2023
26th Presentation Session for Traffic Accident Investigations, Analysis, and Research

Insights for reducing injuries and accidents derived from the latest trends in bicycle accidents

Kenji Kawaguchi
Senior Researcher, Research Division

1. Introduction

For the first time, a target for reducing serious injuries was set forth in the 11th Basic Plan for Traffic Safety formulated in March 2021. The target set for serious injuries is 22,000 or less by 2025 which, when combined with the target for fatalities of 2,000 or less, results in a combined target of 24,000 or less for fatal and/or serious injuries. (Serious injury: An injury requiring 30 or more days of treatment.) In 2022, the total number of fatal and/or serious injuries amounted to 28,637 persons, of which 23.4% were riding bicycles (6,702), showing that the total percentage made up of bicycles is gradually increasing (see Fig. 1).

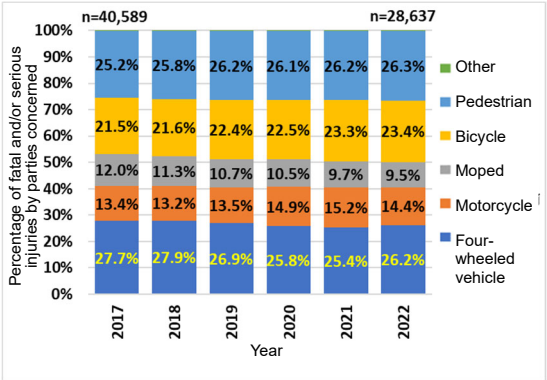

Fig. 1. Percentage of fatal and/or serious injuries by circumstance

Various changes have been seen in recent trends surrounding bicycle traffic, including an increase in the number of electric bicycles and sports bicycles that riders tend to ride at high speeds, as well as the popularization of rental bicycles, shared bicycles, and of food delivery services that utilize bicycles. In this paper, we will analyze the latest trends in bicycle accidents from the following perspectives, and search for insights aimed at reducing accidents involving bicycles.

- Overview and effects of wearing helmets[(1)]
- Accidents involving single bicycles
- Accidents involving pedestrians and bicycles
- Accidents involving bicycles and passenger cars

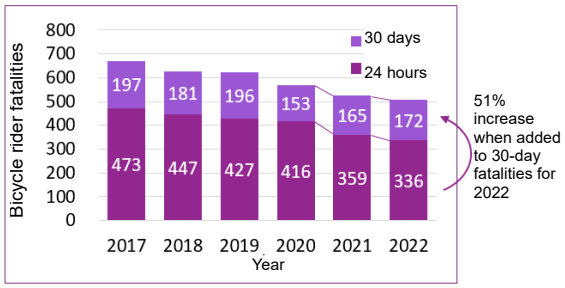

Fig. 2. Total number of fatalities in 24-hour and 30-day periods (primary & secondary parties)

2. Overview and effects of wearing helmets

2-1. Total number of fatalities and head injuries in 24-hour and 30-day periods

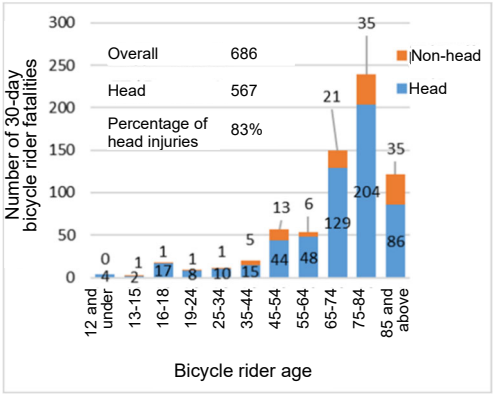

Fig 3. Most seriously injured part of the body in 30-day fatalities (Head/Non-head) (2019 to 2022, primary + secondary parties)

Looking at numbers bicycle rider fatalities, we can see that a significant number of persons survived the initial 24 hours following the accident, but died within 30 days, causing the number of 30-day fatalities to be relatively high (see Fig. 2). Although the number of 24-hour fatalities is decreasing, the number of 30-day fatalities has not decreased since 2020 and were equivalent to 51% of 24-hour fatalities in 2022 alone.

When looking at the most seriously injured part of the body in 30-day fatalities, head injuries accounted for 83% (see Fig. 3). Because head injuries accounted for 55% of 24-hour fatalities, we can also assume that the percentage of 30-day fatalities made up by head injuries is also high. We can presume that there are many cases in which the injured party hit their head and suffered serious enough injuries that they became unconscious and were unable to

be saved. This fact highlights the importance of head protection.

2-2. Effects of wearing helmets

When looking at fatality rate by helmet usage, it was observed that wearing a helmet reduced the likelihood of the head being the most seriously injured part of the body by 1/3, and also reduced the fatal and/or serious injury rate by 1/2 (see Fig. 4 and Fig. 5).

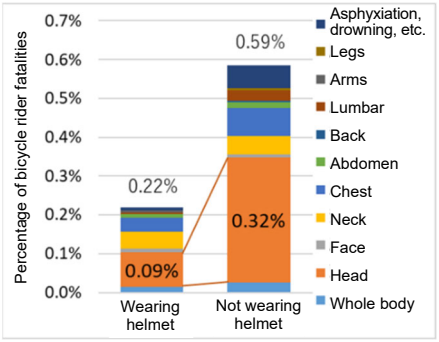

Fig 4. Fatality rate by helmet usage &
Most seriously injured part of the body
(2019 to 2022, primary + secondary parties)
Wearing helmet: Helmet worn correctly

3. Accidents involving single bicycles

3-1. Casualty accidents involving single bicycles

The number of rider casualties in single-bicycle accidents had been on a decreasing trend until 2016, but started to rise again from around 2017, and has been increasing rapidly in recent years (see Fig. 6). Such accidents have been increasing particularly in Tokyo, and this increase seems to be due to an increased use in the types of bicycles mentioned above.

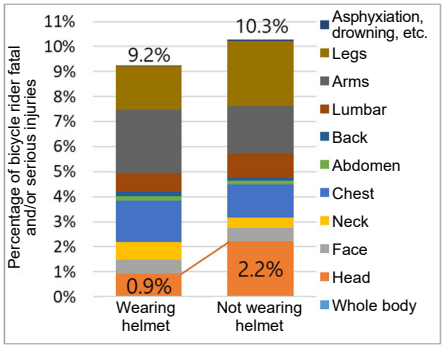

Fig 5. Fatal and/or serious injury rates by helmet usage &
Most seriously injured part of the body
(2019 to 2022, primary + secondary parties)

3-2. Fatal accidents involving single bicycles

When looking at percentages of single-bicycle accidents by detailed accident type, most serious and minor injuries were the result of accidents in which the rider or bike tipped over. However, 65%, or approximately 2/3rds, of fatalities were the result of accidents in which the bicycle fell from an elevated height (see Fig. 7).

Furthermore, when looking at the part of body that suffered the most serious injury in the event of a falling accident, suffocation and drowning accounted for 49% of fatalities, followed by injuries to the neck at 27% (see Fig. 8). This highlights the need for riders to be more careful of their forward direction when riding in areas where waterways such as irrigation ditches are common. The fatality rate in the event of a falling accident was 56%, or more than one in two riders, while the fatal and/or serious injury rate was also extremely high at 76% (see Fig. 9).

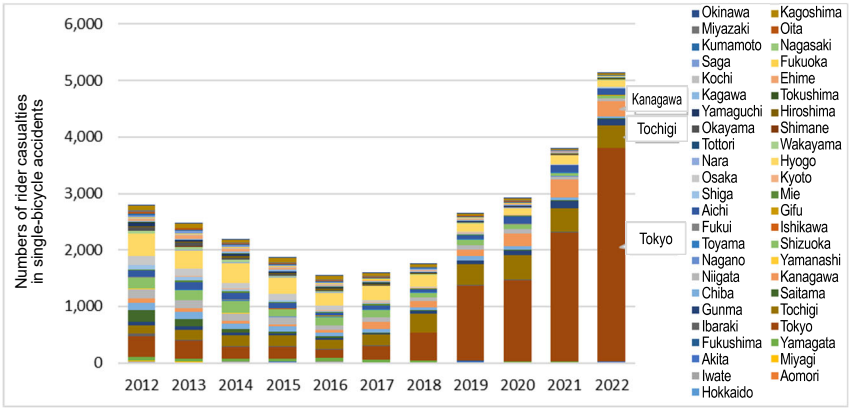

Fig. 6. Numbers of rider casualties in single-bicycle accidents

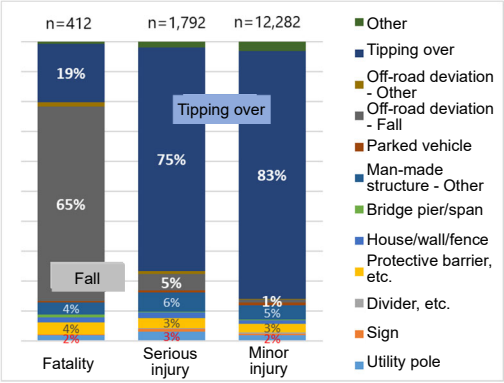

Fig. 7. Single-bicycle accidents by detailed accident type
(Bicycle riders, 2019 to 2022)

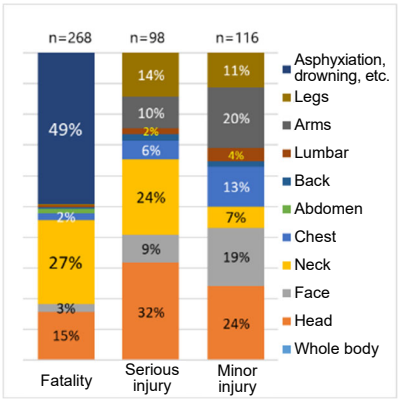

Fig. 8. Most seriously injured part of the body in single-bicycle falling accidents by percentage
(Bicycle riders, 2019 to 2022)

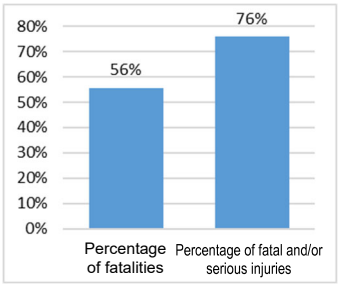

Fig 9. Fatality rate in falling accidents
Percentage of fatal and/or serious injury
(Bicycle riders, 2019 to 2022)

4. Accidents involving pedestrians and bicycles

4-1. Trends in recent years

From here on, we will look at accidents in which pedestrians were injured in collision accidents with bicycles. Figure 10 shows trends for numbers of pedestrian fatal and/or serious injuries. Although such accidents increased from 2016, they decreased in 2019 and have remained flat since then. Similarly, the number of pedestrian casualties decreased temporarily in 2020, but then started to increase again (see Fig. 11).

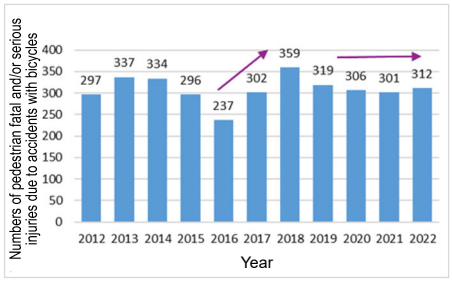

Fig. 10. Number of pedestrian fatal and/or serious injuries
(Bicycle-pedestrian accidents, primary + secondary parties)

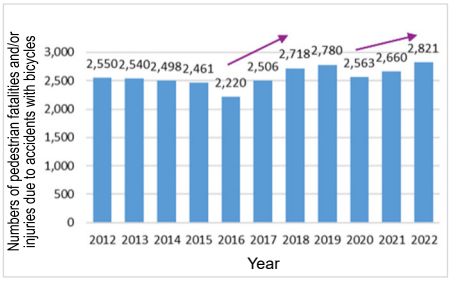

Fig. 11. Number of pedestrian casualties
(Bicycle-pedestrian accidents, primary + secondary parties)

Shown here are trends for Tokyo and Osaka, which account for a large proportion of pedestrian fatalities among prefectures in Japan (see Fig. 12). Since 2017, the number of pedestrians who suffered fatal and/or serious injuries has increased rapidly. Furthermore, the number of pedestrian casualties in Tokyo has started increasing since 2017, and tends to be similar to those for bicycles seen in Fig. 6 (see Fig. 13). Furthermore, the number of pedestrian casualties in Tokyo has

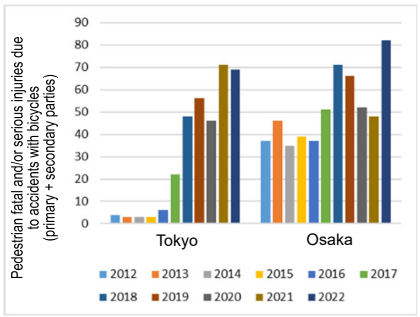

Fig. 12. Numbers of pedestrian fatal and/or serious injuries

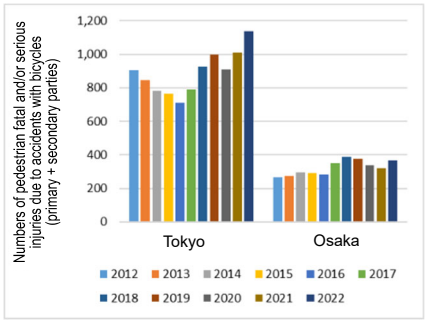

Fig. 13. Number of pedestrian casualties

Tokyo and Osaka (Bicycle-pedestrian accidents, primary + secondary parties)

started increasing since 2017, and tends to be similar to those for bicycles seen in Fig. 6 (see Fig. 13). In other words, if a cyclist rides at a high speed or drives without paying attention in the forward direction and collides with a structure, etc., it results in a "single-bicycle accident". Instead, if they collide with a pedestrian, it results in a "bicycle-pedestrian accident".

4-2. Characteristics of accidents

(1) Relationship with population density

Figure 14 shows the population density by prefecture and the number of pedestrian casualties per 100,000 people. While not a simple linear relationship, it is evident that the higher the population density, the greater the number of pedestrian casualties resulting from collisions with bicycles per 100,000 people. In cities with high population densities, it is necessary for riders to ride their bikes in a pedestrian-friendly manner.

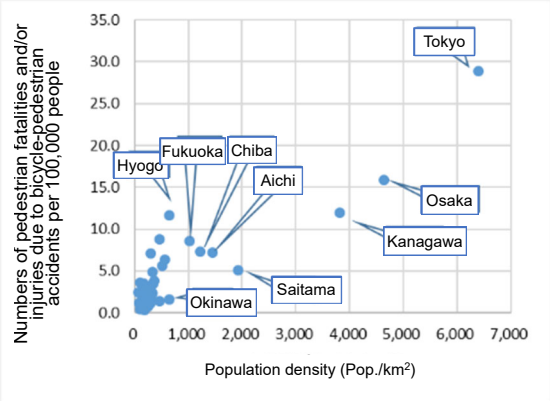

Fig. 14. Population density and numbers of pedestrian casualties due to bicycle-pedestrian accidents per 100,000 people
(2019 to 2022, primary + secondary parties)

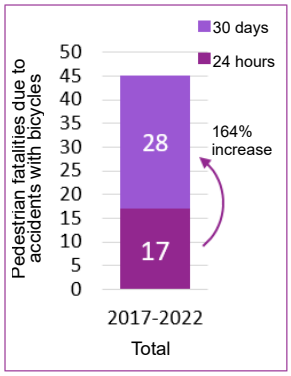

Fig. 15. Numbers of pedestrian fatalities due to bicycle-pedestrian accidents
(2017 to 2022, primary + secondary parties)

(2) Pedestrian fatalities

Figure 15 shows the number of pedestrians who died as a result of a collision with a bicycle. Although 24-hour fatalities over the six-year period from 2017 totaled 17 people, 30-day fatalities were high at 28 people, indicating that many people died after the initial 24-hour period following the accident.

5. Accidents involving bicycles and passenger cars

Finally, we will look at accidents between bicycles and passenger cars from the perspective of passenger cars in order to clarify whether newer passenger car models are involved in fewer accidents with bicycles. Conditions of the vehicle types selected here are as follows:

- Full Model Change Year (Mo.CY) 2011-2020 (Note that this is not equivalent to the first year in which the model was registered.)
- Vehicle types with both hybrid models (HEV) and non-hybrid (CE) models
- Vehicle types with 40,000 or more total registered vehicles over the four-year analysis period from 2019 to 2022

As a result of these conditions, 22 vehicle types were selected and analyzed, enabling a decreasing trend to be

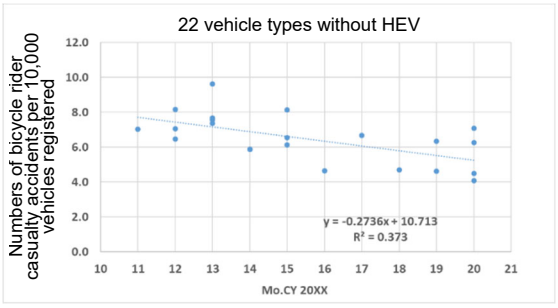

Fig. 16. Trends in numbers of casualty accidents involving bicycles per 10,000 vehicles owned by Mo.CY
(2019 to 2022, primary + secondary parties)

confirmed for newer vehicle types. (see Fig. 16). However, when comparing models of the same vehicle, it was observed that HEV models tended to be involved in more accidents with bicycles, regardless of Mo.CY (see Fig. 17). Furthermore, when comparing HEV models to CE models in terms of rates of accidents involving bicycles, HEV model rates exceeded those of CE models by 100% in the case of almost all 22 vehicle types (see Fig. 18). Because both HEV and CE models have the same vehicle body design, and therefore the same direct visibility and preventive safety systems, it can only be assumed that because the engines are different, that engine noise may be the cause for this. It is possible that further research and technological developments may bring levels of accidents between HEVs and bicycles down to those of CE.

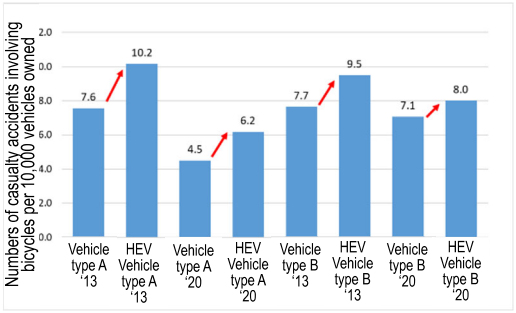

Fig. 17. Comparison of HEV and CE in terms of numbers of casualty accidents involving bicycles per 10,000 vehicles owned
(2019 to 2022, primary + secondary parties)

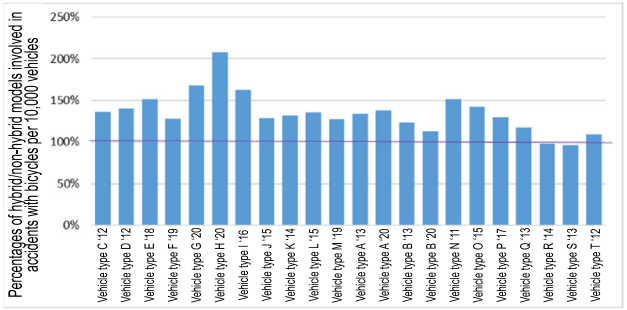

Fig. 18. Ratio of HEV to CE in terms of numbers of casualty accidents involving bicycles per 10,000 vehicles owned
(2019 to 2022, primary + secondary parties)

6. Summary

(1) Compared to other circumstances, the rate of bicycle rider fatalities over a 30-day period is high, with over 80% being due to head injuries. Wearing a helmet greatly reduces the chance of fatal and/or serious injuries due to head injury.

(2) Number of casualty accidents involving single bicycles is increasing rapidly, mainly in Tokyo. Falling accidents account for 2/3 of all fatal accidents involving single bicycles, with suffocation and drowning accounting for 49% of these deaths, while accidents in which the neck was most seriously injured part of the body also accounting for a large portion at 27%.

(3) Numbers of pedestrian fatal and/or serious injuries due to collisions with bicycles remains flat, while numbers of pedestrian casualties is on the rise. Particularly in cities with high population densities, it is necessary for riders to ride their bikes in a pedestrian-friendly manner.

(4) Although newer models of passenger cars tend to be involved in fewer accidents involving bicycles, hybrid models are involved have more such accidents than non-hybrid models, and there are expectations that future research can help reduce such accidents with bicycles.

<Source>

(1) 2022, ITARDA Information (No.144), “Head injuries and the effects of helmets in bicycle accidents”