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Evaluation of Traffic Fatality Countermeasures Implemented in Japan from 1992 to 2007

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Abstract: This study aims to evaluate the comprehensive safety programs that were launched around 1990 in Japan in terms of their effectiveness in reducing traffic fatalities. Traffic fatalities (hereinafter called “fatalities”) in Japan recorded by the National Police Agency (NPA) declined from 11,415 in 1992 to 5,744 in 2007. For this period, comprehensive traffic safety programs were carried out by police agencies, road authorities, automobile manufacturers and other organizations in Japan. Penalties for drunk-driving, vehicle speed, rate of seatbelt use, road infrastructure improvements and so on are adopted as performance indicators to evaluate effects of the countermeasures. The effects of each fatality-reduction countermeasure on the corresponding number of fatalities were estimated. The comprehensive nationwide traffic safety program was shown to be highly effective in reducing traffic fatalities. In particular, it could be inferred that increasing the rate of seatbelt use and vehicle speed reduction are the most effective.

Keywords: *Traffic accident, Fatality, Traffic fatality countermeasure, Evaluation*

1. INTRODUCTION

Traffic fatalities (hereinafter called “fatalities”) in Japan recorded by the National Police Agency (NPA) declined from 11,415 in 1992 to 5,744 in 2007 (ITARDA, 2009). A fatality is defined as the death of a person within 24 hours after a traffic accident. Figure 1 breaks down the number of fatalities between 1992 and 2007 for four crash types. Fatalities decreased for all four crash types, with the decrease for the category “car-to-car and single-car accidents” being particularly dramatic.

The Government of Japan has taken a comprehensive approach to decreasing the number of fatalities. This approach included enhancing driver education, increasing impact of enforcements (particularly severe penalties for drunk-driving and enforcement for overspeeding), increasing the active and passive safety of vehicles, improving road facilities, reducing traffic blackspots, and improving the emergency system. These approaches have been implemented simultaneously since 1990 to reduce the number of fatalities. The comprehensive approach to improving traffic safety in Japan has resulted in a large reduction in fatalities. The "*Towards Zero* report (OECD, 2008)" documents the numbers of fatalities between 1995 and 2007 in Australia, the Netherlands, New Zealand and Sweden. In Australia, New Zealand and Sweden, fatalities decreased by about 20% over that period. However, in the Netherlands and Japan, fatalities decreased by about 50% over the same period. The Netherlands, Sweden, Switzerland, Norway, the United Kingdom, Denmark and Japan have attained rates below 6.0 fatalities per 100,000 inhabitants by 2006. In Asian countries, traffic safety problems are a key issue to be resolved because the mileage of vehicles is rapidly increasing. As these countries the appropriate countermeasures, Japan's success in cutting fatalities in the past 15 years can serve as guidance.

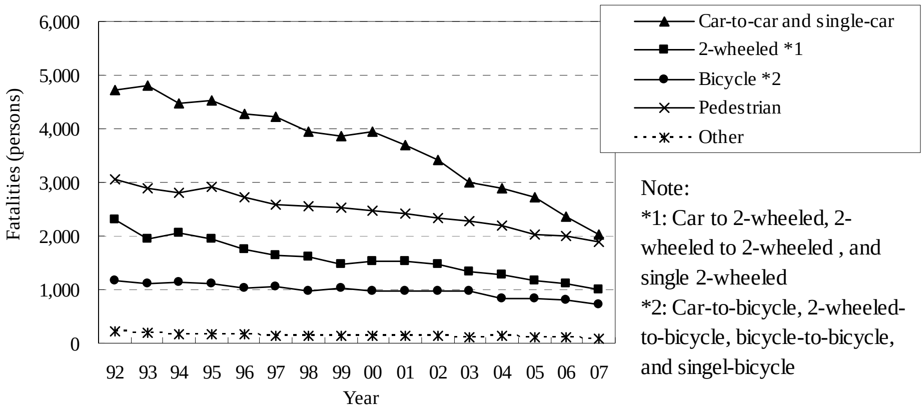


Figure 1. Fatalities according to four crash types in Japan (1992-2007)

The NPA has reported the effects on road safety of advanced traffic-signal control systems and improvements to traffic signals (NPA, 2008a; NPA, 2005; NPA, 2008b). The National Agency for Automotive Safety & Victim's Aid (NASVA) conducts various safety tests every year and measures collision safety performance for commercially available vehicles (NASVA, 2005a). NASVA (2005b) reported the effects of passive systems (crash protection) and active systems (crash avoidance) on fatalities in 2005. Hagita et al (2006) evaluated the traffic accident reduction effectiveness of a program, launched in 2002, to increase enforcement of drunk-driving regulations. They compared the number of fatalities before and after the revised program started, and estimated the effects of the program on the number of fatalities.

However, it is not entirely clear which fatality-reduction measures are the main causes for the decrease in fatalities, and why there is such a steep decrease in the number of car-to-car and single-car fatalities (Figure 1). In addition, few studies have compared the relative effectiveness of fatality-reduction measures. This study aims to determine the relationship between countermeasures and safety performance. It is also expected that this information could contribute to the drafting of effective and comprehensive plans in countries with lower levels of road safety. Thus, the objectives of the study are to evaluate each major fatality-reduction measure in terms of its contribution to the decrease in fatalities, and to identify which of these countermeasures has been responsible for the greatest decline in fatalities in Japan.

To determine the effectiveness of each countermeasure, the number of fatalities related to the target factor before and after the fatality-reduction measure was implemented is determined. These estimates are not simple projections of past reduction rates but are based on a comprehensive understanding of all the basic trends likely to affect traffic safety. Other factors around the target factor affect the number of fatalities. Also, the number of fatalities is influenced by demographic and socioeconomic changes. During the 15-year period from 1992 to 2007, there were changes in the economy, population demographics, the traffic system and so on. These should also be taken into account; however, it is difficult to quantify their effect on traffic fatality-reduction. It was assumed that the number of fatalities related to the target factor before and after the fatality-reduction measure could represent the effect of the target factor on traffic safety.

Based on these considerations, the following sections evaluate the effects of each factor in terms of decrease in fatalities. Section 2 evaluates the effects of driver education implemented by the driver license system of Japan from 1990. Section 3 evaluates the effects of strict enforcement implemented by the NPA. Section 4 evaluates the effects of the increase in the use of seatbelts and helmets. Section 5 evaluates the effects of road infrastructure improvements. Section 6 evaluates the effects of changes in vehicle speed.

2. EVALUATION OF SAFETY EDUCATIONAL PROGRAMS FOR DRIVERS

2.1 Effects of Training Programs for Moped[1] Drivers

The driver license system of Japan has various safety educational programs for drivers to reduce the number of traffic accidents. All drivers in Japan, for example, must undergo a refresher course when they renew their driver's license every three or five years. The renewal period depends on the driver's record of accidents and traffic violations, age, and driving experience.

For the purpose of reducing moped traffic accidents, training programs for moped drivers have been conducted since 1992. Before 1992, the only licensing requirement for moped drivers was a paper test, and moped licenses were available to drivers as young as 16. Since 1992, all moped license applicants have had to undergo a driver training program for moped license applicants before/after passing the paper test. Figure 3 shows the number of fatalities caused by novice moped drivers (i.e., those who had been licensed for less than a year) from 1990 to 2007. These include fatalities caused by novice moped drivers who have a car driver license instead of moped license. A driver who has a moped license is permitted to drive a moped. According to this figure, fatalities caused by novice moped drivers tended to decrease since moped license applicants were required to complete the driver's training program for moped license applicants.

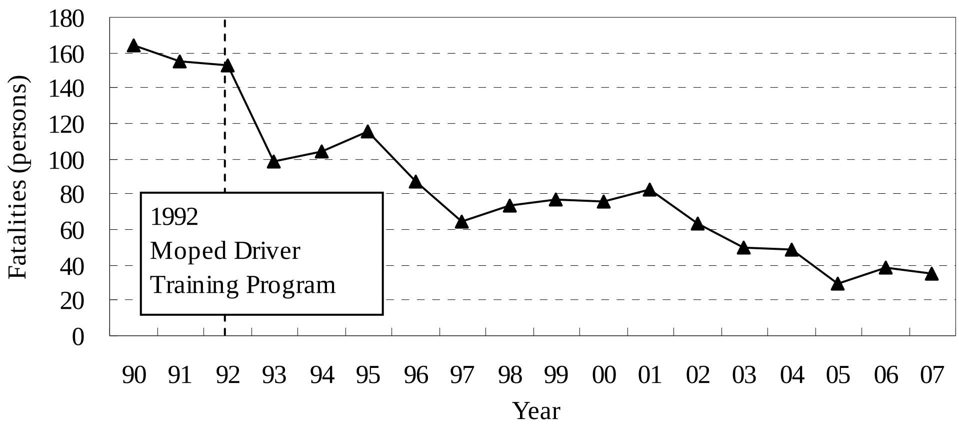


Figure 2. Fatalities caused by novice moped drivers in Japan

[1] "Moped" means a motorized 2-wheel vehicle with a displacement of less than 50 cc.

2.2 Effects of Educational Program for Elderly Drivers

For the purpose of reducing accidents caused by elderly drivers, an educational program for elderly drivers has been conducted since 1998. Drivers aged 70 or over must renew their driver's license every three years, and drivers aged 75 or over must complete elderly driver educational program. In 2002, the age for the elderly driver educational program was reduced from 75 years to 70 years. Figure 4 shows the fatalities from 1996 to 2007 caused by drivers aged 70 or over. Fatalities caused by drivers aged 75 or over show a continuous increase. However, fatalities caused by drivers aged 70 to 74 years show little change or a slight decreasing tendency since 2002.

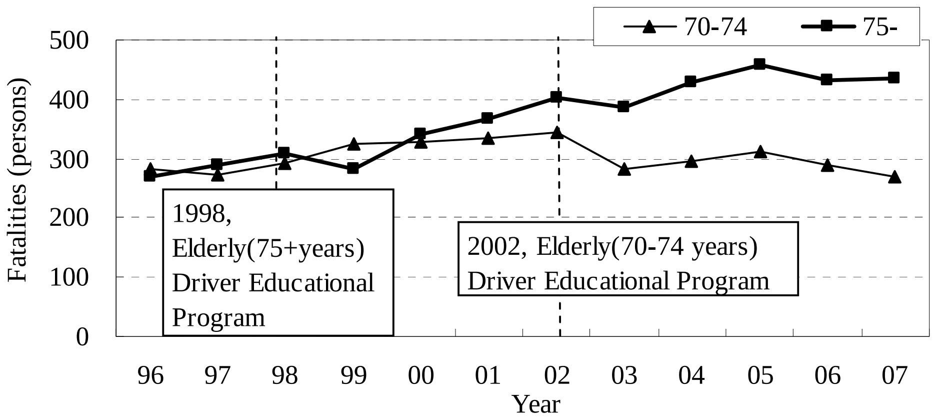


Figure 3. Fatalities caused by elderly drivers (aged 70 or over) in Japan

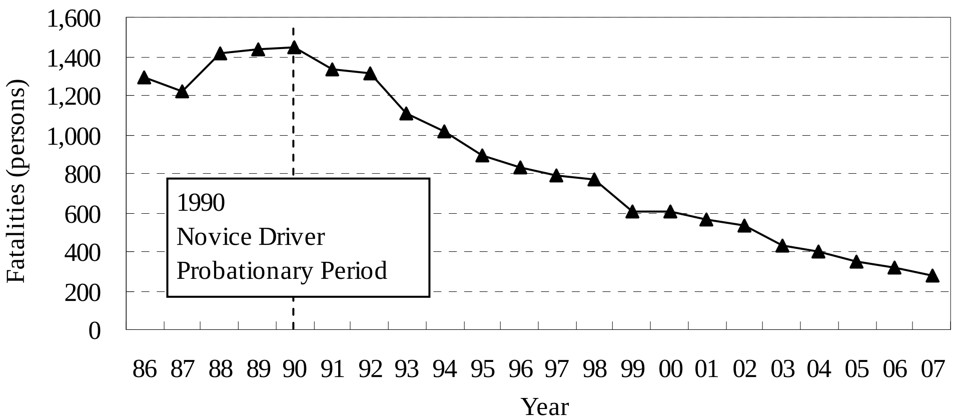


Figure 4. Fatalities caused by novice drivers in Japan

3. EVALUATION OF ENFORCEMENT

3.1 Effects of Novice Driver Probationary Period

For the purpose of reducing fatalities caused by novice drivers, the driver license system of Japan has adopted a novice driver probationary period to prevent accidents caused by new drivers who had been licensed for less than a year since 1990. A novice driver who receives 3 penalty points for traffic violations within the first year after licensing must complete the novice driver educational program. After this, a novice driver who receives another 3 penalty points must retake the driving license test. This system is much stricter for novice drivers than for more experienced drivers. Figure 2 shows the number of fatalities for each year from 1986 to 2007 caused by novice drivers (i.e., drivers who had been licensed for less than a year). Since the system started, fatalities caused by novice drivers have declined rapidly.

3.2 Effects of Severe Penalties for Drunk-Driving

The NPA increased the severity of penalties for drunk-driving in 2002 and again in 2007. Breath Alcohol Concentration (BrAC) is used to measure alcohol concentration instead of Blood Alcohol Concentrations (BAC) in Japan. Table 1 indicates the penalties for drunk-driving before and after *The Road Traffic Law* was amended in 2002 and 2007. The maximum permissible BrAC was reduced from 0.25 mg/l to 0.15 mg/l in 2002. Penalties for drunk-driving were also made more severe. For example, the driver's license is suspended when the BrAC exceeds 0.15 mg/l from 2002.

Table 1. Penalties for drunk-driving in Japan, before and after *The Road-Traffic-Law* was amended

		Before Amendment	After 2002 Amendment	After 2007 Amendment
Criminal penalties	Drive While Intoxicate	Imprisonment less than 2 years or Fine less than 100,000yen	Imprisonment less than 3 years or Fine less than 500,000yen	Imprisonment less than 5 years or Fine less than 1,000,000yen
	Drunk-Driving	Imprisonment less than 3 months or Fine less than 50,000yen	Imprisonment less than 1 years or Fine less than 300,000yen	Imprisonment less than 3 years or Fine less than 500,000yen
	BrAC Legal Limit	0.25 mg/l ~	0.15 mg/l ~	
	Breathalyzer Refusal	Fine less than 50,000yen	Fine less than 300,000yen (2004 Amendment)	Imprisonment less than 3 month or Fine less than 500,000yen
	Hit-and-Run	Imprisonment less than 5 years or Fine less than 500,000yen		Imprisonment less than 10 years or Fine less than 1,000,000yen
	Accessory to Drunk-Driving	No penalty		Imprisonment less than 5 years or Fine less than 1,000,000yen
Administ rative penalties	Drive While Intoxicate	15 Penalty Points (Cancellation of driver's license)	25 Penalty Points (2-year-cancellation of Driver's License)	
	Drunk-Driving (0.25 mg/l ~)	6 Penalty Points (Suspension of Driver's License)	13 Penalty Points (Suspension of Driver's License)	
	Drunk-Driving (0.15 mg/l ~)	No penalty	6 Penalty Points (Suspension of Driver's License)	

In 2007, penalties for drunk-driving were made more severe than those in 2002. A driver who refuses to take a breath test conducted by the police will receive a very severe penalty. In addition, the penalties extended to those abetting the driver in drinking (e.g., restaurant managers, liquor shop managers, passengers aware of the driver's status, etc.). Figure 5 shows fatalities due to drunk-driving from 1992 to 2007. These data include fatalities caused by drivers whose BrAC is detected even if the amount of BrAC is smaller than 0.15 mg/l. Fatalities caused by drunk-driving numbered 1,319 in 2001. By 2004, shortly after the 2002 amendment of *The Road Traffic Law*, they had fallen to 791. In 2007, immediately after the 2007 amendment of *The Road Traffic Law*, fatalities fell to 475.

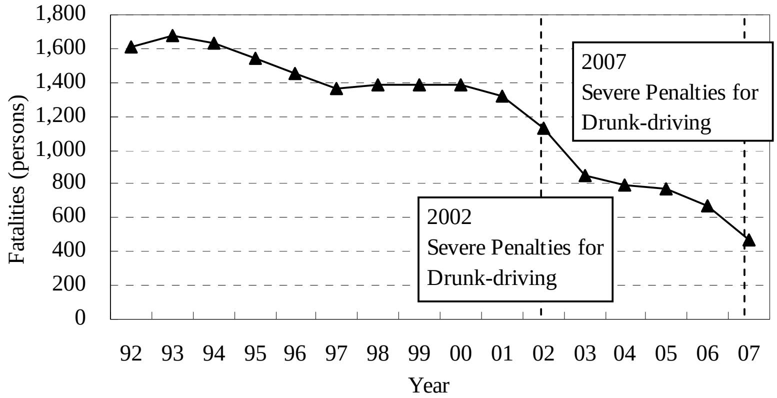


Figure 5. Fatalities caused by drunk-driving

4. EVALUATION OF THE USE OF OCCUPANT PROTECTION DEVICES

4.1 Effects of Seatbelt Use

The rate of seatbelt use has been increasing steadily (Figure 6). This section estimates the reduction in fatalities for 2007 compared with those in 1992 afforded by increased seatbelt use. In order to understand effectiveness of seatbelt use accurately, we confined crash types and crash conditions for this analysis to the following:

1) Passenger cars and trucks (Both drivers and passengers are analyzed.)
2) Vehicles involved in head-on collisions
3) Vehicles that collided with a passenger car, a truck, or a special vehicle such as a farm tractor or a vehicle with caterpillar tread; or, those involved in accidents without any other vehicles or pedestrians
4) Vehicles that do not meet an accident on expressways
5) Those that were not involved in multi-vehicle collisions

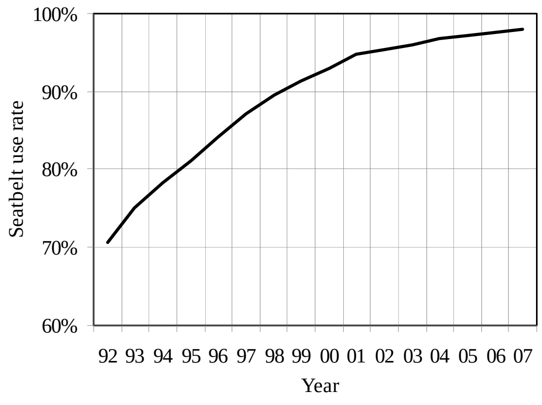


Figure 6. Seatbelt use rate in accidents

Figure 6 shows the seatbelt use rate for injured occupants in the vehicles described above. The seatbelt use rate in 1992 was 74.2%. It rose to 98.5% in 2007, an increase of 24.3 percentage points. Table 2 shows the total number of occupants and fatal occupants with/without seatbelts in 1992 and 2007, respectively. Table 3 shows the total number of occupants and the number of fatal occupants throughout 1992-2007 and fatality rate with or without seatbelt.

Table 2. Total number of occupants and fatal occupants with or without seatbelt

		1992	2007
	with seatbelt	252,245	415,084
	without seatbelt	87,830	6,334
All occupants		340,075	421,418
Seatbelt use rate (%)		74.2	98.5

Table 3. Total number of occupants and fatal occupants with or without seatbelt (throughout 1992-2007)

	Fatalities	All occupants	Fatality rate (%)
with seatbelt	6,217	6,241,137	0.100
without seatbelt	14,532	635,382	2.287

Using the information above, fatalities for 2007 were estimated based on the assumption that the seatbelt use rate was the same as that of 1992. The evaluation equation is shown here:

$$\text{Fatalities of 2007} = I_{07} \cdot RU_{belt92} \cdot RF_{withbelt} + I_{07} \cdot \left(1 - RU_{belt92}\right) \cdot RF_{withoutbelt}$$
$$= 421{,}418 \times 0.742 \times 0.100 + 421{,}418 \times (1-0.742) \times 2.287 \quad (1)$$
$$= 2{,}801$$

where

I_{07} : total number of occupants in 2007

RU_{belt92} : seatbelt use rate in 1992

$RF_{withbelt}$: fatality

As fatalities numbered 744 for 2007, it was estimated that a reduction of 2,057 fatalities was achieved through the increase in the rate of seatbelt use.

4.2 Effects of Helmet Use by Motorcyclists

Figure 7 shows the rate of helmet use for motorcyclists involved in injury accidents. That rate is high, and the increase in that rate has continued up to the present. The reduction of fatalities due to helmet use was evaluated. The helmet is used to protect the head or face of a rider. With this in consideration, the number of motorcyclist fatalities and occupants injured on the head or the face is determined to calculate the fatality rate. Table 5 shows the number of motorcyclist fatalities and the fatality rate of injured occupants with and without helmet use from 1992 to 2007. Using the information in Table 4 and Table 5, fatalities for 2007 were estimated based on the assumption that the helmet use rate was the same as that of 1992. The evaluation equation is shown here:

$$\text{Fatalities in 2007} = I_{07} \cdot RU_{helmet92} \cdot RF_{with\,helmet} + I_{07} \cdot (1 - RU_{helmet92}) \cdot RF_{without\,helmet}$$
$$= 15{,}949 \text{x} 0.884 \text{x} 0.0369 + 15{,}949 \text{x} (1-0.884) \text{x} 0.0719 \quad (2)$$
$$= 654$$

where

I_{07} : all occupants in 2007

$RU_{helmet92}$: helmet use rate in 1992

$RF_{with\,helmet}$: fatality rate of occupants with helmet

$RF_{without\,helmet}$: fatality rate of occupants without helmet

As the number of fatalities recorded in 2007 was 494, it was evaluated that a reduction of 160 fatalities was achieved by the increase in helmet use.

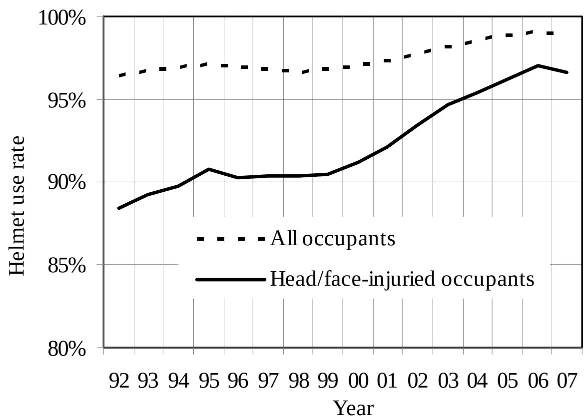


Figure 7. Helmet use rate for injured occupants

Table 4. All injured occupants and fatalities with/without helmet with head or face injury in 1992 and 2007

		1992	2007
	with helmet	19,196	15,413
	without helmet	2,529	536
All injured occupants		21,725	15,949
Helmet use rate (%)		88.4	96.6

Table 5. The number of motorcyclist fatalities and injured occupants with head or face injury from 1992 to 2007

	Fatalities	All injured occupants	Fatality rate (%)
with helmet	11,265	305,099	3.69
without helmet	1,891	26,312	7.19

5. EVALUATION OF ROAD INFRASTRUCTURE IMPROVEMENT

5.1 Effectiveness of Road Safety Facilities

Road administrators throughout Japan have installed various road safety facilities to reduce traffic accidents. To measure the effectiveness of such facilities, the integrated traffic accident database for the years 1996 to 2005 by the Japanese Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is used. This database links traffic accident data for national highways with a road geometry database of road alignments, roadside devices and facilities in Japan. The road geometry database of the MLIT is called the MICHI Database (MILT Comprehensive HIway Management System)

The installation of traffic safety facilities is expected to reduce the number of fatalities. This study evaluated the construction of sidewalks, median strips and guard fences in terms of fatality-reduction. In this section, we compare the change in the number of fatalities with the cumulative length of each road safety facility along national highways.

Figure 8(A) shows fatalities per year and cumulative length of sidewalks installed from 1996 to 2005 for 774.4 km of national highways. Fatalities numbered 49 in 1996, but only 35 in 2005 after installation of sidewalks along the 774.4 kms of national highways, equivalent to a fatality reduction rate of 30%. . Figure 8(B) shows fatalities per year and cumulative length of median strips installed from 1996 to 2005 for 397.8 kms of national highways. Fatalities along the 397.8 kms without medians numbered 39 in 1996, but only 19 in 2005, after installation of medians, equivalent to a reduction rate of 50%. Figure 8(C) shows the cumulative lengths of guard fences installed on 1,987.2 km of national highways. Figure 8(C) also indicates changes in the number of fatalities along the 1,987.2 km from 1996 to 2005. The number of fatalities declined from 147 in 1996 to 96 in 2005, equivalent to a reduction rate of 30%. Fatalities decreased with increases in the cumulative length of each of the three safety facilities shown in Figure 8.

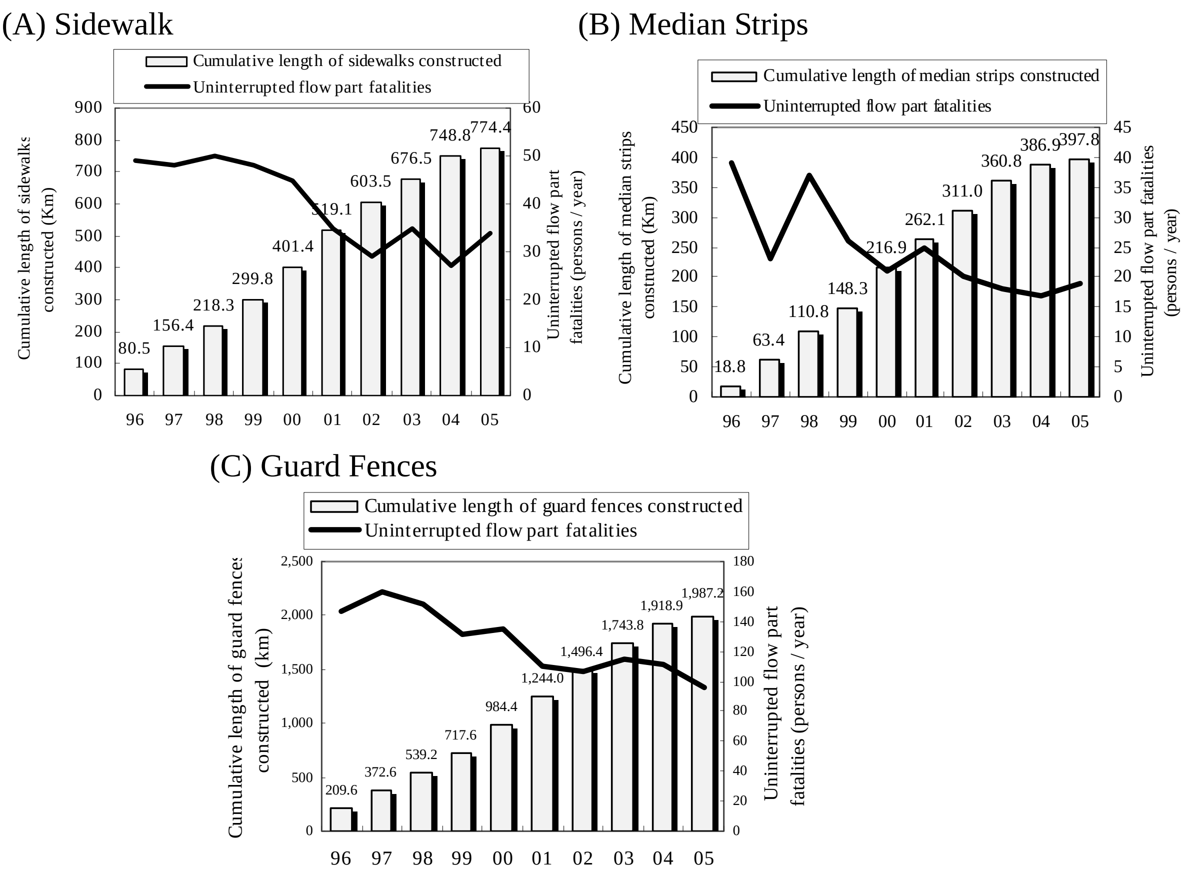


Figure 8. Cumulative lengths of three safety facilities versus Fatalities (1996 to 2005)

5.2 Effects of the 1st Nationwide Blackspot Program in Japan

Accidents on arterial highways tend to concentrate at specified locations known as "blackspots." It is effective to implement fatality-reduction measures at these blackspots. In 1995, the MLIT conducted a nationwide survey and designated about 3,200 blackspots on arterial highways. The MLIT cooperated with the NPA in implementing various fatality-reduction measures, such as intersection improvements and road lighting installation to reduce traffic accidents at these blackspots from 1996 to 2005.

The 1st Nationwide Blackspot Program monitored the number of accidents at each hazardous spot and the numbers of traffic accidents. Based on the monitoring results, the effects of implementing improvements on the fatality reduction were estimated. However, the monitoring survey measured the number of traffic accidents and number of fatal accidents only; it did not separate the number of fatalities from the number of fatal accidents. A converted rate of fatalities per the number of fatal accidents was estimated using the accident data for the 3,200 blackspots from 1990 to 1993.

The number of accidents was estimated at 2,127 blackspots where improvement works were finished until 2001. The average annual number of accidents for "before improvement" using the accident record from 1990 to 1993 was calculated. The average annual number of accidents for "after improvement" is calculated using the accident data from the following year when the improvement works had finished to 2002. Figure 9(A) indicates the number of traffic accidents per year before and after the improvements. Figure 9(B) indicates the number of fatal accidents per year before and after each improvement at all of the 2,127 blackspots. Figure 9(C) shows the fatalities before and after the program using the converted rate. The 1st Nationwide Blackspot Program was found to have achieved an annual reduction of 1,269 traffic accidents and 464 fatalities (Figure 9(C)).

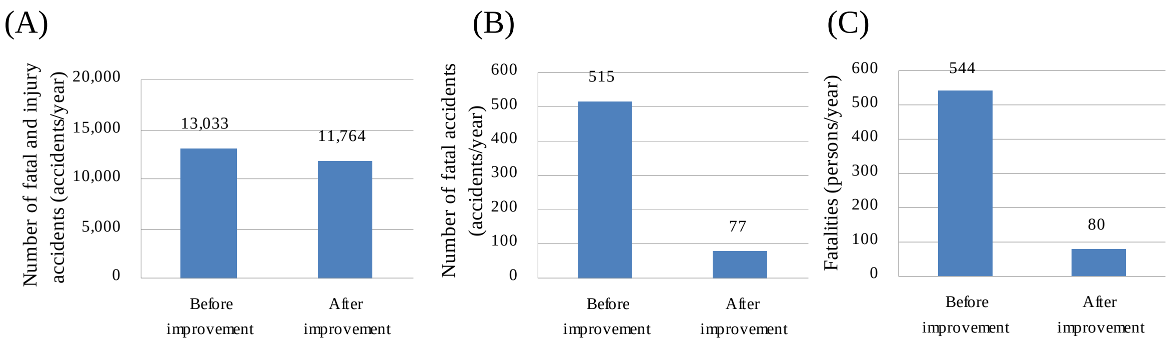


Figure 9. Fatality reduction of the 1st Nationwide Blackspots Program

5.3 Effectiveness of the 2nd Nationwide Blackspot Program

The 2nd Nationwide Blackspot Program in Japan went from 2003 to 2007, after the 1st Nationwide Blackspot Program finished in 2002. The second program designated 3,956 blackspots on arterial roads. The MLIT cooperated with the NPA in implementing various fatality-reduction measures throughout Japan from 2002 to 2006. The second program monitored changes in the number of traffic accidents and the number of fatalities at each of the 2,216 blackspots up to 2005.

The number of traffic accidents and fatalities before and after each improvement at each blackspot was measured. The average annual number of traffic accidents and fatalities for "before the improvement" is calculated using the accident record from 1996 to 1999. The average number of traffic accidents and fatalities per year for "after the improvement" is calculated using the accident record from the following year when the improvements finished to 2006. Figure 10(A) indicates the number of traffic accidents per year before and after the program. Figure 10(B) indicates the number of fatal accidents per year before and after the program. Based on the accident records before and after the improvements, the Nationwide Blackspot Program reduced traffic accidents by 2,047 per year and fatalities by 84 per year (Figure 10(C)). These fatalities were estimated using the converted rate.

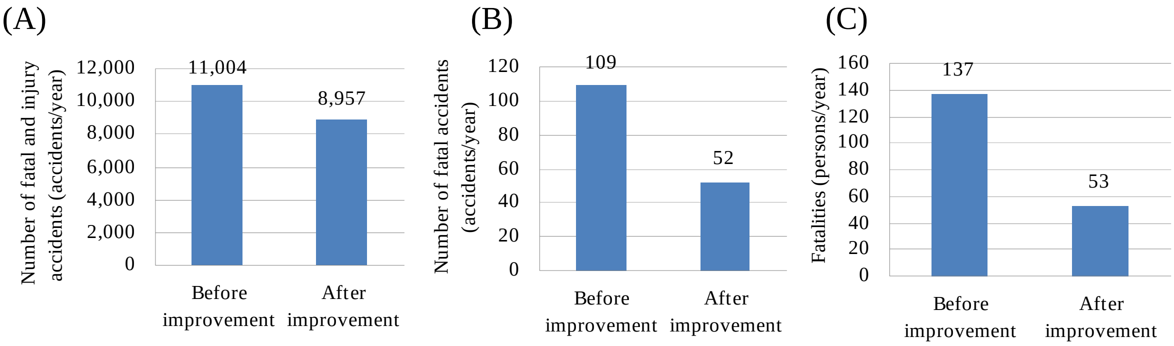


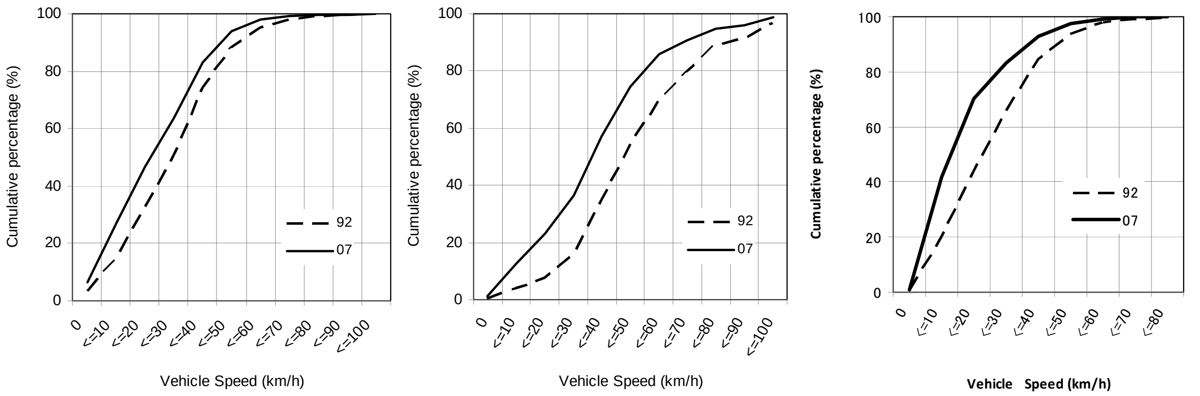
Figure 10. Fatality reduction of the 2nd Nationwide Blackspots Program

6. EFFECTS OF CHANGES IN VEHICLE SPEED

Recently, the reduction of vehicle speeds is observed in almost all accidents. Vehicle speed means the speed when the driver noticed the conflict before an accident, and it does not mean the speed at impact during an accident. It is determined by the policeman who settles the traffic accident. Decreasing of vehicle speed might be caused by the following reasons: a reduction in the automobile use share of the younger generation, an increase in the number of elderly drivers, and an increased awareness of the importance of road safety. However, lower vehicle speeds tend to mean lower impact velocities. Reductions in impact speed tend to reduce the severity of occupant injury. In fact, the number of fatal accidents caused by the excessive speed driving (mainly of young drivers) has been decreasing rapidly from 1992-2007.

Five accident types were selected for this analysis:

1) "Car-to-car accidents" are collisions between passenger cars or trucks. Rear-end collisions, which account for almost half of car-to-car accidents but in which the injuries tend to be minor were excluded. Fatalities of drivers and passengers of the two vehicles involved were analyzed.
2) "Car-to-2-wheeled-vehicle accidents" pertain to collisions between passenger cars or trucks and motorcycles or mopeds. The injuries tend to occur to the occupants of the 2-wheeled vehicle, so only fatalities of occupants of the 2-wheeled vehicle were analyzed.
3) "Single-car accidents". The fatalities of drivers and passengers are analyzed.
4) "Single-2-wheeled-vehicle accidents". The fatalities of occupants of the 2-wheeled vehicle are analyzed.
5) "Pedestrian-car accidents" pertains to pedestrians being hit by a passenger car or truck.
6) The difference in vehicle speeds between 1992 and 2007 for each accident is shown in Figure 11.



(a) Car-to-car collisions (b) Single-car accidents (c) Pedestrian-car accidents

Figure 11. Cumulative percentages of the number of accidents in terms of vehicle speed in 1992 and 2007

Factors such as seatbelt-use and helmet-use greatly affect the fatality rate. This is why seatbelt-use and helmet-use should be taken into account when the influence of vehicle speed on fatalities is considered. The fatality rate is estimated for each vehicle speed considering the with or without seatbelt or helmet in each accident case which occurred since 1992 to 2007. Thus, the fatalities for each vehicle speed were estimated using the fatality rate, and the total fatalities in 2007 were estimated.

In the accident database, vehicle speeds are divided into intervals of 10 kph up to 100 kph, and then into intervals of 20 kph up to 160 kph. The number of fatalities and occupants involved in the accident for each speed classification was calculated. Total fatalities F_N in year N was estimated using equation (3), and total occupants I_N in year N was evaluated using equation (4).

$$F_N = \sum_{V1}\sum_{V2} F_{V1V2,N} \tag{3}$$

$$I_N = \sum_{V1}\sum_{V2} I_{V1V2,N} \tag{4}$$

where[2], N=year, $V1$= the vehicle speed of the first vehicle concerned, $V2$= the vehicle speed of the second vehicle concerned, $F_{v1v2,N}$ = the total number of fatalities including fatalities by the first vehicle concerned and fatalities by the second vehicle concerned, and $I_{v1v2,N}$ = the number of all occupants.

If the speeds of the two cars are expressed as ($V1$, $V2$), the fatality rate for these speeds RF_{V1V2} is shown in equation (5).

$$RF_{V1V2} = \sum_{N} F_{V1V2,N} \Big/ \sum_{N} I_{V1V2,N} \tag{5}$$

Total occupants in 2007 $I'_{V1V2,07}$ at the speed ($V1$, $V2$) were estimated by equation (6).

[2] There are at least two vehicles in a car-to-car accident. "The first vehicle concerned" is the primary vehicle that causes the accident; when two vehicles are equally at fault, the first vehicle concerned is the vehicle whose occupants are less injured. "The second vehicle concerned" is the other vehicle.

$$I'_{V1V2,07} = \left(\sum_{V1} \sum_{V2} I_{V1V2,07} \right) \times RN_{V1V2,92} \quad (6)$$

where $RN_{v1v2,92}$ = the percentage of occupants at the speed ($V1$, $V2$) in 1992, and $I'_{V1V2,07}$ = total occupants in 2007 at the speed ($V1$, $V2$).

The number of fatalities at the speed of ($V1$, $V2$) is estimated as follows:

$$F_{V1V2,07} = I'_{V1V2,07} \times RF_{V1V2} \quad (7)$$

The results of the evaluation for each of five accident types are summarized in Table 6, where the corrected fatalities means estimated figure by multiplying all occupants by the average fatality rate throughout 1992-2007.

Table 6. Estimated fatalities in 2007 assuming that the distribution of vehicle speed in 2007 is the same as that in 1992

		1992		2007			Estimated fatalities [1]	Reduction of fatalities
		Fatalities	All persons sampled	Fatalities	Corrected fatalities	All persons sampled		
					(a)		(b)	(a)-(b)
1	Cat-to-car (All occupants)	2,176	346,570	948	946	414,926	1,570	-623
2	Car-to-2-wheeled (All occupants of 2-wheeled)	1,412	137,562	657	710	112,467	783	-74
3	Single-car (All occupants)	2,114	28,663	828	737	33,731	1,025	-289
4	Single-2-wheeled (All occupants)	731	12,718	285	361	14,132	506	-145
5	Pedestrian-car	2,739	69,660	1,763	1,440	61,009	2,669	-1,229
Total		9,172	595,173	4,481	4,194	636,265	6,553	-2,359

1) Estimated fatalities are based on the vehicle speed of 1992.

7. CONCLUSION

The study aims to evaluate the outcome of fatality-reduction measures based on the reduction of fatalities in Japan achieved through a comprehensive safety program that was launched in 1990. As shown in Table 7, fatality-reduction measures covered in the study were effective in reducing fatalities. The effectiveness of each fatality-reduction measure was determined by estimating the number of fatalities related to the target factor before and after the implementation of the fatality-reduction measure. Safety training programs for novice moped drivers and educational programs for elderly drivers achieved moderate reductions. The driver license system of Japan has been strictly enforced to prevent accidents caused by novice drivers. This strict enforcement achieved large reductions. Increasing the severity of penalties for drunk-driving implemented by the NPA also achieved large reductions, as well as the use of occupant protection devices like seatbelts and helmets. Increasing the installation of road safety facilities by the MLIT achieved steady reductions. In addition, the Nationwide Blackspots Program implemented by the MLIT and NPA achieved large reductions in traffic accidents and fatalities.

Table 7. Summary of countermeasure and effectiveness to reduce traffic accident fatalities

Countermeasure		Evaluation Period	Program Period	Decreasing number of fatalities by countermeasure
Education	Moped Driver Training Course	1990-2007	1992	uncountable
	Elderly Driver Educational Course	1996-2007	1998	uncountable
Enforcement	Novice Driver Probationary Period	1986-2007	1990	uncountable
	Severe Penalties for Drunk Driving	2001-2007	2002, 2007	844
Occupant Protection Device	Seatbelt Use	1992-2007	1987 (for front seat) 2008 (for rear seat)	2,057
	Helmet Use	1992-2007	1986 (for all occupant)	160
Engineering	Road Safety Facilities	1996-2005	1996-2005	85
	Blackspot Program(1st)	1990-2002	1996-2002	464
	Blackspot Program(2nd)	1996-2006	2003-2005	84
Vehicle Speed		1992-2007	1992-2007	2,359

The comprehensive traffic safety program was launched in 1990. Japan achieved a 50% reduction in fatalities for 2007, compared with 1995. Japan attained low fatality rate which is below 6.0 fatalities per 100,000 inhabitants by 2006. Also, the Fundamental Traffic Safety Program proposed by the Cabinet Office in 2002 which calls for bringing annual fatalities to less than 5,500, is expected to achieve its goal by the end of 2012. To achieve this purpose, many agencies, private companies, and other organizations develop and implement traffic safety programs. . It can be concluded that the nationwide comprehensive traffic safety program has resulted in a large reduction in fatalities in recent years. It should be noted that reducing number of fatalities in the study was affected not only by improvements in the target factor but also by improvements in other factors. Also, fatalities may have been influenced by the social changes that occurred during the 15 years from 1992. In the future, additional in-depth analysis of data is required to identify trends in the number of fatalities and the causes of traffic accidents.

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