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Special feature

Characteristics of bicycle accidents on neighborhood roads

– Let's explore the prominent crossing collision accidents –

1 Introduction

Roads in urban residential areas are the "neighborhood roads" that we use in our daily lives. On such roads, traffic safety measures are implemented within designated zones, and speed humps, narrow sections, and chicanes (see the "Column" on p. 12) are installed individually to encourage safe driving behavior by motor vehicle drivers, thereby helping to ensure the safe passage of pedestrians.
On the other hand, bicycles are vehicles that travel at a certain speed, and bicycle users do not necessarily hold a driver's license. Therefore, appropriate responses may not always be taken in various traffic situations on "neighborhood roads," and the actions of bicycle users themselves may become a cause of accidents.
This article aims to analyze the characteristics of bicycle accidents on "neighborhood roads" and identify the "inappropriate responses" of bicycle users and others in such circumstances. We hope that readers will use this article as a resource when considering how bicycle users and other parties involved should act to prevent bicycle accidents on "neighborhood roads" and to mitigate injuries when accidents occur.

2 Bicycle accidents on neighborhood roads

2.1 Challenges on neighborhood roads

Roads in urban residential areas, located close to our homes and generally not very wide, are the "neighborhood roads" that we use in our daily lives. On such roads, traffic safety measures are implemented within designated zones, such as Zone 30[1)] and Zone 30 Plus[2)], and there are also cases where humps and similar structures are installed individually.
In Zone 30 and similar zones, one of the rules is that traffic safety measures are to be implemented within areas bounded by roads with two or more lanes, rivers, railways, and the like[3)]. This is considered to be because drivers traveling on roads with two or more lanes outside the zone are expected to recognize that they have entered a single-lane road within the zone and to take safe driving actions, such as reducing their speed, within the zone. Similarly, on roads where humps and other structures are installed individually, drivers themselves are likewise expected to take safe driving actions.
Even in locations where Zone 30 measures have not been implemented and where humps and similar structures have not been installed, drivers holding a driver's license are expected to drive safely in accordance with the road design. This is expected to enable pedestrians, who are at risk of being involved in accidents, to travel safely. Here, "road design" is defined as the "road traffic environment," which includes not only the road geometry and the arrangement of facilities, but also traffic regulations, traffic conditions, and even the roadside environment, such as residential areas.
On the other hand, bicycles are vehicles that travel at a certain speed, and bicycle users, including children, students, and older people, do not necessarily hold a driver's license. Therefore, appropriate responses are not always taken in various traffic situations on "neighborhood roads." For example, bicycle users may proceed straight through a non-signalized intersection without sufficient safety confirmation, and their actions may become a cause of accidents.
In the following sections, we analyze the characteristics of bicycle accidents on "neighborhood roads" and organize the issues associated with bicycle users.

As noted at the beginning of this article, "neighborhood roads" refer to roads in urban residential areas. Accordingly, in the following analysis using accident statistics, "neighborhood roads" are defined as roads meeting all of the following conditions.

• They are not major arterial roads, such as expressways, national highways, or prefectural roads.
• They are not agricultural roads, forest roads, or other roads of a similar nature.
• They are located in urban areas.
• They are single-lane roads with a narrow road width (less than 5.5 m).

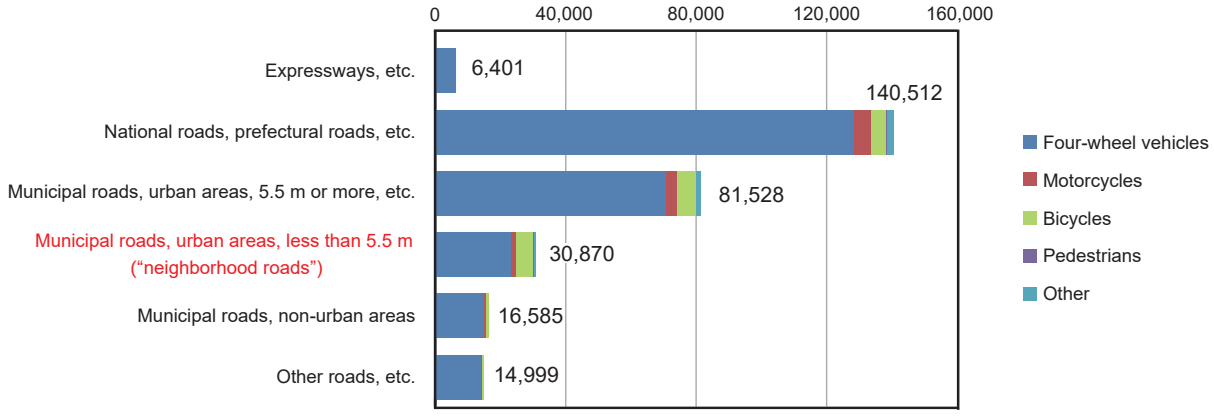
Strictly speaking, the first two conditions mean that the roads in question are “municipal roads,” excluding those designated as major arterial roads. However, for simplicity of presentation, “neighborhood roads” will hereinafter be indicated as “municipal roads in urban areas with a road width of less than 5.5 m.”

2.2 Bicycle accidents on neighborhood roads

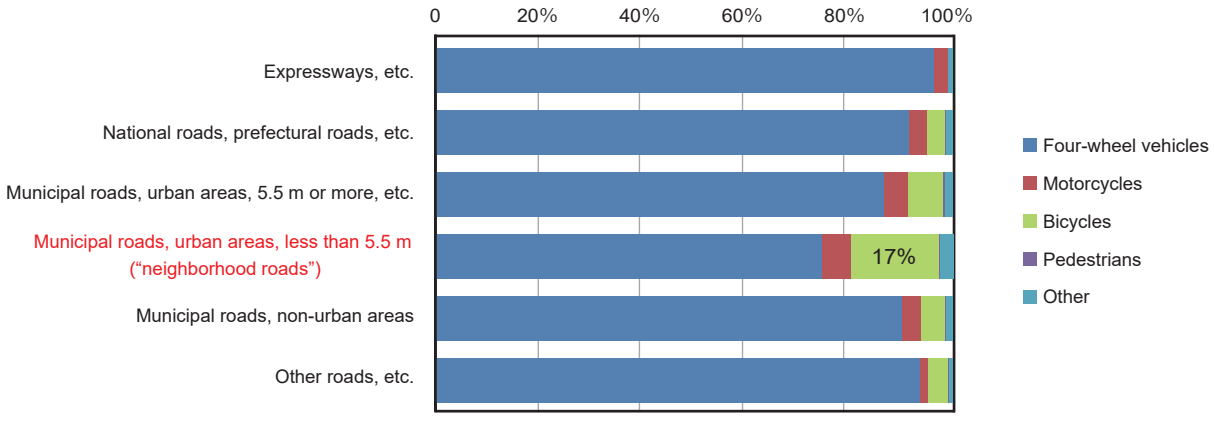
We will examine the occurrence of bicycle accidents by defining “road classifications” based on road type, urban/non-urban area, and road width. As shown in Figures 1 and 2, there are six road classifications, among which “municipal roads in urban areas with a road width of less than 5.5 m” correspond to “neighborhood roads.”

Figure 1(a) shows the number of accidents by road classification. Accidents on “neighborhood roads” are the third most frequent, and a considerable number of cases involve the bicycle as the primary party (the party initially involved in the accident who is more at fault). Looking at the proportion of accidents by primary party in Figure 1(b), accidents in which the bicycle is the primary party account for 17% on “neighborhood roads,” which is a larger proportion compared to other road classifications.

Figure 2(a) shows “bicycle-related accidents,” defined as accidents in which the bicycle is either the primary party or the secondary party (the other party to the primary party in the accident), by road classification. Compared to all accidents in Figure 2(b), the high proportion of bicycle accidents on “neighborhood roads” is particularly prominent. These results indicate that bicycle accidents on “neighborhood roads” are a significant issue that cannot be overlooked, and that it is important for bicycle users to take appropriate measures to help prevent accidents.

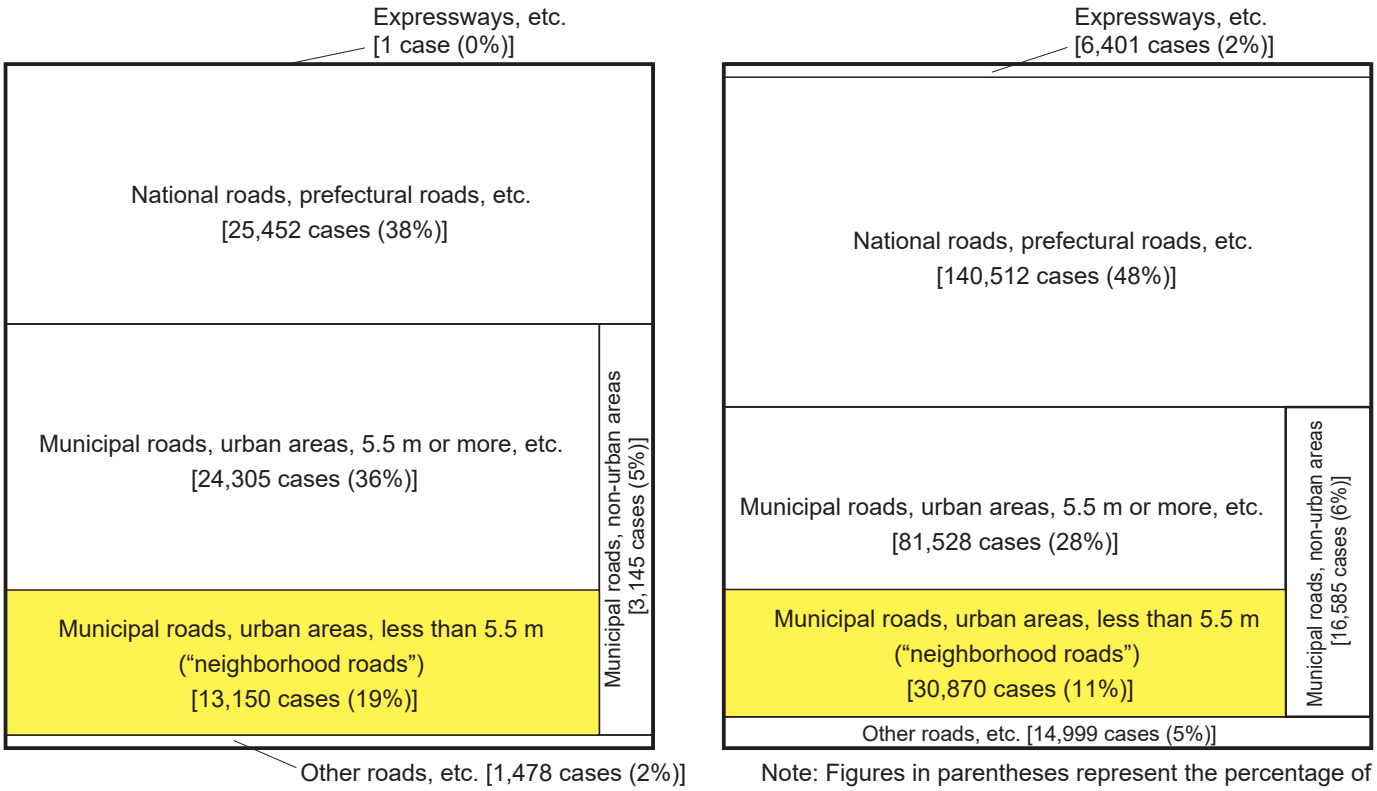


(a) Number of accidents



(b) Percentage of accidents

Figure 1. Number and percentage of accidents by road classification and primary party involved (2024)



Note: Figures in parentheses represent the percentage of the total number of bicycle-related accidents.

(a) Bicycle-related accidents (Total: 67,531 cases)

Note: Figures in parentheses represent the percentage of the total number of accidents.

(b) Total accidents (Total: 290,895 cases)

Figure 2: Number and percentage of accidents by road classification (2024)

Let us now focus on bicycle accidents on "neighborhood roads."

Table 1 summarizes the number of bicycle accidents on "neighborhood roads." In the figures and tables that follow, results based on data from the five-year period from 2020 to 2024 are presented, and the discussion is developed based on those results. In fact, the number of accidents has not changed significantly during these five years. However, this may also indicate that bicycle accidents on "neighborhood roads" are a deeply rooted problem, and we hope readers will bear this point in mind.

According to Table 1, the number of accidents on "neighborhood roads" exceeds 30,000 each year and accounts for approximately 10% of all accidents. The table also shows the following characteristics of bicycle accidents on "neighborhood roads":

- Accidents in which a bicycle is the primary party number approximately 4,000 to 5,000 per year and account for about 15% of accidents on "neighborhood roads."
- Accidents in which a bicycle is the secondary party number just under 10,000 per year and account for about 30% of accidents on "neighborhood roads."
- Accidents in which a four-wheel vehicle or motorcycle is the primary party and a bicycle is the secondary party number approximately 8,000 per year and account for about 25% of accidents on "neighborhood roads."

In accidents in which the bicycle is the secondary party, the actual circumstances of the accidents are easier to understand when the analysis is limited to cases in which a four-wheel vehicle or motorcycle is the primary party. Accordingly, this category is shown as "e." in Table 1.

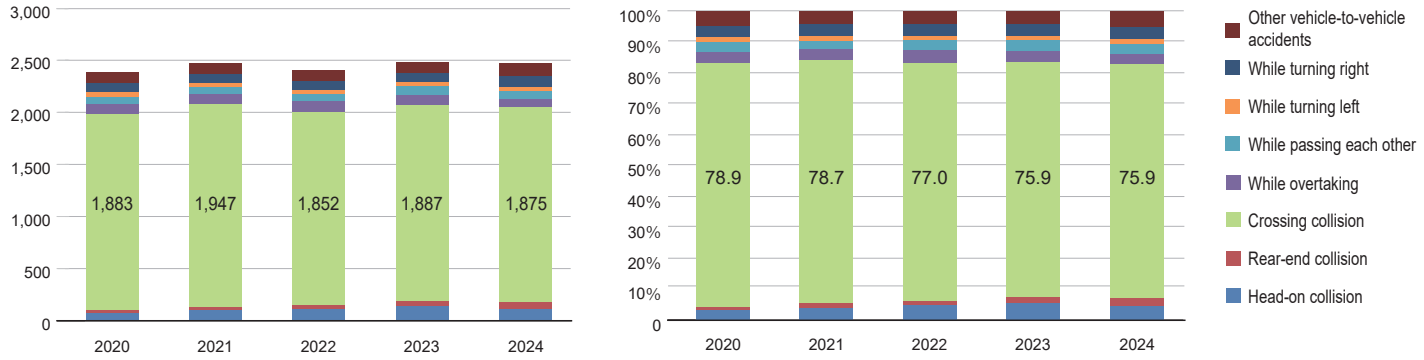
Table 1. Number of bicycle accidents on “neighborhood roads”

		2020	2021	2022	2023	2024
a.	Total number of accidents	309,178	305,196	300,839	307,930	290,895
b.	Number of accidents on “neighborhood roads”	31,357	32,114	31,116	32,432	30,870
	(Percentage)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
c.	Of b., accidents in which the bicycle was the primary party	3,797	4,193	4,858	5,177	5,172
	(Percentage)	(12.1)	(13.1)	(15.6)	(16.0)	(16.8)
d.	Of b., accidents in which the bicycle was the secondary party	9,305	9,777	9,139	9,510	8,927
	(Percentage)	(29.7)	(30.4)	(29.4)	(29.3)	(28.9)
e.	Of d., accidents in which a four-wheel vehicle or motorcycle was the primary party	8,167	8,522	7,877	8,243	7,676
	(Percentage)	(26.0)	(26.5)	(25.3)	(25.4)	(24.9)

Note: Percentages in parentheses are relative to “b. Number of accidents on ‘neighborhood roads.’”

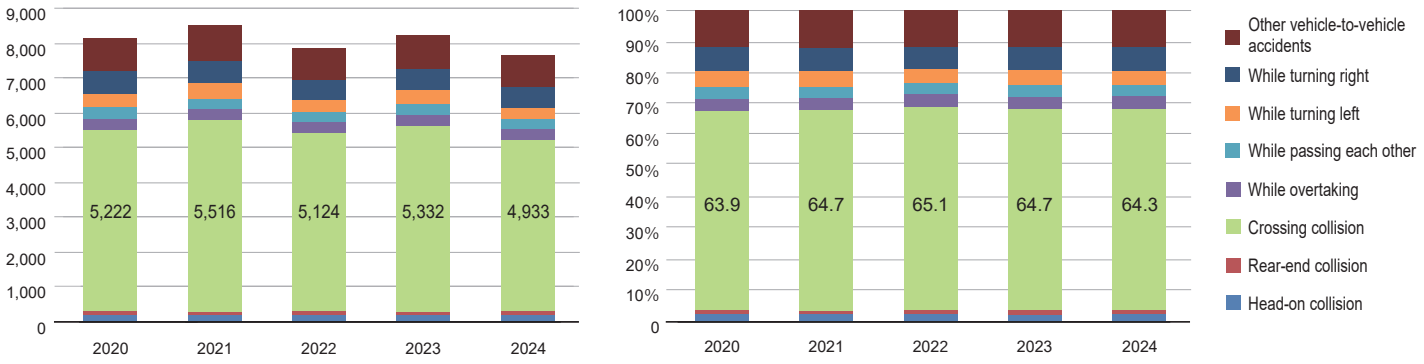
Let us now focus on the types of bicycle accidents on “neighborhood roads.” Types of accidents are broadly classified into pedestrian-vehicle accidents, vehicle-to-vehicle accidents, and vehicle alone accidents. Here, we focus on vehicle-to-vehicle accidents, which account for the largest proportion of bicycle accidents on “neighborhood roads.”

Figure 3 shows the number and percentage of vehicle-to-vehicle accidents in which the bicycle was the primary party, while Figure 4 shows the number and percentage of vehicle-to-vehicle accidents in which a four-wheel vehicle or motorcycle was the primary party and the bicycle was the secondary party. Figure 3 shows that crossing collision accidents account for nearly 80% of such accidents, while Figure 4 shows that crossing collision accidents account for nearly 65%, indicating that they are markedly more common than other types of accidents.



(a) Number of accidents **(b) Percentage of accidents**

Figure 3. Type of accident in vehicle-to-vehicle accidents with the bicycle as the primary party



(a) Number of accidents **(b) Percentage of accidents**

Figure 4. Type of accident in vehicle-to-vehicle accidents with a four-wheel vehicle or motorcycle as the primary party and the bicycle as the secondary party

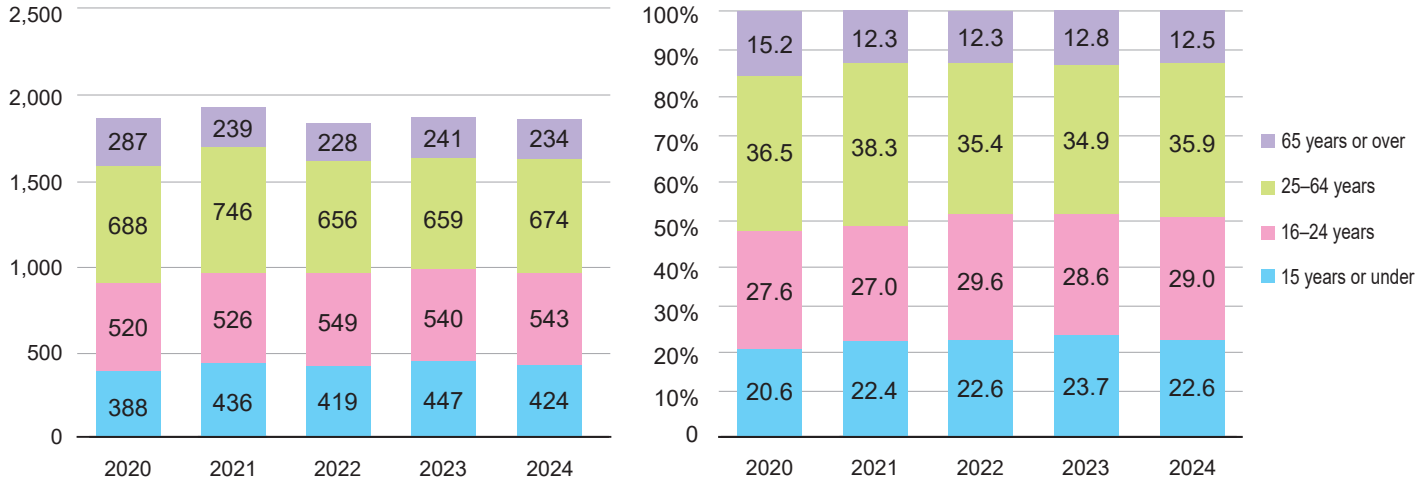
3 Characteristics of crossing collision accidents

3.1 Cases where the bicycle is the primary party

The following are the characteristics of crossing collision accidents in which the bicycle is the primary party.

○ Age group of cyclists (primary party)

According to Figure 5, among cyclists (primary party), those aged 15 years or under account for slightly more than 20%, while those aged 16 to 24 years account for slightly less than 30%. Together, these two age groups account for approximately 50%. Although not shown in the figure, in crossing collision accidents in which the bicycle is the secondary party, those aged 15 years or under account for slightly less than 20%, while those aged 16 to 24 years account for slightly more than 20%, together accounting for approximately 40%. The high proportion of young people involved in accidents as primary parties suggests the need for appropriate traffic safety education and awareness activities targeted at young people.

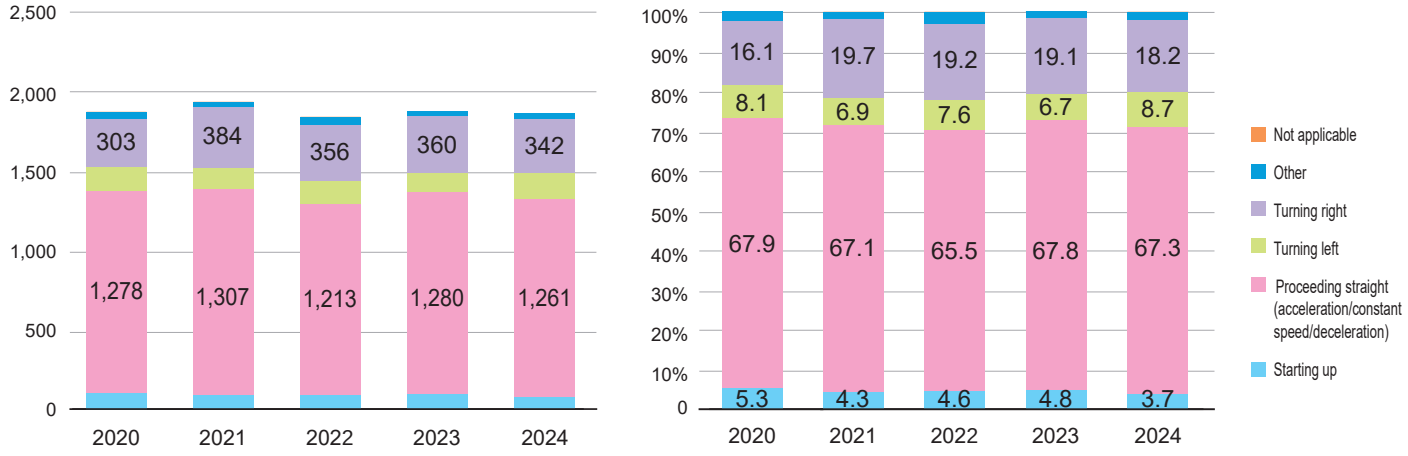


(a) Number of accidents　　(b) Percentage of accidents

Figure 5. Age group of cyclists (primary party)

○ Type of movement of bicycles (primary party)

According to Figure 6, the most common type of movement of bicycles (primary party) is proceeding straight, accounting for slightly less than 70%. Although not shown in the figure, in crossing collision accidents involving four-wheel vehicles and motorcycles as the primary parties, approximately 55% occurred while proceeding straight, and slightly more than 20% occurred while starting up. While four-wheel vehicles and motorcycles may be involved in accidents after starting from a stop at an intersection, bicycles appear to be involved in accidents while proceeding straight through intersections without stopping.



(a) Number of accidents　　(b) Percentage of accidents

Figure 6. Type of movement of bicycles (primary party)

○ Legal violations and human factors for bicycles (primary party)

Tables 2 and 3 show the legal violations and human factors associated with bicycles (primary party). Among legal violations, failure to stop at a designated stop location is the most common, followed by failure to confirm safety. Among human factors, failure to confirm safety is the most common. This suggests that bicycles become involved in accidents because they fail to stop or proceed into intersections without sufficient safety confirmation.

Table 2. Legal violations by bicycles (primary party) (2020–2024)

Legal violation	Percentage
Failure to stop at a designated stop location, etc.	44.4%–46.8%
Violation of safe driving obligations (failure to confirm safety)	24.4%–27.5%
Violation of safe intersection passage obligations	12.6%–15.3%

Table 3. Human factors of bicycles (primary party) (2020–2024)

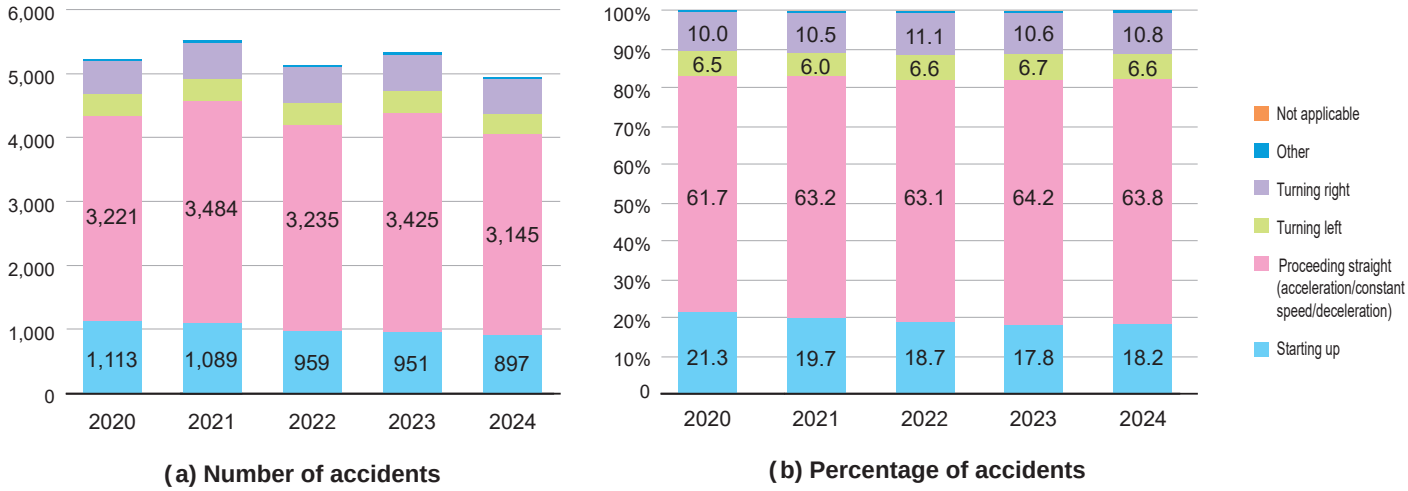
Human factor	Percentage
Delay in noticing (failure to confirm safety)	77.0%–80.7%
Judgment error, etc. (failure to observe surrounding traffic movement)	3.4%–5.5%
Judgment error, etc. (improper prediction)	2.8%–4.3%
Judgment error, etc. (road environment recognition error)	8.1%–10.3%

3.2 Cases where the bicycle is the secondary party

The following are the characteristics of crossing collision accidents in which the bicycle is the secondary party. In this section, accidents in which four-wheel vehicles and motorcycles are the primary parties, and bicycles are the secondary parties, are analyzed because they facilitate understanding of the actual circumstances of these accidents.

○ Type of movement of four-wheel vehicles and motorcycles (primary party)

According to Figure 7, the most common type of movement for four-wheel vehicles and motorcycles (primary party) is proceeding straight, accounting for more than 60%, followed by starting up, accounting for slightly less than 20%. Although four-wheel vehicles and motorcycles may reduce their speed before entering an intersection, accidents involving bicycles still occur in these situations.



(a) Number of accidents

(b) Percentage of accidents

Figure 7. Type of movement of four-wheel vehicles and motorcycles (primary party)

○ Legal violations and human factors for four-wheel vehicles and motorcycles (primary party)

Tables 4 and 5 show the legal violations and human factors associated with four-wheel vehicles and motorcycles (primary party). Failure to confirm safety is the most common factor among both legal violations and human factors. This suggests that four-wheel vehicles and motorcycles proceed into intersections without sufficient safety confirmation and become involved in accidents.

Table 4. Legal violations by four-wheel vehicles and motorcycles (primary party) (2020–2024)

Legal violation	Percentage
Violation of safe driving obligations (failure to confirm safety)	45.5%–51.0%
Violation of safe intersection passage obligations	21.2%–24.3%
Violation at slow-speed locations	13.7%–16.4%
Failure to stop at a designated stop location, etc.	6.2%–8.8%

Table 5. Human factors of four-wheel vehicles and motorcycles (primary party) (2020–2024)

Human factor	Percentage
Delay in noticing (failure to confirm safety)	83.5%–85.1%
Judgment error, etc. (failure to observe surrounding traffic movement)	3.0%–3.7%
Judgment error, etc. (improper prediction)	3.0%–4.2%
Judgment error, etc. (road environment recognition error)	2.1%–2.9%

4 Characteristics revealed by in-depth accident case study results

Let us examine the circumstances of bicycle crossing collision accidents on "neighborhood roads" based on the results of the in-depth accident case studies conducted by our Center (Figures 8 and 9).

Case studies 1 and 2 exhibit very similar characteristics. At intersections where a stop sign was provided on the bicycle approach, children riding bicycles proceeded straight through the intersection without stopping or making sufficient safety confirmation, resulting in accidents. These cases may be regarded as typical patterns corresponding to the results presented earlier in the section "Cases where the bicycle is the primary party."

On the other hand, in both cases, the collision speed of the motor vehicle was 35 km/h, and the driver failed to confirm safety at the intersection. The roads on which these accidents occurred were not roads where relatively high speeds would normally be expected, such as two-lane roads. Therefore, drivers should select an appropriate speed in accordance with the road design and, in addition, drive with hazard anticipation and make proper safety confirmation while remaining aware of the presence of cyclists and pedestrians. Had the speed of the motor vehicle been lower, the accident might not have occurred, or the resulting injuries might have been less severe.

These findings suggest that, in order to prevent bicycle crossing collision accidents on “neighborhood roads,” it is important to disseminate the results of accident statistics analyses, accident patterns, and the sequence of events leading to accidents to both bicycle users and motor vehicle drivers, and thereby encourage behavioral changes such as “stopping where stopping is required (for example, at locations with poor visibility of intersecting roads and stop-sign control)” and “proceeding into intersections only after making sufficient safety confirmation (while also anticipating potential hazards).”

- Occurrence: Weekday in July, during the 5 p.m. hour.
- Weather: Bright cloudy weather. Road surface: Dry.
- An accident occurred in an “urban residential area” laid out in a grid pattern.
- The residential area extends over an area of more than 1 km², with two-lane roads located at intervals of approximately 500 m.
- The bicycle proceeded straight through a non-signalized four-way intersection and collided with a passenger car approaching from the right and proceeding straight.
- The roads forming the intersection were of approximately equal width.
- A stop sign was provided on the bicycle approach.
- The cyclist was 11 years old and sustained slight injuries in the accident. It appears that the cyclist was preoccupied with catching up with friends who had already passed through the intersection and therefore failed to stop and check for approaching traffic from the left and right.
- The passenger car driver assumed that his or her vehicle had priority because the intersecting road was controlled by a stop sign. As a result, the driver failed to confirm safety. The collision speed was 35 km/h.

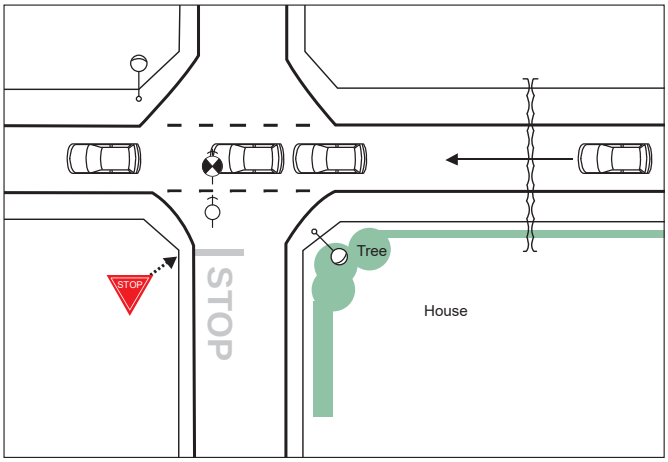


Figure 8. Case study 1

- Occurrence: Weekday in June, during the 5 p.m. hour.
- Weather: Sunny. Road surface: Dry.
- An accident occurred in an “urban residential area.”
- The residential area extends over an area of approximately 1 km² and is partially laid out in a grid pattern. Two-lane roads are located along the outer perimeter of the residential area.
- A passenger car proceeding straight through a non-signalized four-way intersection collided with a bicycle approaching from the left and proceeding straight.
- Both roads forming the intersection were single-lane roads of approximately equal width.
- A stop sign was provided on the bicycle approach.
- The cyclist was 12 years old and sustained serious injuries in the accident. It appears that the cyclist failed to stop and make proper safety confirmation before entering the intersection.
- The passenger car driver failed to confirm safety at an intersection where visibility of the intersecting road was restricted. The collision speed was 35 km/h.

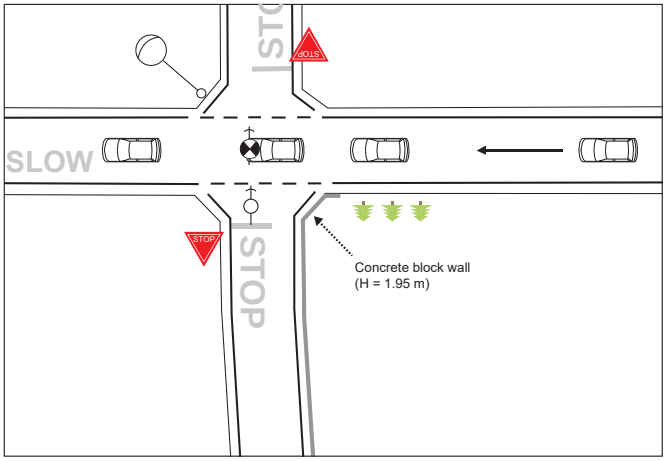


Figure 9. Case study 2

5 Conclusion

5.1 Characteristics of prominent crossing collision accidents

In the foregoing sections, based on the results of accident statistics analyses and in-depth accident case studies concerning bicycle accidents on "neighborhood roads," we have particularly examined the characteristics of prominent crossing collision accidents. As a result, the following observations can be made.

Crossing collision accidents in which the bicycle is the primary party

- A high proportion of primary parties are young people, particularly those aged 15 years or under and those aged 16 to 24 years.
- A high proportion of accidents occur when bicycles proceed straight through intersections without stopping.
- A high proportion of accidents occur when bicycles proceed into intersections without making sufficient safety confirmation.

Crossing collision accidents in which a four-wheel vehicle or motorcycle is the primary party, and the bicycle is the secondary party

- A high proportion of accidents occur when four-wheel vehicles and motorcycles proceed straight through intersections without sufficiently reducing speed before entering the intersection, or when they start moving after slowing down.
- A high proportion of accidents occur when four-wheel vehicles and motorcycles proceed into intersections without making sufficient safety confirmation.

5.2 Preventing crossing collision accidents

In cases where the bicycle is the primary party, it is important for cyclists to develop the habit of stopping where necessary and making sufficient safety confirmation before proceeding into intersections. For drivers, it is important to select an appropriate speed according to the road design and, recognizing that bicycles may proceed into intersections without stopping, to anticipate the risk of collisions with bicycles, make sufficient safety confirmation, and take appropriate action.

To address these issues, it is necessary to disseminate information on the results of accident statistics analyses, accident patterns, and the sequence of events leading to accidents, as presented in this article, to both cyclists and drivers, thereby encouraging behavioral change. In cases where a child is the primary party while riding a bicycle, it is important for parents, who hold driver's licenses and understand appropriate responses in various traffic situations, to teach their children about hazardous situations encountered by cyclists on "neighborhood roads" and safe bicycle riding practices, including stopping where necessary. Such opportunities may arise through conversations at home and through occasions when children ride bicycles on "neighborhood roads."

Reducing the number of cases in which a child is the primary party may take many years. This is because, even if efforts begin immediately, traffic safety education and awareness activities may need to continue until today's children become parents and begin teaching their own children how to ride bicycles safely. However, Japan has a proven record of significantly reducing "pedestrian rushing-out accidents" compared with other types of accidents through long-term awareness activities. Therefore, it is important to continue such efforts persistently.

In cases where the bicycle is the secondary party, it is important for drivers of four-wheel vehicles and riders of motorcycles to select an appropriate speed and develop the habit of making thorough safety confirmation before proceeding through intersections to avoid overlooking potential hazards. On the other hand, cyclists should remain aware of how they appear to drivers and whether they may be overlooked, and should take appropriate precautions to avoid collisions with motor vehicles.

Considering all of the above, it is clear that, in order to reduce bicycle accidents on “neighborhood roads,” it is also extremely important for motor vehicle drivers to select an appropriate speed according to the road design. We believe that choosing an appropriate speed is the first step toward ensuring the safety of both pedestrians and cyclists on “neighborhood roads.”

As noted at the beginning of this article, we have analyzed the characteristics of bicycle accidents on “neighborhood roads” and summarized the “inappropriate responses” of bicycle users and other parties. We hope that readers will use this article as a resource when considering appropriate actions for bicycle users and motor vehicle drivers and will work toward preventing bicycle accidents on “neighborhood roads” and mitigating injuries in the event of an accident.

Susumu Takamiya

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Column

Speed Hump, Narrow Section, and Chicane

- Representative examples of facilities installed on "neighborhood roads" to reduce motor vehicle speeds.
- By reducing vehicle speeds, these facilities may also contribute to reducing the volume of through traffic passing through the area.

Speed Hump

A facility that raises the road surface in the vehicle travel area and, by causing discomfort to drivers when vehicles pass over it at excessive speed, encourages them to reduce their speed.

(Photo provided by Hisashi Kubota, Professor Emeritus, Saitama University)

Narrow Section

A facility that narrows the width of the vehicle travel area and thereby encourages drivers to reduce their speed.

(Photo provided by Hisashi Kubota, Professor Emeritus, Saitama University)

Chicane

A facility that changes the alignment of the vehicle travel area from side to side and, by requiring drivers to make steering adjustments, encourages them to reduce their speed.

(Photo provided by Hisashi Kubota, Professor Emeritus, Saitama University)

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