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Older drivers in rural and urban areas: Comparisons of crash, serious injury, and fatality rates

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Abstract

Previous analyses of crash statistics have indicated that older drivers (aged 65 years and older) have fewer crashes than other age groups. However, they have an elevated crash risk on a per kilometre driven basis and are at an increased risk of death and serious injury from crashes. Rural older drivers may be particularly at risk due to a greater dependence on driving, which may create a reluctance to cease driving. It is often demonstrated that motor vehicle crash fatality rates are higher in rural areas than urban areas. However, more research that compares the crash, serious injury, and fatality rates of rural and urban older drivers is required. A database of police-reported road crashes in South Australia, the Traffic Accident Reporting System, was used to obtain crash, serious injury, and fatality data for 2004 to 2008. The crash involvement of drivers of various age groups from both rural and urban areas was adjusted for population and licensure exposure measures. Crashes involving rural drivers aged 75 and over were more likely to have resulted in a serious or fatal injury than crashes involving their urban counterparts. The results indicate that rural older drivers present a unique road safety problem.

Keywords

Older drivers, crash rate, rural areas, urban areas, fatality, serious injury

Introduction

Research investigating the crash risk of older drivers (here defined as persons aged 65 years and older) has demonstrated that crash numbers decline with age [1, 2]. In fact, drivers over the age of 65 have a lower number of crashes than all other age groups. Even after controlling for decreases with age in population and rates of licensure, older drivers still have fewer crashes. Older drivers also drive fewer kilometres, on average, than drivers from other age groups, which may account for their low crash numbers. Indeed, when controlling for the number of kilometres driven, studies have demonstrated that older drivers have an elevated crash risk on a per kilometre driven basis, which is second only to the very youngest age groups.

In addition to this elevated crash risk per distance driven, older drivers are at an increased risk of death [3] and serious injury [1-5] from crashes in which they are involved. This is attributed to increased frailty with older age [6]. In support of this, Hanrahan et al. [3] have demonstrated that drivers aged 85 years and older were greater than five times more likely to experience a moderate or severe injury than those aged 25 to 44 and are the age group most likely to die or to suffer an injury in a crash.

The crash, serious injury and fatality risk of older adults in rural areas may be greater than that of urban older drivers because they may be less able to reduce or cease driving when they are no longer fit to drive. This may be due to several reasons. First, public transport is generally less available or not available at all. Indeed, Corcoran et al. [7] found that in Victoria, Australia the proportion of older drivers with access to public transport decreases as rurality increases. Second, family and friends are likely to live further away and, therefore, be less available to provide transport [8]. Finally, necessary services, such as general practitioners and supermarkets, are often further away and only accessible by car. Therefore, older adults who live rurally are more dependent on the car and the ability to drive to meet their mobility requirements. Consequently, rural older drivers may have a greater crash risk.

Past research has shown that motor vehicle crash death rates, in general, are higher in rural areas than urban areas [9-13], which has been attributed to higher speed limits [14], delayed medical care [15], reduced availability of medical care [13], and alcohol use [9]. With regard to age, two studies [9, 12] examining motor vehicle crash deaths in rural areas of Michigan, USA found an association between

driver age and fatal crashes in rural areas and that older drivers were more likely to be involved in rural crashes. However, they did not directly compare the serious injury and fatality rates between rural and urban older drivers, and their analyses only examined three age groups (16-25, 26-50 and over 50). Therefore, further research is required to comprehensively compare the crash, serious injury and fatality rates of rural and urban older drivers to determine whether they are higher for rural older drivers. The current research was designed to meet this need.

This study examined the crash involvement (total crashes, crashes per head of population and per licensed driver) of rural and urban drivers separately, and compared the likelihood of a serious injury or fatality from a crash for rural and urban older drivers. Based on the literature, it was hypothesised that older drivers (65 years and older) have lower crash rates but higher rates of serious or fatal injury than drivers aged 16 to 64 years, and that rural older drivers have higher rates of serious or fatal injury than urban older drivers.

Method

Materials

Crash data for the years 2004 to 2008 inclusive were obtained from the Traffic Accident Reporting System (TARS), which is a database of all police-reported road crashes in South Australia managed by the Department for Transport, Energy and Infrastructure (DTEI). For a crash to be included in TARS, at least one of the participants must have been injured, \$3000 or more worth of damage caused, or one of the vehicles towed away. If any of these criteria are fulfilled, then the participants are required to report the crash to the police.

Population data for South Australia were obtained from the Australian Bureau of Statistics (ABS). These data were organised by age and rural or urban area (as defined by the statistical local area and postcode) from 2004 to 2008. From these data, the average annual population over the five years for each age group across both areas was calculated. This was then used to calculate the crash rate per head of population for all age groups in both living areas.

DTEI provided data on driving licensure, which were used to estimate the number of licensed drivers in South Australia by age and postcode of the individual so that crash rates on a per licensed driver basis could be calculated for rural and urban areas. Ideally these data would have been obtained for the years 2004 to 2008 so that a yearly average over the five years could be calculated, but data were only available for 2009. An estimate of the number of licensed drivers that is based on data from the year subsequent to the time period of interest is likely to introduce some bias to the results but was expected to be minimal, given that the difference in amount of licensure would be relatively small.

Procedure

The variables in the TARS database that were extracted were age, postcode of the driver, crash injury severity and driver injury severity. The postcode of the driver was used to determine whether he or she lived in a rural or urban area of South Australia. Crashes where the driver lived interstate or where the postcode was not known were excluded. Crash injury severity refers to the degree of injury incurred by the most severely injured participant (vehicle occupant or pedestrian) involved in the crash and has five levels of severity: property damage only (no injury), injury requiring treatment from a private doctor, injury requiring treatment at a hospital, injury requiring admission to a hospital, and fatal injury. Driver injury severity has the same five levels of severity but refers to degree of injury incurred by the driver. For the purposes of this research, a serious injury was defined as admission to hospital. Data from TARS are particularly useful because property damage only crashes are included. This provides a much more detailed picture of the extent of overall crash involvement in comparison to databases that only include injury crashes.

Age was divided into the following groups: 16-24, 25-34, 35-44, 45-54, 55-64, 65-74, 75-84, and 85 and over. For present purposes, drivers aged 65 and older were labeled "older drivers". An individual cannot obtain a driver's licence in South Australia until they are 16 years of age. There were, however, crashes recorded in the TARS database in which the age of the driver was less than 16, suggesting that these

individuals were unlicensed and driving illegally at the time. Consequently, these crashes were included in the initial assessment of total crash involvement but excluded from subsequent analyses.

It was necessary to use data from TARS that related to crash-involved drivers rather than the crashes themselves in order to examine the age of the drivers involved in crashes. One of the consequences of using these data is that, for crashes involving multiple drivers, each driver would have a separate entry in the database. Therefore, a single crash that involved more than one driver would represent multiple crashes. Crashes were only included in this study if the crash-involved driver was driving a car or similar vehicle (e.g. utility, panel van, station wagon). Car drivers were deemed to be of central interest in this study because the characteristics of crashes involving drivers of other vehicles (e.g. taxis, trucks, etc.) may be fundamentally different.

Results

The crash sample in this study was very large. Therefore, the common technique of analysing frequency data, using chi-square analyses, would be likely to find small group differences statistically significant, while meaningful significance (i.e. a substantial road safety issue) would be minimal. Thus, a comparison of frequencies and 99 per cent confidence intervals was used instead. Statistical significance was determined at the $p < .01$ level by assessing any overlap of confidence intervals. If there was no overlap between the groups being compared they were considered to differ significantly. A conservative alpha level of .01 was used in order to protect against the increased likelihood of Type I errors resulting from multiple comparisons and to maintain a consistent alpha level across all analyses.

Crash rates

There was a total of 157,312 South Australian drivers of passenger vehicles who were involved in crashes in South Australia that were reported to the police in the years 2004 to 2008. In 149,729 (95.2%) of these, the age of the driver was recorded.

Table 1 illustrates the total number of crashes by age group in both rural and urban areas, and reveals that they decline with each successive age group (excluding those under 16 years of age, as they are not licensed drivers). Additionally, for all age groups, urban drivers have a larger number of crashes than rural drivers.

Table 1: Number of Crash-Involved Drivers by Age for Rural and Urban Areas of South Australia for the Years 2004 to 2008

Age Group	Rural Number of Crashes	% (where age known)	Urban Number of Crashes	% (where age known)
<16	27	0.1	81	0.1
16-24	8,013	31.0	34,076	27.5
25-34	4,594	17.8	26,149	21.1
35-44	4,392	17.0	23,145	18.7
45-54	3,699	14.3	18,531	15.0
55-64	2,533	9.8	11,563	9.3
65-74	1,411	5.5	5,783	4.7
75-84	930	3.6	3,818	3.1
85 +	221	0.9	763	0.6
Unknown	757	-	6,826	-
Total Known	25,820	100.0	123,909	100.0
Total	26,577		130,735	

In order to understand better the crash rates by age of urban and rural drivers, it was necessary to examine their rates on a per head of persons of that age in the population. This was achieved by dividing the number of crashes by the number of people in each age group (5 year average, 2004 to 2008) for rural and urban areas. Table 2 displays the 5 year average (2004 to 2008) population numbers for each of the age groups for rural and urban areas and illustrates that, for both areas, the largest population group is for middle age and numbers then steadily decrease into the older age groups. Figure 1 additionally displays the percentages of the population in each age group across both areas who were involved in a crash

between 2004 to 2008. This shows that the crash rates decline with increasing age in both areas and that older drivers are under-represented in crash involvement when the data are adjusted for population numbers. Additionally, it can be seen that, except for the 85+ age group, urban drivers have a higher level of crash involvement on a per head of population basis.

Table 2: Rural and Urban Population by Age Group (Aged 16 and Over, 5 Year Average 2004 to 2008) for South Australia

Age Group	Rural (<i>n</i>)	%	Urban (<i>n</i>)	%
16-24	43,711	13.3	147,649	15.9
25-34	46,796	14.2	153,099	16.5
35-44	60,541	18.4	165,127	17.8
45-54	61,216	18.6	160,828	17.3
55-64	52,650	16.0	129,262	13.9
65-74	34,704	10.5	84,042	9.0
75-84	22,545	6.8	65,227	7.0
85+	7,556	2.3	23,631	2.5
Total	329,719	100.0	928,865	100.0

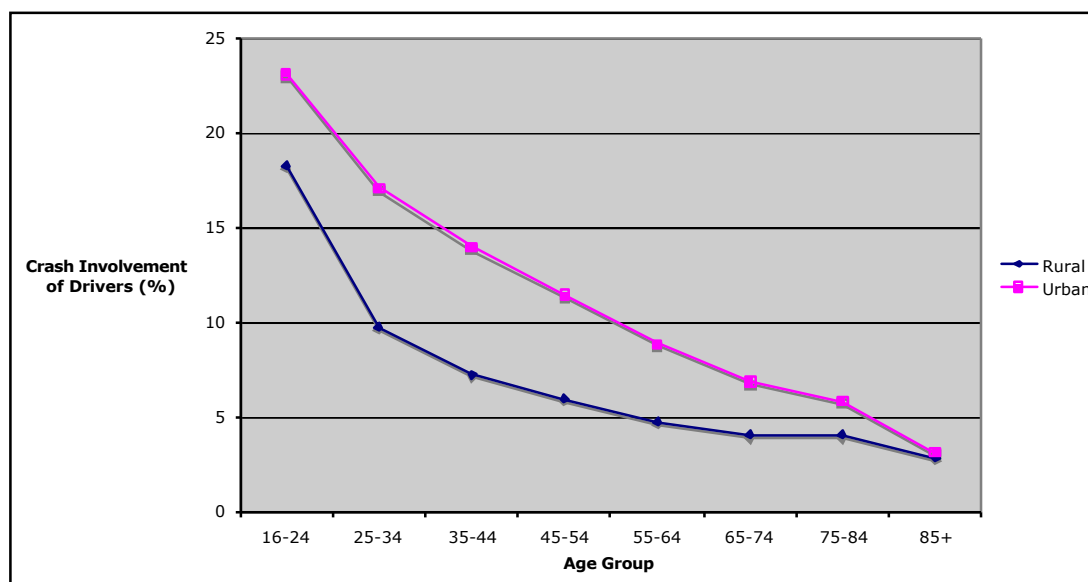
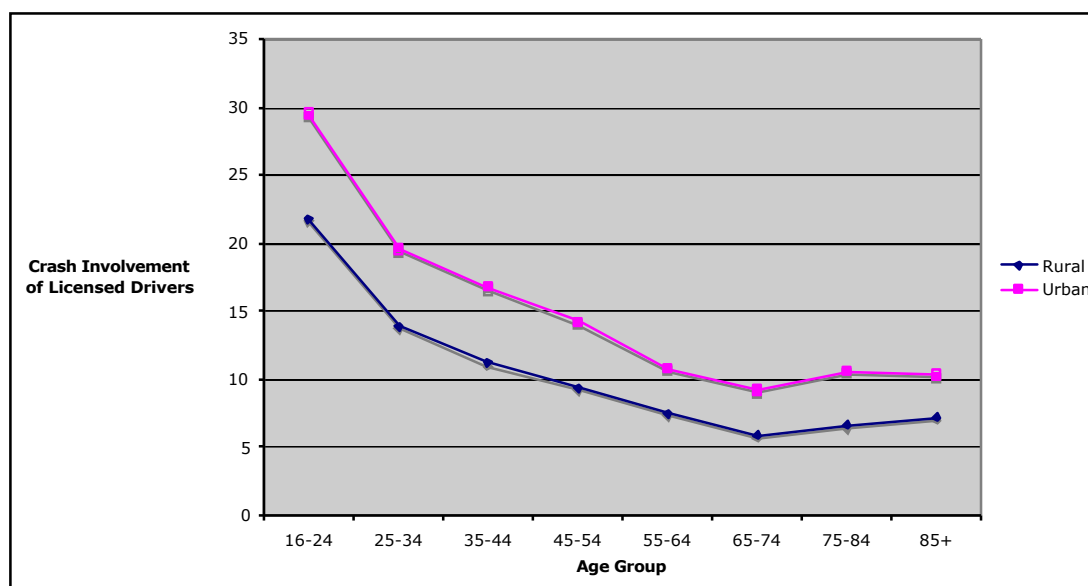


Figure 1: Proportion of rural and urban population (based on 5 year averages of population, 2004 to 2008) who were drivers involved in crashes by age group, South Australia.

Table 3 presents the number of licensed drivers in each age group for rural and urban living areas in 2009 and shows that licensure decreases markedly over the age of 64. Therefore, to understand better the crash rates for different age groups, it is also important to examine crash rates on a per licensed driver basis. To do this, the number of crashes was divided by the number of licensed drivers in 2009 for each age group across both areas. Figure 2 presents the percentages of licensed drivers in each age group across both areas who were involved in a crash between 2004 and 2008. In the 16 to 64 age groups, these crash rates per licensed driver display a similar trend as the per head of population rates, in that they decline with each successive age group. However, in the older age groups (65 and over), especially in rural areas, the rates level out and even begin to slightly increase. Additionally, it can be seen that urban drivers have a higher level of crash involvement on a per licensed driver basis across all age groups.

Table 3: Number of Licensed Drivers in South Australia, 2009, by Age Group and Living Area

Age Group	Rural (<i>n</i>)	%	Urban (<i>n</i>)	%
16-24	36,822	16.5	115,409	15.8
25-34	33,114	14.8	133,704	18.3
35-44	39,166	17.5	137,524	18.8
45-54	39,334	17.6	130,836	17.9
55-64	33,959	15.2	106,829	14.6
65-74	23,767	10.6	62,882	8.6
75-84	14,175	6.3	35,921	4.9
85+	3,063	1.4	7,443	1.0
Total	223,400	100.0	730,548	100.0

**Figure 2:** Percentage of rural and urban licensed drivers involved in crashes by age, South Australia.

Note: The number of licence holders is based on 2009 figures while the number of crashes is based on a 5 year average over 2004 to 2008.

Crashes involving serious or fatal injury

The hypothesis that crashes involving older drivers would be more likely than crashes for drivers aged 16 to 64 to have resulted in a serious or fatal injury (according to crash injury severity) was assessed by calculating the proportion of serious or fatal injury crashes for each age group separately for rural and urban areas.

Figure 3 illustrates a trend in which, for both rural and urban areas, the proportion of serious crash involvement generally declines slightly with age, reaching a low around middle adulthood (i.e. the 45-54 and 55-64 age groups), but begins to increase to the highest levels in older age. For rural drivers, there is an overlap of the confidence intervals for all age groups, despite the trend being in the expected direction. Thus, rural older drivers are not statistically significantly more likely than drivers aged 16 to 64 to be involved in serious crashes. However, for urban drivers, the 75 to 84 and 85+ groups are significantly more likely to be involved in serious crashes than the other age groups. Additionally, except for the 85+ age group, rural drivers have higher percentages of serious or fatal injury resulting from crashes than urban drivers.

Figure 3 indicates that, at least for urban areas, the difference in the likelihood of serious or fatal injury between older drivers and drivers in younger age groups exists predominantly between drivers aged 75 years and above and those aged 16 to 74. Therefore, although drivers aged 65 years and older have conventionally been categorised as “older drivers”, it appears that, in this study, drivers aged 75 and older are the older drivers of particular interest when investigating the likelihood of serious or fatal injuries resulting from a crash.

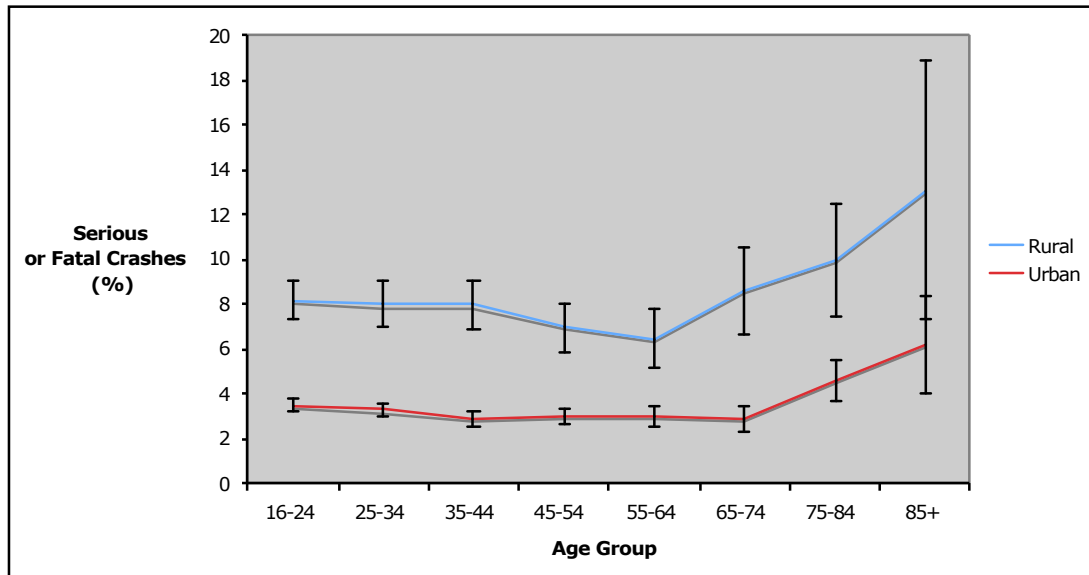


Figure 3: Percentage of serious or fatal injury crashes by age group and residential location of the driver (rural or urban) for the years 2004 to 2008, South Australia.

Note: Confidence intervals are illustrated by the black lines.

Consequently, the hypothesis that crashes involving rural older drivers would be more likely than those for urban older drivers to have resulted in a serious or fatal injury was assessed by using the figures for drivers aged 75 years and over instead of for 65 years and over. The percentage of serious or fatal crashes involving a rural driver aged 75 and over (10.6%, 99%CI = 8.3-12.9) was more than double that for urban drivers aged 75 and over (4.8%, 99%CI = 4.0-5.6), as illustrated in Figure 4. In addition, serious or fatal crash involvement was compared for rural and urban drivers aged 16 to 74. The serious or fatal crash involvement for drivers aged 16 to 74 in both rural (7.8%, 99%CI = 7.4-8.2) and urban (3.0%, 99%CI = 2.9-3.1) areas were significantly lower than the corresponding crash involvement for drivers aged 75 and over. As there is no overlap in any of the confidence intervals, this indicates that living rurally and being aged 75 and over both lead to a significantly greater likelihood that a serious or fatal injury will result when involved in a crash. The effect of location, however, is stronger than age.

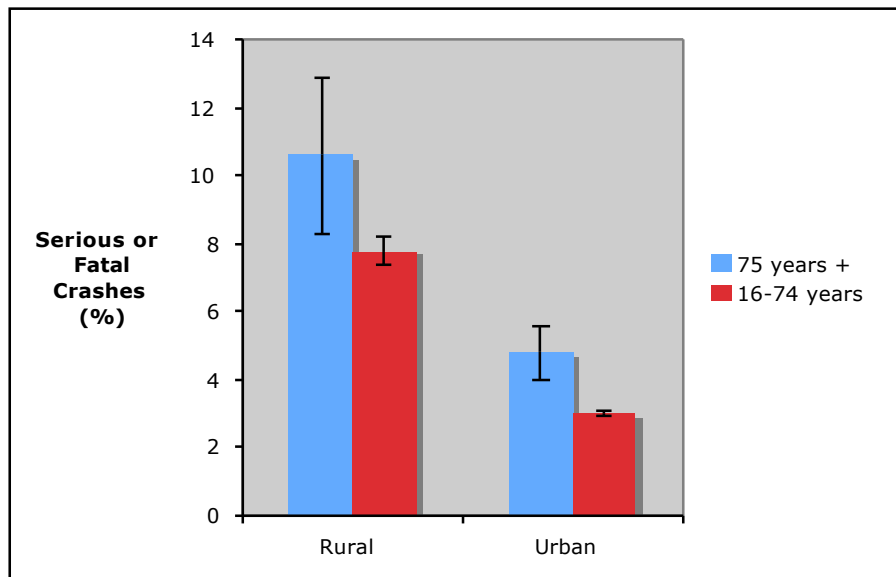


Figure 4: Comparison of the serious or fatal crash involvement of older drivers (aged 75 and over) and drivers aged 16 to 74 by residential location of the driver (rural and urban) for the years 2004 to 2008, South Australia.

Note: Confidence intervals are illustrated by the black lines.

The percentage of serious or fatal injury to rural and urban *drivers* in each age group is shown in Figure 5. There is a general trend in which, for both rural and urban drivers, the percentage steadily declines with age until older age when it begins to increase to the highest levels. For rural drivers the confidence intervals overlap so that only the oldest driver group (85+) and the two middle age groups (45-54 and 55-64) are statistically different from each other. For urban drivers, the 75 to 84 and 85+ groups are significantly more likely to be seriously injured or killed than the other aged groups. Additionally, except for the 85+ age group, rural drivers have higher percentages of crashes where the driver was seriously or fatally injured than urban drivers.

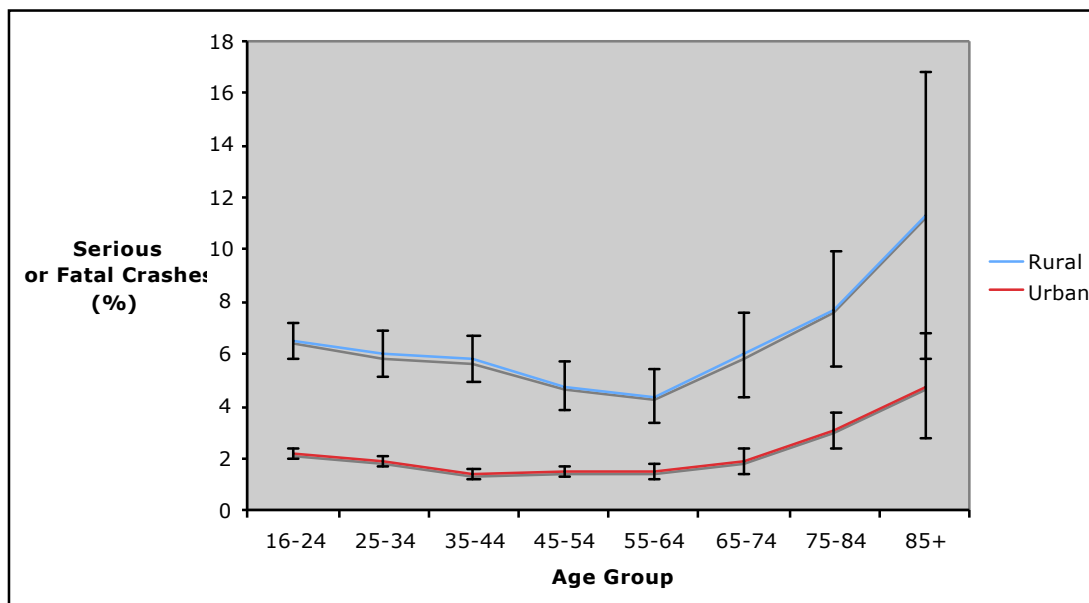


Figure 5: Percentage of rural and urban drivers seriously injured or killed by age group for the years 2004 to 2008, South Australia.

Note: Confidence intervals are illustrated by the black lines.

Figure 5 indicates that the difference in the likelihood of older drivers being seriously or fatally injured in crashes compared to drivers in younger age groups exists predominantly between drivers aged 75 years and above and those aged 16 to 74. Therefore, it appears that drivers aged 75 and older are also the older drivers of particular interest when investigating the likelihood of the driver being seriously or fatally injured in a crash.

It was predicted that the rural older drivers who were involved in a crash would be more likely than urban older drivers to have been seriously or fatally injured. For this comparison, serious crash involvement of rural and urban drivers aged 75 and over was compared. Consistent with the prediction, the percentage of rural drivers aged 75 and over who were seriously or fatally injured (8.4%, 99%CI = 6.3-10.5) was more than double that of urban drivers aged 75 and over (3.4%, 99%CI = 2.7-4.1), as demonstrated in Figure 6. Figure 6 also shows that the percentages of seriously or fatally injured drivers aged 16 to 74 in both rural (5.8%, 99%CI = 5.4-6.2) and urban (1.8%, 99%CI = 1.7-1.9) areas were significantly lower than the corresponding percentages for drivers aged 75 and over. As there is no overlap in any of the confidence intervals, this indicates that living rurally and being aged 75 and over both lead to a significantly greater likelihood of serious or fatal injury for crash-involved drivers. The effect of location, however, is stronger than age.

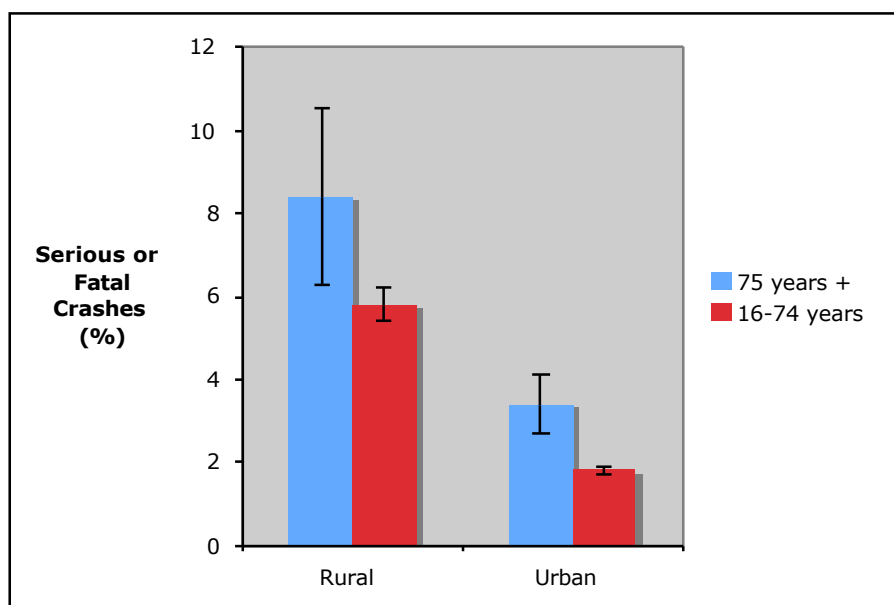


Figure 6: Comparison of the proportions of seriously or fatally injured rural and urban drivers by age (75 and over; 16 to 74 years) for the years 2004 to 2008, South Australia.

Note: Confidence intervals are illustrated by the black lines.

Discussion

The results of this investigation replicate some of the findings of previous research into the crash involvement of older drivers. Consistent with past research [1, 2], it was found that older drivers have fewer crashes than all other age groups and that this is still the case when differences between age groups in population numbers and amount of licensure are taken into account. These previous findings were extended by demonstrating that these trends in crash involvement were evident in both rural and urban drivers. Also, corresponding with previous research [1-5], older drivers had a greater likelihood than other age groups of being involved in crashes that resulted in a serious injury or fatality and where they were themselves seriously or fatally injured. Again, this study additionally assessed this for both rural and urban drivers.

Furthermore, serious and fatal injury crash rates for rural and urban drivers aged 75 years and older were compared and it was found that rural drivers of that age have more than twice the likelihood of being involved in such crashes than their urban counterparts. When the serious injury and fatality rates of rural and urban drivers aged 75 and older were compared to rural and urban drivers aged 16 to 74, the drivers

aged 75 and older for both areas had a significantly greater likelihood of being involved in these crashes. Therefore, a greater likelihood of serious injury and fatality is related to the driver living rurally and being in the 75 and older age range. Thus, this study indicates that the age range of particular interest when looking at serious or fatal injury crashes is 75 years and above, rather than the traditional conception of older drivers being those aged 65 years and older. This would fit with notions that people are living longer and healthier lives, and that their health and abilities do not decline until later in life compared with previous cohorts.

It was hoped that crash rates on a per kilometre driven basis could have been assessed. However, due to the inadequacy and paucity of the available distance travelled exposure data this assessment was not possible. In particular, exposure data that would allow a comparison of rural and urban older drivers was not available. Consequently, future research should attempt to gain reliable and objective exposure data that could be used for such analyses. Research [16], however, has indicated that, especially from the perspective of the re-licensing of older drivers, the important crash rate to consider is that of crashes per licensed driver, and this was undertaken in the current study.

Another limitation of the study relates to the possibility that the police-reported crash data are affected by the under-reporting of crashes. This is likely to be a greater problem for crashes of low severity. If the likelihood of low severity crashes being reported differs by the age of the driver or the location of the crash (urban versus rural), then this will affect the pattern of results. Previous research has indeed found a greater degree of under-reporting of lower severity crashes in rural or remote locations [17, 18]. Whilst such under-reporting could lead to an over-estimate of the increased likelihood of a severe injury in a rural crash, it is unlikely to be the sole reason for the patterns of crash injury severity identified in this study.

The overall conclusion of this investigation is that older drivers who live rurally present the highest risk of serious injury and fatality from the crashes in which they are involved, when compared to all other driver groups defined in terms of age and residential locality. When investigating the safety of older drivers in general, this study provides clear evidence that rural older drivers comprise a subgroup that deserves significant attention from road safety research.

With regard to future research, it would be particularly beneficial to examine the potential underlying causes of the greater likelihood of serious or fatal injury crashes for rural older drivers. The age effect may be due to increased frailty or declining abilities, while the location effect may be related simply to the higher speed limits on rural roads. However, given the need for the ongoing mobility of older adults [19-21], and the likely greater needs for driving in rural areas due to the lack of availability of other options [7, 8], there is often a compelling need for older drivers in rural areas to continue driving. For this reason, it is important to take a closer look at the nature of crashes involving rural older drivers, and the nature of their mobility needs, to determine if there are changes that can be made to driving patterns or behaviours to mitigate the risk of severe injury crashes, while enabling continued mobility. Furthermore, such an analysis could identify changes that could be made by road and transport authorities to help older adults in rural areas safely meet their mobility needs.

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