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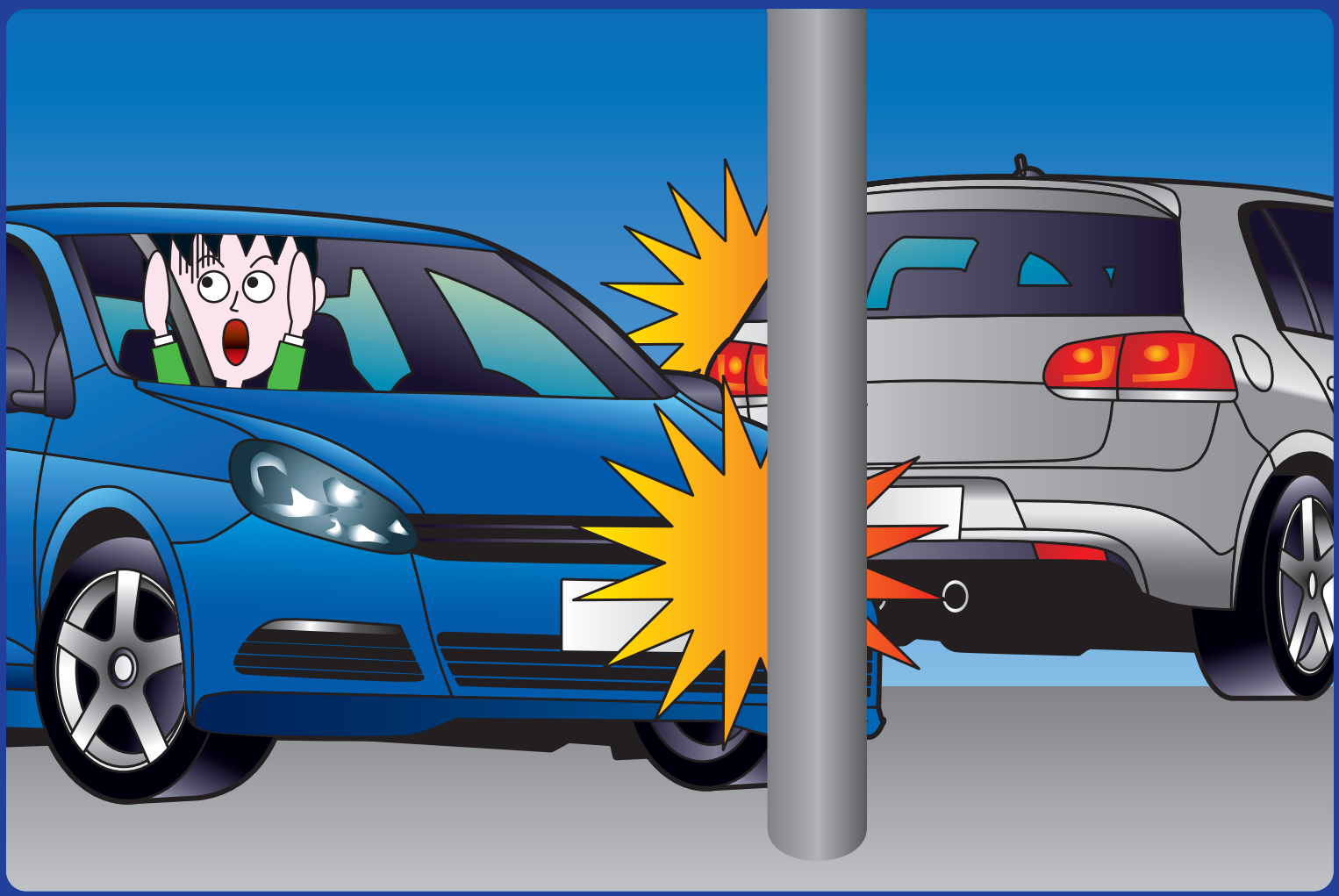
No.139

Special feature

Pedal Misapplication Accidents

~ Uncovering the reality of multiple collisions through statistical accident analysis ~



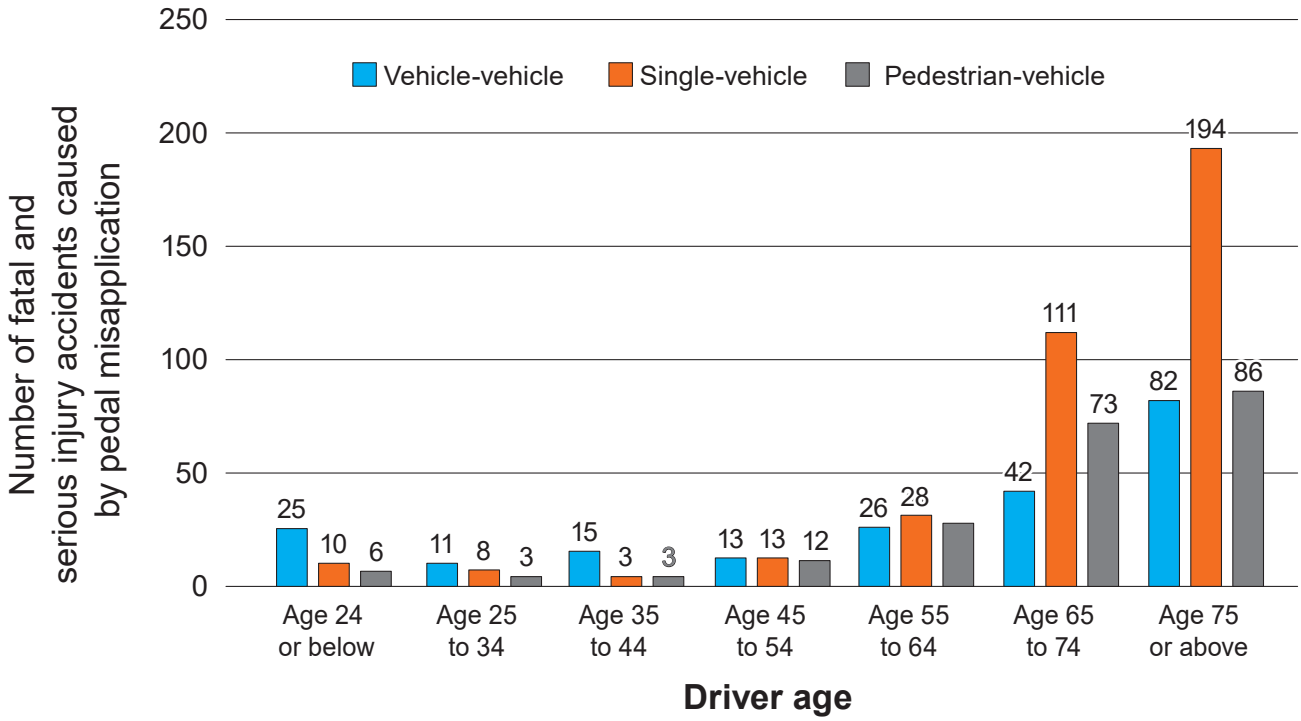


Figure 1. Distribution of pedal-misapplication accidents by driver age

(Fatal and serious injury accidents with primary party of small or medium-sized passenger vehicle in 2018 to 2020)

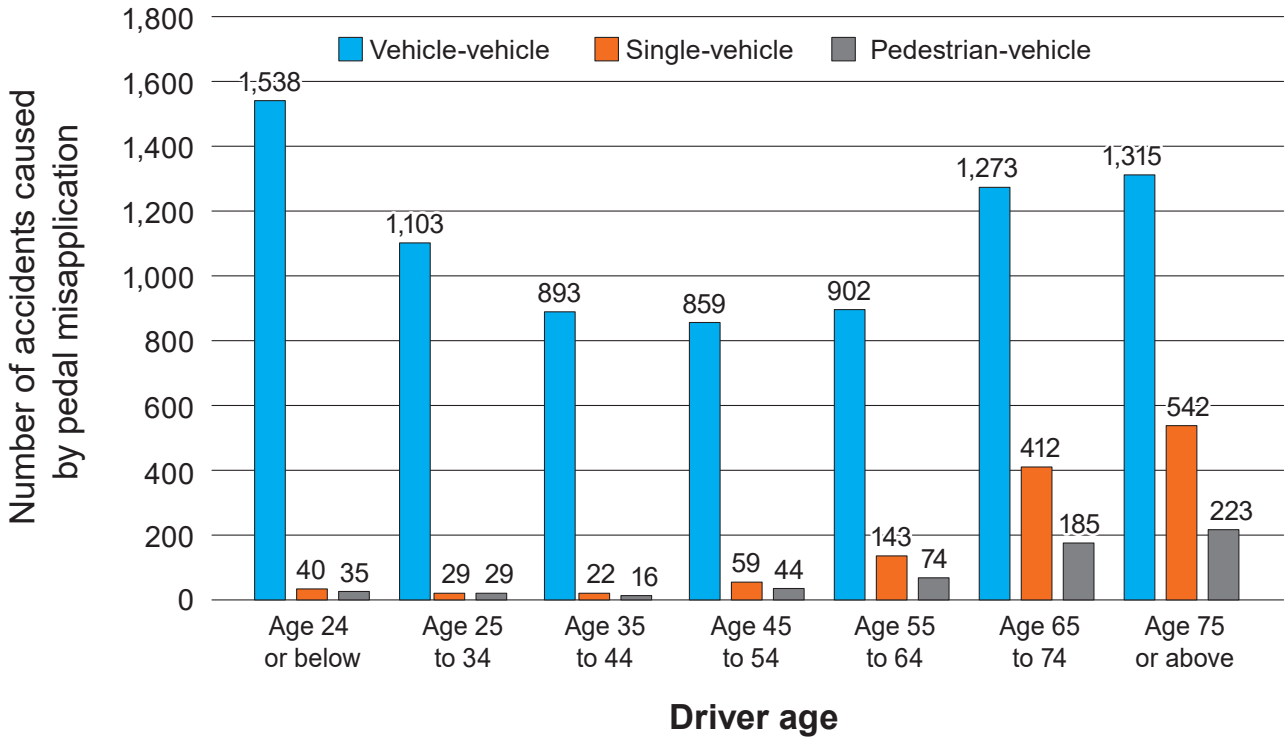


Figure 2. Distribution of pedal-misapplication accidents by driver age

(Casualty accidents with primary party of small or medium-sized passenger vehicle in 2018 to 2020)

1 Introduction

You have likely heard about accidents caused by the misapplication of the accelerator and brake pedals (hereinafter “pedal misapplication”) as they are sometimes presented in the news. While pedal misapplication is an error related to the most basic of driving operations, it is a major error that can have serious consequences. This is because the driver ends up accelerating the vehicle when trying to stop it, so a situation in which the opposite of the driver’s intention occurs. In fact, pedal misapplication sometimes causes tragic accidents involving vulnerable road users such as pedestrians, or causes significant damage to convenience stores or other buildings due to vehicles driving into them. We have already introduced specific examples of such accidents in ITARDA Information No. 137, so on this occasion, we would like to take a look at the numbers and characteristics of pedal-misapplication accidents, based on statistical accident analysis. The analysis below will target human error during accidents in which a small-sized passenger vehicle (or K-cars) or a medium-sized passenger vehicle is the primary party*1.

First of all, Figure 1 and Figure 2 on the previous page show the numbers of accidents caused by pedal misapplication divided by type of accident, and divided by driver age. Here, the types of accident are broadly divided into the three categories of “vehicle-vehicle,” “single-vehicle,” and “pedestrian-vehicle.” Among the fatal and serious injury accidents in Figure 1, accidents caused by elderly drivers account for a large portion of the total, and single-vehicle accidents are particularly frequent among drivers age 65 or above. Meanwhile, looking at the total casualty accidents (fatal and serious injury accidents, plus accidents with slight injuries) in Figure 2, vehicle-vehicle accidents, which include rear-end collisions and so on, are the most frequent, and it appears that a large amount of pedal misapplication is occurring among young drivers in addition to elderly drivers. The reason for this is likely that young drivers have a low level of driving proficiency, and are not accustomed to the vehicle that they are driving.

Next, Table 1 shows the total numbers of accidents, not divided by age. In the totals for each type of accident, it is apparent that a large amount of casualty accidents have been caused by pedal misapplication, with the number over a period of three years at close to 10,000. Considering what the number is for casualty accidents alone, it can be presumed that the total including property damaging accidents would be even more substantial.

In this issue of ITARDA Information, we would like to take a detailed look at the positioning of pedal misapplication among the types of human error, and the actual circumstances regarding multiple collisions caused by pedal misapplication.

Table 1. Number of accidents caused by misapplication of accelerator and brake

(Accidents with primary party of small or medium-sized passenger vehicle in 2018 to 2020)

Type of accident / Accident content	Vehicle-vehicle	Single-vehicle	Pedestrian-vehicle	Total (*2)
Casualty accidents	7,883	1,247	606	9,738
Fatal and serious injury accidents among above	214	370	211	797
Fatal accidents among above	14	86	22	123

(*1) The “primary party” is the party that was the most at fault. When the fault is about the same, it is the party that sustained the least damage, and in single-vehicle accidents, it is the party of the vehicle in question.

(*2) The total includes vehicle-train accidents.

2 Accidents caused by operation error

■Cognition, decision, and operation errors

We will now take an overall look at human error. The “primary party,” which is the target for our analysis on this occasion, is basically the party that was the most at fault. As such, the primary party is recorded as having carried out some type of human error, with the exception of cases in which investigation is not possible. Such human error is categorized into the three driving steps of “cognition,” “decision,” and “operation.”

Cognition errors include “drowsy driving,” “distracted driving,” “absent-minded driving,” “failure to check safety,” and “insufficient checking of safety.”

Decision errors include “neglecting to pay attention to whether there were specific dangers,” “neglecting to pay attention due to thinking that the other party would yield,” and “incorrectly predicting the actions of the other party.”

Operation errors include “brake and accelerator misapplication,” “brake application that is too weak or late,” “steering error,” and “shifting to the wrong gear.”

Figure 3 shows the composition ratios of the three errors regarding accidents in which the primary party was a small-sized passenger vehicle or medium-sized passenger vehicle, during the three-year period of 2018 to 2020. It is clear that operation error is frequent among single-vehicle accidents. It seems that in the case of single-vehicle accidents, since the other party of the collision does not move, there are few cognition errors, and there are frequently operation errors, such as steering operation mistakes at curves, in addition to pedal misapplication.

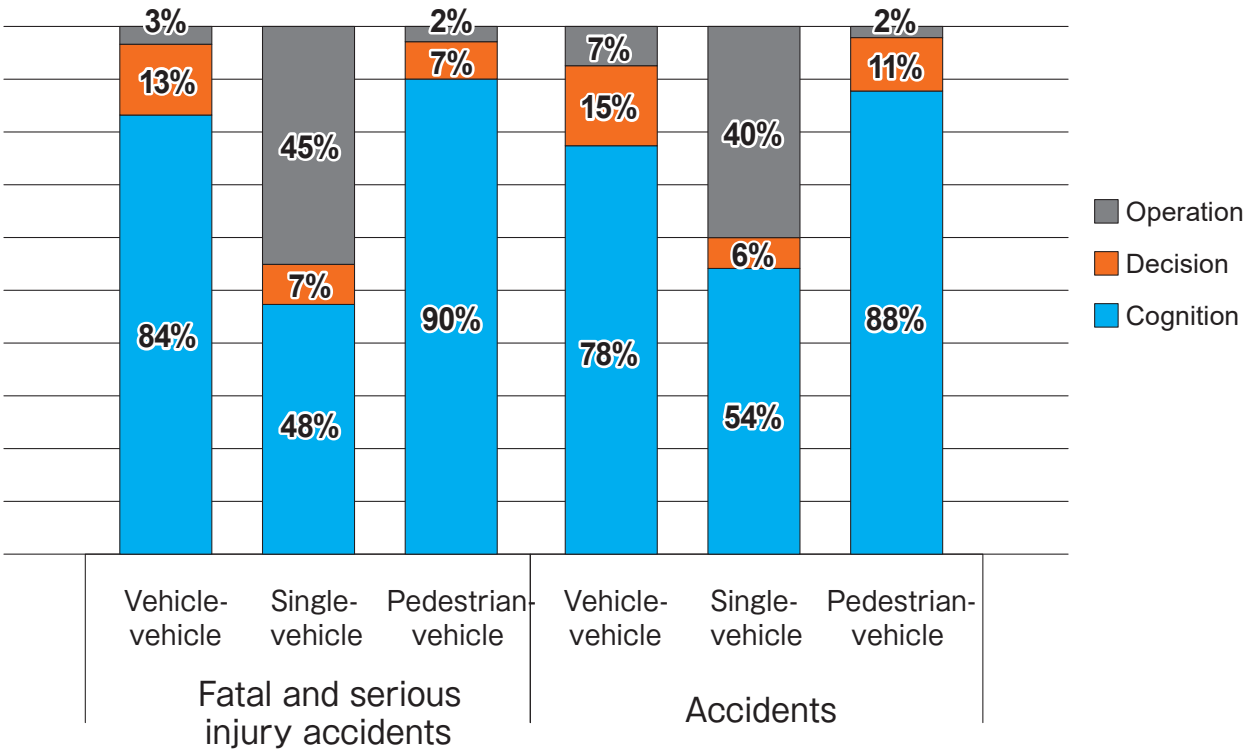


Figure 3. Human error composition ratio (excluding cases in which investigation not possible)

(Accidents with primary party of small or medium-sized passenger vehicle in 2018 to 2020)

■Details of operation errors

Next, we would like to look at operation errors in more detail.
Figure 4-1 is a graph that shows the composition ratios of operation error regarding each type of accident, among fatal and serious injury accidents. Among vehicle-vehicle and single-vehicle accidents, “steering error” is the most frequent, and next is “brake and accelerator misapplication.” Among pedestrian-vehicle accidents, “brake and accelerator misapplication” is the most frequent at 55%.

Figure 4-2 is a graph that shows the same regarding casualty accidents overall. Among vehicle-vehicle accidents, the most frequent error is “brake application that is too weak or late.” This error causes rear-end-collision accidents and so on. While the composition ratio of pedal misapplication is 16%, the absolute number of cases appears to be large at 7,883. Among single-vehicle and pedestrian-vehicle accidents, the composition ratio of pedal misapplication is higher.

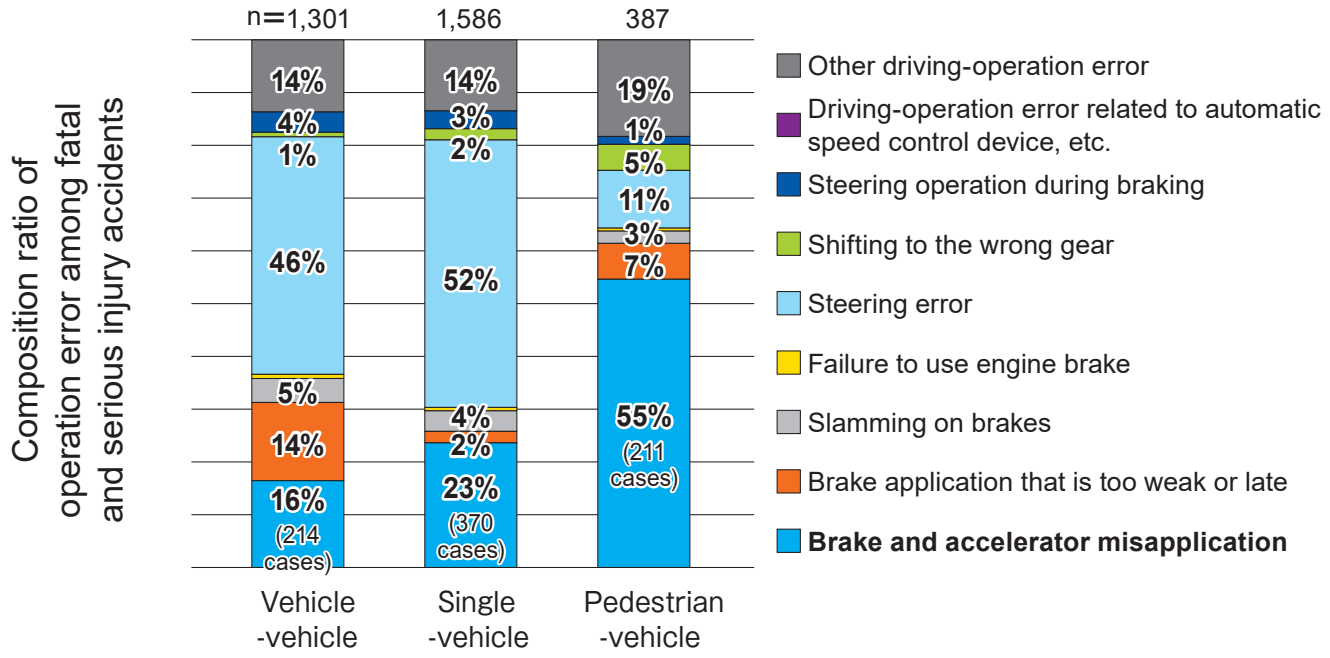


Figure 4-1. Composition ratio of operation error

(Fatal and serious injury accidents in 2018 to 2020)

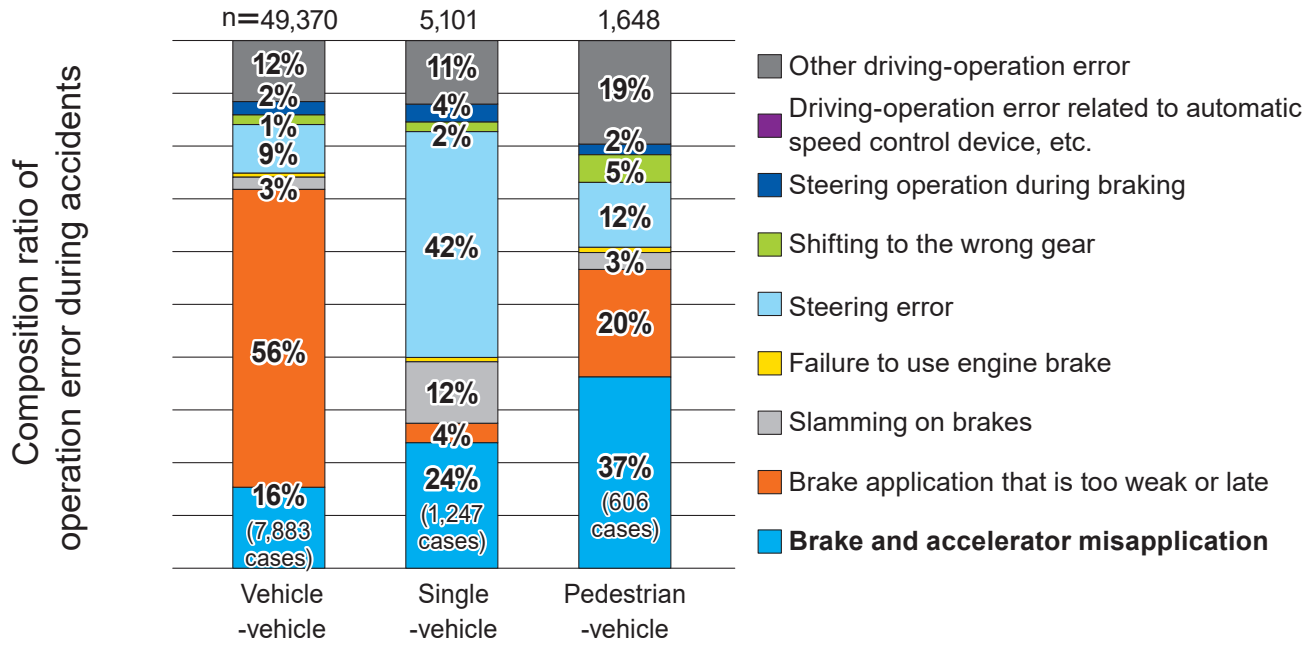


Figure 4-2. Composition ratio of operation error

(Casualty accidents in 2018 to 2020)

3 Characteristics of accidents caused by pedal misapplication

■Driving-movement

Figure 5 shows the driving-movement during pedal misapplication among fatal and serious injury accidents.

Among vehicle-vehicle and single-vehicle accidents, “going straight on” is the most frequent, and this is followed by “starting up.” In the case of pedestrian-vehicle accidents, in addition to going straight on and starting up, “reversing” is frequent at 26%. Relative to other types of accidents, “turning right” is also frequent at 11%. It seems that at parking areas and so on, pedestrians need to avoid moving into the area in the front or back of vehicles that are advancing or reversing.

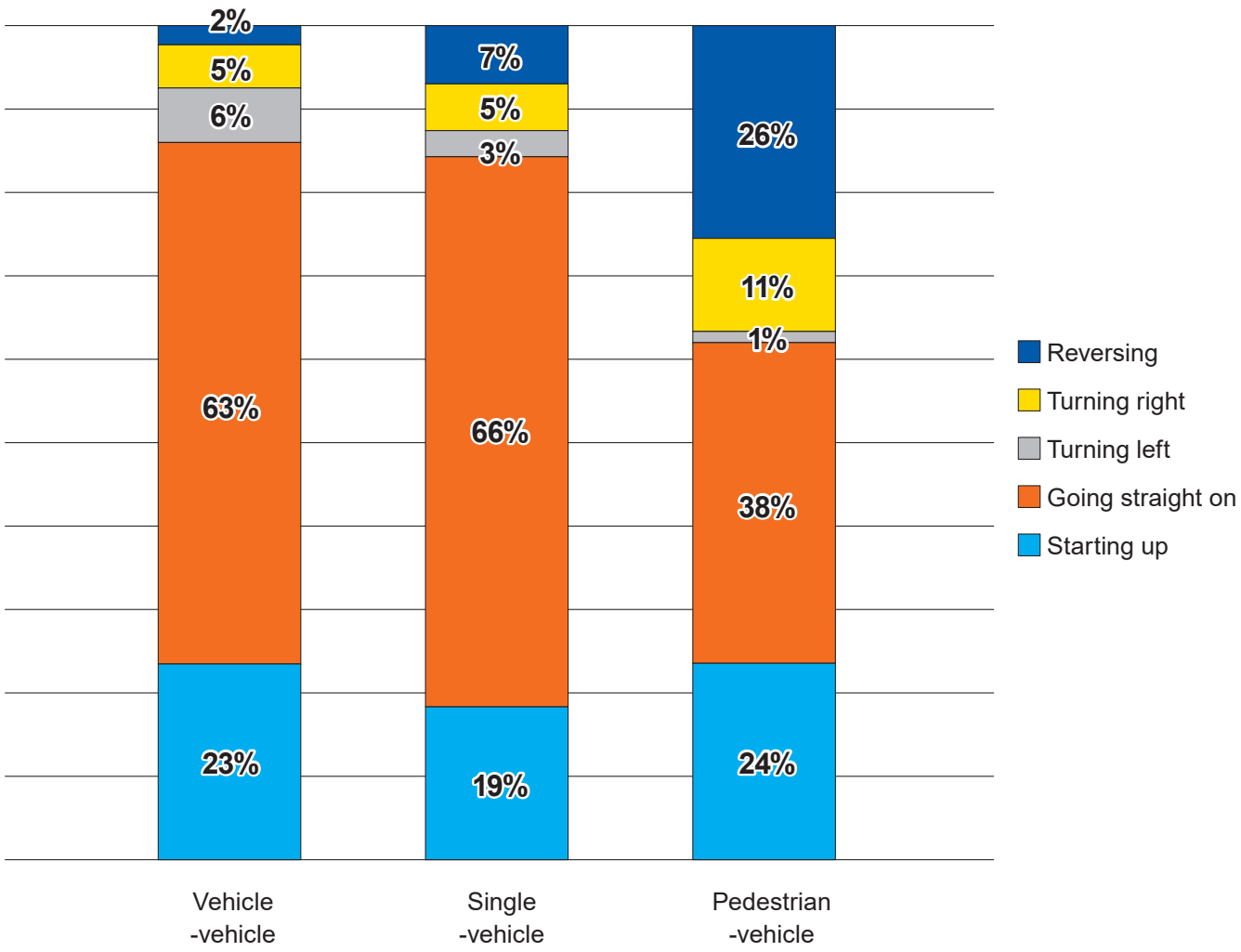


Figure 5. Driving-movement during pedal misapplication among fatal and serious injury accidents

(2018 to 2020)

■Type of accident and driver age

Figure 1 and Figure 2 show the status of pedal-misapplication accidents divided by the type of accident and divided by the driver age. Figure 6 additionally shows the number of casualty accidents per 100,000 holders of a license for a medium-sized vehicle or above. Compared with Figure 2, it is even clearer that there is high risk of pedal-misapplication accidents among drivers “age 24 or below” and “age 75 or above.” While attention is often placed on elderly drivers in this regard, it seems to be necessary to sufficiently focus on the prevention of pedal misapplication among young drivers as well.

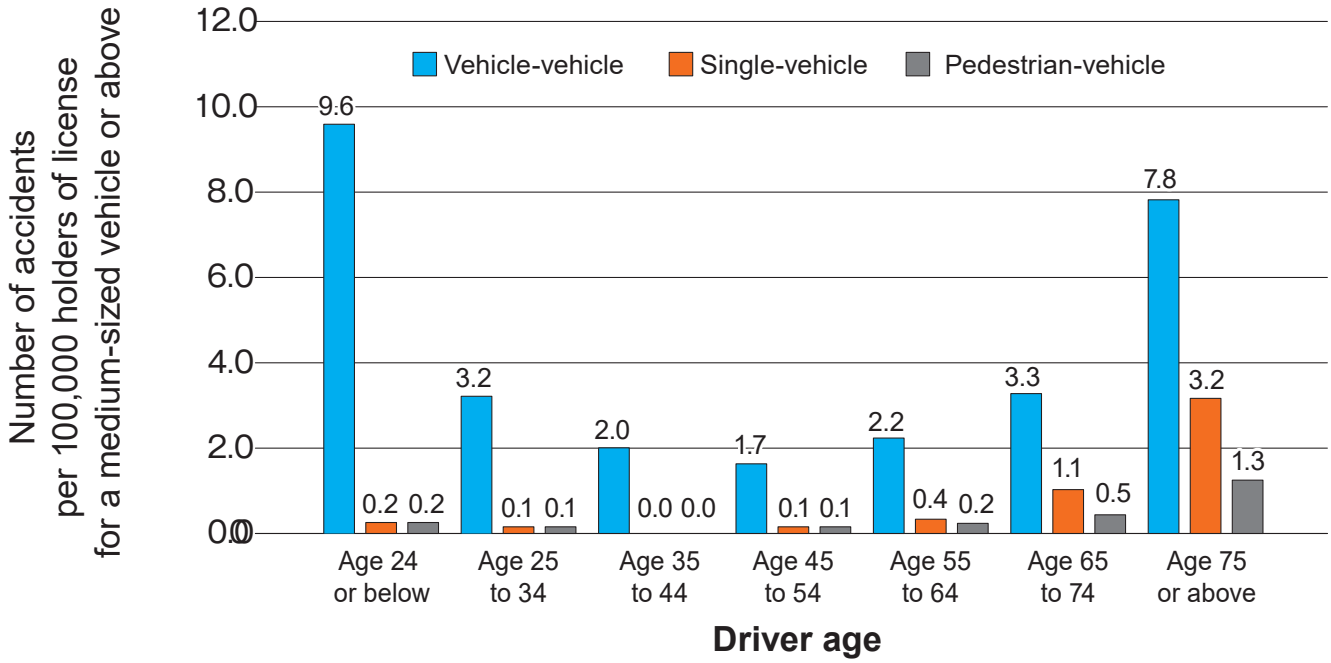


Figure 6. Number of accidents caused by pedal misapplication per 100,000 license holders divided by driver age

(Casualty accidents in 2018 to 2020)

■Multiple collisions

In the news regarding pedal-misapplication accidents, there are cases of accidents involving collisions with various objects. Here, we would like to take a look at the actual circumstances regarding multiple collisions. Figure 7 shows the multiple-collision ratio among all types of accidents, during all types of human error and during pedal misapplication. While overall the multiple-collision ratio is 8% regarding both fatal and serious injury accidents and casualty accidents, in the case of pedal misapplication, the ratio of multiple-collision accidents appears to be high, at 37% regarding fatal and serious injury accidents and at 29% regarding casualty accidents.

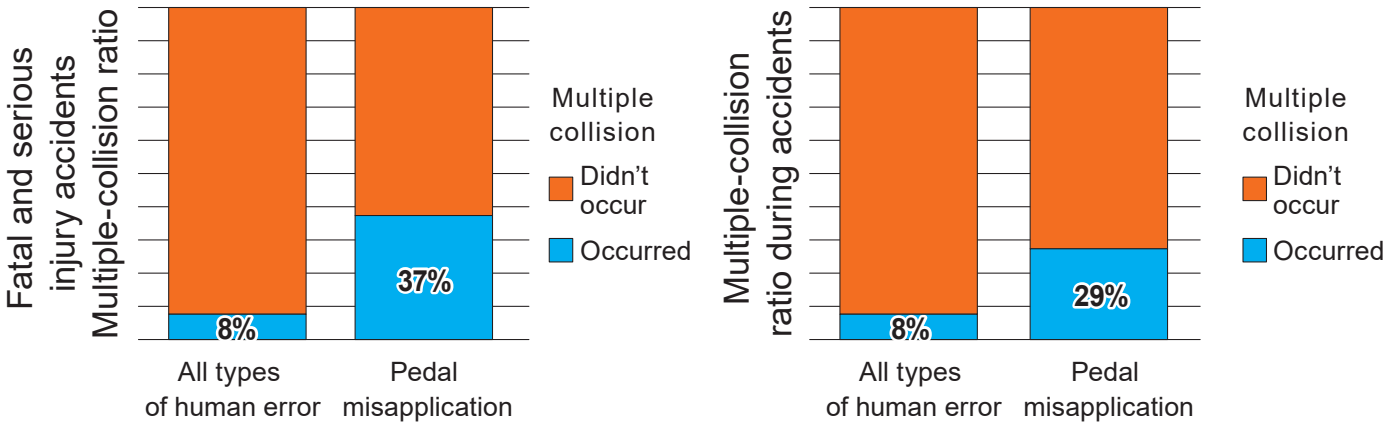


Figure 7. Comparison of multiple-collision ratio overall versus during pedal misapplication

(Fatal and serious injury accidents & casualty accidents in 2018 to 2020)

Figure 8 shows the fatal and serious injury accidents caused by pedal misapplication, divided by the age of the primary-party driver. The left shows the absolute values, and the right shows the multiple-collision ratios. While "age 24 or below" is high at 34%, the multiple-collision ratio decreases as the age increases. At "age 55 or above," the ratio increases again, and at "age 65 or above," it is at around 40%. Figure 9 shows the same regarding casualty accidents. It is clear that the multiple-collision ratio rises at "age 55 or above."

Namely, this seems to show that at age 55 and beyond, there is an increase in the probability of cases in which the vehicle does not stop after initially colliding and ends up colliding with other objects as well. This is likely one result of the fact that when elderly drivers make a driving-operation error, it is difficult for them to correct their driving movements. 1)

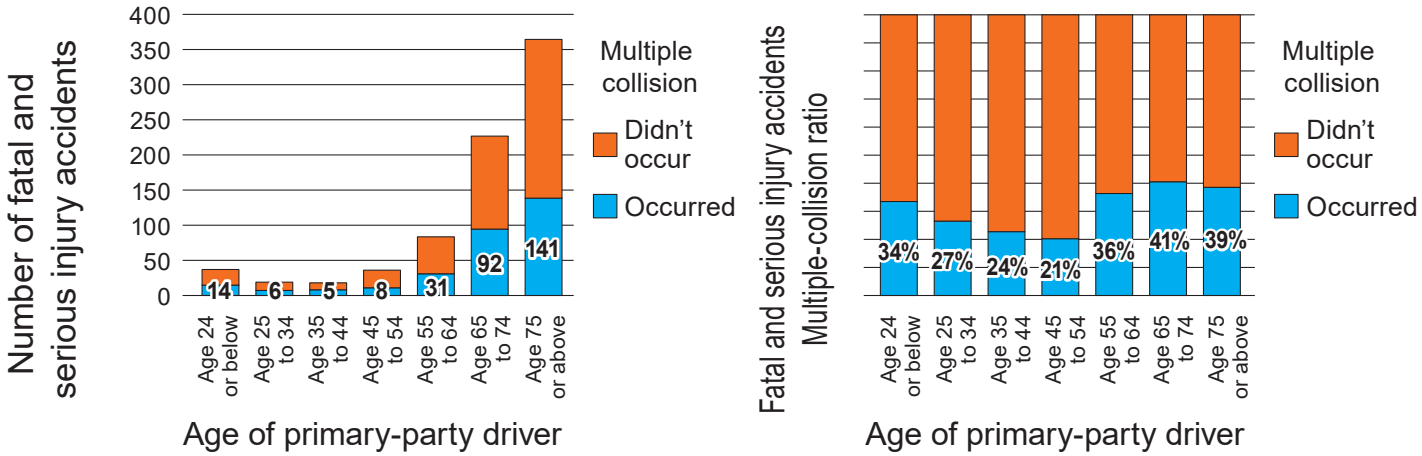


Figure 8. Rate of occurrence of multiple collisions among fatal and serious injury accidents caused by pedal misapplication, divided by driver age

(2018 to 2020)

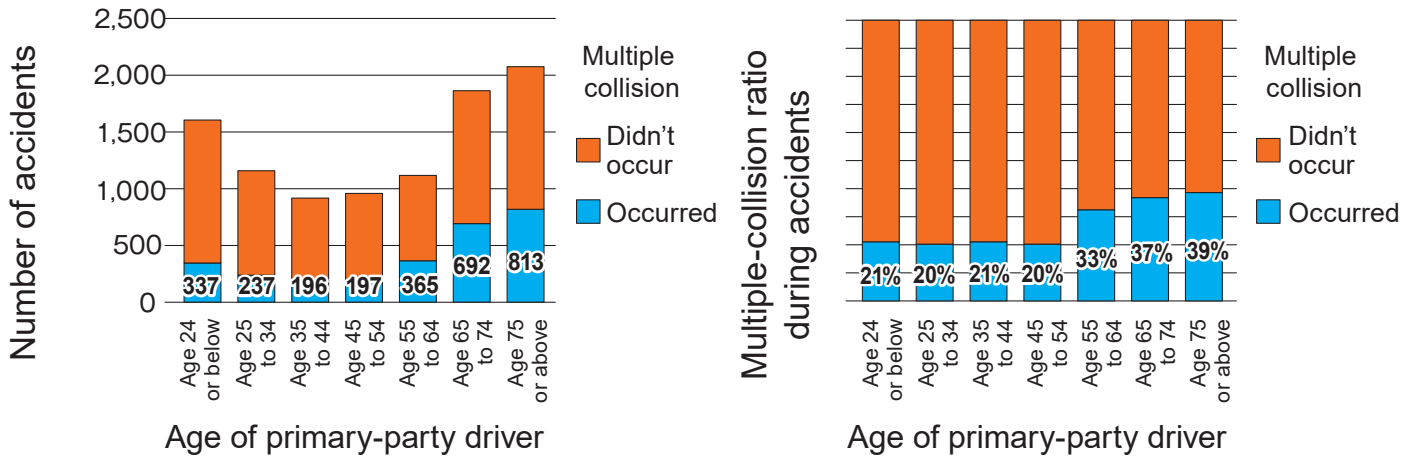


Figure 9. Rate of occurrence of multiple collisions among casualty accidents caused by pedal misapplication, divided by driver age

(2018 to 2020)

■Driver age and injury-sustaining parties (vehicle-vehicle accidents)

We have shown that multiple collisions are frequent among accidents caused by pedal misapplication, and we would now like to take a look at which parties sustain injuries in such accidents. Figure 10 shows the injury-sustaining parties in vehicle-vehicle accidents. The numbers of people who sustained injuries are shown, so the values are larger than those for the numbers of accidents that we have been looking at thus far. Figure 10-1 is regarding casualties. Since the accidents are "vehicle-vehicle," there are many casualties among secondary-party drivers and fellow passengers that are on the other side of the collisions. Nevertheless, it can be seen that there are also certain numbers of casualties among the drivers and fellow passengers of the tertiary-or-lower party. Looking at the graph of number of fatalities and serious injuries in Figure 10-2, it appears that at age 55 or above, the drivers and fellow passengers of the primary party that the carried out the pedal misapplication are also becoming fatalities and sustaining serious injuries. Furthermore, it seems that at age 65 or above, tertiary-party vehicle passengers and pedestrians are additionally becoming fatalities and sustaining serious injuries. This coincides with the trend that we looked at earlier that the multiple-collision ratio is high among elderly drivers.

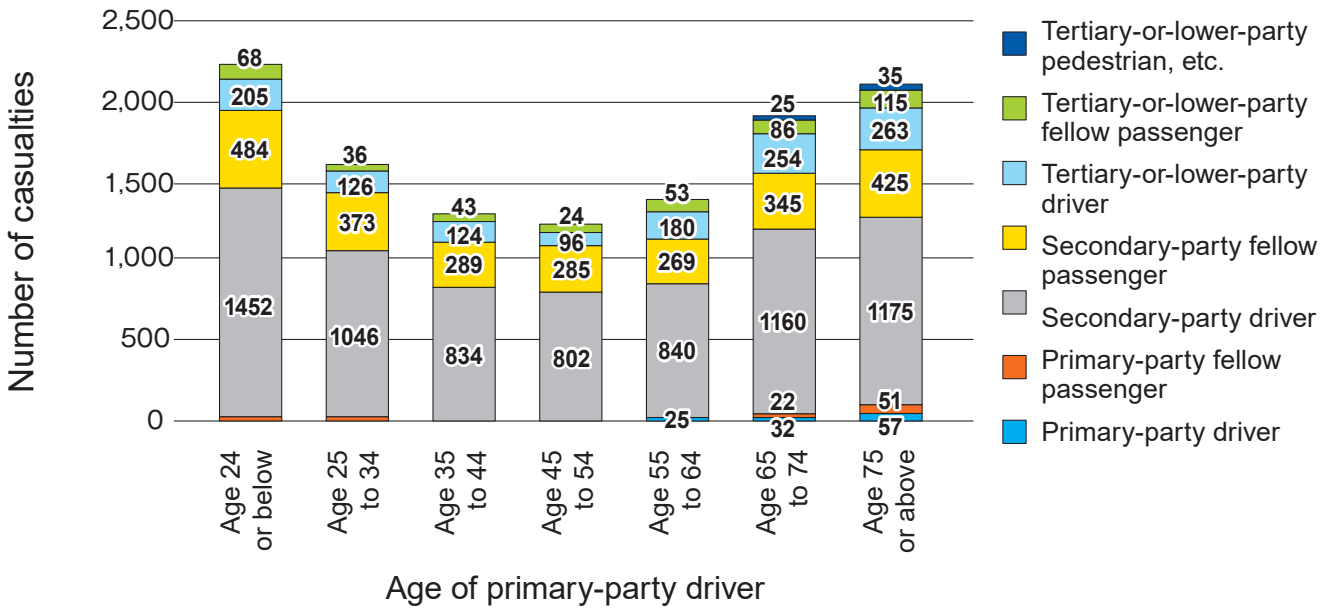


Figure 10-1. Injury-sustaining parties in pedal-misapplication vehicle-vehicle accidents

(Casualties in 2018 to 2020)

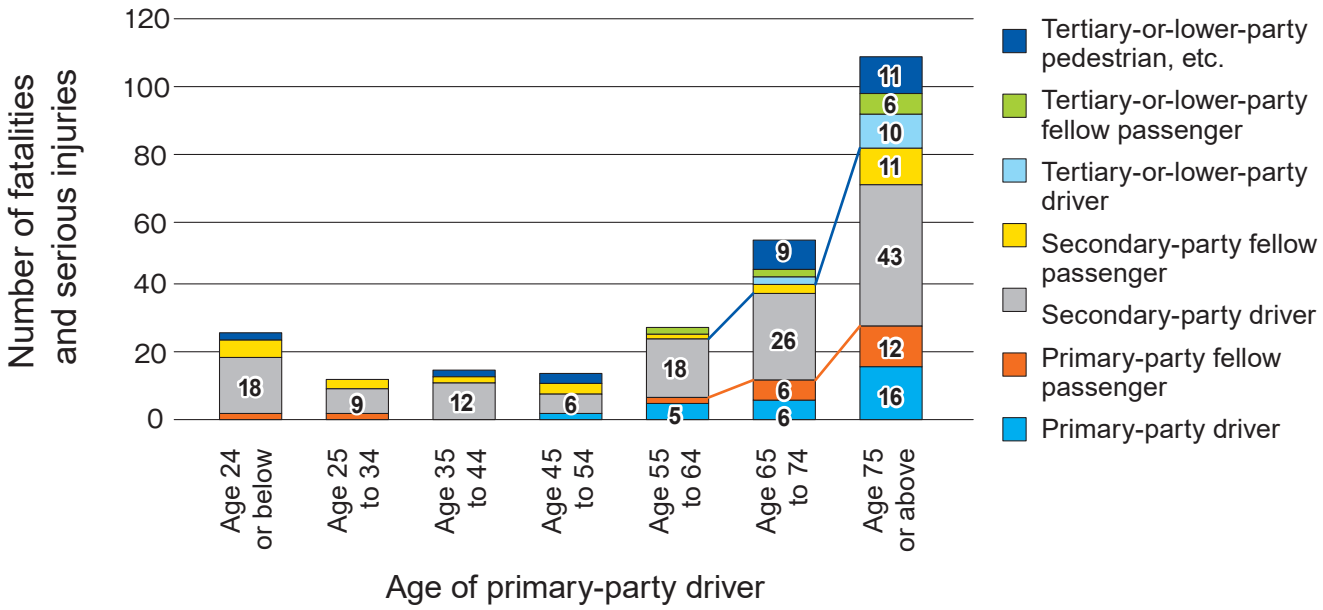


Figure 10-2. Injury-sustaining parties in pedal-misapplication vehicle-vehicle accidents

(Fatalities and serious injuries in 2018 to 2020)

■Driver age and injury-sustaining parties (single-vehicle accidents)

Next, we will take a look at single-vehicle accidents. While “single-vehicle accidents” refers to accidents in which the party initially collided with is a utility pole, house, guardrail, or the like, such accidents included cases in which another vehicle or a pedestrian is collided with following the initial collision, and such parties collided with are referred to as “tertiary-or-lower parties.” Figure 11-1 shows the numbers of casualties. Among single-vehicle accidents there are course many cases in which there is no secondary party and the casualties are the primary-party driver and fellow passengers. Nevertheless, there are also significant numbers of casualties among tertiary-or-lower-party drivers, fellow passengers, and pedestrians, etc. Thus, it is clear that even though the accidents are categorized as “single-vehicle,” passengers of other vehicles and pedestrians are also sustaining injuries during such accidents due to multiple collisions.

Cases in which a vehicle drives into a store and injures people inside also fall under this category. In Figure 11-2, it is clear that among drivers “age 65 to 74” and “age 75 or above,” tertiary-or-lower-party pedestrians are also becoming fatalities and sustaining serious injuries.

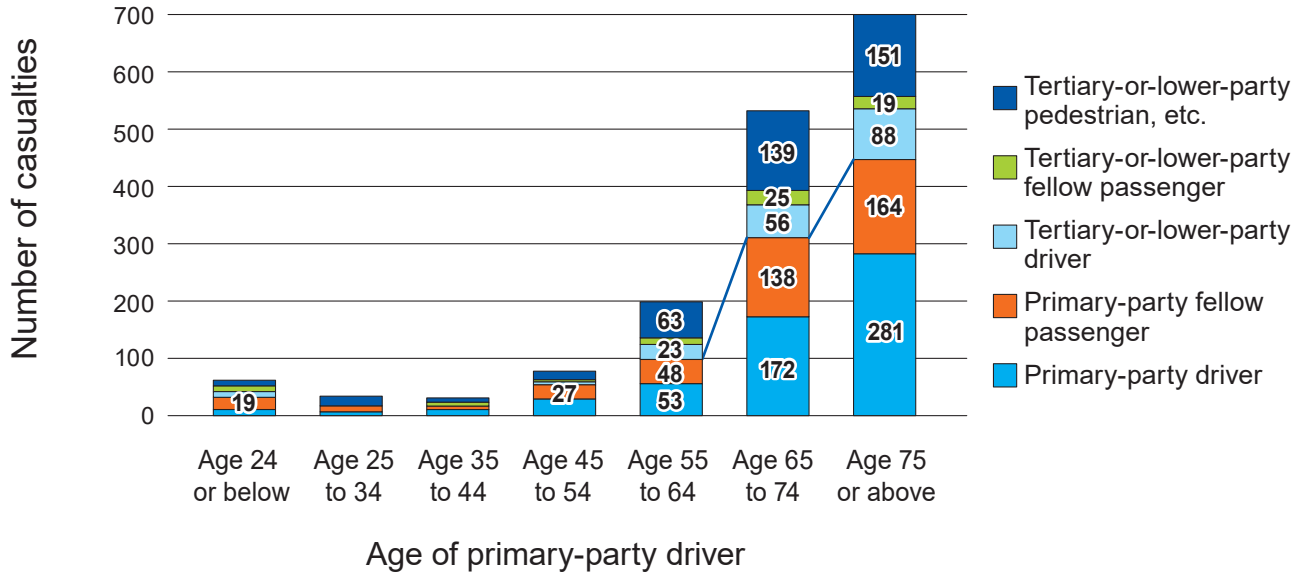


Figure 11-1. Injury-sustaining parties in pedal misapplication single-vehicle accidents

(Casualties in 2018 to 2020)

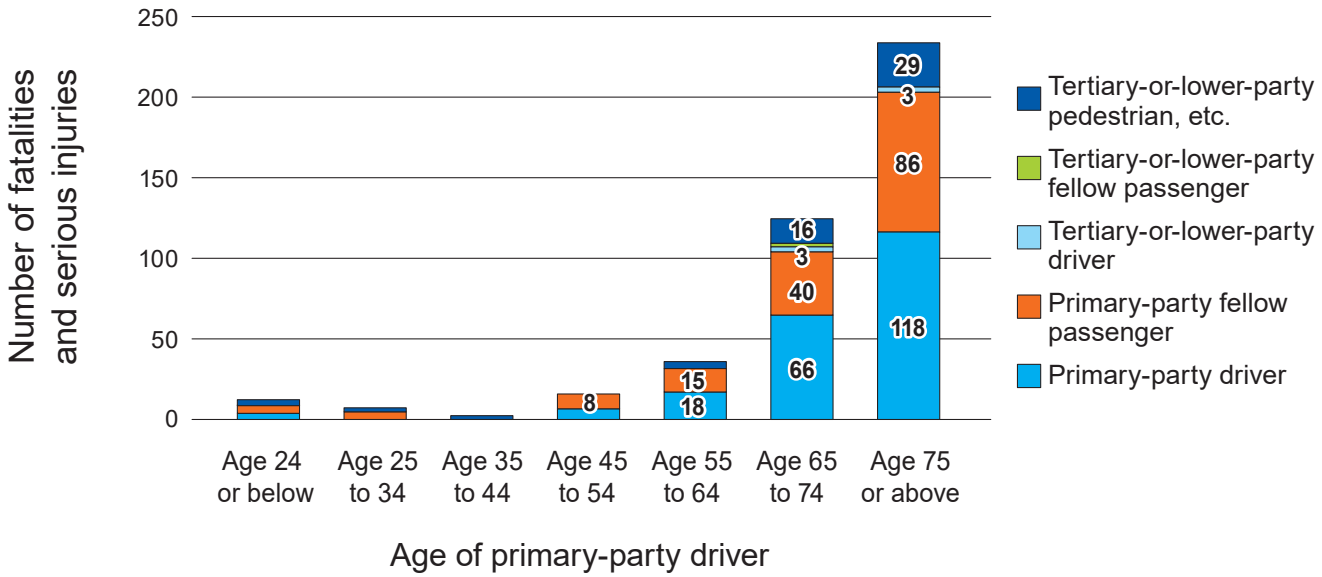


Figure 11-2. Injury-sustaining parties in pedal misapplication single-vehicle accidents

(Fatalities and serious injuries in 2018 to 2020)

■Driver age and injury-sustaining parties (pedestrian-vehicle accidents)

Lastly, Figure 12-1 shows the driver age and injury-sustaining parties regarding pedestrian-vehicle accidents caused by pedal misapplication. Since the accidents are recorded as “pedestrian-vehicle accidents,” the injury-sustaining parties are of course frequently secondary-party pedestrians. Nevertheless, it appears that when the driver age reaches “age 65 or above,” the injury-sustaining parties are very frequently tertiary-or-lower-party pedestrians, etc.

In Figure 12-2, which is a graph regarding fatalities and serious injuries, in the case of accidents caused by elderly drivers, around 10% of the injury-sustaining parties are tertiary-or-lower-party pedestrians, etc. As such, it is clear that when the drivers are elderly, among pedestrian-vehicle accidents caused by pedal misapplication, the accidents are involving multiple people.

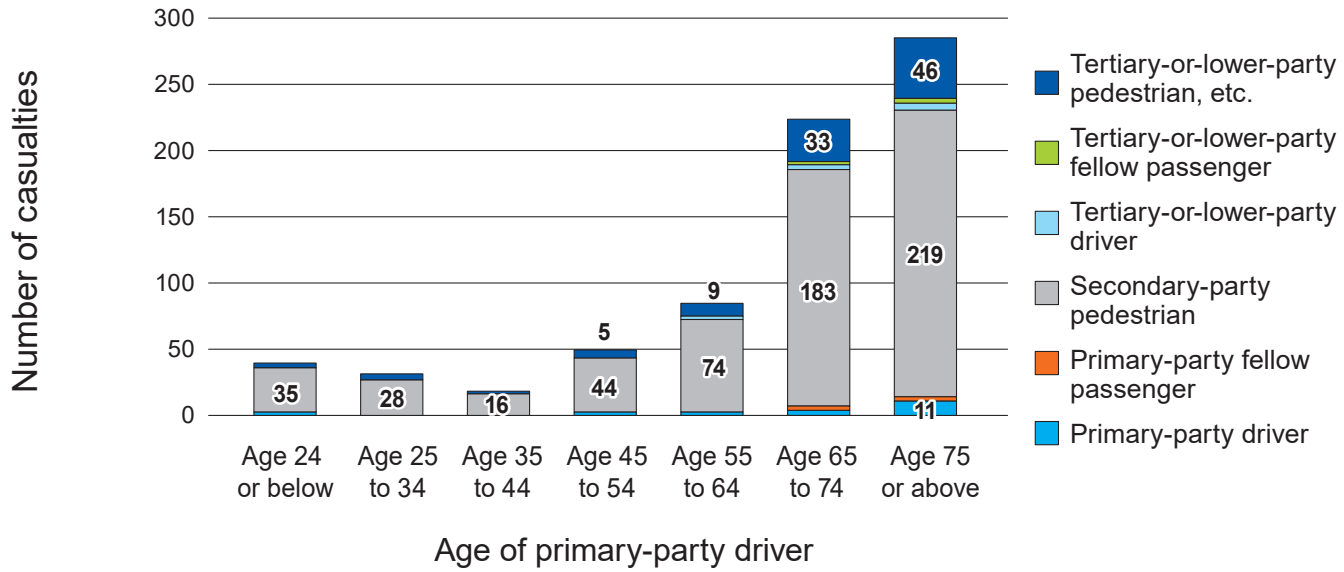


Figure 12-1. Injury-sustaining parties in pedal misapplication pedestrian-vehicle accidents

(Casualties in 2018 to 2020)

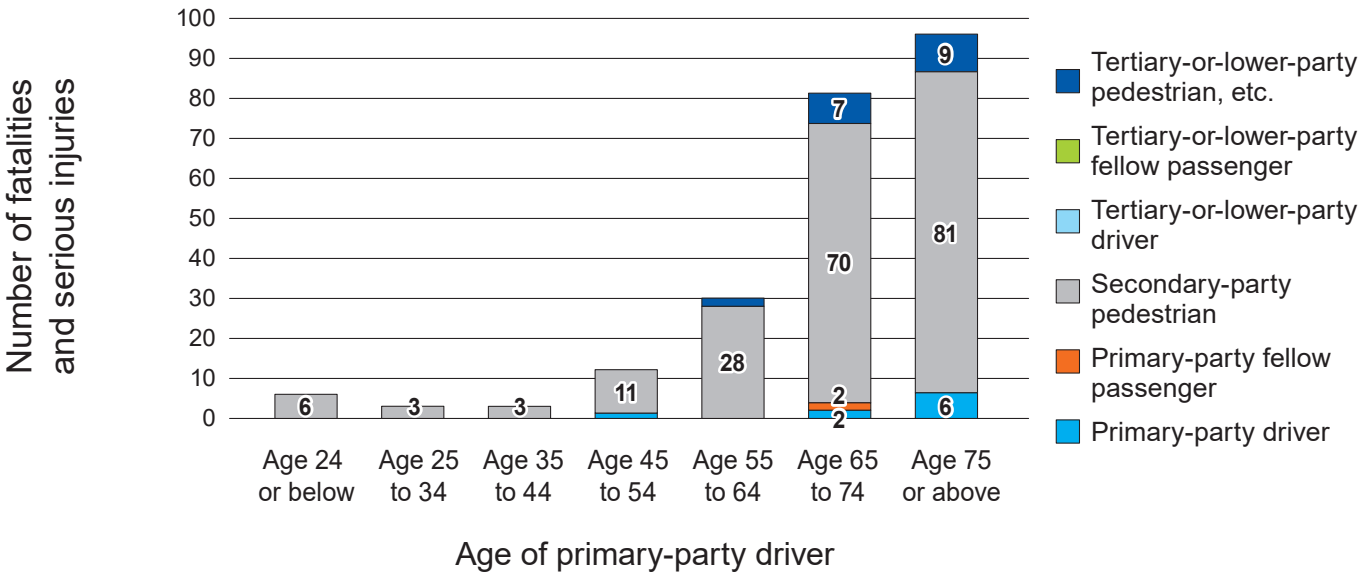


Figure 12-2. Injury-sustaining parties in pedal misapplication pedestrian-vehicle accidents

(Fatalities and serious injuries in 2018 to 2020)

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4 Conclusions

On this occasion, we carried out statistical analysis regarding brake and accelerator misapplication (pedal misapplication) using the latest accident data, and we thus shed light on the status of multiple collisions and some of the characteristics in this regard, such as the persons sustaining injuries. The insights that we gained are as follows.

■Insights gained

1. Nearly 10,000 casualty accidents caused by the operation error of “pedal misapplication” occurred during the three-year period of 2018 to 2020 (Table 1). While fatal and serious injury accidents were frequently caused by elderly drivers, among casualty accidents, vehicle-vehicle accidents were frequently caused by young drivers (Figures 1 and 2).

2. Multiple collisions: Among fatal and serious injury accidents caused by pedal misapplication, multiple collisions occurred in 37% of the accidents. This ratio is much higher than the ratio of 8% among all types of accidents (Figure 7). Furthermore, multiple collisions were frequent among elderly drivers (Figures 8 and 9).

3. Tertiary-or-lower parties: Since the ratio of multiple collisions is high among pedal-misapplication accidents, in all types of accidents, there are certain numbers of persons sustaining injuries who are of a tertiary-or-lower party, which is the receiver of a second-or-subsequent collision during an accident (Figures 10, 11, and 12).

The care that drivers should take to prevent pedal misapplication is covered in ITARDA Information No. 137 and so on, so please refer to these issues if you have an interest in this regard. As for the multiple collisions that we newly analyzed on this occasion, it seems that measures could be taken regarding the functions of vehicles for the avoidance of such accidents. These functions could include responding to initial collisions with braking operations and engine-output reductions in order to lessen damage during the secondary and subsequent collisions with pedestrians and so on. We have high hopes regarding the further evolution of vehicles in this regard.

(Kenji Kawaguchi)

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