trends of RTFs per 100,000 people derived from both WHO reports [1] [3] [15] and the three Thailand database sources were similarly declining. If such trends remain unchanged, at the end of the road safety decade of action period (in 2020), the RTFs per 100,000 people of Thailand will be predicted as 27.6, approximately 3 times greater than the target.

• The government budgets for the actual implementation of the proposed road safety projects for the Thailand road safety actions were minimal. This situation, unfortunately, caused tremendous obstacles and barriers to achieving the challenging road safety target.

### 6.2 Safer roads and mobility

• Based on [16], approximately 55 percent of the total number of road accidents were roadside hazard accidents. Such road accidents led to approximately 38 percent of all RTFs on national highways. The main causes of such RTFs were hitting fixed objects, rolling over or losing control.

• In 2015, the main causes (approximately 90 percent) of all road accidents that occurred at U-turn locations were speeding and instant overtaking [16].

• Road safety audit (a pro-active process) and black spot treatment (a reactive process) approaches have been highly recommended for implementation to address the road safety crisis in Thailand. There is no official body to certify professional experts in these areas.

### 6.3 Safer vehicles

• As shown in Figure 6 [1] [3] [11], the Thailand fleet composition and the RTFs proportion by road user types are graphically illustrated. For the vehicle composition, 2/3-wheelers were the dominant modes of road transport, followed by cars and 4-wheeled light vehicles. In Figure 6, the proportions of 2/3-wheelers in the total fleet composition were approximately double those of cars and 4-wheeled vehicles. However, the percentage of RTFs caused by 2/3-wheelers was over 5.5 times greater than those generated by cars and 4-wheeled vehicles. Riders and passengers of such 2/3-wheelers were consequently the most dangerous road users in Thailand.

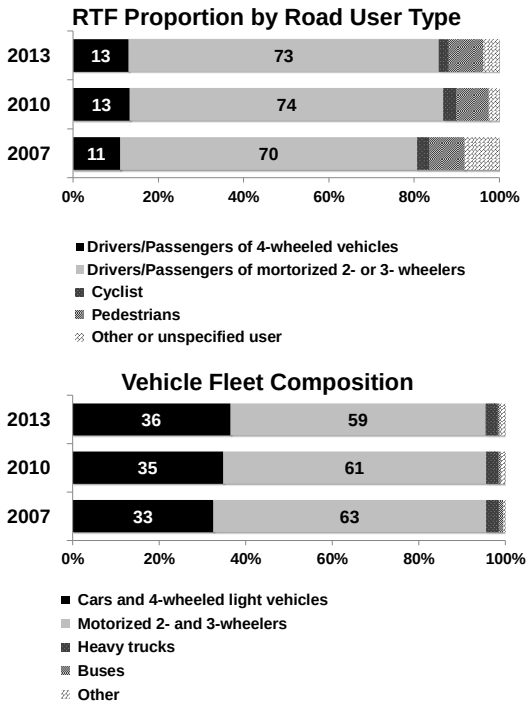


Fig. 6 Vehicle composition and RTF proportion by road user type among Asian countries [1] [3] [11]

• The ThaiRoads Foundation [17] found that based on the number of road accidents and RTFs per 10,000 registered vehicles, two-level buses and public vans were 6 and 2 times more dangerous than the typical one-level buses, respectively.

• Vehicle inspections in practice have never been effective.

### 6.4 Safer road users

• Based on [1], the proportion of total RTFs involving the violation of drinking and driving laws was 26 percent. The ThaiRoads Foundation [17] noted that the number of recorded road accidents involving drinking and driving was considerably underreported because of the lack of manpower (policemen) and alcohol testing equipment.

• For the past 10 years, the violation of speed limit laws has ranked as the 1st key causation of road accidents on national highways and rural roads of Thailand. Two-thirds of all road accidents and RTFs on national highways in Thailand were caused mainly by speeding [17].

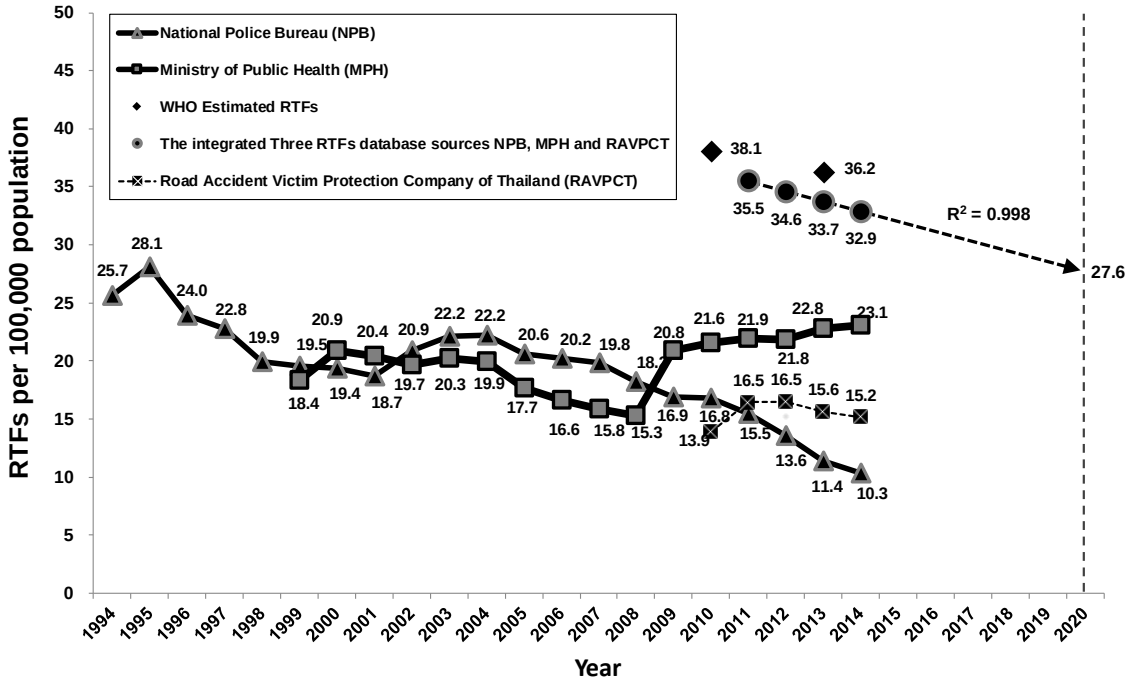


Fig. 7 Thailand RTF data from various sources [1] [3] [15]

• During 2010 – 2012, the helmet wearing rates for motorcycle drivers, passengers and the combination of the two in Thailand were 52, 20 and 43 percent, respectively [ 18] . In addition, such helmet wearing rates in urban areas were approximately 2-3 times greater than those in rural areas where the majority of RTFs occurred.

• In 2010, the seat belt wearing rates for drivers and front-seat passengers in Thailand were 61 and 42 percent, respectively [17]. The seat belt wearing rates for passenger cars in 2010 and 2011 were approximately 66 and 64 percent, respectively [17]. The improvement of seat belt wearing rates could potentially reduce the risk of serious injuries and fatalities by 8-14 percent [19].

• In Thailand, the child restraint law has never been officially adopted. In the U.S., child restraints can potentially reduce the RTF rates by approximately 71 and 54 percent for infants and small children, respectively [19].

• In Thailand, the rating scores for the speed limit law, drinking and driving law, motorcycle helmet law and seat belt law were 3, 6, 6 and 6, respectively. There was no adoption and enforcement score for the child restraint law in Thailand because this law has never been officially issued. As shown in Figure 8, the enforcement scores of different national road safety laws in Thailand in 2007, 2010 and 2013 were generally improved [1] [3] [11]. The speed limit enforcement scores were the worst (with scores of 2, 3 and 3 in 2007, 2010 and 2013, respectively). However, the maximum scores of the drinking and driving law, motorcycle helmet law, and seat belt law in Thailand were equal to 6. The performance of the adoption and enforcement of Thailand road safety laws was therefore relatively moderate.

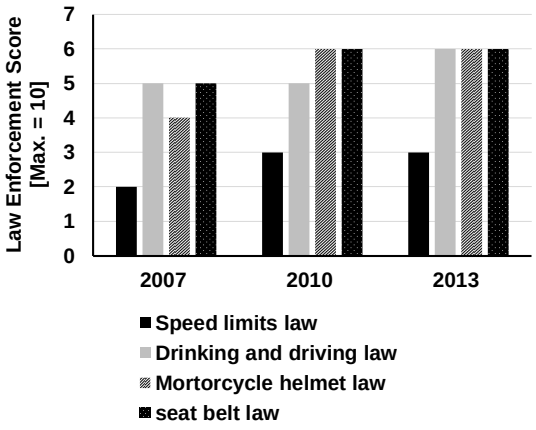


Fig. 8 The enforcement scores of different national road safety laws of Thailand [1] [3] [11]

### 6.5 Post –crash response

• The emergency first-aid treatments for injured persons prior to transfer to a hospital in Thailand have been relatively efficient and effective. Emergency services from hospitals and several active rescue foundation teams have provided excellent and collaborative tasks and saved people's lives after road accidents, particularly in urban areas. However, with limited human resources and extremely large service areas, such emergency services have been less effective in rural areas.

Table 1 The proposed urgent road safety actions of Thailand [20]

| Road Safety Pillars | Proposed Urgent Road Safety Actions |
|---|---|
| Road safety management | 1. Amend the national road safety acts (the speed limits and seatbelt laws) and adopt the new road safety act (the child restraint law).<br>2. Develop global standard road safety database systems.<br>3. Officially promote and implement in-depth crash investigation as a compulsory procedure for serious road accidents.<br>4. Develop the road safety master plan and action plans for Thailand and provide the appropriate budget schemes. |
| Safer roads and mobility | 1. Establish the road hierarchy classification system of Thailand and set up the appropriate speed limits for different road classes in urban and rural areas.<br>2. Establish the safe system design standard for all motorcycle infrastructure and facilities.<br>3. Implement road safety audits for all stages of road infrastructure development.<br>4. Conduct black spot treatments.<br>5. Manage roadside hazard and U-turn locations for all national highways. |
| Safer vehicles | 1. Adopt global basic vehicle design standards for safer vehicles.<br>2. Promote advanced information technologies and innovative safety devices for all types of road vehicles, particularly for public vehicles and motorcycles.<br>3. Improve vehicle inspection practices.<br>4. Develop the structural and stability design global standard for all vehicle types, particularly commercial vehicles (articulated trucks), public vehicles and motorcycles. |
| Safer road users | 1. The campaign to promote safer driving behaviors.<br>2. The issue, adopt and enforce national road safety laws (including speed limits, drinking and driving law, motorcycle helmet law, seat belt law and child restraint law).<br>3. Adopt advanced information technologies and innovations to control driving behaviors and enforce the road safety laws (speed cameras and red-light cameras).<br>4. Improve the standard of driving license testing procedures, particularly for commercial vehicles, public vehicles, and motorcycles. |
| Post-crash response | 1. Establish pre-hospital care, trauma care and rehabilitation.<br>2. Develop ambulance network systems along the road networks in urban, suburban and rural areas. |

## 7. THE PROPOSED URGENT ROAD SAFETY ACTIONS

After the comprehensive review and analysis of road safety situations in Thailand, several main causes of road accidents in Thailand could be specified, and then, several urgent road safety actions for Thailand to address the road safety crisis were proposed. Some of these recommended urgent actions arranged according to the 5 road safety pillars scheme are briefly summarized in Table 1 [20].

## 8. CONCLUSIONS

A comprehensive review and analysis of the road safety status of Thailand and 43 Asian countries were completed. RTFs per 100,000 people had no correlation with GNIs per capita, while RTFs per 1,000 vehicles revealed reasonable correlations with the number of registered vehicles per 1,000 people. When vehicles per 1,000 people increased, the RTFs per 1,000 vehicles decreased. As the GNI per capita increased, the proportions of 2/ 3-wheelers decreased, and in contrast, those of cars and 4-wheeled vehicles increased. For low- and medium-income Asian countries, 2- and 3-wheelers were the dominant modes of the total road fleets. These 2/3-wheelers were also the main cause of RTFs in Thailand and several Asian countries. As the proportion of 2/3-wheelers in Asian countries increased, the percentages of RTFs caused by 2/3-wheelers were enhanced. In Thailand, the percentages of RTFs caused by 2/3-wheelers were approximately 5.5 times greater than those involving cars and 4-wheeled vehicles. Hence, the 2/3-wheelers became the most hazardous on-road vehicles in Thailand and required urgent road safety actions to address such a crisis. As the GNIs of any Asian country increased, the performances of the enforcement of national road safety laws were generally improved. Based on the estimated RTFs per 100,000 people, Thailand ranked 2$^{nd}$ (36.2) in the world [1]. The RTFs per 100,000 people estimated from the 3 database sources (NPB, MPH, and RAVPCT) [15] were generally close to the WHO estimates [1] [3]. This result means that Thailand is one of the most dangerous road transport countries in the world. In 2020, the RTFs

per 100,000 people in Thailand are predicted to be approximately 3 times greater than the set target. Hence, Thailand is unlikely to achieve the challenging target of SGD 3 associated with Target 3. 6. Finally, when various main causes of road accidents in Thailand were identified, urgent actions to address the road safety crisis were recommended accordingly.

## 9. ACKNOWLEDGEMENT

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