International Journal of Gerontology 13 (2019) 246–250
https://doi.org/10.6890/IJGE.201909_13(3).0013

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Effect of Age on Severity of Injuries in Traffic Accidents Involving Elderly Drivers

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ARTICLE INFO

Accepted 21 November 2018

Keywords:
aged,
traffic accidents,
trauma severity indices,
wounds and injuries

SUMMARY

Background: The number of elderly drivers involves in traffic accidents is increasing with the aging of the population. This study aimed to investigate the relationship between the driver's age and injury severity in traffic accidents caused by elderly drivers.
Methods: Data from the Emergency Department-based Injury In-depth Surveillance (EDIIS) from 2011–2016 was used to analyze traffic accidents by drivers aged 60 and older. Patients were classified into non-severe and severe injury group. The driver's age was subdivided by 5-year interval to compare the difference in age groups. Multivariate logistic regression was used to identify the factors related to the severe injury.
Results: Among a total of 262,361 subjects, 6,427 patients were included, of which 890 (13.9%) were severely injured. There were more male in all age groups. The accidents occurred most in the daytime and general roads. In multivariate analysis, drivers aged 75–79 had 1.39 odds ratio (OR) of severe injury compared to drivers aged 60–64 (95% confidence interval [CI]: 1.06–1.84). Male (OR: 1.71, 95% CI: 1.40–2.09), alcohol intake (OR: 2.02, 95% CI: 1.39–2.94), and non-use of seatbelt (OR: 2.06, 95% CI: 1.71–2.48) were associated with severe injury, as well as the counterpart and road class.
Conclusion: Among elderly drivers, there were significant differences in characteristics of traffic accidents according to age groups. The risk of severe injury increased in drivers aged over 75 years comparing to relatively young elderly drivers. These results provide the practical adjustment in determining the age standard when establishing traffic safety policies.

1. Introduction

An 'aging society' is defined when the number of people aged 65 and older reaches 7% of the population. When the proportion reaches 14%, the society is defined as an 'aged society' and when the proportion reaches 20%, it becomes a 'super-aged society'.[1] Korea has already become an aging society in 2000 and reached an aged society in 2018. At this rate, it is expected to become a super-aged society by 2026.[2,3] As the population ages worldwide, the number of elderly drivers will increase, and this can lead to various situations that threaten traffic safety.

According to the Korea Road Traffic Authority database, traffic accidents caused by drivers over 65 years increased by 19.3% annually. The number of casualties also increased by three-folds in 2016 compared to 2001.[4] In the case of the United States, compared to 1999, there will be a 178% increase in the number of elderly drivers involved in traffic accidents and a 155% increase in fatal crashes by 2030.[5]

Most previous studies on the elderly drivers involved traffic accidents were based on non-medical data. They have analyzed the characteristics of crashes and focused on the impairment of physical or cognitive function of drivers due to aging.

The purpose of this study was to evaluate the association between age and severe injury in elderly drivers. We analyzed the difference of characteristics related to traffic accidents and the factors associated with injury severity according to age groups.

2. Materials and methods

2.1. Data collection

This study used data from the Emergency Department-based Injury In-depth Surveillance (EDIIS) which was established by the Korea Centers for Disease Control and Prevention (KCDC) in 2006. The number of hospitals participating in this surveillance expanded to 21 hospitals in 2010, and there were 23 hospitals nationwide as of December 2016. The trained coordinator of each hospital registered data about all types of injuries with the KCDC online system. The KCDC conducts quality control through periodic error analysis.

2.2. Study population

We used data of the EDIIS from January 1, 2011, to December 31, 2016. Since the year of 2011, the number of participating hospitals has expanded to 21, and data collection has been stable. The

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study subjects were drivers over 60 years old involved in traffic accidents who visited the ED during the study period. Traffic accidents included crashes related to general cars and trucks. The accidents which were related to bicycles, motorcycles, and special vehicles like cultivators were excluded. We also excluded patients who did not visit the ED of participating hospitals primarily, but were referred from other hospitals. Patients without essential data concerning the injury severity were also excluded.

2.3. Variable definitions

The characteristics of subjects including sex, age, transportation to the ED, alcohol intake, and seatbelt use were collected. In previous studies, the range of age in elderly drivers was varied.[5–8] In order to identify the change in injury severity according to age, patients were subdivided into 5-year intervals in this study; 60–64, 65–69, 70–74, 75–79, and ≥ 80 years. The time of onset of the accident was divided into daytime (00:80–16:00), evening (16:00–24:00), and night (00:00–08:00). Transportation to the ED was classified as either via public ambulance or others. When alcohol intake was suspected, it was noted, and the use of seatbelt was also checked. The counterpart of the traffic accident was divided into vehicles, fixed object (parked car, bench, tree, guardrail, building, a bridge post, etc.), single car crash (no counterpart vehicle, sudden use of brakes, change in direction and cornering by the driver, rollover of the car without a crash), and others. Road class where the accident took place (alley/farm road, general road, or highways) was indicated. The injuries were divided into head and neck, chest, abdomen, and extremities by body region. In the case of multiple injuries, the injured parts were marked separately. The prognosis of the patient, ED outcome (discharge, transfer, admission, or expire), and mortality were also investigated.

Injury severity was assessed using the excess mortality ratio-adjusted injury severity score (EMR-ISS). EMR-ISS is a system that evaluates injury severity based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).[9] Based on the severe injury criteria,[10,11] patients with mild and moderate EMR-ISS grade were classified as the non-severe injury group and patients with severe and critical EMR-ISS grade were classified as the severe injury group. Even with identical injuries, mortality and morbidity will be higher in elderly drivers compared to young adult drivers. In order to minimize this influence, we used the injury severity as an outcome variable instead of the mortality or length of hospital stay.

2.4. Statistical analysis

In order to compare the difference in characteristics for each age group of elderly drivers, the chi-square test was used. To examine the risk factors related to severe injury, variables with $p < 0.01$ through univariate analysis and clinically important variables were analyzed with multivariate logistic regression and backward stepwise elimination was applied. Data analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA), and $p < 0.05$ were considered significant.

2.5. Ethics statement

This study was approved by the Institutional Review Board (IRB No. GCIRB2016-242).

3. Results

During the study period, a total of 262,361 traffic accident patients were identified. Among these patients, 7,956 drivers were older than 60 years old. After applying the exclusion criteria, 6,427 patients were included in the analysis (Fig. 1).

The percentage of males was higher than females in all subgroups (Table 1). The highest number of patients of 3,200 (49.8%) were occurred during the daytime. There was a significant difference in the distribution of total accident time by age ($p < 0.001$). The number of patients who visited the ED by public ambulance was 3,110 (51.5%), and alcohol intake was noted in 137 (2.1%). Vehicles were the most common as the counterpart, but in older age groups, the

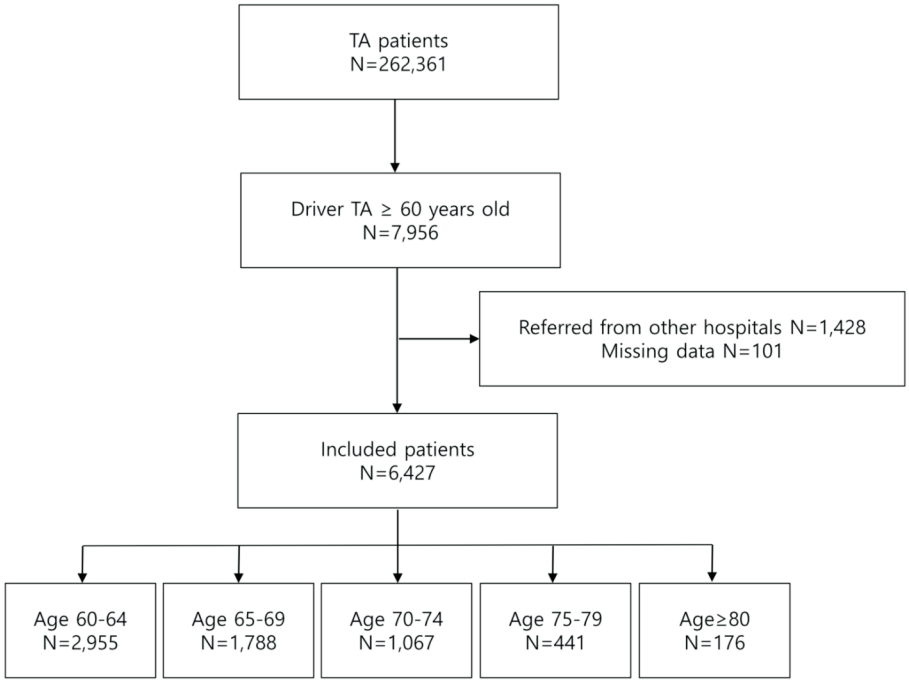

Fig. 1. Flow chart of study patients. TA, traffic accident.

Table 1
Baseline characteristics of elderly driver traffic accidents, N (%).

Variables	Age range, years						*p*
	Total (n = 6,427)	60–64 (n = 2,955)	65–69 (n = 1,788)	70–74 (n = 1,067)	75–79 (n = 441)	≥ 80 (n = 176)	
Sex, male	4878 (75.9)	2109 (71.4)	1384 (77.4)	864 (81.0)	382 (86.6)	139 (79.0)	< 0.001
TA onset time (hr)							< 0.001
00:00–08:00	1288 (20.0)	640 (21.7)	370 (20.7)	193 (18.1)	63 (14.3)	22 (12.5)	
08:00–16:00	3200 (49.8)	1343 (45.5)	867 (48.5)	593 (55.6)	274 (62.1)	123 (69.9)	
16:00–24:00	1924 (29.9)	965 (32.7)	548 (30.7)	280 (26.2)	100 (22.7)	31 (17.6)	
Transportation to ED							0.058
Public ambulance	3310 (51.5)	1533 (51.9)	888 (49.7)	548 (51.4)	234 (53.1)	107 (60.8)	
Others	3117 (48.5)	1422 (48.1)	900 (50.3)	519 (48.6)	207 (46.9)	69 (39.2)	
Alcohol intake noted	137 (2.1)	74 (2.5)	38 (2.1)	20 (1.9)	4 (0.9)	1 (0.6)	0.110
Counterpart							0.001
Vehicles	3939 (61.3)	1829 (61.9)	1127 (63.0)	646 (60.5)	260 (59.0)	77 (43.8)	
Fixed objects	766 (11.9)	338 (11.4)	198 (11.1)	139 (13.0)	61 (13.8)	30 (17.1)	
Single car crash	422 (6.57)	174 (5.9)	114 (6.4)	80 (7.5)	35 (7.9)	19 (10.8)	
Others	21 (0.33)	6 (0.2)	9 (0.5)	4 (0.37)	1 (0.23)	1 (0.57)	
Road class							0.013
Alley/Farm road	235 (3.6)	92 (3.1)	66 (3.7)	47 (4.4)	26 (5.9)	4 (2.3)	
General road	3822 (59.5)	1758 (59.5)	1057 (59.1)	639 (59.9)	270 (61.2)	98 (55.7)	
Highways	688 (10.7)	311 (10.5)	212 (11.9)	116 (10.9)	36 (8.2)	13 (7.4)	
Seatbelt use							0.088
Belted	4364 (67.9)	2025 (68.5)	1214 (67.9)	722 (67.7)	292 (66.2)	111 (63.1)	
Unbelted	1005 (15.6)	426 (14.4)	281 (15.7)	178 (16.7)	80 (18.1)	40 (22.7)	
Injury severity							0.027
Non-severe	5537 (86.1)	2567 (86.9)	1554 (86.9)	908 (85.1)	361 (81.9)	147 (83.5)	
Severe	890 (13.9)	388 (13.1)	234 (13.1)	159 (14.9)	80 (18.1)	29 (16.5)	
Injured body region							
Head and neck	3482 (54.2)	1620 (54.8)	967 (54.1)	573 (53.7)	231 (52.4)	91 (51.7)	0.808
Chest	1507 (23.5)	651 (22.0)	403 (22.5)	285 (26.7)	123 (27.9)	45 (25.6)	0.003
Abdomen	1056 (16.4)	505 (17.1)	280 (15.7)	169 (15.8)	72 (16.3)	30 (17.0)	0.730
Extremities	1553 (24.2)	724 (24.5)	430 (24.1)	240 (22.5)	116 (26.3)	43 (24.4)	0.570
ED outcome							0.028
Discharge	4525 (70.4)	2138 (72.4)	1256 (70.3)	735 (68.9)	278 (63.0)	118 (67.1)	
Transfer	459 (7.1)	199 (6.7)	123 (6.9)	87 (8.2)	37 (8.4)	13 (7.4)	
Admission	1351 (21.0)	587 (19.7)	382 (21.4)	224 (21.0)	118 (26.8)	40 (22.7)	
Expired	87 (1.4)	28 (01.0)	26 (1.5)	20 (1.9)	8 (1.8)	5 (2.8)	
Mortality							0.017
Survival	6304 (98.1)	2913 (98.6)	1749 (97.8)	1042 (97.7)	432 (98.0)	168 (95.5)	
Death	123 (1.9)	42 (1.4)	39 (2.2)	25 (2.3)	9 (2.0)	8 (4.5)	

TA, traffic accident; ED, emergency department.

rate of crash with fixed objects or single car crashes was increased. The overall difference in the counterpart was statistically significant (p = 0.001). Accidents mostly occurred on general roads. With increasing age, the proportion of non-use of seatbelts increased. However, there was no statistical difference by age (p = 0.088). Head and neck injuries were the most common with 3,428 (54.2%) cases. Among the injured body regions, there was a significant difference only in the chest region (p = 0.002) according to age groups. There were 890 (13.9%) severely injured and 5,537 (86.1%) non-severely injured patients. There was a significant difference in the overall distribution of injury severity (p = 0.027), ED outcome (p = 0.028), and mortality (p = 0.017).

The 60–64 year age group had the most patients with 2,955 (46.0%), followed by the 65–69 year age group with 1,788 (27.8%), 70–74 year age group with 1,067 (16.6%), 75–79 year age group with 441 (6.9%), and 80 years and older group with 176 patients (2.7%), showing a decrease in total patient number as the age range increased (Fig. 2a). The drivers aged 75–79 and ≥ 80 were 41 (5.7%) and 12 (1.7%) respectively in 2011, but it gradually increased up to 106 (7.5%) and 49 (3.5%) in 2016. Similarly to overall patient number, the number of severely injured drivers shows increasing trends with each successive age group (Fig. 2b).

Multivariate analysis was performed with variables including age groups, sex, traffic accident onset time, transportation to ED, alcohol intake, seatbelt use, counterpart, and road class to identify the risk factors associated with severe injury (Table 2). As a result, the odds ratio (OR) of severe injury for the driver aged 75–79 was 1.39 compared to the driver aged 60-64 (95% confidence interval [CI]: 1.06–1.84). In addition, the male gender, alcohol intake, and non-use of seatbelt had higher OR of severe injury. The OR was significant in cases of accidents with fixed objects or single car crashes, and in terms of road class, OR was higher in general road or highway than alleys/farm road.

4. Discussion

This study was meaningful in identifying that there were differences in accident-related characteristics by age groups in elderly drivers. In addition, we demonstrated the factors related to the occurrence of severe injuries. Among elderly drivers, there was an increased risk of severe injury in the older age group. The OR of severe injury was 1.39 in drivers aged 75–79 compared to drivers aged 60–64.

It has been reported in previous studies that mortality or the ratio of severe injury is higher in the elderly driver than in the youn-

ger population in the event of a traffic accident.[6,12–14] However, studies demonstrating the relationship between age and the occurrence of severe injuries were rare. Zhang et al.[15] reported an increased mortality and risk of injury requiring ED treatment or hospital admission in older age groups among elderly drivers. Another study that analyzed traffic accident patients in the Wisconsin area also reported increased relative risk ratio of moderate injury and severe injury with increasing age of the driver.[16] The result of our study is similar with previous studies in aspects of showing an increased OR of severe injury occurrence in older age among elderly drivers. However, we compensated the limitations of prior studies using data based on the ED and evaluating the injury severity of a patient during a stay in the ED. In multivariate analysis, the drivers aged 65–69 (OR: 0.99, 95% CI: 0.83–1.19) and 70–74 (OR: 1.11, 95% CI: 0.90–1.36) did not show differences in the occurrence of severe injuries, while drivers aged 75–79 showed a statistically significant result of 1.39 OR for the severe injury (95% CI: 1.06–1.84). In drivers 80 years and older, the rate of severe injury was 16.5%, which was higher than 13.1–14.9% in drivers aged 60–74. However, the result of multivariate analysis was not statistically significant in this age group. It may have been difficult to confirm the tendency because of the small number of patients in this age group.

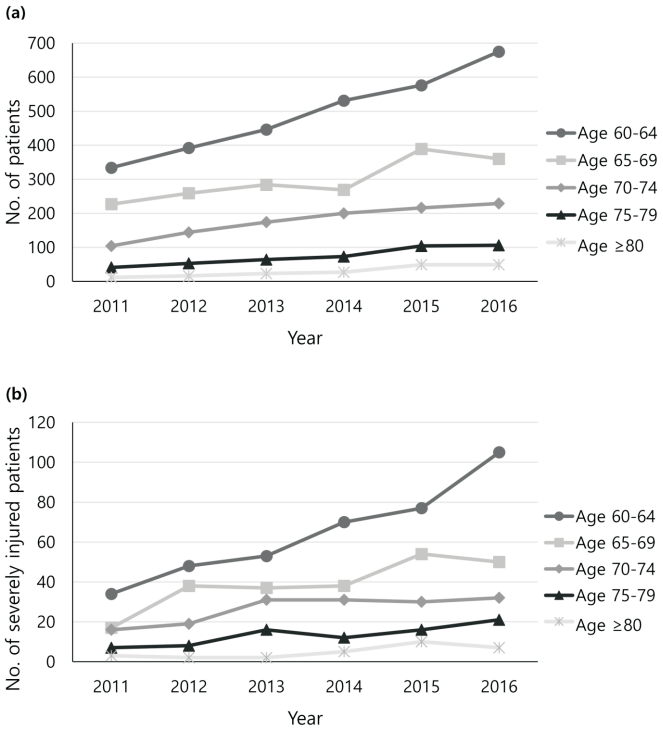

Fig. 2. Crash involved (a), severely injured drivers (b) by age group and year (2011–2016).

In elderly drivers, the incidence of severe injury can increase because of increased exposure to trauma due to various physical and mental restrictions that decreased reaction capability. It is reported that elderly drivers have more accidents at intersections due to impairment in vision and risk recognition.[17] Also, the accident rate was increased in the elderly driver that did not pass the test of useful field of view.[18] In a study that explained an association between cognitive ability and traffic accident, people who are 70 years and older had a lower cognitive score and higher rate of traffic accidents than the 65–69 year age group.[19] In this study, vehicles were the most common counterpart in all age groups, followed by a fixed object and single car crashes. However, as the age increases, the number of crashes with a fixed object or single car crashes increased. The reason can be explained by decreased driving capability due to declining physical and mental functions of the elderly drivers. In multivariate analysis, crashes with fixed objects or single car crashes were investigated as risk factors of severe injury.

Considering that life expectancy is extended and quality of life is improved compared to the past, preventing the elderly from driving would not be a realistic approach. A study has reported that training drivers aged 65–94 significantly increased their ability to detect risk factors while driving.[18] Also, there was a report that elderly drivers over 85 years of age have higher physical activity and mental function than non-drivers.[20] Therefore, in order to prevent elderly traffic accidents, it may be effective to promote accident prevention through safety education and training rather than simply reducing the proportion of elderly drivers.

The reported rate of elderly drivers who were non-use of seatbelts showed a high deviation with 12.1–81.0%,[8,12,13] for which

Table 2
Risk factors for severe injury in the univariate and multivariate analysis.

Variables		Unadjusted		Adjusted	
		Odds ratio	95% CI	Odds ratio	95% CI
Age (yr)	60–64	reference		reference	
	65–69	0.99	0.84–1.19	0.99	0.83–1.19
	70–74	1.16	0.95–1.41	1.11	0.90–1.36
	75–79	1.47	1.13–1.91	1.39	1.06–1.84
	≥ 80	1.31	0.86–1.97	1.06	0.69–1.63
Sex	Male	1.96	1.61–2.37	1.71	1.40–2.09
TA onset time (hr)	08:00–16:00	reference		–	
	16:00–24:00	1.13	0.95–1.33		
	00:00–08:00	1.41	1.18–1.69		
Public ambulance	Yes	3.17	2.70–3.72	2.81	2.38–3.30
Alcohol intake	Noted	3.85	2.70–5.49	2.02	1.39–2.94
Seatbelt	Unbelted	2.48	2.09–2.96	2.06	1.71–2.48
Counterpart	Vehicle	reference		reference	
	Fixed object	2.21	1.81–2.70	2.00	1.62–2.48
	Single car crash	2.55	1.99–3.26	2.14	1.64–2.79
	Others	0.42	0.06–3.11	0.28	0.04–2.17
Road class	Alley/farm road	reference		reference	
	General road	1.45	0.94–2.23	2.25	1.42–3.57
	Highway	1.36	0.84–2.18	2.46	1.48–4.09

CI, confidence interval; TA, traffic accident.

this study showed 15.7%. The deviation is interpreted as the result of differences in the data collection areas such as urban or rural areas, and the inclusion of cultivators and motorcycles in traffic accidents. In this study, the rate of non-use of seatbelts in drivers aged 60–64 was 14.4%, which increased gradually with age, up to 22.7% in drivers 80 years and older. This is thought that reduction in awareness of the traffic accident and confidence in driving ability. This provides evidence to emphasize the education related to safe driving to elderly drivers. The rate of alcohol intake was 2.1% in total and decreased with increasing age. There was no statistically significant difference in the overall age distribution. In general, both alcohol intake and non-use of seatbelts are associated with increased severity of injury and mortality.[21–24] In this result, both factors were associated with risk of severe injury occurrence.

In elderly drivers, ED outcome and mortality showed a significant difference in the overall distribution by age groups. The rate of hospital admission and death in the ED were all higher in drivers aged over 75 years compared to the average rate of entire patients. The mortality rate of the group aged 60–64 was 1.4%, while that was high at 2.0% and 4.5% in the group aged 75–79 and over 80 years respectively. Compared to non-elderly drivers, elderly drivers show a high frequency of severe injuries such as traumatic cerebral hemorrhage and severe lung injury,[25] as well as pelvic injuries accompanying arterial bleeding in low energy trauma.[26]

The limitations of this study are as follows. This study was not a population-based study but a cross-sectional study. Because we analyzed data from the ED of 23 hospitals nationwide, the results cannot be generalized to the entire population of Korea. Another limitation is that because most participating hospitals were tertiary hospitals, the severity of injury may have been overestimated as transferred patients were included. In order to prevent such possibility, we excluded patients who were transferred from other hospitals, but the severity may still be relatively higher. In addition, the EMR-ISS was used for the evaluation of injury severity instead of the injury severity score (ISS). It should be considered that the assessment of ISS is very difficult in large data. Lastly, comorbidities, such as diabetes, coronary disease, and stroke were not included as variables because they contained too much missing data. These variables planned to be collected from only 7 of the 23 hospitals, resulting in almost 70% missing rate, and so authors could not be used these variables.

In this study, characteristics related to traffic accidents involving elderly drivers according to the age group were identified using data from the ED. Especially the injury severity increased in the group aged 75 years and older. In addition to age, the male, alcohol intake, non-use of seatbelt, crash with fixed objects, single-car crash, general roads, and highways were factors associated with the occurrence of severe injuries. The age of drivers should be reflected when a traffic safety policy is set, and we expect our results to provide an evidence in determining the practical age standard.

Acknowledgement

The authors are grateful to the Korea Center for Disease Control and Prevention for supporting data of Emergency Department-based Injury In-depth Surveillance (EDIIS).

Disclosure

All authors have no potential financial and non-financial conflicts of interest to disclose.

References

1. United Nations, Population Division. *World population aging 2017*. Available at: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Report.pdf. Accessed July 21, 2019.
2. Kim IK. Demographic transition and population aging in Korea. *Korea J Popul Dev.* 1996;25:27–40.
3. OECD. OECD stat; 2018. Available at: http://stats.oecd.org/. Accessed May 18, 2018.
4. KoROAD. *Road Traffic Environment And Traffic Accident*; 2018. Available at: http://taas.koroad.or.kr/web/shp/dre/initRoadTraffic.do. Accessed July 21, 2019.
5. Lyman JM, McGwin G Jr, Sims RV. Factors related to driving difficulty and habits in older drives. *Accid Anal Prev.* 2001;33:413–421.
6. Lyman S, Ferguson SA, Braver ER, et al. Older driver involvements in police reported crashes and fatal crashes: trends and projections. *Inj Prev.* 2002;8:116–120.
7. Hong K, Lee KM, Jang SN. Incidence and related factors of traffic accidents among the older population in a rapidly aging society. *Arch Gerontol Geriatr.* 2015;60:471–477.
8. Boufous S, Finch C, Hayen A, et al. The impact of environmental, vehicle and driver characteristics on injury severity in older drivers hospitalized as a result of a traffic crash. *J Safety Res.* 2008;39:65–72.
9. Kim J, Shin SD, Im TH, et al. Development and validation of the excess mortality ratio–adjusted injury severity score using the international classification of diseases 10th edition. *Acad Emerg Med.* 2009;16:454–464.
10. Baker SP, O'Neill B. The injury severity score: An update. *J Trauma.* 1976;16:882–885.
11. Stephenson S, Henley G, Harrison JE, et al. Diagnosis based injury severity scaling: Investigation of a method using Australian and New Zealand hospitalisations. *Inj Prev.* 2004;10:379–383.
12. Kim TS, Lee KH, Kim TH, et al. Clinical characteristics and prognostic factors of geriatric patients involved in traffic accidents. *J Trauma Inj.* 2014;27:101–107.
13. Lee DH, Kim SP, Kim S, et al. Factors associated with the severity of injuries in old driver trauma patients. *J Korean Soc Emerg Med.* 2009;20 177–184.
14. Bauza G, Lamorte WW, Burke PA, et al. High mortality in elderly drivers is associated with distinct injury patterns: Analysis of 187,869 injured drivers. *J Trauma.* 2008;64:304–310.
15. Zhang J, Lindsay J, Clarke K, et al. Factors affecting the severity of motor vehicle traffic crashes involving elderly drivers in Ontario. *Accid Anal Prev.* 2000;32:117–125.
16. Hanrahan RB, Layde PM, Zhu S, et al. The association of driver age with traffic injury severity in Wisconsin. *Traffic Inj Prev.* 2009;10:361–367.
17. Clarke DD, Ward P, Bartle C, et al. Older drivers' road traffic crashes in the UK. *Accid Anal Prev.* 2010;42:1018–1024.
18. Horswill MS, Anstey KJ, Hatherly CG, et al. The crash involvement of older drivers is associated with their hazard perception latencies. *J Int Neuropsychol Soc.* 2010;16:939–944.
19. Lee JA, Choi H, Kim DA, et al. Relationship between cognitive perceptual abilities and accident and penalty histories among elderly Korean drivers. *Ann Rehabil Med.* 2016;40:1092–1099.
20. Brayne C, Dufouil C, Ahmed A, et al. Very old drivers: Findings from a population cohort of people aged 84 and over. *Int J Epidemiol.* 2000; 29:704–707.
21. Borgialli DA, Hill EM, Maio RF, et al. Effects of alcohol on the geographic variation of driver fatalities in motor vehicle crashes. *Acad Emerg Med.* 2000;7:7–13.
22. Noh Y, Yoon Y. Elderly road collision injury outcomes associated with seat positions and seatbelt use in a rapidly aging society—A case study in South Korea. *PLoS One.* 2017;12:e0183043.
23. Kwak BH, Ro YS, Shin SD, et al. Preventive effects of seat belt on clinical outcomes for road traffic injuries. *J Korean Med Sci.* 2015;30:1881–1888.
24. Park JH, Park JO, Ro YS, et al. Effect of alcohol use on emergency department length of stay among minimally injured patients based on mechanism of injury: multicenter observational study. *Clin Exp Emerg Med.* 2018;5:7–13.
25. Ferrera PC, Bartfield JM, D'Andrea CC. Outcomes of admitted geriatric trauma victims. *Am J Emerg Med.* 2000;18:575–580.
26. Krappinger D, Zegg M, Jeske C, et al. Hemorrhage after low-energy pelvic trauma. *J Trauma Acute Care Surg.* 2012;72:437–442.