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Sex differences evident in self-reported but not objective measures of driving

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ABSTRACT

It has been consistently reported that women self-regulate their driving more than men. Volunteer drivers aged 75 years and older from the suburban outskirts of Sydney, Australia joined a longitudinal study in 2012–2014. GPS in-vehicle monitoring was used to objectively measure driving and surveys of driving patterns. The study included 343 drivers (203/343, 59% men) with an average age of 80 years. Our results revealed that men were 3.85 times more likely to report driving beyond their local shire during the past year (95% CI 2.03–5.72) and 1.81 times more likely to report that they do not avoid night driving (95% CI 1.21–3.22). In contrast sex was not predictive of any objective measure of driving during a one-week period of monitoring. These findings suggest that men and women report different self-regulation practices but that actual driving exposure is quite similar. These findings can inform strategies to promote safe mobility.

1. Introduction

The high rate of injuries among older drivers on the road has been associated with age-related increases in responsibility for fatal crash involvement (Williams and Shabanova, 2003) and vulnerability to injury (Li et al., 2003; Meuleners et al., 2006; Tefft 2008; Koppel et al., 2011). Injuries to older people in motor vehicle crashes are a major cause of death and disability and of increasing concern, considering the ageing of the population (Australian Transport Council 2015).

Self-regulation has been proposed as a means to increase safety on the road while preserving independent mobility (Oxley and Whelan 2008). There is some evidence to support this strategy including an analysis of a case series of fatal crashes involving older drivers from the Fatality Analysis Reporting System (FARS-2003) which found that those who drive in the daylight were 28% (8am–1pm) and 37% (2pm–8pm) less likely to be injured in a crash (Classen, et al., 2007). Older drivers with a previous motor vehicle conviction are 35% less likely to be injured in a crash, presumably as these individuals or their families acknowledge their limitations and take corrective action (Classen et al., 2007).

Self-regulation has been defined as intentionally adjusting driving exposure to match driving ability and confidence (Molnar and Eby 2008) and there is a substantial body of literature examining the predictors of self-regulation. Wong and co-authors (2016) published a systematic review investigating the factors which predict self-regulation, summarised findings from 29 studies and reported that most studies found women were more likely than men to practice self-regulation. Brabyn et al. (2005) reported a cross-sectional study which found that men over 85 years were 6.6 times more likely to be driving at night than women, independent of visual function. There are numerous other surveys of older drivers that found women were more likely to self-regulate and that this influence of sex on self-regulation is independent of age and other measures of function (Vance et al., 2006; D'Ambrosio et al., 2008; Kostyniuk and Molnar, 2008; Molnar and Eby 2008; Morgan et al., 2009; Ross et al., 2009, Gwyther and Holland 2012) Few studies have used objective measures of driving to estimate self-regulation (Wong et al., 2016).

Objective measures or naturalistic driving assessment is emerging as the gold standard in research into driving behaviour. Porter (2015) compared driving exposure through self-report and objective in-vehicle monitoring in the Candrive II study. They reported only moderate agreement between estimated and objectively measured mileage for a

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subgroup of 159 drivers aged 70 years and older. One study reported on the influence of sex on driving using in-vehicle devices to assess natural driving patterns of 39 older drivers and reported that sex was not associated with maximum radii from home (Blanchard and Myers, 2010). While there are strong associations between sex and self-reported driving, the relative strength of the association of sex to objectively measured driving behaviour is not known. We sought to examine the influence of sex on both self-reported and objectively measured driving in a large group of older drivers.

2. Materials AND MethodS

2.1. Study Design

We measured driving exposure objectively using an in-vehicle monitoring device and through self-report in a community-based sample of older drivers who resided in the suburban outskirts of Sydney, Australia. Study participants were enrolled in a trial evaluating a safe-transport program (Keay et al., 2013) and we analysed data from their enrolment visit and from a one-week period of travel within the first month of the study, prior to the intervention being delivered. The primary purpose was to determine the associations between driver sex and different ways to estimate driving exposure. We considered factors which are known to be predictive of driving including age, self-reported comorbidities (Groll et al., 2005) and performance on a global measure of visual and cognitive function, the DriveSafe/DriveAware assessment tool (Kay et al., 2012).

2.1.1. Participants

The study eligibility criteria were that participants were to be aged 75 years or older, have conversational English, hold a current drivers' licence and have access to a vehicle for which they were the primary driver. Participants were also limited to residents of the Hills, Parramatta, Hornsby, and Ku-ring-gai Shires in North and Northwestern Sydney, Australia.

We invited participation through advertisements in the local media, seniors groups, churches and letters of invitation from a New South Wales motoring organisation. Letters of invitation were only sent to members meeting age and residential address requirements. Interested volunteers contacted the study centre by telephone and were further screened for eligibility. As we were unable to identify the driver in our vehicle monitoring system, we excluded drivers who shared use of a vehicle with another person for more than 20% of trips. The Short Portable Mental Status questionnaire was also used to screen for cognitive impairment and a score of > 2 was used as criteria for exclusion (Pfiefer, 1975). The study protocol was approved by the University of Sydney Human Research Ethics Committee (10-2011/14235) and all participants signed a record of informed consent.

During a home visit, structured questionnaires were administered to gather information about the social and demographic characteristics of the study population including age, sex, country of birth, language spoken at home, years of formal education, residential address, living circumstances and assistance with activities of daily living. The distance to essential services was calculated by estimating the distance by road to the closest major supermarket or a centre where essential services such as medical practices and pharmacies were located. Study enrolment is shown in Fig. 1.

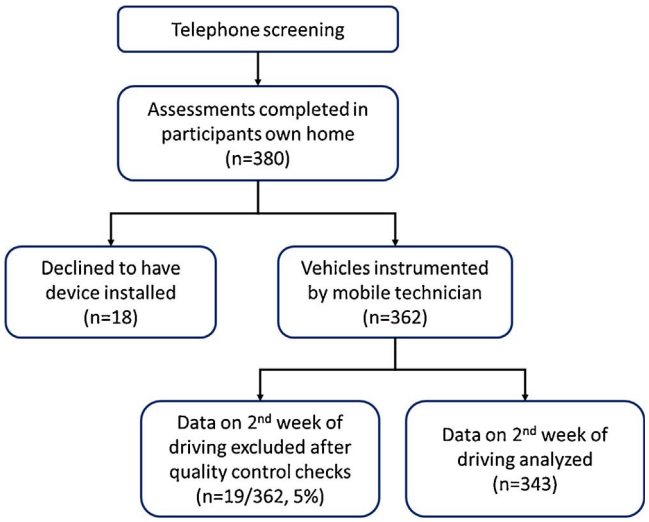

Fig. 1. Enrolment into the study, instrumentation of vehicles and collection of study data.

Table 1
Details on the variables included in analysis of driving exposure.

Variable	Type of data	Units
Outcome measures		
Driving exposure		
Total distance driven in one week (objective)	Continuous	Kilometres
Driving Space		
Driving space beyond shire in last 12 months (self-report)	Binary	Yes/No
Furthest distance travelled from home 20+ km (objective)	Binary	Yes/No
Night driving		
Driving at night in one week (objective)	Binary	Yes/No
Avoidance of night driving (self-report)	Binary	Yes/No
Predictive factors of interest		
Age	Continuous	Years
Sex	Binary	Male/Female
Comorbidities	Count	Number
DriveSafe score	Continuous	Points
DriveAware score	Continuous	Points

2.2. Objectively Measured and Self-Reported Driving Exposure

Driving exposure was the outcome of interest and was measured both objectively and through self-report (Table 1). Self-reported measures of driving exposure included the furthest distance driven in the past year (driving space) from the Driving Habits Questionnaire (Owsley et al., 1999) and self-reported avoidance of night driving (Baldock et al., 2006). Objective measures of driving distance, driving space (radius of travel from home) and night driving were recorded using an in-vehicle monitoring device.

The surveys were completed with a trained research assistant and a battery of functional assessments administered during a home visit (Keay et al., 2013). At a later date a mobile technician came to the participant's home and hardwired an in-vehicle monitoring device (C4D, Mobile Devices Ingenierie, Villejuif, France) into the participant's vehicle. Though the devices were intended for continuous monitoring of up to 12-months, we analysed a one-week snapshot of driving data. The second full week of driving data was chosen to allow for resumption of regular driving patterns. The device logged global positioning system (GPS) each second during vehicle operation. The time-stamped GPS location data was transmitted over the mobile telecommunications network and processed to determine the length of routes of travel, radius of travel from home and any travel outside daylight hours. Each of the measures of driving exposure had a contemporary references except for driving space, which was self-reported for the last 12 months.

2.2.1. Total distance driven in one week (objective)

The GPS location was used to estimate the length of driving routes in kilometres. The distance travelled was the sum of all routes recorded during the 1-week period. Identical equipment has been used in other studies and found to be reliable, capturing 97% of trips (Greaves et al., 2007). We scrutinised the data and removed data which was