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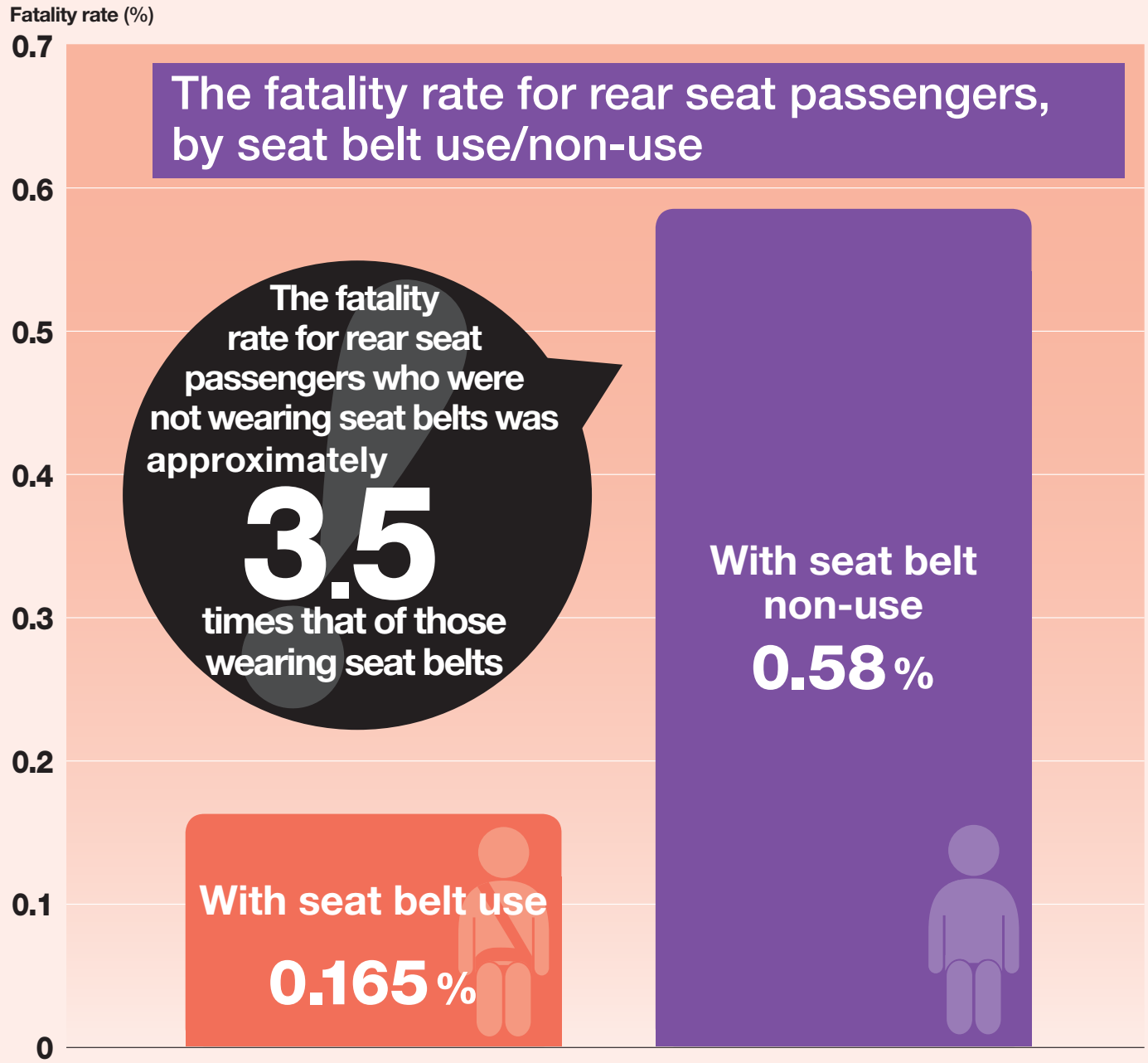

Special feature

Characteristics of accidents in which rear seat passengers were not wearing seat belts

~Wearing a seat belt increases safety 3.5-fold~

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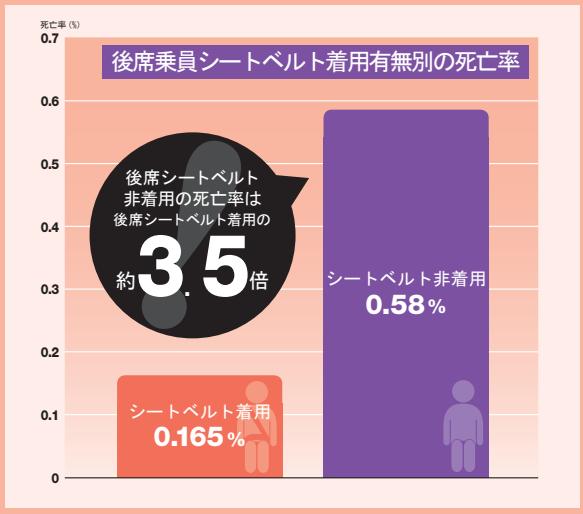

Special feature

Characteristics of accidents in which rear seat passengers were not wearing seat belts

~Wearing a seat belt increases safety 3.5-fold~

The number of motor vehicle occupants killed has been decreasing year on year, and has been second to pedestrians since 2009, but the level is still high.

Wearing a seat belt has the effect of lessening the severity of injury suffered by car occupants during accidents, yet the percentage of rear seat passengers who wear seat belts is lower than those of drivers or front seat passengers.

The fatality rate for car occupants not wearing seat belts is generally higher than that for car occupants wearing seat belts, and in some cases the results were of huge importance; this was equally true for rear seat passengers. At the time of collision, if a rear seat passenger is not wearing a seat belt, his or her body will be sent flying in a forward direction into the back of the seat in front or other places, which can result in major injury or death. It can also increase the danger for the driver or passenger seat passenger. The passenger can also be thrown out of the car, resulting in death. In this issue of ITARDA Information, we focus on the wearing of seat belts by rear seat passengers and discuss the characteristics of related accidents.

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2 Analysis of fatal accidents in which rear seat passengers were not wearing seat belts
3 Examples of accidents
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SECTION 1

State of damage to car occupants not wearing seat belts

(1) The seat belt use rate based on the Traffic Accident Database

Fig. 1 shows the trends over the last five years in the seat belt use rate of car occupants who were involved in fatal accidents, by the car occupants' position in the car, based on the Traffic Accident Database.

The cars included in the data were standard-sized passenger cars (with no more than 11 seats), mini-sized passenger cars, standard-sized trucks (no more than 5t in gross vehicle weight) and light trucks, these comprising the majority of registered vehicles. People involved in accidents in the data were considered to be rear seat passengers who were in the vehicles of primary parties or secondary parties, which make up the majority of accidents. We analyzed the data using these conditions.

Looking at Fig. 1, because the wearing of seat belts in the rear seat was made mandatory in June 2008, the seat belt use rate which had been low up to that point has risen; nevertheless, with the use rate of rear seat passengers at approximately 60% by 2010, the rate remains lower than the use rates of drivers and passenger seat passengers.

Here, the seat belt use rate shows the rate of casualties who were wearing seat belts as a percentage of all casualties in traffic accidents.

$$\text{Seat belt use rate (\%)} = \frac{\text{Number of casualties who were wearing seat belts}}{\text{Total number of casualties}} \times 100$$

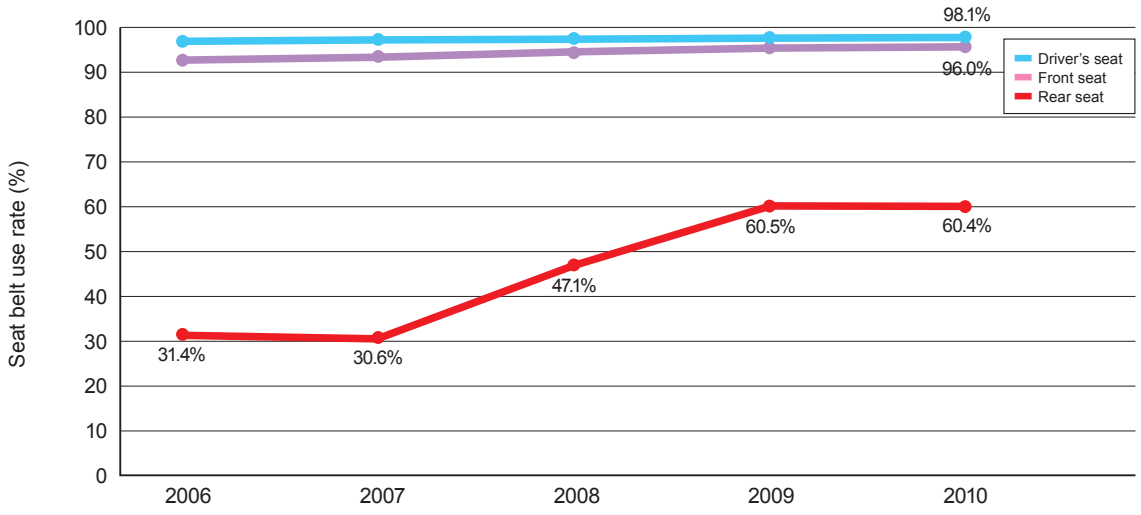


Fig 1: Trends in the seat belt use rate, by car occupants' position in traffic accidents

(2) Results of seat belt use in rear seats being made mandatory

Fig. 2 shows the trends in the numbers of rear seat passengers who were killed or seriously injured over the last five years, with the aim of confirming the effects of rear seat belt use, which was made mandatory in June 2008.
The number of rear seat passengers who were killed or seriously injured has been on a decreasing trend year on year, with the number of fatalities and serious injuries decreasing compared to the previous year by a considerable margin in 2008, allowing us to confirm that seat belt use being made mandatory has indeed had an effect. A considerable decrease was seen immediately after seat belt use was made mandatory, but from 2009 onwards the decrease has slowed down. If we are to decrease still further the numbers of fatalities and serious injuries, further educational outreach concerning seat belt use is essential.

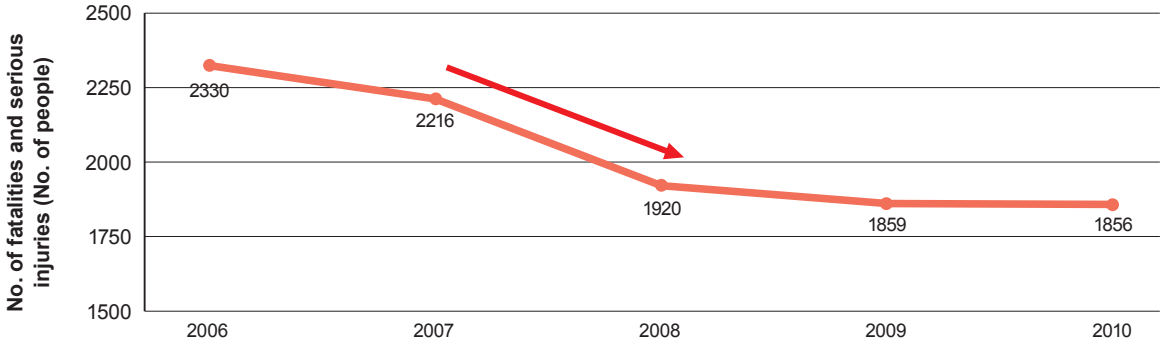


Fig. 2: Trends in the number of rear seat passengers killed or seriously injured

(3) The seat belt use rate in fatal accidents

Table 1 and Fig. 3 show the figures for fatalities categorized by whether or not the car occupants were wearing seat belts, and their position in the car in terms of driver's seat, front seat or rear seat, using the Traffic Accident Database from 2010.
The seat belt use rate during fatal accidents was 53% for drivers, 64% in the front seat and 30% in the rear seat, the lowest use rate of all the seats.

Table 1: Seat belt use rate of car occupants who were killed, by position in the car (2010)

	Fatalities with seat belt use (No. of people)	Fatalities with seat belt non-use (No. of people)	Fatalities with seat belt use unclear (No. of people)	Total fatalities (No. of people)	Use rate for fatal accidents (%)	Non-use rate for fatal accidents (%)	Use-unclear rate for fatal accidents (%)
Driver's seat	561	474	34	1069	53	44	3
Front seat	118	64	2	184	64	35	1
Rear seat	54	119	7	180	30	66	4

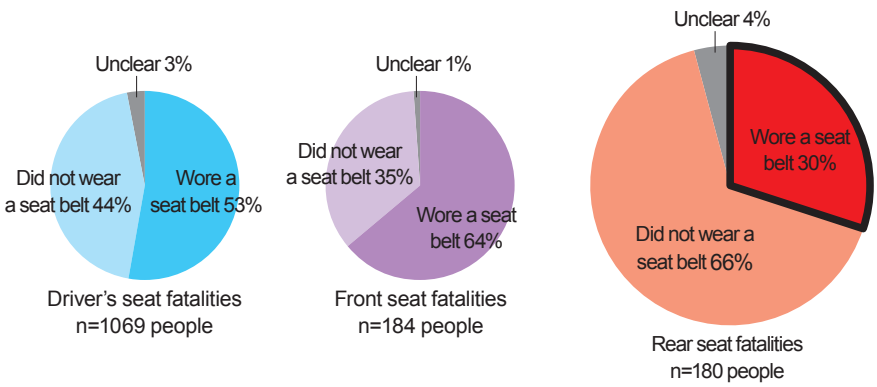


Fig. 3: Seat belt use rates for fatalities, by position (2010)

(4) Risks of non-use in the rear seat

What degree of risk does non-use of seat belts pose?
Table 2 and Fig. 4 compare the fatality rates and fatality and serious injury rates for rear seat passengers, by whether or not people were wearing seat belts, using the Traffic Accident Database from 2010 as with the previous section.
The fatality rate and fatality and serious injury rate are defined as follows.

$$\text{Fatality rate (\%)} = \frac{\text{No. of fatalities}}{\text{(No. of fatalities + no. of serious injuries + no. of slight injuries)}} \times 100$$

$$\text{Fatality and serious injury rate (\%)} = \frac{\text{(No. of fatalities + no. of serious injuries)}}{\text{(No. of fatalities + no. of serious injuries + number of slight injuries)}} \times 100$$

The fatality rate is the rate of fatalities as a percentage of all casualties in traffic accidents. The fatality and serious injury rate is the rate of fatalities and serious injuries as a percentage of all casualties in traffic accidents. For both, the higher the rate the higher the risk is considered to be.
With a fatality rate of 0.58% for seat belt non-use and of 0.165% for seat belt use, the rate for seat belt non-use is approximately 3.5 times that for seat belt use.
With a fatality and serious injury rate of 5.69% for seat belt non-use and 1.88% for seat belt use, the rate for seat belt non-use is approximately 3 times that for seat belt use. This signifies that rear seat passengers who do not wear seat belts are facing a high degree of risk.

Table 2: The fatality rate and fatality and serious injury rate for rear seat passengers, by seat belt use/non-use

	Fatalities (No. of people)	Serious injuries (No. of people)	Slight injuries (No. of people)	Total casualties (No. of people)	Fatality rate (%)	Fatality and serious injury rate (%)
Seat belt use	54	562	32075	32691	0.165	1.88
Seat belt non-use	119	1049	19345	20513	0.58	5.69

NB: Cases where seat belt use was unclear are excluded from the table

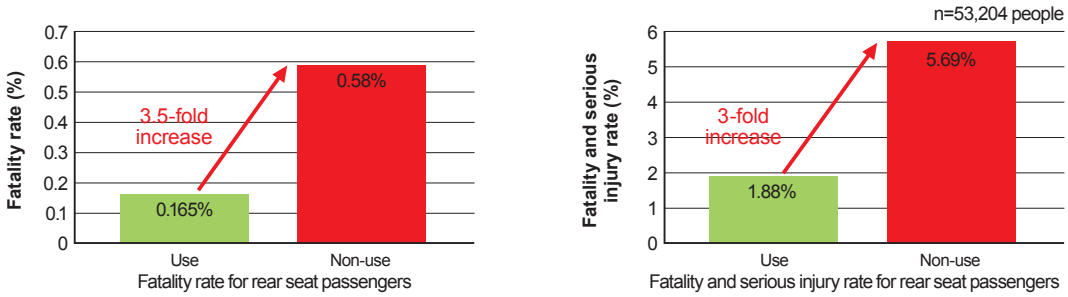


Fig. 4: Fatality rate and fatality and serious injury rate for rear seat passengers, by seat belt use/non-use (2010)

The state of damage for rear seat passengers who were not wearing seat belts may be summarized as follows.

- The seat belt use rate in the rear seat using the Traffic Accident Database is approximately 60%, well below the rates for drivers (approximately 98%) and front seat passengers (96%). Many rear seat passengers do not take seat belt use seriously, compared to drivers and front seat passengers.
- The number of fatalities and serious injuries for rear seat passengers is decreasing year on year. In 2008 in particular there was a considerable decrease in the number of fatalities and serious injuries compared to the previous year. It can be confirmed from this that making the wearing of seat belts in rear seat mandatory is having an effect to a certain extent.
- The rate of seat belt non-use in the rear seat in fatal accidents was considerably lower than those for drivers and front seat passengers, and rear seat passengers have a low level of awareness regarding the wearing of seat belts.
- People who were not wearing seat belts had a fatality rate approximately 3.5 times higher than that of people wearing seat belts, and a fatality and serious injury rate approximately 3 times higher, representing a significant degree of damage.

SECTION 2

Analysis of fatal accidents in which rear seat passengers were not wearing seat belts

The above analysis indicates that people who were not wearing seat belts had a fatality rate and fatality and serious injury rate higher than those who were wearing seat belts.
In this section, we will attempt to analyze the component rate of seat belt use/non-use for rear seat passengers in terms of casualties in traffic accidents using the Traffic Accident Database from 2008～2010, in order to provide some hints as to how to raise the seat belt use rate.

(1) The non-use rate for trucks is high

Fig. 5 is a graph showing the seat belt non-use rate for standard-sized passenger cars, mini-sized passenger cars, standard-sized trucks and light trucks.
The seat belt non-use rate is defined as follows.

$$\text{Seat belt non-use rate (\%)} = \frac{\text{No. of casualties with seat belt non-use}}{\text{Total no. of casualties}} \times 100$$

Overall, the seat belt non-use rate was higher for trucks than for passenger cars. In particular, the seat belt non-use rate was highest of all for light trucks. Since loading of goods is prioritized in cab-over vehicles, they are equipped with a loading platform, for which reason seat-belts are sometimes not fitted in these vehicles so as to facilitate easy-folding up of seats. It is believed that this is one reason for the high seat belt non-use rate in trucks. In addition, it is not mandatory to fit seat belts in seats which are designed to be folded up easily.

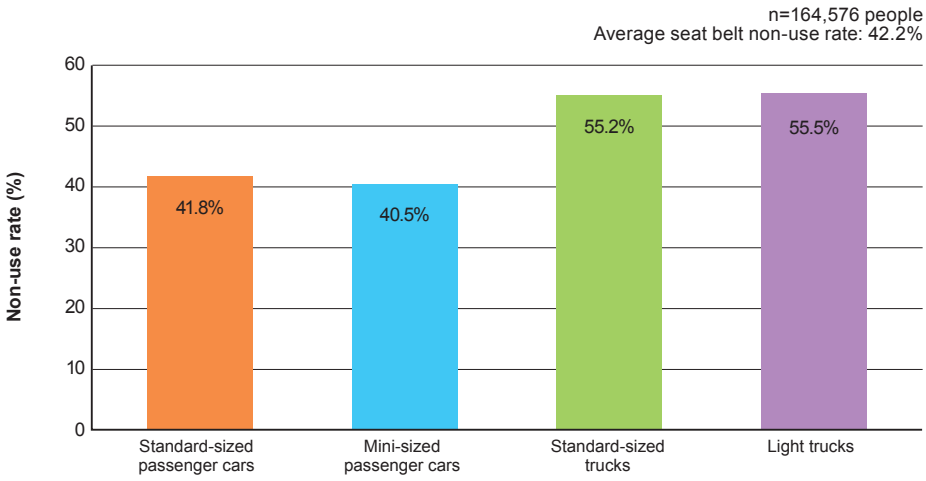


Fig. 5: Seat belt non-use rate in the rear seat, by vehicle type [2008~2010]

(2) In fatal accidents or other traffic accidents which occur in the time slots around the nighttime and early morning hours, the seat belt non-use rate is high

Fig. 6 is a graph showing the seat belt non-use rate in the rear seat, by time period, divided into two-hour slots. The seat belt non-use rate over the 0~6 am period is high at around 56%, and in particular reaches a high point of 59% during the 2~4 a.m. time slot. Conversely, the rate falls to around 40% during the 8 a.m.~6 p.m. period. This indicates that the seat belt non-use rate is higher during nighttime and early morning hours than during the daytime hours. Let us look at the travel purposes of rear seat passengers during these time slots.

Fig. 7 is a graph showing the seat belt non-use rate in the rear seat, by time slot and by travel purpose. The seat belt non-use rate for the time slots around the nighttime and early morning hours is higher across all travel purposes. In the 2~4 a.m. time slot in which the seat belt non-use rate was particularly high, approximately 70% of journeys were made for the purposes of dining or shopping, the highest level among all items. Conversely, during daytime hours approximately 60% of journeys were made for the purpose of commuting to work/study, a higher level than for other travel purpose items.

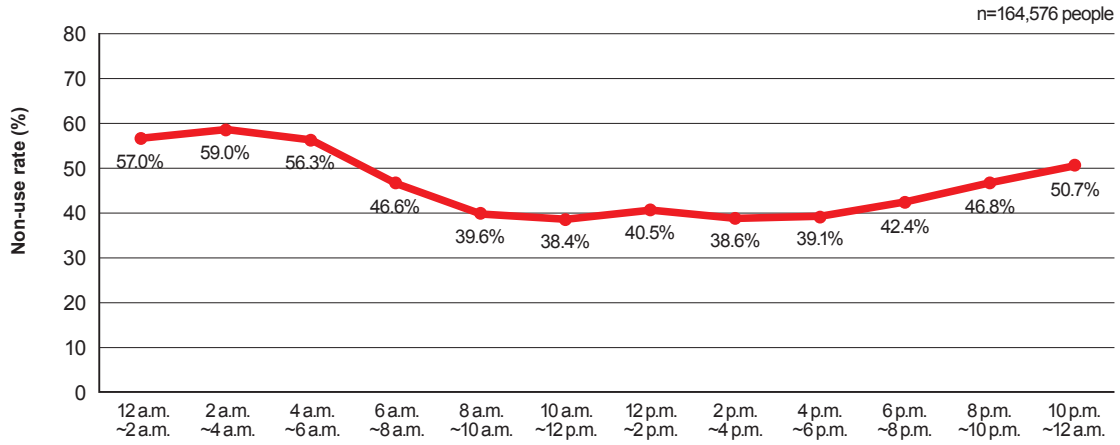


Fig. 6: Seat belt non-use rate in the rear seat, by time [2008~2010]

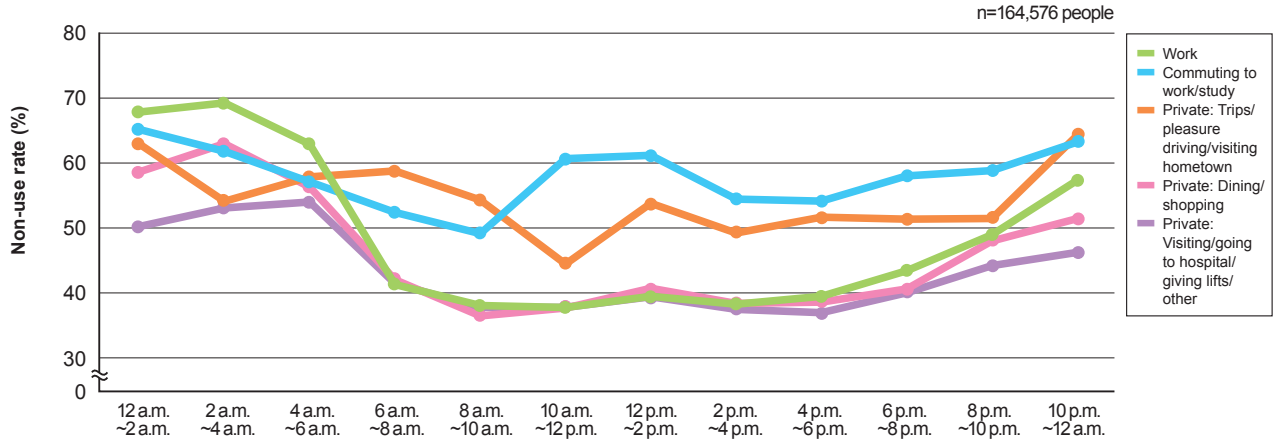


Fig. 7: Seat belt non-use rate in the rear seat, by travel purpose and time [2008~2010]

(3) Breakdown by age indicates that the seat belt non-use rate is lowest for passengers under 2, and highest for those aged 16～24

Fig. 8 is a graph showing the seat belt non-use rate in the rear seat, by age group. The seat belt non-use rate for passengers under 5 is low, but rises steadily with increasing age between the ages of 6 and 24. In particular, the seat belt non-use rate for passengers aged 6～9 at 41.2% represents a considerable increase from that for passengers aged 3～5 (24.3%).
What is the situation regarding use of child seats by passengers aged 6～9?
In general, it is said that a height of at least 135cm～140cm must be attained in order to be able to use an adult seat belt. The results of the Ministry of Education, Culture, Sports, Science and Technology (MEXT)'s School Health Statistics Survey of 2009 show that students attain a height of at least 135～140cm after the 5th grade of elementary school (aged 10). It may be said therefore that passengers aged 6～9 also need to use child seats.
Let us analyze the situation regarding use of child seats by passengers under the age of 9.

Fig. 9 is a graph showing the child seat use rate for passengers under 2, aged 3～5, and aged 6～9.
The child seat use rate is defined as follows.

$$\text{Child seat use rate (\%)} = \frac{\text{No. of casualties with child seat use}}{\text{Total no. of casualties}} \times 100$$

The child seat use rate is 81% for passengers under 2 and 60% for passengers aged 3～5, decreasing to 10% for passengers aged 6～9. It is believed that the rates are higher for passengers under 5 because child seat use is mandatory for this age group. In addition the seat belt use rate for passengers aged 6～9 is approximately 56%, of which it is evident that 46% are using adult seat belts. It is believed that most drivers and guardians lack adequate understanding of the physical requirements necessary to be able to use an adult seat belt.

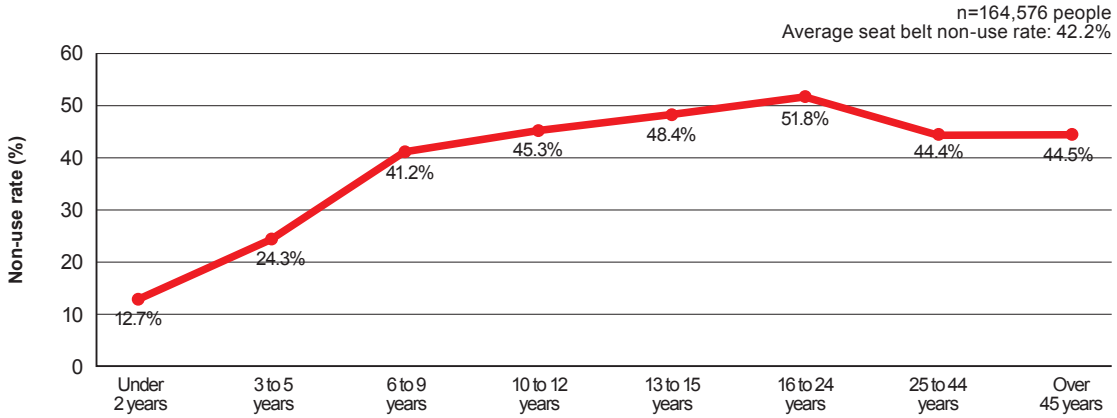


Fig. 8: Rear seat belt non-use rate, by age group [2008~2010]

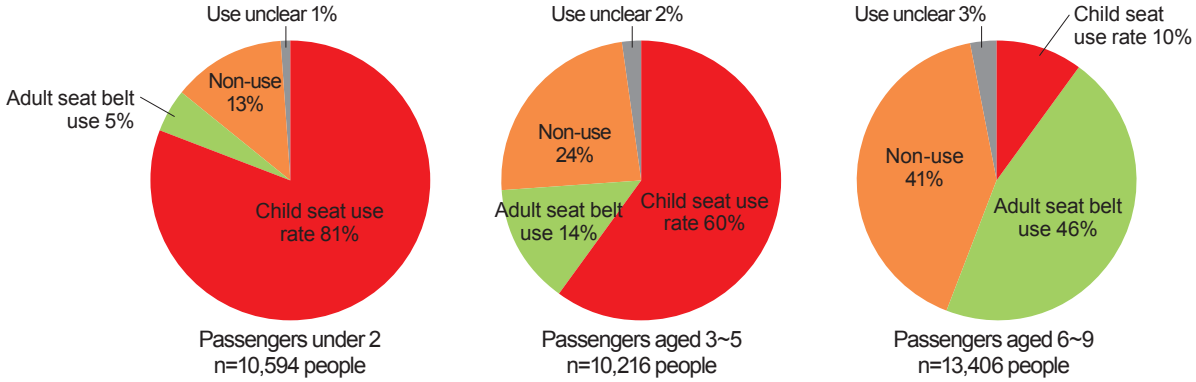


Fig. 9: Child seat use rate, by age group [2008~2010]

(4) Why did passengers not use a seat belt?

Why do some passengers not use a seat belt even though using a seat belt greatly decreases the fatality rate? We attempted to investigate the reasons for seat belt non-use, using our in-depth study database gathered at the Institute.
The reasons for seat belt non-use were clarified for 74 passengers who had suffered traffic accidents while not wearing seat belts in the rear seat (1993～2010).
Fig. 10 is a graph which divides the 74 passengers into proportional categories by their reason for not using a seat belt. “It is not a habit with me” formed the largest proportion of reasons for not using a seat belt, followed by “It’s a nuisance/tedious” and “I won’t cause an accident/it’s only a short trip.” Based on this, it is considered that passengers are not taking the wearing of seat belts seriously because of a strong belief that they will be all right without wearing seat belts, not because they are unable to wear a seat belt.

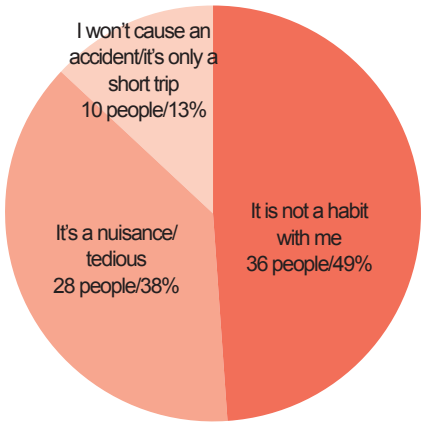


Fig. 10: Reasons why passengers did not wear a seat belt [1993~2010]

The characteristics of fatal accidents or other traffic accidents in which rear seat passengers were not wearing seat belts may be summarized as follows.

- Among trucks, in car types with loading platforms where the seats are designed to be folded up easily, such seats are sometimes not fitted with seat belts, meaning that rear seat passengers cannot wear a seat belt even if they desire to do so.
- From the nighttime to early morning hours, passengers who do not wear a seat belt outnumber those who do. In terms of travel purpose, approximately 70% of those traveling for dining/ shopping purposes during the 2~4 a.m. time slot in particular do not wear a seat belt, a higher rate than for other travel purposes.
- Among passengers aged 6~9, only 10% use a child seat due to low awareness levels among guardians, even though a child seat suited to their physical requirements is essential.
- Reasons for not wearing a seat belt were “It is not a habit with me,” “It’s a nuisance/tedious” and “I won’t cause an accident/it’s only a short trip.” This shows that there is a strong belief among such passengers that they will be all right without wearing seat belts, rather than an inability to wear seat belts.

SECTION 3

Examples of accidents

Finally, we will present two examples of accidents which further exemplify the effects of rear seat belt use, based on the Traffic Accident Database.

Case 1: Rear seat passenger thrown out of the car

[Accident situation]

At around 7 p.m. on a sunny day, a man in his 30s was driving a car (A) (a standard-sized passenger car) along a six-lane expressway. When the driver for some reason changed lanes, he made an error in operating the steering wheel causing the car to skid sideways, resulting in the front of the car colliding at an estimated speed of approximately 75 km/h with a guard cable which had been laid out on the outside of the road shoulder. Following this, the rebound force of the collision span the car around in an anti-clockwise direction while simultaneously flipping it over into the right-hand lane, immediately after which another vehicle collided with it from the rear; finally, the car collided from the front with a guard rail which had been laid out as a central divider.

[Seat belt use/injury situation]

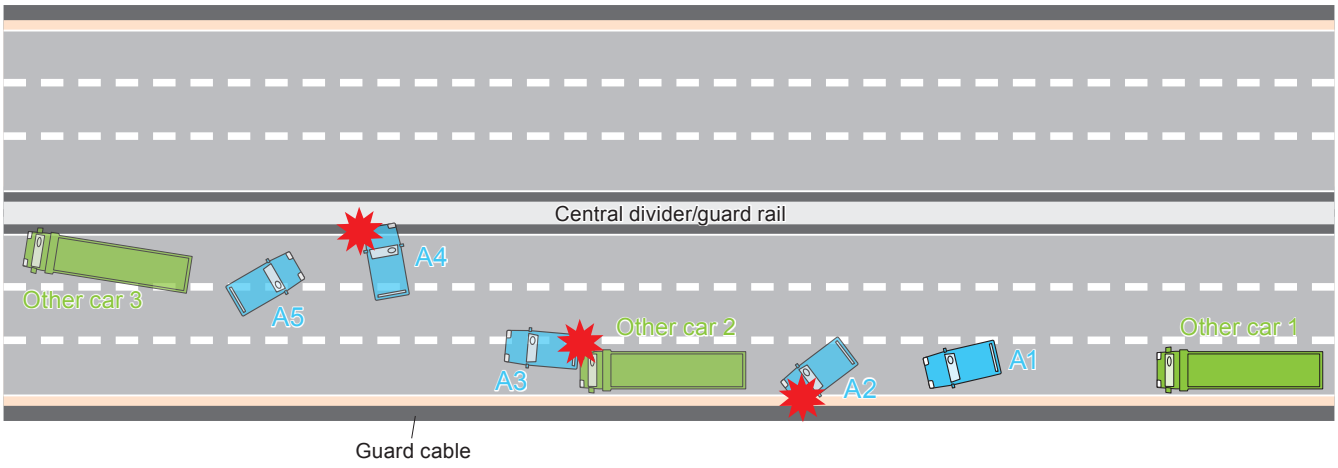
In addition to the driver, the car (A) was also occupied by a passenger in the passenger seat (a man in his 30s), a passenger in the right-hand rear seat (a woman in her 60s) and a passenger in the left-hand rear seat (a boy); the driver and passenger seat passenger were wearing seat belts, but neither rear seat passenger was wearing a seat belt.

In this accident, the guard cable was sent crashing through the glass of the driver's seat window, resulting in injuries to the driver including head injuries which caused his death. The passenger seat passenger was uninjured.

At the time of the collision with the guard cable the shock of the collision threw the right-hand rear seat passenger out of the car through the right-hand rear seat window or the rear window; she collided with the road surface resulting in heart/head injuries which killed her. It was conjectured that had she been wearing a seat belt, she could have avoided being thrown from the car and would not have been killed.

The left-hand rear seat passenger suffered injuries (slight injuries) in the form of brain concussion as a result of colliding with the back of the seat in front at the time of the collision.

Diagram of the scene of the accident



Case 2: Rear seat passengers uninjured or sustaining only slight injuries because they were wearing seat belts

[Accident situation]

At 2:00 am on a clear night, a man in his 20s was driving a car (A) (a standard-sized passenger car) around the leftward curve of a one-way road at an estimated speed of approximately 80～100 km/h. For some reason, the car (A)'s driver did not completely follow the left-hand curve and veered rightward outside the road; the right-front side of the car collided with a tree, after which the left-front side also collided with a utility pole.

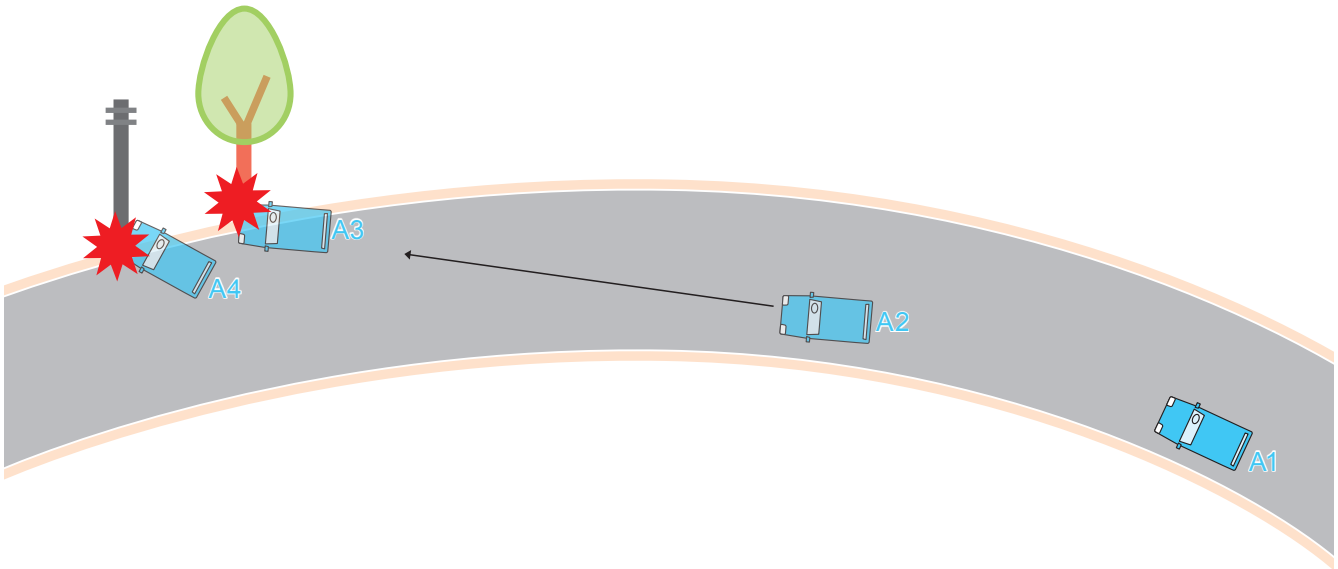
Seat belt use/injury situation

The car (A)'s driver had been driving without wearing a seat belt, but the car's other occupants —the passenger in the passenger seat (a man in his 20s), the passenger in the right-hand rear seat (a man in his 20s) and the passenger in the left-hand rear seat (a man in his 20s)— put on their seat belts immediately prior to the collision because they sensed the danger of the speed at which the car was travelling.

Because the driver in this accident was not wearing a seat belt, his body was sent forward with the shock of the collision, causing his head to collide with the right-hand pillar of the car (A), resulting in his death.

The passenger seat passenger sustained a sprain to the cervical vertebrae (slight injury) and the right-hand rear seat passenger a thoracic fracture (slight injury), while the left-hand rear seat passenger was uninjured. As the bodies of all three had been restrained by seat belts, they did not collide with the internal structure of the car and escaped with slight or no injuries.

Diagram of the scene of the accident



SECTION 4

Summary/recommendations

In order to reduce injuries caused by traffic accidents

1. **Because wearing a seat belt cuts the fatality rate to approximately 1/3.5, and the fatality and serious injury rate to approximately 1/3, drivers should not only wear their own seat belts but also encourage other occupants to wear theirs. Particular care is needed regarding the time around nighttime and early morning hours.**

2. **Children under the age of 9 need child seats suited to their physical requirements. Drivers and guardians should use appropriate child seats for children, even if this seems like a nuisance. We should also conduct educational outreach on the importance of child seats.**

3. **Rear seat belts have not been made mandatory in some trucks; however, these should be fitted, as they can save passengers' lives.**

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