1 **Impact of mandating a driving lesson for older drivers at license renewal in Japan**

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13 **Abstract**

14 In Japan, a driving lesson consisting of a lecture, a driver aptitude test, on-road driving
15 assessment and a discussion session was added to the driving license renewal procedure for drivers
16 aged 75 years or older in 1998 and for drivers aged 70 years or older in 2002. We investigated
17 whether these additions contributed to a reduction in at-fault motor vehicle collisions (MVCs) by
18 examining the trend of the at-fault MVC rates per licensed driver and the rate ratios of the older
19 drivers relative to those aged 65 to 69 years for the years 1986 to 2011. All data were derived from
20 nationwide traffic statistics. If the introduction of the lesson was effective in reducing at-fault
21 MVCs of older drivers, the rate ratio should have declined, given that the lesson targeted only the
22 older drivers. We found this was not the case, i.e., there was no declining trend in the at-fault MVC
23 rate ratios of both drivers aged 75 years or older and drivers aged 70 years or older, relative to
24 drivers aged 65 to 69 years, after the driving lesson at license renewal became mandatory for these
25 older drivers. Therefore, the mandatory lesson for the older drivers at license renewal needs to be
26 reconsidered.

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28 Keywords: Older drivers; License renewal; Driving lesson; Collision risk

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30 **1. Introduction**

31 In countries with aging populations, older drivers and their involvement in motor vehicle
32 collisions (MVCs) are increasing (Organization for Economic Co-operation and Development 2001,
33 National Police Agency 2013). To ensure that older drivers drive safely, some countries are
34 imposing medical screening and driving skills tests at re-licensing of older drivers (Kahvedžić 2013).
35 These assessments are intended to help older drivers modify driving behaviors according to their
36 functional changes and maintain their mobility on one hand; older drivers might be prompted to
37 avoid or stop driving for safety reasons on the other. In whichever way, the assessments are
38 expected to reduce MVCs among older drivers, but previous studies suggest this is not the case
39 (Rock 1998, Grabowski *et al.* 2004, Langford *et al.* 2004a, Langford *et al.* 2004b, Langford *et al.*
40 2008, Siren and Meng 2012, Tay 2012).

41 Australian studies that compared crash involvement rates of older drivers between states
42 with and without medical and on-road testing requirements in driver licensing reported that such
43 mandatory testing had no protective effects on fatal and serious injury crashes for both older drivers
44 themselves and other road users (Langford *et al.* 2004a, Langford *et al.* 2004b, Langford *et al.*
45 2008). Similarly, a study in Canada that compared collision rates of older drivers across five
46 provinces with different levels of licensing requirements found no significant relationship between
47 stricter requirements and collision rates (Tay 2012). A study in the state of Illinois in the United
48 States found no increase in fatal crashes after the elimination of an on-road testing requirement for

49 drivers aged 69 to 74 years (Rock 1998). A study evaluating the effect of in-person renewal at the
50 driver license office, vision tests, and road tests, and the frequency of license renewal on driver
51 fatalities in the United States, revealed that only in-person renewal for drivers aged 85 years or older
52 reduced driver fatalities (Grabowski *et al.* 2004). A study in Denmark reported that the introduction
53 of cognitive screening in the license renewal of older drivers did not reduce fatalities (Siren and
54 Meng 2012).

55 Besides these observational studies examining the assessments at re-licensing, several
56 randomized controlled trials (RCTs) have been conducted to evaluate the effectiveness of older
57 driver retraining (Kua *et al.* 2007, Korner-Bitensky *et al.* 2009, Ball *et al.* 2010). A systematic
58 review of the RCTs concluded that an educational intervention, on-road training, and a physical
59 retraining intervention for older drivers would improve their driving knowledge and performance
60 (Kua *et al.* 2007, Korner-Bitensky *et al.* 2009). However, an educational intervention appeared to be
61 ineffective in reducing their crashes and there are no studies that have investigated whether other
62 two components of the interventions reduce the crashes. Meanwhile, a more recent RCT
63 demonstrated the effectiveness of cognitive training in reducing at-fault crashes (Ball *et al.* 2010).

64 In Japan, a driving lesson and a cognitive test have been added to the license renewal
65 procedure for older drivers nationwide, providing us an opportunity to examine the impact of these
66 additional requirements. We focused on “at-fault” MVCs in which older drivers were primarily
67 responsible, because at-fault MVCs can be a more direct indicator of the impact of older-driver

68 education than all MVCs. We therefore investigated whether at-fault MVCs declined after the
69 introduction of the mandatory driving lesson at license renewal among drivers aged 70 years or
70 older, compared with the case for drivers aged 65 to 69 years, who are not subject to the lesson.

71

72 **2. Methods**

73 *2.1 Driving license renewal in Japan*

74 In Japan, driving license holders are required to renew their license regularly, every 3 to 5
75 years depending on drivers' age and their commitment to traffic violations. Until September 1998,
76 drivers of all ages were required at the renewal to take a vision test and attend a 30-min (at least)
77 class on traffic safety. This renewal procedure was revised for older drivers: a 3-hour driving lesson
78 became obligatory at renewal for those aged 75 years or older since October 1998 and this
79 requirement was extended to those aged 70 to 74 years since June 2002. Additionally, those aged 75
80 years or older have been obligated to take a cognitive test before the lesson since June 2009.

81 The lesson is conducted by trained instructors at driving schools, consisting of a 30-min
82 lecture, a 1-hour driver aptitude test (in which, older drivers are tested for sensory motor skills using
83 a driving simulator, and also tested for a field of vision, kinetic and night vision), a 1-hour on-road
84 driving assessment, and a 30-min discussion session. The lesson aims to make older drivers aware
85 of their changes in driving ability and give them advice for safe driving based on the test results
86 (Cabinet Office 2012).

87 The cognitive test, a paper-based screening guided by an examiner, determines whether
88 older drivers are impaired, slightly impaired or not impaired (National Police Agency, Oroku 2010).
89 Those identified as being impaired can renew their driving license only if they have not been
90 ticketed for violation of certain traffic rules such as not obeying a traffic signal in the previous year
91 before the renewal. Those who have been ticketed have to take a medical examination. For those
92 diagnosed with dementia, their driving license is revoked. The same procedure is applied once the
93 older drivers violate the rules.

94 2.2 Data

95 The number and rate of at-fault MVCs including motorcycles and other motorized
96 two-wheelers per 10,000 licensed drivers by age groups of 65 to 69 years, 70 to 74 years, 75 to 79
97 years, and 80 years or older were obtained from the traffic statistics of the National Police Agency
98 for the period 1986 through 2011 (Institute for Traffic Accident Research and Data Analysis
99 1987-2012, each year). The rate of MVCs per 100 million vehicle-kilometers travelled (VKT) was
100 also obtained from the traffic statistics for the same period but the rate in 1986 was excluded from
101 the analysis because VKT by light motor vehicles (up to 660 cc.) was added to the denominator of
102 the rate from 1987 onwards. MVC data by sex are not available in the traffic statistics. We
103 calculated the number of licensed drivers from the aforementioned at-fault MVC numbers and rates
104 because the number of licensed drivers was not available separately for those aged 75 to 79 years
105 and 80 years or older in the driving license statistics of the National Police Agency up to the year

2004. Which driver was most responsible for an MVC (“at-fault” driver) was determined by the police officers who investigated the collision at the scene. The number of licensed drivers who surrendered their driving license was obtained from the driving license statistics (National Police Agency 2011). The data by age group were available from the year 2002.

2.3 Analysis

We first show the annual numbers of at-fault MVCs and licensed drivers by age groups of 65 to 69 years, 70 to 74 years, 75 to 79 years, and 80 years or older for the period 1986 through 2011 (Figure 1). We then show the annual at-fault MVC rates per 10,000 licensed drivers by age group and the annual MVC rates per 100 million VKT (Figure 2). Finally, we show the annual at-fault MVC rate ratios of drivers aged 70 to 74 years, 75 to 79 years, and 80 years or older, relative to drivers aged 65 to 69 years (Figure 3).

If the driving lesson at license renewal for drivers aged 70 years or older was effective in preventing at-fault collisions, the rate ratios should decline; if not, the rate ratios should remain constant. The effects of the driving lesson, if any, would appear gradually; that is, there would be a time lag while all drivers of the targeted ages renewed their license and received the lesson. It is therefore too early to assess the effects of the cognitive test.

The advantage of using the rate ratio, instead of the rate, is the ability to control for the effects of extraneous factors affecting the occurrence of MVCs over the study period, such as the road environment (Hingson *et al.* 1998, Voas *et al.* 2000, Nakahara and Ichikawa 2011). Although

125 the trend of the MVC rate would decline if the road environment improves, the rate ratio would not
126 decline unless the improved road environment affects the rate unevenly across the age groups. To
127 avoid this possibility, the rate ratio was calculated within 3 subgroups of older drivers.

128 The introduction of the lesson might have removed older driving license holders who never
129 or rarely drive and thus face no or little risk of collision. If such inactive drivers surrendered their
130 driving license in response to the introduction of the lesson, the proportion of active drivers who
131 actually have a collision risk would consequently increase among the older drivers being subject to
132 the lesson, and this might inflate the at-fault MVC rate and its rate ratio. To examine whether the
133 number of licensed drivers who surrendered their driving license increased after the introduction of
134 the lesson, we showed the annual proportion of those surrendered by the age groups of 65 to 69
135 years and 70 to 74 years since 2002 and the age groups of 75 to 79 years and 80 years or older since
136 2005, depending on the availability of the data (Figure 4).

137

138 **3. Results**

139 From 1986 to 2011, the number of at-fault MVCs among all age groups steadily increased
140 as did the number of licensed drivers, although the increase became stunted in the mid-2000s except
141 for drivers aged 80 years or older (Figure 1).

142

Figure 1. Annual numbers of at-fault motor vehicle collisions (MVCs) and licensed drivers by age group in Japan, from 1986 to 2011

The at-fault MVC rates of drivers aged 75 years or older continued to increase despite the introduction of the lesson for these drivers in 1998 and peaked in the first half of the 2000s. The rates for all age groups had similar trends and seem to be unaffected by the introductions in 1998 and 2002. The MVC rate per VKT had a similar trend (Figure 2).

Figure 2. Annual rates of at-fault motor vehicle collisions (MVCs) per 10,000 licensed drivers by age group and MVCs per 100 million vehicle-kilometers traveled (VKT) in Japan, from 1986 to 2011

The at-fault MVC rate ratios of drivers aged 75 to 79 years or 80 years or older relative to those aged 65 to 69 years did not have a downward trend after 1998, nor did at-fault MVC rate ratios of drivers aged 70 to 74 years after 2002 (Figure 3). Similar trends were found in their at-fault fatal MVCs (data not shown).

Figure 3. Annual rate ratio of at-fault motor vehicle collisions (MVCs) relative to the age group of 65–69 years in Japan, from 1986 to 2011

The proportion of licensed drivers who surrendered their driving license was generally very low (less than 0.5%) and constant in all age groups until 2007. Afterwards, the proportion increased. The increase was particularly notable among drivers aged 80 years or older (up to 1.6%), who were subject to the cognitive test introduced in 2009. There was a slight increase (up to 0.6%) among drivers aged 70 to 74 years, who were not subject to the test, as well as drivers aged 75 to 79 years, who were subject to the test (Figure 4).

Figure 4. Annual proportion of licensed drivers who surrendered their driving license by age group in Japan, from 2002 to 2011

4. Discussion

There was no declining trend in the at-fault MVC rate ratios of both drivers aged 75 years or older and drivers aged 70 years or older, relative to drivers aged 65 to 69 years, after the driving lesson at license renewal became mandatory for these older drivers. If the lesson was effective in preventing at-fault MVCs, the rate ratios should have decreased because the lesson targets only the older drivers, and this could have been achieved through improved driving skills and knowledge or self-regulated driving such as avoiding driving at night. Such modifications in driving could have

183 been induced by the lesson, as shown in previous RCTs (Kua *et al.* 2007, Korner-Bitensky *et al.*
184 2009), but there was no visible impact on at-fault MVCs. The 3-hour lesson might have been too
185 brief to reduce at-fault MVCs, yet more intensive interventions given in the RCTs had no such
186 impact either. The at-fault MVC rate ratios somewhat increased after the lesson was introduced. This
187 was, however, less likely because of the removal of inactive older drivers by the introduction of the
188 lesson. The proportion of licensed drivers who surrendered their driving license was too low in all
189 age groups even after the lesson was introduced to affect the rate ratios substantially.

190 The methodology used in this study, with rate ratios being the outcome variable, has the
191 strength that it can take into account extraneous factors affecting MVCs in all age groups. It is noted
192 that the declining trend in the MVC rate observed among those aged 70 years or older after the
193 lesson was introduced in 2002, may seem to be the effect of the lesson. However, the decline was
194 observed among all age groups including those who were not subject to the lesson. The MVC rate
195 per VKT also decreased. Therefore, the declining trend among the older drivers was more likely to
196 be because of factors other than the introduction of the lesson, and the rate ratio, which takes these
197 factors into account, is a more valid indicator with which to assess the impact of the lesson.

198 While the benefit of the lesson at license renewal is unclear, it is worth examining the
199 reasons why the at-fault MVC rate of older drivers decreased in the mid-2000s. In 2006, there was a
200 major change in road safety policies, placing greater emphasis on the reduction of traffic morbidity
201 and collisions with a numerical target for the reduction, and calling for the protection of vulnerable

202 road users (Nakahara *et al.* 2011). As seen in the decreasing MVC rate per VKT in the mid-2000s,
203 this policy change might have created a safer road environment for all road users including older
204 drivers. While there could be a certain level of under-reporting of older drivers' MVCs (Nakahara
205 and Wakai 2001), we saw the same trend in older drivers' MVCs involving fatalities, which are less
206 likely under-reported. Further investigation is warranted on whether such policy change is more
207 useful than introducing the lesson in efforts to reduce at-fault MVCs of older drivers.

208 While the present study is population-based, we could not examine the impact of the lesson
209 by sex because data on the at-fault MVCs by sex were not available in published statistics. It is
210 important to consider the fact that the proportion of female licensed drivers aged 65 years or older
211 gradually increased over the study period from 4% in 1986 to 31% in 2011 (National Police Agency
212 1987, 2012), which somehow affected the trend of the at-fault MVC rate, given that women are
213 safer drivers than men (Institute for Traffic Accident Research and Data Analysis 2006). However,
214 the difference in the proportion of female drivers is not large between the age groups over the study
215 period: the proportion of female drivers aged 65 to 69 years and aged 70 years or older was 6% and
216 2% in 1986 while it was 39% and 31% in 2011. The rate ratio is therefore less likely to be biased by
217 the sex composition of each age group.

218 In the present study, we could not examine the effects of the cognitive test as it was too
219 early to assess the test. However, it is noted that the introduction of the test seemingly had a certain
220 level of influence on license renewal, especially among drivers aged 80 years or older, and this

221 might affect their at-fault MVCs in the near future. In the United States, in-person license renewal
222 was associated with a lower fatality rate among drivers aged 85 years or older, possibly because
223 obviously impaired drivers were identified by license inspectors, or this renewal process might have
224 deterred their license renewal (Grabowski *et al.* 2004). Such effects might be found in the cognitive
225 test.

226 To justify the age-based requirements of the lesson and cognitive test at license renewal, it
227 is essential to demonstrate the effectiveness of the requirements in reducing MVCs. We should bear
228 in mind that the lesson at license renewal costs each driver 5800 yen (or 6000 yen with a cognitive
229 test), so a total of about 12 billion yen (about 150 million US dollars) were spent by drivers aged 70
230 years or older who renewed their license in the year 2012 alone, which has virtually produced no
231 significant safety benefits so far. Whether this is the case or not for the cognitive test is worth
232 investigating, and this investigation would be an opportunity to reconsider all of Japan's license
233 renewal policies for older drivers.

234 To date, the intervention shown to be effective in reducing at-fault MVCs among older
235 drivers is a cognitive training (Ball *et al.* 2010), yet requiring all the drivers to attend and pay for the
236 time-consuming training is still not justifiable because they have a different level of functioning.
237 Given the previous and current findings, it would be more reasonable to identify at-risk drivers and
238 to ensure through the training that they are fit to drive, rather than the current universal requirement
239 of the lesson at license renewal for older drivers.

240 In conclusion, obligating drivers aged 70 years or older to take a driving lesson at license
241 renewal is not effective in mitigating their at-fault MVCs. The current practice of older driver
242 education should thus be reconsidered.
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