Title: **A Tale of two surveys: Explaining older drivers' low mileage bias.**

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ABSTRACT:

The widespread claim that older drivers are overly involved in crashes has apparent support from crash data, especially when rates are calculated on a per-kilometre basis. However, independent of age, drivers driving long distances will typically have lower crash rates per kilometre than those driving shorter distances. Data from a growing number of sources confirm that when the crash rates of drivers of different ages are compared after being matched for yearly driving distance, most older drivers are as safe or even safer than drivers from all other age groups. The present papers uses two travel surveys- one in Victoria, one in New Zealand - to demonstrate and quantify two factors which contribute to the association between older drivers' extent of annual mileage and level of crash involvement. The two factors are: (1) the extent to which low mileage older drivers are more likely to use the urban road network with its greater concentration of potential conflict points; and (2) the extent to which low mileage older drivers are more likely to have reduced fitness to drive.

1. INTRODUCTION

The claim that older drivers are overly involved in crashes has apparent support from analyses of crash rates, even after corrections have been made for older drivers' extra physical frailty and hence vulnerability to injury. Figure 1 (Fildes et al., 2001) shows for Australian drivers, the direct association between age and serious injury crash involvement per distance travelled and the association corrected for vulnerability. Equivalent curves have been obtained for most Western countries.

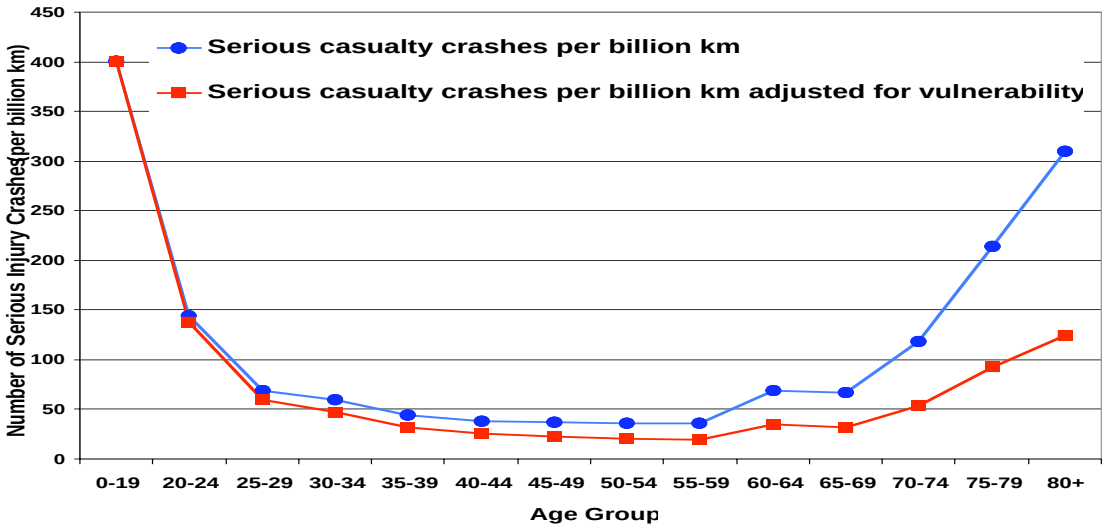

FIGURE 1: Driver involvement in serious injury crashes by age adjusting for exposure and vulnerability, Australia, 1996, (from Fildes et al., 2001).

However Janke (1991) claimed that while it is accurate to say that older drivers have an increased crash rate per distance driven compared to middle-aged drivers, it does not follow that they are therefore more hazardous than middle-aged drivers. Independent of age, drivers travelling more kilometres will typically have reduced crash rates per kilometre, compared to those driving fewer kilometres. Because older drivers typically drive less distance per trip and hence have lower accumulated driving distances per year, they have greater crash involvement per kilometre driven compared to drivers with greater accumulated driving distances. Janke subsequently gave the following warning:

> " … licensing administrators influenced by the exaggerated implied risk of the elderly group when accidents are divided by miles may become more alarmed than is warranted about the safety hazard posed by the increasing numbers of elderly drivers. … an exaggerated notion of the risk older people pose could easily result, for example, in the licensing agency's calling in all drivers beyond a certain age for special testing (Janke, 1991, p187).

Hakamies-Blomqvist and her colleagues (2002) empirically tested the association between driving distances and crash rates by using Finnish survey data. When older drivers were compared with younger drivers who had equivalent annual driving distances, there was no age-related increase in crashes per distance driven (see Figure 2). "These findings cast serious doubt on any previous reports of age differences in accident risk per distance driven" (Hakamies-Blomqvist et al, 2002, p 274).

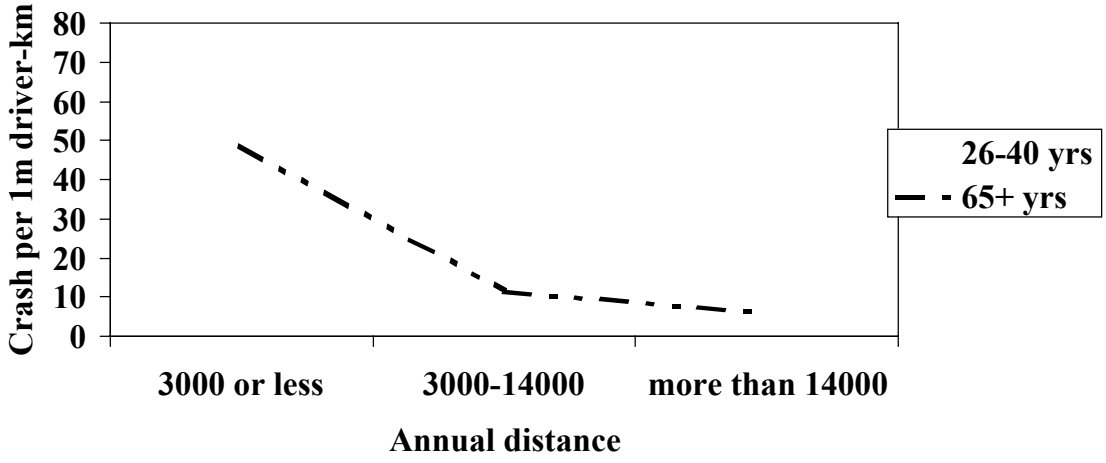

FIGURE 2: Annual driving distances and crash rates per 1 million driver-kilometres, by age, (from Hakamies-Blomqvist, Raitanen and O'Neill, 2002).

Looking at older drivers specifically, there are at least two factors contributing to the association between low mileage and high crash rates.

First, as pointed out by Janke (1991), those with higher mileages are likely to be driving on freeways or other roads with limited access points, which typically have lower crash rates. At the other extreme, low mileage drivers are more likely to be driving on congested urban road with greater numbers of potential conflict points. Particularly older drivers with their shorter driving distances and shorter individual trip distances (OECD, 2001) and their well-documented difficulties in negotiating intersections, are likely to be relatively disadvantaged by predominantly urban travel.

The second possible factor is older drivers' self-regulation. Many older drivers in response to a perceived decline in driving performance restrict their driving as a safety and/or comfort measure (Eberhard, 1996; Evans, 1988; McGwin and Brown, 1999; Pruesser et al., 1998; Smiley, 1999). These drivers would be expected to have more medical conditions and greater functional difficulties leading to reduced driving skills, relative to drivers with higher mileages – and intuitively, a higher probability of crashing. At least some low mileage older drivers may already have been involved in crashes and this experience may also have contributed to reduced driving as a form of self regulation.

2. AIMS

The aims of this paper are to:

- demonstrate the existence of the association between mileage driven and crash risk using data from two older driver surveys, one conducted in Victoria, the other in New Zealand;
- analyse the Victorian older driver survey data to determine whether different mileage groups have different proportions of travel along the urban and rural road networks;
- analyse the New Zealand data to determine whether different mileage groups vary in regard to their perceived and actual fitness to drive.

3. METHOD

3.1 THE VICTORIAN OLDER DRIVER STUDY

In 2004 VicRoads commissioned a survey of 2,000 older Victorian drivers, to determine the proportion of licence-holders aged 65 years and above who were active drivers. Details of the survey methodology, including the questionnaire used, recruitment procedures and response rates, are provided in a separate report to VicRoads (Horman and Persico, *Older driver survey summary report*, Research International, June 2004).

3.2 THE NEW ZEALAND OLDER DRIVER SURVEY

The 905 participants in this survey were recruited from the New Zealand Land Transport Safety Authority (LTSA) database of drivers who were aged 80 years or older and were about to undergo their mandatory re-licensing assessment (a medical examination and an on-road driving test). The survey and assessment occurred between in 2001 and 2002. Full details of the survey can be found in Austroads (2004).

4. RESULTS

4.1 DEMONSTRATING THE ASSOCIATION BETWEEN WEEKLY MILEAGE AND CRASH RATES

Drivers participating in the Victorian and New Zealand surveys were categorised according to self-reported weekly distances driven. Figure 3 compares the annual crash rates per 10 million driver kilometres for the four distance groups, per survey.

For both data sets, older drivers covering 50 kilometres or less per week had the highest apparent crash rates, with crash rates consistently declining as weekly mileage increased. For both samples, the lowest mileage drivers had a crash rate around ten times that of the

highest mileage group. As a general finding, while the crash rate differences between any two contiguous mileage groups were only marginally significant, differences across other mileage groups were statistically significant (using a standard t-test of probabilities based on population confidence limits).

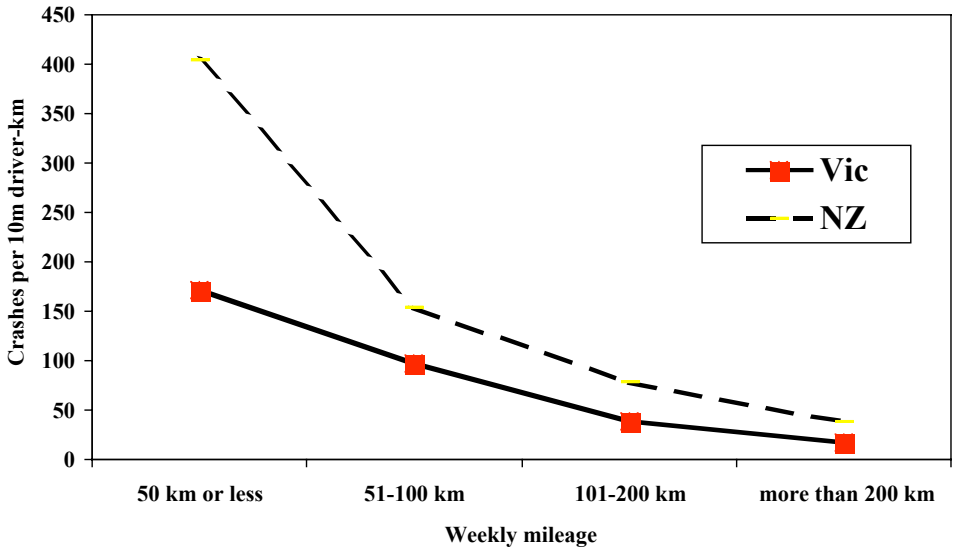

FIGURE 3: Respondents' crash rates per 10 million driver-kilometres for separate mileage groups, (VicRoads older driver survey 2004 and New Zealand older driver survey 2001-02).

4.2 WEEKLY MILEAGE AND LOCATION OF DRIVING

Driving distance and location of driving

The 1897 Victorian drivers who reported that they were still active drivers at the time of the survey were categorized on the basis of self-reported weekly driving mileage thus: 'low' (50 kilometres or less), 'medium' (51-100 kilometres) or 'high' (more than 100 kilometres). For each driver, the most recent trip was categorized as 'Melbourne urban', 'Regional urban', 'Rural' or 'Mixed'. Table 1 shows the different categories of trip for each of the mileage groups.

Table 1 The relationship between mileage driven per week and location of most recent trip, (VicRoads Older Driver Survey 2004).

Location of most recent trip	No. and proportion of drivers per mileage categories							
	Low		Medium		High		Total	
	No.	%	No.	%	No.	%	No.	%
Melbourne	425	59.8	196	61.3	330	47.9	951	55.3
Regional urban	200	28.1	68	21.3	161	23.4	429	24.9
Rural	65	9.1	35	10.9	128	18.6	228	13.3
Mixed	21	3.0	21	6.6	70	10.2	112	6.5
Total	711	100.0	320	100.0	689	100.0	1720	100.0

Note: Missing cases = 177 drivers (insufficient trip details).

Looking at the total sample of active drivers, most of the recent trips were undertaken in urban areas, with over one-half of all trips in the Melbourne area. While the low and medium mileage drivers had comparable levels of urban driving (88 percent and 83 percent, respectively), high mileage drivers had fewer trips in urban areas (71%) – and conversely, more in rural and in mixed areas.

The 109 active Victorian drivers who reported that they had been involved in an accident during the two years immediately before the survey, were categorized into 'low', 'medium' or 'high' mileage groups. For each driver, the crash location was categorized as 'Melbourne urban', 'Regional urban', 'Rural' or 'Mixed'. Table 2 shows the different categories of crash location for each of the mileage groups.

Table 2 The relationship between mileage driven per week and crash location, (VicRoads Older Driver Survey 2004).

Crash location	No. and proportion of drivers per mileage categories							
	Low		Medium		High		Total	
	No.	%	No.	%	No.	%	No.	%
Melbourne urban	22	68.8	16	64.0	36	73.5	74	69.8
Regional urban	8	25.0	6	24.0	9	18.4	23	21.7
Rural	2	6.3	3	12.0	3	6.1	8	7.5
Mixed	0	0.0	0	0.0	1	2.0	1	0.9
Total	32	100.0	25	100.0	49	100.0	106	100.0

Note: Missing cases = 3 drivers (insufficient crash location details).

For the overall sample of drivers in crashes where location of crash was known, 92% of crashes occurred on urban roads and 8 percent on rural roads. The small numbers of drivers involved in crashes did not justify more detailed analyses in this context.

At a simple level, the risk of crashing for an urban road relative to the risk for a rural or mixed trip, may be estimated thus:

	Urban	**Rural/mixed**	**Total**
no. of reported crashes	97	9	106
no. of most recent trips	1380	340	1720
"crash rate" (% of recent trips)	7.03	2.65	6.16
relative risk of crash, urban trips	2.65		

4.3 WEEKLY MILEAGE AND FITNESS TO DRIVE

The 896 drivers in the New Zealand survey who reported on their weekly mileages were categorized thus: 'low' (50 kilometres or less), 'medium' (51-100 kilometres) and 'high' (more than 100 kilometres).

Drivers were asked to rate their current driving performance against three criteria: against the driving performance of others of their own age, against drivers aged 30-50 years and against their own performance twenty years earlier. Table 3 shows for the three mileage groups, the proportions who rated themselves as worse drivers against these three criteria.

Table 3 **The relationship between mileage driven per week and self-reported rating of own driving performance against three specified criteria, (New Zealand Older Driver Survey 2001-02).**

The three criteria	No. and % rating own driving performance as worse against 3 criteria:					
	Low		Medium		High	
	No.	%	No.	%	No	%
Others of own age	5	1.3	0	0.0	0	0.0
Drivers 30-50 yrs	80	20.4	36	12.0	15	7.5
Self 20 yrs earlier	109	27.9	52	17.4	31	15.5

Note: Missing cases = 10, 14 and 16 drivers for criteria 1-3, respectively.

Low mileage drivers were significantly more likely to describe themselves as worse drivers than other drivers aged 30-50 years, relative to high mileage drivers (20.4% compared to 7.5%: Odds ratio = 3.36: 95% CI 1.82-6.28). They were also significantly more likely to describe themselves as worse drivers than they were twenty years ago (27.9% compared to 15.5%: Odds ratio = 2.18: 95% CI 1.37-3.49).

Driving distance and self-reported health and functional performance

Drivers were asked to rate their health or functional performance in a number of areas as 'excellent', 'good' or 'fair'. The proportions of each mileage group who responded as 'excellent' for each area are shown Table 4.

Table 4 **The relationship between mileage driven per week and self-reported rating of health or functional performance, (New Zealand Older Driver Survey 2001-02).**

Item	Proportion of drivers per mileage categories, giving the highest rating ('excellent')		
	Low	Medium	High
Overall health	21.1	22.9	28.1
Day vision	31.5	33.2	43.8
Night vision	8.3	7.0	16.9
Decision making	21.9	22.4	36.5
Arm strength	36.3	42.5	49.3
Neck flexibility	16.8	15.0	21.4
Leg strength	37.4	36.9	42.0

Low mileage drivers were less likely to rate their health and functional performance as 'excellent' compared with high mileage drivers on all measures. The greatest proportional differences were in regard to night vision (where high mileage drivers were twice as likely to give an 'excellent' rating) and decision-making (where high mileage drivers were 1.7 times as likely to give an 'excellent' rating). The differences were statistically significant for both comparisons (Odds ratio = 2.26: 95%CI 1.31-3.91 and Odds ratio = 2.05: 95%CI 1.38-3.03, respectively).

Drivers were also asked to indicate whether they were experiencing problems in certain functional areas. The proportions of each distance group who reported medical problems are shown in Table 5.

Table 5 The relationship between mileage driven per week and self-reported medical problems, (New Zealand Older Driver Survey 2001-02).

Item	Proportion of drivers per mileage categories, reporting medical problems		
	Low	Medium	High
Vision	71.5	69.1	63.2
Heart	28.4	24.8	21.4
Diabetes	5.9	6.0	4.0
Memory	21.7	18.7	13.0
Arthritis	46.8	47.0	37.8
Recent stroke	10.7	8.8	7.4
Multiple medications	79.3	76.8	74.5

Low mileage drivers were more likely to report health problems than high mileage drivers on all measures. The greatest proportional difference was in regard to memory (where low mileage drivers were 1.7 times as likely to report a problem, relative to high mileage drivers). The difference was statistically significant (Odds ratio = 1.88: 95% CI 1.14-3.12).

All 905 drivers included in the New Zealand survey were required to sit for the NZODORT on-road driving test. Table 6 shows the three distance groups, analysed by on-road test performance.

Table 6 The relationship between mileage driven per week and on-road test performance, (New Zealand Older Driver Survey 2001-02).

Results of on-road test	No. and proportion of drivers per mileage categories					
	Low		Medium		High	
	No.	%	No.	%	No.	%
Failed	123	34.9	72	24.8	34	18.5
Passed	229	65.1	218	75.2	150	81.5
Total	352	100.0	290	100.0	184	100.0

Note: Missing cases = 79 drivers.
'Failed' has been defined as failing the first attempt at the NZODORT, 'Passed' as having passed at the first attempt.

There was a consistent association between the NZODORT test results and extent of driving, such that low mileage drivers were most likely to fail the on-road test (34.9% compared to 18.5%) and conversely, high mileage drivers were most likely to pass (81.5% compared to 65.1%). The difference was statistically significant (Odds ratio = 2.37: 95% CI 1.51-3.74).

5. DISCUSSION

5.1 DEMONSTRATING THE ASSOCIATION BETWEEN WEEKLY MILEAGE AND CRASH RATES

Figure 3 has shown that for both surveys, the lower the weekly mileage, the higher the per-distance crash rate - such that older drivers covering 50 kilometres or less per week had a crash rate around 10 times greater than the longest distance group (those driving more than 200 kilometres per week). This association broadly complies with previous research findings (Janke, 1991; Hakamies-Blomqvist et al, 2002).

There is however a major qualification that needs to be made before the mileage/crash associations shown in Figure 3 can be accepted at face value. It is possible that a sub-group of reasonably high mileage drivers and involved in a crash, reduced their amount of driving by the time of the survey – thereby possibly distorting any mileage/crash association. In another survey of older drivers (Oxley et al, 2003), two-thirds of lowest mileage older drivers reported that they had reduced their driving in recent years. Stated reasons included: reduced travel needs arising from either general lifestyle changes (20%) or specific changes in social or business needs (31%); reduced driving confidence and increased difficulties in coping with traffic (15%); and illness and disabilities (11%). Recent crash involvement was not mentioned as a primary factor.

As a final point, low mileage older drivers from the New Zealand survey had substantially higher crash rates than equivalent-mileage drivers from the Victorian survey. The differences can perhaps be attributed to two main factors: age differences (New Zealand drivers were all aged 80 years or above, compared to 17% for the Victorian sample); and sample variability, in that especially crash numbers were relatively low once weekly mileages were taken into account.

5.2 WEEKLY MILEAGE AND LOCATION OF DRIVING

Janke (1991) attributed the association between mileage and crash rates to low mileage drivers making greater use of the urban road network. Using the most recent trip as an indicator of driving patterns, it was found from the survey of 1897 older Victorian drivers that while most of the driving for all mileage groups occurred on urban roads, low mileage drivers were indeed more likely to be urban drivers relative to high mileage drivers.

The Victorian survey data also showed that urban travel had a 2.65 times crash risk, relative to travel in rural and mixed areas. This heightened crash risk is in close agreement with Janke's 2.75 increased risk. Table 7 shows for the four main weekly mileage groups, the expected and observed relative crash rates based on location of driving.

Table 7 The expected and observed relative crash rates for the four mileage groups, (VicRoads Older Driver Survey 2004).

Weekly mileage	No. of drivers	Proportion of driving in:		Expected relative crash rate[1]	Observed relative crash rate[2]
		Urban	Rural/mixed		
50 km or less	744	.879	.121	1.3	10.0
51-100 km	329	.825	.175	1.2	5.7
101-200 km	326	.812	.188	1.1	2.3
more than 200 km	399	.632	.368	1.0	1.0

[1] The expected relative crash rates assume that urban travel has 2.7x the crash risk of rural/mixed travel. Crash rates have been expressed relative to the rate for the highest mileage group.

[2] The observed relative crash rates are based on the crash rates per 10 million driver-kilometres using the data in Attachment 1. Crash rates have been expressed relative to the rate for the highest mileage group.

The expected relative crash rates based on location of driving show that a small proportion of the lower mileage groups' higher crash involvement can be attributed to this factor. The small contribution is not difficult to understand, given that for all mileage groups, the majority of driving (based on the location of the most recent trip) occurred in urban areas.

This finding appears to contradict the explanation for the low mileage/high crash risk put forward by Janke (1991). However Janke's explanation was for the total, all-age driving population. It may well be that for younger drivers, there are more marked differences in urban-versus-rural travel across the different mileage groups, whereas older drivers of any mileage may be more likely to restrict their travel to urban roads.

5.3 WEEKLY MILEAGE AND FITNESS TO DRIVE

There is strong evidence to support the proposition that low mileage older drivers were characterised by both perceived and actual reduced fitness to drive. Low mileage older drivers were significantly more likely to report that they were driving worse than middle-aged drivers and that their driving had deteriorated over the past twenty years. They also generally reported a greater range of health conditions and functional limitations and most markedly differed from high mileage drivers regarding night vision, decision-making and memory. Their perceptions of their poorer driving performance were substantiated by the results from an on-road test of driving performance: compared to high mileage drivers, low mileage drivers were significantly and almost twice as likely to fail on their first attempt.

It has not been possible to quantify the exact contribution of these multiple measures of perceived and actual fitness to drive to crash levels. Given the small impact of location of driving (whether urban or rural/mixed) to crash rates, the default position is that fitness to drive explains most of any association.

However a major qualification has to be made to this conclusion. The present paper has made use of two existing older driver surveys which were initially conducted for other purposes. A major difference between the two surveys relates to the age of respondents, with the New Zealand drivers being substantially older. It is possible that the age differences between the two samples may have contributed to the relative importance of location of driving and fitness to drive in explaining the mileage/crash association.

5.4 MANAGING THE SAFETY OF OLDER DRIVERS

An implication arising from this research is that any program aiming to manage the safety of older drivers, can most readily be justified if it is restricted to low mileage older drivers, rather than treating all older drivers as a single group. However this is not meant to imply that low mileage older drivers represent a fully homogeneous group. For example, while some may restrict their driving as a safety measure arising from perceived and actual driving limitations, others may drive short distances solely because of reduced travel needs or because of the frequent availability of another driver.

Further, the evidence is consistent with this sub-group having already restricted their amount of driving in response to perceived and actual driving difficulties. The result of this reduction in driving is to produce a high crash risk over distance driven but a very low crash risk per time as a licensed driver (Frith, 2005). Arguably, given the many costs of immobility arising from loss of licence, the most productive safety strategy for this sub-group might be to develop targeted educative, physical and/or cognitive rehabilitative measures aimed at improving their driving without increasing their mileages.

5.5 FURTHER RESEARCH NEEDS

The present paper is based on two existing older driver surveys initially conducted for other purposes. Apart from major age differences in the two sets of respondents, the reliance on data derived from two different collections has resulted in limited opportunities to explore the mileage/crash association and the various factors underlying the association. There is the general need to survey an adequate sample of older drivers, using a questionnaire specifically designed to assess matters related to the mileage/crash association.

In the proposed survey, an early priority would be to better understand the general process (or more likely, processes) which determine older drivers' extent of driving activity. In particular, it is necessary to establish whether some older drivers have converted from high mileage to low mileage as a consequence of having crashes, thereby contributing to an inflated low mileage/high crash association. The proposed survey will also need to explore possible gender differences, especially the proposition that women are more likely to drive short distances for social or cultural reasons, whereas men are more likely to drive short distances in response to perceived health and driving performance issues. If a safety program targeting low mileage drivers as the principal at-risk group is to be developed, it is necessary that the safety status of male and female drivers be separately identified.

In addition to the proposed survey of older driver, there is the need to extend the explanation of the low mileage/high crash association to drivers of other ages. This paper has provided evidence suggesting that for older drivers, the low mileage and high mileage groups differ significantly in perceived and actual fitness to drive. In contradistinction, differences in location of driving have been modest and unlikely to have made an appreciable contribution to the low mileage group's higher crash rates. It is questionable however whether this situation exists in regard to drivers from other age groups, where it would be reasonable to assume that reduced fitness to drive might be less prevalent.

6. CONCLUSIONS

Currently there is only a limited amount of research into the association between drivers' mileage and crash rates. There is however strengthening evidence that the traditional depiction of older drivers as being overly crash prone cannot be accepted at face value without controlling for different driving mileages: once this is done, recent findings "cast serious doubt on any previous reports of age differences in accident risk per distance driven" (Hakamies-Blomqvist et al, 2002, p 274).

The present paper has used data from two older driver surveys, first to demonstrate the association between mileage and crash rates and secondly, to assess the contributions of two key factors possibly underpinning this association. The conclusions reached from the survey data were that the low mileage/high crash association is pertinent to older drivers and that at least in the case of this age group, it can be partly attributable to different usage of the urban and rural road networks and more particularly, to differences in perceived and actual fitness to drive.

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