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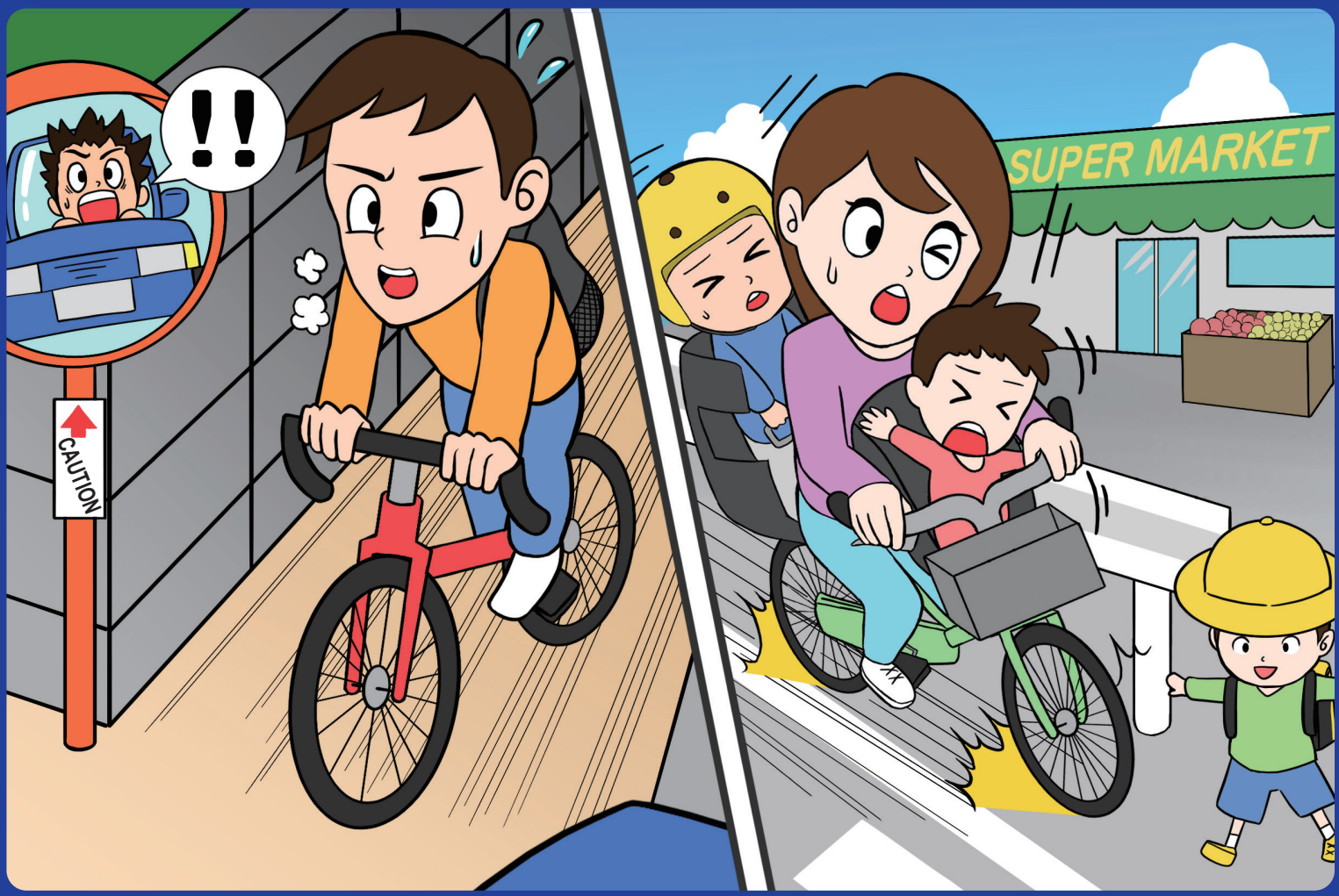
No.144

Special feature

Head injuries in bicycle accidents and the effect of wearing helmets



1 Introduction

Making efforts to wear a helmet for head protection has become mandatory for cyclists and their passengers from April 2023. While the decision to wear a helmet remains with the individual cyclist, this ITARDA Information provides accident data that emphasizes the reality of head injuries sustained during bicycle accidents, as well as the advantages of wearing a helmet in the hope that this information will be a helpful resource when deciding whether to wear a helmet while cycling.
The effect of wearing a helmet was discussed in ITARDA Information[1)] published a decade ago. This issue utilized the most recent bicycle accident statistics to provide new insights into the analysis, including data on the 30-day fatalities after 24 hours of accidents and the condition of bicycle passengers.
As a result, it was discovered that (1) the 30-day fatality rate for cyclists who died within 30 days after 24 hours of accidents was high, with head injuries being the most frequent cause, (2) the percentage of cyclists who wore helmets was 20% or more for those aged 15 or below, but it decreased significantly after age 16, particularly among females, and (3) the percentage of fatal or serious head injuries among cyclists under age 6 who wore helmets was substantially reduced to approximately one-tenth.
Let's examine the details below, along with any relevant information.

2 Bicycle accidents and the status of head injuries

■ Fatalities [24-hour fatalities] and [30-day fatalities] and Head injury ratio

Let's first examine the number of fatalities that occurred while riding a bicycle by age. The data presented is the sum of primary and secondary parties involved in the accidents. Figure 1-1 shows the number of "24-hour fatalities," referring to individuals who passed away within 24 hours after a traffic accident in the four years from 2019 to 2022. The number of cyclist fatalities increases significantly after age 45, with the majority being elderly. In total, 1,538 fatalities were recorded. Figure 1-2 illustrates whether the primary body site that sustained maximum damage was the head or another site. The head was the primary injury site in 842 people, accounting for 55% of the fatalities. Regarding the age category, the age range between 13-15 and 16-18 was divided to distinguish junior high school students from high school students.

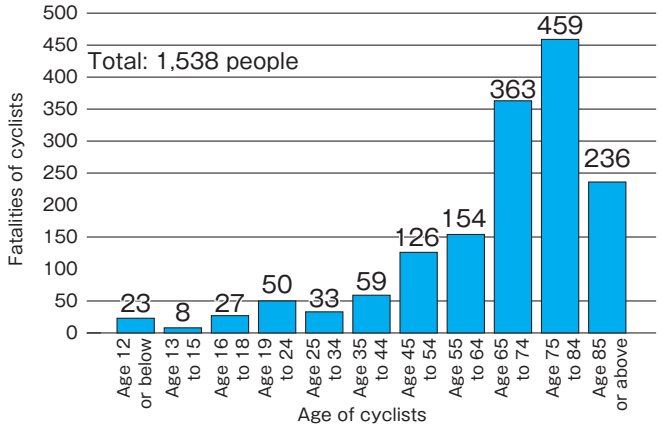


Figure 1-1. Fatalities of cyclists

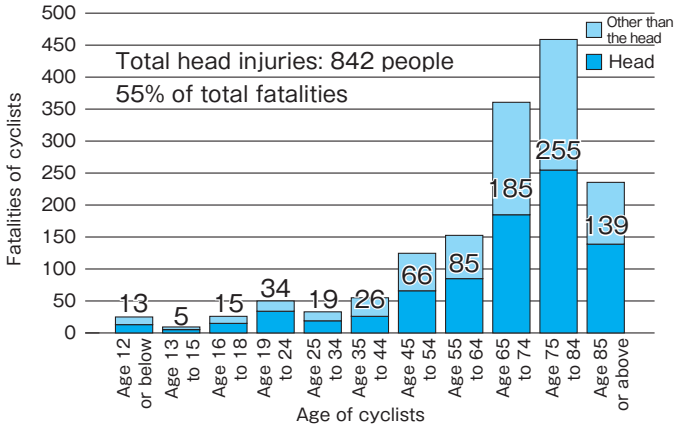


Figure 1-2. Primary injury site - Head/Other than the head

Figure 1. 24-hour fatalities of cyclists (2019 to 2022; primary + secondary parties)

Figure 1 only accounts for fatalities within 24 hours after an accident. However, there may be instances where individuals became severely ill and passed away two or three days after the accident. Figure 2 shows a graph with "30-day fatalities" added to the "24-hour fatalities" among cyclists. The orange section of the graph represents the 30-day fatalities, which includes those who died within 30 days following the initial 24-hour period. Over a period of four years, from 2019 to 2022, a total of 1,538 people died within 24 hours of an accident. However, there were also 686 fatalities within 30 days, accounting for 31% of the overall "within-30-day fatalities."

Is this more prevalent in comparison to other scenarios like driving or walking? According to Figure 3, the rate of 30-day fatalities for cyclists is significantly higher than in the other scenarios.

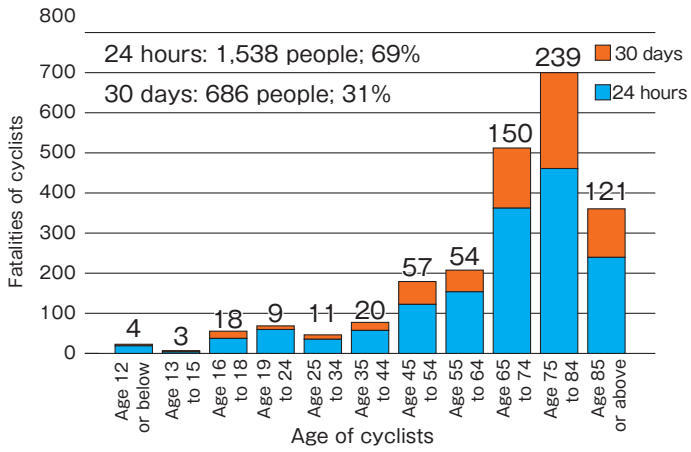


Figure 2. 24-hour fatalities and 30-day fatalities of cyclists
(2019 to 2022; primary + secondary parties)
(30-day fatalities refer to fatalities that occur within 30 days of the accident and exceed 24 hours.)

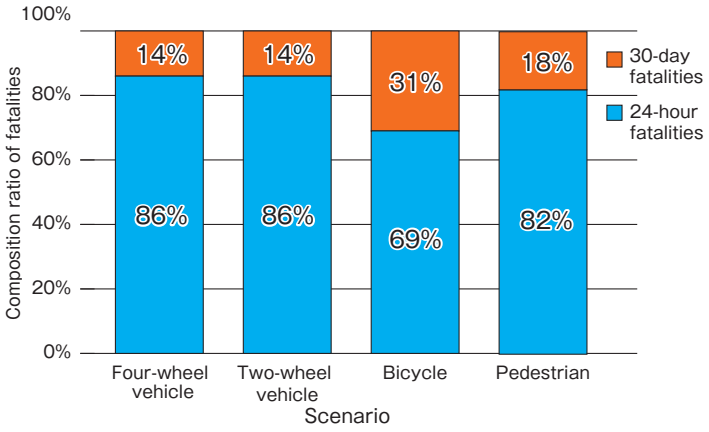


Figure 3. Ratio of 24-hour fatalities and 30-day fatalities for drivers and pedestrians by scenario
(2019 to 2022; primary + secondary parties)

Let's examine the 30-day fatalities based on age groups. Figure 4-1 indicates that many middle-aged and elderly individuals died, but it also reveals that some young people have also lost their lives. Figure 4-2 shows that 83% of the 30-day fatalities were due to head injuries, notably higher than the 55% rate for the 24-hour fatalities. This suggests that there may have been instances where people suffered head injuries and lost consciousness but were unable to recover thereafter. The figures so far are summarized in Table 1. Considering that a significant number of head injuries lead to deaths, let's take a closer look at the serious and slight injuries.

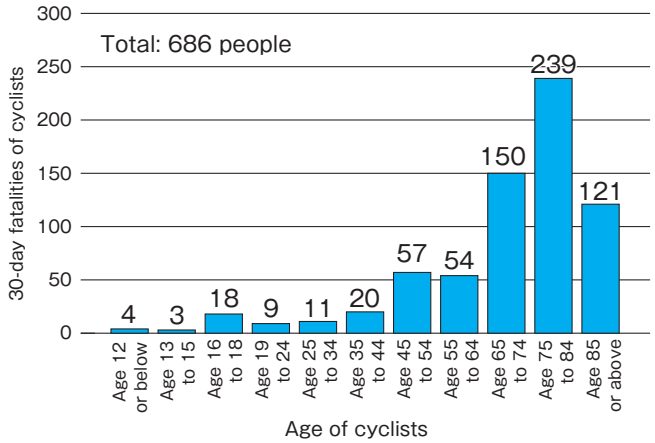


Figure 4-1. Fatalities of cyclists

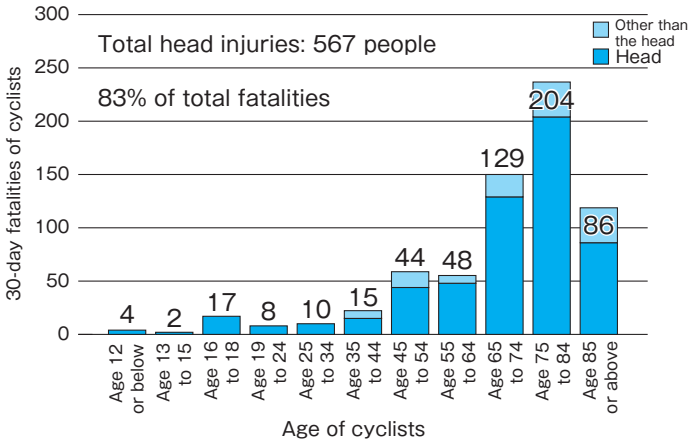


Figure 4-2. Primary injury site – Head/Othan than the head

Figure 4. 30-day fatalities of cyclists (2019 to 2022; primary + secondary parties)

Table 1. Primary injury site and head injury rates of cyclist fatalities
(2019 to 2022; Primary + Secondary parties)

		Head	Other than the head	Total	Rate of head injury
①	24 hours	842	696	1,538	55%
②	30 days	567	119	686	83%
③	Within 30 days (①+②)	1,409	815	2,224	63%

■ Serious injuries/Slight injuries

The graph in Figure 5 shows the occurrence of serious injuries among cyclists. The data reveals that many young people, in addition to the elderly, sustained serious injuries compared to the data on fatalities presented in Figure 1. Moreover, there is a noticeable peak in the number of high school students aged 16-18. A total of 26,677 individuals of all ages have suffered serious injuries.

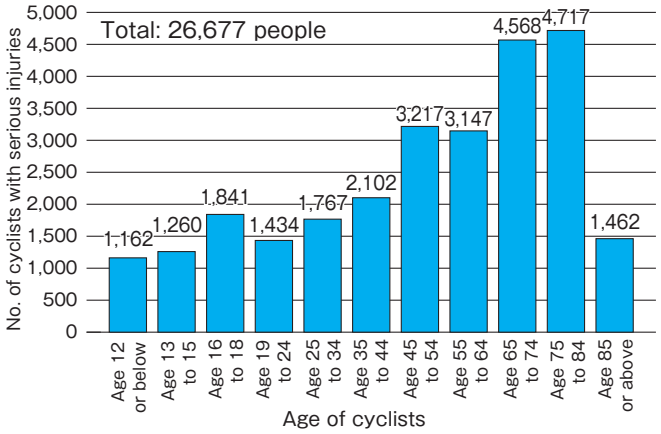


Figure 5. Cyclists with serious injuries
(2019 to 2022; primary + secondary parties)

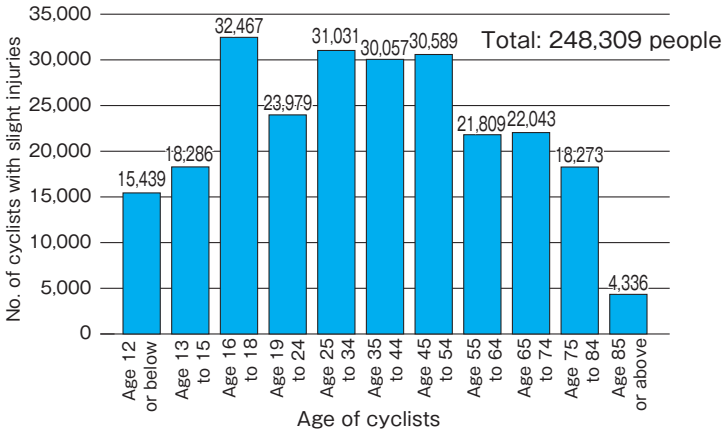


Figure 6. Cyclists with slight injuries
(2019 to 2022; primary + secondary parties)

Let's take a closer look at the slight injuries of cyclists, shown in the graph of Figure 6. It is important to note that many high school students aged 16-18 experienced slight injuries, despite a 3-year age range. The total number of reported casualties for all ages was 248,309. Even though the injuries were minor, this is the number of casualties reported to the police, including accidents requiring three or four weeks to recover fully.
What is the incidence of head injuries among those who suffered serious or slight injuries?
Figure 7 illustrates cases where the head was the primary injury site among those seriously injured. According to accident statistics in Japan, seriously injured include those who require 30 days of treatment and those who died after 24 hours. In total, 4,977 individuals suffered serious head injuries, which accounted for approximately 19% of all serious injuries. Examples of serious head injuries include fractures, brain contusions, and cerebral damage. Although the person's life may be saved, they may experience long-term effects such as consciousness disturbance and higher brain dysfunction.

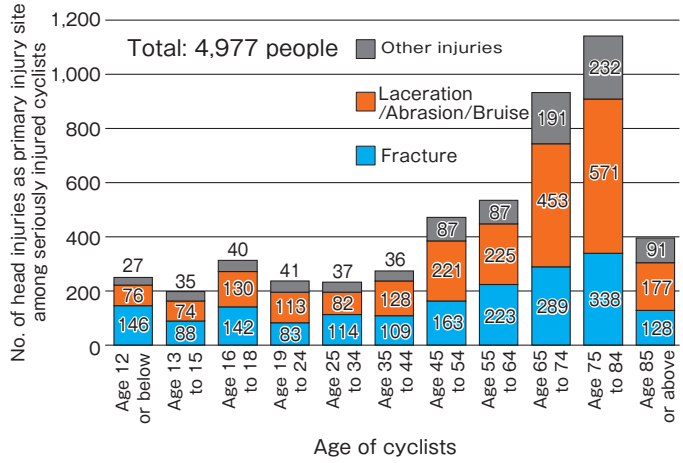


Figure 7. Serious injuries of cyclists – Injury state when the head is the primary injury site
(2019 to 2022; primary + secondary parties)

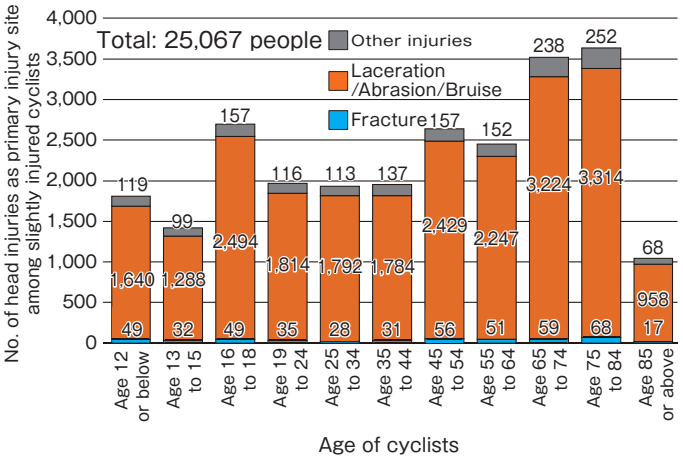


Figure 8. Slight injuries of cyclists – Injury state when the head is the primary injury site
(2019 to 2022; primary + secondary parties)

Figure 8 shows the case where the head is the primary injury site among slightly injured cyclists. A total of 25,067 people have suffered head injuries, from children to the elderly. It is important to note that although there is slight injury, the data for head fracture is also included. Incidentally, the head was the primary site of injury among the cyclists who sustained slight injuries, accounting for 25,067 of the total 248,309 people, or about 10%.

3 Analysis related to helmet use

Thus far, our focus has been on examining bicycle accidents and head injuries, regardless of whether the individual was wearing a helmet. Now, we will shift our attention to the analysis findings specifically related to helmets.

■ Helmet use rate of cyclists during casualties

First, let's examine the helmet use rate of cyclists during accidents.
Figure 9 shows the helmet use rate of cyclists at the time of casualties by gender and age group. In 2008, it became mandatory for children aged 12 or below to wear helmets, resulting in a higher helmet use rate of 27% for boys and 25% for girls in this age group. However, this is still only about a quarter of the total. Comparatively, the helmet use rate for cyclists aged 13-15, who are not required to wear helmets, is similar to that of children aged 12 or below. This could be attributed to junior high schools mandating students to wear helmets when commuting to school. Conversely, the helmet use rate significantly declines after age 16. Additionally, the rate of women aged 19 or above who wear helmets is only 2-3%, substantially lower than men. This could be due to "not wanting to mess up their hair" or "thinking a helmet is unnecessary because they ride safely without speeding." Furthermore, it is assumed that the high helmet use rate among men is influenced by those who ride sport-type bicycles as a hobby.

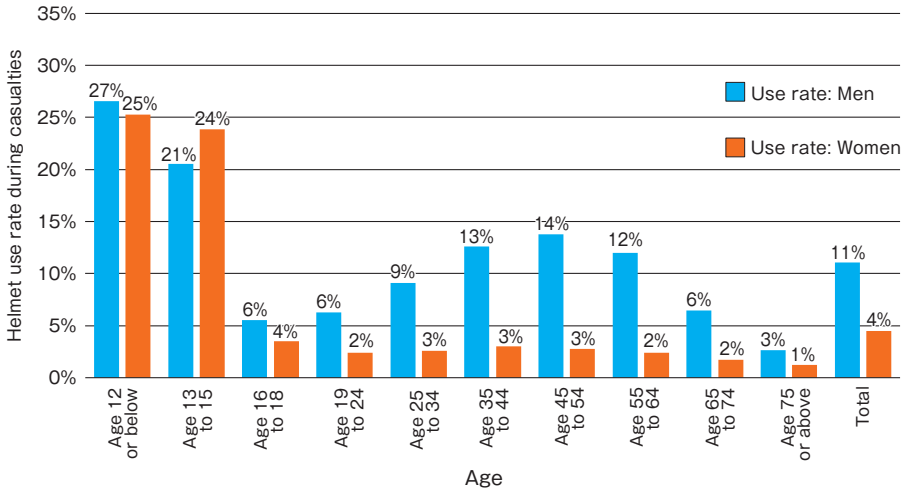


Figure 9. Helmet use rate of cyclists during casualties
(2019 to 2022; primary + secondary parties)

■ Effects of wearing helmets and summary

Next, let's examine how wearing helmets affects cycling safety. The following graphs distinguish between two categories: "Helmet worn," referring to cases where the cyclist was wearing a helmet and it remained intact during the accident, and "Helmet not worn," which includes situations where the cyclist was either not wearing a helmet or was wearing one that came off during the accident.

Figure 10-1 shows the fatality ratio, calculated by dividing the number of fatalities by the total number of casualties. The fatality ratio of "Helmet worn" is 0.22%, and that of "Helmet not worn" is 0.59%, which is about 2.7 times higher. This graph also displays the primary injury sites of the deceased, revealing that head injuries are less common when wearing a helmet. Specifically, if there are 100 casualties, the number of people who died due to the head being the primary injury site is 0.09 for “Helmet worn” and 0.32 for “Helmet not worn.”
Figure 10-2 compares the fatality or serious injury ratios similarly. Wearing a helmet reduces the likelihood of the head being the primary injury site by half, from 2.2% to 0.9%. This means that the probability of the head being the primary site of injury, whether fatal or fatal/serious, is significantly reduced by wearing a helmet.

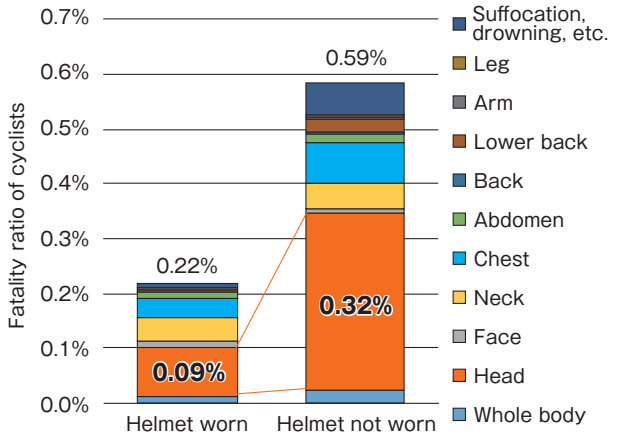


Figure 10-1. Fatality ratio

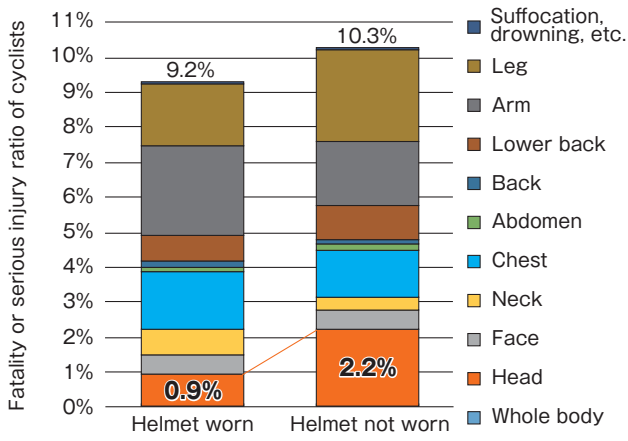


Figure 10-2. Fatality or serious injury ratio

Figure 10. Cyclists (2019 to 2022; primary + secondary parties)

■ Effect of a helmet in a collision accident with a passenger car

Let's next focus on specific accident conditions. Here, the most common type of collision involving light or standard passenger cars, which account for over 60% of casualty or fatal/serious injury bicycle accidents, is analyzed. It is often debated whether the car body or the road surface causes the injury, and thus the data are presented separately for each. Figure 11 shows the fatality or serious injury ratios when a bicycle collides with a light or standard passenger car. Wearing a helmet proved effective as it reduced head injuries by half, from 2.0% to 0.9% when the car body caused the damage, and lowered it by about a quarter, from 1.9% to 0.5% when the road surface was the cause.

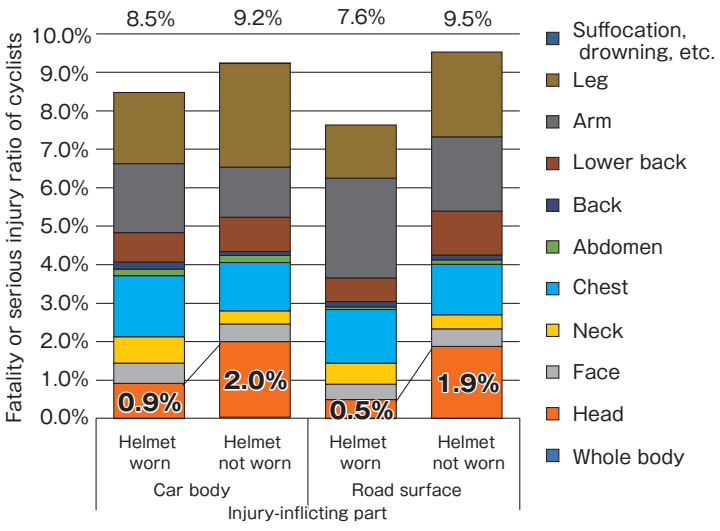


Figure 11. Fatality or serious injury ratio of cyclists during collisions with light and passenger cars
(2019 to 2022; primary + secondary parties)

4 Bicycle passengers

After examining cyclists, we will now shift our focus to bicycle passengers. Table 2 displays the driver and passenger's age during the accident resulting in the passenger's death or injury. The table shows that many accidents involved combinations of drivers aged 25-34 and 35-44 with passengers aged 3 or below and 4-6.

Table 2. Age of the drivers and passengers in bicycle passenger casualties

(2019 to 2022; Primary + Secondary parties)

Age of drivers	Age of passengers: Age 3 or below	Age 4-6	Age 7-12	Age 13-18	Age 19-24	Age 25-64	Age 65 or above	Total
Age 12 or below	3	5	22	1	0	0	0	31
Age 13-18	7	5	15	74	0	0	0	101
Age 19-24	96	26	2	1	21	2	0	148
Age 25-34	690	470	58	0	3	13	0	1,234
Age 35-44	535	728	178	1	1	5	0	1,448
Age 45-54	29	111	58	1	0	6	1	206
Age 55-64	9	15	6	1	0	6	0	37
Age 65 or above	6	7	4	0	0	0	2	19
Total	1,375	1,367	343	79	25	32	3	3,224

Moving forward, we will focus on passengers aged 6 or below, comparable to preschool-aged kids who are legally permitted to ride bicycles as passengers. Figure 12 shows the primary injury sites for passengers who wore helmets and those who did not. Figure 12-1 provides information on the number of fatalities or serious injuries, while Figure 12-2 shows the number of casualties. Only one instance was recorded where a passenger wearing a helmet sustained a fatal or serious head injury. Next, let's calculate the rate of fatalities or serious injuries.

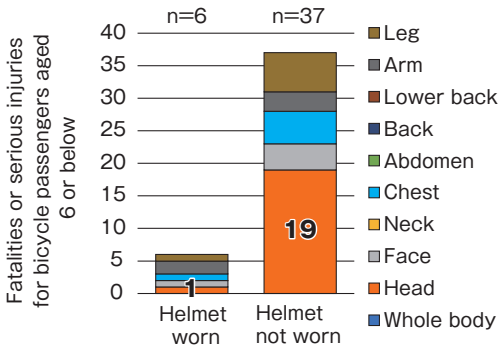


Figure 12-1. Number of fatalities or serious injuries

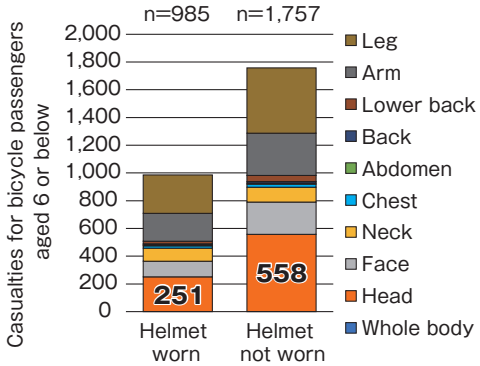


Figure 12-2. Number of casualties

Figure 12. Bicycle passengers- Helmet worn/Helmet not worn

(2019 to 2022; primary + secondary parties)

Like Figure 10, Figure 13 calculates the fatality and serious injury ratio for passengers aged 6 or below. When wearing a helmet, the likelihood of sustaining a fatal or serious head injury is only 0.1%, significantly lower than the 1.1% chance for those who do not wear a helmet.

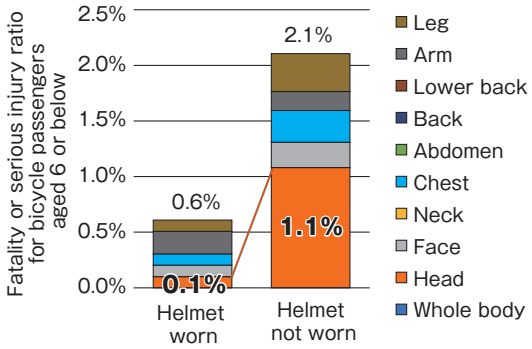


Figure 13. Fatality or serious injury ratio for bicycle passengers aged 6 or below

(2019 to 2022; Primary + Secondary parties)

Just a quick note, if the numerical values from Figure 12-2 are used to calculate the helmet use rate when a passenger suffers a fatal or serious injury, it comes out to be 985/(985+1,757) = 36%. This is significantly higher than the cyclist use rate in Figure 9, but there is still room for improvement. It's important to remember that wearing a helmet cannot wholly prevent head injuries, so it's crucial to avoid accidents and take steps to prevent them from happening in the first place.

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5 Conclusion - Insights gained and Observations

■ Insights gained

In this issue, we introduced the accident data analysis results regarding the status of head injuries in bicycle accidents and the effects of helmets. Specific insights are as follows.

[Cyclists]

1. The number of cyclist fatalities increases from around the age of 45, with many of these fatalities occurring among elderly people (Figure 1). Meanwhile, high school students and other young people are also at risk of sustaining serious or slight injuries (Figures 5 and 6).
2. The 24-hour fatalities in the four years from 2019 to 2022 were 1,538 people. The number of “30-day fatalities” who died after 24 hours and within 30 days of the accident was 686 people (Figure 2), which accounts for 31% of all "fatalities within 30 days" combined. This percentage is higher than the fatalities that occurred while driving or walking (Figure 3).
3. Whereas the rate of head being the primary injury site was 55% among 24-hour fatalities (Figure 1-2), it was higher at 83% among 30-day fatalities (Figure 4-2, Table 1).
4. The helmet use rate of cyclists in casualty accidents is more than 20% up to age 15, but it drops sharply after age 16. Additionally, women aged 19 or above have a very low helmet use rate of only 2-3% (Figure 9).
5. Wearing a helmet can significantly reduce the risk of a head injury as the primary injury site (Figures 10 and 11). The fatality ratio dropped from 0.32% to 0.09%, less than one-third, and the fatality or serious injury ratio decreased from 0.2% to 0.09%, less than half.

[Bicycle passenger]

6. Wearing a helmet greatly reduces the likelihood of sustaining a head injury, even for bicycle passengers aged 6 or below. Furthermore, the fatality or serious injury ratio decreased from 1.1% to 0.1%, a ten-fold decrease (Figure 13).

■ Observations

Safety awareness activities for bicycles are typically aimed at children and seniors, but it's important to extend these efforts to include adults, particularly high school students, who are also prone to accidents. It's crucial that everyone, including young people, takes steps to avoid life-threatening bicycle accidents and permanent disabilities. Parents or guardians should also take precautions to minimize risks when allowing young children to ride bicycles as passengers.

Remember, even with helmets, it's essential to avoid unsafe speeds and prioritize safe driving to prevent accidents. On top of that, wearing a helmet can significantly reduce the risk of head injuries in the unlikely event of an accident. We encourage you to consider wearing helmets while cycling, based on the actual accident data provided in this issue of ITARDA information.

With everyone's cooperation, we can create a safe and secure road traffic society that includes bicycles.

Kenji Kawaguchi

Reference

1) “Wear a helmet to reduce injuries from cycling accidents,” ITARDA Information No. 97, 2012

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