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Title:

ROAD TRAFFIC CRASHES AND FATALITIES IN JAPAN 2000–2010 WITH SPECIAL REFERENCE TO THE ELDERLY ROAD USER

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ABSTRACT

Objective:

To investigate comparative road-user crash and fatality rates in Japan between 2000–2010 in the elderly and young.

Methods:

Data from the Japan Ministry of Health, Labour and Welfare Vital Statistics Database and the Institute for Traffic Accident Research and Data Analysis were used to calculate crash rates by age group, vehicle, and license category.

Results:

Fatal crash rates per 100,000 licensed drivers for four-wheeled motor vehicle drivers decreased by 53%, 56% and 42% among the 65–69, 70–74, and ≥75 age groups between 2000–2010, respectively, compared with 66% and 60% among the 16–19 and 20–24 age groups, respectively. Fatal crash rates per 100,000 licensed riders for two-wheeled motor vehicles decreased by 64%, 23%, and 33% in the 65–69, 70–74, and ≥75 age groups, respectively. Similarly, fatal crash rates per million population among bicyclists and pedestrians decreased in all age groups but were highest in the elderly age group in all years; the annual fatal crash rate for elderly pedestrians was 3 to 10 times higher than that for younger pedestrians.

Conclusions:

Despite the overall decrease in the elderly crash and fatal crash rates in all road use categories, elderly pedestrians are more susceptible to road traffic crashes and are more likely to be killed than younger persons. Further research may reduce this risk.

Keywords:

Elderly, Japan, legislation, motor vehicles, pedestrians, traffic accidents

INTRODUCTION

Aging is taking place in many countries (WHO 2011) and although this demographic shift is most prominent in Western countries, the proportion of elderly people in low- and middle-income nations is also predicted to increase by the year 2030 (Kinsella et al. 2008). The change in age structure affects a wide range of health and economic issues, and presents novel challenges to countries and society.

Road safety is one of these challenges (OECD 2001; Transportation and Research Board 2001), and the question "how safe is an elderly person on the road?" whether as a vehicle driver, pedestrian, or cyclist presents a challenge that has to be addressed (Braver et al. 2004; Eberhard et al. 1996).

Over the last few decades, road safety in the elderly population has been actively addressed in Japan. With 23.0% of the Japanese population in 2010 being 65 or over (Japan Statistics Bureau, 2011), Japan has the highest proportion of elderly people in the world (OECD et al. 2011). Furthermore recent data from the National Police Agency showed that since 2003, Japan has administered more licenses to elderly (≥65 years) than young (16–24 year old) drivers (Japan National Police Agency 2010).

Several authors have reported concerns and provided evidence that the risk of injury or death from road crashes increases with age. Reports of elderly drivers losing control and killing people (Bowles 2011; Gougis 2003) or of elderly people killed while crossing the road (CBS San Francisco 2012; Chandran and Sousa 2012; Dunn 2012) emphasize the importance of improving road safety for the elderly. Other studies show that age affects a person's ability to make safe decisions on the road, such as when to cross, brake, or make a turn (Campagne et al. 2004; Goode et al. 1998; Lyman et al. 2001; Owsley et al. 1998), and highlight the relationship of age and co-morbidities (Dobbs et al. 2005; Janke et al. 1994) or taking medication (McGwin et al. 2000; Ray et al. 1993). Moreover, Li et al. (2003) showed the likelihood of death or serious injury in crashes increases because fragility increases with age.

Over the past two decades, the Japanese government has sought to reduce serious crash rates by introducing a number of road traffic legislations specifically aimed at elderly drivers. The most recent legislation introduced cognitive screening for drivers aged 75 years or over, as a prerequisite for license renewal. This measure is similar to that introduced in Denmark (Siren et al. 2012), and other countries have introduced other licensing regulations intended to decrease fatal road crashes among elderly drivers (McGwin et al. 2008).

Thus our main objective in this paper is to describe and examine the trends in crash and fatality

rates for different classes of vehicles and age groups of road users in Japan during 2000–2010 and compare the rates in older and younger age groups.

METHODS

Data sources

Data for the age/population structure of Japan from 2000-2010, were obtained from the Japan Ministry of Health, Labour and Welfare (MHLW) Vital Statistics database (Vital Statistics, MHLW). Data for road traffic events during the same period were obtained from the Institute for Traffic Accident Research and Data Analysis (ITARDA) database (*Kotsu Tokei*, ITARDA). These data include total crashes, fatal crashes, and license holders by age, year, road user, and vehicle category (motorized four-wheeled, motorized two-wheeled, bicycles, pedestrians). We calculated the annual total and fatal crash rates per licensed driver, for each vehicle category, and for different age groups. The age groups were divided into elderly (65–69, 70 –74, and ≥75 years), young (16–19 and 20–24 years), and adult (25–64 years).

The population data categories were obtained from MHLW database; and road user and vehicle categories were obtained from ITARDA and NPA databases. The database categories originally appear in Japanese and were translated into English with special care. From the ITARDA database, the terms 'total crashes', 'fatal crashes' and 'primary party' were translated from Japanese into English and verified with ITARDA and the National Police Agency (NPA) for exactness of the translations. The legislature changes listed in Table.2 were translated into English with special care and verified with the Japan Ministry of Justice for exactness of the translations.

Data analysis

We used SPSS 19™ (IBM, USA) to calculate and plot frequencies for crash rates (the total in a specific age or user group divided by the total age group population), for different road user categories per licensed driver/rider for each age group and year.

RESULTS

Motorized four-wheeled vehicle drivers

Between 2000 and 2010, the proportion of the population aged 65–69, 70–74, and ≥75 years

increased by 16%, 19% and 58%, respectively. In contrast, the population in the 16–19 and 20–24 age groups decreased by 19% and 24%, respectively (Table 1). Among those aged 25–34 and 45–59 years, the population decreased, and the population of the 35–44, and 60–64 age groups increased (Table 1).

From 2000–2010, the numbers of licensed drivers for four-wheeled motor vehicles in the three elderly age groups increased by 67%, 77% and 201%; the numbers of younger licensed drivers aged 16–19 and 20–24 years fell by 27% and 25%, respectively; and the numbers of licensed adult drivers increased, except in the 25–29, 30–34, and 50–54 age groups (Table 1).

The total crash rates (fatal and non-fatal, Table A1) and fatal crash rates (Figures 1 and A1) decreased in all age groups from 2000–2010. Fatal crash rates per licensed driver were highest in the 16–19 followed by the ≥75 age groups. Injury rates resulting from four-wheeled motor vehicle crashes decreased in the elderly age groups.

Motorized two-wheeled motor vehicle riders

The total crash rates (fatal and non-fatal) per 100,000 licensed riders decreased among the elderly age groups and in the 16–19 and 20–24 age groups (Table A2). Fatal crashes per 100,000 licensed riders decreased in the elderly and the youngest age groups while there was an increase in crash rates for the 25–64 age groups (Figure A2).

Bicyclists

The total crash rates (fatal and non-fatal) among the three elderly groups decreased between 2000 and 2010. In contrast, crash rates increased in younger age groups (Table A3).

Fatal crash rates involving bicycles decreased in all age groups and decreased most in the elderly age groups (Figure 2). However, the annual fatality rate was highest among the elderly.

Pedestrians

Total pedestrian crash (fatal and non-fatal) rates per 1,000,000 population decreased steadily between 2000 and 2010 across all age groups, although the elderly experienced the highest crash rates throughout this period (Table A4).

Fatal pedestrian road traffic crash rates fell in all age groups between the years 2000 and 2010. The annual fatality rates increase with age (Figure 3), and were highest in the ≥75 age group. Although the annual pedestrian fatality rates declined by 71% between 2000 and 2010 for the ≥75 age group, the 2010 fatality rate for the same age group was nine times higher than the rate for the 16–19 age group (Figure 3).

DISCUSSION

The Japanese population structure has changed over ten years; the elderly population has increased and the proportion of young people has fallen. The ≥75 age group had the highest rate of population increase among all the groups, and this partly explains the increase in licensed drivers in this age group. The changes reflect the ageing of Japan's baby–boomer generation from the country's period of rapid economic growth in the late 1960s and early 1970s and the subsequent rapid increase of automobile use in Japan. We attribute the decrease in the number of young license holders (16–24) to Japan's low fertility rate and decreased population.

Although the number of elderly license holders has increased, the road traffic crash rates for all vehicle classes have decreased, and the elderly persons' crash rate for four-wheeled motor vehicles was lower than that in the younger age groups (Table A1). We attribute a large part of this decrease to the introduction and enforcement of road traffic legislations (Table 2).

Differences in crash rate may also arise because the elderly are more likely to use other types of road transport than younger persons. We note there could be inherent differences in elderly persons who drive, ride, or walk, versus those who do not. Many local governments in Japan subsidize public transport for the elderly by issuing free bus coupons, taxis on demand, or other special transportation arrangements. However, public transport systems targeted at the elderly are still under development and could be improved to better serve the growing elderly population.

The rates of fatal crashes resulting from four-wheeled motors vehicles also vary depending how the population of interest is defined. When the overall population proportion of each age group is considered, there is a decrease in fatality rates in all age groups, and the fatality rate for the elderly was lower than that for younger age groups. This indicates that at the population level, road traffic crash fatalities were less frequent among the elderly than among younger people. However, when the number of licensed drivers per age group is used to calculate fatal crash rates, the highest fatality rates are for elderly age groups. The differences in calculated fatality rates using different sample populations at risk has also been reported from other countries (Eberhard et al. 2005; Hakamies-Blomqvist et al. 2005) and may indicate increased fragility with age instead of increased crash risk (Li et al. 2003).

The rates of two-wheeled motor vehicle crashes per licensed rider were lower among the elderly

compared with other age groups, although the rates of fatal crashes were the highest. This may show how increased fragility affects the elderly.

However, we also note that the fatal crash rate calculation does not distinguish licensed active drivers from inactive drivers. This may mean that the real risk of fatal crashes among the active elderly differs from the calculated rates. If inactive, self-limiting elderly riders were excluded from the calculation, the real crash rates in the elderly could be higher than those reported here.

Road traffic crash rates among cyclists differ from those calculated for four-wheeled motor vehicles. Total crash rates increased among younger but decreased in the elderly age groups, but fatal crash rates were higher among the elderly cyclists. We offer two possible explanations: elderly cyclists may be more fragile and thus the fatality rates increase with advanced age. Second, transport preferences may change, and elderly persons may be more likely to use bicycles; in this case elderly cyclists are more likely to be involved in fatal crashes.

Although pedestrian crash rates have decreased in all age groups, the rate among elderly pedestrians was higher than that for younger pedestrians. Elderly persons may be at an increased crash risk because of behaviors such as unsafe crossing of roads or ignoring or being unaware of traffic lights. As above, elderly fatality rates are also higher than those of younger people, reflecting increased fragility. The elderly pedestrian total crash rates decreased significantly (Table A4). This may reflect the implementation of safety advocacy and training by local police agencies throughout Japan.

We consider the decreases in crash and fatality rates in all age groups can be attributed to improved road safety awareness, especially among the elderly, enforcement of legislature to combat risky behaviors among road users, and environmental changes to the road environment (better road construction and management, safer vehicle designs). We intend to use these results to assess the effectiveness of elderly driver licensing legislation in Japan and to compare the effectiveness of different international approaches to road traffic safety among the elderly.

LIMITATIONS

A better measure of risk and crash rates would use the distance travelled per year by each road use category. However, these data were unavailable and we consider that license data indicate vehicle usage and reasonably estimate risk at the group level.

CONCLUSIONS

Crash rates for elderly road users in Japan declined between 2000 and 2010, reflecting improvements in road safety in different modes of transportation. However, elderly pedestrians still have a high risk of being involved in road traffic crashes and fatality rates are high. These results indicate that more effort should be made to enhance road safety for elderly pedestrians, especially considering the expected rapid growth in the elderly population.

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TABLES AND FIGURES

Table 1. Changes in population and number of licensed drivers by age group in Japan between 2000–2010.

Age group	Population			License Holders		
	Year		%	Year		%
	2000	2010	change*	2000	2010	change*
16-19	7,433,115	6,028,600	-18.90	1,110,154	813,105	-26.76
20-24	8,300,297	6,304,880	-24.04	6,742,810	5,041,282	-25.23
25-29	9,626,221	7,154,666	-25.68	8,951,081	6,632,433	-25.90
30-34	8,608,881	8,213,960	-4.59	8,156,635	7,753,537	-4.94
35-39	7,978,061	9,688,045	21.43	7,495,975	9,215,350	22.94
40-44	7,706,162	8,650,602	12.26	6,906,744	8,226,254	19.10
45-49	8,845,461	7,966,133	-9.94	7,334,049	7,473,226	1.90
50-54	10,391,001	7,608,317	-26.78	8,211,384	6,810,665	-17.06
55-59	8,698,453	8,656,055	-0.49	5,698,901	7,140,682	25.30
60-64	7,711,606	10,054,575	30.38	4,217,837	7,821,404	85.44
65-69	7,091,585	8,230,222	16.06	3,119,804	5,198,253	66.62
70-74	5,889,998	6,987,391	18.63	1,958,851	3,468,871	77.09
75+	8,979,838	14,149,539	57.57	1,064,812	3,207,621	201.24

Data sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), Licensing data (Institute for Traffic Research and Data Analysis, Japan)

* Percent change in licensing rate: 2010 from 2000

Table 2. Summary of road traffic laws introduced in Japan between 2000 and 2010

Date	Law
April 1, 2000	Mandatory use of child safety seat until 6 years old
June 1, 2002	Increased enforcement and higher penalties for risky driving
	'Age change' for elderly license laws (testing and mark: 75 to 70 years old)
	"Four leaf clover mark" on cars for disabled drivers
November 1, 2004	Increased enforcement and higher penalties for: ➢ cell phone use ➢ alcohol testing
September 19, 2007	Increased enforcement and higher penalties for drunk driving
June 1, 2008	Mandatory: ➢ seatbelt for rear seat occupants ➢ "autumn leaf mark" use on cars for elderly drivers
April 17, 2009	Mandatory use of "autumn leaf mark" for elderly drivers changed to optional (or encouraged)
June 1, 2009	Cognitive impairment screening test for aged 75 or over

Data Sources: Ministry of Justice, Japan

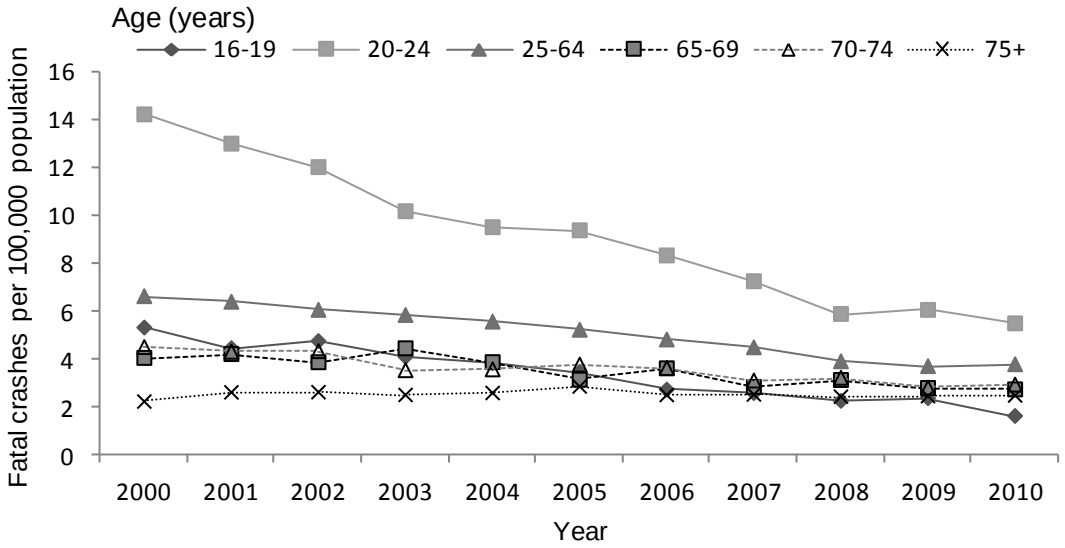

Figure 1. Fatal four-wheeled motor vehicle crashes per 100,000 population among primary party* by age group in Japan, 2000–2010.

Data Sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), fatal crash data (Institute for Traffic Research and Data Analysis, Japan)

*A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

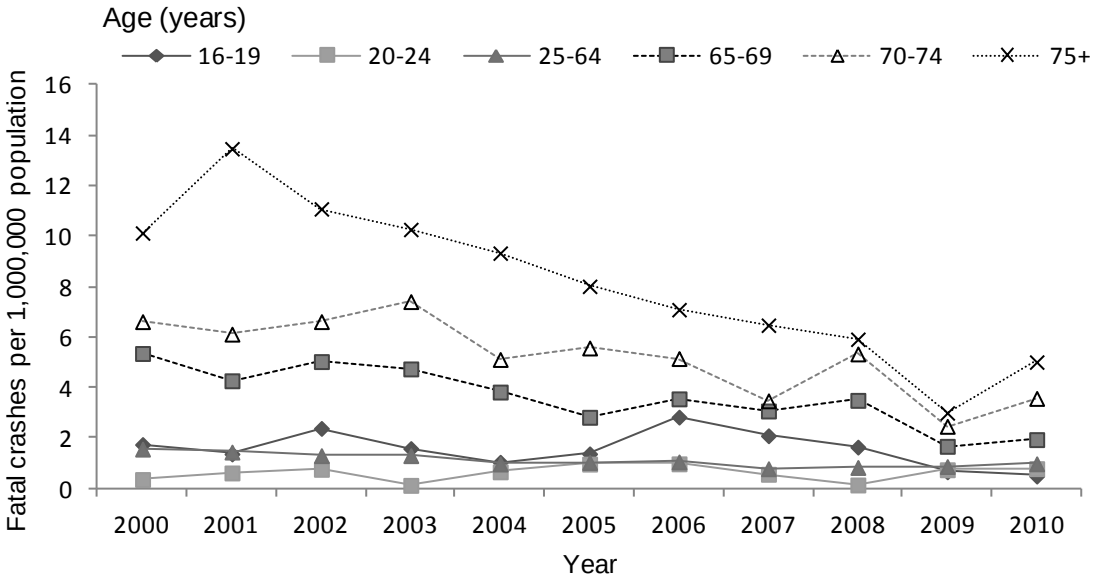

Figure 2. Fatal bicycle crashes per 1,000,000 population among primary party* by age group in Japan, 2000–2010.

Data Sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), fatal crash data (Institute for Traffic Research and Data Analysis, Japan)

*A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

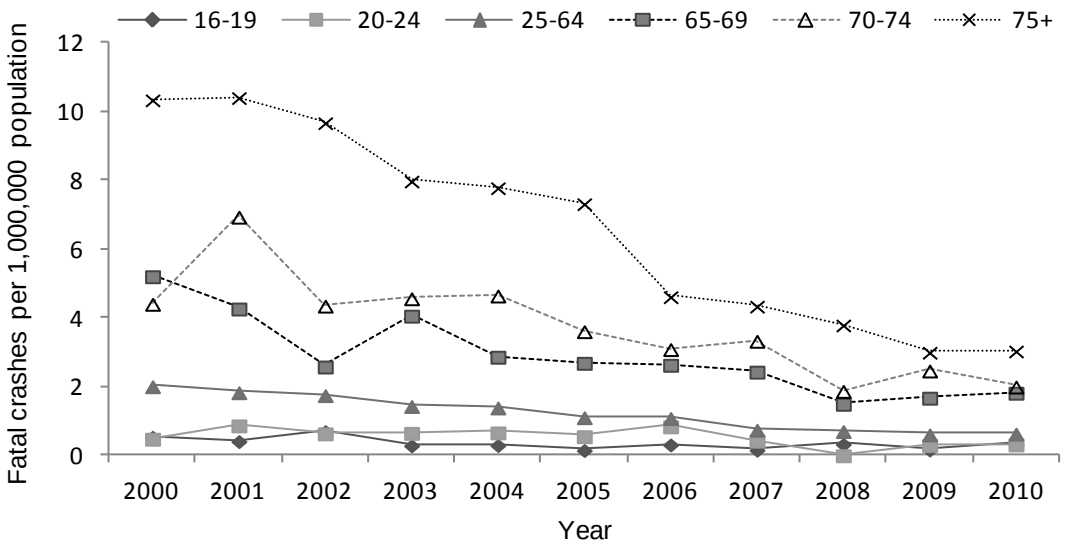

Figure 3. Fatal pedestrian crashes per 1,000,000 population primary party* by age group in Japan, 2000–2010.

Data sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), fatal crash data (Institute for Traffic Research and Data Analysis, Japan)

*A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

Appendix

Table A1 Four-wheeled motor vehicle crashes per 100,000 licensed drivers among primary party* by age group in Japan, 2000–2010

Age group	Year											%Change
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
16-19	3239	3202	3124	3163	3105	3004	2835	2732	2493	2434	2391	-26.2
20-24	1918	1887	1812	1823	1789	1772	1689	1577	1425	1399	1391	-27.5
25-29	1365	1387	1331	1320	1299	1246	1181	1076	992	975	975	-28.6
30-34	1056	1056	1070	1075	1070	1035	975	890	805	778	773	-26.8
35-39	902	961	922	957	968	956	879	823	763	731	735	-18.5
40-44	903	924	897	919	916	894	871	789	732	717	726	-19.6
45-59	932	933	913	916	914	891	838	772	712	683	679	-27.2
50-54	955	982	981	975	969	929	875	810	727	693	682	-28.6
55-59	1110	1101	1017	1021	995	963	929	893	814	764	731	-34.1
60-64	1057	1042	1037	1015	1026	1032	956	872	811	759	727	-31.2
65-69	1024	1040	1025	1035	1021	992	929	894	810	783	790	-22.9
70-74	1015	1036	1018	1018	1037	1025	984	942	882	843	820	-19.2
75+	1190	1174	1177	1180	1200	1177	1113	1072	1007	1012	968	-18.7

Data sources: Licensing data and crash data (Institute for Traffic Research and Data Analysis, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

** Percent change in rates: 2010 from 2000

Table A2 Two-wheeled motor vehicle crashes per 100,000 licensed riders among primary party* by age group in Japan, 2000–2010

Age group	Year											%Change
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
16-19	2552	2599	2590	2521	2634	2610	2562	2695	2542	2445	2354	-7.75
20-24	4293	4340	4414	4431	4587	4617	4414	4534	4097	4016	3762	-12.37
25-29	5722	5679	5659	5319	5445	5099	4733	4381	3815	3750	3613	-36.86
30-34	4863	5115	5493	5585	5775	5511	5109	4866	4221	3808	3561	-26.76
35-39	3688	4023	4376	4712	5069	5333	5148	4957	4650	4278	3795	2.91
40-44	2709	3052	3351	3518	3924	4219	4325	4381	4060	4159	4052	49.55
45-49	1653	2001	2211	2550	2849	3381	3318	3492	3635	3398	3359	103.16
50-54	1072	1210	1366	1556	1753	1888	2069	2265	2416	2577	2672	149.25
55-59	841	882	953	986	1129	1184	1213	1338	1391	1405	1495	77.71
60-64	689	670	726	724	774	844	829	848	833	892	872	26.68
65-69	719	688	711	690	693	684	699	690	617	607	643	-10.56
70-74	759	766	750	721	722	763	729	753	698	651	646	-14.97
75+	1067	1045	973	1015	1008	1003	936	940	929	913	902	-15.51

Data sources: Licensing data and crash data (Institute for Traffic Research and Data Analysis, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

** Percent change in rates: 2010 from 2000

Table A3 Bicycle crashes per 1,000,000 population among primary party* by age group in Japan, 2000–2010

Age group	Year											%Change
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
16-19	600	566	578	583	635	645	655	673	656	628	665	10.96
20-24	212	194	206	220	252	272	271	272	291	290	294	38.83
25-29	126	120	127	133	154	159	166	173	178	179	167	31.89
30-34	103	99	102	111	127	123	130	135	125	122	122	18.53
35-39	99	93	99	107	124	128	120	123	125	119	113	14.93
40-44	84	78	97	100	117	121	123	117	126	112	106	26.73
45-49	102	85	93	96	105	111	109	111	109	102	102	0.07
50-54	117	110	120	122	129	126	119	113	103	96	96	-17.36
55-59	145	133	143	135	141	142	132	132	123	110	99	-31.79
60-64	184	163	166	175	189	177	169	153	146	132	112	-38.85
65-69	212	189	200	211	226	205	204	195	164	156	147	-30.80
70-74	207	196	206	210	230	231	223	222	202	191	165	-20.20
75+	210	196	196	191	204	186	182	181	166	159	149	-29.14

Data sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), crash data (Institute for Traffic Research and Data Analysis, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

** Percent change in rates: 2010 from 2000

Table A4 Pedestrian crashes per 1,000,000 population among primary party* by age group in Japan, 2000–2010

Age group	Year											%Change
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
16-19	27.98	19.38	21.78	17.63	16.75	15.33	15.28	12.42	12.02	12.50	9.45	-66.21
20-24	30.48	29.98	26.57	21.95	21.45	19.32	18.83	17.51	12.66	11.08	11.58	-62.01
25-29	23.37	21.76	21.65	20.10	16.15	15.44	15.66	15.22	12.06	12.38	10.06	-56.95
30-34	22.19	19.38	17.76	16.73	15.17	13.45	13.14	12.34	8.31	8.46	8.52	-61.59
35-39	22.31	17.19	18.27	17.59	14.01	15.01	13.32	13.32	10.51	8.39	7.54	-66.23
40-44	20.89	18.71	16.67	17.85	14.15	15.18	13.40	11.03	9.82	8.78	6.70	-67.91
45-49	20.35	17.30	17.00	15.32	17.14	14.90	12.26	12.34	9.40	7.92	7.91	-61.14
50-54	26.47	25.58	22.59	21.84	17.45	16.01	13.20	12.43	11.12	9.80	7.36	-72.19
55-59	33.11	28.04	26.03	23.37	21.60	17.90	19.53	12.45	10.55	10.37	10.05	-69.64
60-64	37.35	31.73	26.67	22.75	23.12	23.10	17.30	13.90	13.70	10.15	10.74	-71.24
65-69	39.91	33.66	30.77	32.55	25.98	23.44	19.12	20.26	15.50	13.67	12.88	-67.73
70-74	41.77	37.09	30.04	30.61	25.92	24.42	21.66	20.60	19.49	19.62	14.17	-66.08
75+	54.01	46.95	39.76	35.29	35.90	30.01	24.34	23.54	19.51	17.86	15.90	-70.56

Data sources: Population data (Vital Statistics, Ministry of Health Labour and Welfare, Japan), crash data (Institute for Traffic Research and Data Analysis, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

** Percent change in rates: 2010 from 2000

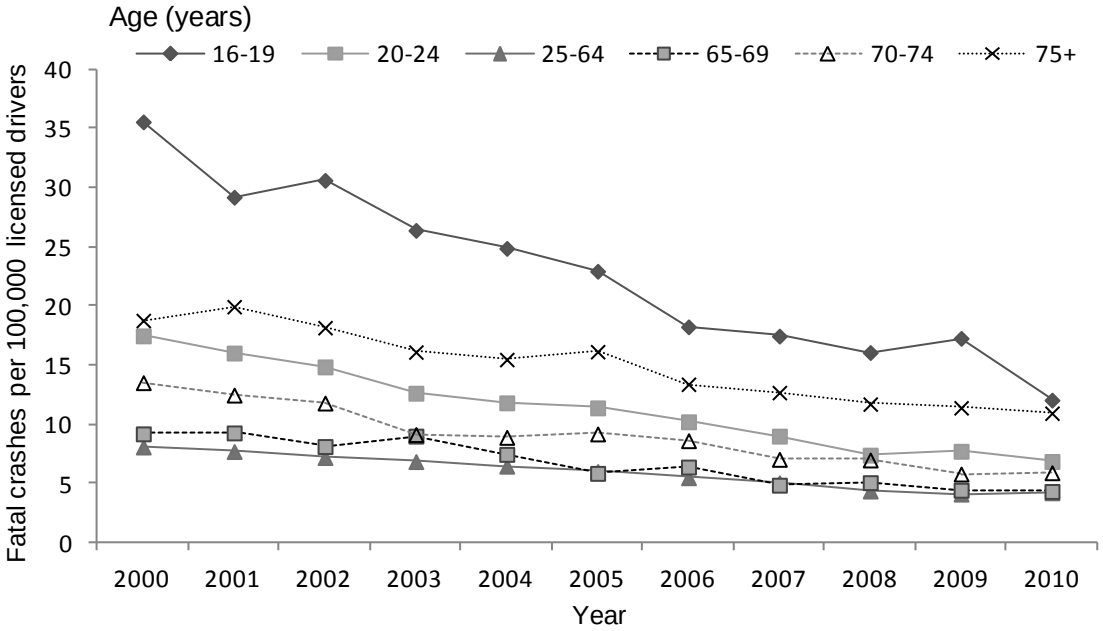

Figure A1 Fatal four-wheeled motor vehicle crashes per 100,000 licensed drivers among primary party* by age group in Japan, 2000–2010

Data Sources: Licensing data and fatal crash data (Institute for Traffic Research and Data Analysis, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.

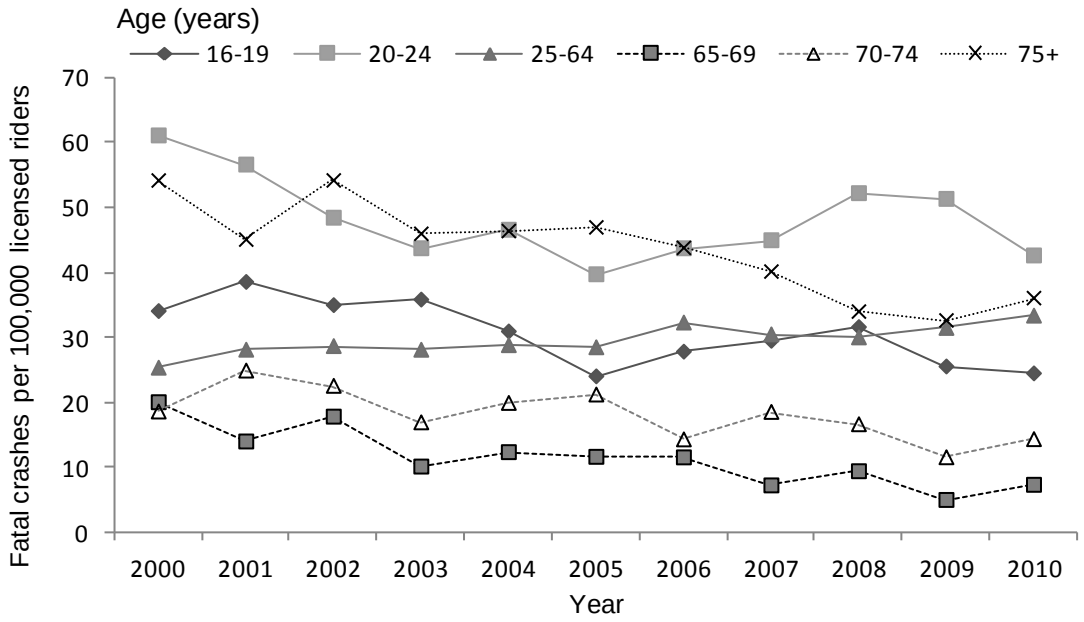

Figure A2 Fatal two-wheeled motor vehicle crashes per 100,000 licensed riders among primary party* by age group in Japan, 2000–2010

Data Sources: Licensing data and fatal crash data (Institute for Traffic Research and Data, Japan)

* A person most negligent of those involved in a traffic crash, or, if the level of negligence is almost the same, the least injured party.