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A longitudinal investigation of the predictors of older drivers' speeding behaviour

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ABSTRACT

There is little objective evidence about the extent older drivers' are involved in speeding or factors that may influence this behaviour. Particular concern exists for the increasing number of older drivers with poor or declining cognitive and visual function. This study investigates whether a reduction in speeding forms part of the self-restrictive driving behaviour evident when older drivers experience poor cognitive and visual function. Driving data over 12 months were collected from 182 volunteers aged 75–94 years. Driving speed was estimated using Global Positioning System location, and speed limit data was based on a service-provider database. Speed events were defined as driving 1 km/h or more, with 3% tolerance, above a single speed limit, averaged over 30 s. Almost all participants (99%) were involved in speed events. While, 16–31% of participants experienced a meaningful decline in cognitive or visual function during the 12-months, these declines were not predictive of a change in speed events. Our results indicate speeding behaviour in this age group was highly prevalent, but less so for the oldest drivers whereby the rate of speed events was 7% lower per year older (IRR = 0.93, 95%CI = 0.89–0.96). Older drivers with worse function were less involved in speed events (unadjusted for distance driven) during 12 months of observation. Weekly distance driven decreased over the year by approximately 0.45 km with every week of monitoring for these older drivers. When distance driven was taken into account, decreased function was not predictive of involvement in speed events, indicating the reduction in speed events may be achieved by older drivers with lower function reducing distance driven. These results are important for developing policy to address speeding behaviour of the growing population of older drivers to reduce the incidence of crashes and resulting casualties.

1. Introduction

Even small increases in speed substantially increase the risk of crash involvement and injury severity (Aarts and van Schagen, 2006; Kloeden et al., 1997; Kloeden et al., 2001; Williams et al., 2006). Speeding is one of the most common driver behaviours contributing to fatal crashes (Geneva, 2008), and contributes to approximately 40% of road fatalities in NSW (Centre for Road Safety Transport for NSW). While Perryman and Fitten (1996) suggested older drivers may reduce speeds to compensate for age-related declines affecting driving ability, there is a paucity of research examining speeding behaviour in older drivers, and the relationship between speeding behaviour and functional decline.

Despite an overall reduction of fatal crashes in Australia in the decade 2004–2013, those involving older drivers are increasing (BITRE, 2014; Rakotonirainy et al., 2012). This may be partially due to the number or older licensed drivers increasing at a rate greater

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than the ageing population, driving for longer than previous generations (BITRE, 2014), and being at increased risk of injury due to fragility (Kent et al., 2005; Meuleners et al., 2006). Research has also found drivers aged 80 years and over were more frequently responsible for causing casualty crashes than drivers aged 17–79 years (Rakotonirainy et al., 2012).

Wong et al. recently conducted a systematic review of research into older drivers' self-regulatory practice, revealing a paucity of research examining the relationship between speeding and self-regulation (Wong et al., 2014). Particular road safety concern exists for those older drivers with reduced cognitive, visual and physical function (Anstey et al., 2012; Wong et al., 2012). Research indicates drivers exhibit greater caution, self-restriction or avoidance with increasing age (Braitman and Williams, 2011; Charlton et al., 2006; Devlin and McGillivray, 2014; Molnar and Eby, 2008; Molnar et al., 2013; Ross et al., 2009a), impaired cognition (Anstey et al., 2012; Braitman and Williams, 2011; Keay et al., 2009b) and poor vision (Anstey et al., 2012; Charlton et al., 2006; Freeman et al., 2006; Keay et al., 2009b; Lotfipour et al., 2010; Owsley et al., 1999; Ross et al., 2009a,b; Sandlin et al., 2014). However, there is a sub-section of older drivers who, despite poor function, do not self-restrict or retire from driving (Devlin and McGillivray, 2014; Okonkwo et al., 2008). This may be partially due to diseases (such as dementia) interfering with the driver's ability to assess competency (Devlin and McGillivray, 2014). For some impaired older drivers, continued driving may also be related to the importance of driving for mobility and independence. Loss of driving has been associated with reduced quality-of-life (Dickerson et al., 2007; Donorfio et al., 2008; Oxley and Whelan, 2008). Furthermore, Ross et al. (2009b) found although at-risk older drivers (based on diminished Useful Field of View) restricted driving, this was insufficient to eliminate their increased crash risk.

We previously conducted a cross-sectional analysis on a week-long snapshot of driving data and found cognitive and visual function, and driving behaviour and attitudes, not predictive of speed events/distance (Chevalier et al., 2016, in press). The question remains whether reduced speeding forms part of the self-restrictive driving response to declines in cognitive and visual function. Furthermore, little is known about the influence of deterrents, such as citations and crash involvement, on the relationship between speeding behaviour and functional decline in older drivers. For the first time, we have used longitudinal data captured through naturalistic monitoring of older drivers beyond one week, to examine the influence of cognition, vision, functional decline, citations and crash involvement over time.

2. Methods

2.1. Study design

We evaluated the longitudinal driving patterns amongst the control group in a randomised control trial (RCT) investigating the effectiveness of an education program encouraging safe transport (Keay et al., 2013). Participants' involvement in speed events over time was investigated using a driving monitoring system hard-wired into participants' vehicle ignitions. Data were collected for approximately 12 months.

2.2. Participants

Control group participants from the RCT (n = 190) were included in this analysis. Of these participants, 96% (182/190) had their vehicle instrumented. Participants not instrumented were excluded from the analysis. Based on the average rate of 15 speed events per participant per week and assuming an over-dispersion parameter of 2, a sample size of 182 provides 80% power to detect about a 16% (Incident Rate Ratio (IRR) = 1.16) increase in the rate of speed events per participant per week for each unit increase in a predictive covariate (Signorini, 1991).

Between July 2012 and October 2013, participants were recruited through letters sent by a local motoring association to members, and promotion through local media and community groups. A brief telephone interview confirmed eligibility. Eligibility criteria included being 75 years or over, holding a current driver's licence, owning a vehicle, and residing in north-west Sydney. To ensure driving data was largely from the individual, participants were required to be the main vehicle driver (undertaking greater than 80% of driving). Volunteers were excluded who received >2 errors on the Short Portable Mental Status Questionnaire cognitive assessment (Pfeiffer, 1975). The University of Sydney Human Ethics Committee approved the study (Protocol: 14235), and written consent was provided by all participants.

2.3. Outcome and exposure measures

A previous cross-sectional analysis examining this cohort found increased age and decreased function were significantly associated with reduced mileage (Coxon et al., 2015). Therefore, we modelled both the count of speed events without a measure of exposure (absolute number of speed events) and with distance driven as a measure of exposure (rate of speed events/km driven).

The in-vehicle device consisted of a C4D Data Recorder and external GPS receiver. Data were transmitted over the mobile telecommunications network and transferred weekly to secure servers.

While other researchers have used objective driving data to measure the proportion of time speeding, as well as the mean, maximum and standard deviation of speed (af Wahlberg, 2006; Greaves and Ellison, 2011), we elected to define speed events, based on the concept of point-to-point speeding. This method is closer to current enforcement measures, while catering for any potential inaccuracies in high readings.

Driving speed data to the nearest km/h were recorded in approximately one-second intervals by the in-vehicle device. Greaves et al. (2010) validated the device as capturing highly reliable data, with only 3% of trips determined as missing, affecting one or two of 30 study participants. Speed limit data was based on a service-provider database developed through on-road mapping of the road network (Speed Alert by Smart Car Technologies Pty Ltd). Speed events were identified from a comparison of average driving speed with mapped speed limits. To minimise identification of false positive events, events were defined as driving an average 1 km/h or more above the speed limit plus 3% tolerance over a 30-s duration (Chevalier et al., 2016, in press). The 1 km/h was applied to ensure the driving speed was above the speed limit, a further 3% tolerance was applied to account for inaccuracies in the measuring equipment or participant's speedometer and thereby the driver's awareness of speeding. The 30-s duration was applied as average speed does not reduce sufficiently quickly to define the end of an event as driving at or below the speed limit. An event was required to occur in a single valid speed zone. We excluded speed zones less than 40 km/h, for example carparks. A minimum three satellites per record were required to triangulate speed. Events were required to contain a minimum of 25 GPS records in 30 s, to account for missing GPS records as is common with GPS data. If no event was identified, the search re-commenced at the next record. To examine data accuracy, speed events/100 km, peak and average speeds were assessed per participant week.

An audit was conducted of a random sample of 300 speed events to investigate the agreement between the Speed Alert database and the speed zone estimated by Google Maps API. The audit revealed