イタルダ インフォメーション

# ITARDA INFORMATION
# 交通事故分析レポート

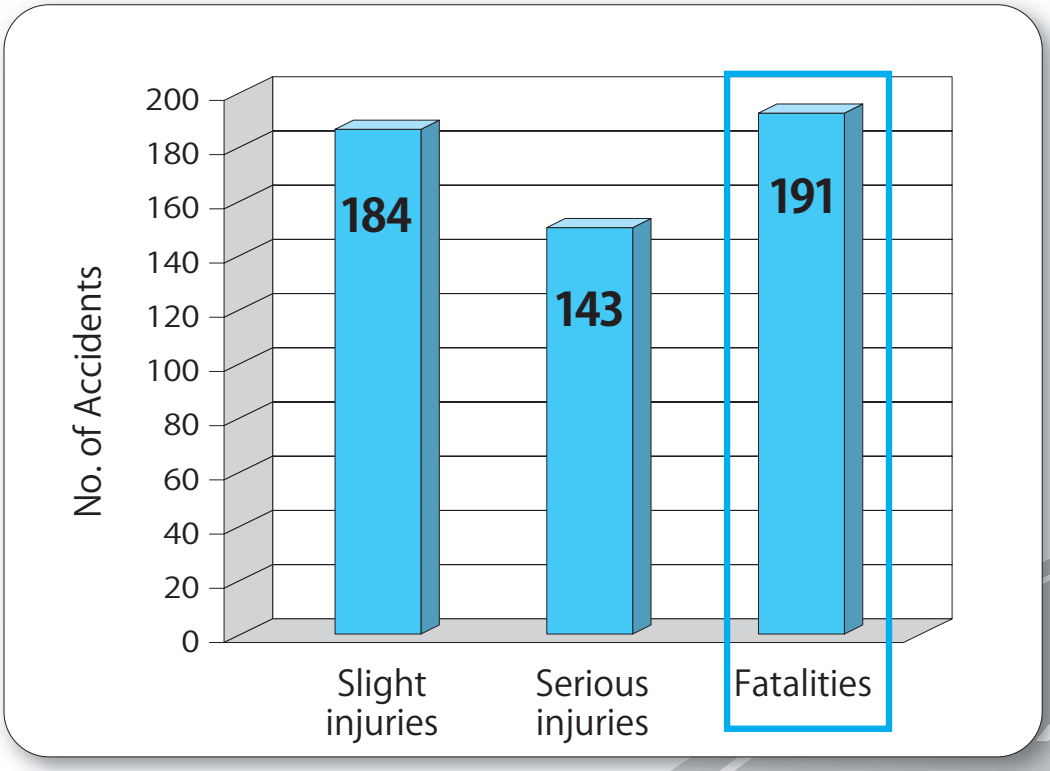
No.103

Special feature

## Pedestrian Crashes on Expressways

### ~No way! There can't be pedestrians in a place like this! ~

**Person-vehicle accidents on expressway lanes and shoulders (2003-2012)**





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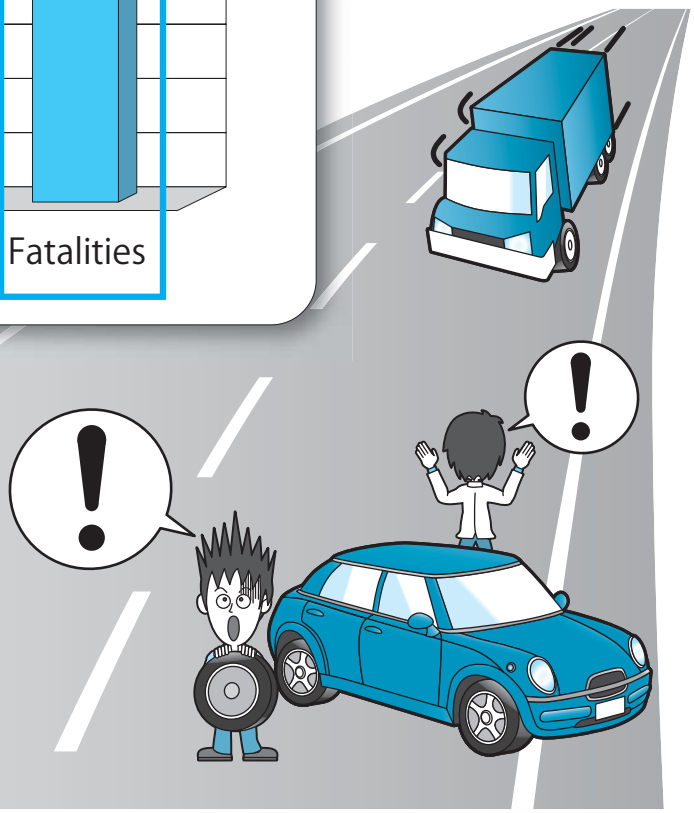


# 1 Introduction

A thoroughgoing expressway network enhances economic activities of man and material and helps expanding the sphere of action of man. However, the development of expressways may bring unforeseen problems along with the increase in its users. Last year, there was an unfortunate incident where a famous comedian, who got out of his car after it was involved in a single-vehicle accident on the expressway, was run over by a following car. Stopping or parking of vehicles and pedestrians are prohibited on expressways so as to ensure a safe and fast riding experience. Nevertheless, we may end up in a situation where we may have to step out of our vehicles on to the expressway lanes or shoulders if any problem occurs during the drive. Table 1 below shows the top ten reasons because of which assistance of JAF Road Service was sought on expressways in 2012. Every year, more than 0.1 million cases of vehicle breakdown or accidents are reported for assistance. In this issue we shall focus on the secondary pedestrian crashes with vehicles that are considered to occur following such breakdowns or accidents of vehicles.

**Table 1 List of rescue requests to JAF Road Service on expressways in 2012 (4-wheeled vehicles)**

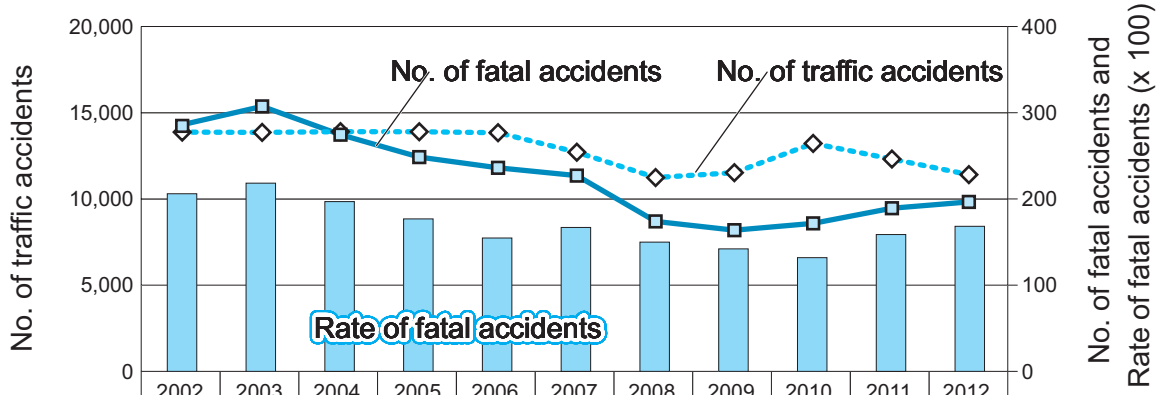
| Rank | Description of rescue requests | No. of requests | Composition ratio (%) |
|---|---|---|---|
| 1 | Tire-related problems (flat tires/explosion/low air pressure) | 31,707 | 31.49 |
| 2 | Out of fuel | 14,116 | 14.02 |
| 3 | Accidents | 9,459 | 9.39 |
| 4 | Over-discharged battery | 7,129 | 7.08 |
| 5 | Generator/ battery charging circuit | 2,161 | 2.15 |
| 6 | Locking of key inside the vehicle | 1,898 | 1.89 |
| 7 | Automatic transmission | 1,383 | 1.37 |
| 8 | Auxiliary drive belt | 1,217 | 1.21 |
| 9 | Damaged/deteriorated battery | 1,157 | 1.15 |
| 10 | Out of engine oil/replenishment | 1,124 | 1.12 |
| | Total of requests other than the above | 29,335 | 29.14 |
| | Total | 100,686 | 100.00 |

Source: Excerpt from JAF webpage (http://www.jaf.or.jp/rservice/data/index.htm)

# 2 Traffic accidents on expressways

Let us look at the transition in the number of traffic accidents and fatal accidents on expressways*1 (Refer Fig. 1). By and large, the following trend prevails.
1) Both traffic and fatal accidents on expressways are progressively on the decline.
2) However, over the recent years, there is an increase in the number and rate of fatal accidents.
3) Roughly 11,000 cases of traffic accidents and 200 cases of fatal accidents are reported every year.
Data compiled by the National Police Agency in their report "Traffic accident situation in 2012" reveals that the occurrence rate of fatal accidents on national roads is 0.89% whereas it is 1.73% (in 2012) on expressways indicating that once an accident happens on the expressway, the situation is about 2-fold critical as compared to the one on the national road.

*1 Expressways include national expressways and the highways for exclusive use by motorized vehicles like metropolitan expressways and Hanshin expressway.




| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rate of fatal accidents (x100) | 206 | 219 | 199 | 181 | 170 | 175 | 161 | 146 | 137 | 162 | 173 |
| No. of traffic accidents | 14,083 | 13,993 | 13,799 | 13,776 | 13,803 | 12,675 | 10,970 | 11,114 | 12,202 | 11,710 | 11,299 |
| No. of fatal accidents | 290 | 307 | 274 | 249 | 234 | 222 | 177 | 162 | 167 | 190 | 196 |

**Fig.1 Transition in numbers of Traffic and Fatal accidents and Rate of fatal accidents on Expressways (2002-2012)**

Rate of fatal accidents = (No. of fatal accidents)/ (No. of traffic accidents) x 100 x100　Rate of fatal accidents is scaled 100 times to suit the plotting of graph

## ③ Frequently-occurring accident types

Let us observe the type of accidents that occur frequently as well as the number of fatal accidents. Fig.2 shows the composition of traffic accidents (top) and fatal accidents (bottom) that occurred on expressways from 2003 through 2012 by type of accidents.

Sixty-seven percent of accidents on expressways were multiple-vehicle rear-end-collisions. The reasons for such high occurrence of collisions were longer stopping time and distance as compared to general roads and the absence of intersections and traffic signals which may tempt the drivers into aimless driving. Following the lead are the single-vehicle collisions, multiple-vehicle collisions (crashes or contacts) and other multiple-vehicle collisions with each accounting for about 10%.

Whereas the composition of fatal accidents differs considerably with single-vehicle collisions leading the lot, followed by multiple-vehicle rear-end-collisions and multiple-vehicle collisions (crashes or contacts) in that order. Here, attention is paid to the person-vehicle accidents that occurred occasionally after the “single-vehicle and multiple-vehicle collisions.” Though their occurrence is very low at 1.1%, they account for roughly 10% of the fatal accidents.

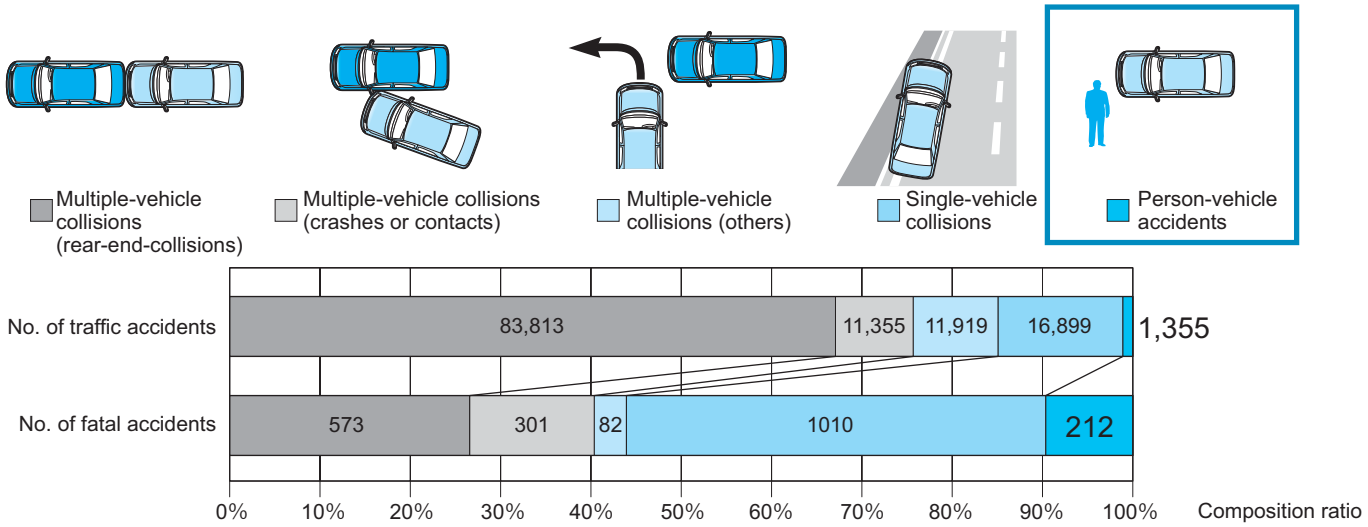



**Fig.2 Composition ratio of Traffic accidents and Fatal accidents on expressways by type of accident (2003-2012; n=125341)**

Multiple-vehicle collision (rear-end-collisions): When both vehicles are facing in the same direction and the front of the following vehicle hits the back of the preceding vehicle when the latter is on the move, parked or stopped.

Multiple-vehicle collisions (crashes or contacts): Collisions other than rear-end ones such as when the vehicle crashes into or comes in contact with the front or side of a running vehicle or an entering/exiting vehicle.

Multiple-vehicle collisions (others): Accidents involving multiple vehicles other than the rear-end-collisions, crashes or contact accidents.
(Example, hit by the following car soon after the vehicle on front had proceeded from its stopped position for changing the lane, or crash at service area etc.)

## 4 Case example of person-vehicle accidents on expressways

Explained below is a case example of person-vehicle accident taken from our In-depth case studies.
It was still early in the morning on a clear winter Sunday and the silhouettes of surrounding objects were only dimly visible. Mr.A, in his fifties, was driving a medium-sized truck on the lane-1 of a driveway with 3-lanes on one-side, with the headlights on. A little before the accident, Mr.B, in his twenties, had somehow pulled over his passenger car onto the road shoulder when his car tire was punctured and he could not continue driving any further. However, a part of his car was still protruding into the lane-1. Mr.C, also in his twenties and travelling with Mr.B had alighted the car and was helping the latter fix the punctured tire when Mr.A's truck collided into the stopped car. Both Mr.B and Mr.C were run over along with the car; Mr.B was crushed under the truck and died on the spot, whereas Mr.C sustained serious injuries.
This case exemplifies a typical person-vehicle secondary crash where the occupant had alighted the vehicle after it was broken down and was hit by an approaching vehicle. The lanes and shoulders of expressways are enclosed by fences so that the pedestrians ought not enter. For that reason the person-vehicle accidents occurring on general roads can be attributed to different circumstances whereas on expressways such accidents are secondary in nature characterized by a prior incidence of a vehicle breakdown, primary accident or any other kind of traffic accident. (Nevertheless, person-vehicle accidents occurring on the service areas or parking lots of expressways are mostly similar in situation to those happening on general roads and parking lots.)

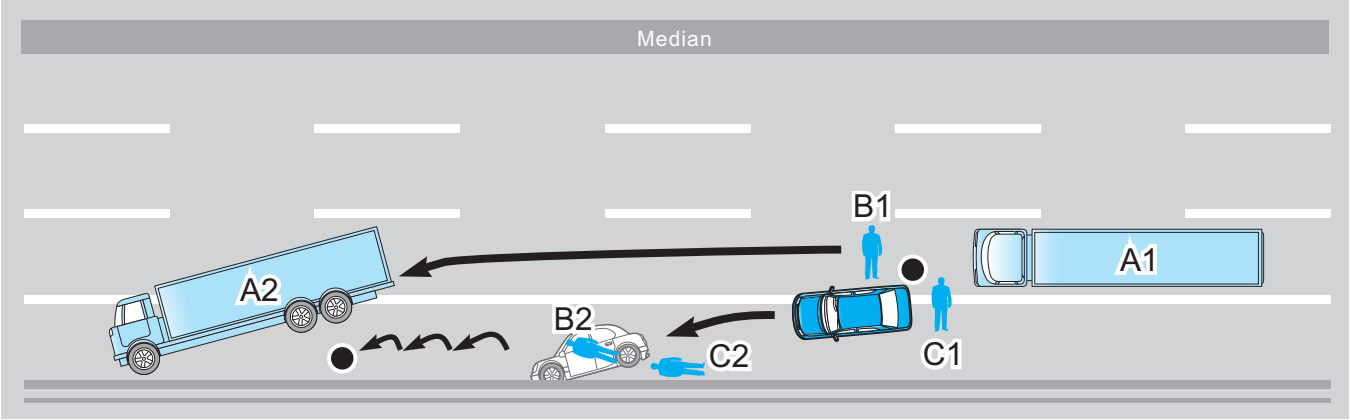



**Fig.3 Example of a secondary accident situation on the expressway**

## 5 Accidents that lead to fatalities more often

Comparing person-vehicle accidents that are considered mostly secondary in nature with other types of accidents may seem like an apple to orange comparison; nevertheless, the rate of fatal accidents of other types is compared as under.
Fig.4 shows the rate of fatal accidents by type of accidents based on the numbers of traffic accidents and fatal accidents given in Fig.2. Apparently, rate of person-vehicle fatal accidents (15.65%) is significantly higher as compared to other types of accidents and is nine times more likely to occur than the overall average of accidents (1.74%) occurring on expressways. In other words, one among every six person-vehicle accidents occurring on expressways leads to fatalities.

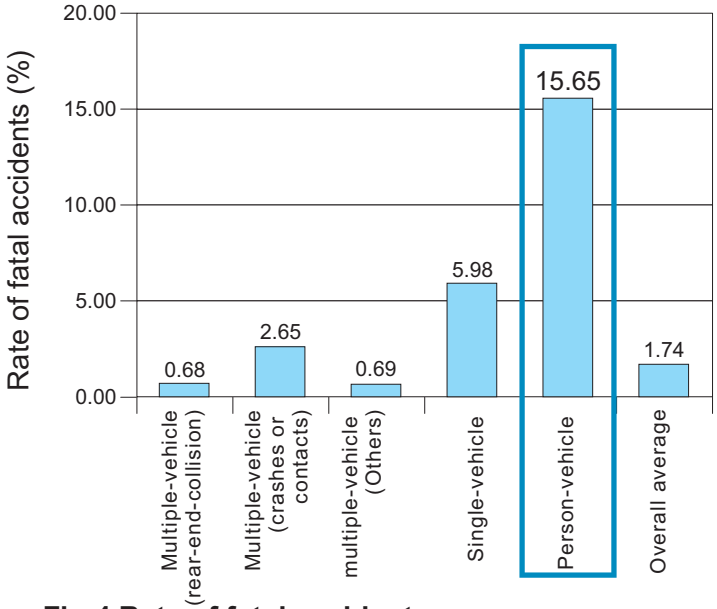



**Fig.4 Rate of fatal accidents on expressways by type of accidents (2003-2012)**

# 6 Characteristics of person-vehicle accidents

Let us now observe the characteristics of person-vehicle accidents occurring on expressways.

## Place of occurrence

Fig. 5 shows the place where person-vehicle accidents occurred by the injury level of the victim in terms of the composition ratio of road segments.
Accidents on service areas and parking lots led mostly to slight injuries whereas fatal accidents occurred more on the expressway lanes or shoulders accounting for nearly 90%. Furthermore, the number of person-vehicle accidents at lanes and shoulders combined, resulted in more fatal accidents (191 cases) than slight injured accidents (184 cases) and one in every 2.7 accidents (518/191 cases) is fatal.

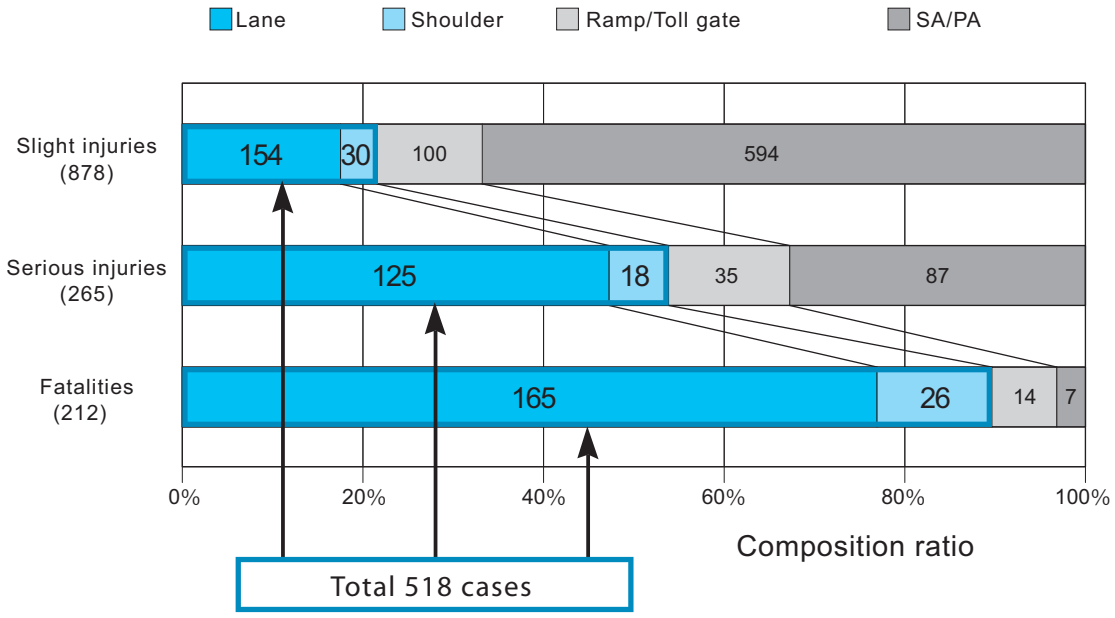



**Fig.5 Person-vehicle accidents on expressways by injury level and by composition ratio of road segments (2003-2012)**

<Road segments>
Lane: Driving lane, passing lane, accelerating lane, decelerating lane and slow-traffic lane
Shoulder: Area starting from the outer lane of the road up to the edge of the road marked by safety barrier, guard rail etc.
Ramp/Toll gate: Slip roads for entry and exit, junctions, toll gate, others
SA/PA: Service area, parking area

## Speed

Fig. 6 compares the composition rate of danger perception speed*2 in person-vehicle accidents occurring at “expressways” and “other roads.” On expressways accidents mainly occur at the danger perception speed of 10km/h and under accounting for about half of the total and the location happened to be service areas and parking areas. This is because the chances of encountering pedestrians here are more, as is the case with general parking lots. Moreover, accidents peak at around 80~100km/h on other roads, where they are most unlikely to happen.

Fig. 7 shows the correlation between danger perception speed and fatality rate in person-vehicle accidents. Be it on expressways or other roads, the fatality rate projects a similar trend. Fatality rate grows in proportion with the danger perception speed and is 50% at the speed of 80km/h.

Fig.8 shows the distribution of danger perception speed in person-vehicle fatal accidents. As compared to other roads, the danger perception speed is higher by 40km/h in expressways at around 90km/h. Therefore it is essential to always keep in mind while driving on expressways that we are at a high fatal risk.

*2 Danger perception speed: The speed of the vehicle when we perceive the other party as a danger.

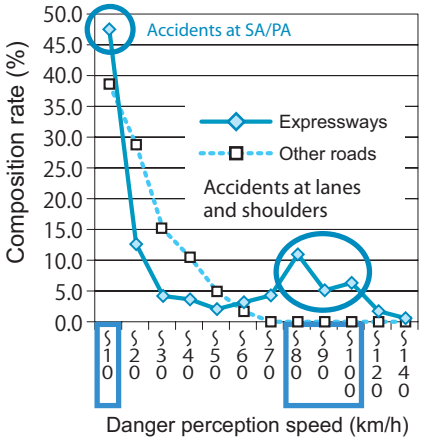



**Fig.6 Danger perception speed in person-vehicle accidents (Primary and secondary vehicles, 2003-2012)**

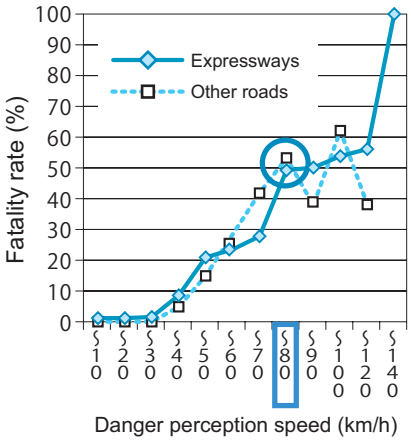



**Fig.7 Danger perception speed and fatality rate of person-vehicle accidents (Primary and secondary vehicles, 2003-2012)**

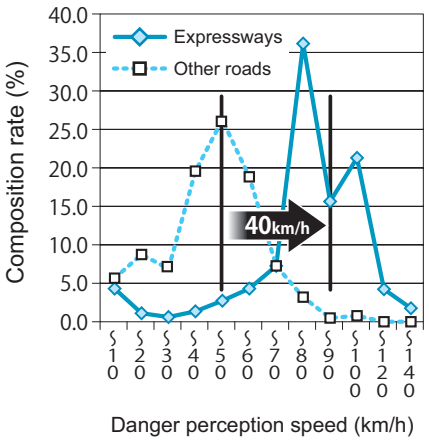



**Fig.8 Danger perception speed in person-vehicle fatal accidents (Primary and secondary vehicles, 2003-2012)**

## Radius of curvature of expressways

Do the curved lanes and tunnels in expressways have any influence on person-vehicle accidents? In Fig.9 person-vehicle accidents are distributed by the injury levels, and then plotted based on the radius of curvature of curved roads. The legend "not applicable" refers to places like service and parking areas where the radius is not clear. Apparently, 80% of fatal accidents occur on straight roads (139 cases) and on roads with 1000m or more radii (31 cases) with unobstructed view. Let us now observe the case of tunnels where the view becomes obstructed if the roads there are curved (Fig. 10). No accidents have occurred in tunnels with roads having small radius of curvature. It can be said that person-vehicle fatal accidents occur more frequently in places with unobstructed view.

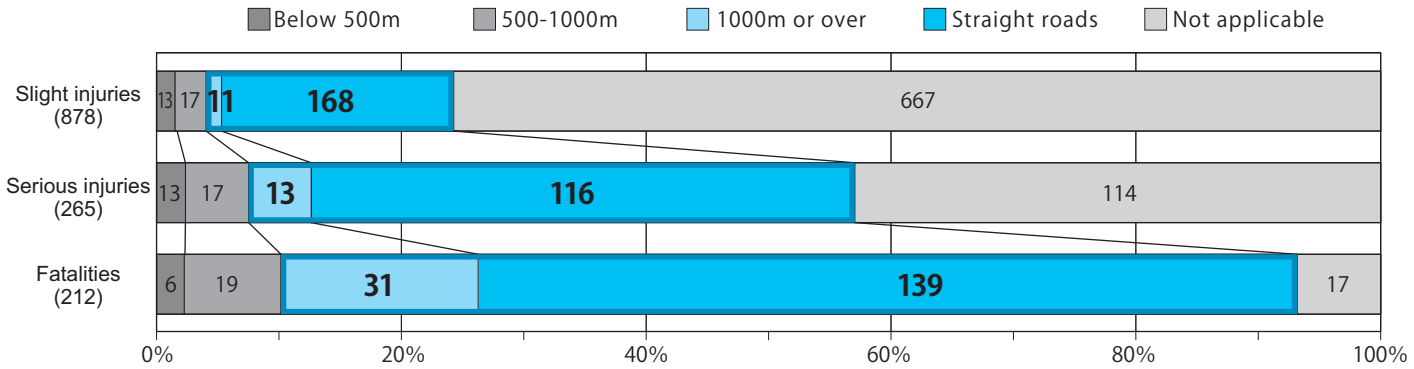



**Fig.9 Composition ratio of injury levels of person-vehicle accidents by radius of curved expressway segments (2003-2012)**

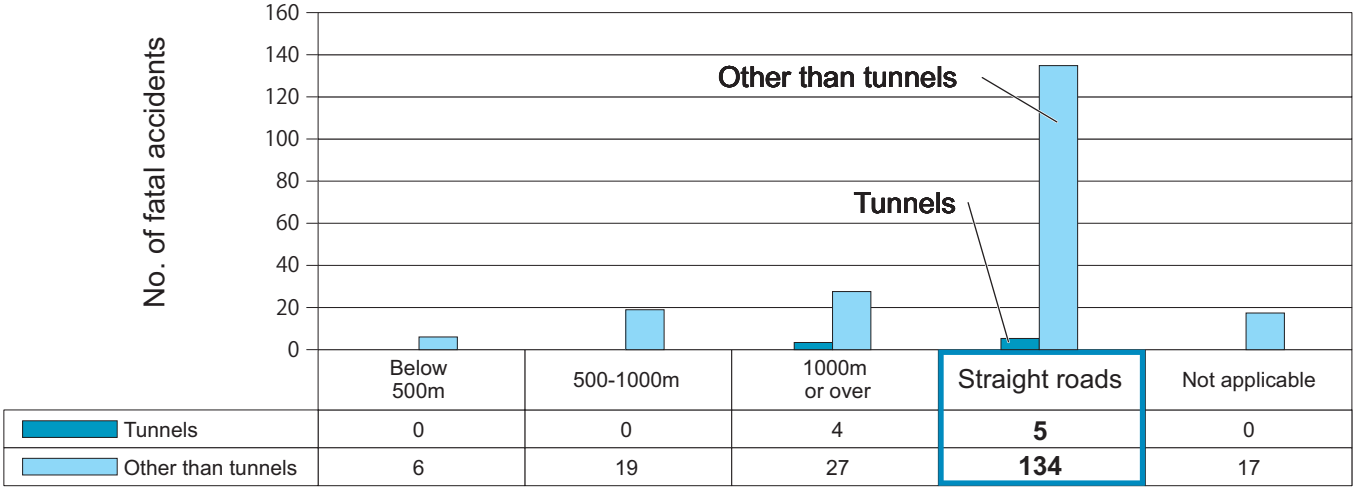



**Fig.10 Comparison of fatal accidents in tunnels and other than tunnels by radius (2003-2012)**

## Human factors

Fig.11 and Fig.12 shows respectively the influence of vehicle drivers and pedestrians in person-vehicle accidents. More than 85% (180/208) of drivers failed to notice their front involving in aimless or distracted driving, thus unable to detect pedestrians on time which resulted in accidents. In other words, since the view on expressways is unobstructed, many drivers were complacent that would detect any pedestrians, but rather failed to notice one. In places like expressways where there is a tendency of oversight, devices aiding the recognition of pedestrians such as pedestrian detection system, and the deceleration or stopping of vehicles or avoidance of pedestrians can be quite reassuring. On the other hand, some pedestrians are also at fault because they step out of their vehicles assuming that the following vehicle will either give way or stop, giving them priority just like in general roads. It appears that together with the emergence of more and more expressway users, there are pedestrians who are not fully aware of the difference between expressways and general roads. The above-mentioned factor is only validated by fellow passengers or witnesses or for that matter the driver of the other vehicle as all the pedestrians in question have died in those accidents.

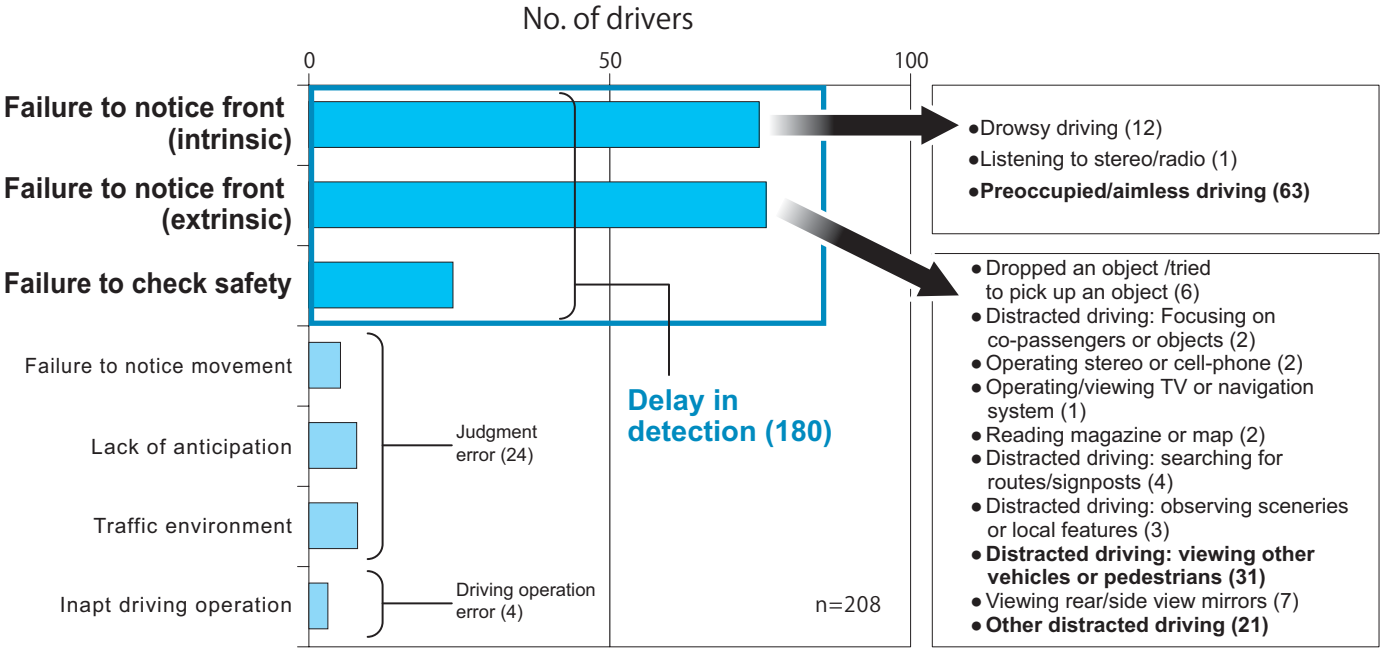



**Fig.11 Human factors of drivers (primary and secondary parties) involved in person-vehicle fatal accidents (2003-2012)**

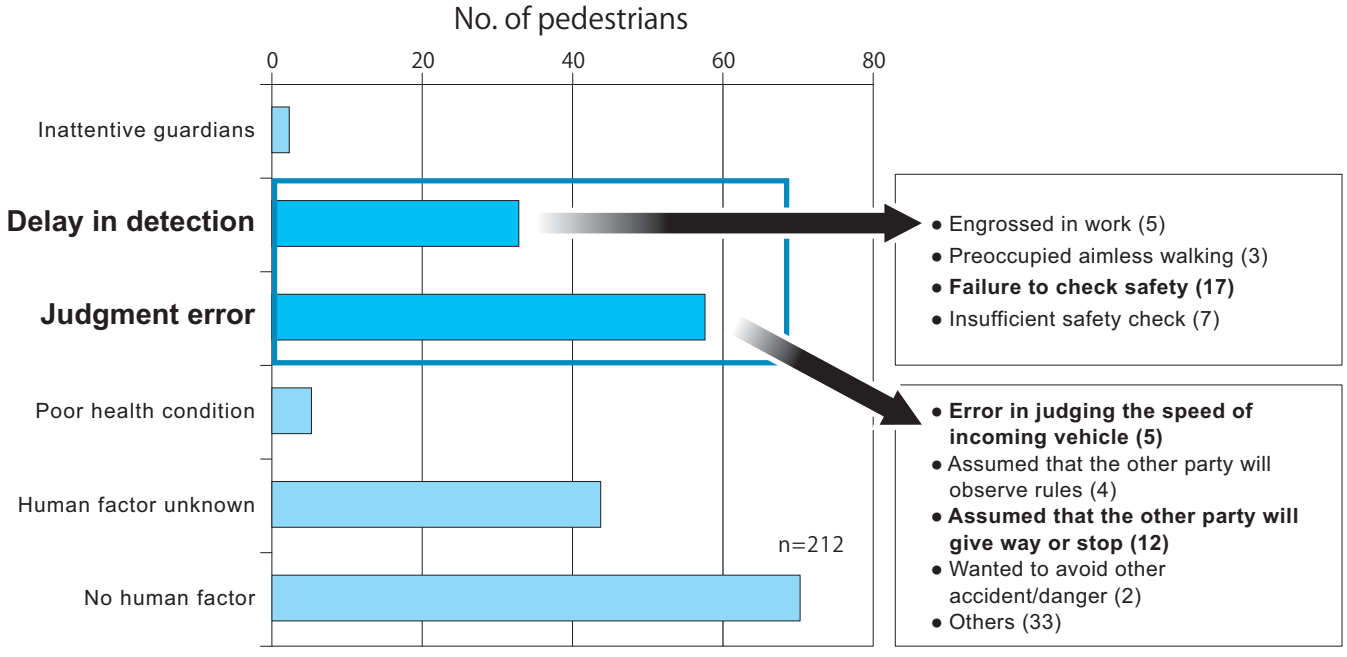



**Fig.12 Human factors of pedestrians (primary and secondary parties) who died in person-vehicle accidents (2003-2012)**

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## 7 Conclusion

### ■Characteristics of person-vehicle accidents on expressways

1. One out of every six person-vehicle accidents is fatal, while one out of every 2.7 such accidents occurring on road shoulders or lanes is fatal.
2. Person-vehicle fatal accidents occur more on straight roads with unobstructed view.
3. “Delay in detection” resulting from human factors like “distracted” or “aimless” driving cause majority of the drivers to be involved in person-vehicle accidents.
4. Human factors of pedestrians mainly include “delay in detection” rooted in complacency such as “failure to check safety assuming that no vehicle is approaching” and “judgment error” such as “the vehicle will avoid me” and “the vehicle will come to a stop.”

### ■Ways to prevent person-vehicle accidents on expressways

1. When you see a stopped vehicle while driving, anticipate the presence of pedestrians nearby and exercise extra caution. Be fully prepared to tackle any probable danger by observing the surroundings carefully, shifting your foot from accelerator to brake etc.
2. Presence of pedestrians on shoulders and lanes is an abnormal situation. Nevertheless, drivers are expected to continuously pay attention to their front for any humans or objects. So keep ample distance with vehicles and be flexible in the vehicle operation to cope with contingencies.
3. When stopping your vehicle on shoulders or lanes is unavoidable owing to an accident or break down, it is essential to be fully aware to prevent secondary accidents. Alert the approaching vehicle using smoke candles or warning triangles and quickly retreat to safety beyond the guard rail etc. along with fellow passengers and thus be prepared for any probable collision.
4. It is equally important to prevent vehicle breakdowns while driving. Always perform vehicle inspection on routine basis especially before driving on expressways.
5. Technical development and dissemination of recognition devices are preferred which assist the drivers in detecting pedestrians and decelerate, stop or avoide their vehicles automatically when there is heightened danger of collision during high-speed driving.

(Makoto Shiota)

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当センターは、平成4年（1992年）に国家公安委員会、運輸省（当時）、建設省（当時）から設立許可を受けて、公益法人として設立されました。その後平成24年（2012年）4月に公益財団法人に移行しました。我が国で唯一道路交通法の定める「交通事故調査分析センター」の指定を国家公安委員会から受けた調査研究機関であり、交通事故の防止と被害の軽減のための交通事故の調査分析を行っています。

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