Changes in Traffic Safety Policies and Regulations in Taiwan (1950–2010)

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1. Introduction

The evolution of traffic safety issues and practices in Taiwan had not been noted between the 1950s and 1960s. Some important facts such as numbers of accidents, road type classifications, registration numbers of vehicle types and driver's licenses were not well recorded until the 1970s. Taiwan has unique characteristics in its traffic system when compared with most developed countries, since the number of motorcycles accounts for two-thirds of total motor vehicles, and that has caused more difficult situations in traffic management. This paper organizes government facts, reports, and research literatures to offer some perceptions of the development of traffic safety practices in Taiwan. Firstly, a profile of changes in traffic related facts including the composition of population, road type, vehicle ownership and driver's licenses are illustrated. Secondly, fatalities and injuries by various road types, transport modes, victims' age and gender combinations are analyzed. Thirdly, we introduce organizations in charge of traffic safety work and their system structure. Finally, we describe some traffic safety measures that are discussed in Taiwan which may be considered effective in the developing process.

2. Basic Information

2.1 Population

Taiwan has a population of 23.2 million with a density of 645 persons per square kilometer in 2010. As shown in Figure 1, the yearly growth rate of the total population is about 0.9% on average during the last 40 years, and the population number between genders has been approaching since 1970s onward (detailed facts can be found in appendix 1). Per capita income GNP per year in Taiwan has increased to 19,155 US dollars in 2010, a rise of about 50 times in the past 40 years, which caused the rise in the use of motor vehicles. The composition of age distribution (see Table 1) has also changed in recent years. Taiwan entered an ageing society (65 years of age or older accounted for more than 7% in total population) in 1993. This ageing index reached 10.8% in 2010, and is forecasted to be 14% (i.e. aged society) in 2017 and 20% (i.e. super-aged society) in 2025 (Council for Economic Planning and Development, 2010). This implies we will face more serious challenges in elderly traffic safety issues.

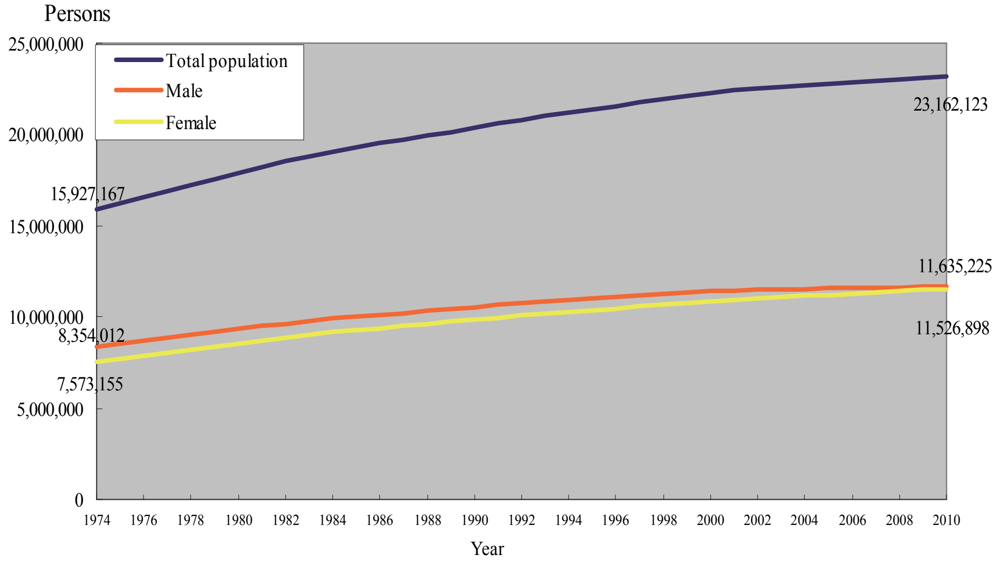


Figure 1 Population Growth Trend between 1974 and 2010

Source: Ministry of the Interior (2011)

Table 1 Age Composition of Population in Taiwan

Year	age 0-14	age 15-64	age 65+
2000	21.10%	70.30%	8.60%
2001	20.80%	70.40%	8.80%
2002	20.40%	70.60%	9.00%
2003	19.80%	71.00%	9.20%
2004	19.30%	71.20%	9.50%
2005	18.70%	71.60%	9.70%
2006	18.10%	71.90%	10.00%
2007	17.60%	72.20%	10.20%
2008	17.00%	72.60%	10.40%
2009	16.30%	73.10%	10.60%
2010	15.70%	73.50%	10.80%

Source: Ministry of the Interior (2011)

2.2 Road Types

Road types in Taiwan can be classified into five main categories: freeways, provincial roads, county roads, rural roads, and urban roads. In general, freeways and provincial roads are constructed and maintained by the central government, while county roads, rural roads, and urban roads are constructed and maintained by 23 local governments. Figure 2 shows that except from the length of urban roads which had an increasing growth rate, the other four types of roads have a slowing growth rate from 2000 to 2010. In general, freeways and provincial roads offering traffic function between cities have a faster travelling speed of around 100-110 km/h for freeways and 70-90 km/h for provincial roads (expressways are classified into provincial roads). On the other hand, county roads, rural roads, and urban roads are positioned as intra-city roads with a lower speed limit of 40-60 km/h.

In 2010, freeways accumulated to 993 km, provincial roads 4,984 km, county roads 3,544 km, rural roads 11,765 km, and urban roads 19,701 km, respectively. Detailed facts about road lengths can be found in appendix 2.

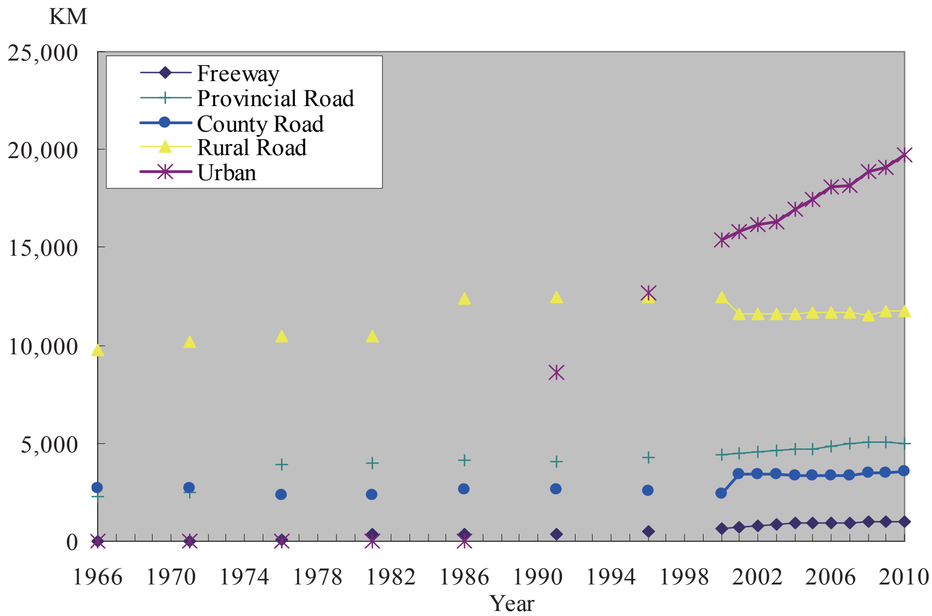


Figure 2 Road Type and Length between 1966 and 2010

Source: Ministry of Transportation and Communications (2011)

2.3 Vehicle Registration and Driver's License

2.3.1 Vehicle registration

Road traffic regulations define motor vehicles including buses, heavy trucks, passenger cars, light trucks and motorcycles. Excepting motorcycles, over four-wheeled vehicles are classified by private and business uses and only professional drivers are eligible to drive their corresponding business vehicles, endorsed by a professional license (Ministry of Transportation and Communications, 2008).

Motorcycles accounted for about 20% of all registered motor vehicles in the early 1950s, followed by an increase to 60% in the early 1960s, and then rose to over 85% during the 1970s, accompanying economic booms in Taiwan. Since then on, motorcycles still comprise two-thirds of all registered motor vehicles (see Figure 2 and details in appendix 3). In 2010, the number of registered motorcycles is around 14,845 thousand, and passenger cars is 5,803 thousand, respectively. Over the last forty years, the number of motorcycles has risen 18 times, and even for a high ownership rate with 641 motorcycles per thousand people owned, it sill kept an annual growth rate of 2.6% on average after the year 2000. However, light-typed motorcycles (mopeds with engines sized under 50 cc.), which accounted for about 40% of total motorcycles in 2000 and dropped to 25% in 2010, decreased by 19% during 2003-2010, with an annual decrease rate of 2.7% on average. This might be that a stricter 2-stroke-engine motorcycles (mostly light-typed) emission standard has been implemented by the

Environmental Protection Administration (EPA) in recent years.

Different from motorcycles which had an early growth in the 1960s to 1970s, the amount of automobiles had a steady growth after the 1980s. Among four types of automobiles, passenger cars showed an increase rate of 10.5 times in the last 30 years, while light trucks 2.9 times, heavy trucks 1.4 times, and buses 0.5 times in the same period (see Figure 4).

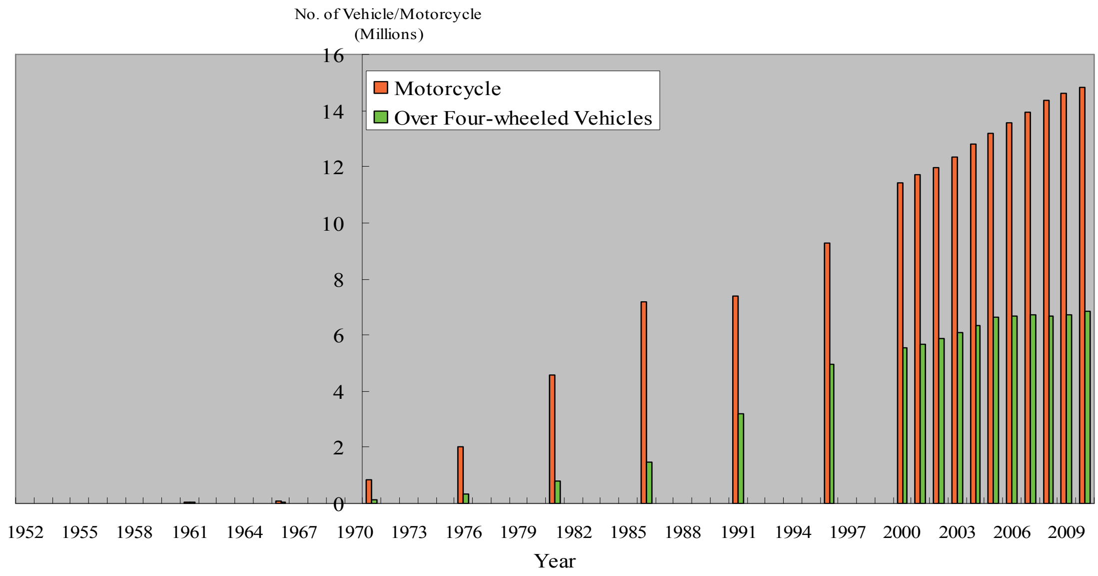


Figure 3 Compositions and Growth between Motorcycle and Automobile after 1970

Source: Ministry of Transportation and Communications (2011)

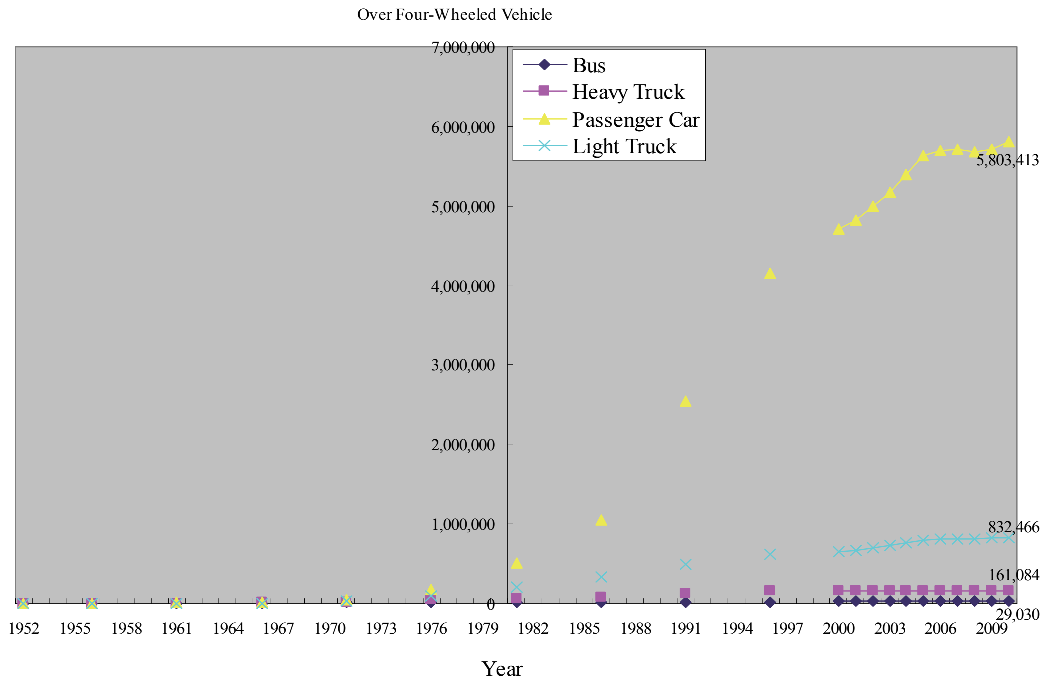


Figure 4 Compositions and Growth of Automobile after 1980

Source: Ministry of Transportation and Communications (2011)

2.3.2 Driver's license

Road traffic regulations define driver's licenses based on professional and private use. Professional drivers have a stricter training and test process, and higher medical standards to obtain their licenses. The maximum age limit for a professional driver is also set according to specifically authorized commercial vehicles. For example, professional licenses for a heavy commercial vehicle is restricted to 65 years old, whereas professional licenses for a taxi might be released to 68 years old. Figure 5 shows that the registered number of professional driver licenses kept steadily constant in the last 20 years, while private driver licenses and motorcycle licenses had a comparable increase rate of double the number of registered licenses during the same period (see detailed facts in appendix 4).

The motorcycle licensing system in Taiwan classifies motorcycles according to engine capacity: mopeds (engine capacity less than 50 cc), light motorcycles (50–250 cc), and heavy motorcycles (greater than 250 cc). Without additional speed or power limitations for vehicles, engine capacity is the only classification standard (Ministry of Transportation and Communications, 2008). The minimum licensing age for mopeds and light motorcycles is 18 years, whereas for heavy motorcycles, the minimum age is 20 years. Except for medical examinations, no prior experience or compulsory training is required for mopeds and light motorcycles before the license tests. An individual can obtain a moped license simply by passing the theoretical test, or obtain a light motorcycle license by passing the theoretical and practical tests. In contrast, heavy motorcycle licenses require an individual to have held a light motorcycle license for at least 1 year, and to have completed 32 hours of compulsory training at a driving school before completing the theoretical and the practical tests. Without compulsory education and training requirements for mopeds and light motorcycles, almost all riders gain experience and skills by a process of self-learning.

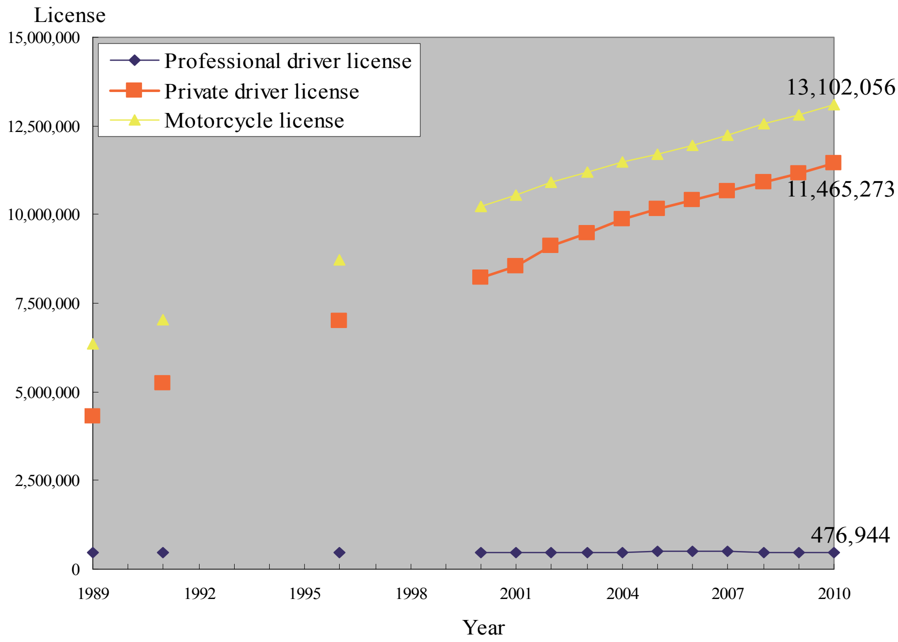


Figure 5 Compositions and Growth of Driver License after 1990

Source: Ministry of Transportation and Communications (2011)

3. The Profile of Traffic Accidents

The definition of road traffic accidents are divided into three categories: A1, A2, and A3. The latest definitions of A1, A2, and A3 accidents, revised in 2000, are whether at least one person died within 24 hours, at least one injury occurred, and only property damage occurred in the accident, respectively. The difference between the latest and its previous definition is that in the previous version, A1 data could represent either the death of at least one person within 24 hours of the accident, or at least one severe injury in the accident. However, only A1 and A2 crash data were recorded in the Taiwan police-reported accident database, Road Accident Investigation and Reporting System (RAIRS) data. RAIRS has been operating since 1985 but only A1 accident data have been fully recorded. A2 accident data were not formally recorded until 1998, and A3 data, had not yet been incorporated into RAIRS at the end of 2010.

In addition to A1 data which records fatalities within 24 hours, this paper also applied traffic fatality facts published by medical systems and estimated 30-days fatalities in Taiwan for the purpose of international comparison.

3.1 Fatality and Injury Accident Trends

Figure 6 shows A1 and A2 data spanning from 1966 to 2010. The number of traffic fatalities was around one thousand in mid-1960s, and then fatalities rose to three thousands in mid-1970s, and finally reached the peak of above four thousands in mid-1980s. Followed by the fluctuation between

2,500 and 3,500 in the next two decades, the fatalities approached nearly two thousands in 2010. This implies that the deaths caused by crashes have been decreased since the year 2000. On the contrary, both number of accident events and injuries soaked between 2001 and 2010. The reason why A2 data increased so rapidly needs to be studied. It might be caused by either well-recorded A2 data or the increase of accident likelihood. More detailed facts about accident data is listed in appendix 5.

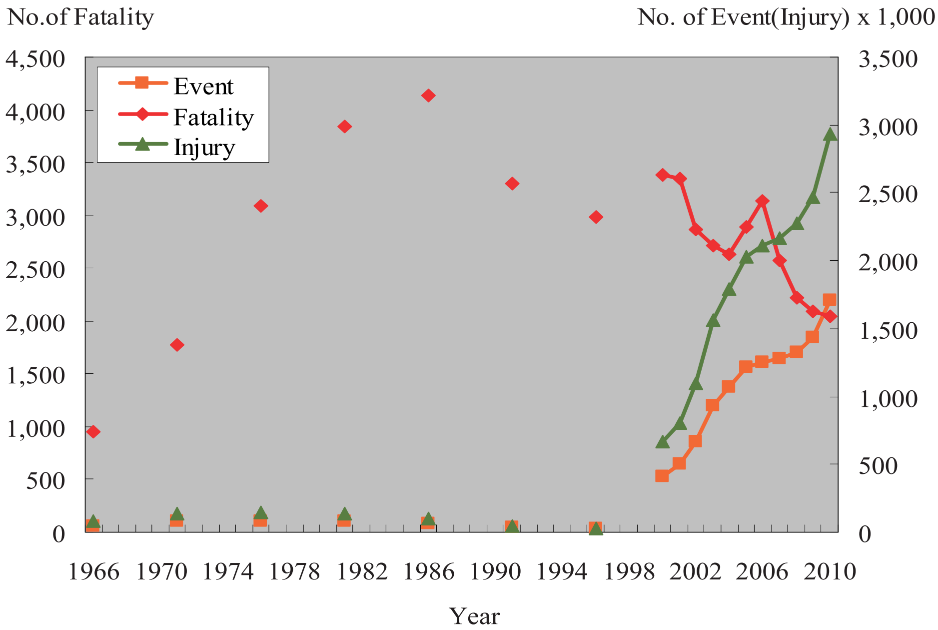


Figure 6 Fatality and Injury Accident Trend between 1966 and 2010

Source: Ministry of Transportation and Communications (2011)

According to UN/ECE (2003), the most commonly cited definition of a road traffic fatality is: "any person killed immediately or dying within 30 days as a result of an injury accident". For comparison, we use different data sources to demonstrate traffic fatalities in Taiwan. In addition to police-reported A1 fatalities within 24 hours, medical systems-reported estimated 30-days fatalities are also used in this report. The estimated 30-days fatalities have been produced by the Institute of Transportation (IOT) since the year 2003. IOT linked police-reported A1 and A2 data with death certificate data in medical systems to identify injury victims that finally died within 30 days.

Table 2 shows that medical system reported number of fatalities were about 1.6-1.8 times as much as police-reported fatalities within 24 hours, while the estimated 30-days fatalities had an adjustment factor of 1.4-1.6 times that of police-reported 24 hour fatalities in the same time span between 2003 and 2009. Based on the medical system reported data, the number of fatalities reached the peak of over 7,500 persons during 1988-1989 (also see Figure 7). The adjustment factor between medical system reported and police-reported fatalities were higher than 2 between 1991 and 1999, showing that police-reported fatalities seem to have been seriously underestimated during that period. From a long term perspective, medical system reported fatalities had a decreasing trend from 1996 onward, while police-reported 24 hour fatalities had a fluctuating pattern during 1991-2006, followed by a greater decreasing rate after 2007. Over the last 20 years, even though the population and number of motor vehicles have been steadily increasing, medical reported accident deaths have reduced by half.

Table 2 Police-reported, Medical System Reported, and Estimated Fatalities

Year	Police-reported Fatality (within 24 hr) (1)	Medical System Reported Fatality (2)	Adjustment Factor (2)/(1)	Estimated Fatality (within 30 days) (3)	Adjustment Factor (3)/(1)
1966	948	—	—	—	—
1971	1,780	—	—	—	—
1976	3,087	—	—	—	—
1981	3,840	—	—	—	—
1986	4,139	6,270	—	—	—
1987	—	7,034	—	—	—
1988	—	7,524	—	—	—
1989	—	7,584	—	—	—
1990	—	7,333	—	—	—
1991	3,305	7,322	2.22	—	—
1992	2,717	7,216	2.66	—	—
1993	2,349	7,367	3.14	—	—
1994	3,094	7,250	2.34	—	—
1995	3,065	7,427	2.42	—	—
1996	2,991	7,077	2.37	—	—
1997	2,735	6,516	2.38	—	—
1998	2,507	5,903	2.35	—	—
1999	2,392	5,526	2.31	—	—
2000	3,388	5,420	1.60	—	—
2001	3,344	4,787	1.43	—	—
2002	2,861	4,322	1.51	—	—
2003	2,718	4,389	1.61	3,714	1.37
2004	2,634	4,735	1.80	3,948	1.50
2005	2,894	4,735	1.64	4,358	1.51
2006	3,140	4,637	1.48	4,411	1.40
2007	2,573	4,007	1.56	3,756	1.46
2008	2,224	3,646	1.64	3,459	1.56
2009	2,092	3,464	1.66	3,219	1.54
2010	2,047	3,515	1.72	—	—

Source: Institute of Transportation (2011a) and Department of Health (2011)

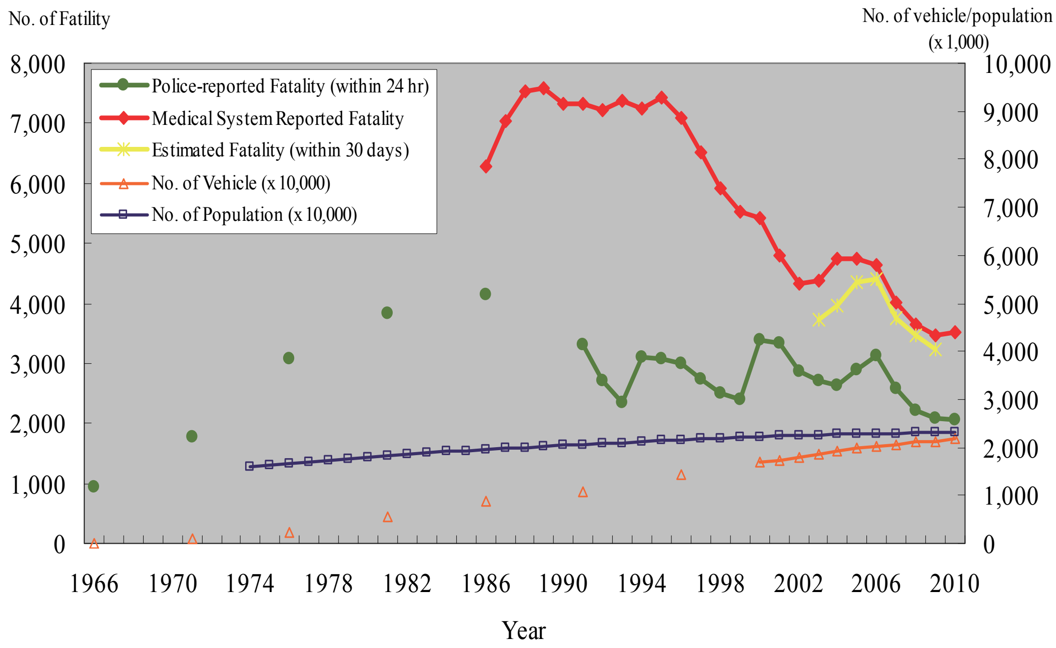


Figure 7 Comparison between Police-reported, Estimated, and Medical System Reported Fatalities

Source: Ministry of the Interior (2011), Department of Health (2011), Institute of Transportation (2011a) and Ministry of Transportation and Communications (2011)

3.2 Fatality and Injury Accident by Road Type, Transport Mode, and Victim's Age

3.2.1 Fatality and injury proportion by transport mode

Based on police-reported fatalities, the number of fatalities and injuries by different transport modes were analyzed between 1999 and 2009. Traffic accidents have caused over 1,186 motorcycle rider fatalities (57% of all deaths) and over 179,000 injuries (73% of all injuries) in 2009 (detailed facts demonstrated in Appendix 6). Figure 8 and Figure 9 shows that motorcycle rider fatalities and injuries have the biggest portion in all fatalities and injuries respectively. Motorcycle rider fatalities comprised 50% of all fatalities in average between 1999 and 2009, and the rider death percentage was 39% in 1999 and reached to 57% in 2009. Motorcycle rider injuries also had a high proportion in all injuries, comprising 70% on average between 1999 and 2009, and increased from 60% in 1999 to 73% in 2009. Thus, improving motorcycle safety is a pressing issue in Taiwan.

Over the past 10 years, pedestrians took the second highest portion in fatalities, around 14% on average, passengers of all modes the third (around 13%), and then passenger car drivers (around 11%) and bicycle riders (around 6%). In terms of injuries, passengers of all modes had the second highest portion (around 14%), passenger car drivers the third (around 6%) and then pedestrians (around 5%) and bicycle riders (around 4%) spanning from 1999 to 2009.

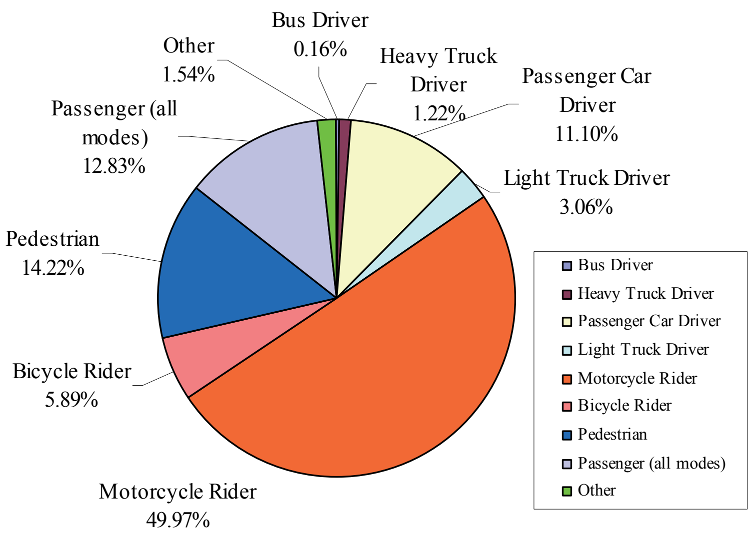


Figure 8 Fatality Compositions by Transport Mode between 1999 and 2009

Source: Institute of Transportation (2011b)

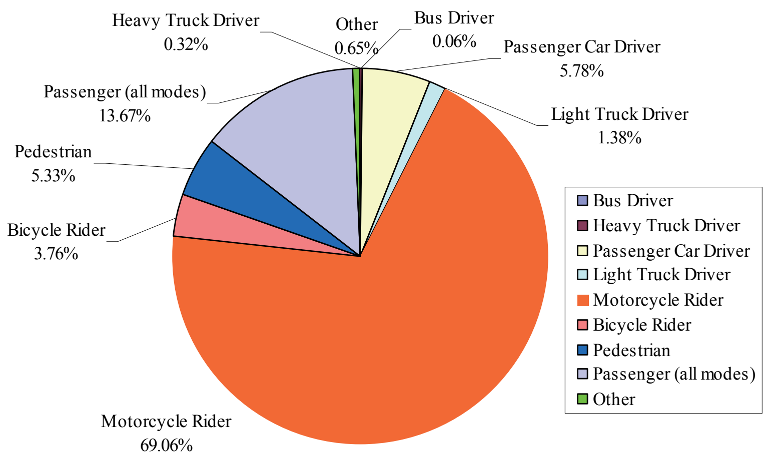


Figure 9 Injuries Composition by Transport Mode between 1999 and 2009

Source: Institute of Transportation (2011b)

3.2.2 Fatality rate by road type, transport mode, and victim's age

As mentioned earlier, the number of fatalities tends to be decreasing in recent years. To further explore the composition of fatality changes, we use the corresponding road length, vehicle registration number, and number of populations to calculate the fatality rate among different types of roads, modes of transport, and age group of victims. Only the 24-hour police-reported data is able to be reached, and the corresponding fatality rate spanning from 1999 to 2009 are demonstrated in Figure 10 through Figure 17.

Figure 10 shows that freeways, provincial roads, and county roads had a higher but similar significantly decreasing trend on fatality rates of about 200 to 80 fatalities per thousand km over the last ten years. Urban roads had a slightly downward pattern of about 70 to 30 fatalities per thousand km, while rural roads had a rather stable rate about 20 fatalities per thousand km between 1999 and 2009. Freeways, provincial roads and county roads revealed a higher fatality rate, which may be caused by the higher running speed on these types of roads.

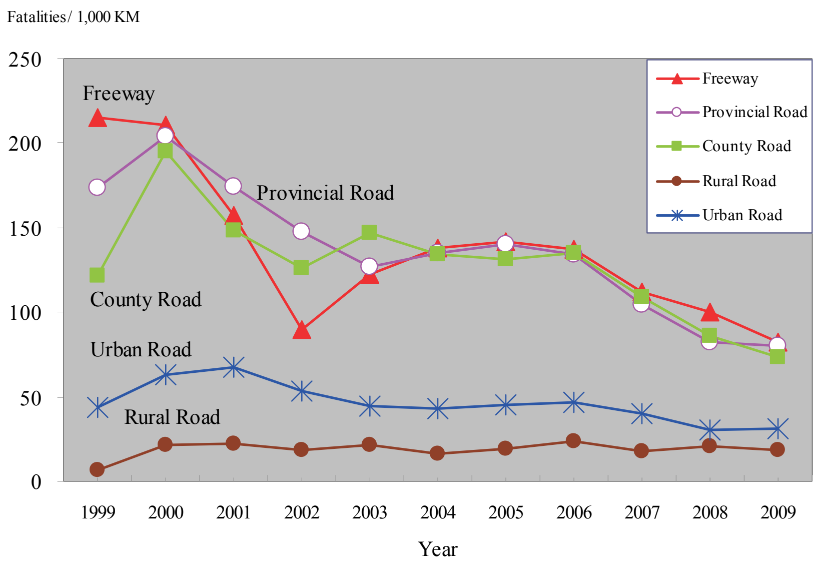


Figure 10 Fatality Rate by Road Type between 1999 and 2009

Source: Institute of Transportation (2011b)

In terms of different transport modes (see Figure 11) passenger car drivers had the lowest fatality rate during the ten-year period, while heavy truck, light truck drivers, and motorcycle riders had a higher fatality rate as compared with passenger car drivers. Bus drivers, on the other hand, showed an unstable pattern of fatality rates because of a relatively fewer of vehicle. All transport modes revealed a slightly decreasing trend on fatality rates with 3.26 fatalities of passenger car drivers, 5.19 fatalities of light truck drivers, 5.67 fatalities of heavy truck drivers, 7.23 fatalities of bus drivers and 8.12 fatalities of motorcycle riders per one hundred thousand registered vehicles in the year 2009.

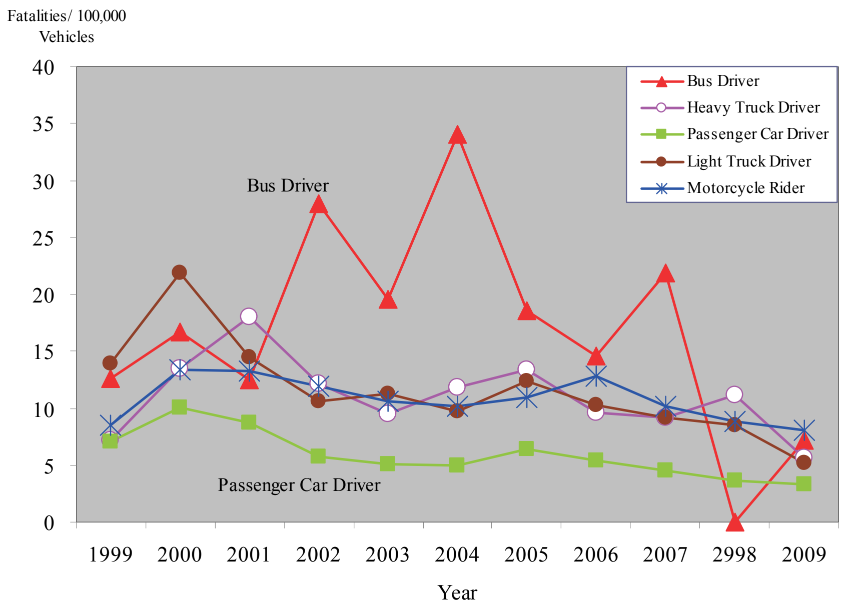


Figure 11 Fatality Rate by Motor Vehicle Type between 1999 and 2009

Source: Institute of Transportation (2011b)

We further examined the fatality rate of drivers and passengers for different transport modes based on various age and gender groups, shown in Figure 12 through Figure 17. Figure 12 shows that male passenger car drivers, especially aged between 18 and 64, had a comparatively higher fatality rate compared with their female counterparts. Male car drivers aged between 18 and 64 also had an obviously decreasing trend of fatality rates over the past ten years. Moreover, male car drivers aged 18-24 had a dominantly high fatality rate between the year 1999 and 2006, but male drivers aged 25-64 ranked top since 2007.

The population-based motorcycle fatalities per one hundred thousand persons (Figure 13) is higher than any other kind of their same age and gender counterparts of drivers or passengers shown in Figure 12, Figure 14 through 17. For example, male motorcycle riders aged 18-24 had 14.5 fatalities as compared with male passenger car drivers of the same age which had only 1.6 fatalities per one hundred thousand persons. Similarly, male motorcycle riders also showed a higher fatality rate as compared with female riders. Male riders aged 65 or above had the highest death risk in traffic accidents, possibly because their frailty and lower resistance capacity to trauma. In addition to the problem of older riders, male motorcycle riders aged 13-17 also had the risk even higher than any age groups of female riders. Riders aged under 18 in Taiwan experiencing unlicensed motorcycling has been an important issue. According to the ten years' data, the fatality rate among different age and gender combinations for motorcycle riders revealed a rather stable pattern.

Elderly bicycle riders had a higher fatality risk as compared with their young counterparts (as demonstrated in Figure 14). Older male bicycle rider aged 65 or above had the highest rate, and then older female aged 65 or above had the second highest rate. However, the difference between the two elderly gender groups seemed to be close in recent years. For the pedestrian part in Figure 15, similarly with bicycle riders, both elderly genders as pedestrians show a higher fatality rate than their younger counterparts. The population-based death rate of older pedestrians were higher than older bicycle riders, and the rate for female pedestrians aged 65 or above was slightly higher than male pedestrians aged 65 or above. However, in both genders, elderly pedestrians had a diminishing trend in death rates since 2003.

As for passengers seated in passenger cars and motorcycles, it is difficult to find a consistent trend for both kinds of passengers in Figure 16 and Figure 17. Passengers aged 18-24 seated in cars seemed to have a higher death rate between 2003 and 2008; however, male passengers aged 18-24 seated in motorcycles also seemed to have a higher death rate between 1999 and 2003 and it turned out that female passengers aged 18-24 seated in motorcycles have a higher rate of fatalities after 2005. It should be noted that passengers aged 13-17 seated in motorcycles also contribute to a significant part of passenger deaths.

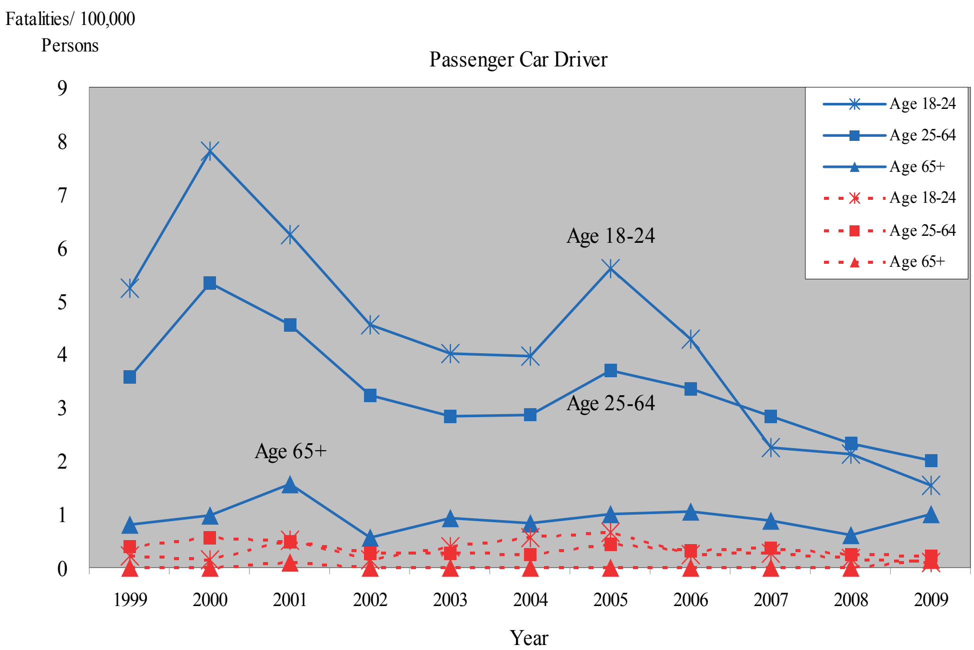


Figure 12 Fatality Rate by Age of Passenger Car Driver between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

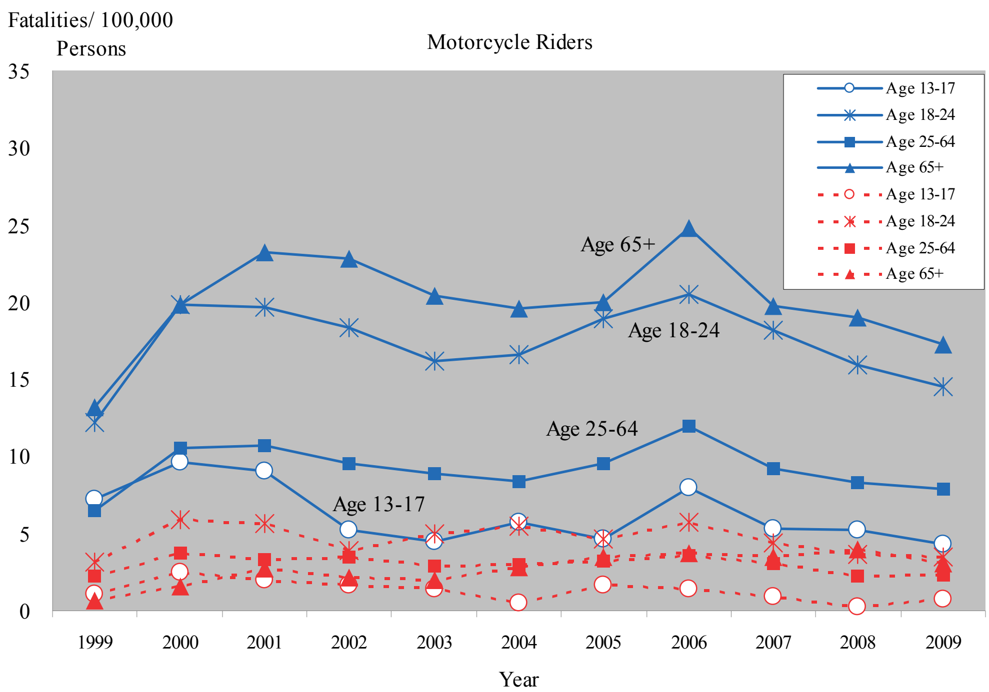


Figure 13 Fatality Rate by Age of Motorcycle Rider between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

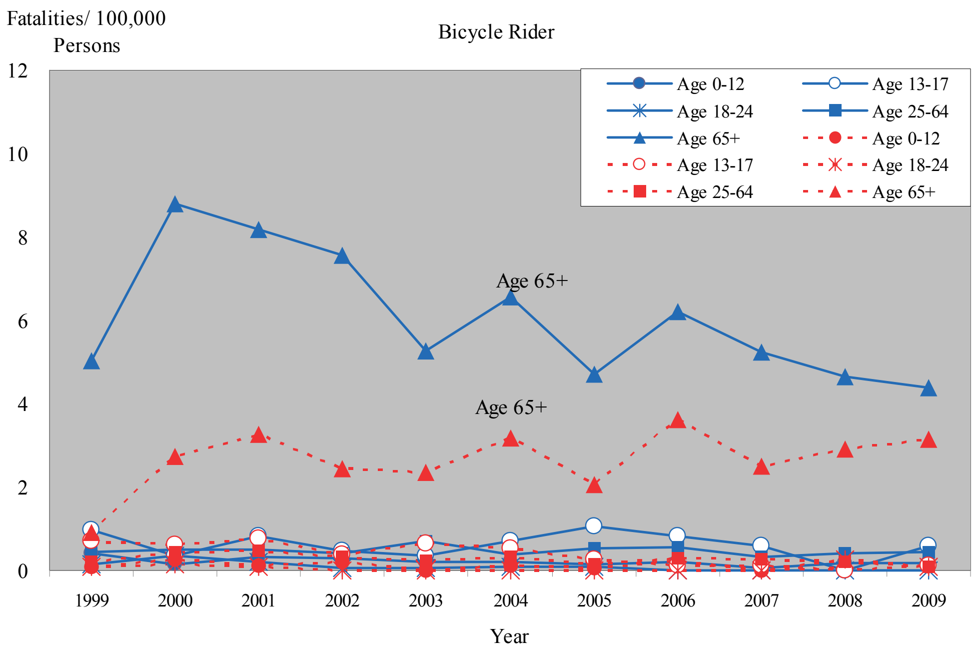


Figure 14 Fatality Rate by Age of Bicycle Rider between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

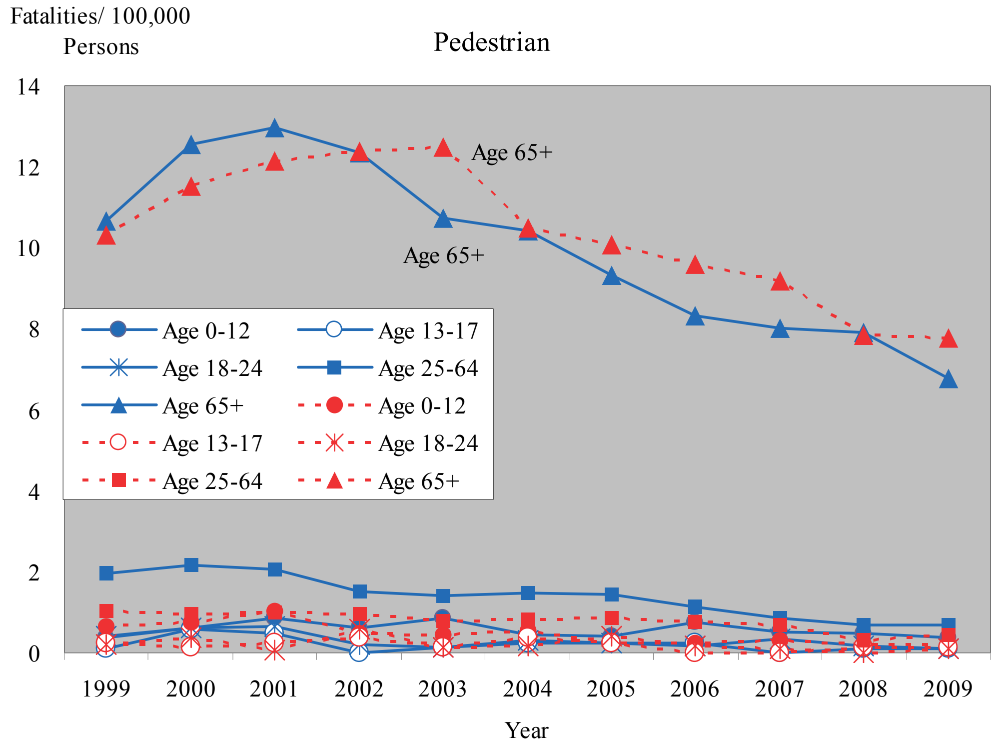


Figure 15 Fatality Rate by Age of Pedestrian between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

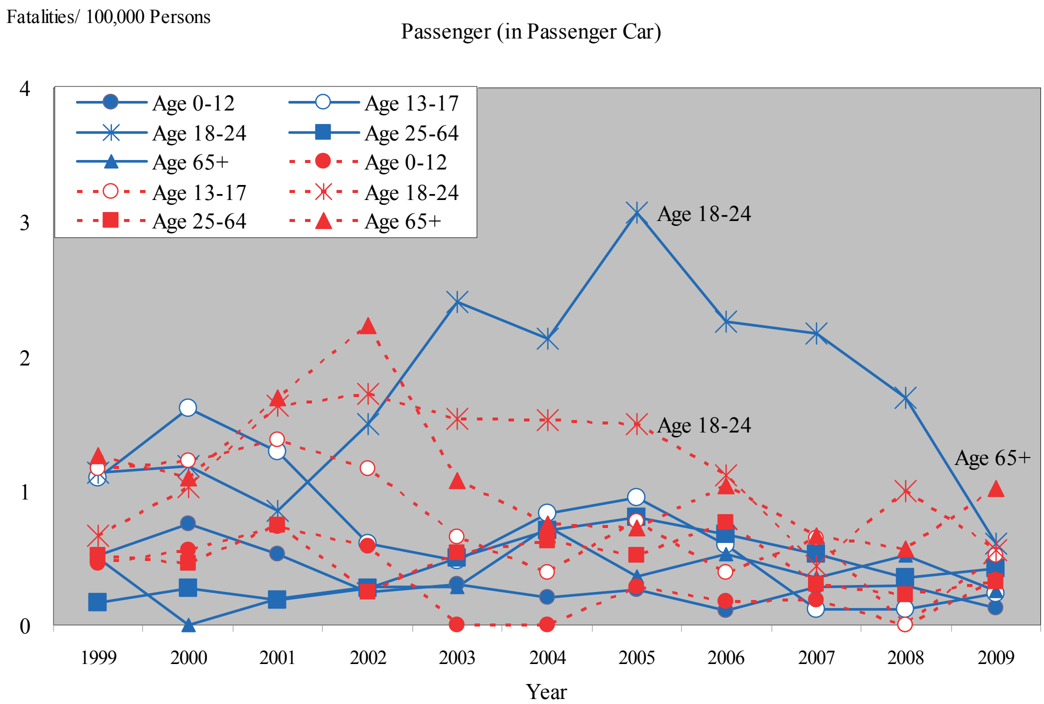


Figure 16 Fatality Rate by Age of Passenger Seated in Passenger Car between 1999 and 2009 (Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

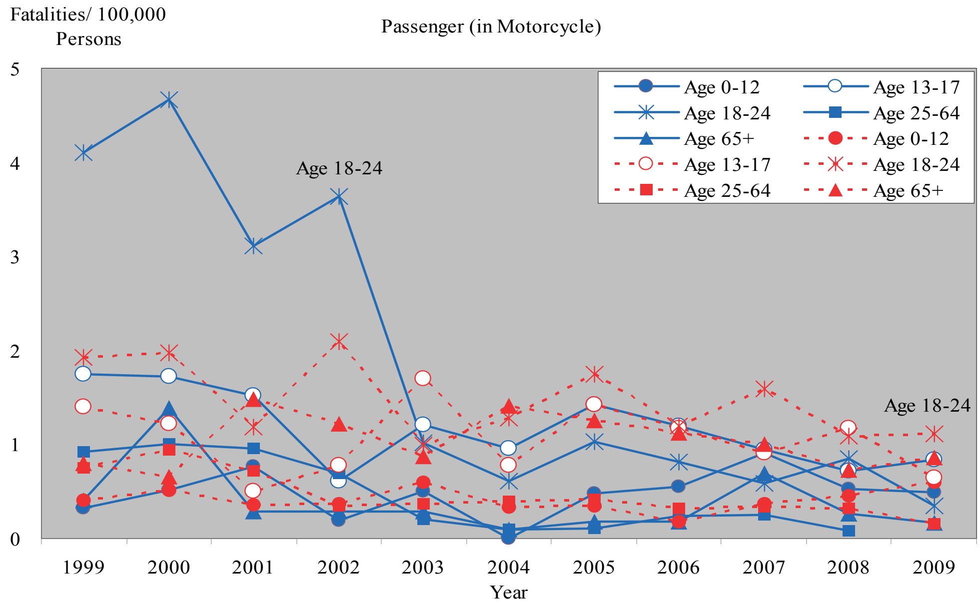


Figure 17 Fatality Rate by Age of Passenger Seated in Motorcycle between 1999 and 2009 (Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

3.2.3 Injury rate by road type, transport mode, and victim's age

Different from fatality rates, the number of injuries appears to be increasing in recent years. Consistent with fatality rates between 1999 and 2009, we applied 24-hour police-reported data to analyze the corresponding injury rate by road type, transport mode and age and gender groups of victims. The related figures are demonstrated in Figure 18 through Figure 25.

In Figure 18, we can find that only freeways had a slightly decreasing tendency over the past ten years. Both urban and county roads had a similar increasing rate on road length based injury rates from the year 1999 to 2008. Provincial roads and rural roads also had a comparable increasing rate. Up until 2009, urban roads had the highest injury rate with 7,342 injuries per thousand km, and county roads had the second highest rate with 4,771 injuries per thousand km. However, provincial roads, rural roads, and freeways had a lower injury rate of about 3,515, 1,742 and 1,376 injuries per thousand km respectively.

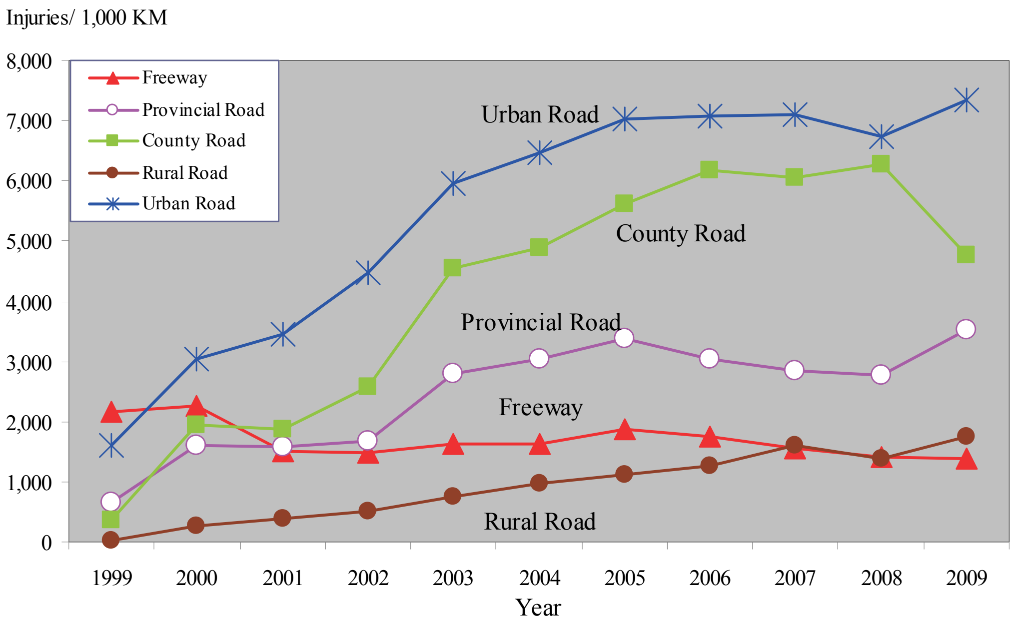


Figure 18 Injury Rate by Road Type between 1999 and 2009

Source: Institute of Transportation (2011b)

To analyze injury rates by transport mode, Figure 19 shows that over the past ten years, only motorcycle riders have revealed a sharply increasing rate with over 60% growth in injury rates per year. However, bus drivers showed a sharply decreasing trend since 2004, and heavy truck drivers a slightly decreasing rate in 2008 and 2009. Both bus drivers and heavy truck drivers had a comparable injury rate with passenger car drivers for the last two years. Light truck drivers had a little higher rate of injuries than passenger cars over the ten-year period. Based on the vehicle based injury rate in the year 2009, motorcycle riders revealed a high rate of 1,234 injuries per one hundred thousand registered vehicles, and in addition, light truck drivers had a rate of 302 injuries, passenger car drivers 180 injuries, heavy truck drivers 145 injuries, and bus drivers with 137 injuries on the basis of per one hundred thousand registered vehicles.

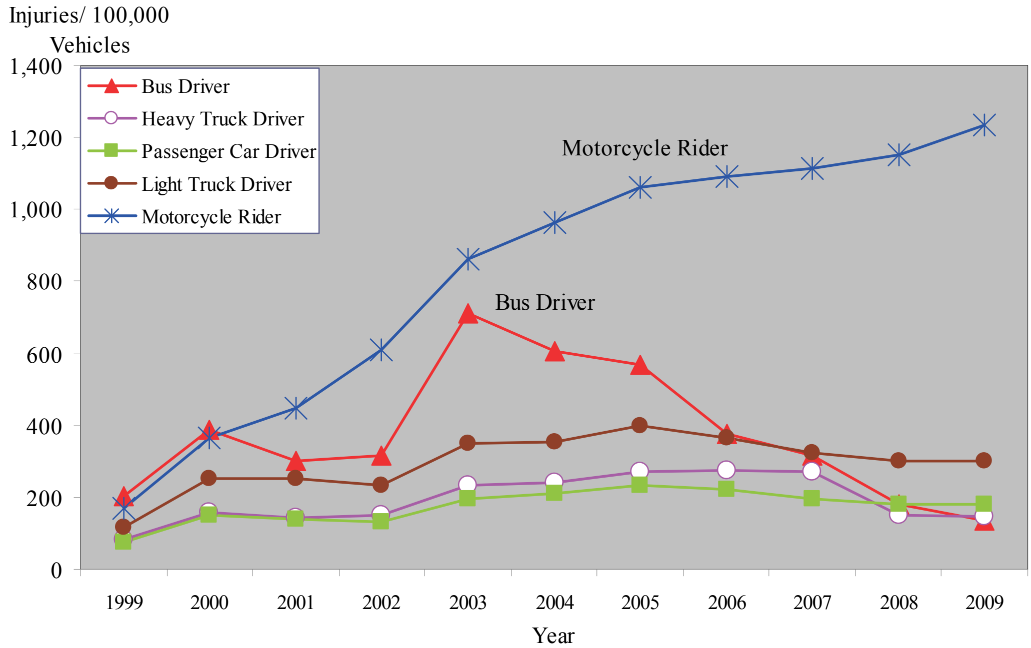


Figure 19 Injury Rate by Motor Vehicle Type between 1999 and 2009

Source: Institute of Transportation (2011b)

The population-based injury rate of drivers and passengers for different transport modes based on different age and gender groups are demonstrated in Figure 20 through Figure 25. Figure 20 shows that male car drivers aged between 18 and 64 had a relatively higher injury rate compared with their female counterpart drivers. Male car drivers aged 65 or above also had a higher injury rate than female drivers of the same age, and the injury rate of these elderly male drivers were just a little lower than female drivers aged 25-64. The changes of injury rates over the past ten years revealed that male car drivers aged 18-24 and 25-64 both demonstrated a sharp rise between 1999 and 2005, which is then followed by an obviously downward trend since 2006, and male car drivers aged 25-64 took the highest rate of injury in the recent two years. Moreover, male car drivers aged 65 or above and female drivers aged 18-24 also increased slowly but steadily over the ten-year period.

Motorcycle rider injuries per one hundred thousand persons, as shown in Figure 21, is extraordinarily higher than any other kind of drivers or passengers of the same age and gender combinations as shown in Figure 20, and Figure 22 through 25. Over the last ten years, except for unlicensed male and female riders aged 13-17 having a stable pattern, all the other age and gender combinations revealed an obviously increasing trend in injury rates, and the increasing trend was relatively significant for young rider aged 18-24 for both genders (see Figure 21). In 2009, motorcycle riders aged 18-24 experienced 3,087 injuries for male and 1,890 injuries for female riders per one hundred thousand persons respectively.

Bicycle riders also experienced an increasing injury rate over the last ten years. It should be noted that bicycle riders aged 13-17 and aged 65 or over had a relatively higher injury rate, especially for male bicycle riders.

For the pedestrian part in Figure 23, both elderly genders aged 65 or greater as pedestrians show a higher injury rate than their young counterparts. The population-based injury rate of older pedestrians were a little higher than older bicycle riders, but different from older bicycle riders, elderly female pedestrians experienced a higher injury rate as compared to their elderly male counterparts. The reverse results in bicycle riding and walking injury risk between elderly genders may be caused by the difference in exposure to these two means of traffic.

As for passengers seated in passenger cars in Figure 24, young passengers aged 18-24 for both genders seemed to have a higher injury rate. The injury rate for young female passengers was even higher than their young male counterparts. Figure 25 shows that besides the age 18-24, younger motorcycle passengers with relatively high injury rates also extended to passengers aged 13-17. Both young female motorcycle passengers aged 13-17 and aged 18-24 had a higher injury rate than their male counterparts of the same age since 2003. Female motorcycle passengers aged 18-24 experienced an extraordinarily high rate of accident injuries. In addition, it should also be noted that children aged under 12 as a passenger for both genders underwent a slow but steady increasing trend of injury rates since 2003.

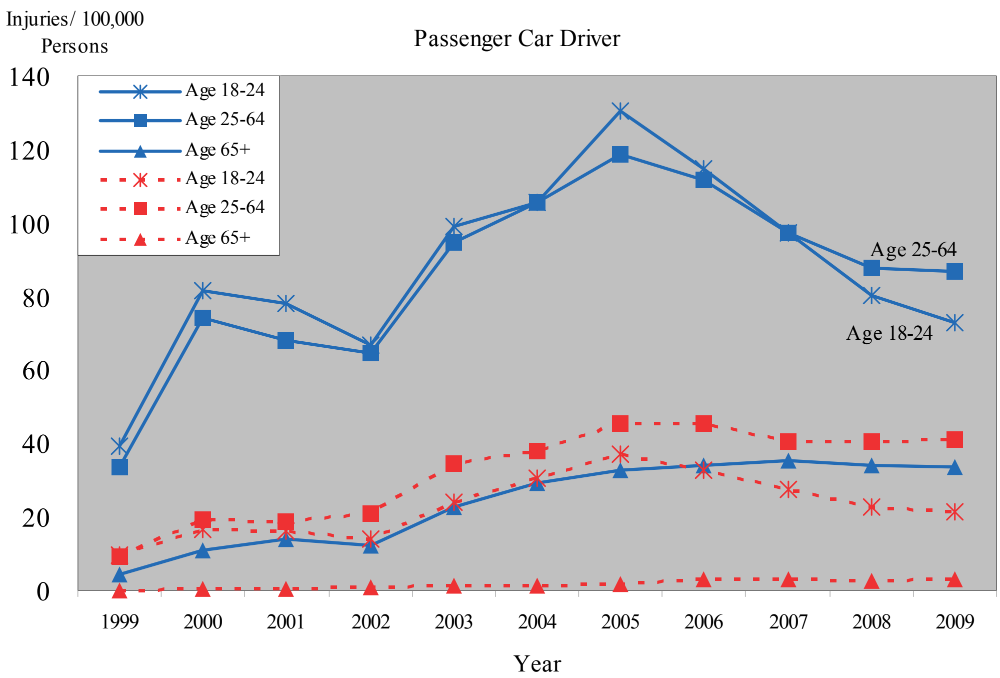


Figure 20 Injury Rate by Age of Passenger Car Driver between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

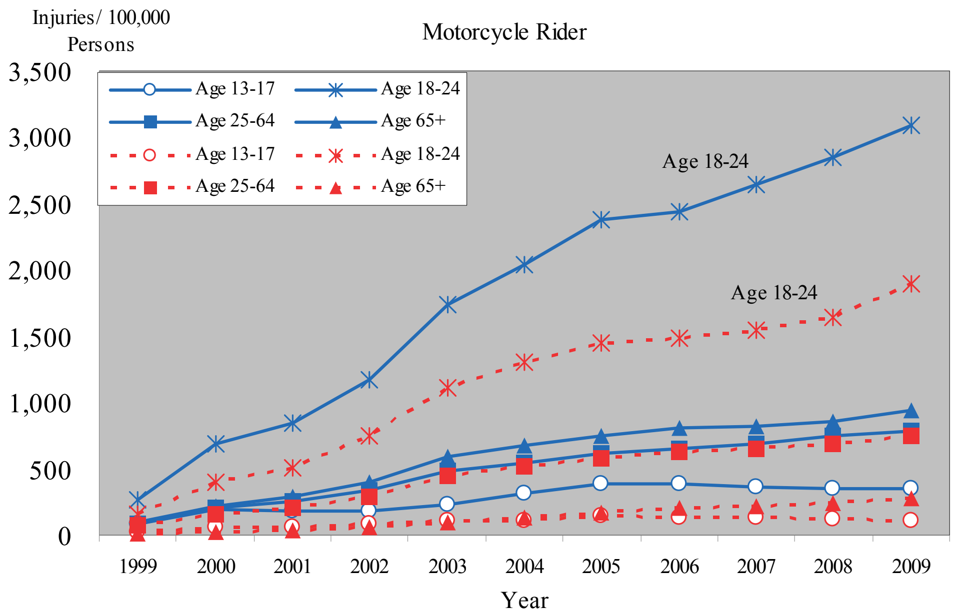


Figure 21 Injury Rate by Age of Motorcycle Rider between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

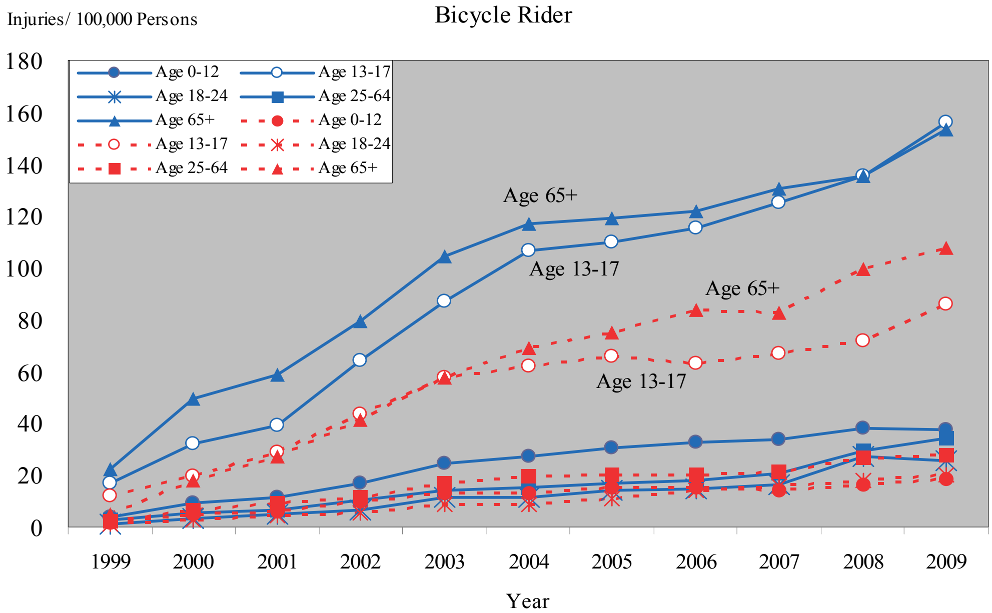


Figure 22 Injury Rate by Age of Bicycle Rider between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

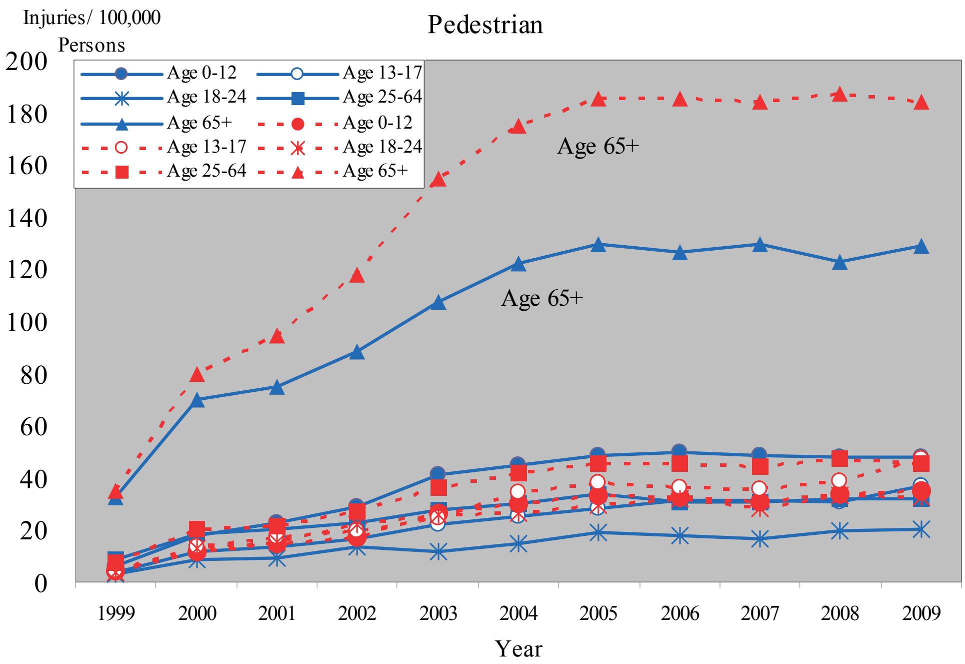


Figure 23 Injury Rate by Age of Pedestrian between 1999 and 2009

(Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

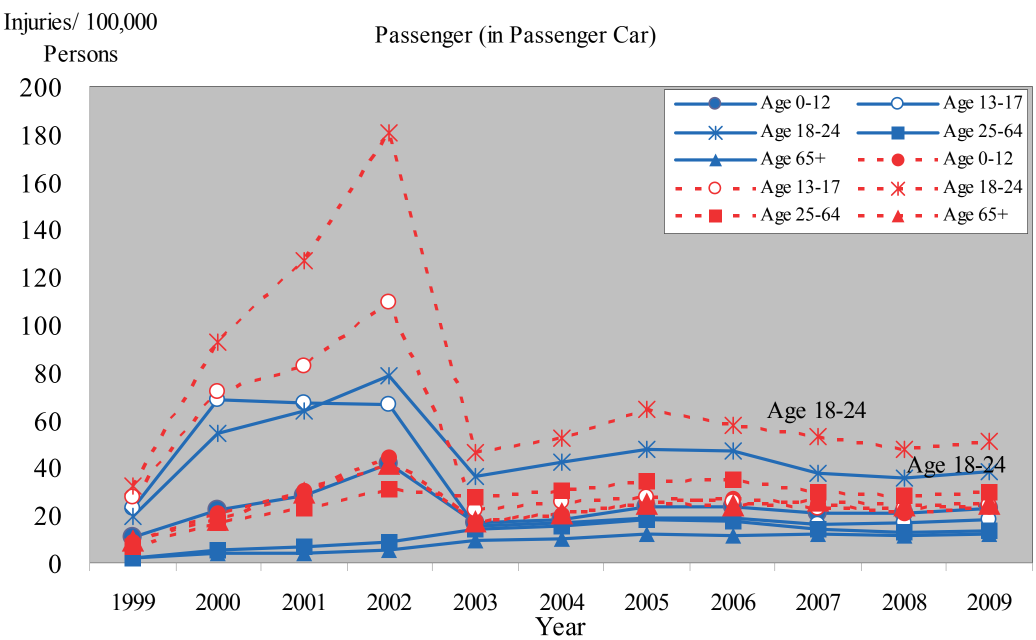


Figure 24 Injury Rate by Age of Passenger Seated in Passenger Car

between 1999 and 2009 (Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

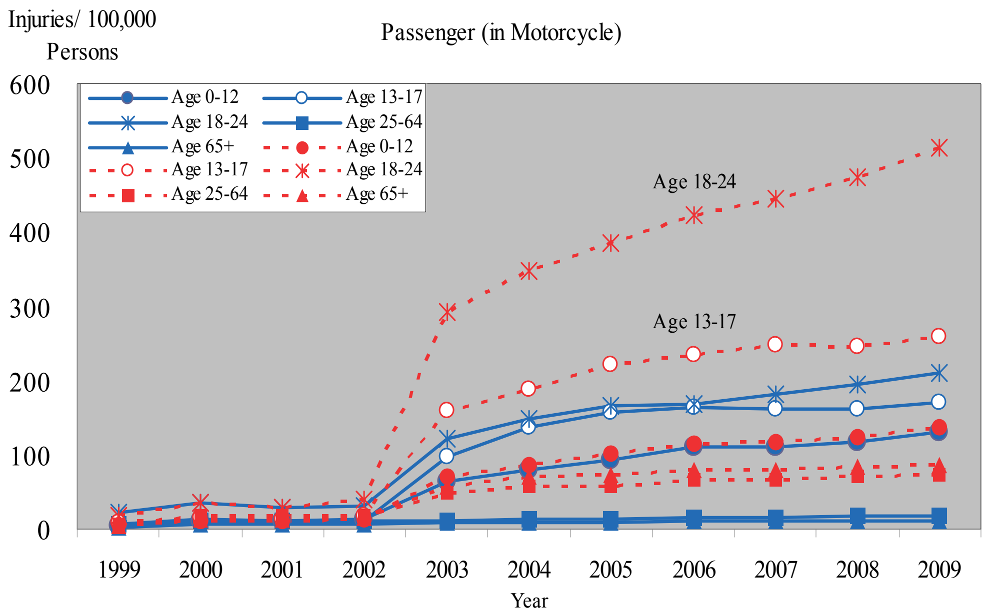


Figure 25 Injury Rate by Age of Passenger Seated in Motorcycle between 1999 and 2009 (Blue: Male, Red: Female)

Source: Institute of Transportation (2011b)

3.3 International Comparisons

As mentioned earlier, the trend of accident fatalities in Taiwan diminished over the past ten years, while accident injuries increased in the same period. Fatality rates have been one of the most common indicators for international comparisons, even though some advanced countries are extending their focus on accident injury prevention, such as the European Union (EU) (European Commission, 2010). To compare traffic safety performance with other developed countries, we use the estimated 30-days fatality data to demonstrate population-based fatality rates from 1998 to 2008 (i.e. Taiwan with data from 2003 to 2008) in Figure 26 (detailed facts can be found in Appendix 7). Figure 26 indicates that Taiwan had 191 fatalities per million persons in 2006 and reduced to 150 in 2008. Compared with the countries with the best performance such as Sweden, United Kingdom, Japan, and Norway with 50 or fewer fatalities per million persons in 2008, the traffic fatality rate in Taiwan was three times greater. The traffic fatality rate in Taiwan also had 1.8-1.9 times more than the average of Organization for Economic Cooperation and Development (OECD) countries and EU. Thus, even with the reduction of fatality rates in recent years, Taiwan still appears to have much to improve, especially concerning the specific issues relating to motorcycle use, elderly road users, and the leading accident cause produced by drunk driving.

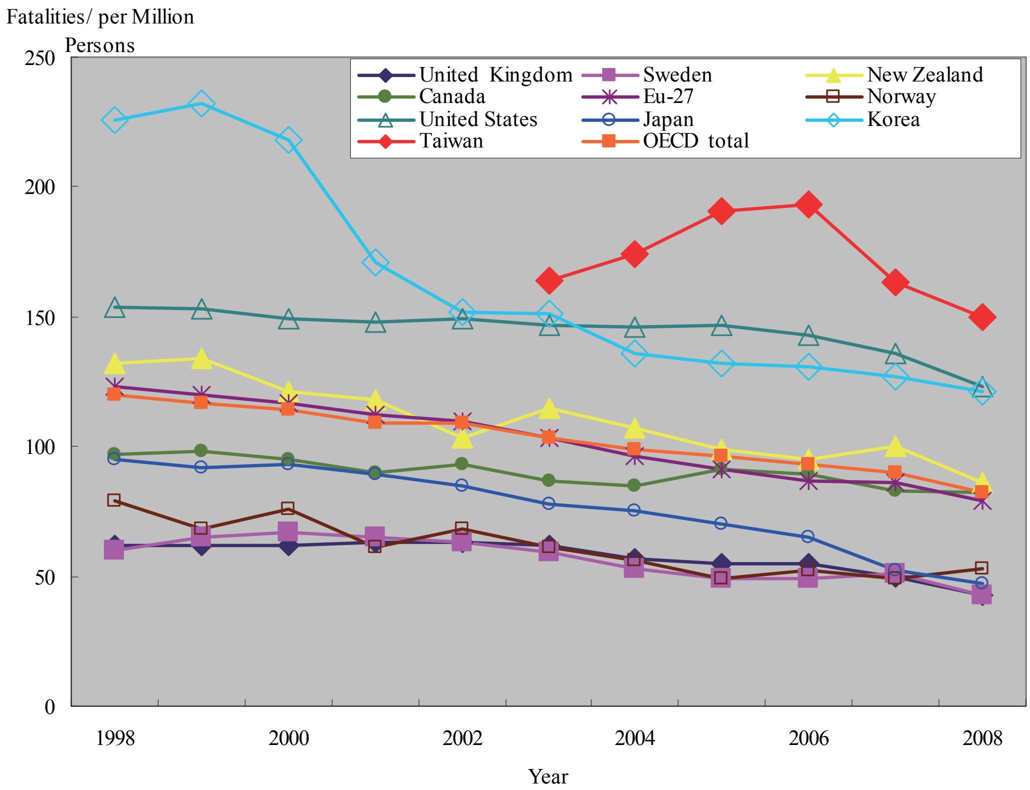


Figure 26 International Comparison of 30-days Fatality Rate between 1998 and 2008

Source: Institute of Transportation (2011b)

4. Organizations for Traffic Safety

For promoting road traffic safety activities, Taiwan has established the National Road Traffic Safety Committee (NRTSC) under the Ministry of Transportation & Communications (MOTC) in 1983. It assumes the responsibility of planning and supervision of nationwide road traffic safety administrative agencies, and also invites the representatives of central administrative agencies to form the Committee, which meets regularly once a month. These representatives include the Ministry of Education, Ministry of the Interior, Administration of Police (under the Ministry of the Interior), Government Information Office (under Executive Yuan), Department of Health (under Executive Yuan), Taiwan Area National Freeway Bureau (under MOTC), Directorate General of Highways (under MOTC), Institute of Transportation (under MOTC) and 25 local governments concerned, as well as academic and professional specialists. The Meeting of the Committee examines traffic safety problems and supervises nationwide and city authorities in the implementation of their corresponding safety programs. There are three functions of the Committee as follows:

(1) To strengthen the planning of special programs for road traffic safety and the coordination and supervision of its implementation;
(2) To examine, supervise and monitor the planning, expenditures and implementation status of subsidized traffic safety programs for central and local administrative; and
(3) To recommend the revision of road traffic safety regulations.

All the local governments have established their corresponding Task Forces in connection with the operation of NRTSC. The freeways, provincial roads and some county roads are maintained and managed by the central agencies, while urban roads, most of county roads, and rural roads are maintained and managed by the local agencies. The annual budget of NRTSC is based on 1.76% of the nationwide fuel tax revenue, approximating NT$0.3 billion (US$10 million) annually in recent years.

To support the mission of road safety improvements, in addition to the dedicated organization established, MOTC has also set up and promoted "Improving Highway Traffic Order and Safety Projects" triennially since 1982. The Projects, conducted by NRTSC, aims to enhance traffic order and safety but also to reduce deaths, injuries and economic losses resulting from motor vehicle crashes. To achieve their aims, NRTSC coordinates with central and local governments' plans and annual implementation programs through the connected links of traffic engineering, enforcement, education, propaganda, and motor vehicles supervision, etc.

The ongoing 2011 Project belongs to the second year of the 10th triennial Project (from 2010 to 2012). Three major issues are focused in recent years: reducing the accidents of the motorcyclists, senior citizens and drunk drivers. As a recent task, NRTSC has advocated the project “Pedestrian Right of Way” since July 2010. This project promotes the concept of priority for pedestrians when motor vehicles approach intersections. Other important programs that NRTSC continues focusing on are engineering based improvements such as “Implementing the Projects of Accident-prone Locations Improvement in Taiwan Area” and “Riding a motorcycle in order,” and enforcement based improvements such as “Deterring Drunk from Driving”, “Promoting Motorcycle Helmets Use by Enforcement and Education” and “Promoting the Concept of right of way Projects”. In addition to engineering based and enforcement based improvements, NRTSC has promoted through measures of traffic propagandas to raise people's awareness about road accident risks.

5. Changes in Traffic Safety Measures

5.1 Main Accident Causes

To further discuss changes in traffic safety measures in Taiwan, it is helpful to observe the trend of main traffic causes in recent years. Figure 27 shows the changes of six main A1 accident causes including drunk driving, careless driving, failing to yield, violating signals or signage regulations, inappropriate turning, and losing control out of speeding, over the past ten years. The number of the six main causes comprised about 60-70% of the total sum of main causes. Drunk driving has risen to the peak in the year 2006, and though followed by a three-year decline, it remains to be the highest cause since 2006. On the other hand, careless driving appears to have a decreasing trend. Failing to yield and violating signal or signage regulations slightly increased, while inappropriate turning slightly decreased during the same period. The most dramatic change in main accident causes was losing control out of speeding. Speeding was the second highest cause of accidents in 2000 and then dropped to the fewest among the six main causes in 2009. However, since only one main cause was requested to be recorded by the police, it is believed that speeding was usually underestimated and has remained to be a serious problem in Taiwan.

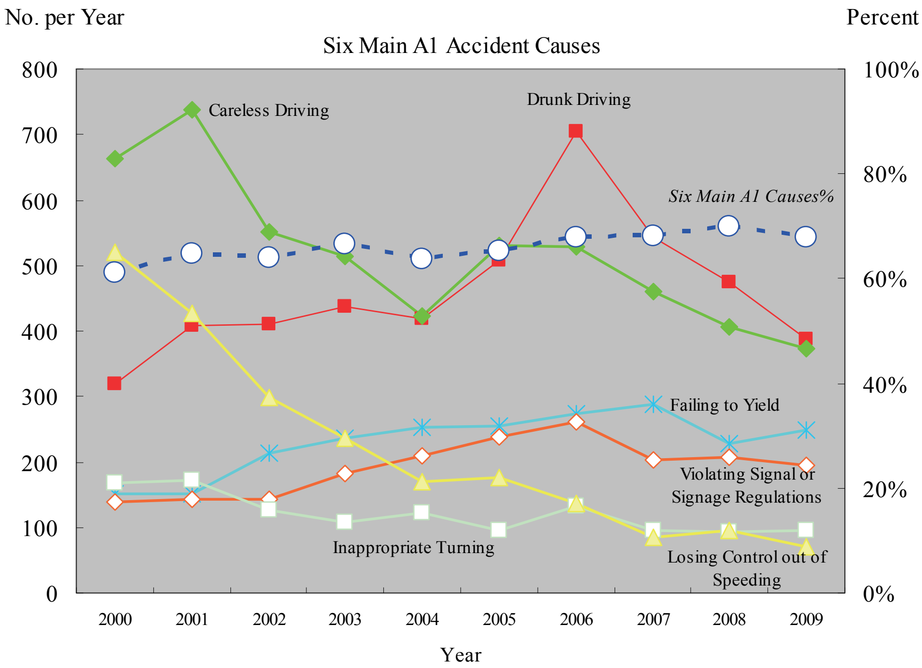


Figure 27 Six Main Accident Causes between 2000 and 2009

Source: National Road Traffic Safety Committee (2010)

5.2 Traffic Safety Measures

As mentioned earlier, triennially issued "Improving Highway Traffic Order and Safety Projects" has been the principal guideline for traffic safety improvements followed by central and local governments since 1982. The Projects basically emphasize the measures of the three Es (Engineering, Enforcement, and Education), which are commonly applied to tackle traffic safety problems in international safety communities. Enforcement, however, appears to be the most effective measure in Taiwan. The inverse relationship between accident event rates and traffic violations cited or fined might strengthen the image of the effectiveness of enforcement. In Figure 28, we can find the negative association between event rates and traffic violations cited or fined during the period 2002-2010. From this, we can say the principal changes in traffic safety policies in Taiwan may be regarded as waves of amendments on traffic laws and regulations. In addition, the comparably large number of motorcycles and their high proportion of accident composition in Taiwan, which has resulted in special engineering design for motorcycle riders, may have unique safety implications.

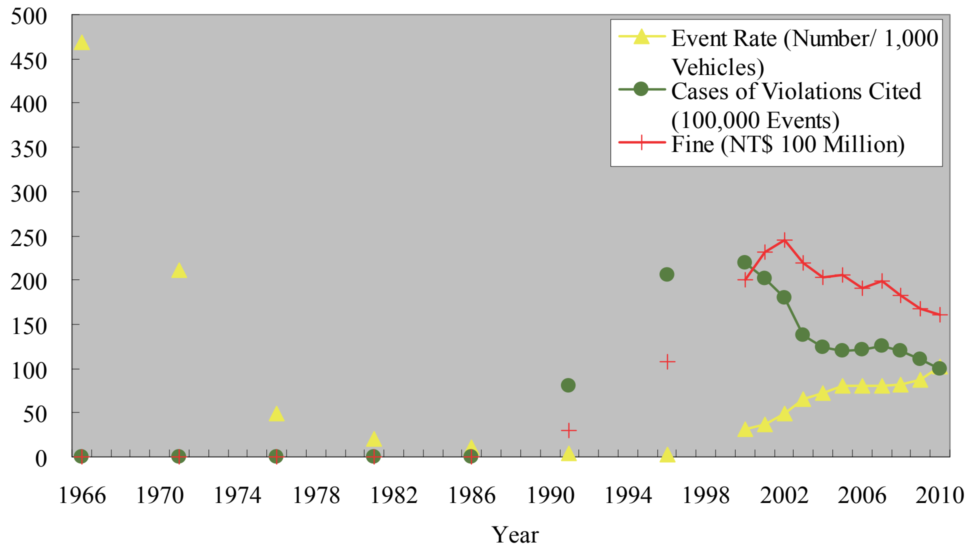


Figure 28 The Relationships between Accident Event Rate, Traffic Violation Cited and Fined between 1966 and 2010

Source: Ministry of Transportation and Communications (2011)

5.2.1 Law amendments

Several waves of law amendments in Taiwan for accident prevention has been thought effective, including mandatory helmets for motorcyclists, mandatory seatbelts for front seat occupants of cars, and stricter punishments for drunk driving.

Mandatory restrain use laws for motorcycle riding and automobile driving was not enacted until the year 1996 and 1985 respectively (see Table 3). Motorcycle helmet wearing was encouraged through promotions and campaigns in 1981, but there were no punishments for violators at that time. Mandatory helmet wearing law with a fine for motorcyclists took effect in 1996. Car seatbelt fastening law was enacted only for front seat occupants travelling on freeways in 1985, and was expanded to include front seat occupants travelling on expressways in 1996, and general roads in 2001 respectively. The fine for not fastening seatbelts on freeways is higher than any other types of roads. Together with mandatory seatbelt fastening for front seat occupants on general roads, mandatory law for baby car seats also took effect in 2001, and the fine was raised for violating car drivers in 2005. Following the successful examples of international practices, mandatory seatbelt fastening will expand to include back seat occupants in the upcoming 2012.

Although mandatory helmets and seatbelts were conducted over 15 years, the helmet wearing rates and seatbelt fastening rates have never been investigated through a large scale sampling survey. A recent convenient sampling survey (Institute of Transportation, 2012) showed that restraint use measures should be even more emphasized, since even with a low not-wearing rate(<5%), the unsuitably fastening rate is still high(>15%) for motorcyclists, and in addition, a high not-fastening rate for front seat occupants(ranging from 5% to over 60%) and a extremely high not-fastening rate for back seat occupants(>95%) reveals that there is much room for improvement in various cities in Taiwan.

Table 3 Law Amendments for Mandatory Helmet and Seatbelt Wearing

Target	Time	Amendment Contents
Motorcycle Helmet Wearing	July 17th, 1981	◆Specific regulations for encouraging helmet wearing were enacted, but there were no punishments for violators.
	December 31th, 1996	◆ Mandatory helmets for both riders and passengers took effect, and violators were fined 500 NT dollars.
Car Seatbelt Fastening	March 1st, 1985	◆ Mandatory seatbelts for front seat occupants running on freeways took effect (defined by traffic regulations on freeways), and violators were fined 500 NT dollars. (The amount of fine was raised to 1,000 NT dollars on May 13th, 1986, and to 3,000 NT dollars on December 31th, 1996).
	December 31th, 1996	◆ Mandatory seatbelts for front seat occupants running on expressways took effect and violators were fined 1,500 NT dollars.
	January 2nd, 2001	◆ Mandatory seatbelts for front seat occupants expanded to general roads and violators were fined 1,500 NT dollars. ◆ Car drivers violating the mandatory rule for baby car seats were fined 500 NT dollars. ◆ Violating mandatory seatbelts for front seat occupants running on freeways was formally defined by traffic law but no further adjustment was made to the amount of fine (3,000 NT dollars).
	December 9th, 2005	◆ The fine of violating the mandatory rule for baby car seats was raised to 1,500-3,000 NT dollars. ◆ The baby car seats applying for children aged under 4 or weight under 18 kg was clearly defined.
	April 22th, 2011 (taking effect in 2012)	◆ Mandatory seatbelts expanded to back seat car occupants. ◆The fine of violating the mandatory seatbelt wearing on expressway was raised to 3,000 NT dollars, comparable with freeways.

Source: The Legislative Yuan: Legal System Database (2012)

Law amendments for drunk driving has always been the main focus, since drunk driving has been the first two main causes of traffic crashes since 2002. Two types of laws were amended against drunk drivers in Taiwan: Administrative and Penalty Law respectively. The BAC standard for drunk drivers in administrative law is 0.05% (defined by the traffic regulations), and BAC standard for drivers that "cannot safely drive" while intoxicated is not rigidly defined in penalty law but 0.11% is the practically accepted number by most of the judges.

Administrative law against drunk driving has been extensively amended since 1996. The scope of the law was expanded to drugged drivers and suspected drivers refusing to take the alcohol breath test. The license suspension and revocation measures were used, and the fines for violators were largely increased (see Table 4). The life-time license revocation was adopted in the Administrative Law in 1996 under the conditions that the accident caused a victim severe injury or death, but was abandoned in 2005 because it was against the authorization by the Constitutional Law. However, a longer period for license revocation was still applied. Penalty law for punishing drunk driving took effect in 1999 and the recent amendment in 2011 has increased the fines and imprisonment durations for serious drunk drivers (see Table 5).

Table 4 Administrative Law Amendments for Drunk Driving

Law Type	Time	Amendment Contents
Administrative Law for Drunk Driving	July 11th, 1975	◆ Drunk drivers were fined 300-600 NT dollars and restricted driving on the scene. ◆ The license for drunk drivers were also revoked for 3 years on conditions that the accident caused a victim severe injury or death. (i.e. The definition of drunk driving is defined as BAC over 0.05%.)
	May 13th, 1986	◆ The fines for drunk drivers were raised to 900-1,800 NT dollars.
	December 31th, 1996	◆ The fines for drunk drivers were raised to 6,000-12,000 NT dollars. ◆ Drugged drivers and suspected drivers refusing to take the alcohol breath test were also be fined 6,000-12,000 NT dollars.. ◆ The license for the above violators were suspended for 6 months without causing any other injuries and one year when causing injuries. ◆ The licenses for the above violators were revoked for life-time on conditions that the accidents caused a victim severe injury or death. ◆ The sentence for imprisonment duration were extended by half on conditions that an unlicensed or drunk driver should receive a penalty law when they caused a victim severe injury or death.
	January 2nd, 2001	◆ The fines for drunk drivers, drugged drivers and suspected drivers refusing to take the alcohol breath tests were raised to 16,000-60,000 NT dollars. ◆ The suspension duration for the above violators' licenses were extended from 6 months to one year without causing any other injuries and from one year to two years with causing injuries.
	December 9th, 2005	◆ Regardless of causing injuries, the licenses for commercial heavy vehicle drivers were revoked for 4 years on conditions that they drove while intoxicated. ◆ The life-time license revocation for drunk drivers, drugged drivers and suspected drivers refusing to take the alcohol breath test were lifted because life-time revocation had been declared against the Constitutional Law and were revoked for 8 years, 10 years, and 12 years on conditions that the accidents caused a victim injuries, severe injuries and death, respectively.

Source: The Legislative Yuan: Legal System Database (2012)

Table 5 Penalty Law Amendments for Drunk Driving

Law Type	Time	Amendment Contents
Penalty Law for Drunk Driving	March 30th, 1999	◆ A driver taking drug, alcohol or similar substance and cannot safely drive would receive at most one-year imprison sentence, custody or at most 30,000 NT dollars. (i.e. The definition of "cannot safely drive" is practically regarded as BAC over 0.11% or over and is through the verdict by the judge.)
	December 18th, 2007	◆ The fine was extended to at most 150,000 NT dollars.
	November 9th, 2011	◆ At most one-year imprisonment sentence was extended to two years and would be extended to 6 months to 5 years and one to 7 years on conditions that the accident caused a victim severe injury or death respectively. ◆ The fine rose to at most 200,000 NT dollars.

Source: The Legislative Yuan: Legal System Database (2012)

From a chronological perspective (see Figure 29), mandatory law for helmet wearing in 1996 appeared to have a significant effect on reducing crash deaths. Followed by the amendments of Penalty Law in 1999 and fine rises in 2001 for drunk driving, and together with mandatory law for seatbelt fastening in 2001, the fatalities steadily went downward. However, traffic accident fatalities increased with a reversing trend since 2003 till 2006.

In 2005, law amendments on speeding higher than 60 km/h of the speed limit was attributed to dangerous driving and violators would be fined 6,000-24,000 NT dollars, but it seemed no evidence that the second wave of fatality reduction between 2006 and 2010 was contributed by an effective speed management. On the contrary, the 2005 law amendments for general speeding enforcement also limited the enforcement flexibility of the police since the position of the fixed speed cameras should be informed in advance ahead of the cameras. Though without scientific evidence, it is believed that the fatality reduction between 2007 and 2010 was due to the heavier enforcement by the police on drunk driving, red-light running, and several violation behaviors since the beginning of 2007.

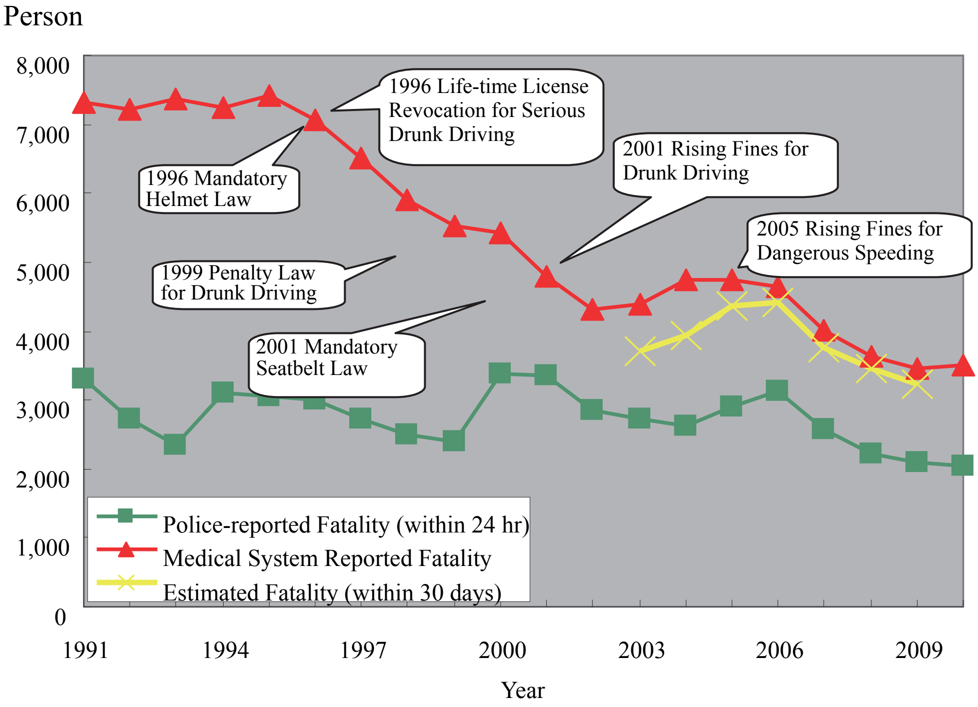


Figure 29 Major Traffic Law Amendments between 1991 and 2010

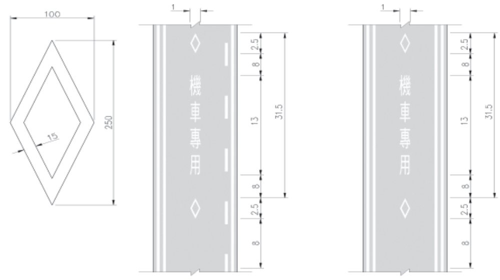
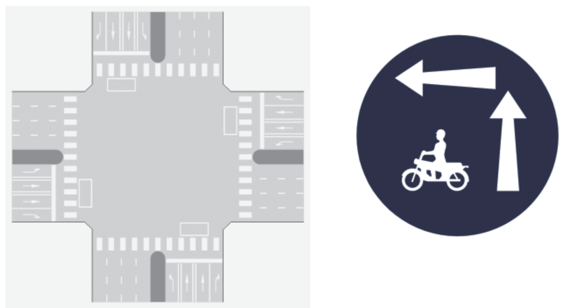
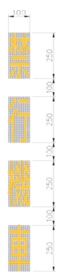
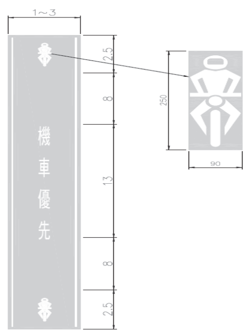
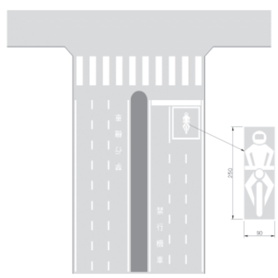
Source: Department of Health (2011), Institute of Transportation (2011a), Ministry of Transportation and Communications (2011) and The Legislative Yuan: Legal System Database (2012)

5.2.2 Special engineering design for motorcycle running

As mentioned before, motorcycle riders have comprised a big portion of all injured accidents, and also sustained severe accident outcomes. Densely mixed with cars, motorcycle riders may experience a higher accident risk. Thus, some special designs for segregating the running of motorcycles with engines sized under 250 cc and cars have been applied in Taiwan (see Table 6). For intersectional segregation measures, a two-phased left-turning, together with applying the inner prohibited lanes for motorcycle riders requires the left-turning riders to wait temporarily in front of the stop line of the transverse direction, and to start when the green light of that direction turns on. It is usually installed in a running direction with over two lanes. In addition, a motorcycle exclusive stopping area behind the stop line offers motorcycle riders an isolated space in front of cars when waiting for a green light. Motorcycle exclusive lane offers a separate lane space dedicated to motorcycle riders and a priority lane also offers a separate lane space mostly for motorcycle riders unless cars have to pass through for the purpose of parking along the curbs or turning right in the approaching intersection. Limited by road space, a two-phased left turning, inner prohibited lanes and exclusive stopping areas behind the stop line are more likely to be installed than motorcycle exclusive or priority lanes.

According to Yeh's (2011) study on motorcycle injury likelihood on different positions of the roads using the 2009 A1 and A2 accident data, inner fast moving lanes for cars (i.e. usually motorcycle running prohibited) had 51% higher and motorcycle priority lane had 28% higher injury likelihood as compared with a slow moving lane (i.e. the rightmost lane with mixed traffic and 40 km/h speed limit if installed), while motorcycle exclusive lanes had 14% lower injury likelihood compared to a slow moving lane. In addition, compared with right turning movements at intersections, motorcycle direct left turning also had 93% higher and straight running had 3 times higher injury risk. The results showed that two-phased left turning and motorcycle exclusive lanes might provide a protective function for motorcycle riders.

Table 6 Special Traffic Engineering Design for Motorcycles

Special Type	Time	Road Markings
Motorcycle Exclusive Lane	November 30th, 1978	
Motorcycle Two-Phased Left Turning	December 15th, 1989	
Motorcycle Prohibited Lane	December 15th, 1989	
Motorcycle Priority Lane	July 13th, 2000	
Motorcycle Exclusive Stopping Area	September 24th, 2003	

Source: Ministry of Transportation and Communications: Administrative Traffic Law and Regulation Database (2012)

6. Conclusions

The evolution of traffic safety performance in Taiwan has made a significant progress in reducing crash deaths over the past two decades. It might be mainly contributed by several waves of law amendments including mandatory helmet and seatbelt wearing as well as stricter punishments for drunk driving. Stricter enforcements also played a crucial role for implementing these revised regulations.

The effectiveness of a new revision of Penalty Law on stricter sentence of imprisonment and higher fines for serious drunk driving requires more detailed observations. In addition, motorcycle involved accidents, which still covers a big portion and with severe outcomes, has become the principal target for promoting traffic safety in Taiwan. However, some structural barriers such as the riders' training system and traffic engineering design still need to change to enhance the safety performance of motorcycle riding. Along with the coming of aging society, the safety of elderly road users has been inevitably becoming a high priority issue in Taiwan. More research, evaluations, and institutional changes on these safety issues need to done to face the upcoming challenges.

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Appendix 1 Number of Population in Taiwan

Year	Total	Male	Female
1974	15,927,167	8,354,012	7,573,155
1975	16,223,089	8,501,391	7,721,698
1976	16,579,737	8,678,165	7,901,572
1977	16,882,053	8,829,635	8,052,418
1978	17,202,491	8,991,263	8,211,228
1979	17,543,067	9,160,239	8,382,828
1980	17,866,008	9,320,105	8,545,903
1981	18,193,955	9,479,508	8,714,447
1982	18,515,754	9,636,285	8,879,469
1983	18,790,538	9,769,572	9,020,966
1984	19,069,194	9,904,853	9,164,341
1985	19,313,825	10,023,344	9,290,481
1986	19,509,082	10,114,710	9,394,372
1987	19,725,010	10,217,434	9,507,576
1988	19,954,397	10,328,081	9,626,316
1989	20,156,587	10,424,102	9,732,485
1990	20,401,305	10,540,635	9,860,670
1991	20,605,831	10,640,276	9,965,555
1992	20,802,622	10,734,609	10,068,013
1993	20,995,416	10,824,161	10,171,255
1994	21,177,874	10,907,032	10,270,842
1995	21,357,431	10,990,657	10,366,774
1996	21,525,433	11,065,798	10,459,635
1997	21,742,815	11,163,764	10,579,051
1998	21,928,591	11,243,408	10,685,183
1999	22,092,387	11,312,728	10,779,659
2000	22,276,672	11,392,050	10,884,622
2001	22,405,568	11,441,651	10,963,917
2002	22,520,776	11,485,409	11,035,367
2003	22,604,550	11,515,062	11,089,488
2004	22,689,122	11,541,585	11,147,537
2005	22,770,383	11,562,440	11,207,943
2006	22,876,527	11,591,707	11,284,820
2007	22,958,360	11,608,767	11,349,593
2008	23,037,031	11,626,351	11,410,680
2009	23,119,772	11,636,734	11,483,038
2010	23,162,123	11,635,225	11,526,898

Source: Ministry of the Interior (2011).

Appendix 2 Road Length and Road Density in Taiwan

Year	Total (KM)	Freeway (KM)	Provincial Road(KM)	County Road(KM)	Rural Road(KM)	Exclusive Road(KM)	Urban Road (KM)	Road Density (M/KM^2)
1966	15,040	—	2,264	2,733	9,762	281	—	—
1971	15,747	—	2,471	2,725	10,216	335	—	—
1976	17,100	44	3,892	2,332	10,459	373	—	—
1981	17,522	373	3,981	2,330	10,451	386	—	—
1986	19,885	382	4,107	2,612	12,396	388	—	—
1991	28,472	382	4,062	2,613	12,429	387	8,600	791
1996	32,778	484	4,246	2,533	12,465	390	12,660	910
2000	35,750	608	4,447	2,455	12,475	390	15,375	993
2001	36,445	718	4,515	3,401	11,630	390	15,791	1,012
2002	37,016	789	4,573	3,426	11,613	414	16,201	1,028
2003	37,289	872	4,621	3,426	11,613	414	16,343	1,036
2004	37,918	901	4,680	3,359	11,639	414	16,925	1,053
2005	38,517	912	4,721	3,360	11,653	414	17,457	1,070
2006	39,285	954	4,843	3,358	11,654	414	18,062	1,091
2007	39,521	954	5,000	3,360	11,654	414	18,139	1,098
2008	40,306	993	5,024	3,484	11,560	396	18,849	1,119
2009	40,860	993	5,092	3,518	11,765	396	19,096	1,135
2010	41,383	993	4,984	3,544	11,765	396	19,701	1,149

Source: Ministry of Transportation and Communications (2011).

Appendix 3 Composition of Motor Vehicle in Taiwan

Year	Grand Total	Bus		Heavy Truck		Passenger Car			Light Truck		Motorcycle	
		Private	Business	Private	Business	Private	Business	Business (Taxi Only)	Private	Business	Heavy-type	Light-type
1952	10,710	244	1,379	1,511	2,188	2,089	490	490	316	9	—	—
1956	16,753	423	2,176	1,919	2,480	4,760	834	834	262	10	—	—
1961	56,774	498	3,102	2,880	3,675	6,671	2,297	2,297	1,280	34	—	—
1966	152,636	963	4,576	3,291	7,852	11,038	8,171	8,171	3,816	781	—	—
1971	957,295	1,732	7,168	8,028	13,964	32,824	22,287	22,287	24,686	907	517,684	308,808
1976	2,347,298	2,661	11,063	19,145	22,619	127,416	43,568	43,568	85,514	2,575	1,710,500	299,198
1981	5,413,409	4,726	14,064	34,782	31,782	438,052	68,239	68,239	206,748	4,556	3,833,293	758,254
1986	8,696,045	5,976	15,722	46,350	39,771	956,625	90,035	90,035	327,427	4,664	5,419,023	1,775,179
1991	10,611,036	5,381	14,739	66,184	54,977	2,440,685	100,679	100,679	489,381	5,786	4,798,804	2,610,371
1996	14,273,465	3,487	18,285	81,964	73,776	4,039,649	106,826	106,826	615,966	6,178	5,455,570	3,828,344
2000	17,022,689	2,748	21,175	81,003	74,620	4,608,960	107,257	107,257	643,796	9,167	6,848,116	4,575,056
2001	17,465,037	2,580	21,473	81,813	73,327	4,720,641	104,940	104,940	665,718	9,815	7,131,438	4,601,764
2002	17,906,957	2,326	22,753	82,649	73,156	4,888,050	101,286	101,286	690,750	10,228	7,386,784	4,596,973
2003	18,500,658	2,196	23,432	83,912	73,244	5,071,981	97,752	97,752	717,915	10,709	7,759,650	4,607,214
2004	19,183,136	2,042	24,411	85,662	74,798	5,262,693	128,155	95,665	743,939	14,870	8,239,700	4,554,250
2005	19,862,807	1,883	25,084	88,049	76,199	5,495,693	138,669	94,278	770,659	18,563	8,746,286	4,448,979
2006	20,307,197	1,812	25,710	90,142	76,069	5,555,507	142,817	92,418	783,979	21,611	9,225,155	4,331,873
2007	20,711,754	1,793	25,568	91,050	72,954	5,567,687	145,155	89,738	787,361	24,285	9,762,555	4,180,918
2008	21,092,358	1,723	25,616	91,215	70,016	5,530,314	144,112	88,779	786,782	25,658	10,349,865	4,015,577
2009	21,374,175	1,909	25,758	91,543	67,269	5,559,247	145,065	88,589	792,288	35,667	10,749,348	3,854,982
2010	21,721,447	1,856	27,174	93,304	67,780	5,642,969	160,444	87,449	803,493	28,973	11,112,224	3,732,708

Source: Ministry of Transportation and Communications (2011).

Appendix 4 Composition of Driver License in Taiwan

Year	Grand Total	Automobile Total	Automobile Driver										Motorcycle Total	Motorcycle Rider	
			Professional Driver					Private Vehicle Driver							
			Subtotal	TractorTrailer	Bus	HeavyTruck	SmallVehicle	Subtotal	TractorTrailer	Bus	HeavyTruck	SmallVehicle		Heavy-type	Light-type
1989	11,119,592	4,766,627	463,529	38,200	95,543	133,635	196,151	4,303,098	2,589	33,901	187,688	4,078,920	6,352,965	5,781,691	571,274
1991	12,743,375	5,717,706	479,595	45,931	91,779	138,387	203,498	5,238,111	4,259	41,961	225,769	4,966,122	7,025,669	6,372,518	653,151
1996	16,194,060	7,465,839	462,832	63,529	72,163	139,421	187,719	7,003,007	11,750	57,444	323,294	6,610,519	8,728,221	7,835,157	893,064
2000	18,934,549	8,692,270	465,117	82,460	67,826	136,709	178,122	8,227,153	18,157	67,773	400,630	7,740,593	10,242,279	9,185,365	1,056,914
2001	19,583,958	9,023,240	473,474	85,008	67,905	138,117	182,444	8,549,766	19,250	70,436	414,289	8,045,791	10,560,718	9,487,453	1,073,265
2002	20,509,658	9,611,677	479,541	88,790	70,945	138,486	181,320	9,132,136	21,305	77,742	446,380	8,586,709	10,897,981	9,802,092	1,095,889
2003	21,165,753	9,969,719	482,090	92,593	72,832	137,938	178,727	9,487,629	23,093	83,297	463,279	8,917,960	11,196,034	10,078,034	1,118,000
2004	21,803,355	10,334,755	482,931	96,201	74,218	136,974	175,538	9,851,824	25,185	89,207	478,777	9,258,655	11,468,600	10,345,748	1,122,852
2005	22,362,540	10,649,187	485,169	99,482	75,682	136,980	173,025	10,164,018	26,788	93,291	489,748	9,554,191	11,713,353	10,594,164	1,119,189
2006	22,846,348	10,885,591	486,501	108,170	79,180	136,850	162,301	10,399,090	28,192	96,585	493,249	9,781,064	11,960,757	10,849,663	1,111,094
2007	23,403,464	11,149,212	485,604	110,046	80,447	136,109	159,002	10,663,608	29,711	100,371	502,364	10,031,162	12,254,252	11,161,299	1,092,953
2008	23,939,606	11,390,746	483,240	111,291	82,045	134,124	155,780	10,907,506	31,478	103,697	509,645	10,262,686	12,548,860	11,480,318	1,068,542
2009	24,484,174	11,656,279	480,982	111,262	84,724	131,847	153,149	11,175,297	33,808	108,196	516,517	10,516,776	12,827,895	11,785,932	1,041,963
2010	25,044,273	11,942,217	476,944	111,371	85,828	129,271	150,474	11,465,273	36,477	112,703	524,715	10,791,378	13,102,056	12,083,127	1,018,929

Source: Ministry of Transportation and Communications (2011).

Appendix 5 Accident Frequency, Rate and Traffic Violations in Taiwan

Year	Total			A1 Accidents			A2 Accidents		Accident Rate per Ten Thousand Vehicles			Road Traffic Violations	
	Number (Event)	Fatality (Person)	Injury (Person)	Event (Number)	Fatality (Person)	Injury (Person)	Number (Event)	Injury (Person)	Event Rate (Number/ 1,000 Vehicles)	Fatality Rate (Number/ 1,000 Vehicles)	Injury Rate (Number/ 1,000 Vehicles)	Cases of Violations Cited (1,000 Events)	Fine(NT$ Million)
1966	6,045	948	7,793	6,045	948	7,793	—	—	468.19	73.42	603.58	—	—
1971	10,088	1,780	13,412	10,088	1,780	13,412	—	—	210.76	37.19	280.21	—	—
1976	10,517	3,087	14,792	10,517	3,087	14,792	—	—	48.53	14.24	68.26	—	—
1981	10,072	3,840	13,377	10,072	3,840	13,377	—	—	19.99	7.62	26.54	—	—
1986	8,630	4,139	9,983	8,630	4,139	9,983	—	—	10.37	4.97	11.99	—	—
1991	4,729	3,305	4,308	4,729	3,305	4,308	—	—	4.58	3.20	4.17	8,083	3,009
1996	3,619	2,990	2,939	3,619	2,990	2,939	—	—	2.63	2.18	2.14	20,538	10,713
2000	52,952	3,388	66,895	3,207	3,388	1,541	49,745	65,354	31.76	2.03	40.13	21,987	20,003
2001	64,264	3,344	80,612	3,142	3,344	1,490	61,122	79,122	37.27	1.94	46.75	20,192	23,096
2002	86,259	2,861	109,594	2,725	2,861	1,284	83,534	108,310	48.77	1.62	61.97	17,931	24,504
2003	120,223	2,718	156,303	2,572	2,718	1,262	117,651	155,041	66.04	1.49	85.86	13,781	21,932
2004	137,221	2,634	179,108	2,502	2,634	1,248	134,719	177,860	72.83	1.40	95.06	12,336	20,344
2005	155,814	2,894	203,087	2,767	2,894	1,383	153,047	201,704	79.81	1.48	104.02	11,966	20,547
2006	160,897	3,140	211,176	2,999	3,140	1,301	157,898	209,875	80.11	1.56	105.14	12,067	19,064
2007	163,971	2,573	216,927	2,463	2,573	1,006	161,508	215,921	79.95	1.25	105.77	12,493	19,908
2008	170,127	2,224	227,423	2,150	2,224	983	167,977	226,440	81.39	1.06	108.80	11,957	18,324
2009	184,749	2,092	246,994	2,016	2,092	893	182,733	246,101	87.01	0.99	116.32	11,027	16,738
2010	219,646	2,047	293,793	1,973	2,047	774	217,673	293,019	101.93	0.95	136.34	9,918	16,104

Source: Ministry of Transportation and Communications (2011).

Appendix 6 Numbers of Fatalities and Injuries by Transport Mode between 1999-2009

Year	Passenger Car Driver		Light Truck Driver		Heavy Truck Driver		Bus Driver		Motorcycle Rider		Pedestrian		Bicycle Rider		Passenger (all modes)		Other	
	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury	Fatality	Injury
1999	320	3,107	87	650	29	236	3	45	933	17,579	421	1,821	134	938	444	4,742	21	149
2000	476	6,646	143	1,502	39	390	4	89	1,526	40,383	477	4,488	200	2,123	493	10,946	31	297
2001	421	6,370	98	1,600	51	335	3	69	1,556	51,015	491	5,173	205	2,778	472	12,341	46	374
2002	287	6,256	74	1,560	30	371	7	72	1,429	71,537	443	6,447	168	4,044	384	15,319	39	426
2003	265	9,853	82	2,480	28	576	5	177	1,314	105,352	421	8,570	160	5,754	350	21,813	81	1,711
2004	267	11,001	74	2,618	34	607	9	151	1,304	121,960	409	9,867	170	6,473	315	24,983	52	1,440
2005	362	12,838	98	3,054	40	731	5	148	1,442	138,808	398	10,889	142	7,093	337	27,940	69	1,576
2006	309	12,353	83	2,858	37	716	4	100	1,742	146,372	361	10,926	183	7,356	367	29,214	49	1,387
2007	256	10,922	74	2,539	31	676	6	80	1,415	153,834	330	10,814	141	7,985	282	28,518	35	1,272
2008	209	10,124	69	2,389	27	437	0	49	1,263	164,415	278	11,369	139	9,593	218	29,053	21	1,239
2009	186	10,102	43	2,454	22	394	2	36	1,186	179,096	271	11,515	140	10,686	219	30,725	23	1,339
Total	3,358	99,572	925	23,704	368	5,469	48	1,016	15,110	1,190,351	4,300	91,879	1,782	64,823	3,881	235,594	467	11,210

Source: Institute of Transportation (2011b).

Appendix 7 Fatality Rate (per million population) among Developed Countries

Year / Country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Taiwan	—	—	—	—	—	164	174	191	193	163	150
United States	154	153	149	148	149	147	146	147	143	136	123
Korea	226	232	218	171	152	151	136	132	131	127	121
New Zealand	132	134	121	118	103	115	107	99	95	100	86
Canada	97	98	95	90	93	87	85	91	89	83	82
OECD total	120	117	114	109	109	103	99	96	93	90	82
Eu-27	123	120	117	112	110	103	96	91	87	86	79
Norway	79	68	76	61	68	61	56	49	52	49	53
Japan	95	92	93	89	85	78	75	70	65	52	47
United Kingdom	62	62	62	63	63	62	57	55	55	50	43
Sweden	60	65	67	65	63	59	53	49	49	51	43

Note: No. of fatalities is based on (or estimated) 30-days.

Source: Institute of Transportation (2011b).