

Characteristics of Accidents and Violations Caused by Elderly Drivers in Japan

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ABSTRACT

The number of elderly drivers has been increasing in Japan with the rapid progress of the nation's population aging. Securing safety for elderly drivers is an important issue in Japan. In this paper, authors conduct analysis on characteristics of accidents and violations caused by elderly drivers based on data for 2009. As there is a tendency that elderly drivers generally have less opportunity to drive vehicles than younger drivers do, it is necessary to conduct this analysis considering driving frequency when making comparison among age groups. Then, we calculated the normalized ratio (odds ratio) based on the number of rear-ended accidents in order to exclude the influence of driving frequency. As a result of the analysis, it was found that the likelihood of violations committed by elderly drivers was not particularly higher, while the likelihood of accidents caused by them was higher than younger drivers. The risk of causing an accident was judged to be about two times higher in elderly drivers than in the 35-44 year age group. Looking at each type of accident and violation, it is conjectured that they do not purposely disregard traffic signals or commit stop sign violations, but end up having accidents as a result of simply failing to notice them.

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INTRODUCTION

Reducing the damage from traffic accidents is an issue shared by all countries. [Figure 1](#) shows the trends in the numbers of traffic accidents and fatalities in Japan from 1948 to 2011 according to data from the Institute for Traffic Accident Research and Data Analysis (ITARDA) in Japan [1]. The number of fatalities peaked at 16,765 in 1970, after which there has generally been a steady decrease. Aside from a slight increase around 1990, the number has dropped significantly, falling to 4,612 in 2011. (In Japan, deaths within 24 hours of an accident are counted as traffic fatalities.)

The number of traffic accidents peaked at 952 thousands in 2004, and recently the trend has been decreasing. The steady decreases in the numbers of fatalities and accidents are thought to be a result of the various safety measures that have been taken, including technologies to reduce collision damage.

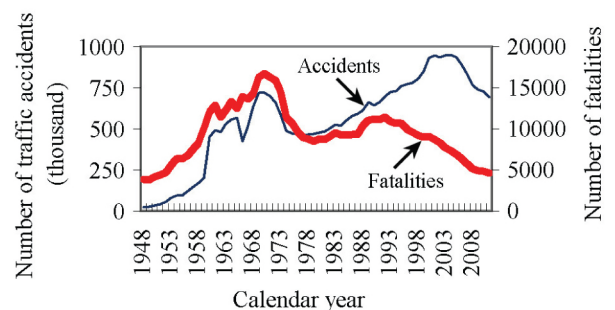


Figure 1. Trends in traffic accidents and fatalities in Japan

Something that needs to be considered now is the increase in elderly drivers that has come with the overall aging of Japanese society. [Figure 2](#) shows the trends in the numbers of driving license holders in various age groups for the 10 years of 2002-2011. While the number of young driving license holders aged ≤ 24 years gradually decreased, the number of elderly license holders aged ≥ 65 years increased.

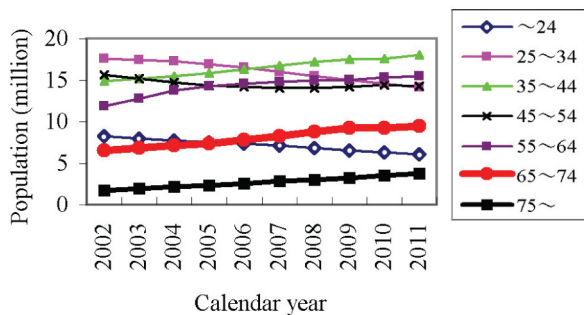


Figure 2. Trends in the number of driving license holders in different age groups

For ease of understanding, we calculated the trends in the number of driving license holders of all age groups, in young people aged ≤ 24 years, and in elderly people aged ≥ 65 years, using an index in which the 2002 value for each age group is taken as 100 (Figure 3). The index for drivers of all age groups is about constant. In other words, the total number of drivers did not change significantly over the years of 2002-2011. During that time, however, young drivers aged ≤ 24 years decreased to a value of 74, whereas elderly drivers aged ≥ 65 years increased considerably to 160. The number of elderly drivers is expected to continue increasing in the future.

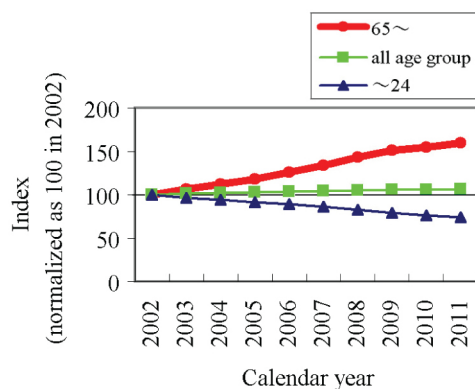


Figure 3. Trends of driving license holders expressed with an index (normalized as 100 in 2002)

An increase in the number of driving license holders means an increase in the number of traffic accidents caused by those drivers. The trends in the number of vehicle (including motorcycle) accidents caused by drivers of all age groups, elderly drivers, and young drivers are shown using an index for each group, with the 2002 value normalized as 100 (Figure 4). This figure shows the trends in accidents in which these drivers were the 1st party. Here, "1st party" refers to the person who causes the most culpable failure or who is the least injured among parties concerned when their culpable failures are at the same level.

While there was a decrease in traffic accidents by 1st party drivers of all age groups and young drivers, which

reflects the decreasing trends of traffic accidents shown in Figure 1, the 2011 index for elderly drivers increased to 125. This trend is likely to continue in the future, from which it may be understood that safety measures for elderly drivers are an urgent problem.

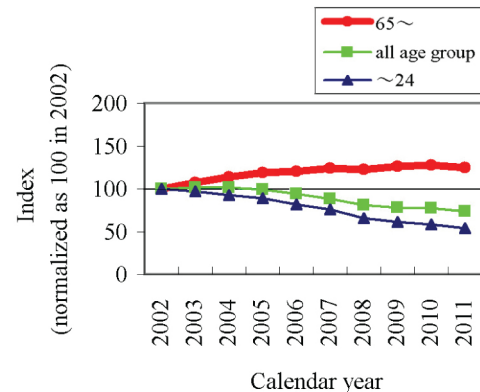


Figure 4. Trends in number of accidents of 1st party in different age groups (normalized as 100 in 2002)

Some people view elderly drivers as a risk and more likely to cause accidents because of their deterioration in abilities such as visual search, useful field of view, working memory, situational awareness, decision-making, reaction time [2], and contrast sensitivity [3]. An opposing view is that they are less likely to be involved in accidents because of their greater caution. Liberty [4] reported that elderly drivers tend not to drive long distances and to drive at lower speeds.

In this study we focused on elderly drivers and conducted an analysis, based on macro data, of whether or not they are truly more likely to be involved in traffic accidents. The accident data used were from ITARDA. The data on traffic violations used were driving license data from the same institute. In this analysis, we paid ITARDA to aggregate data in the first stage, then we ourselves conducted a detailed examination based on these aggregated data. In this analysis we examined the data from the year 2009 that were available to us.

DRIVING FREQUENCY OF ELDERLY DRIVERS

It is thought that because elderly drivers limit unnecessary driving, they have fewer occasions to be involved in traffic accidents. Since there are no data that directly show how much they limit their driving, here we decided to examine the number of accidents in which they were rear-ended. If traveling mileage data for each age group existed we could adopt another methodology, such as accident data per mile traveled. Unfortunately no such data exists in Japan and so we adopted the present methodology.

Conditions for determining accidents in which a person was rear-ended were "rear-end collision" for type of accident, "rear end of vehicle" for impact site, and "parking, stopping"

for type of action. In addition, a rear-ended driver was taken to be one who committed no violation in relation to the accident. Thus, they were drivers who were rear-ended by chance, with no culpable failure on their part. Our assumption was that the possibility of being accidentally rear-ended would increase in proportion to driving frequency.

The number of accidents with frontal or side impacts could also have been used instead of rear-ended ones, but in that case the possibility of some level of negligence on the part of those drivers would have been high. In other words, drivers involved in such accidents may be fundamentally more likely to cause accidents. Hence, we did not consider use of the number of those accidents to be appropriate for the aim of estimating overall driving frequency. We therefore decided to adopt the number of accidents in which a driver was rear-ended, as this is thought to occur by chance. In addition, since this was a macro-analysis, we did not conduct a detailed investigation of things such as the size or color of the rear-ended vehicles.

Figure 5 shows the number of accidents in which a person was rear-ended in daytime and nighttime in each age group, and the ratio of number of rear-ended accidents to the number of driving license holders, based on 2009 data. If the opportunities for driving are assumed to be constant for all age groups, it is thought that the ratio would also be constant. However, the rate decreased as drivers became older. Moreover, the rate was lower at night than during the day, a trend which was conspicuous in elderly drivers. Thus, it was found that driving frequency decreased with age and that older drivers tended to further limit driving at night [3,5].

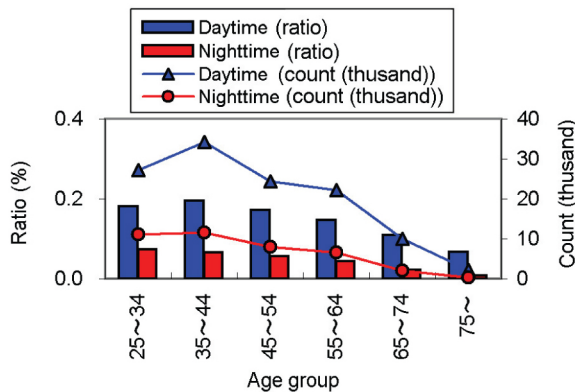


Figure 5. Number of accidents in which a driver was rear-ended and the ratio of these accidents to number of driving license holders in each age group (based on 2009 data)

THOUGHTS ON POSSIBILITY OF ACCIDENT AND VIOLATION OCCURRENCE

As described in the preceding section, driving frequency needs to be considered when comparing the accident and

violation characteristics of elderly drivers with those other age groups. Even if elderly drivers cause fewer accidents, this may be due simply to lower driving frequency. Consequently, in order to analyze whether or not accidents and violations actually occur at a higher rate in any group, we must adopt a method of analysis that considers driving frequency. For this reason we conducted our analysis with number of collisions in which a driver was rear-ended as an intermediary. Our thinking is shown in the following.

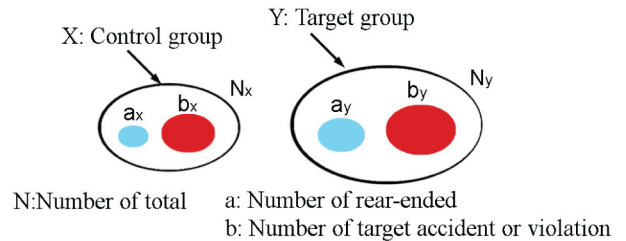


Figure 6. Analysis concept based on number of collisions in which a driver was rear-ended

Collisions in which a driver was rear-ended were taken to be a_x and a_y , respectively, for the control group (X) and analysis group (Y) shown in Figure 6. The occurrence of accidents or violations was taken to be b_x and b_y , respectively. It should be noted that driving frequency may differ between groups X and Y. When taking a group of drivers without accidents, including people who have driving licenses but do not actually drive (drivers on paper only), as X, the probability of this group having accidents will be low since the drivers on paper only basically do not drive. Therefore, the number of accidents or violations shown with b_x may be extremely small relative to the total number X. Therefore, we cannot analyze the accident or violation rate simply with the number of b_x and b_y alone. It is necessary to consider the likelihood of an accident or violation occurring in accordance with driving frequency.

The exposure rate related to driving frequency is taken here to be ε_x and ε_y . When the respective total numbers in groups X and Y are taken to be N_x and N_y , respectively, they are apparent parameters but not parameters related to accidents or violations. Group parameters that consider the exposure rate ε_x and ε_y are taken to be Ω_x and Ω_y , as shown in the following.

$$\Omega_x = N_x \times \varepsilon_x \quad (1)$$

$$\Omega_y = N_y \times \varepsilon_y \quad (2)$$

Here, N_x and N_y are known from aggregation of accident data, but Ω_x , Ω_y , ε_x , and ε_y are unknown. The exposure rate is considered to be different for each group.

If one considers collisions in which a driver is rear-ended to be accidents that occur haphazardly and to occur with the