講演番号	189

文献番号	20226189

Statistical Analysis of Cyclists Accident Involving Passenger Cars Focusing on Full Model Change Year

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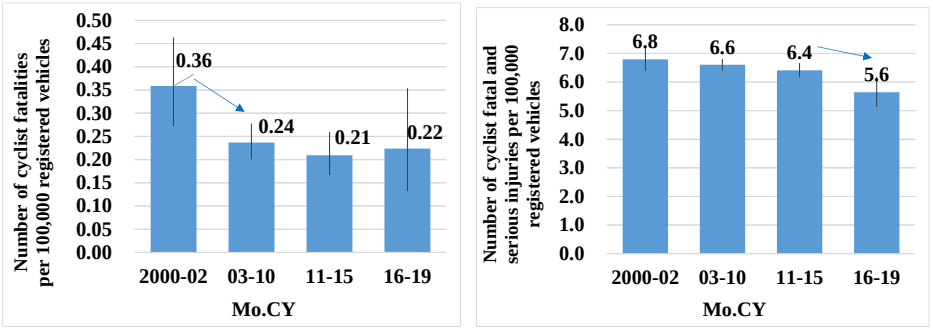
KEY WORDS: **safety, passive safety/active safety, statistical accident analysis,** Cyclist, Damage mitigation brake [C1]

The number of fatalities and injuries due to traffic accidents in Japan has decreased significantly in recent years, reaching 364,767 in 2021. However, the number means as many as around 1,000 injured people per day. In detail, the composition ratio by person type shows that four-wheeled vehicle driver has a gradual downward trend, but the most common yet. Conversely, the percentage of vulnerable road users such as pedestrians and motorcyclists are on the rise, with the largest increase in the percentages of pedalcyclists. The most frequent collision partner with bicycle was a four-wheeled vehicle. On the other hand, the evolution of automotive safety technology and performance in recent years has been remarkable. For example, even if a pedestrian's head collides with the hood, energy absorption has been largely improved to minimize the degree of injury. This is expected to provide some injury reduction for even pedalcylcists in the event of a collision with the passenger cars. Based on the above, this paper focused on collisions between bicycles and standard-sized passenger cars. Then, it was attempted to show the reduction effect statistically and quantitatively by analyzing a large number of accidents in the Japanese market. Specifically, 411 passenger car models were grouped into four groups based on the year of full model change (Mo.CY), and the differences in injury risk among the groups were examined to clarify the effect of vehicle evolution on reducing bicycle occupant injuries in the big picture. The conditions for the data used in this analysis are as follows:

- Clarifications: G1 (Generation 1): 2000-2002 Mo.CY, G2: 2003-2010, G3: 2011-2015, G4: 2016-2019
  The fact that the year is not “model year” but “full-model change year” should be emphasized.
- Years of analysis: 4 years from 2017 to 2020
- The number of registered vehicles: the total number of registered vehicles over the four years from a minimum of about 8 million to a maximum of about 63.7 million for the four groups: G1 to G4. These are the denominators when deriving the per-unit indicator.
- Area of car where crash occurred: Front (front + right-front + left-front)
- Accident data: Fatal, serious, and minor injury accidents between bicycles and the relevant standard passenger car models in Japan
- Evaluation index: Number of injured accidents in the four groups per 100,000 vehicles registered during the four years

The results are shown in Figure 1. On the left is the number of cyclists’ fatalities per 100,000 registered vehicles, and on the right is the number of cyclists’ fatal and serious injuries as well. Looking at the index for fatalities, there is a significantly large reduction from G1 to G2. A more detailed analysis shows a reduction in head injuries, which may include the effect of improved crash safety performance with the introduction of pedestrian head protection performance assessment in JNCAP in 2003. In the index for fatal and serious injuries, the reduction from G3 to G4 is significant. Some pedestrian AEBs launched in 2016 or after have the function that can also detect bicycles, and the effect of these systems may be one of the reasons for the reduction.

In conclusion, the method derived in this study allowed us to quantify the overall real-world benefits of safety equipment and safety performance as a whole by utilizing and analyzing elaborate statistical accident data in Japan. As a result, it was successful to derive a better understanding of the reduction in fatalities and fatal and serious injuries due to pedalcyclists accidents with the newer car groups of Mo.CY.



Fatalities　　Fatal and serious injuries

Fig.1 Number of cyclists casualties per 100,000 registered vehicles
by full Model Change Year (Mo.CY) group
in the accident year of 2017 to 2020